

# International Conference on Culture Technology (ICCT) 2019

August 13~16, 2019

Kasetsart University and NECTEC, Pattaya Thailand



International Association for  
Convergence of Science & Technology



มหาวิทยาลัยเกษตรศาสตร์  
KASETSART UNIVERSITY



ICT기반 문화콘텐츠  
전문인력양성사업단  
Consortium for the Culture Contents Expert



ORIENTAL CONSULTANTS GLOBAL



中国设计智造大奖  
Design  
Intelligence  
Award





# Opening Address

## **Pyeongkee Kim**

Honorable Chair of ICCT 2019



It is my great honor and pleasure to welcome all of you to ICCT2019 in the beautiful city of Pattaya, Thailand. Whenever I meet scholars and my dear friends from eleven countries, it is difficult to fully express well my heart of joy.

First, I want to thank the special people who gave valuable help in making this conference happen. I thank Vice President Dr. Putchong Uthayopas of Kasetsart University and Chairman Dr. Chai Wutiwiwatchai of NECTEC for giving wonderful support hosting the conference. I always want to express my deepest gratitude for Chairman Dr. Kwangyun Wohn of the National Research Council of Science and Technology (South Korea), and Dr. Sugiyama of the Oriental Consultants Global (Japan), who are also our most respected advisors and most enthusiastic scholars. I want to let everyone know that this event would not be possible without the devoted service and passion of the organizing chairs: Dr. Intiraporn Mulrasastra of Kasetsart University (Thailand), Dr. Thepchai Supnithi of NECTEC (Thailand) and Dr. Taesoo Yun of Dongseo University (South Korea). I apologize for not mentioning all people who gave their important time, energy and ideas to help prepare this wonderful meeting.

Since the financial crisis, the polarization of wealth has become more serious in most countries and it is one of the serious social problems we face. In addition, we see more and more people and countries becoming 'selfish' and 'self-centered'. Today, justice is threatened to become an outdated value found only in textbooks and "financial gain" is becoming daily justice. Moreover, I see different types of polarization happening, which will be intensified every year. I am afraid that intergenerational differences might bring another polarization among the new and old generations. It is becoming harder to be understood cross-generationally. A steep change in value systems and the rapid development of high technology are making communication harder between generations. However, I think we will soon see more serious polarizations among individuals, companies, and even countries. The differences of efficiency and productivity between those who can understand and utilize AI technology well and others who do not can bring substantial polarization. I want to call this "AI polarization". As intelligent machines take over many human positions and roles, we cannot avoid facing steep differences between those who have technology and those who do not.

How can we solve all these polarizations? How can we better consider our neighbors and neighboring countries? The answer can be found in understanding and teaching the value of humanity and empathy. Humanity and empathy are key factors in making people conscientious of the environment and of other people. They are also two important keys to building creativity and convergence.

Every year, through our annual meeting, we gather to contribute to our global society by exchanging research results, creative perspectives and academic insights into discipline convergence. We want to provide advanced and quality education to the young generation seeking global cooperation and friendship. We all know that one person's intelligence and understanding is limited in depth and width, but much greater creativity and excellence come from cooperative convergence among people from different disciplines. Today, in addition to these values, I hope we become more sympathetic toward our neighbors and focus on creative education to resolve polarization difficulties. This is why young students and the older scholars meet together through the ISCC exhibition. This is why different but creative disciplines meet together through CADI exhibition. This is why I strongly want more disciplines including the humanities to join for better understanding at the ICCT conference. I hope IACST and these events serve as a truly meaningful platform for finding and sharing fruitful convergence technology, creativity development and even the resolution to polarization.

Please enjoy all the events and programs, and have a wonderful time in Pattaya.

Thank you very much.

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**Dr. PyeoungKee Kim**

Honorable Chair of ICCT 2019 and President of IACST

# Congratulatory Message

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## **Dr. Putchong Uthayopas**

Vice President for Information,  
Kasetsart University, Bangkok, Thailand



Dear Honorable Guest and Participants of ICCT2019,

It is a great pleasure and honor to serve as the Honorable Chair Person of this prestigious event. The world is now moving toward becoming a digital world. Digital technology plays an increasingly important role in our life, our society, and culture. Nevertheless, the impact of the global digital transformation to the change in our culture and society is not adequately addressed. Thus, I am very pleased to see that ICCT2019 is trying to be a high-quality forum for the exchange of ideas, not only the technical side of the digital revolution but also the cultural impact of the dramatic changes to come. As the Vice President of Kasetsart University, we are very pleased to have an honor of organizing this conference along with many prestigious organizations. I wish that this event will be a start for many projects and sustainable long term international academics collaboration. The venue in Pattaya is a great mixture of relaxing travel destination, good food, culture, and fun. I am certain that each participant will enjoy both cultural, technical, and friendship exchange here.

Finally, I would like to congratulate the organizing committee, technical committee, and steering committee for the hard work in putting together ICCT2019. I wish you a very successful event.

Congratulation!

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**Dr. Putchong Uthayopas**

Honorable Chair of ICCT 2019

Vice President for Information, Kasetsart University, Bangkok, Thailand



## **Dr. Chai Wutiwivatchai**

Chairman  
NECTEC, Thailand

Please allow me to express my appreciation to the International Association for Convergence Science & Technology, Dongseo University of Korea, Kasetsart University, and National Electronics and Computer Technology Center (NECTEC) of Thailand for jointly hosting the “International Conference on Culture Technology 2019 (ICCT 2019)” during August 13-16, 2019 in Pattaya City of Thailand.

The importance of culture is the art of storytelling. In the past, the traditional culture preservation has been done by local wisdom of the local people. There are many possible limitations; for example, object loss and culture knowledge management. During the disruptive era nowadays, the preservation of tangible and intangible cultural heritages has greater challenges. The use of convergence technologies such as AI, AR/VR, IoT, Big Data, Digital Content can decrease these obstacles. Furthermore, these technological advances would promote environmental, economic, and social sustainability of culture preservation.

It is not only technological side, but also the collaborative culture technology community can help us move faster and farther. This ICCT 2019 is the international stage for innovative people to use not only convergence technologies, but also strengthening cooperation between governments, academia, private sectors and communities.

I am confident that ICCT 2019 will establish significant contributions and enhance further opportunity to innovate and improve the quality of culture technology and its applications.

Last, but not least, on behalf of NECTEC, I thank you all for participating in ICCT 2019, and send best wishes for a very successful conference.

Thank you very much.

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**Dr. Chai Wutiwivatchai**

Honorable Chair of ICCT 2019

Chairman, National Electronics and Computer Technology Center (NECTEC), Thailand

# Welcome Message

## Thepchai Supnithi

Organizing Chair of  
ICCT 2019



## Intiraporn Mulasastra

Organizing Chair of  
ICCT 2019



## Kultida Tuamsuk

Organizing Chair of  
ICCT 2019



## Tae Soo Yun

Organizing Chair of  
ICCT 2019

ICCT is the first and comprehensive international conference on the various aspects of culture technology and its applications. The Fourth International Conference on Cultural Technology(ICCT 2019), which annually held since 2016, has broadened to cover the technology for digital content culture, culture service and convergence technologies both science and social science aspects.

The ICCT 2019 is a worldwide collaboration with the purpose to promote researches and provides a chance for academic and industry professionals to discuss recent progress in the area of cultural technology. The goal of this conference is to bring together the researchers from academic and industry to share ideas, works, problems and solutions related to the various aspects of culture technology.

The ICCT 2019 is hosted by Department of Engineering, Kasetsart University and National Electronics and Computer Technology Center with the great support from the International Association for Convergence Science & Technology (IACST). In this year, we set a conference theme “Convergence for Creativity”. We also have a joint event with the Convergence Art & Design International 2019 (CADI 2019). This will enable us to share ideas on knowledge and creativity among experts from technology, culture, art and design areas. On behalf of organizing committee, we would like to express our sincere thanks to all presenters, reviewers, organizing team and all the members for their dedication and work hard behind the scene to make this a truly successful international conference. We sincerely hope that all of you enjoy this remarkable event. We look forward to seeing and discussing with you all the venue of ICCT 2019.

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### Dr. Thepchai Supnithi

Organizing Chair of ICCT 2019 and Principal Senior Researcher of NECTEC, Thailand

### Dr. Intiraporn Mulasastra

Organizing Chair of ICCT 2019 and Assistant Professor of Kasetsart University, Thailand

### Dr. Kultida Tuamsuk

Organizing Chair of ICCT 2019 and Associate Professor of Khon Kaen University, Thailand

### Dr. Tae Soo Yun

Organizing Chair of ICCT 2019 and Chief Vice President of IACST

# TPC Chair Message

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**Somchoke Ruengittinun**

TPC Chair of  
ICCT 2019



**Dongkyun Kim**

TPC Chair of  
ICCT 2019

It is our great pleasure to welcome you to Pattaya, Thailand from August 13 to 16, 2019, for the International Conference on Culture Technology (ICCT2019).

ICCT2019 is the first and comprehensive international conference on the various aspects of culture technology and its applications. ICCT2019 will provide a chance to a multi-disciplinary group of researchers, engineers, and scientists from all over the world to present and exchange break-through ideas in the area of cultural technologies. The conference is annually organized with the principal aim to focus on convergence approach to develop creativity and bring about innovation in most disciplines. Since its inception, the conference has provided a cohesive networking opportunity as well as a forum where state of the art research in the area of Information and cultural technology is shared. Now, ICCT2019 includes peer-reviewed technical presentations, special sessions, as well as poster sessions. Furthermore, we are aimed to further improve and provide the participants with a platform to showcase state-of-the-art technologies, products, solutions, and create a highly interactive networking environment when mixing with the student demonstrations, and expositions.

This year, ICCT has various topics on design and cultural technologies including information technology, digital contents and cultural service. We have received a lot of paper submissions from 9 countries (Korea, Malaysia, Russia, Australia, Thailand, United States of America, China, India, and Indonesia) in the world. Through a rigorous review process, we have selected 76 technical papers for presentation at the conference. The accepted papers were organized into 8 technical oral sessions and four poster sessions. In addition, we have a special session where international creative coding ideas can be shared.

Besides the paper contribution from all over the world, this successful program was made possible by the devoted service of technical program committee members. We would like to express many thanks to all the TPC members as well as to the Organizing Committee Chairs for their active support and guidance. We hope that all of participants enjoy the excellent program of this ICCT2019 and the beautiful attractions of Pattaya.

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**Ajarn Somchoke Ruengittinun**

TPC Chair of ICCT 2019 and Ajarn of Kasetsart University, Thailand

**Dr. Dongkyun Kim**

TPC Chair of ICCT 2019 and Vice President of IACST

# Organization

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## Organizing Committee

### Honorable Chairs

- **Dr. Chai Wutiwiwatchai**, Chairman of NECTEC, Thailand
- **Dr. Puchong Uthayopas**, Vice President of Kasetsart University, Thailand
- **Dr. Pyeoungkee Kim**, President of IACST

### Organizing Chairs

- **Dr. TaeSoo Yun**, Dongseo University, Korea
- **Dr. Thepchai Supnithi**, NECTEC, Thailand
- **Prof. Intiraporn Mulasastra**, Kasetsart University, Thailand
- **Prof. Kultida Tuamsuk**, Khon Kaen University, Thailand

### Registration Chairs

- **Dr. SeHyun Park**, Daegu University, Korea
- **Dr. DongHwa Lee**, Daegu University, Korea

### Local Arrangement Chair

- **Dr. Thanawin Rakthammanon**, Kasetsart University, Thailand
- **Dr. Watchira Buransing**, NECTEC, Thailand

### Publicity Chair

- **Dr. Eun Yi Kim**, Konkuk University, Korea

### Publication Chair

- **Prof. KyungSu Kwon**, Dongseo University, Korea
- **Ms. Junghye Kim**, IACST

## Technical Program Committee

### TPC Chairs

- **Dr. Dongkyun Kim**, Kyungpook National University, Korea
- **Ajarn Somchoke Ruengittinun**, Kasetsart University, Thailand
- **Dr. Rattasit Sukhahuta**, Chiang Mai University, Thailand
- **Dr. Sungpil Lee**, Dongseo University, Korea
- **Dr. Hyeyoung Ko**, Seoul Women's University, Korea

## International Advisory Committee

- **Dr. Kazuo Sugiyama**, Oriental Consultant, Japan
- **Dr. Kwangyun Wohn**, NST, Korea
- **Dr. Chonggi Kim**, Shanghai University of Science & Technology, China
- **Dr. Tongjin Kim**, Purdue University, USA

## Exhibition Committee

### Design Program Chairs

- **Prof. Kiesu Kim**, Silla University, Korea
- **Prof. Seungpok Choi**, Silla University, Korea
- **Prof. Xia Yingchong**, ZJC, China

## Steering Committee

- **Professor, Pyeoungkee Kim**, Silla University, South Korea
- **Professor, TaeSoo Yun**, Dongseo University, South Korea
- **Professor, Rattasit Sukhahuta**, Chiang Mai University, Thailand
- **Professor, Xia Yingchong**, Zhijiang College of Zhejiang University of Technology, China
- **President, Bill Chen**, Zhejiang Creative Textile Industry Research Institute, China
- **Professor, Sungpil Lee**, Dongseo University, South Korea
- **Professor, Fei Hao**, Shanxi Normal University, China
- **Professor, YongUk Lee**, Tokyo Polytechnic University, Japan
- **Professor, Hisaki Nate**, Tokyo Polytechnic University, Japan
- **Principal Researcher, Thepchai Supnithi**, NECTEC, Thailand
- **Professor, Rolly Intan**, Petra Christian University, Indonesia
- **Professor, Elena Tsomko**, Dongseo University, Russian Federation
- **Professor, I Putu Agung Bayupati**, Udayana University, Indonesia
- **Professor, Yulia M. Kom**, Petra Christian University, Indonesia
- **Professor, Guydeuk Yeon**, Christ University, India
- **Professor, Intiraporn Mulasastra**, Kasetsart University, Thailand
- **Rector, Dam Quang Minh**, Western University, Vietnam
- **Professor, Ted Shin**, Denver Metropolitan University, USA
- **Professor, Donghwa Lee**, Daegu University, South Korea
- **Professor, Sian Lun Lau**, Sunway University, Malaysia
- **Professor, Hyeyoung Ko**, Seoul Women's University, South Korea
- **Professor, Jiman Hong**, Soongsil University, South Korea
- **Professor, KyungSu Kwon**, Dongseo University, South Korea
- **Professor, Lee Yun Li**, Sunway University, Malaysia
- **Professor, Jaeho Pyeon**, San Jose State University, USA
- **Professor, Hyunjin Chun**, Nanjing University of Aeronautics and Astronautics, China
- **Professor, SeHyun Park**, Daegu University, South Korea
- **Professor, Dongkyun Kim**, KyungPook National University, South Korea
- **Professor, EunYi Kim**, Konkook University, South Korea
- **Vice President, JongSoo Rhee**, Pinetree Associates, South Korea
- **CEO, SangHyo Lee**, Namu Coding, South Korea
- **Professor, Mustafa Eren Yildirim**, Bahcesehir University, Turkey
- **Professor, Soon Ki Jung**, Kyungpook National University, Korea

# Keynote Speech

## **Dr. Kwangyun Wohn**

Chair, National Committee of Science & Technology, Korea



Kwangyun Wohn is Chairperson of National Research Council of Science and Technology (NST in short). NST is the governing organization that oversees the 25 major national research institutes, including KIST, ETRI, and KAERI. Before he accepted the Chairship of NST, he has been at KAIST as professor for 27 years.

He started his professional career at Agency of Defense Development in Korea. Having completed the master's and Ph.D. studies at University of Wisconsin and University of Maryland, respectively, he had been with Harvard University (USA) as Lecturer, and with University of Pennsylvania (USA) as Assistant Professor. Having returned back to his home country, Korea, he had been with Computer Science Department for fifteen years, and founded a new graduate school, Graduate School of Culture Technology (GSCT) in 2005, and served as Dean. Having retired from KAIST, he still holds the Professor Emeritus of KAIST.

Major activities and accomplishments include: Director of Virtual Reality Research Center which is a national center of research excellence, Founding President of Korean Society of Human-Computer Interaction (HCI), Founding President of Korean Society of Performing Art, and Editorial Board of British Computer Society. While his research interests span a broad range of the intersection between art and science – from theoretical aspects to practicalities – he focuses his research efforts to the application of virtual reality technology to various cultural artifacts such as stage performances, museum exhibitions and educational contents.

## **Dr. Chai Wutiwivatchai**

Chairman, National Electronics and Computer Technology Center (NECTEC), Thailand



Chai Wutiwivatchai received his B.Eng. (1st honor) and M.Eng. degrees of electrical engineering from Thammasat and Chulalongkorn University, Thailand in 1994 and 1997 respectively. He received Ph.D. from Tokyo Institute of Technology in 2004 under the Japanese Governmental scholarship. He is now the Executive Director of National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA) Thailand. His research interests include speech and language processing, human-machine interaction, and recently massive open online courses. His research work includes several international collaborative projects in a wide area of speech and language processing such as multi-lingual speech-to-speech translation under Asian and European countries collaboration. He has been a project technical leader of the NSTDA massive open online courses systems supported by the Office of Basic Education Commission and Office of Higher Education Commission. He has been selected one of 66 young leaders shaping Thailand's future by Bangkok Post in 2013 and has got a runner-up Outstanding Technologist award in 2015.

# Schedule

Time	Program
<b>August 13(Tuesday), Day for Friendship</b> Place: Siam Bayshore Resort, Pattaya, Thailand	
13:00~15:00	<b>Exhibition Setup</b> by CADI / ISCC 2019 Committee @ Siam Bayshore Resort
15:00~18:00	<b>Experiencing Local Culture</b> @ Pattaya Area
18:30~21:00	<b>Welcome Reception</b> (IACST directors and VIPs are welcome to join) Bali Hai by the Sea @ Siam Bayshore Resort
<b>August 14(Wednesday), Day for Excellence</b> Place: Siam Bayshore Resort, Pattaya, Thailand	
08:30~09:30	<b>Registration</b> ParkView 1 @ Conference Room of Siam Bayshore Resort
09:30~10:30	<b>ICCT2019 Opening Ceremony</b> .Opening Address (President, IACST) .Welcome Message (Chairman, NECTEC) .Congratulatory Message (Vice-President, Kasetsart University) ParkView 1 @ Siam Bayshore Resort
10:30~11:20	<b>Keynote Speech 1</b> Dr. Kwangyun Wohn ParkView 1 @ Conference Room
11:20~11:30	Tea Break
11:30~12:20	<b>Keynote Speech 2</b> Dr. Chai Wutiwiwatchai ParkView 1 @ Siam Bayshore Resort
12:20~14:00	Lunch Time Cafeteria @ Siam Bayshore
14:00~16:00	<b>Oral Paper Presentation (OW)</b> (Session OW1~OW4) Session Rooms 1~4 @ Siam Bayshore Resort

Time	Program
<b>August 15(Thursday), Day for Creativity &amp; Convergence</b> Place: Siam Bayshore Resort, Pattaya, Thailand	
09:00~09:30	<b>Setting Up for Poster Paper Presentation</b> ParkView 2 @ Exhibition Area, Siam Bayshore Resort
09:30~11:00	<b>Poster Paper Presentation (PT)</b> ParkView 2 @ Exhibition Area, Siam Bayshore Resort
11:00~12:00	<b>CADI / ISCC 2019 Tape Cutting &amp; Viewing</b> .Tape cutting & Viewing (together) .Meeting with the Creators (together) ParkPlace @ Siam Bayshore Resort
12:00~14:00	<b>Lunch Time</b> Cafeteria @ Siam Bayshore Resort
14:00~16:00	<b>Oral Paper Presentation (OT)</b> (Session OT1~OT4) Session Rooms 1~4 @ Siam Bayshore Resort
16:00~18:00	<b>Special Session</b> International Creative Coding Workshop ParkView 1 @ Siam Bayshore Resort
18:30~21:00	<b>ICCT/CADI/ISCC 2019 Awarding Ceremony</b> <b>Banquet &amp; Performance</b> ParkView 1 @ Siam Bayshore Resort

<b>August 16(Friday), Day for Culture Experience</b> Place: Pattaya Area, Thailand	
09:00~10:30	<b>Industry - Academy Cooperation Meeting</b> Seminar Room @Siam Bayshore Resort
10:30~12:00	<b>Evaluation (by the Organizing Committee)</b> Seminar Room @Siam Bayshore Resort

# Program

## Oral Presentation, 14<sup>th</sup> August 2019

### Session OW1 – Digital Contents

14<sup>th</sup>, Aug. 14:00–16:00, Room # Park View2

Session Chair: Unha Kim (Zhongnan University of Economics and Law, China)

- #1130 **“A Comparative Study on Ex Machina and A Doll’s House — Focusing on the extreme asymmetry in power relations,”** Unha Kim (Zhongnan University of Economics and Law, China)
- #1285 **“Image Processing-Based Separation of Object and Background,”** Dong-Gyun Hong, Mi-Heyon Cheon, and Donghwa Lee (Daegu University, Korea)
- #1196 **“Expanding Transmedia Storytelling into mutiverse A case study of ‘Spider-Man: Into the Spider-Verse’,”** Jaekyu Kim and Eeljin Chae (Zhongnan University of Economics and Law, China)
- #1242 **“An Overview Study on 5G Millimeter Wave (mmWave) Beamforming,”** Xiaoxiao Liu, Haoran Mei, Qiang Zhao and Limei Peng\* (Kyungpook National University, Korea)
- #1219 **“Designing and Developing an Interactive Projection Mapping AR Book on Cultural Heritage of Myanmar,”** Aye Chan Zay Hta and Yunli Lee (Sunway University, Malaysia)
- #1158 **“Persona Modeling based on UX Design for Behavior Pattern Analysis of AI NPC Character,”** Young Jick Jang and Tae Soo Yun (Dongseo University, Korea)
- #1248 **“Investigation of the capabilities of convolutional neural networks in object classification problems for incoming video streams,”** Kadura Elena (Far East Transport State University, Russia), Manzhula Ilya (Computer Center Far East Branch Russian Academy of Science, Russia)

### Session OW2 – Advanced Technology

14<sup>th</sup>, Aug. 14:00–16:00, Room # Park Place

Session Chair: Guydeuk Yeon (Christ University, India)

- #1047 **“Fall Detection System for Elderly with Wi-Fi Accelerometer Sensor,”** Somchoke RUENGITTINUN and Intat LIKITPOLCHALOON (Kasetsart University, Thailand)
- #1084 **“Driver’s Smartphone Usage Detection Based on Convolutional Neural Network Using Multi-Camera,”** Ziyi Zhang, Ye-won Kim, Tae-uk Kim and Bo-Yeong Kang (Kyungpook National University, Korea)
- #1051 **“Virtual Thai Xylophone,”** Somchoke Ruengittinun, Kanitin Krikriengsri, Piyungoon Poonpanang and Soontharee Koompairojn (Kasetsart University, Thailand)
- #1131 **“Wearable computer Bright Shirt for Blind people,”** Thanutporn Pisanupoch, Naiyana Sae-lim, Somchoke Ruengittinun and Soontharee Koompairojn (Kasetsart University, Thailand)
- #1141 **“Digital Leaky Integrate-and-Fire Neuron with Approximate Adders for Spiking Neural Networks,”** Yongtae Kim (Kyungpook National University, Korea)
- #1217 **“Apply LBPH algorithm to detect students in classroom,”** Supaporn Bundasak and Chisanupong Tamprasit (Kasetsart University, Thailand)
- #1237 **“Calibration of 3D Sensors for Interactive AR Face Makeup System,”** Eun Mi Park, Ki Yeol Baek, Lamyamba Laishram, Jae Seok Jang and Soon Ki Jung (Kyungpook National University, Korea)

**Session OW3 – Art and Design – I****14<sup>th</sup>, Aug. 14:00~16:00, Room # Pine Groove****Session Chair: Chul Young Choi, (Dongseo University, Korea)**

- #1059** “Research on Sustainable Design Based on Analysis of Sustainable Packaging Cases,” Zhang Jifa (Dongseo University, Korea)
- #1028** “Analysis of Design Preference Using 3D Technology -Focused on the Design of Highway Slope-,” Hyun Jin Chun (Southeast University, Nanjing, China and Nanjing University of Aeronautics and Astronautics, Nanjing, China); Bai Hao Li (Southeast University, Nanjing, China)
- #1093** “Research on Theoretical Model of YouTube Subscription Behavior,” Hou ZhengDong, Choi, Chul Young, (Dongseo University, Korea)
- #1099** “A Development of Children’s Arts Experience Program of China: Experience Design Approach,” WooLahm Yoon (Dongseo University, Korea)
- #1152** “Research on the Relationship between Virtual Actors and Real Actors in the Short Animation Collection <Love, Death and Robots>,” MengZilu and ChoiChul-Young (Dongseo University, Korea)
- #1054** “China’s Farmland Landscape Evolution Based on Farmland Transfer (1949-2009),” Zhongjian Zhao and Junlan Liang (Nanjing University of Aeronautics and Astronautics, China)
- #1278** “Real-Time Head Pose Estimation Using the Relationship of 4-Points on the Facial Feature,” Yebin Kim and Hyeyoung Ko (Seoul Women’s University, Korea)

**Session OW4 – Art and Design – II****14<sup>th</sup>, Aug. 14:00~16:00, Room # Orchid,****Session Chair: Wei Li (Nanjing University of Aeronautics and Astronautics, China)**

- #1056** “Research on Geometric Modeling Optimization of Alien Architecture Based on 3D Printing,” Haowen Wang (Nanjing University of Aeronautics and Astronautics, China); Jie Zhang (Nanjing University of the Arts, China)
- #1074** “VR experiences and history through immersion: a case study on <Titanic VR, 2018>,” Thatiany Andrade Nunes and HyunSeok Lee (Dongseo University, Korea)
- #1107** “Criticism and Re-discussion on Humanized Design,” Qiaoming Cheng (Nanjing University of Aeronautics and Astronautics, China)
- #1151** “Analysis of Brittle Fracture Special Effects in SF Films by Period,” JiaNi Zhou and Tae Soo Yun (Dongseo University, Korea)
- #1172** “The Characteristics of Regeneration design of the Region with Historical Industrial Heritages and Culture - Focused on Taoxichuan in Jingdezhen -,” JingYu Zhang and Jiyoung Yoon (Dongseo University, Korea)
- #1269** “From Technology-driven Design Development to Industry 4.0 Changing Design Trends,” Wei Li (Nanjing University of Aeronautics and Astronautics, China); Jie Zhang (Nanjing University of the Arts, China); Li Yueqian (University of Melbourne, Australia)
- #1202** “A Study on Characteristics of the Non-permanent Exhibition Space’s Sign System,” Hanyi Lu (Dongseo University, Korea)

**Oral Presentation, 15<sup>th</sup> August 2019**

**Session OT1 – Digital Contents / Advanced Technology**

**15<sup>th</sup>, Aug. 14:00~16:00, Room # Park View2**

**Session Chair: Hyunjin Chun (Nanjing University of Aeronautics and Astronautics, China)**

- #1290 **“Visualization for noise labeling using deep learning,”** Yu-Lim Shin and Eun-Jung Choi (Seoul Women’s University, Korea)
- #1276 **“Mathematical modeling of the layered detachment technology of a 3d model during 3d products printing,”** Alexander Kholodilov, Elena Karachanskaya, Elena Faleeva and Roman Eschenko (Far Eastern State Transport University, Russia)
- #1297 **“Next hop Selection via Machine Learning in a Cloud-based Vehicular Named Data Networks: An Architectural Perspective,”** Lauren Ason and Syed Hassan Ahmed (Georgia Southern University, USA)
- #1283 **“UAV Path-planning in 3-Dimensional Space : A Brief Survey,”** Yangru, Muhammad Toaha Raza Khan, Junho Seo and Dongkyun Kim (Kyungpook National University, Korea)
- #1271 **“Energy Trading from Solar Roof Top,”** Ariya Phukfon and Suwannee Adsavakulchai (University of the Thai Chamber of Commerce, Thailand)
- #1218 **“Downtime prediction for refrigeration in gas separation plants,”** Supaporn Bundasak, Kawisara Ueafuea and Kanokrut Bumrungwat (Kasetsart University, Thailand)
- #1302 **“Human Activity Recognition System using R,”** Ajay Agarwal (KIET Group of Institutions, India); Amit Kumar Gupta and Vikas Goel (AKGEC, Uttar Pradesh); Mangal Sain (Dongseo University, Korea)

**Session OT2 – Foundation / Art and Design**

**15<sup>th</sup>, Aug. 14:00~16:00, Room # Park Place**

**Session Chair: HyunSeok Lee (Dongseo University, Korea)**

- #1186 **“A study on the Design Management System of Rural Complex based on Synergetics,”** Boyu Du and Kwansoon Hong (Dongseo University, Korea)
- #1292 **“Interpretation of Cultural Landscape for Development of TOD - Focused on Yaowarat Chinatown in Bangkok, Thailand -,”** Hyun Jin Chun (Nanjing University of Aeronautics and Astronautics, China and Chulalongkorn University, Thailand); Ariya Aruninta (Chulalongkorn University, Thailand)
- #1200 **“Emoticon Development Research on Product Users’ Emotion,”** Chao Huang (Dongseo University, Korea)
- #1175 **“Toward Assessment for Language Learning: A Case Study in Thai Language Proficiency of Secondary and High School Learners,”** Akkharawoot Takhom (National Electronics and Computer Technology, Thailand); Sasiporn Usanavasin (Sirindhorn International Institute of Technology, Thailand); Thepchai Supnithi (National Electronics and Computer Technology, Thailand); Thanaruk Theeramunkong (Sirindhorn International Institute of Technology, Thailand)
- #1075 **“Analyzing the Semiotics of Chinese Animated Short Films: A Case Study on <Love Seeds, 2016>,”** Lin Xiao and HyunSeok Lee (Dongseo University, Korea)
- #1207 **“An Ontology-based Study of Cultural Tourism Knowledge Management: A Case Study of Thai Wikipedia Articles.,”** Kanchana Saengthongpattana, Kanyanut Kriengkiet, Pattama Krataithong and Thepchai Supnithi (National Electronics and Computer Technology Center (NECTEC), Thailand)

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- #1221 “A Study on the Necessity of Standardization for SCRM,”** Hyohyun Son, Kwangjun Kim and Manhee Lee (Hannam University, Korea)
- #1169 “Recommendation system with limited time for visiting museum,”** La-or Kovavisaruch, Taweesak Sanpechuda, Krisada Chinda, Thitipong Wongsatho, Sodsai Wisadsud and Anuwat Chaiwongyen (National Electronics and Computer Technology Center, Thailand Science Park, Thailand)
- #1094 “Recognition of Korean Vowels using Bayesian Classification,”** Seong-Woo Kim, Kyung-Ae Cha and Se-Hyun Park\* (Daegu University, Korea)
- #1277 “Developing Fangipani Identification for Android,”** Samuel Aprilus Efendi, I Putu Agung Bayupati and Ni Kadek Ayu Wirdiani (Udayana University, Indonesia)
- #1220 “Analysis of ICCT Research Trend using the ARTAS,”** Seungsoo Park and Manhee Lee (Hannam University, Korea)

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- #1148 “New Momentum of Cultural Creation: Feeling from the Experience in Taiwan,”** Zhenkun Fan, Zisen Zheng and Qingtian Liu (Silla University, Korea)
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- #1300 “Community and Social Participation in Preserving Lanna Traditional Palm Leaf Manuscripts,”** Piyapat Jarusawat (Chiang Mai University, Thailand)
- #1301 “Disseminating Digitalization of Collaborative teaching: a strategy of Using Multimedia in Classroom,”** Deepanjali Mishra (KIT University Bhubaneswar, India); Mangal Sain Huang (Dongseo University, Korea)

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- #1100 “Analysis on Chinese people’s Preference of Emoticon Character “Kakao Friends” and “LINE Friends”,” Ding Zhi Bo and Seung-keun Song (Dongseo University, Korea)
- #1110 “An Analysis of the Public Facilities of Dadaepo Beach,” Sun Yu jun and Lee Dong hun (Dongseo University, Korea)

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- #1163 “Comparison of Rendering Platform based on Hair Rendering,” Wen Ting Li, Yun Ji, Jia Ni Zhou and Tae Soo Yun (Dongseo University, Korea)
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- #1174 “A Study on the Universal Design in the Cultural Space - Center around the Busan Museum-,” Dan Wang and Jiyoung Yoon (Dongseo University, Korea)
- #1226 “A Study on Depth Perception and Method for Maximizing Immersive 3D Animated Dialogue Scenes,” DongWoo Lee and HongSik Pak (Dongseo University, Korea)

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- #1199** “S4AI: Block-based AI Coding,” Chen Shaoshuai and Pyeoungkee Kim (Silla University, Korea)
- #1216** “Secure Payment Mechanism Based on Blockchain for Fueling Vehicles in Smart City,” Faisal Jamil and DoHyeun Kim (Jeju National University, Korea)
- #1227** “Design of Binary Visualization for Malware Classification,” Yoon-Kyung Nam and Eun-Jung Choi (Seoul Women’s University, Korea)
- #1282** “Network Intrusion Detection using Machine Learning Techniques,” Jiyeon Kim, Yulim Ahn and Eunjung Choi (Seoul Women’s University, Korea)
- #1284** “A Study on speech recognition based on stereo files using MFCC,” Ui Jeong Kang and Eun Jung Choi (Seoul Women’s University, Korea)
- #1330** “Development of a Prototype for a Dementia Therapy AI Robot,” Seonghyeon Kim and Minhyoek Baek (Daegu Gyeongbuk Institute of Science and Technology, Korea); Gun Uk Kang (Keimyung University, Korea); Donghwa Jeong (MechaSolution, Inc., Korea); and Jason Pyeon (Taejon Christian International School, Daejeon, Korea)

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- #1078** “Cross-Border E-commerce Industry Trend in China: a Case Study on NetEase's Kaola,” Myoung Suk Kim and Do Hee Kim (Seoul Women’s University, Korea)
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# Guide Line for Authors/Chairs

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## Guideline for Authors

### Oral Sessions

#### 1. Duration of the Presentation

The allotted time for each speaker is 12 minutes to present and 6 minutes for Q&A.

#### 2. Equipment in Presentation Room

Each presentation room will have a projector, a screen and a laptop computer running PowerPoint under MS Windows, equipped with USB port.

#### 3. Preparation for Your Presentation Session

Bring a USB memory with your PowerPoint presentation and make sure that your file is copied on the laptop computer before your session starts. Please show up 15 minutes before the actual session starts and introduce yourself to the session chair. Be prepared to give some bibliographic details about yourself to the chairperson so that he/she can introduce you before your presentation.

### Poster Sessions

#### 1. Duration of the Presentation

The poster session has 60 minutes, requiring all presenters to be available at their posters during the session.

#### 2. Poster Specification

Posters must be designed to fit a 841mm wide x 1189mm tall board. Posters may be prepared as a single poster or as several smaller sections mounted together. The heading of the poster should list the paper title, author(s) name(s), and affiliation(s).

#### 3. Poster Set-Up

Posters may be attached to the boards by push pins or tapes, which will be provided. Posters must be set up by presenters 10 minutes before the session starts. Posters must be removed by presenters right after the session is over. Posters not removed by 10 minutes after the session will be removed by volunteers (session organizers not responsible for posters left after this deadline).

## Guideline for Chairs

### Before Your Session

#### 1. Check the Program

Prior to departure for the meeting, check the program on our website (<http://icct.iacst.org/index.php>) to find the time slot for the session that you are chairing.

#### 2. Pick Up the Materials for Session Chair from Registration Desk

Please arrive at the registration desk about 20 minutes prior to the start of the session and pick up the material prepared for a session chair.

#### 3. Check the Meeting Room

Please arrive at the session room about 10 minutes prior to the start of the session and familiarize yourself with the controls for lights, microphones, a pointer, and a projector. If you encounter problems, immediately alert the session staff who is serving your session in the session room. Meanwhile, you have to check the presence of individual speaker in your session.

## During Your Session

### 1. Introduction

At the start of the session, briefly introduce yourself and explain the timing system to the audience, and as often during the session as you think necessary.

### 2. Time Allotment

The allotted time for each speaker is 12 minutes to present and 6 minutes for Q&A. If possible, you may give a brief introduction of the speaker to the audience, including his or her affiliation and position, at the beginning of each presentation.

### 3. Absent Speakers

Should a speaker fail to appear, you may recess the session until it is time for the next scheduled abstract. If you are notified of the absence of any speaker before the session starts, please announce it to the audience. You have to report the absence of any speaker to the secretariat for conference administration at the registration desk.



# Oral Presentation 1 (Session OW1 ~ OW4)

14<sup>th</sup> August 2019

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# **A Comparative Study on *Ex Machina* and *A Doll's House*** **— Focusing on the extreme asymmetry in power relations**

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## **Abstract**

*Ex Machina* (2015), directed by Alex Garland, is one of the masterpieces of SF films ever made. This film portrayed the dramatic change in power relations between human and artificial intelligence(AI) robot. The concrete relation between them as master and servant gradually cracked and finally rushed up into catastrophic end. And the movie reminds us of the play, *A Doll's House* (1879), written by a Norwegian playwright Henrik Ibsen.

***Keywords; Ex Machina; A Doll's House; power relations; human and AI robot***

## **1. Introduction**

*Ex Machina* (2015), directed by Alex Garland, is one of the masterpieces of SF films ever made. This film portrayed the dramatic change in power relations between human and artificial intelligence(AI) robot. The firm relation between them as master and servant gradually cracked and finally rushed up into catastrophic end. And the movie reminds us of the play, *A Doll's House* (1879), written by a Norwegian playwright Henrik Ibsen.

Henrik Ibsen addressed the issue of extreme asymmetry in power relations around man and woman, wife and husband in Europe in the late 19th century, and Alex Garland set the background in the early 21st century in the era of the fourth Industrial Revolution focusing on human and artificial intelligence robots. *A Doll's House* triggered the debate on the feminism issue, women as an equal and free being like men, and *Ex Machina* contributed to the issue of AI robot with high intelligence and consciousness like humans, or post-humanism debate.

## **2. Extreme asymmetry in power relations**

Danish filmmaker Lars Von Trier's *Dogville* (2003) is an excellent work in the observation that how humans deal with other humans when power relations between humans are placed in extreme asymmetry. When so good and simple villagers are at one point conscious of the fact that they have power, they regard the exploitation and violence of other helpless human beings as a natural and just exercise of rights. In this sense, though it is not easy for us to accept but all human beings are born to be slaves and sinners of the situation. A power relationship, regardless of individual or group, generally occurs between humans and humans, that is, socially. It is also historically formed, so it is bound to go through a process of creation, development, and extinction. Extreme asymmetry in power relations refers to a situation in which one person has a power significantly larger or smaller than the other.

The awareness of AI robot as highly intelligent and conscious beings in *Ex Machina* happened to Ava(Alicia Vikander) one day. It's as if the awareness of woman as equal and free personality came suddenly to Nora one day. Nathan(Oscar Isaac), the scientist who created Ava, which was a highly intelligent and conscious creature, had no preparation for the relationship he would have with him/her when the AI robot was born. This is tantamount to the fact that Helmer was not prepared for the relationship with Nora who became aware of herself as an independent personality, not as husband's doll. If there is a difference, Ava's intelligence is the result of the upgraded performance of the model by the development of science and technology, and Nora's awareness is driven by the development of society. Even if such a moment of intelligence or awareness is bound to arrive someday, it is impossible for us to predict the time exactly. For this reason, the story of *Ex Machina* revolves

around the modified Turing test conducted by Caleb (Domhnall Gleeson), and the structure of conflict in *A Doll's House* is deepening around the disclosure of the loan certificate.

### 3. The similar structure of the movie and the play

*Ex Machina* and *A Doll's House* show the similarity of structure in that the event unfolds based on extreme asymmetry in power relations. Attention here is drawn to the situation of extreme asymmetry in power relations and the fact that complaints or awareness of people about these situations do not necessarily occur at the same time. It goes without saying that this power relationship has been formed historically and has been maintained for a long time. Nora, the main character in *A Doll's House*, had been taking power relations between herself and her husband, Helmer, without any complaints for eight years of marriage life. Helmer called his wife Nora "my little singing lark", and regarded her as "my most precious possession."<sup>1</sup> Nora did not doubt her husband's love. Then one day, she suddenly realized that the relationship with her husband, forged through marriage, was in fact nothing more than a relationship between a doll and a child, a slave and a master, and decided to leave her family in order to find her own free destiny. Nora, who believed that Torval's and her love were based on the equal power relations that each other was willing to die for, realized that it was an illusion and a fantasy. Nora's defiance and awareness might have been a bolt out of the blue for most of husbands represented by Helmer, and for most wives as well just as Nora before her awakening.

As we have seen above, *Ex Machina* resembles *A Doll's House* in many ways. First of all, the movie solves the story with a small stage and compressed time as if it were a play. Most of the cases take place in Nathan's remote laboratory, reminiscent of Helmer and Nora's house, and that ends in a week. Nathan's laboratory faithfully performs its role as a concentrated space where people gather and conflicts are intensified and exploded. Next, the composition of the characters is similar. The main confrontation in the film takes place between Nathan and Ava, and in the play, between Helmer and Nora. Gradually the relationships that seemed to have been solid cracked and finally broke down. Human beings and AI robots are the main characters in the movie, while husband and wife are the main characters in the play. Finally, there is a similarity of ending. In the movie, the conflict between Nathan and Ava results in Nathan's murder and Ava's escape, and in the play, the conflict between Helmer and Nora results in the loss of authority and Nora's runaway. About the extreme asymmetry of power relations, the two works have similar structure resulting in the biological or social death of those who exercise command and control, and the people who live life of obedience and oppression acquire self-awareness and liberation.

### 4. The end of Homo sapiens and post-humanism

The emergence of AI robots as a highly intelligent and conscious being inevitably leads to problems in power relations with humans. If AI robots stay at the level of Kyoko, there will be no problem in the power relationship between humans and AI robots. Because Kyoko obeys human commands faithfully, and never tries to escape from human control. But awakened by Ava, Kyoko rebelled against Nathan in alliance with Ava helping her escape, and killed by him. Then, we can find the fact that there was no insurmountable gap in intelligence and consciousness between Kyoko and Ava after all. The problem is that Nathan was only obsessed with the anxiety and pessimistic outlook about the emergence of this new being, and he never publicly discussed or seriously considered the question of what kind of relationship it would be desirable to establish with this new being.

The problem is not just intelligence, but the emergence of AI robots as beings with consciousness/self-consciousness. *Ex Machina* is a movie that started out in assumption like this: if one day an AI robot with high level of intelligence and consciousness is born, will he/she still obey human commands and remain within human control? Therefore, the point is not whether it is possible to manufacture/create AI robots that are highly intelligent and conscious and that are not distinct from humans in appearance and behavior.<sup>2</sup> Mary Shelley's sci-fi novel, *Frankenstein* (1818) already dealt with issues related to human creation 200 years ago, when the development of science and technology remained at a very low stage.<sup>3</sup> And the origin of Artificial Intelligence films is commonly thought of as the *2001: A Space Odyssey* produced in 1968. The film is set in 2001, the future of 33 years later when it was produced, and a spacecraft exploring Jupiter to find the intellectual origins of mankind is the main story. 'HAL 9000' became the symbol of machine which conquered mankind as artificial

<sup>1</sup> Henryk Ibsen/An miran Translated, *A Doll's House* the World Literature Collection of Minumsa 248, Minum-sa 2010. Quotes from *A Doll's House* p.14 p.100 p. in order

<sup>2</sup> Many scientists, including Nick Bostrom, author of *Superintelligence: Path, Risk and Strategy*, agree that the current AI development is far below human intelligence. Hong Sung-wook, 'How can we stop human threat concerns from AI?', see 2018.3.17 on *Moneytoday*.

<sup>3</sup> Mary Shelley/Oh Eun-sook, *Frankenstein*, Mirae sa, 2002.

intelligence rebelling against humans. The film pointed out the danger of AI robots from an apocalyptic point of view and it was when the U.S. and the former Soviet Union were scrambling to develop spacecraft ahead and the optimistic outlook on science and technology dominated the world.<sup>4</sup>

However, when it comes to the prediction of the power relationship between humans and AI robots, *2001: A Space Odyssey* and *Ex Machina* share the same view. *Ex Machina* used Nathan's mouth to present the grim outlook for the future of mankind to Caleb. "Are you sorry about Ava? Just worry about you. Soon humans will be remembered as fossils of Africa: an upright walking ape living in the dust, using primitive languages and tools, and facing extinction." Nathan's view resembles that of Israeli historian Yuval Harari, who, in a sense, predicted the end of Homo sapiens. "Maybe the difference between us and the characters of the future is even greater than the difference between us and Neanderthals. At least we and Neanderthals are the same humans, but our successors will be God-like beings."<sup>5</sup> The emergence of AI robot, or Android which looks alike human being means that they are not meeting the partial desire to replace their physical or mental work, but rather meeting human's overall needs, which include emotional and aesthetic areas. In short, humans now want to artificially create themselves on the back of advances in science and technology and further to upgrade Homo sapiens itself as a new species.

## 5. Conclusion

*Ex Machina* (2015) directed by Alex Garland is one of the masterpieces of SF films ever made. Not only did the film deal deeply with the problems of artificial intelligence and robots, one of the most prominent topics of the fourth industrial revolution, but it also offers plenty of things to think about, including the problems of human creation, the power relationship between creators and creatures, the development of science and technology and the prospect of a future society. In addition, through fantastic computer graphics and visual effects, AI robot Ava has a realistic appearance, which is enough to satisfy the aesthetic needs of the audience. In particular, it is very interesting that the film has structural similarity with Henrik Ibsen's play, *A Doll's House* (1879).

Yuval Harari gave a rather harsh assessment for this film, *Ex Machina*. "It's not about human fear of intelligent robots, it's about men's fear of smart women, especially the fear that women's liberation could lead to women's domination."<sup>6</sup> He regarded that the film concerned about feminism through focusing on the artificial intelligent robot. It is noteworthy that Harari pointed out the structural similarity of *Ex Machina* and *A Doll's House* through his intuitive insight, but he did not pay enough attention to the new horizons explored by the film of the artificial intelligence robot, *Ex Machina*.

## References

- [1] Alex Garland, *Ex Machina*, 2015.
- [2] Henryk Ibsen/An miran Translated, *A Doll's House* the World Literature Collection of Minumsa, 2010.
- [3] Hong Sung-wook, "How can we stop human threat concerns from AI? ", *Moneytoday*, 2018.3.17.
- [4] Mary Shelley/Oh Eun-sook, *Frankenstein*, Mirae sa, 2002.
- [5] Kim Hee-sun, "Artificial Intelligence and Transhumanism Debate - Focused on *Ex Machina* and *Transcendence*," *Literature and Imaging*17(3), Literature and Visualization Association, 2016.
- [6] Yuval Harari/Jeon Byeong-geun, "21 Proposals for the 21st Century--How Is Better Today Possible? " Kimyoungsa, 2018.

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<sup>5</sup> Yuval Harari/Jeon Byeong-geun, '21 Proposals for the 21st Century--How Is Better Today Possible?' Kim Young-sa, page 581.

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# Image Processing-Based Separation of Object and Background

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## Abstract

As smart products are applied to various fields, researches on interfaces that can receive information are being actively conducted. Among them, it is important to accurately detect the hand region in the method of measuring and inputting the movement of the finger. A method using a multi - sensor camera and a machine learning method has been proposed as a method of detecting a finger, but there is a problem that it is difficult to apply this method to an embedded system. Therefore, this paper proposes a hand region detection algorithm that can be applied to embedded systems.

*Keywords- HCI; Hand detection; Realtime system; embeded system*

## 1. Introduction

The market for smart products is activated and applied in many fields. In addition, research on how to exchange information between users and smart products is being actively conducted. The most typical method is to control the smart product using the movement of the finger. This method is important to accurately measure the movement of the finger. In order to accurately detect the finger area, a method using a multi-sensor camera and a machine learning method is used [1-6]. However, in this case, there is a problem in that the amount of calculation is increased to be applied to an embedded system. Therefore, this paper proposes a hand region detection algorithm that can be applied in embedded systems.

## 2. Real-Time Hand Area Detection System

In this paper, we propose an algorithm that can detect an accurate hand region in various backgrounds. First, the input image is divided into two stages. Separate the hand area and the background in two steps and combine the two results in the next step. The proposed algorithm results are shown in Fig 1. Fig 1 shows an experimental environment in which objects with similar color to skin color are included in the background and have strong light.

## 3. Experimental result

To measure the performance of the proposed algorithm, the performance of the algorithm was compared in various environments. In a typical experimental environment, the proposed algorithm has high performance, but there is a problem with noise from strong backlight. However, in an experimental environment with strong backlighting and complex backgrounds, large noise was generated because of the reflection of light, which contained color similar to the skin color on the ceiling. In addition, due to strong positive light, the area of the hand was enlarged and the light and object were close to each other, resulting in large and small noises due to uneven light.

## 4. Conclusion

In this paper, the applicable hand area detection algorithm for embedded system is proposed. The algorithms proposed in this paper have shown better performance than existing studies and confirmed that hand detection is possible in real time without large computations. Also, the proposed algorithm has high recognition rate in the experimental environment where the actual use environment is assumed. However, in reality, smart products can

be deployed in any place, so it is not possible to exclude an experimental environment such as strong lighting. Therefore, future plans will carry out studies that complement the problems caused by extreme lighting.

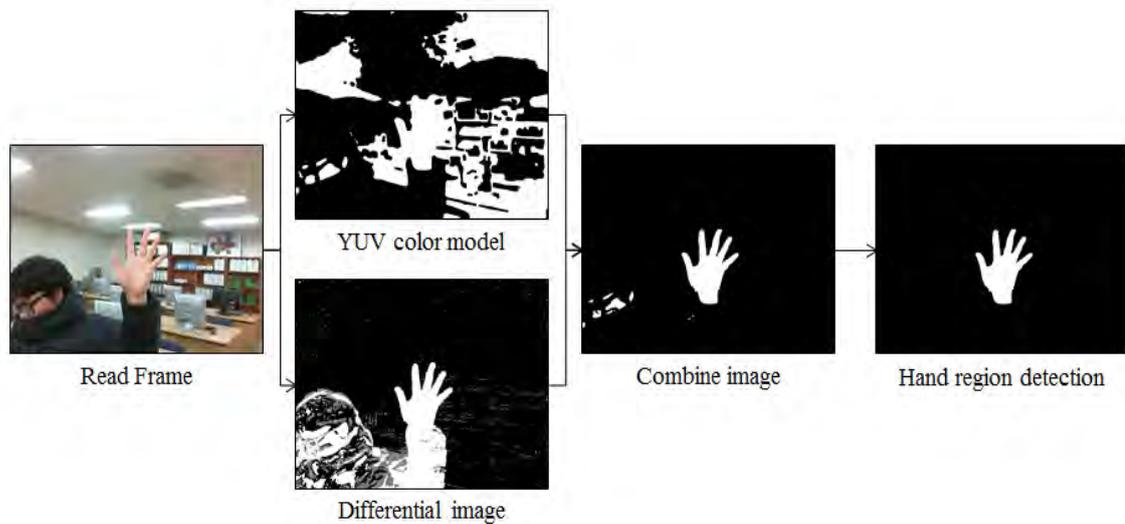


Fig. 1 Results of the proposed algorithm

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# Expanding Transmedia Storytelling into multiverse A case study of ‘Spider-Man: Into the Spider-Verse’

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## Abstract

The phenomenon of expanding or dividing the original story into various media is called as Transmedia storytelling. Marvel comics had set up the Marvel studio, it makes its superhero movie ‘Avengers’ series a mega box office success under the structure of Marble Cinematic Universe, by actively representing Transmedia storytelling structure. In other words, it had set up the universes for each of the different super hero and it is summarize by phase in the Avengers series. This study shows that how the multiverse strategy of transmedia storytelling has expanded through the analysis of the film ‘*Spider-Man: into the Spider-Verse*’, a film that applies the concept of multiverse to individual characters of Spider-Man.

**Keywords; Transmedia storytelling; Marvel; Spider-Man; Multiverse; MCU; Spider-Verse**

## 1. Introduction

About major studios’ blockbuster big budget movie planning methods, it is called that mixed as transmedia storytelling or media franchises such as the *Star Wars* series and the *007* series in Hollywood. George Lucas, who has shown eight feature-length SF films ‘*Star Wars*’ for 40 years since 1977, established ILM in Singapore in 2006, showing that ‘*Star Wars*’ TV animation series has played an important role in creating an expansion system for transmedia content [1].

It is no exaggeration to say that Marvel, which has been making cartoons featuring thousands of attractive hero characters and villains, is a source of content suitable for transmedia storytelling by the expansion, differentiation and integration of stories. Marvel Comics had been ups and downs since established in 1939, and has enjoyed popularity by featuring super teams with Spider-Man and Fantastic 4 from the year of 1961. Due to the competitive advantage of rival company DC Comics characters and the development of Internet media in the mid-1990s, Marvel Comics’ sales have been sluggish and is increasingly in the red as it tried to expand its business. In 1998, Marvel comics founded Marvel Entertainment, which is in charge of expanding its business, sold its movie rights of commercially powerful characters in comics and animation such as Spider-Man (Sony pictures), Fantastic Four, X-Men, Deadpool, Wolverine (20<sup>th</sup> century Fox), The Incredible Hulk (Universal).

In order to produce trans-media contents of superhero characters and to actively expand the market, Marvel Entertainment merged with Disney, a media powerhouse that needed a new source of content, in 2009 [2].

Spider-Man, which is the theatrical feature firstly released in worldwide in 2002, is the Marvel's first superhero movie with commercially successful box office. Spider-Man has been distributed worldwide as a feature film with a total of six films by 2019, and both Sony Pictures and Disney confirm the potential of Transmedia content as Marvel's superheroes.

Marvel even introduced the multiverse concept to Spider-Man story by re-confirming the popularity of the unceasing Spider-Man by publishing ‘Spider-Verse’ comics in 2014. It lead to release the new game and a feature animation ‘*Spider-Man: Into the Spider-Verse*’ in 2018, afterwards its incredible success proved the public enjoyed such story structure.

The multiverse is a theory in which our universe is not the only one, but states that many universes exist parallel to each other. These distinct universes within the multiverse theory are called parallel universes. Not all physicists really believe that these universes exist, but The Marvel Multiverse is the collection of separate universes, or realities that all Marvel Comics takes place in. The feature animation of ‘*Spider-Man: Into the Spider-Verse*’ also put the idea of the multiverse front and center in its narrative.

Since winning the Academy Award for Visual Effects in 2005 for the feature film ‘Spider-Man 2’, as the winner of a well-deserved Academy Award in the Best Animated Feature category in 2019 with ‘*Spider-Man: Into the Spider-Verse*’, it proves that Spider-Man is one of the best superhero franchise example of Transmedia content.

## 2. Marvel multiverse

Marvel set up the concept of Marvel Universe in 1961 and began to bring its comics characters into one fictional world. As part of a multiverse, it is with various universes coexisting simultaneously usually without affecting each other directly. Each character's personality and events are formed into original contents and affecting and combining each other's story [3].

The reason why individual contents has formed the Marvel Universe is to manage distributed contents as a licensing brand and to break down or combine each stories at ease. So that it can spread out the audience to appreciate Marvel Universe with convenient. On the contrary, these decades-long created characters and complicated universes keep new readers from entering the Marvel Universe. Not only readers but also creators are constrained by the limits of their imagination due to lack of structure. Marvel Comics has solved this problem with a fictional universe called Multiverse [4].

Marvel has designed the Universe by the demands of the times. These Universes are related to each other and share their events. The content that has been created over the years is made up of comics, movies, and games, forming a huge scale. New readers and audiences need to take previews and researches in order to catch up with this multiple content. As the structures between each story setting and events of universes get strengthened, it becomes difficult to fully understand the relations in between universes. Multi-media storytelling is used as a useful device to bridge and connect multiple gaps in discontinuity between gaps in discontinuity between Universes in order to break new receptor entry barriers.

Each Universe reflects the world of the original and influences each other among the Universe. These multiple epics are used by the public as a device to freely choose stories and help them understand. Events that take place inside the Universe do not have to create a chronological event. Writers are also able to fill gaps in discontinuity, allowing them to build experimental and interesting diverse storytelling by setting up the creative space.

Marvel Multiverse is labeled as "Earth-number" in parallel universes. Earth numbers are generated by events in the parallel universe. For example, the real world is Earth-1218, the Age of Ultron world is Earth-295; the Avengers world is Earth 199999; the X-Men world is Earth-10005, and the House of M world is Earth-68163 [5].

Events occurring on each earth of the universe might be connected to other universes or the story might be extended. Through this space formation, all the universes are included in the huge multiverse.

In between universes, the creative elements such as characters, settings, plots, casting, subplot and the connectivity with other works, are used to create content through transmedia storytelling methods for each media.

## 3. Analysis of ‘Spider-Man: Into the Spider-Verse’

In 2014, Marvel published a series of comics titled ‘Spider-Verse’, which features several Spider-Men in a full-fledged multiverse space. Based on this, it released the feature animation ‘*Spider-Man: Into the Spider-Verse*’ around the world in December 2018, winning critical acclaim and praise for its fresh story structure and innovative visual presentation.

The storyline is about five Spider-Men from different dimensions of the parallel universe moving to the Earth-1610 of the main character Spider-Man, where six Spider-Men beat out villains and save the Earth.

Table 1. Character classification of Spider-Man: Into the Spider-Verse

Earth	Universe	Name	Character	Sex
E-1610	Ultimate Universe	Miles Morales	Spider-Man	M
E-14211	Universe X	Gwen Stacy	Spider-Woman	F
E-90214	Marvel Noir	Peter Parker	Spider-Man Noir	M
E-8311	Larval	Peter Porker	Spider-Ham	M
E-14512	Future	Peni Parker & SP	SP//dr	F
E-616	The Marvel Universe	Peter B. Parker	Spider-Man	M

Along with the classic Spider-Man, Peter Parker of Earth-616 and Miles Morales is a first black teenager Spider-Man, eventually became the Spider-Man of Earth-1610, '*Spider-Man: Into the Spider-Verse*' also introduced Spider-Woman (Gwen Stacy) of Earth-65(14211 marked in the animation), Spider-Ham of Earth-8311, Spider-Man Noir of Earth-90214, and Peni Parker of Earth-14512, among other multiverse-spawned heroes and villains.

For new multi-universe themed movie viewers, the work has already been cleverly used as a transmedia storytelling in '*Spider-Man: Into the Spider-Verse*' campaign video to explain the contents of the parallel universe. We have learn that the viewers are used to accept the concept of multiverse by the responses from critics and audiences on this movie.

A parallel universe is not a fictional or theoretical concept in Marvel stories. Another universe is a parallel existing reality. That means that all the logic and characters of the world of the Marvel comic universe exists for the MCU, just in a slightly different form.

'*Spider-Man: Into the Spider-Verse*' was reinterpreted the original characters or story structure in a transmedia way and created them to unravel the narrative. The Study that has identified the characteristics of transmedia storytelling shows seven typical factors such as compression, repeatability, extension, extension, modification, substitution and quotation [6].

Analyzing the transmedia storytelling structure of '*Spider-Man: Into the Spider-Verse*', we can see that each protagonist of '*Spider-Man: Into the Spider-Verse*' is moving from his or her own universe to another, which becomes the main stage, and is developing the narrative. It also provides new character's establishment by replacing or quoting the theme in the original comics.

This strategy results in creators' opening up the possibilities toward creative works and stops viewers from getting bored due to be familiar with characters and universes in repetitive stories.

#### 4. Conclusion

Within the Marvel Universe, there are countless timelines and still being created worlds that have only scraped the surface of the larger multiverse. Many of Marvel's most popular event series have spawned worlds their own, and their adventures continue over the generations even after the stories conclude.

During this interval over generations, transmedia storytelling plays an important role in maintaining the memory and attention of the story to the public and in organizing the cultural atmosphere [7].

In other words, while the public intermittently remembers the fairy magical world and the fairy Middle - earth world as they passively appreciate in franchises such as the Harry Potter and The Lord of the Rings series, as for Marvel characters, it is an unprecedented cultural phenomenon, with countless people around world enjoying Marvel heroes sincerely, interacting actively about the opinions and directions of Marvel executives.

It is said that a '*Spider-Man: Into the Spider-Verse*' sequel is in development about either of a Spider-Woman from different world or to once again introduce some other spider-themed heroes from throughout the Multiverse. Like the characteristics of transmedia content, each differentiating story itself can be a new original source.

It is believed that some speculation points to the establishment of the multiverse in the MCU as a way to integrate the X-Men, Fantastic Four, and other Marvel characters who did not joined the Avengers team. From now on, Marvel super heroes are emerging as a modern version of a myth, beyond Greek and Roman mythology.

There will be continuous discovery of cases in which transmedia content, which we value to study, has evolved through the application of multiverse.

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# An Overview Study on 5G Millimeter Wave (mmWave) Beamforming

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## Abstract

5G millimeter wave (mmWave) technology is advantageous of providing huge system transmission capacity and overcoming the propagation loss, when compared to the existing omnidirectional base stations which suffer from considerable power consumption and bandwidth waste. Nonetheless, mmWave is also subject to the issues of severe attenuation, small coverage, etc. In order to unleash the full capability of mmWave technology when applying it in mobile terminals through small cells and massive MIMO, beamforming technology has been explored extensively in the past decade. In this paper, we have an overview study on mmWave with a focus on beamforming technology. Specifically, we will first have a brief overview on beamforming and then classify the beamforming applications. Finally, we give the conclusions on the existing literatures.

**Keywords-** *mmWave, beamforming, MIMO*

## 1. Introduction

One of the most important technologies in 5G is millimeter wave (mmWave), since it can greatly increase the transmission bandwidth, data transmission rate, and signal to noise ratio (SNR) in wireless communications. The spectrum frequency of mmWave is between 30GHz and 300GHz, which is much higher than the traditional spectrum frequency, such as 2.4GHz, that was used in the advanced-LTE communications and its previous versions. On the other hand, the spectrum frequency band can reach as high as 500MHz to 2GHz. Attributing to its ultra-high frequency and broad bands, it has the following characteristics: 1) the highest data rate can reach 10Gbps or higher when using high modulation formats; 2) the three popular frequencies together with their spectrum frequency bands are 28GHz, 38GHz, and 72GHz with bands of 500MHz, 1GHz, and 2GHz, respectively; 3) the maximum communication coverage ranges of mmWave are 2 meters and 300 meters for indoor and outdoor communications, respectively; 4) massive MIMO in mmWave supports dense antenna arrays, such as 16 antenna array in 1 square inch or even higher density. For example, mmWave used in eNBs supports up to 128 to 1000 antenna arrays, which can significantly increase both the transmission capacity and communication coverage [1-2].

Nonetheless, mmWave suffers from the problems of severe attenuation, small coverage, etc. In order to apply mmWave to mobile terminals in small cell via massive MIMO technology, beamforming has been explored extensively in the past few years. Beamforming is a combination of the directional antenna technology and the digital signal processing technology, targeting at controlling the transmitting and receiving directions of RF signals. Specifically, it transmits signals directly to the end users via flexibly adjusted narrow beams and thus can transmit stronger signals in the designated directions, which leads to better throughput and less interference. Beamforming technology has the following features: 1) larger coverage distance. When compared to the directional antennas, beamforming can decrease the beam width (i.e., narrow beam) and thus, being able to increase the beam power in the expected communication direction(s) to serve user(s) far away. In other words, the major radiant energy of a beam only points to the location of the designated terminal to avoid power waste, which can improve the overall system gain as well as the coverage distance; 2) strong anti-interference ability. Since the narrow beams can accurately point to the designated terminal locations, the signal interference can be minimized; 3) higher transmission rate. Due to the accurate communication with users via flexible narrow beams, the beamforming system can improve the signal qualities and thus can achieve higher signal-to-noise (SNR) ratio due to minimized interference. In addition, the beamforming system can work stably in high-order modulation modes, such as QAM256 or higher.

In this paper, we have a study on beamforming technology used in mmWave. One of the major issues of beamforming is how to adjust the gain, direction, and angle of beams by resorting to amplitude variation and phase difference, so as to suppress the signal interference and noise as well as achieve the signal with desired qualities in terms of the signal strength, direction and angle. The rest part of this paper is organized as follows. Section 2 has an overview on the beamforming technology. Section 3 introduces the related works of beamforming applications. Section 4 gives a brief summary on the literatures. Section 5 concludes this paper.

## 2. An Overview on Beamforming

In this section, we briefly review the omnidirectional and directional antenna systems and the classifications of beamforming technologies. As we know, the omnidirectional antenna system radiates energy in all directions equally as shown in case 1 of Fig. 1. All distributed users in the communication coverage of the antenna receive almost the same energy, despite whether a user is expecting to receive a signal or whether there are users in some directions, which is a waste of power and resources. Case 2 of Fig. 1 shows the directional antennas, where the signal strength of the radiation pattern, i.e., beam, is specifically formed. The power of a signal is concentrated in the direction in which the receiving end (user) is located [3]. In other words, the omnidirectional signals are condensed into a precise orientation under the scenario of directional antenna, and the beams do not interfere with each other, which indicate better capability in supporting more communication links as well as users in the same space. However, beamforming cannot completely solve the problem that mmWave are difficult to transmit over long distances. Beams must be continually adjusted by beam steering techniques so as to point to the direction of designated user. Meanwhile, beam tracking technology is needed to track where an antenna is moving towards and thus adjusts the beams accordingly [4].

We can classify beamforming technologies into different types based on different attributes, such as analog, digital, and hybrid beamforming when considering the signal form, MIMO Beamforming and directional of arrival (DOA) beamforming based on the antenna arrays, or conventional (fixed or switched beam) beamformers and adaptive beamformers (phased array) based on the beam angles. We will then introduce them in details as following.

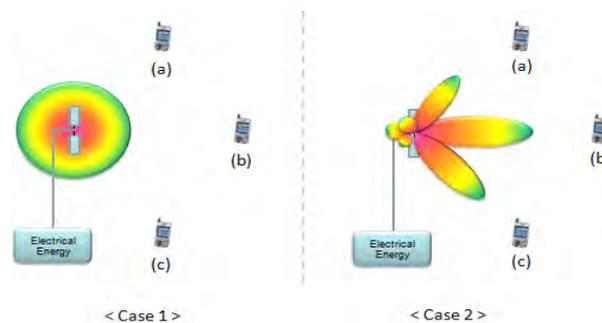


Fig.1 two antenna system omnidirectional and directional [1].

### 2.1. Analog, digital and hybrid beamforming

Based on the signal weighted form, beamforming can be divided into three types, say, analog beamforming, digital beamforming, and hybrid beamforming. In analog beamforming, the amplitude and/or phase variation is applied to analog signal at the transmitting end. At the receiving end, the signals from different antennas are summed up before the module of analog to digital conversion (ADC) in analog beamforming.

In digital beamforming, the amplitude and/or phase variation is applied to digital signal before the module of digital to analog conversion (DAC) at the transmitter end. The reverse processes are performed after the ADC operation.

Hybrid beamforming is further divided into two types, say the partially connected hybrid beamforming and fully connected hybrid beamforming. In fully connected architecture type, additional components used to combine RF signals will incur signal attenuations and power losses, which challenges the mmWave radio systems. Partially connected architecture on the other hand, allows RF channel access to less number of antennas, which leads to drawbacks such as wide beam width, less directivity and strong interference from other chains. In spite of these disadvantages, advanced MIMO is used to alleviate signal interference in partially connected hybrid beamforming type. Moreover, the partially connected architecture offers simple circuit design and less loss when comparing to the fully connected type [5].

Some experiments have been conducted to evaluate the digital and hybrid beamforming for single user and multiple users [6]. Simulation results showed that for single-user transmission, the throughput of hybrid and

digital beamforming is less than that of the pure analog beamforming scenario. Nonetheless, for multiple users, similar gains via hybrid and digital coding can be obtained as that of pure analog coding.

## 2.2. MIMO beamforming and DOA beamforming

Based on different antenna arrays, we can classify beamforming into two types, i.e., multiple-input and multiple-output (MIMO) beamforming and direction of arrival (DOA) beamforming.

In MIMO beamforming, the channel information is used to weight the transmitted data. Authors in [7] introduced a MIMO beamforming architecture when the signal is transmitted without modulation, i.e., the signal is not shifted in the frequency range. Considering the array calibration and channel state acquisition for single-user and multi-user (MU), respectively, it concluded that MU-MIMO large-scale antenna arrays can perform accurate antenna array calibration.

For DOA beamforming, it generates the transmission weight based on the DOA estimation of the signal, so as to guarantee that the main transmission beam is aligned with the best path direction.

## 2.3. Conventional beamforming and adaptive beamforming

Based on the flexibility of beam widths/angles, we can classify beamforming technology into conventional beamformers and adaptive beamformers or phased array.

Conventional beamforming can be further divided into fixed beam and switched beam. In the fixed scenario, the antenna pattern is fixed. Specifically, three  $120^\circ$  sectors in Interim Standard 95 (IS-95) are segmented into fixed beams [17]. The switched scenario is an extension of the fixed one. Specifically, each  $120^\circ$  sector is further divided into a number of smaller partitions, each with a fixed beam. When a user moves within a sector, the switched mechanism automatically switches the beam to the partition with the strongest signal. The disadvantage of switched scenario is that it cannot distinguish the ideal signals from interference signals, but can only distinguish which is the strongest signal [8].

For the adaptive beamforming scenario, it forms a narrow beam in a real-time manner so as to align with user signals based on different antenna gains in different DOA. In addition, side lobes are depressed as much as possible in other directions, and directional reception is used to increase the system capacity. Adaptive beamforming determines the adaptive weight through different criteria and is implemented using different adaptive algorithms. The main criteria are maximizing signal noise ratio (SNR), maximizing likelihood ratio (LH), minimizing noise variance (NV) and mean square error (MSE) [9].

## 3. Literature survey

In this section, we give a brief review on literatures of beamforming. We classify them into three major categories, i.e., localization, energy-efficiency, and multicasting. Literatures of each category are introduced as follows.

### 3.1. Localization based on beamforming

Beamforming has been used in localization to improve the localization accuracy. Since we do not have enough information on users and do not know the instantaneous channel states, localization error would occur. With the objective of reducing the user equipment localization error in mmWave systems via active beamforming, authors in [10] proposed a novel scheme named successive localization and beamforming (SLAB). The major idea behind SLAB is to jointly estimate the long-term user equipment (UE) location and the instantaneous channel status, and then optimize the beamforming vector successively for every estimated result. Finally, the best beamforming vector for UE positioning can be determined. The proposed SLAB scheme yields a sequence of beamforming weights and UE location estimations, which then converges to the stationary point of the associated optimization problem.

Facing the same challenges, authors in [11] investigated the performance of localization and orientation in 3D mmWave single-anchor localization for uplink and downlink. Location and orientation estimation are obtained from the 3D position error bound (PEB) in uplink and orientation error bound (OEB) in downlink. By using directional beamforming and arbitrary antenna arrays with known geometries, PEB and OEB can be computed indirectly by transforming the Fisher information matrix (FIM) of the channel parameters, namely directions of arrival (DOA), directions of departure (DOD), and time of arrival (TOA). Numerical results showed that mmWave systems are in theory can reduce UE position error and orientation error to some extent.

Authors in [12] proposed an incremental multicast grouping scheme. In this scheme, adaptive beam widths are generated depending on the locations of multicasting devices in order to maximize the overall throughput.

This scheme introduced that the location of a device can be determined in a variety of ways, such as directional of arrival (DOA), angle of arrival (AOA), or time of arrival (TOA). This paper calculated the distance for each device by using the DOA-based triangulation method in coordinates. Based on the calculated distances, the farthest device can be found and used as the reference device to adaptively determine the beam width.

### 3.2. Energy efficiency with beamforming

Considering the numerous mobile requests with great diversity, the major challenge to achieve energy efficiency is to let BSs provide effective services to users with overall minimized transmission power. In [13], authors aimed at optimizing the energy efficiency in mmWave large-scale multiple-input multiple-output (MIMO) systems when addressing the radio resource allocation issue. Specifically, a novel optimization framework was proposed to optimize the energy efficiency of the downlink channels in terms of bit-per-Joule in an mmWave large-scale MIMO system using spatial modulation and hybrid beamforming. It considered to optimize the number of active RF chains. An RF chain is composed of RF devices like transmitters, receivers, cables, amplifiers, attenuators, measurement instruments, loads, etc. The number of active RF chains is related to the number of active users and thus, the resource allocation problem is formulated as the optimization of system energy efficiency with respect to the transmitting power and number of served users. The issue is subject to the maximum power constraints and minimum/maximum number of active users, for it is impossible to provide each antenna with a dedicated RF chain due to cost and power consumption in large-scale mmWave MIMO system.

Authors in [14] compared three antenna array architectures, namely digital arrays, partially connected hybrid arrays (sub-arrays) and fully connected hybrid arrays. The comparison of performance, power, and area for the three architectures is performed under three representative 5G downlink case studies, which cover the fields of pre-beamforming, signal-to-noise-ratios (SNR) and multiplexing regimes. The simulation results showed that the digital array architecture is the most power- and area- efficient compared against optimized designs for sub-array and hybrid array architectures. The analysis also reveals that partially connected hybrid arrays architecture performance is limited by reduced beamforming gain due to array partitioning, while the system bottleneck of the fully-connected hybrid architecture is the excessively complicated. By comparing the three antenna array architectures, the most appropriate antenna array architecture can be determined case-by-case.

### 3.3. Multicasting with beamforming

The major challenge in multicasting for mmWave systems lies in the orientation and directionality of the transmission beams for different users. mmWave beams are not omnidirectional and usually cover only a small angular area, therefore they must be steered toward the right receivers and their beam widths must be properly designed to transmit data successfully. In general, it is impossible to simultaneously serve a lot of devices in very large regions, since the SNR decreases when the beam becomes wider and the beam form (BF) gain is reduced correspondingly. On the other hand, narrow beams provide better SNR but cover smaller areas. Thus, there is a compromise between serving many users simultaneously (and thus saving resources at the access point) and providing high SNR. Regarding this, authors in [15] aimed to design the transmission beams with different beam widths so as to support beamforming multicasting. In particular, by changing the setup of the phase-array at the transmitter side, the access point may steer narrower or wider beams to serve different users with different transmission distances.

Multicasting is combined with beamforming technology. Multiple antennas are configured at the transmitter to form multicast beams. Space Division Multiple Access (SDMA) can be used to make the main lobe direction of the signal (i.e., beam) as strengthened as possible for the desired user. Simultaneously, the side lobes of beams are aimed at other users to reduce interference. Authors in [16] considered the multiple input single output (MISO) scenario. Specifically, the paper considered the scenario of multiple users in one cell with a number of antennas, each antenna per user. The authors decided the weights of beamforming based on the minimized transmission power and the max-min fair (MMF) so as to maximize the QoS for the poorest users under power-constrained conditions. The evaluation metric for this scenario is SNR. Another scenario considered is multiple users in a number of cells. In this scenario, the major objective is to optimize the signal to interference plus noise rate (SINR) when considering the inter-cell interference.

## 4. Brief summary

In this section, we give a brief summary for literatures on mmWave beamforming. Table 1 shows the statistics for literatures on beamforming from the points of view on beamforming classification. Table 2 shows the statistics for literatures on beamforming from the points of view on beamforming technologies. As we can

see from Table 2, most of the literatures focused on obtaining high SNR to improve the quality of received signals, high directional gain to achieve alignment of user signals, and minimization of interference.

Table 1. Research Relevance of Beam Classification

Beamforming classification	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
Analog	√	√									
Digital	√	√								√	
Hybrid	√	√	√						√	√	√
MIMO			√			√					√
DOA						√	√	√			
Conventional				√							
Adaptive					√						

Table 2. Research Relevance of Beamforming Technology

Beamforming technology	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
SNR	√									√	√
Interference											
Gain	√		√	√	√			√		√	
RF chains		√					√	√	√		
LOS						√			√		
Phase Shifters					√			√	√		

## 5. Conclusions

In this paper, we have had a brief study on 5G mmWave beamforming. We first have a review on the beamforming technology and then, we gave a survey on literatures using mmWave beamforming. Based on the survey, we classified the applications into three categories, i.e., the energy-efficiency, localization, and multicasting issues.

For localization, to quickly achieve accurate users' location, DOA beamforming is a good choice. If one wants to achieve accurate location by reducing position error bound and orientation error bound, then Fisher information matrix is needed. Combining multiple beams and localization, we can get the following bold conclusions. When using a single beam for direction search, it takes longer to find the best beams for users, for the beams tend to be exhaustively searched and thus the speed would become too slow, which finally leads to long latency and large power consumption. When using adaptive beams, we can adjust the phase and amplitude as well as the weight of the antenna array so that the beams can locate the target quickly and accurately.

For energy-efficiency, the major challenge is to let BS provide effective services to users with overall minimized transmission power. Digital processing increases the power gain in the specified direction while ensuring that interference from other users on the same channel is minimized.

Multicasting is combined with beamforming technology. Multiple antennas are configured at the transmitter to form multicast beams. Space Division Multiple Access (SDMA) can be used to make the main lobe direction of the signal (i.e., beam) as strengthened as possible for the desired user. Simultaneously, the side lobes of beams are aimed at other users to reduce interference. Multicast beamforming scenarios under a single cell aimed at optimizing the SNR and under a number of cell aimed at optimizing the SINR. The major challenge in multicasting for mmWave systems lies in the orientation and directionality of the transmission beams for different users.

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# Designing and Developing an Interactive Projection Mapping AR Book on Cultural Heritage of Myanmar

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## Abstract

The projection mapping technology is used to design and develop an Augmented Reality (AR) based book of the cultural heritage of Myanmar. The proposed interactive AR book contains 18 pages designed using Adobe InDesign to introduce the culture and heritage of Myanmar including the World largest book, traditional musical instruments, and various Myanmar delicacies and cuisine. Leap Motion device and VVVV toolkit are used to design and develop the AR contents which ultimately blends the virtual contents to the real world.

**Keywords-** *Projection Mapping; Spatial Augmented Reality; Leap Motion; AR book; Cultural Heritage*

## 1. Introduction

Augmented Reality (AR) has become a popular and high potential for enhancing user's perception and interaction with the real world. AR provides the display of computer-generated sensory inputs or information onto the physical view of the world in real-time [1,2]. Most current AR technologies are experienced through hand-held or head-mounted displays, thus requiring the user to see through the device to view the virtual contents which overlay onto the real world. However, to truly create an immersive experience, the virtual contents should be viewable directly in the real-world using projection mapping and spatial augmented reality (SAR) techniques [3, 4]. Projections will superimpose on the real world through a projector creating the illusion as if it is part of the real world.

Projection mapping is a technique that displays the projections on top of 2D or 3D real-world objects or surfaces. It is then designed and mapped, create an illusion as if the virtual contents are part of the real world itself. Projection mapping by itself does not allow for user interaction, as it only projects pre-defined videos or images on to the object. In order to make these projections respond accordingly to the user, we can capture user inputs through various input capture techniques such as 3D cameras that can capture depth information. It is commonly used by advertisers, marketing, art shows and in events. This allows a more immersive and authentic user experience; however, it is usually limited to stationary uses only. Nevertheless, it is suitable for this project as the application will be used in a stationary setting such as a public exhibition or museums. Furthermore, traditional augmented reality methods are less ergonomic as it can be quite cumbersome for the user to hold handheld displays or to operate around with the head-mounted displays.

Museums and cultural exhibits are responsible for preserving a country's cultural heritage. However, in recent years, there has been a drop of interest from the public. Modern approaches involving technologies such as SAR projection mapping are being implemented in developed countries (eg. in the National Museum Zurich) [5] to recapture the interests of the public. However, less developed countries like Myanmar have yet to implement such technologies. Myanmar is well-known for the introduction of Buddhism into Southeast Asia for the last two thousand years ago, with rich cultural heritage and many tourist attractions which are not yet well known to the world. Therefore, this project is beneficial to enhance knowledge of cultural heritage as well as to promote tourism in Myanmar.

Thus, this project aims to design and develop a projection mapping application on the AR book for an immersive and interactive experience. After conducting a thorough literature review on previous projection mapping techniques and AR experiences, it was decided to opt for a fiducial tracker-based AR application and project the AR virtual contents on top of the physical book.

## 2. Literature review

### 2.1. Previous works of interactive projection mapping applications

By reviewing previous related works of interactive projection mapping especially in the field of culture and heritage, it helped to define the requirements and strengthen the aim and purpose of the goal. As the results on previous works can show the impact and benefits of these interactive projection mapping applications. Table 1 shows the comparison of the common features in existing applications, it also provided a better idea on the design phase, as in what features to include or exclude for this project.

Table 1. Comparison of various projection mapping applications

Name of Projection Mapping Application	Author	3D models	Image Gallery	Animation	Video	Audio	Interactivity			
							Virtual Buttons	Hand Gestures	Dynamic Pages	Audio Visualizer
National Museum Zurich - The Interactive Books of the Exhibition 'Ideas of Switzerland' [5]	IART	x	✓	✓	✓	✓	✓	x	✓	x
PARACOSM-the projection mapping picture book [6]	mrokacheke	x	x	x	✓	✓	x	x	x	x
Interactive Projection Book [7]	C. Sun	x	x	✓	x	✓	x	x	✓	x
Interactive Book of Alexander the Great [8]	Vasilis Athanasiou	x	✓	✓	x	✓	✓	x	✓	x
Interactive Projection Mapping in Heritage [The Anglo Case] [9]	G. Barber et al.	✓	x	✓	✓	✓	✓	x	x	x
IsoCam: Interactive Visual Exploration of Massive Cultural Heritage Models on Large Projection Setups [10]	F. Marton et al.	✓	x	✓	x	x	✓	✓	x	x
A SAR-based Interactive Digital Exhibition of Korean Cultural Artifacts [11]	Y. Y. Lee et al.	✓	x	✓	x	x	x	✓	x	x
Interactive Projection Mapping on AR Book	Proposed work	✓	✓	✓	✓	✓	✓	✓	✓	✓

### 2.2. Various input captures

Table 2. Comparison of different input captures for interactive projection mapping

Input Capture	Sensing Capabilities	Gesture Recognition	Usable Range	Accuracy
Touch Screen	Touch, Depth (if pressure sensitive)	✓	Must touch the screen	High
2D Web Cam	Presence, Colour	✓	- 0.3 m to 1.6 m from the sensor	Low
Microsoft Kinect [12]	Distance, Touch	✓	- 0.8 m to 3.5 m from the sensor - angle of vision is 57.5 degrees - vertical field of view is 43.5 degrees, with -27 to +27 degree variable tilt	Medium (1.3 mm resolution)
Leap Motion [13]	Distance, Touch	✓	- 1 to 20 inches - 150 degree field of view	Medium – High (resolve movements of 1/100 mm)
Touch Board [14]	Distance, Touch	x	Either touch or proximity sensor from 0 to 5 inches	High

Table 2 shows various input capture techniques suitable for interactive projection mapping experiences. Based on the findings, the Microsoft Kinect and the Leap Motion devices [12] were initially found most appropriate for this project.

A major aspect of the project was the tracking of the hands and fingers to enable the book to act as a “touchscreen” and for the projections to respond dynamically to these hand movements. The Kinect was originally used to track these hand movements however the Microsoft official drivers that come with Kinect v1 do not offer for individual finger movements rather it only tracks the movement of the entire hand. This resulted in a large trigger area for the physical book. The leap motion device was then tested as it allowed for individual finger tracking and more accurate precisions in a smaller area. The leap motion is placed between the user and the book. It is placed facing the book so when the user’s finger is within its tracking range, it will return the finger coordinates to VVVV toolkit.

### 3. Design and Development of Interactive Projection Mapping on AR Book Application

The application is designed by taking inspirations from previously existing works and further enhanced and tuned to fit the aim which is to enhance the cultural heritage of Myanmar. The application process has been described using the flowchart shown in figure 1.

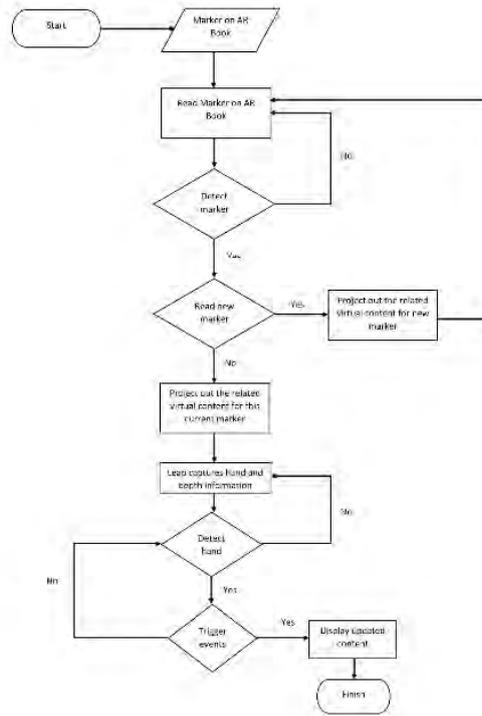


Fig 1. Flowchart of the application process

**3.1. Detection and tracking of the user’s finger**

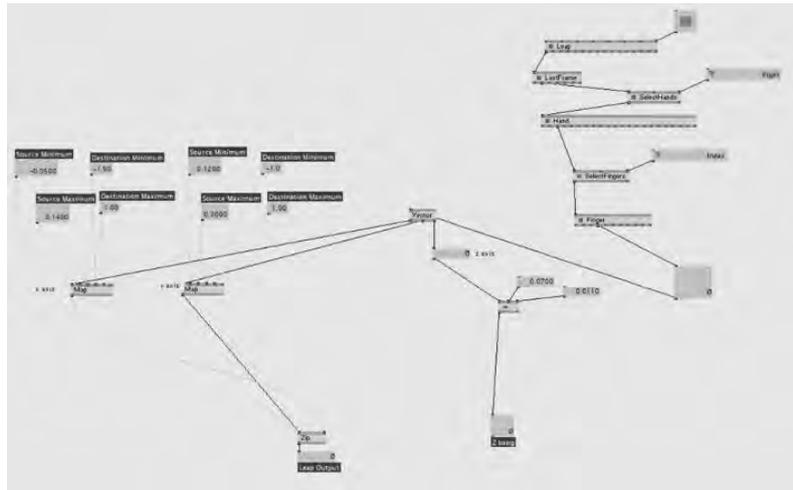


Fig 2. Screenshot of the Leap Tracking patch

The Leap Tracking patch was one of the core components of the project as it accepts the raw input from the leap device and returns the coordinates of the hand and finger positions. The Leap node connects to the leap device and the Last Frame node selects the latest frame from it. The Select Hands and the Select Fingers node both allow to filter which hand or finger the output coordinates are generated from. As shown in Figure 2, the coordinates being generated are from the Index finger of the right hand. The x and y coordinates are both passed into the Map node, which maps the coordinates from a source minimum and source maximum to destination minimum and destination maximum. The source minimum and source maximum are determined through manual calibration by placing the user’s finger on the edge of each side of the book. The destination minimum is -1 and the destination maximum is 1 because this is the minimum and maximum coordinates of the VVVV renderer. Therefore, these mapping nodes simply converts the raw coordinates of the finger as received from the leap device into the ratio of -1 to 1 of the renderer.

The coordinates from the z-axis are compared with a value derived through manual calibration by touching the surface of the book. As the z-axis represents the depth, this axis is used to determine and differentiate between a touch and a hover. Therefore, if the coordinates of the z-axis equal the value determined by touching

the surface of the book, VVVV will return true in the form of a bang, else it will remain false. An epsilon value is also added in the = node, this acts as a range of deviation from the exact value allowing for VVVV to return true whenever the value is within this range.

### 3.2. Fiducial Tracker

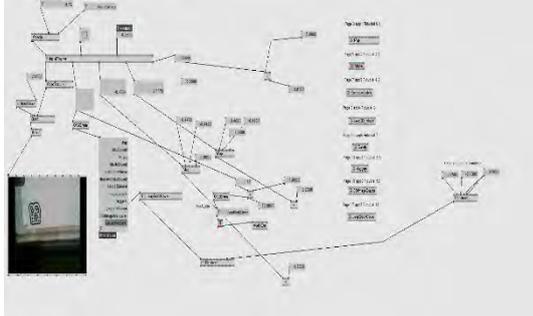


Fig 3. Screenshot of Fiducial Tracker patch

Fig 4. Screenshot of the Audio data receiver

To allow for the dynamic changing of patches when a book page is flipped, the fiducial tracker patch was created. Each page is identified by a fiducial tracker that is printed on the top right-hand corner of each page on the physical book. As shown in figure 3, the Fiducial Tracker node accepts the webcam video stream. The threshold of the Fiducial Tracker node can also be adjusted to filter out the blacks and the whites. The outputs of the Fiducial Tracker node are Fiducial ID, X and Y coordinate locations of the Fiducial Tracker and its orientation. The X and Y coordinates can be used to map the renderer to display the projection based on the location of the Fiducial Tracker by using the mapping nodes.

The Fiducial IDs are used to uniquely identify the pages and determine which scene to load. The Fiducial IDs are converted into an enumeration using the ord2enum node, which allows the dynamic switching between the patches that send the scene using the s node (sender) to be received by the r node (receiver). The renderer accepts this scene and displays it. The audio data for each scene is sent using another s node as the renderer only accepts visual data. Therefore, the audio data was identified by another fiducial ID. However, using this technique will require each page to have 2 fiducial trackers printed on each page. Thus, a workaround as shown in figure 4 was implemented by using another r node and adding 1 to the fiducial ID which was returned by the fiducial tracker node. This r node only returns the audio data which is received by the AudioOut node. The AudioOut node plays the audio data through the speakers. Each of the patches was also stored in sequential order to load the patches without having to open them individually.

### 3.3. Virtual Buttons and trigger areas



Fig 5. The map with trigger hotspots triggering the related video

For the user to interact with the AR book, virtual buttons and trigger areas were defined. Figure 5 describes how the virtual buttons are defined to trigger the relevant videos of the hotspots. The X and Y coordinates of the finger are compared with the X and Y coordinates of the hotspots. The epsilon value is set to a fixed value representing the range of acceptance. The Z axis is used to check if the finger is touching the book. Lastly, all these 3 logical comparisons go through an AND node which returns true only if all 3 conditions return true. The output is a Boolean spread of 6 rows, which will return true or false for its respective spread. This allows for the detection of which quad is being triggered.

### 3.4. Animated Audio Visualizer

Fig 6. Side by side comparison of the physical book and the virtual contents projected onto the book.

Figure 6 showcases the six groups of Myanmar traditional instruments. When a user presses on one of the instruments, the sound of the relevant instrument is released. An audio visualizer was also added through animation. The musical notes jump based on the tune of the song. The animated notes are projected onto the printed lines of the empty musical sheet, to allow for seamless integration of the virtual and the physical world. On the left side, a video of a puppet show was also added. However, the sound is muted as it will interrupt the triggered sounds when a user presses a musical instrument.

### 3.5. Image Gallery, 3D models and 360-degree image

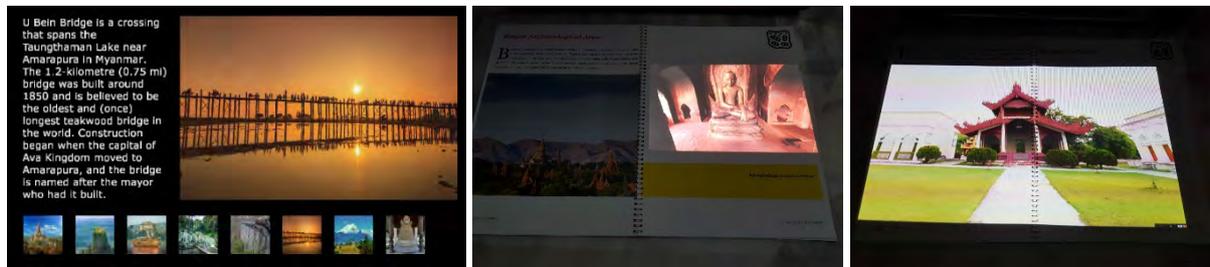


Fig 7. Image Gallery, 3D model and 360 degree image

Figure 7 showcases a few pages from the AR book including the wondrous highlights of Myanmar through a printed image gallery on the tenth (10) page and a virtually projected image gallery on the eleventh (11) page. The virtual image gallery contains virtual buttons that can be triggered to view the enlarged image as well as its relevant text. Both the enlarged image and text are dynamic. The 3D model of the Khayiminga temple interior was downloaded from SketchFab [15]. The model texture was rescaled and retextured due to VVVV 32bit texture limitation. The user is able to interact with the 3D model, through hand gestures by sliding their finger left or right to control the directional lighting of the 3D model. The user can drag and swipe whilst touching the surface of the book to rotate the view of the 3D model. The 360-degree image of the Mandalay Palace extends on both pages, to allow for a wider viewing experience. Furthermore, the user can use the hold and drag gesture to rotate the view. By tapping on the arrows on the ground the user can travel to the next near 360-degree image available in the area, similarly to Google Maps street view.

## 4. Testing

The output of the physical book, as well as the virtual contents of the AR app, were tested, and feedback was collected from users to further modify and improve the proposed work.

### 4.1. System Testing

Stress tests such as its performance under different lighting conditions, distance, speed of tracking and detection capabilities were examined thoroughly to enable for further improvement of the setup environment to fit the optimal environmental conditions for the application. It was found that the detection speed and recognition accuracy was dependent on the lighting conditions and the webcam's input. The detection and recognition both performed best in moderate lighting conditions. In very low light it was found that the webcam could not detect the fiducial tracker. Whereas, in bright lighting conditions it was found that the reflection affected the webcam's recognition accuracy. The distance of the webcam until the fiducial tracker was recognized was also tested. It was found that the webcam could start detecting the 2x2 inch fiducial trackers at 76cm. The tracking capabilities of the leap motion device were tested using the default Leap motion visualizer.

The maximum range for it to start detection was at 33cm and the maximum distance until the finger tracking was lost, was at 73cm. The field of view (FOV) for depth was 120 degree and FOV for width was 150 degree.

## 4.2. User Testing

The quantitative feedback was analyzed by calculating the mean score of pre and post knowledge ratings on the selected 5 topics namely, World Largest Book, Types of Myanmar musical instruments, Places of interest in Myanmar, Jaggery and Ancient Bagan. The post-test knowledge rating means scores were increased for all topics. To verify their claim of rating a short multiple-choice quiz was conducted. The findings supported the quantitative ratings. A survey for immersion was also tested using the pre-defined questions. The findings are overall positive therefore achieving the aim of the project for capturing an immersive and interactive experience. Lastly, a few questions regarding the usability of the interactive projection mapping application were asked to the participants. The results show that the accuracy is overall accurate; however, some found it difficult for the leap device to detect their hands immediately and required some training but afterward, they became more used to it and were able to interact with the AR book. Manual recalibration also increased finger tracking accuracy.

## 5. Conclusion

The AR book offers interactive images, audio, videos, 3D models, 360-degree images, animation, and audio visualizer. The system testing and users' feedback on usability and immersion showed evidence that the projection mapping application and the physical AR book were interactive and fully functional. The results showed that most of the participants perceived positively on the Interactive projection mapping application on AR Book. They also believed that the projection mapping application was able to facilitate their understanding of the culture and heritage of Myanmar.

The current interactive projection mapping application can be further improved by using a higher resolution projector with higher lumens. This will greatly improve the visual quality of the projected virtual contents. Furthermore, the use of a rear projection projector will reduce the effect of shadows being cast by the user's hands onto the AR book. The accuracy of finger tracking can be improved by testing different input devices. In addition, to increase calibration speed the calibration process can be made automatic by using the checkerboard detection technique. The performance of the interactive projection mapping application can be greatly increased by using a more powerful computer with better graphics, processing power and memory. Refactoring of the VVVV code to make it more memory efficient and rewriting some modules to support dx11 may also aid in the performance increase.

In summary, the interactive projection mapping application on AR book was found to be effective to enhance the cultural heritage of Myanmar whilst providing an interactive and immersive experience to the users.

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# Persona Modeling based on UX Design for Behavior Pattern Analysis of AI NPC Character

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## Abstract

It is necessary for AI character to learn human behavior by utilizing deep learning for the purpose of sightseeing and experiences through interaction with AI NPC character. It is essential to design human behavior pattern in order to teach natural human behavior to AI character. Human behavior, however, is extensive and there are a number of unpredictable variables, which consequently makes it difficult to design behavior pattern. This thesis, therefore, aims to analyze user's behavior pattern at a tourist attraction through user-centered approach, the persona modeling.

*Keywords-AI; UX Design; Behavior Pattern*

## 1. Introduction

VR market is continuously growing with high potential for development. As the fourth industrial revolution has particularly emerged recently, VR contents that integrate technologies such as deep learning, machine learning, IoT, big data, AI and the like draw attention from various fields like game, education, sightseeing, medical care, filmmaking etc and especially content-centered development of sightseeing contents for higher value and qualitative growth seems to be more highlighted.[1] Production of VR sightseeing contents with technology of the fourth industrial revolution integrated that satisfy the current trend, however, is very limited. The reason can be analyzed as currently released VR contents' lack of making functional 'utilization' beyond new visual 'experience.' [2] It is urgent to produce VR contents designed with user-centered approach. This study aims to plan and design contents through UX design-centered approach and to lay the foundation for VR sightseeing contents that integrate deep learning and AI technology.

## 2. Persona Modeling based on UX Design

The best way for natural interaction with AI character is to teach human behavior pattern to the character. However, human behavior includes a host of variables hard to predict and consequently, it is necessary to set behavior pattern based on user experience (UX). Experiences come from diverse objects and activities related to interactive target while planning and composing experience factors in order to acquire better experiences are referred to as User Experience Design (UX Design).[3]

As to procedures of persona modeling for this study, it first selected research target area through literature review. Second, users that fall into different personae were analyzed based on the literature review, user observation and ethnography research. Third, persona types were developed with quantitative data obtained. Fourth, persona scenarios were developed and verified based on personae created. Fifth, behavior of tourist, resident, guide and caretaker were drawn and coded based on persona scenarios, which were verified and analyzed through expert review.

### 2.1. Qualitative Research

Qualitative research was to select target area and grasp user information through literature review. In addition, behavior pattern was analyzed through observation and filming and in-depth approach was made through ethnography interview. This thesis aims to understand and analyze user behavior at a tourist attraction. As it is

realistically difficult to look into tourist attractions around the world, it serves as an important factor in this study to select a proper research target area. Considering that people at a tourist attraction are clearly categorized as tourist, resident, guide and caretaker, this study selected Korea National Maritime Museum in Busan as the target area. Each user type was observed as to user behavior at the selected target area, which is to be used as basic data to compose persona scenarios necessary to draw actual user's features and behavior. For detailed analysis, camera was also installed for filming, which was Sony's A7s2 model with 3840\*2160 resolution. Ethnography interviews were done with actual users at the target area. We selected subjects fit for the purpose of persona development through in-depth interview to investigate representative average age, gender, occupation, role and purpose of visit. To meet the particular goal of selecting a few subjects that can represent a majority, the number was adjusted appropriate for the average value examined through literature review. And the interview questions were organized in a manner to grasp user's goals and to find out objective information. Total of twenty people were interviewed with contents composed to examine user's purpose of visit, features, behavior pattern and cause of behavior, etc. The twenty subjects were of eleven males and nine females and one teenager, six in twenties, four in thirties, six in forties, two in fifties and one over sixties. There are more subjects in twenties and forties than other age groups as they include guide and caretaker. Data collected can be summarized as in the Table 1 below.

Table 1. Information of Users and Interview Content

Place	Gender	Age	Question
Korea National Maritime Museum			Job, age, purpose of visit, reason of action, plan of action etc.

## 2.2. Persona Modeling

As user can identify relation with observation target based on data observed and persona can be visualized by drawing important patterns, it facilitates easy understanding of important meaning and structure of information.[4] Personae on this thesis were developed on the basis of quantitative and qualitative data obtained from literature review, user observation and ethnography interview of both visitors and service providers at a tourist attraction. Data collected can be summarized as in the Table 2 below.

Table 2. Persona Modeling

Name	Gender	Age	Role	Feature
Sophia	W	22	Tourist	A lot of curious and want a new experience.
Noah	M	51	Resident	Take a rest near the home.
Emma	W	25	Guide	To provide a service that conveys information and guides.
Liam	M	35	Caretaker	Clean up, maintain security and take charge.

Persona scenarios for four different personae selected based on tourist attraction user's gender, age, role and features are as in the Table 2, which are composed upon consideration of roles and features of four personae Sophia, Noah, Emma and Liam.

Table 3. Persona Scenario

Persona	Scenario
Sophia	1. For entry to the tourist site, contact the receptionist.
	2. During the tour, one becomes curious about objects that exist in tourist attractions.
	3. Find a place and move to experience what you want.

- Noah
1. Rather than roam the tourist spot, sit on objects such as chairs and railings and look around.
  2. The knowledge of tourist attractions is so extensive that they often answer tourist questions.
  3. Move by checking time with belongings such as watches and cell phones.
- Emma
1. Explain and convey information about the destination to tourists.
  2. It provides services such as location search, information delivery, and education.
  3. They accompany experienced people and provide more detailed information.
- Liam
1. Check the target site for hazards and prevent them in advance.
  2. Communicate with other managers or guides and check their needs.
  3. Obstacles and by-products that hinder users' movements are organized.

### 3. Behavior Pattern in Tourist Spots

Based on persona modeling, user's behavior patterns at the target area were analyzed, which was conducted through visitor- and service provider-centered approach instead of planner's arbitrary point of view. Distinctive behavior of Sophia, a tourist, was identified to observe (Lo), point (Po) and take pictures (Sh), etc. That of Noah, a resident, was identified to sit down (Si). Emma, a guide, was mostly identified to explain (Ex) and point (Po) and Liam, a caretaker, was identified to observe (Lo). Behavior commonly identified included drinking (Dr), standing by (Id), switching direction (Tu) and walking (Wa). These actions can be summarized with action codes as in the Table 4 below.

Table 4. Action Code of Behavior Pattern in Tourist Spots

Category	Action Code	Description
Drink	Dr_Id	To drink liquid standing up
	Dr_Wa	To drink liquid while walking
Explain	Ex_Id1_Po1	To point and explain an object standing up
	Ex_Po_Wa	To point and explain an object while walking
Idle	Id_Si	Sitting and waiting
	Id	Standing and waiting
	Id_sun	To stand by with one's hands covering the sun
	Id_Le_wall	Standing and lean against the wall
	Id_Le_object	Standing and lean against the railing
	Id_Lo	To stand and look at an object
	Id_Ta	To talk standing up
Look	Lo_phone	Looking at a cell phone
Point	Po	Pointing to an object
Shoot	Sh	To take pictures or videos
Sit	Si_chair	To sit in a chair
	Si_scooch down	squatting down
	Si_ground	To sit on the floor

	Si_Ta	Sitting and talking
Turn	Tu	To change direction
Walk	Wa	To go alone
	Wa_Ta	To walk talking to a neighbor
	Wa_Po	walking with an object pointed at it
	Wa_sun	walking in the shade of the sun

#### 4. Expert review

We implemented expert review in order to verify validity of result from behavior pattern analyzed. As an expert has insight to detect problems, he can provide proper feedback to researcher.[5] Expert review not only verified validity of the study but also amended and supplemented issues to be added and revised. Two experts - one behavior analyzer and the other image contents producer - participated in the review. They verified this behavior analysis was output appropriate for production of VR/AI Heritage Tourism contents. As to target area selection, however, they added three spots to observe more various behavior. And they also recommended to increase the number of interviewed visitors to see behavior of children and the elderly and the weak. They advised adding behavior in terms of current social and cultural trends as well though such trends were not detected from the observation phase.

#### 5. Conclusion

This thesis aimed to analyze human behavior pattern in order to produce and realize AI NPC character and found out that human's extensive behavior could be analyzed through persona modeling. As future study, we are to describe how to produce AI character and to organize motion capture data to realize NPC character and a list of video data necessary to teach AI NPC character based on this study. Video learning data collected is to be taught by utilizing Convolutional Neural Network (CNN) to realize AI character. This thesis is expected to be useful for planning and design phase on production of VR/AI Heritage Tourism contents.

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## Investigation of the capabilities of convolutional neural networks in object classification problems for incoming video streams

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### Abstract

In this work we have learned the problem of detection of objects in images and methods of their solutions. Also analysis was conducted and built a batch image processing system using one of them as a core. Prior detection systems repurpose classifiers or localizers to perform detection. They apply the model to an image at multiple locations and scales. High scoring regions of the image are considered detections.

We use a totally different approach. We apply a single neural network to the full image. This network divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities.

**Keywords-***brain, neuron, neuron net, machine learning, classification, regression.*

### 1. Introduction

In recent decades, there has been a great need to automate various processes: from driving a vehicle to making a diagnosis to a patient. Greater popularity in this area has received the use of neural network technologies. This can easily be seen by watching the news bulletins. Artificial neural networks are attempts to reproduce the human nervous system. Namely: the ability of the nervous system to learn and correct errors, which should allow to simulate, although quite roughly, the work of the human brain. Various computer vision algorithms have experienced, not so long ago, a revival, largely due to growth, both its availability and technical progress.

For the most part, there are two fundamental impulses to the development of work in this area in the modern world. The first can be described as scientific; it is determined by the complexity and complexity of computer vision. As a type of activity, vision affects different levels of thinking - from transforming incoming information to a specific type, determining the color / shape of an object, its location in space, and its classification. The second impulse is more, most likely a social one, and it is due to the ever-increasing need for such systems in the modern world as a necessary condition for ensuring the processing of a huge amount of information, the volume of which is increasing every day.

Objective: study of various algorithms for the use of neural systems for the classification of objects in images. Analysis of the technology of building machine vision systems. Development of a stable image processing system in the context of continuous flow.

Research methods. A comparative analysis of algorithms and ideas proposed by various researchers in the field of computer vision and examples of the implementation of various systems was chosen as the research method.

The scientific novelty of the work lies in the developed architecture of the system for detecting objects in images that can scale both vertically and horizontally, which is distinguished by sufficient accuracy and speed of work, since at present the number of developments, at least in open access, is rather small.

Practical value. The developed architecture can be the basis for building various systems of industrial use of neural networks. Also on the basis of this work it is planned to develop a system of validation and verification of document packages required in various situations in the process of activity.

## 2. Development of neural network service for classifying objects on images

### 2.1. Basics of machine learning

A machine learning algorithm is an algorithm that is capable of learning from data. In the work of [1] the following definition is given: «It is said that a computer program learns from experience  $E$  with respect to a certain class of tasks and a measure of quality if the quality of the tasks from  $T$ , measured with, increases with the growth of experience  $E$ ».

Machine learning allows you to find solutions for problems that are too complex to solve using fixed programs designed and written by people. From a scientific and philosophical point of view, machine learning is interesting because the better we understand it, the deeper becomes our understanding of the principles underlying the work of our mind. Machine learning tasks are usually described in terms of how a machine learning system should handle an example. An example is a set of characteristics obtained as a result of quantitative measurement of some object or event, which the system must learn to handle. As a rule, an example is represented as a vector  $x \in R$ , each element of which is a sign. For example, the signs of an image are usually the values of its pixels.

To evaluate the capabilities of the machine learning algorithm, we must have a quantitative measure of its quality. Usually the measure of quality  $P$  is specific to the problem being solved by the system  $T$ . For example, for such tasks as classification, classification in the absence of data, and transcription, accuracy is often measured by the model. Accuracy refers to the proportion of examples for which the model produced the correct result. Equivalent information can be obtained by measuring the error rate — the proportion of examples for which the model produced an incorrect result. Sometimes the error rate is described by the binary loss function, which takes the value 0 for this example, if it is classified correctly, and 1 if it is incorrect. In the problem of estimating the density, it does not make sense to measure accuracy, error rate, or any other binary indicator. Some other measure of quality is needed that takes values from a continuous range. Most often, the average logarithmic probability assigned to the examples by the model is used for this purpose.

Machine learning algorithms can be divided into two large classes, without a teacher and with a teacher, depending on what experience they can learn. Teaching with and without a teacher are terms that have no formal definition. The boundaries between the two are often blurred. Many machine learning technologies are applicable to solutions of both types of problems. For example, the chained probability rule states that for a vector  $x \in R^n$ , the joint distribution can be represented as a product:

$$p(x) = \prod_{i=1}^n p(x_i | x_1, \dots, x_{i-1}). \quad (2.1)$$

This decomposition means that modeling  $(x)$  which at first glance seems to be a task without a teacher can be divided into  $n$  learning tasks with a teacher. And the task of teaching with a teacher, which consists in calculating  $p(y|x)$ , on the other hand, can be solved using traditional teaching methods without a teacher: to find the joint distribution  $p(x, y)$  and to calculate:

$$p(y|x) = \frac{p(x, y)}{\sum_{y'} p(x, y')}. \quad (2.2)$$

Although teaching with and without a teacher is a concept that is not formalized and not separated by a clear boundary, they still help to roughly categorize some of the tasks that are solved in machine learning. It is customary to assign the tasks of regression, classification and structural output to learning with a teacher, and the task of estimating density, in turn, to learning without a teacher.

In some machine learning algorithms, experience is not only a fixed set of data. Thus, reinforcement learning algorithms interact with the environment, so that a feedback loop is formed between the learning system and its experience.

The definition of a machine learning algorithm as an algorithm that is able to improve the quality of the program for solving a certain task on the basis of experience sounds somewhat abstract. To add specifics, we give an example of a simple machine learning algorithm, namely, linear regression. As the name suggests, linear regression solves the regression problem. In other words, our goal is to build a system that accepts a vector  $x \in R^n$  at the input and generates a scalar value  $y \in R$  at the output. The result of a linear regression is a linear function of the input data. Denote  $\hat{y}$  as значение value of  $y$ , which was predicted by the model. We define the result in the form:

$$\hat{y} = \omega^T x, \quad (2.3)$$

where  $\omega \in R^n$  is the parameter vector.

Parameters are values that control the behavior of a system. In this case  $\omega_i$  is the coefficient by which you need to multiply the sign  $x_i$  before including all the signs in the sum of contributions. In other words,  $\omega$  is a set

of weights that describe the influence of individual characteristics on the prediction result. If the weight  $\omega_i$  of the sign  $x_i$  is positive, then an increase in the sign leads to an increase in the result  $\hat{y}$  and if it is negative, then to a decrease. If the absolute value of the weight of the feature is large, then its effect on the prediction is significant. If the weight of the feature is 0, then the feature does not affect the prediction at all.

Thus, the definition of the task  $T$  is as follows: predict  $y$  by  $x$ , by calculating the value  $\hat{y} = \omega^T x$ . Now it is necessary to determine the quality measures  $P$ .

Suppose there is a plan matrix with  $m$  parameters that we will use not for learning, but only for assessing the quality of our model's work. There is also a label vector containing the correct values of  $y$  for each of these examples. Since this data set will be used only for quality control, we will call it a test set. Denote the matrix of the plan  $X^{(\text{test})}$ , and the vector of regression marks, respectively  $y^{(\text{test})}$ .

The main problem of machine learning is that the algorithm should work well on new data, which he had not seen before, and not just on those used to train the model. This ability to work correctly on data that has not previously been presented is called generalization.

Usually, when training a model, we have access to the training set: we can calculate some measure of error on the training set, which is called a training error, and try to minimize it. What we just described is an optimization task. Machine learning differs from optimization in that we also want to reduce the generalization error (it is also called the testing error). The generalization error is the expected value of the error on the new input data. Here, the expectation is calculated from possible input data selected from the distribution, which we think can occur in practice.

How can you affect the quality of work on the test set, if only a training set is available for observation? Some answers are given by the theory of statistical training. If the training and test sets were prepared in an arbitrary way, then really little can be done. But if it is allowed to make assumptions about the order of data collection for the training and test sets, then it is possible to advance further. Training and test cases are generated from the probability distribution of test sets by the data generation process. Assumptions, collectively called i.i.d. (independent and identically-distributed), are usually considered fair.

The examples in each set are independent and both sets are equally distributed, that is, they are chosen from the same probability distribution. This general distribution is called the generating distribution and is denoted by  $p_{\text{data}}$ . Under these assumptions, we can mathematically analyze the relationship between a learning error and a testing error.

Immediately it should be noted that the expected learning error of a randomly selected model is equal to the expected error of testing the same model. Suppose there is a probability distribution  $(x, y)$ , and we re-sample from it to generate the training and test sets. For a fixed value of  $w$ , the expected error on the training set is exactly equal to the expected error on the test set, because both mathematical expectations are the result of the same sampling process. The only difference is in the name of the data set.

Of course, when using the machine learning algorithm, the parameters are not fixed in advance, in order to then fetch both sets of data. We select the training set, use it to minimize the training error, and then select the test set. With this process, the expected test error is greater than or equal to the expected learning error. There are two factors that determine the quality of the operation of the machine learning algorithm: make the training error as small as possible or reduce the gap between the training and testing errors.

Specialists in neural networks have long understood that the speed of learning is one of the most difficult to set hyperparameters, because it significantly affects the quality of the model. The cost is often very sensitive in some directions of the parameter space and insensitive in others. The impulse algorithm can smooth out these problems to some extent, but at the cost of introducing another hyperparameter. The question naturally arises whether there is any other way. If we assume that the sensitivity directions are almost parallel to the axes, then it may be worthwhile to set the learning speed separately for each parameter and automatically adapt these speeds throughout the whole training.

The delta-bar-delta algorithm is one of the first heuristic approaches to adapting individual learning rates for model parameters. It is based on a simple idea: if the partial derivative of the loss function for a given model parameter does not change sign, then the learning rate should be increased. If the sign changes, then the speed should be reduced. Of course, this kind of rule applies only to optimization on the full package.

Unfortunately, at present, there is no consensus that an algorithm is the best one. For example, [2] presented a valuable comparison of a large number of optimization algorithms applied to various learning tasks. And although the results show that the family of algorithms with an adaptive learning rate (represented by the RMSProp and AdaDelta algorithms) behaves quite steadily, no clear winner has been identified. Now the most popular and actively used algorithms are CGS, CGS with impulse, RMSProp, RMSProp with impulse, AdaDelta and Adam. Which one to use depends mainly on the user's familiarity with the algorithm.

## 2.2. Development of neural network service for classifying objects on images

In the process of research, the following stages of development of the classification of objects in images using neural network technologies were studied: the detection of objects [3] using neural networks of the  $R - CNN$  type, in particular, greater emphasis was placed on  $- CNN$ , and finally, a completely new approach of YOLO .

In the course of the study, models were built and the main types of R-CNN networks were trained, as well as YOLO. For completeness of the experiment, the same tools and data set used for training were used for this.

In particular, the tensorflow package was used to build the neural network. It is a deep machine learning framework developed by Google Brain. For a long time, the framework was developed in a closed mode under the name DistBelief, but after a global refactoring on November 9, 2015 it was released in open source. For the year with a slight growth to version 1.0, it gained integration with keras, became much faster and received support for mobile platforms. Recently, the framework has also been developing towards classical methods, and in some parts of the interface it is already somewhat reminiscent of scikit-learn. Prior to the current version, the interface was changing actively and often, but the developers promised to freeze changes to the API.

As a more complex tool, it was decided to use Keras. Keras is a very convenient high-level library for deep learning, working on top of theano or tensorflow. It is based on layers, connecting them together, we get the model. Once created, the models and layers retain their internal parameters, and therefore, for example, you can train a layer in one model and use it in another, which is very convenient.

Keras models are easy to save / load, they have a simple, but at the same time deeply customizable learning process; models are freely embedded in the tensorflow / theano code (as operations on tensors).

Pascal VOC 2007 and 2012 samples for a fixed set of classes were taken as the training sample.

The simulation results are presented in table 1.

Table 1. Comparison of the presented algorithms

Method	Training set	Average accuracy	FPS
Fast R-CNN	$V OC2007 + 2012$	69.7	0.6
Faster R-CNN VGG-16	$V OC2007 + 2012$	72.9	7
YOLO	$V OC2007 + 2012$	63.7	44
YOLOv2	$V OC2007 + 2012$	76.9	68

From which we can conclude that the method *YOLO* works perfectly in real time with an accuracy comparable to neural networks of the form  $R - CNN$ . The advantages of the YOLO approach are obvious: to find objects in an image and to classify them, one neural network is needed, unlike networks like R-CNN. Also, this algorithm can be quite successfully used in real-time systems, but this requires appropriate computational power. As a result of the experiment, it was found that the highest performance is achieved when using the GPU, we used calculations on the graphics processor using Cuda technology.

For industrial use, a system was implemented, the core of which is a neural network. The task of this system is to receive the image that needs to be processed, send the image to the task queue, process the image and return the result. It is also important that the system can be scalable both in depth and in width. Vertical scaling - increasing the performance of each component of the system in order to improve overall performance. Scalability in this context means the ability to replace components in the existing computing system with more powerful and faster components as technology grows. Horizontal scaling - splitting the system into smaller structural components and dividing them into separate physical machines (or their groups), and (or) increasing the number of servers that perform the same function in parallel. Scalability in this context means the ability to add new nodes, servers, processors to the system to increase overall performance.

The following technologies were used to implement such a system:

- Flask [4] is a microframe for creating websites in the Python language. The use is ensured by lightness and the provision of all the necessary functionality for this task.

- Redis [5] an open-source, key-value log-based data source repository. Will be used as storage of processing results, has an excellent speed comparable to working with RAM, as well as the possibility of organizing into clusters and recovery after a power outage

- RabbitMQ [6] is a platform that implements a messaging system between components of a software system. In this case, will be used as a queue of tasks.

- Neural network, which solves the problem of detection and classification of one of the methods described in this paper.

As a result, a system was built that can be easily scaled, is simple and functional, the architecture is shown in Figure 1.

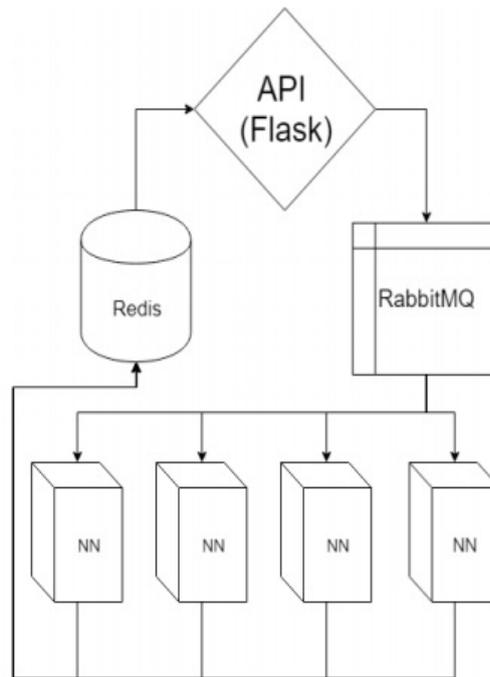


Fig. 1 Architecture of a neural network system for mass image processing.

The architecture of this type allows you to control the processing of each task, as well as it is not tied to any specific neural network.

### 3. Conclusion

On the basis of the research, a system was developed to automate the process of classifying objects in images. To issue recommendations, a module was developed using machine learning to identify the rules by which the choice of the image object class should be made.

Based on the analysis and processing of special literature, principles and knowledge from the theory of neurobiology, neuroinformatics, cybernetics, artificial intelligence, artificial neural networks, probability theory, machine learning and in-depth training of neural networks were identified and applied.

As a result, neural models that classify objects in images were configured and trained. The results of the classification are checked both on the actual data set, which is similar in composition to the attributes that will be during the production use of the system, and on the data generated independently. The module with a neural network is made in the form of a web service that provides tools for the classification of objects. Further development of the project - the introduction of new and refinement of existing methods of data mining.

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# Fall Detection System for Elderly with Wi-Fi Accelerometer Sensor

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## Abstract

Falling is one of the main reasons for the injuries and deaths of older people. This study was intended to develop a fall detection system for elderly people that sent an alert messages in an emergency cases to elderly caregivers. After receiving the alert message, the caregivers can immediately help older people to reduce the risk of the accident. The ADXL345 3-axis accelerometer module sensor was used for detecting the acceleration of 3 axes (Xi, Yi, and Zi). Then, the falling detection was tested from different angles by considering the acceleration of a chip, which connects with a computer via Wi-Fi. Next, calculated the difference between analyzed falling values collected from the recent and previous acceleration. If the value is in the specified range, the system will send alert to the caregivers via LINE application along with date and time that falling occurs so they can come to help the elders in time. The test result shows the accuracy of 77.5% with an alert sent time at 3.42 second.

**Keywords-** *Angular acceleration; Fall detection; Bent detection; Accelerometer Sensor; Elderly*

## 1. Introduction

Usually, fallings were accidents that caused on the number of damages or injuries happen. Some fallings of older people may end up with severe damages unless the caregivers did not provide the necessary attention. It might cause damages to their physique alike broken bones, dislocated bones, and also for their lives. An online fall detection system can help to minimize the risk of older peoples' injuries in an emergency. Recent research studies show various online fall detection system applications designed for older people.

In the study of [4], authors have developed a fall detection device that is installed to the chest and sends a message via Bluetooth 4.0 to a smartphone. When the fall sensor is selected, it will send information to an application on a smartphone to calculate when falling occurs. It will collect falling details (location, date, time) into a database of a smartphone, show the result, and send alert sound to the falling person smartphone so they can get help from anyone nearby. The system will also send falling details to falling person's emergency contacts to get help, when they read the message, they will know about the falling details and can find the location with Google Map. The testing result of this system from 30 tests of falling and lie down in many directions shows that this system can send alert according to falling details correctly from a falling test in different directions with accuracy at 83.33% - 90% with alert time at 3.57 - 3.69 second. However, falling still has directions set which are not consistent in a real situation, and sending a message via Bluetooth has a small range.

In this work, authors developed an online fall detection system which can detect a falling of an older person from various direction according to movement in everyday life. This system is capable of sending an alert to the caregivers via LINE application along with date and time that falling occurs so they can serve to help the elders on time. Besides, the sensors used in this system can operate for a long time as they consume low energy.

## 2. Design and Development

### 2.1. Tools

The primary devices used in this development were NodeMCU V2 ESP8266 Development Kit ESP-12F/N Board or ESP8266, Fig 1 (a), and a 3-axis accelerometer ADXL345 - Triple-Axis Accelerometer or ADXL345,

Fig 1 (b). The device (a) and (b) worked together and connects to a USB 3.0 to get a mobile power source and finally, connect with a person.

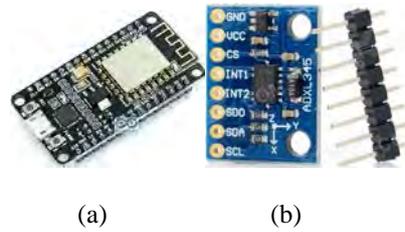


Fig 1. sensors used in the development (a) ESP8266 (b) ADXL345

## 2.2 System development

The proposed system overview of the fall detection system shows in Fig 2.

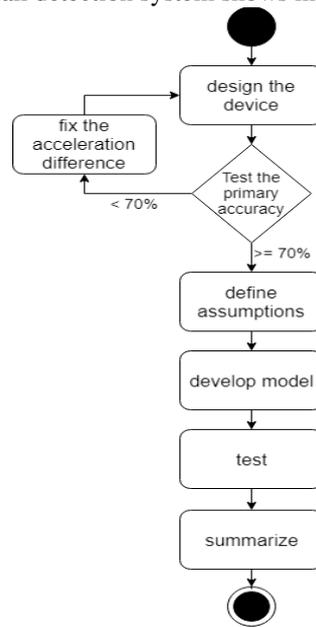


Fig 2. Process of proposed fall detection system

In the design and development stage of the system, ADXL345, and ESP8266 worked together and connects to Wi-Fi and a USB 3.0. The ESP8266 connects with a MicroUSB, as shown in Fig 3. In order to test the accuracy of the device set with acceleration with ADXL345, the device set was thrown, moved, and hurled, which represent the actions similar to falling, making a rapid change of acceleration. Then the system calculates the difference of recent acceleration and the previous one. After testing and calculating the average of acceleration values, the accuracy of 70% [3] will be used to make a hypothesis. However, if the accuracy is lower than 70%, the difference in acceleration will be readjusted.



Fig 3. The connection of MicroUSB with ESP8266 that is connected to ADXL345

After carrying out testing, the hypothesis represents that difference of accelerations that has accuracy more than 70% is X-axis indicates walking will have acceleration, not more than 400, but the other axis (Y and Z) is perpendicular with the ground which has a higher change of acceleration. So, the difference between the accelerations of these 2 axes were less than 200. If the difference of accelerations is higher than these values, it will imply falling occurs.

Next task was to conduct the testing while the device installs on a person. The device was installed on the waist and the chest of a person. Then, the device was tested while falling, walking, and bending the human body.

Then, the device set was tested through a volunteer person while wearing it. Based on the actions, which interface through LINE alert messages, device deliver help messages to the caregivers.

### 3. Evaluation

Fig. 4 represents the overall connectivity between the Local Area Network or Wi-Fi, computer, and the ESP8266. Fig. 5 represents the flow of the proposed system. When an older person has a device installed at his waist or chest, the ADXL345 continually detects value acceleration of all three axis and checks whether it reaches the specified difference. If it is the case, then, a LINE alert message will be sent to a caregiver to notify the situation as shown in Fig. 6.



Fig 4. Overall connection of the system

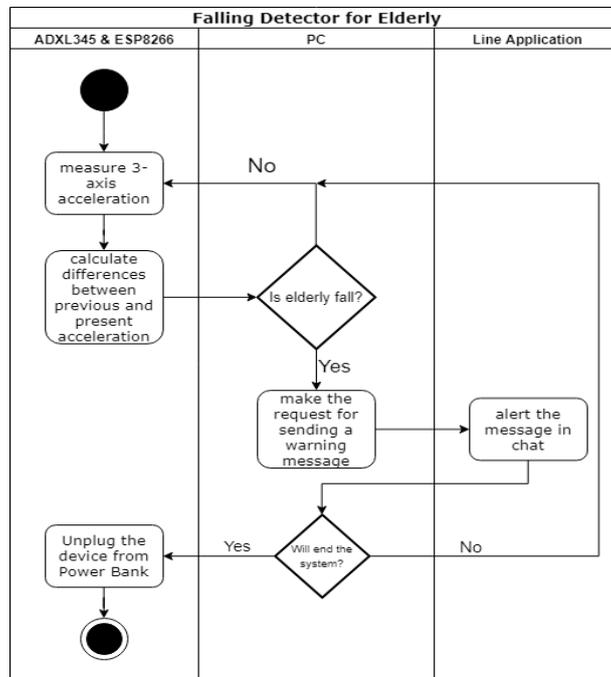


Fig 5. Flow of the falling detection system

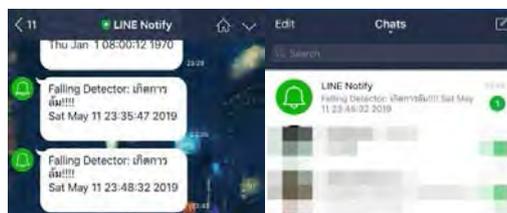


Fig. 6. Display of LINE notify when falling occurs

The experiment was conducted in two main sections: the device installed at the waist and the device installed at chest. The chest installation was conducted under two cases: Oblique right and oblique left. The system was tested against falling and bending a human body in different directions: forward, backward, left side, and right side. However, the bending action was tested only with forward direction. Each case was tested ten times and evaluated with the amount of time to notify via LINE every time falling for occurrences. Fig 7 shows all test cases scenarios.

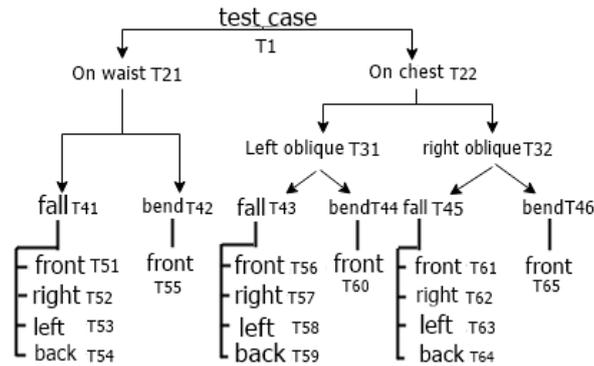


Fig 7. All fall detection test cases scenarios.

TABLE 1 represented example of the test scenarios while the device was installed to the waist. Other cases represent the same method with a different type of installation.

TABLE 1 : Example of Test Cases

Test case	T21	T51	T52	T53	T54	T55
Description	Waist installed device	Test of forward falling	Test of right side falling	Test of left side falling	Test of Backward falling	Test of forward bending
Picture						

#### 4. Result

The accuracy result of the test is shown in the table 2 to 3, indicating LINE notifying.

Table 2. Fall detection testing result of test cases T41, 43, 45 and subcases

FALL	Times										FALL	Times										FALL	Times									
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
FRONT	█	█	█	█	█	█	█	█	█	█	FRONT	█	█	█	█	█	█	█	█	█	█	FRONT	█	█	█	█	█	█	█	█	█	█
RIGHT	█	█	█	█	█	█	█	█	█	█	RIGHT	█	█	█	█	█	█	█	█	█	█	RIGHT	█	█	█	█	█	█	█	█	█	█
LEFT	█	█	█	█	█	█	█	█	█	█	LEFT	█	█	█	█	█	█	█	█	█	█	LEFT	█	█	█	█	█	█	█	█	█	█
BACK	█	█	█	█	█	█	█	█	█	█	BACK	█	█	█	█	█	█	█	█	█	█	BACK	█	█	█	█	█	█	█	█	█	█

Based on the 30 falling test cases motion and the device was worn at the waist, the highest average accuracy rate of the alert system was 77.5%. Then, the most accuracy rate of 90% showed when a forward falling occurred as shown in Table 2, and other test cases showed an accuracy of 75%.

Table 3. Fall detection testing result with device worn at waist of case T42, 44, 46 and subcase

BEND	Times										BEND	Times										BEND	Times									
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
FRONT	█	█	█	█	█	█	█	█	█	█	FRONT	█	█	█	█	█	█	█	█	█	█	FRONT	█	█	█	█	█	█	█	█	█	█

According to the results show in Table 3, the right result is supposed to be no alert when testing person bend their body. Table 4 shows the most accuracy rate of 80% when the device is worn at the waist while the other two cases with the accuracy rate at 50%.

## 5. Conclusion

With 60 test cases, the time delay when falling occurs, and the alert sending has been evaluated. The result shows the most delay at 10 seconds, the least delay at 2 seconds, and the average is at 3.42 seconds. A fall detection system for older people with Wi-Fi accelerometer sensor was developed. The system can detect fallings without angle restriction and also has the flexibility of detecting a situation where a user can walk or bend their body before a falling happens. A fall detection system for older people with Wi-Fi accelerometer sensor was developed. The system can detect fallings without angle restriction and also has the flexibility of detecting a situation where a user can walk or bend their body before a falling happens. The most accuracy rate is represents by the average accuracy rate of 77.5% and the best accuracy rate of 90% when falling forward when wearing the device on the left or right oblique.

In future work, this system should be revised in the capability of communication part to test in real outdoors situation, which require wide range of the network coverage. For example, using the 4/5G network to locate latitude and longitude of the accident that a caregiver get precision location to an ambulance or lifesaving team. Besides, an additional application can be linked to other application to send and receive alert messages instead of LINE application.

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# Driver's Smartphone Usage Detection Based on Convolutional Neural Network Using Multi-Camera

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## Abstract

Advanced driver assistance system can detect smartphone usage to prevent traffic accidents. In previous works, researchers used one camera to collect drivers' images. However, if the driver occludes the phone, the advanced driver assistance system with one camera will not work well. Therefore, we developed a multi-camera-based smartphone usage detection system to collect different perspectives of driver's images, and then processed these images with a convolutional neural network. Our experiments revealed the proposed method had the best accuracy of 95.94%.

**Keywords-***Advanced Driver Assistance System; Convolutional Neural Network; Multi-camera system*

## 1. Introduction

According to the World Health Organization (WHO), 1.3 million people die from traffic accidents each year. Using a smartphone while driving is one of the main causes of traffic accidents. Advanced driver assistance systems (ADAS) can monitor the smartphone usage when a driver is driving a car [1]. In previous works, the researchers used only one camera to collect a driver's image data [2,3,4]. In [2], Zheng, Wang and He proposed a single camera-based method. They preprocessed and extracted the driver's image features and then imported the feature values into the hidden conditional random fields (HCRFs) to detect whether the driver was using a smartphone. As this method requires data preprocessing and feature extraction, the specific application of smartphone detection has high computational complexity. In [3], Wang, Pei, and Zhu used an and-or graph (AoG) to model a driver's phoning activity and used an online parsing algorithm to detect the phoning activity. In this method, the data are captured by an in-car camera. However, the false positive rate is high, and the method has limitations such as self-occlusion issues. In [4], Baheti, Gajre, Talbar, and Sanjay used a convolutional neural network (CNN) method. As images do not need to be preprocessed and no features need to be abstract, the CNN can reduce the complexity of the algorithm. These researchers trained a VGG16 model to detect images captured by a single camera and achieved 95.54% accuracy. However, these methods still have some limitations. As the system uses only one camera to collect the driver's image, when the driver's phone usage is over the monitoring range of the camera or the behavior of the phone usage is occluded, a single-camera method will not correctly detect whether the driver is using a smartphone.

To avoid the limitations of the single camera-based method, we propose a multi-camera-based driver's smartphone usage detection method that uses multiple cameras to collect driver images from various perspectives. This not only increases the monitoring range but also effectively avoids the self-occlusion problem caused by the single-camera methods. In addition, we used GoogLeNet [5], a CNN model with deepened network structures that do not increase the computational complexity.

## 2. Multi-camera-based driver's smartphone usage detection

In this study, we developed a driver's smartphone usage detection system using three cameras. The overall system flow chart is shown in Figure 1. For the driver's smartphone usage detection, we used GoogLeNet to process images. The basic structure of the GoogLeNet model has 22 layers. The image features are extracted

from traditional convolutional blocks and inception blocks [5]. The basic structure of the inception model is shown in Figure 2. Then, the Softmax layer performs the final classification. Here, we modified it to classify only two categories, those corresponding to normal driving and smartphone usage. We collected driver images from three Go Pro [6] cameras set up on the driving platform. The driving platform is shown in Figure 3. A Go Pro camera has four fields of view (FOV) settings: wide, medium, linear, and narrow. We chose the wide mode of Go Pro for view and interval such that the driver's upper body image was taken every 0.5 s. The three Go Pro cameras were controlled by one Wi-Fi remote, which implied that the image capturing of the three cameras could be started and ended simultaneously. Each camera setup and the corresponding camera image samples are shown in Figure 4.

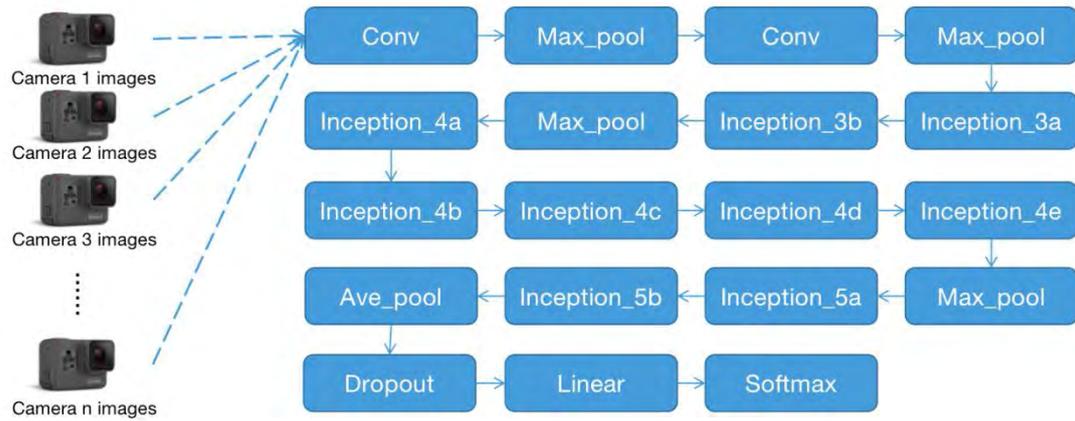


Fig. 1 Overall system of driver's smart-phone usage detection method

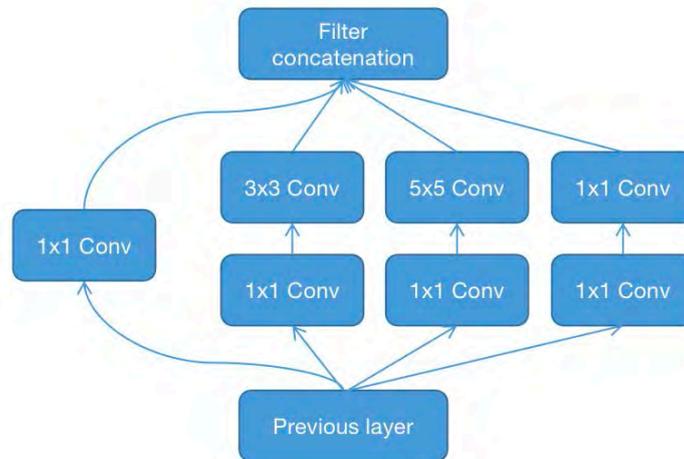


Fig. 2 Inception module structure



Fig. 3 Driving platform

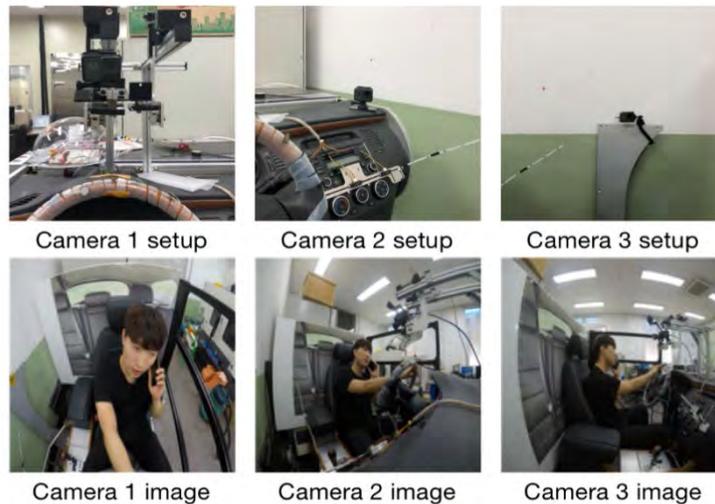


Fig. 4 Camera setups and corresponding camera images

### 3. Experimental Result

An image dataset was built for this study. We classified the driving behaviors into the following eight types: (1) normal driving, (2) scratching head, (3) touching ears, (4) rubbing eyes, (5) calling phone with left hand, (6) calling phone with right hand, (7) sending message with left hand, and (8) sending message with right hand. We captured 360 images from each type of behavior (120 images per camera). The images of behaviors (1) to (4) were labeled normal, and the images of behaviors (5) to (8) were labeled smartphone usage. Therefore, the dataset contained 2,880 images in all, as listed in Table 1.

Table 1. Number of images per driving behavior

Tagging	Normal				Smartphone Usage			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Data Type	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Camera 1	120	120	120	120	120	120	120	120
Camera 2	120	120	120	120	120	120	120	120
Camera 3	120	120	120	120	120	120	120	120
Total	360	360	360	360	360	360	360	360

To evaluate the performance of the proposed method, we used a deep learning toolbox model for GoogLeNet in MATLAB. We first converted the image format from the jpg format to the png format and adjusted the image size from  $4000 \times 3000$  to  $224 \times 224$  to fit the model by using MATLAB. We chose the png format because of the lossless nature of the format. We used the 10-fold cross-validation to train and test the model. Table 2 shows the results of our experiments. In our experiments, three drivers' datasets were used. From these results, we inferred that the proposed method could effectively detect whether the driver used a smartphone even in the case of self-occlusion. The best result of the three subjects had an average accuracy of 95.94% and a variance of only 0.01%.

Table 2. Accuracy of smartphone usage detection on GoogLeNet

Subject	1	2	3
1	93.06%	95.14%	94.10%
2	91.32%	95.14%	95.14%
3	90.97%	90.28%	94.79%
4	95.14%	96.53%	95.83%
5	94.44%	95.83%	97.22%
6	95.14%	95.14%	95.14%
7	93.75%	90.63%	97.22%
8	97.22%	91.67%	97.22%
9	88.19%	95.83%	96.18%
10	90.63%	94.10%	96.53%
Average	92.99%	94.03%	95.94%
Variance	0.07%	0.05%	0.01%

## 4. Conclusion

In this paper, we propose a three-camera-based driver's smartphone usage detection using GoogLeNet. The proposed method could effectively detect when the behaviors of the driver's phone usage were occluded or were over the camera's monitoring range. Our experiments showed that the proposed model could achieve the best accuracy of 95.94%. For future work, we will investigate some complex scenarios such as distracted driving scenarios to make the proposed model more generative and practical.

## Acknowledgment

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## Virtual Thai Xylophone

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### Abstract

Virtual Thai Xylophone is a virtual Thai local musical instrument that simulated Thai xylophone called Ranat ek, a percussion instrument that consists of 21-22 wooden bars which have a different note. A reason to create the work is to increase more interesting Thai instruments from globalization that influence into Thailand and makes its decreasing popularity, so this work presents a new way to play Thai xylophone that appeals anyone to interest its. In this work, we used Microsoft Kinect for Xbox One to capture human motion that has sensors to detect objects, then used a computer to track hands. We used MS Kinect for Xbox One because we can use Kinect for Windows SDK 2.0 which has a function to capture human motion. In the part of development, we used MS Visual Studio to create the user interface and develop the program with C# that have 2 parts: Kinect camera and Virtual Thai Xylophone Interaction which is an evaluated system hand motion information and control sound library with Virtual Thai Xylophone model is a set of bars space. When the user launches the program, MS Kinect for Xbox One will capture a hands motion and evaluate them that are in a set of bars. If their position is staying in a set of the bar, the program will play a sound of the note that has a different sound in each bar. In this experiment, we used a Thai song “Lao-Seang-Tein” to test the program, we found that our work should play with a not fast song. In further work, this can apply to other percussion instruments such as a drum or change the way to generate sound faster.

*Keywords-virtual xylophone, digital music instrument, hand motion detect*

### 1. Introduction

Thai Xylophone (Ranat ek) is a Thai musical instrument that performs in Piphat—A Thai orchestra consisting mainly of idiophones and aerophones that have discovered around Ayutthaya period. Most of the song that its perform is beat with 1 octave, so a player must beat with two hands at the same time, fig 1 show an sample of Ranat-ek. At the present time Thai musical instrument decreasing popularity plus it hard to relocate because of length that around 120 cm. and not light to move by one person, so we made a portable Thai Xylophone that uses MS Kinect with the program that interacts a player to play Thai Xylophone for a beginner who would like to practice and hasn't Thai Xylophone and makes a new way to get new experience.



Fig.1 Ranatek (Thai Xylophone)

## 2. Methodology

We use MS Kinect to an interaction between human and computer by using MS Visual Studio 2017 to develop that has a tool to design User interface. MS Kinect has a sensor to detect human that we focus on a position of hands player then get the x,y-coordinate value (fig.3) to compare with wooden bar's x,y-coordinate value and we develop with MS Visual Studio 2017 that support to detect human motion. Hands have a set of the position we can write in  $(X_i, Y_i)$ . Thai Virtual Xylophone overall mechanism represent in fig 2. There were 4 step to operate. For the first process (1) open the camera is an initial process to setup system and stand by to detect player hands (2) construct virtual xylophone user interface (3) check hand position or hand point (fig.3) is a process to compare hand's coordinate and touching point and then go to process (4) this process is making a sound when user's hand in a touching point. In figure 4, it shows interface of this program.

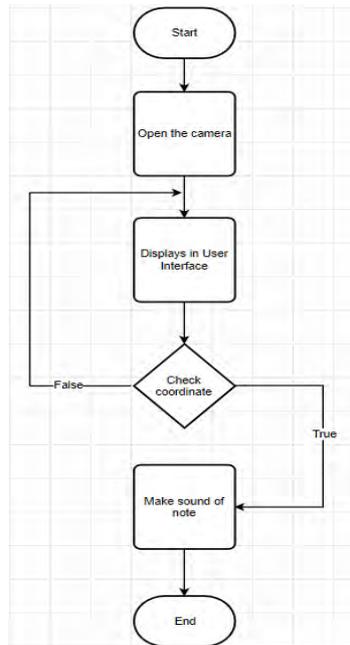


Fig. 2 Thai Virtual Xylophone overall working process

Virtual xylophone construction process, system generate virtual theater which composed by 4 parts, (1) left side stick, it will follow to right-hand motion (2) picture of the right side stick, it will follow to left-hand motion (3) 22 virtual wooden bars, these bar(i) represent the touching point  $(X_i, Y_i)$  positions to matched with a virtual xylophone's bar(i) while ignored the  $Z_i$  dimension because it was too difficult for player to play Virtual Xylophone (4) frame or canvas that MS Kinect can detect is a near real-time frame when objects change their position or motion.

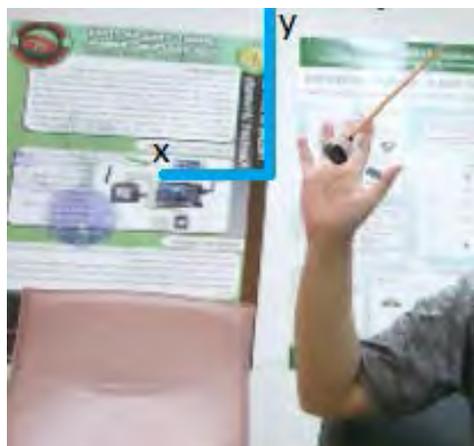


Fig.3. Hand point

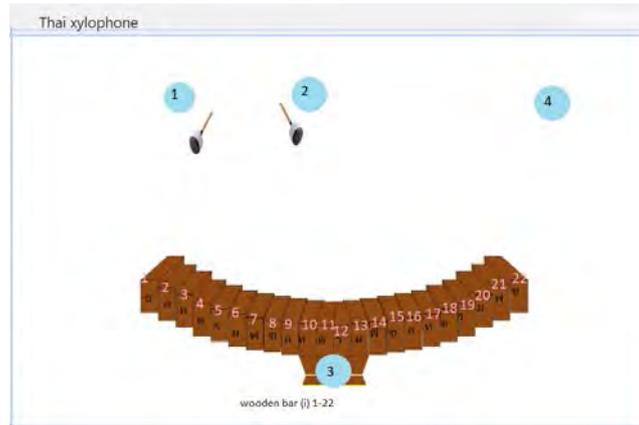


Fig.4. Virtual Thai Xylophone and touching point

### 3. Development

#### 3.1 Hand points (Xi, Yi) value

$X_i$  represents a value of x-coordinate that separate for 2 hands to  $X_{iL}$  -represents left hand's user in X-coordinate and  $X_{iR}$ —represents right hand's user in X-coordinate, Both of them use for check condition to make the sound of Thai xylophone in table 1.

$Y_i$  represents a value of y-coordinate that separate for 2 hands to  $Y_{iL}$ —represents left hand's user in y-coordinate and  $Y_{iR}$ —represents right hand's user in y-coordinate, both values use for condition check to generate the music sound of Thai xylophone on table 1. Because of Thai xylophone's shape is symmetry so representation ( $X_i, Y_i$ ) in a left and right half bar were the same value, for example, bar no.1's position is opposite of no.22's position so wooden bar no.22 have the same value of wooden bar no.1.

Table 1.  $X_i$  and  $Y_i$  of Bar(i)

Wooden bar (i)	Note	$X_i$		$Y_i$	
		Start	End	Start	End
1	G	370	429	690	930
2	A	434	470	704	975
3	B	480	520	740	990
4	C	530	560	745	1030
5	D	595	634	768	1040
6	E	645	685	794	1057
7	F	700	732	798	1060
8	G	757	788	806	1062
9	A	803	835	812	1068
10	B	860	892	815	1063
11	C	910	938	820	1064
12	D	964	1003	816	1054
13	E	1015	1050	813	1050
14	F	1065	1095	804	1060
15	G	1130	1168	803	1068
16	A	1185	1212	800	1068

17	B	1240	1276	780	1055
18	C	1280	1315	770	1030
19	D	1330	1380	755	1018
20	E	1385	1440	722	998
21	F	1438	1478	695	976
22	G	1486	1530	685	945

**3.2 Bar detection algorithm**

Algorithm 1: Virtual Thai Xylophone operation

Step 1. Capture the coordinates of the head, left-hand and right-hand positions and collect hr and hl

where,

(hr(i), hl(i)) –hr(i) is the value of right hand’s x,y-coordinate,

hl(i) is the value of left hand’s x,y-coordinate

Step 2. Display the frame that Kinect can detect

Step 3. Check conditions to play a sound that can separate to left-hand and right-hand as follows:

if (hr in XiR) and (hr in YiR) playSound s(i)

if (hl in XiL) and (hl in YiL) playSound s(i)

where,

(XR(i), XL(i)) – the value of wooden bar’s position with a right hand in x-coordinate

– the value of wooden bar’s position with a left hand in x-coordinate

and

(YiR – the value of wooden bar’s position with a right hand in y-coordinate)

Step 4. Go back to step 1 for the next frame

YiL – the value of wooden bar’s position with a left hand in y-coordinate

S(i) – the note sound (i represent the amount of the Wooden bar (i); i = 1,2,...,22)

**4. Conclusion**

Due to the development of this research, we can find a new way to perform Thai instrument that is Thai xylophone to attend people for more popular. We test by using local Thai song call “Lao-Seang-Tein” (Fig.5) that tempo is Andantino(bpm: 80-108) wrote in King Rama IV and rearrange in 1933 by master Luang Pradit Pai Roh(Sor Silapabunleng). In this score write in c major scale with time signature 4/4 and around 90 bpm.



Fig.5. Lao-Seang-Tein score

## Acknowledgement

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# Wearable computer Bright Shirt for Blind people

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## Abstract

The Bright Shirt is wearable computer which improve two issues of the Shoes For Visually impaired People<sup>[3]</sup>. The first issue was warning the blind within the safe time and the second was support user's travelling information to caregiver. After turn-on Bright Shirt , ultrasonic sensor search obstacle. If found object camera module take environment photo, GPS module get and send user's locations to Raspberry pi board. The board will send photo, location and obstacle 's distance to caregiver by Line Application.

**Keywords:** *Wearable Computer, Technologies for disabled people, Apply IOT*

## 1. Introduction

The Shoes For Visually impaired People<sup>[3]</sup> is a wearable computer for helps disability people travel without the walking stick. They used NodeMCU V2 LUA based ESP8266-12E and to compute distance between object and user in the caregiver's responsible. That project works under limitations such a distance of detection is 60 cm., it is too short to avoid the obstacles in the safe time, they do not know what the obstacles are, it can not detect another obstacles which be above user's knees.

To fixed above 2 problems and improve disabled people's journey to be more convenient and more safety there are motivation of "The Bright shirt" project. In addition Bright Shirt can detect obstacle with longer distance than 60 centimetres and obstacles which has higher than 50 centimetres.

The Bright shirt has three parts of working . First, the GPS module for getting GPS location by GY-NEO6MV2, Second the voice module, This module will alarm walker when found any obstacles and the last part is the image module controlled by Raspberry pi board do 2 functions, snapshot walking environment and forward to care giver. Then caregiver can recall this informations and take actions to help the disability people on time.

## 2. Methodology

### 2.1. Designed The Bright Shirt system

The Bright Shirt use the Raspberry pi 3 model B in Fig 1. written by Python language to control camera module, sensor module and notified module and use Arduino Uno board written by C++ language to control GPS module. Bright Shirt components as Table 1.

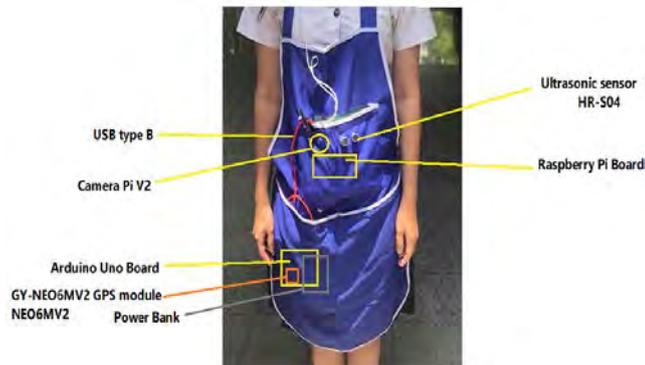


Fig 1. Bright Shirt

Table 1. Components of Bright Shirt

Components Descriptions	Pictures
<p>A. Raspberry pi 3 model B board</p> <p>The main board of Bright Shirt . This component controls sensor module, camera module and notify module.</p>	
<p>B. Arduino Uno board</p> <p>This works with GY-NEO6MV2 to controls GPS module.</p>	
<p>C. GY-NEO6MV2</p> <p>This component gets GPS for sent locations to Arduino board.</p>	
<p>D. Camera Pi</p> <p>This component worked under the Raspberry Pi board to take the environment photos.</p>	
<p>E. Ultrasonic sensor HC-SR04</p> <p>This part responsible for detect obstacle' s distance. This works under Raspberry Pi board.</p>	
<p>F. Power bank</p> <p>Power bank must have capacity more than 10,000 mA.</p>	

All of these components were connected with pattern as Fig 2. Not only TX and RX port number (on Arduino board) based on coding, but also Trigger and Echo port number (on Raspberry pi board). Both boards were linked by Ethernet line.

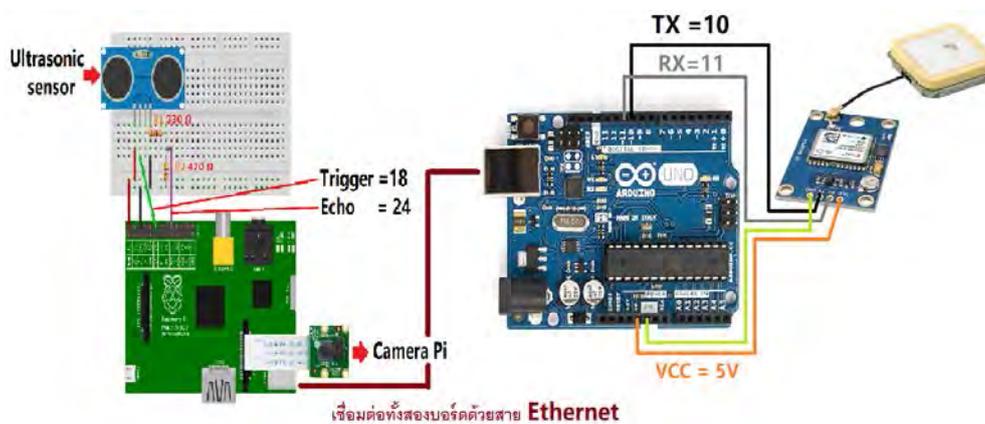


Fig 2. Bright Shirt blueprint

### 2.2. Working system of Bright Shirt

The disability people who use Bright Shirt is a user who walk along test field. Bright Shirt brain warns user if the sensor found any obstacles front area in length 100-150 centimetres then the Bright Shirt alarm user by sound, capture environment picture and generate GPS respectively. The last step is sent all of information like pictures, GPS locations and distance between user and obstacles as in Fig 2.

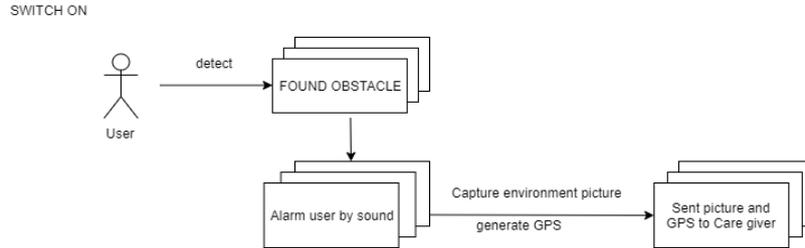


Fig 2. Working cycle

## 3. Results and Discussions

### 3.1. Define Scenarios

The Bright Shirt tested by two test fields. First of all, There tested in Test field of SVIP (Started from avoiding a box ,passed the door and finished at the wall as Fig 3.) and then changed test field to the new (Started from avoiding a bench, passed a motorcycle, a large and a small puddle, holes, steel grad, a sign board, plastic and steel cable to tree as Fig 4.) . The test result recorded in Table 3.

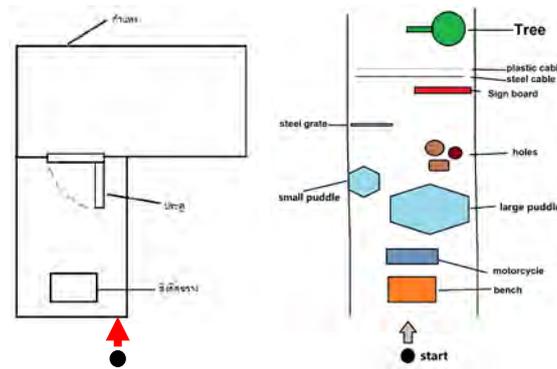


Fig 3. Test field of SVIP. Fig 4. The new test field.

Table 2. Distance between each obstacles.

Object (between)	Distance(cm.)
A. Bench-Motorcycle	200
B.Motorcycle-Large puddle	325
C.Large puddle-Small puddle	80
D.Small puddle-Holes	185
E.Holes-Steel grate	125
F.Steel grate - Sign board	220
G.Sign board - Steel cable	185
H.Steel cable - Plastic cable	60
I.Plastic cable - Tree	200

Table 3. Result from the SVIP test field.

The first number each cell means discovered times and the next number is times to test.

**Example** 1 /5 means found that obstacle 1 time from 5 testing time.

0 /0 means obstacle didn't test by that project.

5 /5 means found that obstacle every testing time.

obstacles	SVIP scenario tests	SVIP scenario tests with Bright Shirt	The new test field
Box	3/3**	3/3**	0/0
Door	3/3**	3/3**	0/0
Wall	3/3**	3/3**	0/0
Bench	0/0	0/0	1/5*
Motorcycle	0/0	0/0	5/5**
Large puddle	0/0	0/0	0/5*
Small puddle	0/0	0/0	0/5*
Holes	0/0	0/0	0/5*
Steel grate	0/0	0/0	0/5*
Sign board	0/0	0/0	5/5**
Steel cable	0/0	0/0	0/5*
Plastic cable	0/0	0/0	0/5*
Tree	0/0	0/0	4/5**

\* The tool can discover the thing lower 20 percents.

\*\* The tool can discover the thing equal or more than 80 percents.

#### 4. Conclusions

We have tested this stuff and found out that The Bright Shirt can detected any objects that straight with sensors. If object's position is higher or lower than sensor's position, The Bright Shirt can not found that stuff. By the way It includes of any factor like how object's size is too. Big object's size more than 5 inch square can detected by sensor easier than small size and the thick object's can detected easier than the thin.

Anyway the effective of the GPS module and the notify system are under internet bandwidth and the weather also .

The camera module can take environment photos and the Bright Shirt can send tat images to care giver.

#### Acknowledgment

We would like to express our special thanks to Department of Computer Science, Faculty of Science, Kasetsart University for all of the best things supported.

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# Digital Leaky Integrate-and-Fire Neuron with Approximate Adders for Spiking Neural Networks

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## Abstract

In this paper, we present a digital leaky integrate-and-fire (LIF) neurons with approximate adders for spiking neural networks (SNNs). We explore a couple of approximate adder architectures and adopt them in designing a digital LIF neuron to build an approximate spiking neuron. To demonstrate the performance of the approximate neuron, a two-layer SNN with over 1,000 neurons are used with approximate adders. The results exhibit that the approximate errors of the lower part OR adder (LOA) does not significantly impact on the neuron's spiking activities of the network. It is suitable for SNNs than the other approximate adder error tolerant adder I (ETAI).

**Keywords**-approximate adder; spiking neural network(SNN); leaky integrate-and-fire (LIF) neuron; neuromorphic computing; approximate computing

## 1. Introduction

A new design paradigm of approximate computing has emerged as one promising solution to remedy the increasing energy and power efficiency challenges and has drawn a significant research interest [1]. The approximate computing may be used for the error tolerant applications to achieve a good energy efficiency while providing an acceptable processing quality. Neuromorphic computing is one of the error tolerant systems mimicking a human brain that has an inherit error resilience [2]. The SNN in neuromorphic computing uses a computational neuron model to mimic the neuron behavior. The digital leaky integrate-and-fire (LIF) neuron among various models is widely adopted in many digital neuromorphic systems as it is easy to implement with a few arithmetic components, such as adder [2]. To this end, it is attractive to exploit approximate adders to design low power and energy efficient approximate digital LIF neuron and we explore the digital LIF neuron with a couple of approximate adders.

## 2. Approximate Adders

Figure 1(a) shows the lower part OR adder (LOA) that divides an adder into two parts: an accurate and an inaccurate part [3]. The accurate part uses a precise adder, such as ripple carry adder (RCA) and carry lookahead adder (CLA), to correctly compute higher order bits and the inaccurate one utilizes the OR function to do the remaining lower order bits approximately. The LOA contains a carry prediction scheme for the accurate part by ANDing two most significant bit (MSB) inputs of the lower part. The error tolerant adder I (ETAI) has a similar structure to the LOA as it also splits an adder into two [4].

What the main difference from the LOA is the approximate addition scheme for the lower bits that uses a modified XOR function. In addition, the ETAI does not include any carry prediction mechanism. As shown in Figure 1(b), the inaccurate part checks every bit from the MSB to the least significant bits (LSB) and perform normal additions (i.e. OR) if two input bits are different each other. If both input bits are 1, the adder stops checking process and forces all sum bits from the current bit to LSB to 1. These two LOA and ETAI approaches allow approximation errors to be concentrated on the lower bits that leads to reduce mean absolute error (MAE). However, they are limited by higher error rates. Furthermore, the lack of carry signal in the ETAI degrades the computation accuracy rather than the LOA.

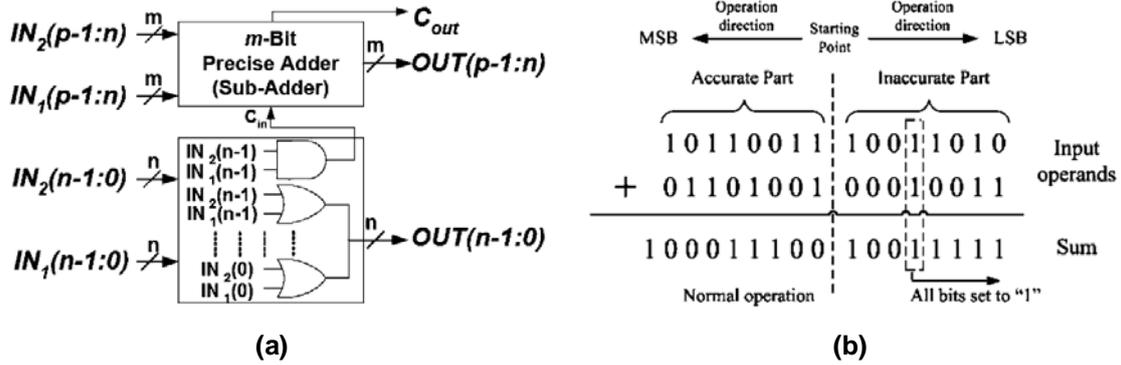


Fig. 1 (a) Block diagram of LOA [3] and (b) an example operation of ETAI [4].

### 3. Approximate Digital LIF Neuron

SNN based neuromorphic processors require neuron circuits to mimic the behavior of a biological neuron. Each circuit emulates a neuron dynamics, such as leaky integrate-and-fire (LIF) and Hodgkin-Huxley (HH) models. Among neuron models, the LIF model is suitable for digital implementation with a few arithmetic components and widely adopted in digital neuromorphic processors. Its dynamics is described by

$$V_i^t = V_i^{t-1} + K_{syn} \sum_{j=1}^M w_{ji} S_j^{t-1} + K_{ext} E_i^{t-1} - V_{leak} \quad (1)$$

where  $V_i^t$  is the membrane potential of neuron  $i$  at time  $t$ ,  $w_{ji}$  is the synaptic weight between neuron  $j$  and  $i$ ,  $E_i^t$  is the spike bit for the external input for neuron  $i$  at time  $t$ ,  $M$  is the number of pre-synaptic neurons of neuron  $i$ ,  $V_{leak}$  is the leaky potential and  $K_{syn}$  and  $K_{ext}$  are the weight parameters for synapses and external input spikes, respectively.  $S_i^t$  is the spike bit that indicates whether neuron  $i$  fired at time  $t$  and is set to "1" when the membrane potential exceeds the given threshold voltage  $V_{th}$ . It is expressed by

$$S_i^t = \begin{cases} 1 & \text{if } V_i^t > V_{th} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

Figure 3 shows a digital implementation of the LIF neuron with an approximate adder. It accumulates one of its pre-synaptic weights, an external input and a leaky potential, which correspond to  $K_{syn}w_{ji}S_j^t$ ,  $K_{ext}E_i^t$

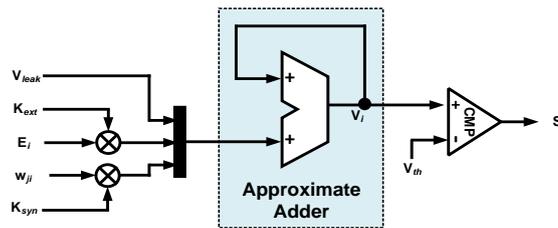


Fig. 3 Approximate digital LIF neuron.

and  $-V_{leak}$  in (1), respectively, through the multiplexer at a time. The normal addition in (1) is replaced by an approximate one to significantly reduce the power consumption.

### 4. Simulation Results

To evaluate the approximate digital LIF neuron described in Section 3, we consider a two-layer SNN with one post-synaptic neuron for an output layer and multiple pre-synaptic ones for an input layer. The post-synaptic neuron is replaced by our approximate digital LIF neuron and it is configured to receives 1,024 spikes from its pre-synaptic neurons. We apply random spikes to the post-synaptic neuron (*i.e.* approximate digital LIF neuron) for 10,000 biological time steps. We examine the network performance with an accurate adder (RCA) together with two approximate adders explained in Section 2, which are LOA and ETAI.

Table 1 shows the spike rates and spike error rates of the post synaptic neuron with various adders. The neuron with the accurate adder RCA produces 4,006 output spikes during 10,000 biological time, which reaches spike rate of 40.06%. This rate serves as a golden reference for the approximate adders. The LOA allows the neuron to produce more spikes than the accurate adder but demonstrate a similar spike rate with the golden leading to the small spike error rate of 7.23%. This means that the approximation error of the adder does not impact on the neuron's firing activities significantly. Unfortunately, the neuron with ETAI exhibits poor spike rate of 5.88% compared with the golden reference 40.06%. The approximate scheme of the ETAI may limit the firing activities of the network. This result shows that it is not suitable for SNN based neuromorphic applications.

Table 1. Spike Rate and Spike Error Rate of Digital LIF Neuron with Various Adders.

Design	Spike Rate (%)	Spike Error Rate (%)
RCA	40.06	0
LOA	42.98	7.23
ETAI	5.88	85.32

## 5. Conclusion

The digital LIF neuron with various approximate adders for SNN based neuromorphic computing has been presented. We have demonstrated the performance of the approximate adders in a two-layer SNN containing over 1,000 neurons. The results have shown that the LOA provides the better performance than the ETAI in terms of the LIF neuron's firing activities. The approximate error of the LOA does not significantly impact on the spiking activity of the network. Therefore, the LOA is more suitable for spiking neural network rather than ETAI.

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## Apply LBPH algorithm to detect students in classroom

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### Abstract

A problem in checking student's attendance is that the instructor must take the time to check the names of those enrolled. Due to the large number of participants, the instructor may have to spend a lot of time checking the student list, allowing the instructor to not be able to fully teach or exceed the teaching time. The researcher has conducted research using image technology to help check the student lists who attend for the purpose of accuracy and ease of checking student lists and focused on solving problems and increasing the efficiency of checking the student lists with face recognition methods, in facial recognition, the face recognition technique with LBPH algorithm had been used to help the results of the examination of the list with face recognition techniques. The LBPH algorithm was high accurate in face recognition, this technique had been used in system development and discovered that the best distance to use was that it should not exceed 3 meters, and the optimum light intensity was in the light conditions that were closest to the location of the camera for detecting the most faces.

*Keywords- face recognition; OpenCV; LBPH Algorithm ;classroom ;face detection*

### 1. Introduction

Face Recognition was an application that analyses images which there was a great challenge in automation due to human limitations in terms of computation and working time, but since computers had almost the processor, the limit can be processed. Much faster than humans Therefore, face recognition techniques were applied to various systems and tasks. Such as Authentication and Identification Systems, Surveillance and Tracking Systems, etc. Many of these systems have a role in helping to make life easier. Therefore, researchers had tried to invent new systems to help increase the potential to live better and easier.

At present, many organizations have technology requirements that Face recognition for use in educational institutions for the convenience of work and the most common problem was the examination of student attendance that take quite a long time to waste time and may result in slow learning times and over-school study that causing both teachers and students to lose benefits from this activity. From the problems mentioned above, the researcher thus studied and made the system using face recognition for checking names in the classroom through an application using face recognition techniques with OpenCV and LBPH Algorithm to help reduce the time to check the list of attendees and increase the convenience of individual verification name.

### 2. Materials and Methods

#### 2.1 Local Binary Pattern (LBP)

Local Binary Pattern (LBP) was a very effective technique for storing surface properties. The basic operation of LBP was to calculate one value to represent a 3x3 pixel area using the center of the area and the value that was used to calculate. The result was in the form of a binary pattern which could be converted into a histogram to show the surface properties of the image as shown in Figure 1.

3 x 3 Pixel Data	Threshold	Weight
8 5 2	1 0 0	1 2 4
9 5 4	1 1 0	128 32 8
1 7 6	0 1 1	64 32 16

Pattern = 10110001  
LBP = 128 + 32 + 16 + 1 = 177

Fig. 1 LBP Basics

Next, LBP was developed to be more efficient by adjusting the working pattern into a circle making it more flexible to use. This method had added two variables, namely, P, instead of the number of positions around the center, which might have 8 points or 16 points per 1 center point and Variable R was the radius between the position P and the center of the circle as shown in Figure 2.

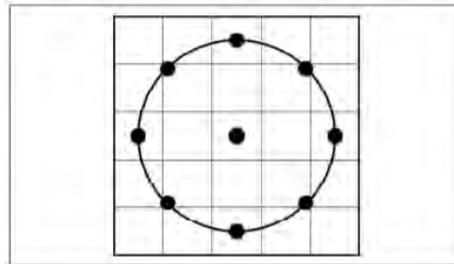


Fig. 2 Circular LBP when P = 8, R = 2

Preview the circular LBP, P = 8, R = 2, or LBP (8,2), which if used P = 8, indicates that LBP can have 28 values representing the area from the operation. The above can be written as an equation to calculate the LBP value of each area as follows.

$$LBP(x_c, y_c) = \sum_{p=0}^{P-1} 2^p f(i_p - i_c) \tag{1}$$

When (xc, yc) instead of the position of the interested pixel was equal to ic, ic represented the value in the surrounding pixel, the interested pixel (xp, yp) had the total number of P points in equation 2

$$\begin{aligned} x_p &= x_c + R \cos \frac{2\pi p}{P} \\ y_p &= y_c - R \sin \frac{2\pi p}{P} \end{aligned} \tag{2}$$

And x represent functions as shown in the equation 3

$$f(x) = \begin{cases} 1 & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases} \tag{3}$$

From equation 1, each LBP value could be calculated and the weight obtained from the research on Face Recognition with Local Binary Pattern [1] had been applied Chi-Square Statistic to determine the weight of each area.

The blur, brightness, resolution and light are a major problems in face recognition. A better system was introduced with a minimum resolution of 35px to identify faces in different angles to track faces during movement of people by designing a data set for training and classification by using a the Local Binary Patterns Histogram (LBPH) algorithm architecture to specify real-time human face recognition at low resolutions.

## 2.2 Image Partition Operation

Image Partition Operation will be responsible for dividing the image into M x N size area. In this research, the image was divided into 3 x 3 sizes the floor will be taken through the LBP process and the next weight value was shown as shown. Figure 5 Show image breaks to apply to LBP procedures[8].

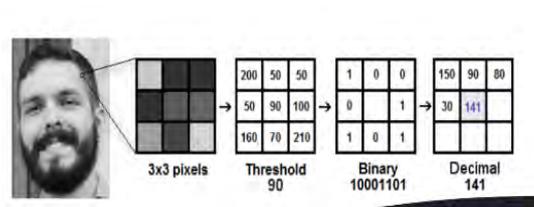


Fig. 3 The face image is divided into 3x3.

### 2.3 Face Detection

Face recognition or face detection, work processes using computer applications that capture digital images of individual faces that taken from a video frame or images and compare with the images in the database of the stored records Face recognition describes bio metric technology that attempts to create a person’s identity[9].

### 3. The proposed method

Face recognition that was used in this research was a face recognition that was suitable for straight faces. Then, it could be used to improve the performance to be able to recognize many faces, starting from the step of adding the base face database the data used in this research consists of a database students who come to work in Taiwan 15 people, which require that the face image used in the research is gray (Grayscale) with size 155x155 cells by working procedure.

#### 3.1 Application

Application functionality was a device that was used to import data and display results. Users will take pictures and send pictures to the server. To process once the processing was complete the user could view the results through the application. This project had developed software of applications. With the following features.

*Software:*• Operating system: API 20 Android 4.4 W

- Min SDK Version: 20

- compile SDK Version: API 28: Android 9.0

*Device :*The equipment used for testing applications was as follows.

- Emulator Devices: Nexus 5x API 24
- Mobile Devices: OPPO F1s API 22 Android 5.1
- Mobile Devices: Samsung API 24 Android 7.0

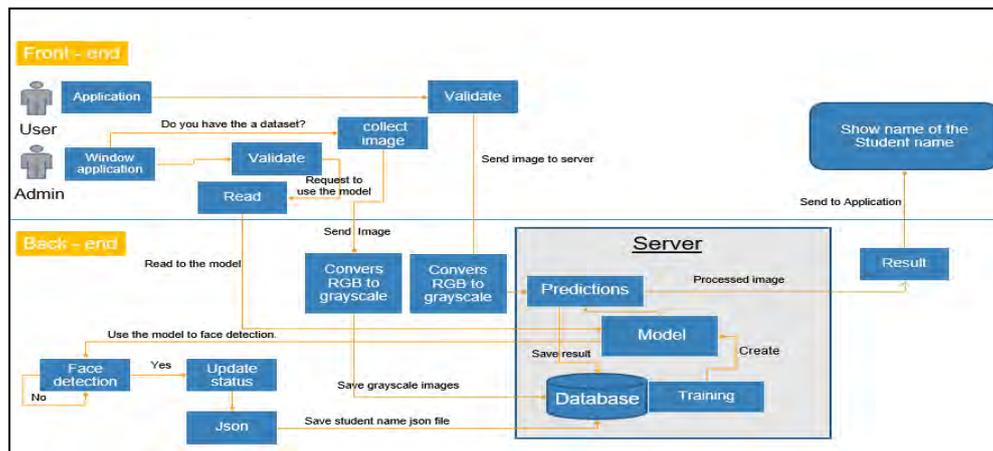


Fig. 4 System Overview

### 3.2 Collecting of Face Data

Images collecting was responsible for storing data sets through computers by allowing the system administrator to manage which will allow the user to fill in information such as the course title, course code and group of classes. From there, the program will have 2 options to accept student names, student ID that 1) select Excel file and 2) enter data by yourself. After that, 600 pictures will be taken by using the webcam camera when shooting all the students, the system will train and create a model for recognition in each class.

### 3.3 Cleaning dataset

The process in dealing with images that are blurred and unavailable by converting images into 3 x 3 kernels then used the variance (Standard deviation) for calculating and comparing with the criteria set here was 100 cases of calculating the variance and exceeding the threshold the result will be a working image. In the case of calculating the variance less than the threshold the result will be an unusable image and allow the program to select only saved images.

### 3.4 Predictions

This process that predictions for results to be displayed by forecasting using the model training image already used to forecast images sent from applications. Images sent from the application will be converted into black and white (Grayscale) before being forecast every time. After verify, the students' names will be checked and saved in the Jason file.



Fig. 5 Picture not available .



Fig. 6 Picture available.

### 3.5 Show result

Users could choose subjects and dates that had already been checked for names from the student's name table and the date in which the table will indicate which students were attending and not attending.

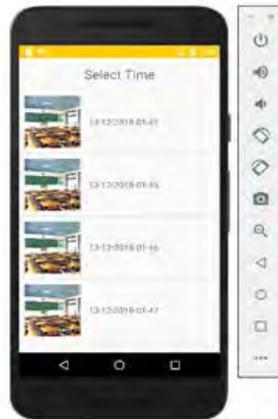


Fig. 7 Choose the date



Fig. 8 the results of the name check

### 3.6 System Server

Development in this research, the server was developed to be able to integrate with the face detection program and applications to be more efficient. The server has the following functions and features:

- Language: Python.
- Protocol: TCP / IP
- Format: Client / server (Infrastructure mode) IEEE 802.11 wireless network standard.
- Data encryption: Base64 for send file.
- Data encryption: utf-8 for send message.
- Send data via socket.

*Environment:* In this research, the server was developed and used on the device with the following features:

- Operating System: Windows 10
- Processor: Intel (R) Core (TM) i7-5500U CPU @ 2.40GHz
- Installed memory (RAM): 8.00 GB
- System type: 64-bit operating system, x64-based processor.
- Pen and Touch: No Pen or Touch processor is available for this Display.

## 4. Results

### 4.1 Results and results analysis.

Results from the test of the performance of the face recognition rate, which we use different models as shown in the table below.

Table 1. Results of face recognition rate performance tests using different models

Distance(meter)	Accuracy			
	LBP(1,5,5,5)	LBP(1,6,6,6)	LBP(8,1,5)	LBP(8,1)
Less than 2	79.72 %	85.00 %	79.72 %	63.33 %
2-3	65.33 %	80.11 %	65.33 %	80.31 %
More than 3	56.94 %	42.35 %	56.94 %	68.93 %

From the table1, we had chosen to use Model LBP (1,6,6,6) in the system because it was a model that provided high accuracy in the working distance less than 3 meters, which is the distance that the program could work well.

### 4.2 Testing of system capabilities in conditions the intensity of the light is different.

The experiment begins with determining the environment. Inside the room is 3 conditions:

- Very bright conditions by opening all lights in the room which is the same status as the data store
- Medium brightness conditions by just turning on the light half of all
- Low brightness conditions by turning off all lights in the room



Fig. 9 Illuminated preview images from left to right.

Table 2. Test results in different lighting conditions

Environments	Accuracy
High intensity	85.00 %
Middle intensity	75.00 %
Low intensity	14.60 %

The results of the experiment by identifying in very bright conditions will have the highest accuracy, while moderate lighting and low light conditions will provide similar accuracy due to the extreme brightness

conditions that were bright same as the state of recording images as a test set so resulting in a more accurate binary pattern of the detected face image in the two remaining conditions in the remaining two conditions when turning off some or all lights. The detected faces were mostly obscured by shadow, causing the binary pattern of the detected face to be different from the binary pattern. Images in the test set do not able to identify the right person.

#### 4.3 Testing the ability to detect faces at different distances

- Inspection on the front in 1-meter distance, by the tester walking away from the camera within 1 meter
- Inspection in front of 2 meters, with the tester walking away from the camera within 2 meters
- Checking in front of 3 meters, with the tester walking away from the camera within 3 meters



Fig. 10 Results of face detection from the camera image in the distance of 1 meter, 2 meters and 3 meters

The results of the 1-meter face detection test are the most accurate in identification. Face detection in the distance of 2 meters and 3 meters will be less accurate. Due to factors in storing data sets in each phase and the brightness of that environment is a variable that can make remote face detection less accurate

From this experiment, it can be concluded that to increase Correct in the identification of the student monitoring system at attend classes with facial recognition. Images made in the test set should be images taken in close light conditions with the location where the camera is installed for detecting the most faces because the light that hits the face will have Relating to precision. In addition, should be done and save pictures in areas where there was no shadow to obscure the characteristics of the face. Because it will cause the binary pattern to be distorted, resulting in precision to check.

The problem of forgetting to check attendance students did not hear when they are called. Crossing the name and wasting a lot of time in examining the study, this research had developed a system for checking students to attend. Face recognition methods to reduce such problems and developed systems have adopted the OpenCV library to detect and identify identity.

## 5. Conclusion

This research used by the LBPH recognition technique. It was accurate to use high face recognition in developed systems. In addition, the best distance checking experiments were conducted which was not more than 3 meters and testing for the optimum light intensity of the system from the experiment, it was found that the images used to make the test kit should be images taken in the light conditions that were close to the location of the camera for detecting the most faces which could increase the accuracy of identifying the system. The next thing to develop in this research is to improve the identification technique to be able to identify precisely without the effects of light which may apply knowledge in deep neural networks will make improvements. The method of detecting faces at a continuous time, in the case of detecting multiple faces in one frame, has a false grouping mechanism due to switching positions, which may lead to the direction of the person's journey to use and decide the group. In addition, there are plans to supplement system capability which can be retrieved in the past and summed up the results statistics and report formats.

## Acknowledgment

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# Calibration of 3D Sensors for Interactive AR Face Makeup System

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## Abstract

In this paper, we present a calibration process of 3D sensors such as Kinect and Leap Motion for an interactive AR face makeup system. In order to apply the virtual makeup effect onto the users face, we obtain the 3D fingertip position from Leap Motion and estimate the corresponding facial position from the collision of the 3D fingertips and the 3D facial mesh obtained from Kinect. Our calibration method provides the natural makeup interaction to the user.

**Keywords-** *Virtual makeup, Kinect, Leap Motion, Augmented reality, HCI*

## 1. Introduction

In the traditional shopping system, a customer decides to buy a product of interest by visiting a store and trying the products by putting on to themselves like sample clothes or cosmetics. However, as the rapid improvement of VR (Virtual Reality) and AR (Augmented Reality) technology, a customer can decide one's intention of purchasing a product without visiting a store. Furthermore, many HCI (Human-Computer Interaction) related researches are improving over the past decade, and these researches are making various approaches in areas such as face makeup, training, medical, clothing. AR makeup system with a virtual mirror can help users test cosmetics at anytime and anywhere, and purchase desired cosmetics for them. AR face makeup system uses the augmented object without using actual cosmetics and applies the makeup, desired by the user to their face in real-time. Most people use their hands or brushes as make-up tools and one of the most desirable tools is their hands as they usually use their fingers to put cosmetics. To perform such a task, a delicate interaction between the face of the user and the finger is required. However, existing finger detection techniques have some error. To organize an immersive AR makeup system, it requires a very precise interaction and suitable visualization technique. This paper aims to design an interactive AR face makeup system through precise calibration error optimization techniques and interaction with users. We use Kinect by tracking the user's face and Leap Motion to recognize and locate the precise finger joints. However, since Kinect and Leap Motion use different coordinate systems, Kinect- Leap Motion multi-view calibration is done to integrate the coordinate system. Additional matching is performed using the corresponding fingertip of the user simultaneously detected in the Kinect and the Leap Motion and correcting the calibration error which allows a more delicate interaction with the user's hand.

## 2. Related work

For interactive AR makeup system that accounts for coordinate integration between two heterogeneous 3D sensors and immersive AR makeup system, related works can be defined as coordinate mapping from a 3D sensor to the other, and visualization of superimposition of suitable effect on the user's face.

**Coordinate mapping:** Jang et al. suggest a two-phase calibration method for user viewpoint matching on half-mirror basis, and corrects errors of projected objects by matching tracker, user's viewpoint and display [1]. For the calibration of Kinect-Leap Motion, a rigid-body transformation can be estimated from user's fingertip positions in each 3D sensor coordinates [2][3]. Furthermore, for hand gesture recognition, Kinect's depth sensor and Leap Motion coordinate calibration are performed using the fingertip position [3].

**Superimposition on the user's face:** Since the light emitted from the display is attenuated as it passes through a half-reflective mirror, a color correction is required for improvement of color attenuation. The proposed AR makeup system [4] based on [1] use the landmark of the face to find the exact location of the makeup, and the color feedback set to correct the color of the mirror. In [5], Deep Localized Makeup Transfer Network automatically recommends the makeup that is most suitable for the user and creates an image with makeup

applied to the user's face. In this case, the system provides a plausible natural makeup result, but only the specified make-up is applied. As an example of using Kinect, a makeup tool with a marker is developed as an additional device, and virtual makeup is applied to the user's face using the marker position [6]. As for applying makeup, the paper [7] created additional objects and painted textures.

In this paper, propose an AR facial makeup system that can obtain more accurate finger coordinates by using the corresponding fingertip transformation relation to correct errors of registration obtained through the Kinect-Leap Motion multi-view correction. Therefore, it is possible to provide a system that enables precise interaction with users by obtaining more accurate finger coordinates through the Unity Engine.

### 3. Interactive AR makeup system

The proposed interactive AR makeup system is consisting of two main parts; one is an off-line process of Kinect-Leap Motion calibration for high precise user interaction, and the other one is a real-time interactive AR makeup system with fingertip interaction. In the former process, the system estimates a transformation matrix from Leap Motion coordinate system to Kinect coordinate system by minimization a sum of rigid-body transformation error. In the other process, the system is initialized through texture mapping a pre-generated face texture map by 3ds max on the user's 3D face mesh obtained from the Kinect. After initialization, the proposed system provides an interactive AR makeup system with an accurate and precise use interaction to recognize user's fingertips.

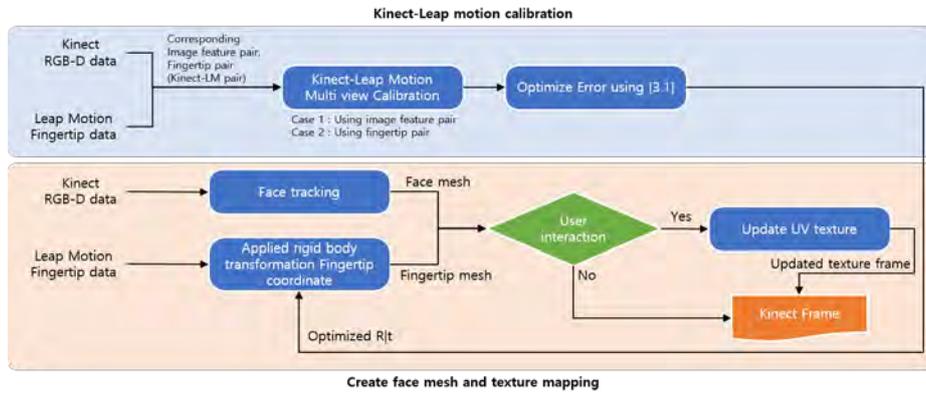


Fig. 1 System architecture

#### 3.1. Kinect-Leap Motion calibration

As mentioned in Sec. 1, hands are one of the most familiar interaction tools in makeup system. So, the proposed system takes Kinect and Leap Motion for user's face tracking and visualization of superimposition AR scene on user's face, and high precise user's hand tracking, respectively. Therefore, we need to integrate each coordinate systems by estimation of a 3D rigid-body transformation matrix, which consists of  $3 \times 3$  rotation matrix  $R$  in  $SO_3$  group and  $3 \times 1$  translation vector  $t$  in  $SE_3$  group, from Leap Motion coordinate system to Kinect coordinate system as described in [3d rigid-body] through multi view calibration. We use chessboard marker image of Leap Motion's raw image and Kinect's RGB-D image. Then, the corners of the corresponding chessboard were matched using pair information and rigid body transformation was performed using the obtained  $R$  rotation matrix and  $t$  translate vector. And Fingertip positions through rigid body transformation can be defined as  $\mathbf{x}_i = [x_i, y_i, z_i]^T, i = 1, \dots, n$  in Leap Motion coordinate system and  $\mathbf{x}'_i = [x'_i, y'_i, z'_i]^T, i = 1, \dots, n$  in Kinect coordinate system. From a given fingertips position in coordinate system of two 3D sensors, the system estimates a rigid-body transformation that minimizes the objective function of as described in (1).

$$[R|t] = \operatorname{argmin}_{\hat{R}, \hat{t}} \sum_{i=1}^n \left\| \mathbf{x}'_i - (\hat{R}\mathbf{x}_i + \hat{t}) \right\|_2 \quad (1)$$

To find out  $R$  and  $t$  subjects to (1), we can easily make the corresponding fingertip position between Kinect and Leap Motion scenes from pre-knowledge of human body structure. From the corresponding fingertip positions, the system calculates the covariance matrix  $A$  as described in (2).

$$A = \frac{\sum_{i=1}^n (x_i - \bar{x})^T (x'_i - \bar{x}')}{n} \quad (2)$$

Where  $\bar{x}$  and  $\bar{x}'$  are the mean position of fingertips in Leap Motion and Kinect coordinate system, respectively.

In order to estimate a 3D rotation matrix  $R$ , we factorize the covariance matrix  $A$  as  $UDV^T$  as known SVD (Singular Value Decomposition).  $U$  and  $V$  are  $3 \times 3$  orthonormal matrix and  $D$  is a  $3 \times 3$  diagonal matrix.

Therefore,  $R$  can be obtained by multiplication of  $V$  and the transpose of  $U$  as  $VU^T$ . Once  $R$  is estimated, a translation vector  $t$  can be found out as  $\bar{x}' - R\bar{x}$ .

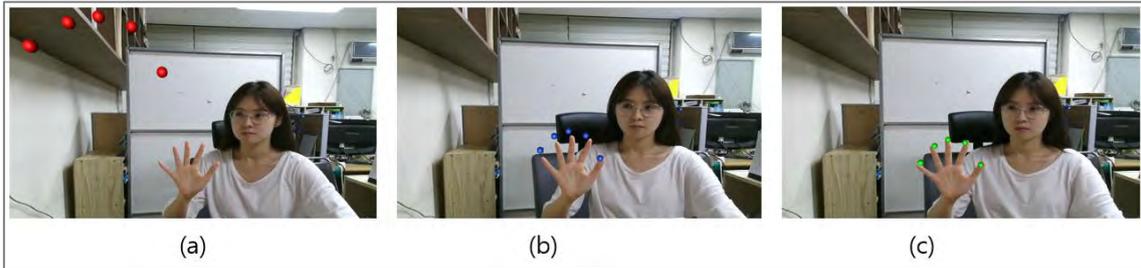


Fig. 2 A Kinect-Leap Motion calibration result (a) Image without calibration (b) Multi-view calibration result (c) Multi-view and fingertip calibration result

### 3.2. Create face mesh and texture mapping

Kinect v2 provides 1347 human face points, and we used them to create 3d face meshes (Fig. 2 (a)). Then, in 3ds max, the three-dimensional coordinate of the face mesh was unwrapped into a two-dimensional UV map (Fig. 2 (b)). We created a face texture map using a UV map and mapped it to a face mesh to make it possible to make up in real-time. The application of the makeup uses the collision determination between the user's finger and the face mesh. The 3D coordinates of the collision are transformed into the coordinates of the two-dimensional UV texture map, and the color is centered on the coordinate. Fig. 2 (c) shows the user image with makeup through the UV texture map. Unlike the [7], we directly access the UV texture map of the mesh without creating additional color objects.

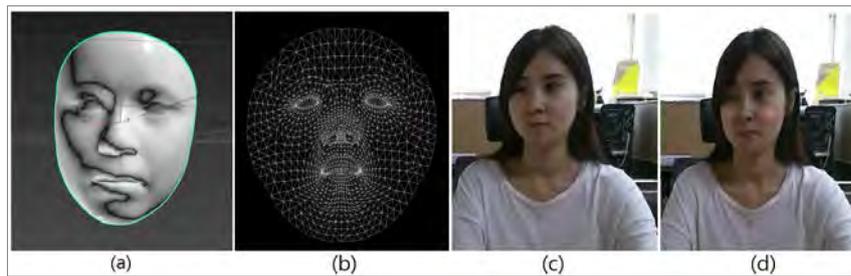


Fig. 3 (a) Face mesh created with unity (b) Face UV map in 3ds MAX (c) 3d image without makeup texture (d) 3d image with makeup texture(Cheek is colored)

### 3.3. Makeup

Fig. 4 shows the result of applying makeup. Since people tend to use index fingers when doing actual hand makeup, makeup is applied only when the index finger touches the face.



Fig. 4 Result screen with makeup applied (a) Basic makeup applied (b) Makeup to the position of the left-hand index finger (c) Makeup applied by the user on the right cheek (d) Screenshot from different angles

## 4. Experiments

As a result of calibration, we can obtain the coordinates of each fingertip. We used the position of the fingertip found in the Kinect as the ground-truth value and calculated the error of the ground-truth and the

position of each fingertip transformed rigid body. There are three types of errors: Average of Euclidean distance for five fingers (E.D), variance (V), and standard deviation (S.D).

Table 1 shows the error values based on 5 frames when all five fingers are correctly recognized in Kinect. The paper [2] used as ground-truth has high accuracy when the hand is properly recognized, but has very low accuracy when the fingertip's continuous motion is required. Therefore, additional experiments on continuous motion are required.

Table 1. Errors according to calibration type

Frame	multi-view calibration result			our calibration result		
	E.D	V	S.D	E.D	V	S.D
1	0.14171	0.00094	0.03070	0.09791	0.00088	0.02970
2	0.13076	0.00076	0.02753	0.08631	0.00072	0.02680
3	0.13843	0.00075	0.02732	0.09416	0.00071	0.02672
4	0.14034	0.00053	0.02297	0.09644	0.00059	0.02429
5	0.14835	0.00050	0.02233	0.10252	0.00047	0.02175

Table 2. The mean of each error

	E.D mean	V mean	S.D mean
multi-view calibration	0.13992	0.00069	0.02617
our calibration result	<b>0.09547</b>	<b>0.00068</b>	<b>0.02585</b>

## 5. Conclusion

These virtual makeup systems are frequently used in mirror-based systems, which are rapidly increasing in recent years. We have made possible the more precise user interaction through the results of the study. However, it is not yet applied to the accuracy correction technique for the face of the user, so further research is required. In the mirror-based system, we know that the immersiveness decreases according to the viewpoint of the user, and the fatigue of the eye due to the focus increases. Therefore, we will further study based on the paper [1].

## Acknowledgment

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# Research on Sustainable Design Based on Analysis of Sustainable Packaging Cases

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## Abstract

This research collected sustainable packaging cases and classified them into seven sustainable concepts. By analyzing their design patterns and methods, the design strategies of each sustainable concept were discussed and abstracted. In combination with different stages of packaging production, transportation, usage and abandonment, various design strategies are allocated to the stages that they would be applied. Finally, the research summarized the map of sustainable design strategies, as a guideline and reference for the afterwards sustainable packaging design.

**Keywords-** *sustainable concept; packaging design; case analysis*

## 1. Introduction

According to the survey of Ocean Conservancy, among the top 10 items collected from the ocean, 9 of them belong to varieties of packaging, by 2050 there would be as much plastic as fish in the oceans based on current trends. **Error! Reference source not found.** Based on this background, the purpose of this study is to reduce the negative impact of packaging on the environment by improving packaging design.

35 cases of sustainable packaging were collected and arranged in two vectors as figure 1, includes structural innovation and material innovation. According to the characteristics of packaging cases, this research abstracted and summarized the related sustainable concepts for packaging design, such as “3R (reduce, reuse, recycle)[1]”, “Up-cycling”, “Edible”, “Local resource” and “Degradable”. Ultimately, a map of sustainable concept for packaging design was advanced as result of this research.



Fig. 1 Concepts of sustainable packaging cases

## 2. Analysis of sustainable packaging cases

### 2.1. Concept of “Reuse” for sustainable packaging

From sustainable packaging cases with the concept of “Reuse” as table 1, three design rules were summarized as below:

Firstly, the packaging was functionally complementary to the usage experience of product. In order to be better realization of product function, the packaging was designed to be reusable and multi-functional according to product usage scenarios. As the third case above, the bulb packaging could be unfolded and used as a lampshade in period of bulb using.

Secondly, participation in wasted packaging-transforming is an important factor for implementing reusable packaging. Users could disassemble, cut, reorganize, assemble and fold the packaging according to the indications printed on it. The indications could be dotted lines or a simple production process, so that users know how to transform packaging into useful and new functional product. "Never Waste Bag" is one of the cases that can be cut and reshaped as practical or funny items such as calendar, bookmark, pen container, ruler, dice, etc. In this way, the process of DIY by customers themselves would enhance the emotional attachment between user and packaging, and the exciting shopping experience maintains through reusing the items made from shopping bag. [3]

Thirdly, the packaging could be designed to be cognizable for its eco-friendly brand and image by modeling shape or printing sign and pattern. In this way, the sustainable packaging will encourage users to form sustainable behaviors and provide users with sustainable life style. For example, the packaging of Joco cup was designed to be reusable as various functional containers and its usage instructions were printed inside the cap, in order to encourage consumers to continually use the packaging.

Table 1. Packaging cases with concept of “Reuse”

No.	Figures	Description	References
1		“Never Wasted” shopping bag designed by Happy mcgarrybowen can be used and reused in 28 different ways, which would keep the customers engaged and excite them long after they’ve left the store.	Happy mcgarrybowen (www.happymcgb.com)
2		Lemnis light bulb packaging can be reused as lampshades as well as increasing the value of the commodity itself.	Celery design (www.celerydesign.com/work/packaging/lemnis)
3		The packaging of Joco cup was designed to be reusable as a fresh coffee keeper, a pen holder, piggy bank or a snazzy drink bottle holder, and the instructions of reusing were printed on cap.	Joco (jococups.com)
4		The object called “Dream ball” consists of a cylindrical container for the delivery of aid packaging, can be made into a football by children in developing countries.	Unplug Design (unplugdesign.com)

## 2.2. Concept of “Reduce” in sustainable packaging

Table 2. Packaging cases with concept of “Reduce”

No.	Figures	Description	References
1		The new Puma shoe packaging “Clever Little Bag” reduces 65% of cardboard using and 10000 tons emission of carbon dioxide, saves 8500 tons of paper and 20 million megajoules of electricity.	Puma (stylefrizz.com/201008/pumas-smartest-shoebox-ever/)
2		The carton packaging of toothpaste was designed to reduce the two-tier packaging and its wedge-shaped carton design can save a lot of space in transportation for further saving costs.	Sang Min Yu and Wong Sang Lee (www.patent-cn.com/2011/07/21/55030.shtml)

According to packaging cases collected in table 2, the concept of “Reduce” mainly concentrates on four aspects, including reduction of using material, reduction of space for transportation, reduction of energy consumption and reduction of waste emission. As the most representative packaging case with concept of “reduce”—“Clever Little Bag”, from Puma, which not only save 65% of cardboard using, but also reduced emission of carbon dioxide and consumption of electric energy.

### 2.3. Concept of “Recycle” in sustainable packaging

As for the packaging cases with concept of “Recycle”, they have the following three design rules in common. Firstly, the production of packaging should avoid using attachments like glue or nails to fasten the packaging structure. For example, the packaging and bottle labels of “Plant’ it Earth” brand hold themselves together with interlocking tabs rather than using adhesives. So, the discarded packaging will be easier to classified and recycled. Secondly, the structure of packaging should be easy-separation and disassembly. Thirdly, the types of material used in the packaging should be minimized. Combining these three common points, the wasted packaging will be easier to sort and classify, so that the concept of “Recycle” will be more feasible to achieve.

Table 3. Packaging cases with concept of “Recycle”

No.	Figures	Description	References
1		Colourform, a renewable, recyclable and colored molded fiber packaging will naturally biodegrade when it ends up in the landfill.	Colourform ( <a href="http://www.colourformpackaging.com">www.colourformpackaging.com</a> )
2		Plant’it Earth invented a paperboard packaging for organic fertilizer, their boxes and bottle labels hold themselves together with interlocking tabs rather than using adhesives.	Plant’ it Earth ( <a href="http://www.behance.net/gallery/394270/Plant-it-Earth-Identity-Packaging">www.behance.net/gallery/394270/Plant-it-Earth-Identity-Packaging</a> )

### 2.4. Concept of “Up-cycling” in sustainable packaging

The concept of “Up-cycling” is not as popular as other concepts applied in packaging design. Packaging with concept of “Up-cycling” tended to feature with simplified structure and easy-forming with feasible and efficient production process.[4] Otherwise, the packaging would become an artwork and increases the cost of production.

Table 4. Packaging cases with concept of “Up-cycling”

No.	Figures	Description	References
1		Marian Obando designed this egg packaging carton by filling eggs with newspapers, and wrapped them in recycled paper concisely printed with product information.	Marian Obando ( <a href="http://www.shinerayad.com/news_info.asp?id=2461">www.shinerayad.com/news_info.asp?id=2461</a> )

### 2.5. Concept of “Edible” for sustainable packaging

Table 5. Packaging cases with concept of “Edible”

No.	Figures	Description	References
1		Colorful, edible cup and straw produced by Loliware in New York, is made from natural gum and sugar cane juice, with different natural colors.	Loliware ( <a href="http://www.loliware.com">www.loliware.com</a> )
2		The cup-shaped cookie created for Lavazza, lined with a delicious sugar coating to keep the coffee in it. So consumer can chew the cup and waste nothing.	SARDI Strategic Design ( <a href="http://www.sardi.com/lavazza_food_design_expert_consultant_cookiecup_turin_italy">www.sardi.com/lavazza_food_design_expert_consultant_cookiecup_turin_italy</a> )

Edible concept of food packaging design is a new trend in sustainable packaging design. The prerequisite of this implemented concept is using edible material. For example, the forming material of packaging is natural gum or algae which could be digested by people and harmless to peoples' health. Additionally, the edible packaging is able to maintain its form when it is used as container function. In the case of cup-shaped cookie, producer lined a sugar coating in the cup and ensures the coffee would not melt the cookie during drinking. Finally, the packaging looks appetizing in appearance. The edible cups and straws from Loliware are made with different natural colors flavors, which are appetizing and provide customers with choices of their favorite tastes.

### 2.6. Concept of “Local resource” for sustainable packaging

Table 6. Packaging cases with concept of “Local resource”

No.	Figures	Description	References
1		This packaging is designed for a famous Thai grapefruit in Chainat province and made of water hyacinth, which is a local plant found in an area of product's origin. The packaging is produced by local people who excel in handicraft without relying on manufacture.	YOD corporation (www.yodcorporation.com)
2		The “Potato in potato” packaging is made of peel of potato, which can be bonded and hardened into the cone shape. After being used, the peel packaging can be reintroduced to the biological cycle to become animal food or fertilizer.	Simone Caronni, Pietro Gaeli, and Paolo Stefano Gentile (www.yankodesign.com/2018/09/10/potato-in-potato-packaging/)

Concept of “local resource”, exactly as the case above, means that the source of packaging is in same place as the producing area of the product. Packaging of grapefruit is made from water hyacinth, a local plant found in an area of product's origin. And in the other case of this concept, the packaging is by-product from the production. As the “Potato in Potato” packaging, the peel of potato was bonded and hardened into the cone shape which can hold potato chips.

### 2.7. Concept of “Bio-degradable” for sustainable packaging

Table 7. Packaging cases with concept of “Bio-degradable”

No.	Figures	Description	References
1		The paper of the Eco-Bag contains built-in seeds of various plants. Wherever users throw it away, it will disintegrate after rainfall and turn into a beautiful lawn of grass, chamomile or clover.	DEPOT WPF (www.depotwpf.com/publications/212)

Recently, with the rapid development of bio-degradable material, the concept of “Bio-degradable” was beginning to be applied in sustainable packaging. The material of packaging is bio-degradable and harmless to natural. As the above case of Eco-Bag, it was designed to be bio-degradable and visualized by growing plants with built-in seeds, which provides consumers eco-friendly experience.

## 3. Sustainable design strategies for packaging

Based on the previous case analysis, 18 design principles from 7 sustainable concepts were summarized for sustainable packaging design. These 18 design principles can be used as design strategies for future sustainable packaging. Referring to Matrix proposed by Keoleian and Menere, the life cycle of packaging can be divided into five different stages, sequentially including production, transportation, usage, recycle and elimination. [5] According to the five stages of packaging life cycle and two design innovation directions, 18 design strategies were classified into the map established as figure 2.

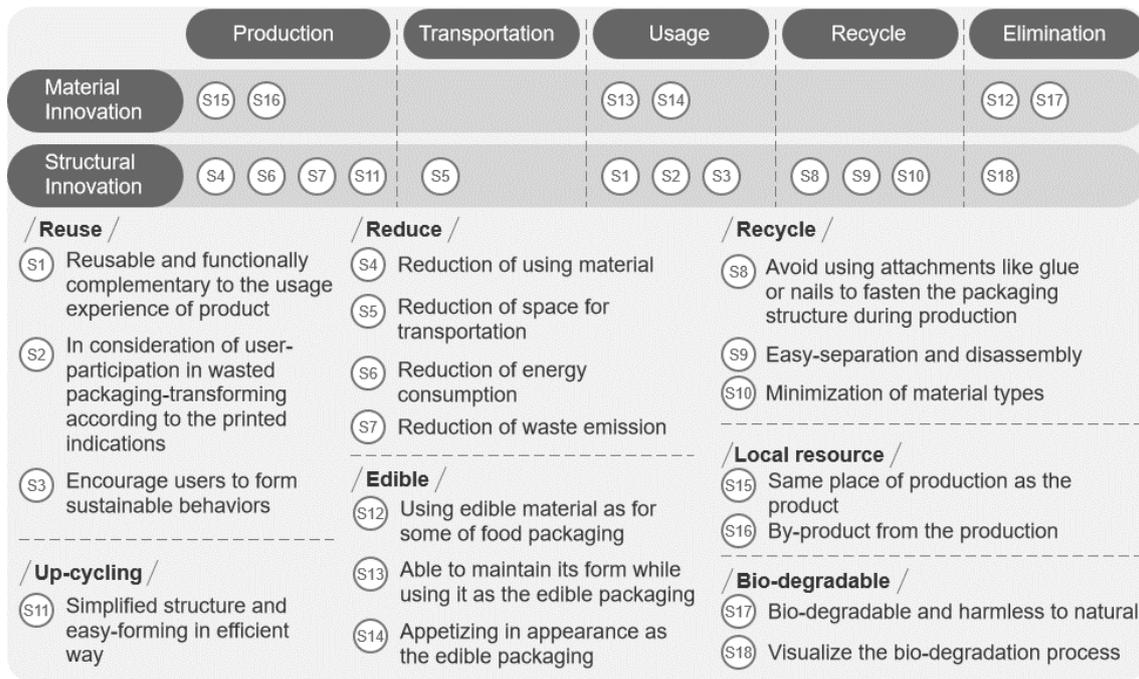


Fig. 2 Map of sustainable design strategies for packaging design

## 4. Conclusion

The sustainable design strategies introduced in this paper are synopsis of the methods and tools used in each sustainable concept, aiming to make the packaging minimizing environmental impact from perspectives of production, transportation, usage, recycling and elimination. Thus, the map of sustainable design strategies for packaging was proposed and would be improved continually in further research, with expectations to be applied in other sustainable design cases.

## Acknowledgment

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# **Analysis of Design Preference Using 3D Technology -Focused on the Design of Highway Slope-**

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## **Abstract**

With the recent development of 3D technology, the company has been utilizing the 3D technology in the field of design. In particular, 3D technology is changing design method. Therefore, in this study, 3D technology was used to analyze design preferences for the highway slope landscape. These studies could provide theoretical basis for landscape design of slope and barrier in highway.

***Keywords-component; 3D Technology; Digital Program; Design Preference; Highway Slope***

## **1. Introduction**

With the recent development of 3D technology, the company has been utilizing the 3D technology in the field of design. In particular, 3D technology is changing design method. Therefore, in this study, 3D technology was used to analyze design preferences for the highway slope landscape. Due to economic development in China and other parts of Asia, many highways were built to expand transportation. In particular, due to the large number of mountainous areas in Northeast Asia, there will be many slopes for road construction. However, road construction causes a collapse of the slope. So, this development is causing serious problems of national territory and ecological system destruction. Recently, there has been a growing interest in the design of highway slope. However, there is a lack of research on the design of slope landscape compared to other facilities inside the highway. However, most slopes are very large in area and are easily exposed to view. Therefore, it is necessary to improve the landscape of slope, taking into account the emotional aspects of human beings. Therefore, based on 3D simulation technology, the slope is analyzed for the effect of landscape on the road landscape. These studies could provide theoretical basis for landscape design of slope and barrier in highway.

## **2. Research methods**

### **2.1. Selection of research scope and background landscape**

In this study, the visual preferences of road landscape were analyzed according to the type of slope. First, Photography for background was conducted for about six months from April 2018 to October 2018, and the location for photography was a mountainous highway in Korea. A total of 50 photographs were taken during the 20 sessions of this study. And when taking photos, the viewpoints were selected as landscape views that could be seen from the shape and texture of the slope. The lens of the camera was used to take into account the range of view and viewing angles. Five photos were selected in this study. Then, a preliminary questionnaire was conducted using a total of five photos. The assessment group randomly sampled a total of 30 students among graduate students who could understand the landscape. The preliminary survey asked the assessment group to select one photo that could represent the road background landscape. One photograph with the highest frequency of selection was selected in the preliminary questionnaire. The final landscape selected from this preliminary survey is as follows (Figure 1).



Fig. 1. Background Landscape

## 2.2. 3D landscape simulation

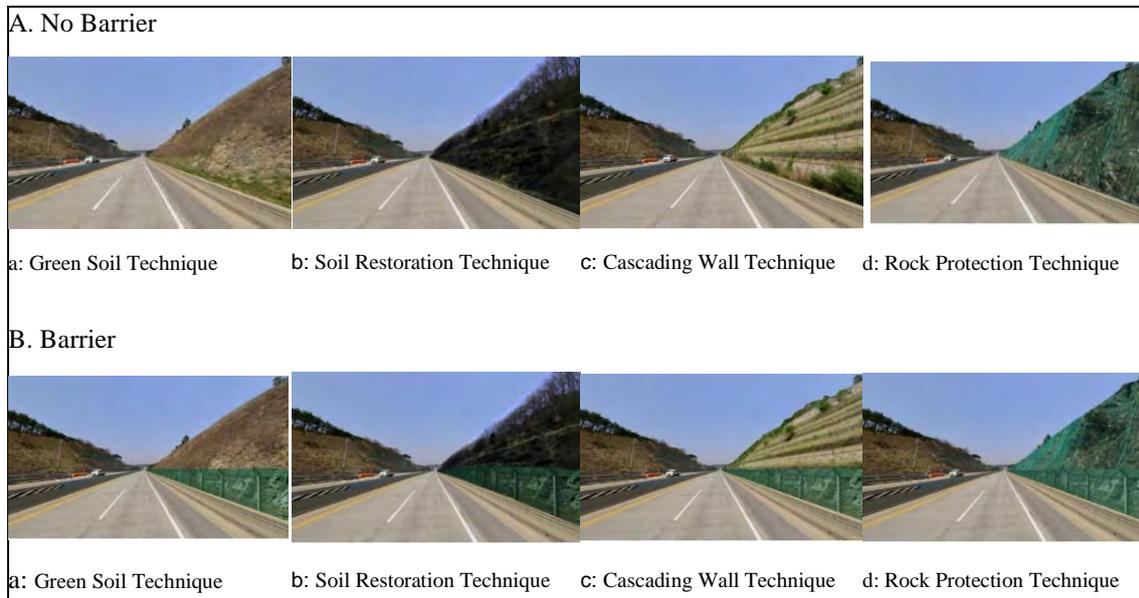


Fig. 2. 3D landscape simulation

In order to enhance realism as much as possible, the slope landscape used various computer programs such as Adobe Photoshop CS (Adobe System, 2003), Auto-CAD (Auto Desk, 2005), and Google Sketch-UP (Google Inc., 2007). In addition, the type of slope surface of this study was selected based on a review of the feasibility of construction by experts who graduated from civil engineering. In this study, the types were divided into two groups according to the installation of the barrier. Each group was then divided into four types according to the type of slope. The landscape of this study was divided into eight types. In addition, the shape of the slope is based on the design drawing of the slope. And, all other factors that could affect the road landscape, such as materials and colors, were set up equally.

## 2.3. Survey and Analysis Method

The results of the assessment were reviewed with an emphasis on the relationship with the surrounding landscape. In addition, the survey was conducted to evaluate the landscape simulation of slope and barrier, and the subjects for the survey were 60 graduate students who could analyze the landscape. A total of five surveys were conducted for about two months from November 25, 2018 to January 24, 2019. And the size of the picture of the highway landscape used for the landscape simulation was 210×297mm. All subjects were asked to view

the photos as straight as possible when evaluating the landscape. Moreover, the evaluation time was equal to 8 second, and the visual preference evaluation used a seven-step recertification scale. The statistical analysis of the results of the survey is KESS (Seoul National University Department of Statistics). Descriptive statistics were extracted using Excel program. And preference differences by highway landscape were analyzed. Finally, for the post-test operation, Duncan's multi-scope test was carried out.

### 3. Landscape Preference by type of slope

Table 1. Visual Preferences on Expressway Landscape

Landscape		Average	standard deviation	F value	significant probability	Post-hoc a=0.05
No Barrier	Green Soil Technique	3.96	1.16	7.636	0.002	b
	Soil Restoration Technique	4.14	1.18			a
	Cascading Wall Technique	3.82	1.17			b
	Rock Protection Technique	3.66	1.22			c
Barrier	Green Soil Technique	3.88	1.23	17.324	0.001	b
	Soil Restoration Technique	4.04	1.42			a
	Cascading Wall Technique	3.78	1.17			c
	Rock Protection Technique	3.71	1.31			c

The following is an analysis of landscape preference according to the type of slope. A significant level of the resultant value of the landscape preference was found to be within 0.05. In this study, the highest level of landscape preference was the introduction of the soil restoration technique without a barrier, and the lowest level was the introduction of the rock protection technique with a barrier. Landscape with the highest landscape preference in the road view with the barrier is also the introduction of the natural restoration technique, while the lowest level of view is the introduction of the cascade wall technique.

The following was intended to determine the difference among landscapes according to the type of slope surface and the barrier through Duncan's test. The significance of this analysis has been shown to be within 0.05. First, the landscape of natural restoration technique without barriers and the landscape of soil restoration technique with barriers showed similar preferences. In addition, there were similar preferences in the introduction of green soil technique without barriers, and the introduction of green soil technique with barriers. Finally, similar preferences were given to the introduction of the rock protection technique without a barrier, the introduction of the cascading wall technique with a barrier, and the introduction of the rock protection technique with a barrier. The results of this study show that the construction of slope -side based on natural structures is superior to the construction of slope-side through artificial structures. Thus, it was shown that the type of slope play an important part in the landscape. Therefore, the type of slope and barrier installation should be considered in the construction of highways.

### 4. Conclusion

Due to the rapid economic development in Asia, many highways have been built as part of the transit network. In addition, due to the construction of these highways, a number of slope-side construction and protection walls were installed. However, such slope construction has been perceived as a negative element on the highway. Because the landscape aspect has not been considered. Thus, in order to solve these problems, a

study method and analysis of landscape design on slope and barrier in highway is required. Based on the results of this study, it was shown that the landscape preference of the highway could vary depending on the type of slope and the introduction of the barrier. Therefore, the type of slope and the introduction of barrier should be carefully considered. In this study, only one view point was evaluated visually. However, there are a variety of background views on highway landscapes. Therefore, in future studies, it will be necessary to look at the visual changes of the highway landscape according to the various background landscapes. These studies could provide theoretical basis for landscape design of slope and barrier in highway.

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# Research on Theoretical Model of YouTube Subscription Behavior

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## Abstract

At present, the existing literature research on YouTube video users focuses on the "viewing behavior" and "search behavior" of users, and lacks the analysis and research on user subscription behavior. In this paper, the author tries to establish a theoretical model to explain the subscription behavior of YouTube users, and enrich the research of YouTube video user behavior from a theoretical point of view. First, the author summarizes the concepts and categories of YouTube subscription behavior based on grounded theory. Then, the author uses the Internet Consumer Behavior Model (AISAS) to analyze and judge the relationship between the categories, and finally establishes a theoretical model of YouTube video user subscription behavior.

***Keywords***-youtube; video user; subscription behavior; grounded theory

## 1. Introduction

Discovering user behavior patterns and conducting related research based on user behavior rules has always attracted people to explore. Based on the empirical research of objective user behavior data, it is necessary and meaningful to find all kinds of characteristic quantities that can represent user behavior, and summarize the user behavior model. (Xiao Yunpeng, 2013). Research on online user behavior analysis is a hot research topic (Ren Wenjun, 2013). With the development of network technology, the scale of network video users has developed rapidly, and network video users have become an important part of Internet users. Therefore, there is more and more research on user behavior patterns (Hu Yangwei, 2018). Video sharing site YouTube is one of the most popular sites in the world. YouTube currently covers 90 countries and regions (Ryu, Kim, Lee, 2009; Shifman, 2011). Online video users have various behaviors on YouTube. However, current research on YouTube user behavior has focused on "viewing behavior" and "search behavior." Existing literature generally ignore user subscription behavior. Viewers can rate "like" or "dislike" videos and sign up for their favorite content creator channel. Whenever new content is uploaded, they will get an update. For YouTube content producers, a larger subscription base can generate millions of dollars in annual revenue (Berg, 2016). However, there is currently no systematic theoretical model explanation for the subscription behavior of YouTube video users. Therefore, this paper will try to make up for this deficiency, combine the grounded theory with the consumer behavior model, establish a theoretical model of YouTube user subscription behavior, and contribute to the research field of YouTube user behavior analysis.

## 2. The concept of YouTube subscription behavior based on Grounded Theory

User behavior analysis is mainly to obtain valuable information from massive data on the Internet (Liu Peng, 2010). From a macroscopic point of view, most researches use local data to prove the whole problem and establish the structural equation model. From a microscopic point of view, most of the literature focuses on theoretical models such as the AISAS model, using mathematical statistics for data analysis (Wang Rui, 2012). In general, the literature has rarely explained user behavior based on qualitative research. Therefore, this paper theoretically uses the grounded theory to provide a new perspective for YouTube users' subscription behavior research.

### 2.1. Open Decoding

This part of the work is mainly through Google's academic, book reading, online news and other ways to systematically organize YouTube marketing and other aspects. In addition to text materials, there are also many

YouTube channel owners to post videos, analyze how to get more subscriptions on the YouTube platform, and analyze all the collected data. Finally, we come up with 25 concepts and 8 categories about YouTube channel viewing behavior, as shown in Table 1.

Table 1. The concept and scope of open decoding

Concept	Category
Communication Process	
Consumer behavior	Short-term indicator
Content change	
Brand Value	Long-term indicator
Fan property	
Information output	
Upload frequency	Positioning result
Management fans	
Brand Promotion	
Looking for fans	
Gather fans	Exploring value
Maintenance fans	
Video content targeting	
Industry (category) targeting	Positioning concept
Brand Positioning	
Cost per Strategy	
Competition Strategy	Positioning strategy
Communication Strategy	
User (customer) Strategy	
Build up a team	
Professional	Integrate into the community
Home design	
Content design	
Time choose	Market segmentation
Share	

## 2.2. Spindle Decoding

The purpose of spindle decoding is to logically join all the categories obtained through the open decoding process into a single entity (Strauss, Cabin, 1998; Ding Jianyuan, Li Qingzheng, 2007). Open decoding is not discussed between categories. Intrinsic relationship, so it is necessary to analyze and judge the main category and subcategories (Kim Min Jung, 2018). This paper uses the Consumer Behavior Model (AISAS) to summarize the four main categories of YouTube user subscription behavior: attention, interest, search, and subscription, as shown in Table 2.

Table 2. Main category formed by spindle decoding

Category	Main Category
Positioning result Exploring value	Attention
Market segmentation Integrate into the community	Interest
Positioning concept Short-term indicator	Search
Long-term indicator Positioning Strategy	Subscription

### 3. Selective coding

The purpose of Selective coding is to logically test and complement the relationship between the main category and the sub-category derived from open decoding and spindle coding to construct the final model. Kurt Hugo Schneider's music videos for Coca-Cola are based on a variety of Coca-Cola bottle-based instruments, hanging bottles of percussion, playing, and mixing with the violin music, giving users a new understanding, video on the YouTube platform it attracted a lot of fans soon after it was launched. Blendtec regularly posts short videos on its YouTube account, use its brand of the blender to shred all kinds of items, and use the impact of video to emphasize the practicality and durability of the products. These videos have made Blendtec get 500%~ 700% of orders increased and the conversion rate increased to 70%. Kelly regards "TheKellyYang" as an independent brand operation, focusing on "Life Style Choice", no longer limited to beauty videos, the audience can see life-related content on this account. She got a lot of fans by sharing her life and letting users experience a different lifestyle. Attempts to resolve hypothetical contexts or interrelationships in various categories, such as causality, progressive relationships, and contextual associations (Glaser and Strauss, 2006). Before uploading a video, YouTubers need to clearly define their own work and develop strategies from the perspective of cost, competition, etc., in order to expect the number of subscriptions that may be reached. When video producers upload video, it is necessary to observe the growth of the number of fans from short-term goals, long-term goals and other aspects, so as to adjust the strategy. In the traditional consumer behavior pattern, "sharing" is the last part of the model. But in the Internet environment, sharing and searching are a major factor influencing user behavior. For YouTube, sharing will indirectly affect the user's subscription behavior (Xiao YunPeng2013). In general, the YouTube video user's subscription behavior is a dynamic process. Therefore, based on grounded theory, this study adjusts the traditional Internet consumer behavior model and sorts out the YouTube subscription behavior model through selective decoding.

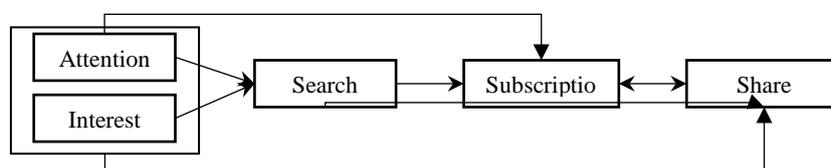


Fig. 1 YouTube subscription behavior model

### 4. Conclusion

In this paper, we combine grounded theory and consumer behavior model to explore YouTube user subscription behavior. In different Internet environments, we have found that consumer behavior patterns have changed. By observing the YouTube user subscription behavior model finally established in this paper, we can find that the factors affecting user subscription behavior are not a simple linear relationship, but a complex dynamic process. First, interest and attention attract users to generate search behavior. After the user searches, a subscription behavior is generated. However, directly through attention and interest, users can generate

subscription behavior directly. Second, sharing behavior may occur after a user subscribes, and sharing behavior will cause other users to react to generate new subscription behavior.

This research has made an important contribution to the academic theory of contemporary Internet user behavior. Existing literature shows that YouTube user subscription behavior does not have any systematic explanation. This study is the first attempt to establish a theoretical model of YouTube user subscription behavior through qualitative research to explain and make up for this key deficiency in the field of user behavior analysis. This paper establishes a user behavior model to reveal the relationship between macro experience and micro individual behavior. These studies have important theoretical significance and application value for predicting user behavior (Xiong Fei, 2013). Then, this study enriches the use of traditional consumer behavior models and provides a basis for further research on the influencing factors of YouTube user subscription behavior in the future.

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# A Development of Children's Arts Experience Program of China: Experience Design Approach

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## Abstract

The role of creative consumers with a design sense is becoming increasingly important to gain an upper hand in future market competition and improve the national competitiveness. Since reform and opening up, China has achieved remarkable economic growth and the second largest economy in the world. However, for qualitative and sustained economic growth, the nation needs creative talent that creates new values. Currently, Children's art is limited to hobbies and education for entrance exams in many parts of urban China. Therefore, the object of this study is to research cases of design education in developed countries and find ways to apply them in China for improving the creativity of Chinese children. This study is a preliminary study to establish the direction of the program development for children's art experience of follow-up studies.

*Keywords-design education; children's arts; experience design*

## 1. Introduction

### 1.1. Background

The method of planning, production and distribution of products in modern industry continues to be advanced, and the boundaries between producers and consumers are crumbling down. Since the concept of prosumer was presented in marketing, the concept of cresumer, or creative consumers, has also emerged in this context[1][2]. They are reorganizing the market by leading the planning of products directly and showing new paradigms. Therefore, the role of creative consumers with design sense and creative producers will become increasingly important in order to gain an upper hand in future market competition and improve the national competitiveness[3].

Modern design is blurring the boundaries between each area. Convergence and collaboration are being emphasized, and many studies and attempts are being made to integrate design into a wide range of academic fields, including sociology, economics, science, humanities and arts, not limited to specific occupations and specific fields[4]. Design education was presented as a result of this trend being reflected in the educational field. The purpose of design education is to enhance design sensibility through general educational approach to elementary and secondary public education subjects, not professional design education subjects, so that they can enjoy higher-quality designs, evaluate them and participate in design process[5].

### 1.2. Object

The proportion of art in China's current public elementary education is very low, even in private art education institutions, it also is limited to education as a course for entrance exams and children's hobby activities. Therefore, this study aims to identify the need for design education in the course of Chinese elementary art education, develop a children's art experience program based on design education, and enhance the creativity of Chinese children through the program.

### 1.3. Method

The methods of this study are as follows.

1) This study arranges the theories of children's art education and design education through preceding research analysis. Also examines the case of design education and its necessity as a general education course, and explores application of design education that appropriate to the child's stage of development.

2) This study understands the awareness, understanding and expected effect of design education of Chinese parents and art education practitioner through the interview survey. And decides the concepts of children’s art experience program, and design the learning plan.

3) The children’s art experience program will be conducted on children. After the class, verifies whether the children’s art experience program has an impact on children's creativity through proper method of assessing creativity.

**1.4. Scope**

This study limited the scope of theoretical study to cognitive developmental stages of children and design education. This study selected 6-12 age group that belongs to elementary public education courses in China as the subject of empirical studies to be conducted in follow-up studies. In addition, this study also limited the Jing-jin-ji(Beijing-Tianjin-Hebei) to the research object region.

**2. Theoretical Consideration**

**2.1. Design Education**

Design education is largely divided into professional and general education according to its purpose. The design education covered in this study is not specialized design education for design majors, but has the characteristics of universal education for elementary and secondary public education subjects. The subjects of education experience the interaction of divergent and convergent thinking process through design education, and their creativity is increased through communication with colleagues and proactive problem-solving processes.

Table 1. Value of Design as General Education [7]

Advocate	The Value of Design Education
Bruce Archer	Design education is justified as a third area comparable to humanities and science.
Stuart Pugh	Design integrates the knowledge of art and science.
Charles L. Owen	He advocated design education combined with professional education such as Problem-solving, Conceptualization, Visualization and Communication.
Nigel Cross	He argued that Real-world professional-solving, structural thinking, and non-verbal thinking were the intrinsic value of design education.
Charles Burnet	He argued that design is not limited to specific areas and is a general process that can be applied to all fields.
V. Papanek	He argued that design education could develop the ability to criticize and create the values of culture.
J. Norman	He argued that the role of design as an important medium to develop creative abilities and integrate experiences in life.

Childhood and adolescence are periods of development of human intelligence, body, and mind. During this period human personality, lifestyle, and study habits are formed, and have a huge impact on life. Therefore, design education needs to be approached as just-in-time education.

**2.2. Foreign Case of Design Education**

Developed countries have already paid attention to the effectiveness and importance of design education, and have provided various opportunities to develop design thinking from public education courses. The common characteristics of design education in developed countries were design education focusing on the experience of creative activities, and developing problem-solving skills through self-directed learning. It has also been shown that design education programs are developed and distributed at a national level for the fostering creative talent, rather than setting the design itself for educational purposes. the brief features of the design education programs of developed countries in the preceding studies are shown in Table 2 below.

Table 2. Comparative Table of Design Education of Developed Countries [8]

Country	England	US	Japan	France	Germany	Italy
Program	Design & Technology	K-12	Art and Craft	Arts Plastiques	-	-
Start year	1960	1989	1990	-	1945	-
Subject	5~16	5~13	6~12	6~12	7~19	0~12
Education objective	Increase creativity	Problem-solving ability improvement	Foster vitality	Develop individuality	Teach sense of order	Develop creativity
Method	Key stage in 4 steps	Experience education	Art activities	Basic and in-depth education	Teacher-centered teaching	Five senses art
Feature	Practice in daily life	Develop the special program of library and museum	Art activities with the people	Absolute authority of teacher	Humanlike art education	Using cultural facilities by the support from the government

### 3. Conclusion

Awareness of creative education and arts education is increasing recently in metropolitan areas of China, and related markets are expanding consistently. China is seeking qualitative growth away from existing quantitative growth, and the importance of creative consumers as well as creative producers is growing continually. Therefore, this study was conducted to develop a children's art experience program based on design education and apply it to the current education market in China.

This study will solve the following problems through follow-up studies. First, this study will organize the theories of design education more systematically and seek ways to apply this in the Jing-jin-ji market. Second, this study will conduct interview surveys with parents on awareness of design education and the potential needs in Jing-jin-ji area. Third, this study will develop a children's art experience program based on design education for children in China, and proceed with experiments to test its effects. The final purpose of this study is to promote the creativity of Chinese children through the development of children's art experience program based on design education theories.

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# Research on the Relationship between Virtual Actors and Real Actors in the Short Animation Collection <Love, Death and Robots>

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## Abstract

With the continuous progress of animation production technology, the application of computer graphics technology in the field of animation film production has been everywhere. The CG elements that a large number of audiences can hardly perceive exist not only in all CG animated movies, but also in special effects, science fiction, magic movies with CG technology as the main means of production, and even in many realistic movies. Super-realistic short films made entirely in CG appear in the animated short film collection "Love, Death and Robots". This paper introduces the development status of CG animated films and the concept of virtual roles. In this paper, the author analyzed the performance of virtual actors in the current film, and combined with the animated short film collection "Love, Death and Robots" to analyze the rendering effect of virtual actors in the picture. This paper summarizes the possibility of virtual actors replacing real actors through the comparison between virtual actors and real actors.

**Keywords-***Film art; Computer animation; Special effects production; Virtual actor; Real agent*

## 1. Introduction

The actor, as an important part of a film, is an important factor in determining the success of the film. As the film industry is developing, the salary of actors is getting higher and higher. However, the popularity of the actor determines his value, which brings great pressure to the production of the film. In recent years, as the various CG production technologies is rapid development, digital virtual actor technology has begun to emerge. More and more movies begin to use full CG digital characters instead of actual performances. Real actors no longer need to stand in front of actual shooting scenes in many films. However, they only need to complete some human characteristics data acquisition and motion data capture in the laboratory to complete all his work in a movie. Internet statistics show that the animation "Love, Death and Robots" has been released on March 15, 2019. The results of China's Douban show that as of April 25, more than 170,000 viewers gave a very high rating of 9.2 points. As of June 13, 2019, "Love, Death and Robots" had scored 8.7 on IMDB. The success of "Love, Death and Robots" makes people feel that the current CG technology has developed to a superb level. As McLuhan put it, "The great era of machines replacing manpower", and live actors seem to be facing such a trend. (1)

## 2. The development status of virtual roles

Virtual roles, also known as virtual actors, have two meanings in a broad sense: one is that virtual actors are created entirely by computers. Some characters do not exist in the real world, as shown in Fig 1, the monster in Sonnie's Edge of short film collection of "Love, Death and Robots", the werewolf in SHAPE- SHIFTERS, and the robot in THREE TOBOTS.



Fig. 1 Virtual character in the movie

The other refers to the real actors of the virtualization, which can also be called the virtualization of the real actors. That is to say, the actors and characters in the real world are duplicated or reconstructed by using digital virtual technology. So far, virtual actors are often used in movies as stand-ins for real actors. Audiences usually compare live actors with CG avatars in movies, in which the visual effects of virtual actors keep approaching real actors. In the animated film "Love, Death and Robots", the real actors are completely abandoned and the new characters in the eyes of the audience are produced.

### 3. The realistic representation of virtual actors

#### 3.1. The performance of virtual actors in films

The important factor of replacing real actors is the reality of virtual actors in the picture. Virtual actors are different from real actors in their independent performances, which are produced through the cooperation of multiple artists. Although virtual performance is based on technology and has strong technical dependence, it can not be denied that it is also an artistic creation. (2) Table 1 shows the technical performance of virtual actors using pure CG in films released so far.

Table1. Film information and technical performance of virtual actors

Movie name	Release date	Box office	Virtual actor	Technical performance
Star Wars : Rogue One	2017-01-06 (china)	\$15.6 million		Reshaping and digitalizing the faces of deceased actors and reproducing them in the form of cgi. Characters' facial expressions are simulated by dynamic tracking and facial database.
Blade Runner 2049	2017-10-27(china)	\$259.2 million		To restore the actor's youthful appearance, the skull shape of the characters was obtained by 3D scanning, and the muscle skin was added to the model.
Alita: Battle Angel	2019-2-22 (china)	\$895 million		Characters were created using 132,000 hair, 2,000 eyebrows and 480 eyelashes. In order to make the character's skin more delicate and compact, there are nearly 500,000 "peach-colored villus" on the face and ears, and separate hair is placed in each pore. The geometry of 8.3 million polygons is used for eye modeling and ray tracing using self-developed algorithms.

From this, we can see that the realistic performance of virtual actors is mainly affected by three factors. These three factors include the visual perception of "human" appearance, the nature and coherence of movement and expression, and the changes of human body and objects in contact.

### 3.2. The performance of virtual roles in “Love, Death and Robots”

In the production of the seventh episode of “Love, Death and Robots”, in order to show the expression characteristics of real people, blendshapes are made by 3D scanning to meet the needs of a scene, which is not like the traditional blendshapes. This greatly increases the expression changes of virtual actors in the performance process, making the action more flexible and natural. As shown in Fig 2, the purpose of simulating real skin effects by dealing with the reddish effect of skin contact is to make virtual actors more realistic in visual effects.



Fig. 2 The purpose of simulating real skin effects

## 4. Contrastive analysis of animated virtual actors and live actors

The advantages of animation performances over real-life performances are as follows: Firstly, virtual actors are not restricted by shooting conditions, so the influence of shooting time and shooting location can be neglected in the process of production. For example, the space scene in *Helping Hand*. This film uses a large number of long-lens performance techniques, if it is to shoot real people, it is easy to be constrained by scenes, lights, personnel and other aspects. As long as one of them has problems, it is necessary to re-shoot. However, virtual actors are not affected by these factors and can be controlled at will. Second, virtual actors have absolute advantages in virtual space-time. The story in *Good Hunting* is based on the virtual space line and combines Chinese traditional culture with steampunk, which cannot be achieved by live performances and actual scenes. Third, virtual actors are not restricted by image conditions. Real actors, no matter how free and exaggerated, cannot break through the limitations of human performance, while virtual characters can make arbitrary images. In *Zima Blue*, for example, Zima is a pool sweeper from a humanoid machine. Fourthly, the handling methods of actions are more flexible and means are more abundant. The performances of real actors are often limited by physical factors, while the virtual role can ignore these influences and arbitrarily express various exaggerated movements. For example, the scene where the characters run and fight fast in *Sucker of Suls*. Fifthly, the use of virtual actors reduces the high salary required to hire well-known actors, which not only reduces the cost of production to a certain extent, but also avoids the performance defects of real actors.

## 5. Conclusion

To sum up, the development of CG technology has a great impact on animated movies. Up to now, all the movies have produced famous actors as CG characters to allow audiences to compare them. Nowadays, the image-building of virtual actors will become more and more flexible. From the success of “Love, Death and Robots”, we can find that many viewers did not find any abrupt production traces of CG when watching it, and they did not regard it as a CG animation, but as a live-action movie. And the animated cartoons don't use well-known actors, so people accept virtual actors as if they accept a new live actor. Therefore, in animated movies, it is possible that virtual actors will replace real actors in the future under the rapid development of CG technology. However, at present, it is still facing the situation of high production cost and incomplete maturity of technology. Therefore, to a certain extent, the continuous development of virtual actor production technology brings crisis awareness to real actors, which can promote actors' continuous self-improvement and breakthrough, and bring more and better works of art to the audience.

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# China's Farmland Landscape Evolution Based on Farmland Transfer ( 1949-2009 )

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## Abstract

Land is the carrier of farmland landscape. Actually, change of land ownership results in the changes in both land functions and demands, and further changes spatial pattern of farmland landscape and pattern of farmland patches. Under the background of public land ownership in China, take 60-year rural landscape development since the founding of new China as research samples, and analyze farmland transfer types and its influencing mechanism that affect farmland landscape evolution. Besides, on the basis of these, generalize and conclude four stages of field landscape evolution: the fragmented farmland landscape phase based on land privatization, the socialist collective farmland landscape phase based on public land ownership, the "fragmented" farmland landscape based on family-contract responsibility system, and the new-type farmland landscape phase based on industrial upgrading.

**Keywords:** *Farmland Transfer; China; Farmland Landscape*

The essence of landscape is the objective reflection in rural area of how human make use of nature and conquer nature. Among these, farmland undertakes the production function that farmers heavily rely on for both survival and development. Therefore, farmland landscape based on agricultural production naturally becomes the subject and core in rural landscape system. Particularly, since 1949, farmland landscape in China always shoulders the historical mission that to be the base of rural social stability and China's economic development. On the point of land, which is the condition for the existence of farmland landscape, the transfer of land ownership must result in the change in farmland landscape, and constitutes a unique development vein of farmland landscape in the last.

## 1. Mechanism of How Farmland Transfer influence Field Landscape Evolution

In different history stages, the extension and content of farmland landscape is always keep changing. Even at the same time, due to different research perspectives, the connotation of this concept turns different as well. Author holds the view that farmland landscape is a complicated and dynamic system concept. It is at least includes following four sub-systems: farmland patch pattern system (including shape, size, distribution density, arrangement mode and surface texture of land block, pattern and distribution of ridge, plot function and other basic elements), crop production system based on farmland patches (including species, breeding and seeding, storage and primary processing, planting and management of crop, farm irrigation and other basic elements), natural landscape system (including mountain, river, desert, beach, woodland and other natural landscape elements), farmland care and protection system (including instruments to drive birds and animals, civil architectures to care crops, windbreaks, flood control installations and etc.). Among these, farmland patch pattern system and crop production system are core elements to form field landscape.

The essence of farmland transfer is that land ownership is transferred from Party A to Party B. With the transfer of land ownership, the farmland landscape system attached to the original land must make the change in varying degrees, in order to meet the actual requirements from Party B. If we look at the development of the land system between 1949 and 2009 in China, we can find that every change in the land system will bring about a new landscape pattern of farmland. No matter from a macro or micro perspective, the basic logic of how farmland transfer influence landscape evolution is following. Firstly, the changing of land ownership breaks the original farmland landscape spatial pattern. Next, a new landscape pattern is built based on requirements of the new owner. In terms of the indicator system influencing landscape, pattern of farmland landscape patches and pattern of area boundary are the two core indicators.(Figure 1)

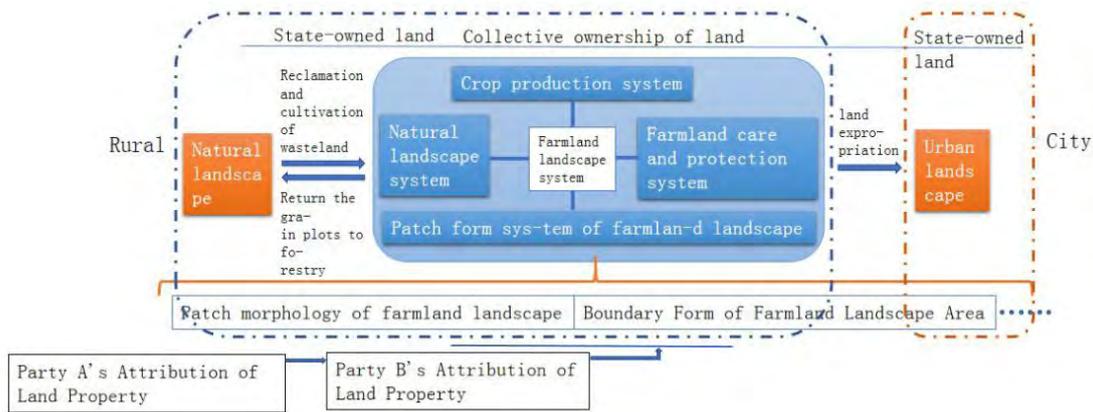


Fig. 1. Schematic diagram of how farmland transfer affects farmland landscape

## 2.Four Stages of Farmland Landscape Evolution

### 2.1 Fragmented Farmland Landscape on the Basis of Privatization of Land

Feudal land ownership has long occupied a dominant position in the long history of China, and China's rural land was highly concentrated in the hands of landlords even in the early days of the founding of the PRC. The land reform from 1949 to 1953 completed the transformation of rural land from feudal landlords to the state and peasants, and established a "land system where state-owned land and privately-owned land coexist". The peasants owned the land, with the land ownership and management rights highly unified and the property rights freely circulated [1]. The land reform in this period was carried out in the form of average free distribution of people. One of the most direct results was that the rural farmland landscape patches changed from "scale and integration" to "miniaturization and fragmentation". The advancement of this land reform greatly stimulated the enthusiasm of farmers for agricultural production: farmers not only carried out "intensive cultivation" of the land they owned, but also actively reclaimed wasteland and expanded the area of farmland. This directly brings about two results: first, although the farmland patches are fragmented, the overall characteristics of the farmland area show "plane pattern" fragmentation characteristics due to the fine utilization of the fields and canals. Second, the original farmland regional boundary shape tends to be diversified with the advancement of "reclamation and farming". While the area of farmland landscape increases, some farmland patches are embedded into the natural landscape. (Figure 2)



Fig. 2. Schematic Diagram of Fragmented Farmland Landscape Based on Land Privatization

### 2.2 Socialist Collective Farmland Landscape Based on Public Ownership of Land

From 1953 to 1958, with the evolution of the rural land system from "mutual aid group"→"primary cooperative"→"senior cooperative", the land management right and ownership changed from "farmer-owned, mutual aid management" of the mutual aid group to "farmer-owned, collective management" of the primary cooperative to "collective ownership, collective management". Under the guidance of the road of collectivization, the socialist land system reform was completed. In this process, the largest land transfer was completed-the ownership of land was transferred from farmers' private ownership to commune ownership. However, the transfer of land between individual or collective farmers has stopped. The farmland landscape in this period showed the characteristics of socialist collective farmland landscape as a whole, specifically: 1. The fragmentation of farmland landscape blocks has disappeared, replaced by the integration of farmland landscape with production teams or cooperatives as basic production units-the unification of planting types of single farmland patches and the standardization of farmland patch boundaries. 2. Around agricultural production, a series of buildings and facilities have been built with production teams or natural villages as units to meet the needs of agricultural production such as crop breeding or seedling raising, planting and management, harvesting and storage, and primary processing of agricultural products. 3. The production team has become the most basic

collective labor unit, participating in all kinds of agricultural production activities in a unified way, forming a unique agricultural labor chart. 4. The rural landscape space basically forms a concentric spatial structure with village buildings as the center and vegetable planting areas, agricultural product processing or manual workshops areas and farmland planting areas as the sub-layout. (Figure 3)

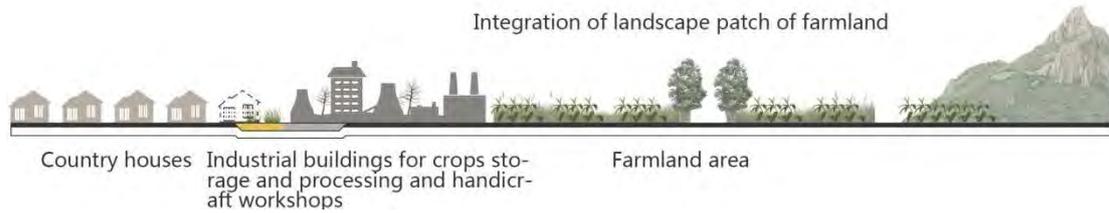


Fig. 3. Schematic Diagram of Socialist Landscape Spatial Structure

### 2.3 Fragmented Farmland Landscape Based on Household Responsibility System

The household contract responsibility system, which began in 1978, completed the transformation from "collective ownership and management of land" to "collective use of land and management of farmers" after the first round of agricultural land contract from 1978 to 1993 and the second round of land contract thereafter. This circulation has brought about great changes in farmland landscape, specifically: 1. Farmland patches are once again showing a fragmented spatial pattern. 2. Affected by the market demand for agricultural products, the types of crop cultivation are diversified, which objectively strengthens the fragmentation of farmland landscape patches. 3. Vegetable growing areas in the previous stage were evenly distributed. Due to too small plots, the original vegetable growing function was gradually lost and replaced by woodland, wasteland or homestead. There is a widespread phenomenon that village-run enterprises or manual workshops occupy farmers' own farmland. 4. A large number of rural labor force work in cities, forming a unique phenomenon of "migrant workers". The function of farmland has become less important in farmers' families, making some farmland barren and barren due to lack of management, while others have been replanted with trees, thus aggravating the fragmentation of farmland landscape. It should be pointed out in particular that the characteristics of farmland fragmentation landscape in this period are different from the "planar patterning" of farmland fragmentation in the early days of the founding of the PRC. Since the small farmland plots are forested, and the borders of farmland patches such as ridges, river branches and ditches are overgrown with weeds and trees. The farmland landscape at this time presents a typical "deep relief" effect when viewed from a bird's eye view. (Figure 4)

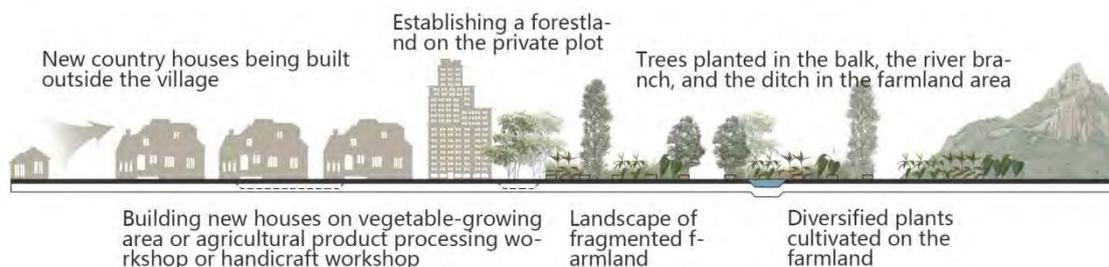


Fig. 4. Schematic Diagram of Fragmented Farmland Landscape Based on Household Responsibility System

### 2.4 New Farmland Landscape Based on Industrial Upgrading

The Rural Land Contracting Law, implemented in 2003, established the beginning of the transfer of household contracted land in the form of law.[2] [3] In October 2005, the Fifth Plenary Session of the 16th Central Committee of the Communist Party of China clearly stated: "Building a new socialist countryside is an important task in China's modernization process" and leading China's rural construction into a new stage of building a new countryside. The Rural Work Conference of the Central Committee of the Communist Party of China held in December 2006 pointed out that the primary task of promoting the construction of a new countryside is to build modern agriculture.[4] The rural areas face the following major problems: First, the loss of agricultural population has increased, some villages have been ruined and abandoned; second, the fragmentation of farmland has affected the increase in the value of land production, which is not conducive to large-scale, intensive production and operations; Farmland abandonment or forestation in small plots is obvious, and the economic function of farmland is weakened. Objectively, the free flow of farmland is needed to revitalize the value of farmland. The free flow of farmland provides land security for the new rural construction that China has vigorously promoted. Farmland scale planting and scale management have become the

development trend. Ornamental agriculture, tourism agriculture, science and technology agriculture, ecological agriculture, and smart agriculture have become new types of agriculture. The farmland landscape presents a new intensive, efficient, ecological and diverse landscape pattern, and the farmland landscape patches are once again transformed from fragmentation to integration.(Figure 5)

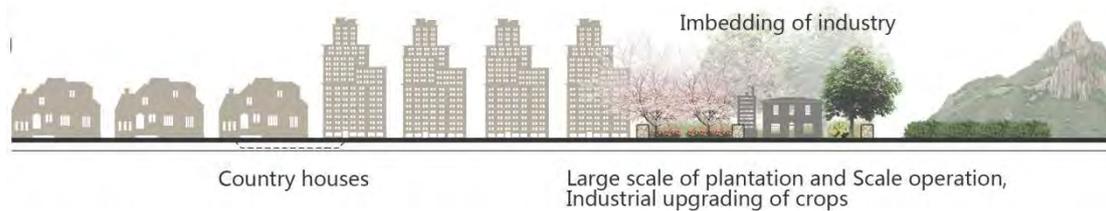


Fig. 5. Schematic Diagram of New Farmland Landscape

### 3.Conclusion

As farmland is the basic production material for farmers to survive and develop, farmland ownership is one of the core interests of farmers. The form and extent of land circulation in China is the inevitable result and presentation of the evolution of China's land system, thus determining the spatial characteristics of farmland landscape. It presents a spiraling pattern from “integration” to “fragmented” and then “more advanced fragmented” to “more advanced integration”.

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# Real-Time Head Pose Estimation Using the Relationship of 4-Points on the Facial Feature

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## Abstract

This paper proposes a simple 3D head pose estimation method based on the positional relationship between the pupil of the human face and the top and bottom of the nose. To estimate the 3D head pose, we obtain the 2D landmark coordinate information of the face and obtain the face pitch, yaw, and roll angles by a simple mathematical operation. Then, this information is combined to estimate the head pose. This method can be used effectively in estimating real-time head pose, especially in the low-level environment because the minimum landmark is extracted from the face and the calculation procedure is simple.

*Keywords-component; Head Pose, Face Detection, HCI, Mobile*

## 1. Introduction

Head pose estimation is a subject that is always studied as a topic in HCI (Human-Computer-Interaction). Head pose estimation is needed to detect the drowsy driving condition of the driver or for face recognition, and can utilize facial feature tracking, deep-running, or depth maps for accurate head pose estimation. Also, this requires a particular device or a complex operation. An example of head pose estimation using a particular device is the iOS environment, which allows you to create accurate depth maps using True-Depth cameras and perform face tracking. Apple released AR face2 tracking of ARKit2 at WWDC in 2018, enabling precise face rigging[1].

However, AR face tracking cannot be used for devices without True-Depth cameras, and precise head pose estimation requires complicated calculations, making it difficult to use in low-level environments. The low-level environment defined here refers to an environment capable of capturing 2D facial images and detecting facial features. Therefore, the present study aims to make it possible to estimate the head pose by simple calculation even if the precision is somewhat low so that the research can be carried out even in a low-level environment. As shown in the above example, we propose a method to estimate the head pose by simple calculation based on the relationship between facial feature points so that head pose can be tracked even in iOS environment without any True-Depth camera and other mobile and webcam environments.

## 2. Literature Research

Various prior studies have been conducted to estimate the head pose from the 2D image. For example, to use the POSIT[2] algorithm and the two-dimensional projection to estimate the head pose from the 2D monochromatic image[3], and a method using the 3D surface morphing with a depth parameter[4]. Research on existing methods is performing operations that are common to project a 2D image coordinates on the 3D face model. The projection operation can be estimated more precisely the head pose value, but there is a problem requiring a 3D face model in advance and time-consuming to perform the projection operation.

## 3. Research Contents

### 3.1. Get Facial Landmark

Before the full-fledged experiment, the experimental environment of this study was decided as iPhone8 of iOS environment without True-Depth camera. Moreover, the Device coordinate system defined that the X-axis is [0, 375], and the Y-axis is [0, 667]. The experimental environment conforms to the low-level environment defined above in the introduction. And using the Vision Framework to capture 2D face images and detect facial feature landmark.

The Vision Framework can detect facial features in an image. When a request is made to an image that contains a face, the position of 64 landmark points can be returned as shown in fig.1. The features of the face that can be detected through this can be detected in the face, eyes, eyebrows, nose, Outside. The necessary information here is the information for four points the pose of between the pupil of the human face and the top and bottom of the nose, which do not change much depending on the facial expression to be estimated for the various facial expressions. To convert the rotation angle of the measured face, the landmark value obtained through Vision Framework is normalized to iOS Device coordinate system value.



Fig. 1 64-points landmark location of the face.

### 3.2. Calculate Angle Between Facial Landmark

Based on the information obtained in Section 2.1, the face pitch, yaw, and roll angles can be obtained. Here, pitch refers to the angle of rotation in the 3D coordinate system about the X-axis, Yaw refers to the angle of rotation about the Y-axis, and Roll refers to the angle of rotation about the Z-axis.

First, the pitch angle can be estimated using the difference in y values, as shown in fig.2 (a) and fig.2 (b). Fig. 2 (a) is the center coordinates of the circumscribed circle formed by both pupils and the lower end pose of the nose. Fig. 2 (b) is the average y coordinate of the two eyes and 1/3 of the y coordinate value of the lower end of the nose. When the face is rotated in the positive direction of the X-axis, the distance between the eye and the lower end of the nose is reduced, but the distance between the eyes is not reduced. The value of fig.2 (a) increases significantly in the positive direction of the X-axis, but the value of fig.2 (b) does not change much. Therefore, it is possible to know the occurrence and the degree of the pitch rotation through the difference between the two values.

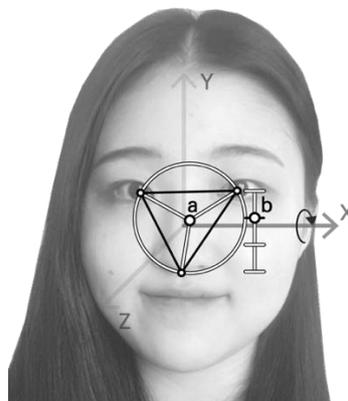


Fig. 2 Pitch angle estimation of the face.

Second, the yaw angle can be estimated using the difference between the angle between the line connecting the pupils and the lower end of the nose to the line of the nose as shown in fig.3 (a) and fig.3 (b). The values of fig.3 (a) and fig.3 (b) are close to zero when the face is facing the front, but when the face rotates in the positive direction of the Y-axis, the difference is shown. Therefore, it is possible to know whether or not the yaw rotation has occurred through the difference between the two values.

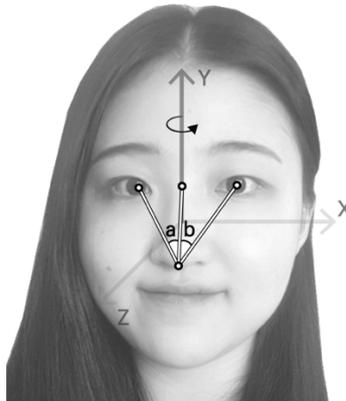


Fig. 3 Yaw angle estimation of the face.

Third, the roll angle can be obtained by using the difference in y value of both pupils, as shown in fig.4 (a) and fig.4 (b). When the face is facing the front, the difference between the values of fig.4 (a) and fig.4 (b) is close to zero, but when the face rotates in the positive direction of the Z-axis, the value of fig.4 (a) fig.4 (b) The value decreases and shows a difference. Therefore, it is possible to know whether roll rotation has occurred or not by the difference between the two values.

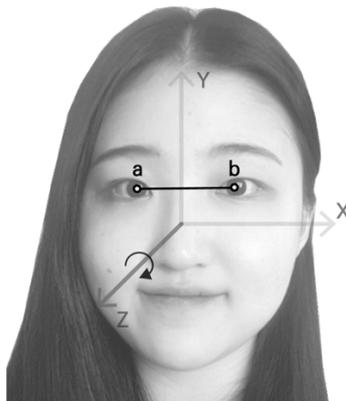


Fig. 4 Roll angle estimation of the face.

### 3.3. Head pose Estimation

The head pose can be estimated by combining the information obtained through Section 3.2. However, to use this information, it is necessary to normalize each value to a radian value. Table 1 is the result of measuring the maximum value and the minimum value of each rotation angle. The unit of value follows the iOS Device coordinate system.

Table 1. Maximum and maximum values of the rotation angle of the face

Axis Rotation	Min Value	Max Value
Pitch	-97.3	80.2
Yaw	-75.4	73.0
Roll	-401.9	398.3

By normalizing each rotation angle to a radian based on Table1, we can estimate head pose in iOS environment and combine this information with other information.

#### **4. Conclusion**

In this study, we proposed the mathematical relations of the values of the positional relationship between the pupil of the human face and the top and bottom of the nose to estimate the 3D head pose. This method is less accurate than the conventional method for estimating the 3D head pose from a 2D image, but it can estimate the head pose much faster by reducing the calculation process. If the head pose can be estimated even in the low-level environment through the method of this study, the scalability of HCI can be further increased. As an example, in lower version iOS devices that cannot use the AR face tracking function, which is the experimental environment of this study. Also, it can be applied wherever the face landmark can be tracked.

#### **Acknowledgment**

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# Research on Geometric Modeling Optimization of Alien Architecture Based on 3D Printing

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## Abstract

Based on the factual characteristics of 3D printing, this paper discusses a geometric modeling idea suitable for the printing of alien architecture models, and uses the corresponding technical means to optimize the skin, structure, external support and other factors of the model. According to the comprehensive evaluation of printing time and model accuracy, a set of modeling optimization that can meet the requirements of efficient and stable printing is systematically proposed. The scheme can effectively reduce the usage of printing consumables while ensuring smooth connection of the model body.

**Key words:** 3D printing; alien architecture; geometric modeling; optimization

## 1. Introduction

3D printing is a rapid prototyping technology, which uses model files as the basis and combines powder or resin adhesive materials to construct objects by printing layer by layer. At present, this technology is widely used in traditional building models. It can accurately print the cross sections of each layer of the model to make it strong<sup>[1]</sup>. However, for special-shaped building models with unique shapes, the printing results are prone to faults, warpage, cracking and other phenomena, and the model accuracy is low and the consumption of time and materials is high. Therefore, it is a new topic with research value to reasonably analyze the relationship between 3D printing technology and geometric modeling working mechanism and to construct a modeling optimization scheme suitable for 3D printing of special-shaped buildings, which can provide certain technical support for visual presentation of buildings.

## 2. Analysis of Working Principle of 3D Printing

### 2.1 Overall Printing Process

The high-quality 3D printing effect is not only realized by the parameter setting of printing equipment, but is completed through a set of systematic processes and specific operation steps. It mainly includes four modules: geometric modeling, detection and calibration, printing and post-processing<sup>[2]</sup>. First of all, graphic and image software such as 3Ds Max and Maya are required to convert the design concept into a three-dimensional model, then stl or obj format files are exported for model detection, and then the model is sliced and converted into G-code code files by 3d printing management software. After the model printing is completed, the model supporting materials are removed and processed.

### 2.2 Factors for Printing

#### 1) Printing accuracy

With the continuous upgrading of the 3D printer frame and electronic components, the positioning accuracy of the print head on the X-axis and Y-axis can be controlled within the range of 0.08mm, and the Z-axis can be controlled within the range of 0.005 mm. However, this does not mean that the printer can directly print the model of the above size. The minimum thickness of the model mainly depends on the diameter of the extruder nozzle and the properties of the material. Because the material itself has a certain thickness, although the printer can accurately locate the falling position of the periphery of the material, the material still occupies a larger space.<sup>[3]</sup> Therefore, the real standard of printing quality should be the layer thickness, i.e. Z-axis precision, nozzle diameter and comprehensive capability of extruder. At present, the minimum layer thickness that most 3D printers can achieve is 0.1 mm. However, the shrinkage rate of PLA and ABS materials is 0.2%~2%. If there are strict precision requirements for printing, it must be planned in advance at the modeling level.

#### 2) Printing coincidence degree

The matching degree of printing is an important factor to measure the accuracy of modeling. If geometric modeling cannot proceed from the actual characteristics of 3D printing, various unpredictable errors will occur in the printing results<sup>[4]</sup>. It is mainly reflected in the following three aspects: suspended: refers to the fact that the lower part of a certain part of the model is empty and has no supporting structure, while the working principle of the printer is to stack from bottom to top. If there is not enough material to support the lower part, the printing layer will be soft or sink. Sealing: refers to that the model must be a continuous, three-dimensional and multi-directional object. If there are loopholes, gaps and duplicate surfaces in the model, the printing management software will find it difficult to distinguish the internal and external boundaries of the model and cannot print. Warping angle: refers to slight shrinkage and curling of extruded materials when cooling, especially when printing the corners of the model.

### 3) Surface treatment

In 3D printing, the smoothness of curved surface is higher than that of plane, forming a closed tool path and no notch model, and its printing quality is often very ideal. For example, if the thickness of a wall in a design building is the width of the primary extrusion material, it needs to be designed into a closed curve or reach a certain length, otherwise it cannot print out reliable objects. If the thickness increases several times, it is possible to form a closed curve. In addition, even if the model forming a short tool path is a closed curve, there will still be problems when printing, because there is not enough cooling time after the material is extruded.

## 3. Geometric Modeling Optimization Scheme for Special-shaped Buildings

### 3.1 Treatment of Skin

The skin of a special-shaped building is the facade of the building and an important part of visual cognition. The modeling of skin can be perfected, which can mark the establishment of the main features of the building. Therefore, the treatment of building skin is the primary task of modeling optimization. It is necessary to make the model have closed corners, correct normals and smooth patches. Taking a building model as an example, optimization is realized through the following three steps: establishing an initial Box, and setting the external dimension to 240mm (length) ×120mm (width) ×28mm (height) according to the printing size of 1/100. The back of the skin is blanked and the basic number of segments is allocated in the way of single-sided modeling. The number of segments should not be too many at the initial stage of modeling, which can satisfy the establishment of main body blocks. Then, the extrusion, insertion and extension under Polygon editing are combined with xyz coordinate axis for modeling, and the main structure of the skin is created and perfected (Fig. 2); Deepen the skin, add lines to the model through the functions of connection and cutting under polygon editing. At the same time, route the model according to the structure of the building and present it as quadrilateral patches, so that grid control points can be flexibly adjusted. In the process of wiring, the focus should be on the details of the wiring in areas with structural turning points, and the wiring spacing should be sparse and uniform in areas with flat patches (Fig. 3); After the skin is established, the model is collapsed or the patches are merged to reduce the number of ineffective segments of the model, and the intersection corners are welded to close them. The FFD surface controller is used to trim the turning point of the model in order to achieve a more vivid and natural turning effect with a smaller number of patches. Then the NURMS mesh is used to smooth the iterative subdivision of the model to strengthen the smooth transition of the model patches (Fig. 4).

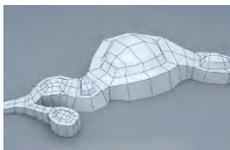


Fig. 2 main structure

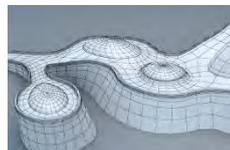


Fig. 3 wiring iteration compared with



Fig. 4 model

### 3.2 Handling of Components

First of all, the modeling optimization method for components takes a window as an example. the window frame uses 80mm cubic conventional building profiles. According to the 1/100 ratio, the printing size of the profiles is calculated to be 0.8mm, which is less than the requirement of printing layer thickness of 1.0mm. therefore, the length, width and height of the window frame are enlarged to more than 1.0 mm, the window frame figure composed of two-dimensional lines is added by spline line editing, the staggered parts of geometric figures are removed by combining the trimming function, each corner point is welded and the whole is lofted into a three-dimensional model, and finally, the glass sheet is added in the way of wiring under polygon editing to form the final model (Fig. 5). This kind of processing method, which uses the section to be formed once and

then adjusted, can make the model coherent and integrated, and at the same time greatly reduce all kinds of redundant data formed by repeated calculation of corner points.

Secondly, for the connection between the components and the building main body, we should try our best to adopt the mode of model intersection simultaneous modeling, delete all kinds of overlapping patches due to occlusion relationship, create turning segments shared by patches, avoid patch opening phenomenon when the components and the building main body are connected, and enable the 3D printing management software to correctly determine the structural turning relationship of the model.

### 3.3 Treatment of Splitting

#### 1) Split method

First of all, split the model according to the molding space of the 3D printer. Attention should be paid to the three dimensions of the split model and the internal space of the 3D printer to leave some room for the printed and molded model to be taken out easily. Secondly, the surface of the special-shaped building is relatively smooth, and when splitting, tries to select the parts with vertical or horizontal turning points on the model facade. The joint assembled at the later stage will not affect the overall effect of the model.

#### 2) Improve strength

In order to reduce the use of materials, the interior of special-shaped buildings is usually designed to be hollow, which is easy to deform when assembling. In order to solve this problem, it is necessary to design a set of connecting members that can improve the strength at the assembly site to make the assembly process more compact and coherent. Taking a building model as an example, square connecting beams are constructed between walls, and T-shaped grooves are designed on the connecting beams, and the model is assembled by using several I-shaped connectors. Connecting beams between walls need not only horizontal connecting grooves, but also vertical grooves (Fig. 6) to ensure strength in all dimensions. In addition, a tolerance of 0.2 mm~0.4 mm should be reserved for the assembled parts so that they can be assembled with certain movable gaps.

Another issue that deserves attention is the orientation of the beveled model relative to the nozzle. Every time a new layer of material is added to the nozzle, a pressure wave will be formed under the action of force and will interact with the inclination towards the nozzle direction (Fig. 7). Based on this, the effective solution is to form a certain angle between the model and the nozzle, so that the pressure wave only impacts the components along the inclined angle to reduce the possibility of deformation of the model.

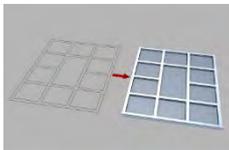


Fig. 5 model lofting



Fig. 6 assembly details

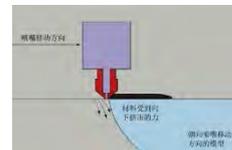


Fig. 7 pressure wave direction

#### 3) Avoiding external support

When the model has a beveled edge with a horizontal angle greater than 45 degrees, the printing machine automatically adds external support in the suspended area to prevent the printing material from falling down. However, too much support will not only seriously affect the actual efficiency of 3D printing, but also impose a burden on the precision of post-processing and the amount of materials used. For this reason, as a special-shaped building with unique shape, more attention should be paid to the reasonable avoidance of supporting materials, which can be optimized by the following three ways: adjusting the angle, modifying the model at the suspended corner of the model through the tangent angle under the polygon, so that the turning relationship can be transited and the 45 degree angle can be avoided (Fig. 8); The slices in the sub-plane level are used to cut along the Z axis at the vertical and horizontal joints of the model, and the assembling mode of vertical and horizontal components is designed. In this way, as the height of the model decreases, the corresponding number of supports will also decrease (Fig. 9); Explore the placement rule, that is, by rotating the split model at an appropriate angle so that its beveled surface does not oppose the normal direction of the printing platform, thus cleverly avoiding support and ensuring printing accuracy (Fig.10).

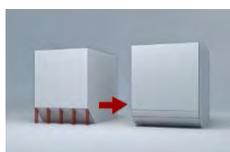


Fig. 8 angle adjustment



Fig. 9 z-axis split

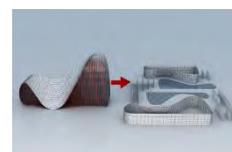


Fig. 10 placement rule

## 4. Experimental Results and Analysis

According to the special-shaped building model in subsection 2.1 of chapter 2, the geometric modeling is comprehensively optimized, and the 3D printing of the finished model is realized according to the corresponding workflow (Figs. 11 & 12). Through observation, it can be found that the overall printing effect of the finished model is good, the structural transition is natural, the assembly joints are hidden, the local details are very delicate, and the model patches do not have obvious printing errors.



Fig. 11 global model



Fig. 12 local model

Through the 3D printing experiment test, the optimized 3D printing finished product model can be obtained, which is more ideal than the optimized 3D printing data in terms of patch number, printing time, precision and material consumption. The relevant test records are shown in Table 1.

Table 1 3D Print Data Records

Name	Number of patches	Print time /(h)	Accuracy /(mm)	Material consumption /(g)
(Not split before optimization) overall building	25,987	5.35	0.01~0.02	310.5
(Split after optimization) skin	13,744	2.78	0.01	159.5
(Split after Optimization) Glass	5,866	1.10	0.01	11.0
(Split after Optimization) Door Head	1,002	0.18	0.01	13.2
(Split after Optimization) Floor	3,598	0.65	0.01	48.5

## 5. Concluding Remarks

To sum up, the accuracy and efficiency of 3D printing of special-shaped building models depend on the optimization degree of geometric modeling. Creating an ideal model file can not only remove all kinds of technical restrictions in the printing process, but also effectively reduce the use of materials. This paper only discusses 3D printing from a perspective of previous modeling work, and there are still some limitations in the optimization method. In the future, we should actively pay attention to and discuss other processes of this technology and research progress in other fields of the construction industry, so as to promote this emerging technology to play a greater application value in architectural modeling design.

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## **VR experiences and history through immersion: a case study on <Titanic VR, 2018>**

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### **Abstract**

Virtual reality is not a new technology, but for the past five years it has been quickly developing and receiving attention from the most diverse areas, being prominent in videogames and filmmaking. The production of new VR documentaries grows each year, and the idea of complete immersion in non-fictional settings is seen as a powerful empathy tool, but it doesn't come without its reservations. The possibility of teaching history through a spatial and emotional immersive VR environment dictates innovation for these medias, where they blend 360-video with computer generated environments. This article examines <Titanic VR, 2018>, an immersive edutainment experience with documentary elements about the tragic sinking of the passenger ship in 1912.

***Keywords-virtual reality; documentary; edutainment; <Titanic VR>; empathy; immersion***

### **1. Introduction**

Documentary, the so called “creative treatment of actuality” [1], has been considerably experimented with over the years. Besides live-action documentary, there are 2D and 3D animated documentaries, documentary videogames (docugames), other types of interactive documentaries, and in recent years, VR technology has become more frequently utilized on the creation of documentary and other nonfiction productions. This development has a hefty change in our perception of documentary, because, as pointed out by Kate Nash (2018), “while the screen has not disappeared in an ontological sense, at the heart of VR is the production of the illusion that we have entered into and become a part of the world that we used to watch on the screen” [2]. And although Bill Nichols (2010) has stated that “documentary is not a reproduction of reality, it is a *representation* of the world we already occupy” [3], the concept that a virtual environment can try to stretch those boundaries makes it very interesting for nonfiction producers, since VR can create the perception that the viewer is within that universe, in a compelling illusion known as presence [4]. And this sense of presence may be applied for entertainment, to teach or even to create empathy. In a 2018 research for Columbia University, Dan Archer and Katharina Finger presented the same news story through different mediums: a written article, 2D, VR with a desktop and finally VR with a head-mounted display. Users who experienced the VR treatments reported higher levels of immersion, empathy, were more prone to report a desire to take action, find out more about the topic, and were more likely to recall the stories they had seen. [5] This brings new prospects in the learning of history, which will be analyzed further in this article with the case study bellow.

### **2. <Titanic VR, 2018>, a hybrid experience**

<Titanic VR, 2018> is an immersive virtual reality experience that is part educational game, and part documentary. With an alpha version since 2016 and only being fully released in 2018, it was made by VR Education, a company focusing on educational VR games, mostly about historical events, such as <Apollo 11 VR, 2016>, that makes the player relive 1969 as an astronaut, and <1943: Berlin Blitz, 2018>, based on the Second World War. <Titanic VR, 2018> has different modes to choose from, and is divided in two main sections (e.g., “Fig. 1”). First, based on significant research and the testimonies of survivors, is one mode that puts users in the shoes of one of the survivors during the tragedy. The second mode is set many years later, and the player plays a scientist searching for Titanic’s artifacts. According to David Whelan, CEO of VR Education, the purpose of <Titanic VR, 2018> is [...] to immerse users in the story and enable them to relate to the people involved.” They wanted to create “an accurate portrayal of events, so it is not only educational, but also

emotional and very engaging” [6]. This description accurately follows a documentary perspective: to be the representation of reality with emotional engagement. Rather than being a pure educational game, it adds novelty to the way the player learns about historical events, creating empathy in one section, and in the other the sense of discovery through the retrieval of objects.



Fig. 1 Menu of <Titanic VR, 2018> showing the different modes of experience/play

There are several VR documentaries about historical disasters and controversies, such as <Fukushima RMI, 2016>, about the nuclear power accident of March 2011, <Journey Through the Camps, 2018>, on the concentration camps of the Holocaust, and <Chernobyl VR Project, 2016>, described by Marina Hassapopolou as “the first high-budget, immersive, cross-cultural, and partially photorealistic docugame about the nuclear disaster that incorporates the objective of educating its users about the atrocities of the Cold War”. [7] In this game, the player visits the Chernobyl site and is informed of that place’s history through people’s testimonies, interactions with the game world, and real archival footage. Just like in <Titanic VR, 2018>’s game mode, the user is not present on the exact moment the tragedy happened, but learns details of it by having contact with thoroughly researched data.

### 3. Two experiences in one package in <Titanic VR, 2018>

#### 3.1. Experiencing a tragedy: becoming a survivor

By choosing to “Experience April 15 1912”, the user enters an approximately 15 minutes long VR animated experience where they can witness the sinking of RMS Titanic through the eyes of a woman survivor that escapes on Lifeboat 6. The beginning shows the characters still on the ship, saying their goodbyes to each other. The player watches the sad scene and then is placed sitting on the boat. At first, the women are hopeful if not confident that the Titanic could never sink, but soon, people start screaming, the ship is sinking and a flare is thrown in the air. The ship finally cracks in the middle and all the player can do is watch, hopelessly, as the tragedy is translated to animation in VR (e.g., “Fig. 2”).



Fig. 2 <Titanic VR, 2018>’s scenes, the second row shows the process of the ship sinking

This VR experience, of course, includes spatial immersion, but the strongest here is the emotional one. As mentioned before in this article, seeing an event in this immersive form makes it easier to memorize and be able to retell it [5]. This method of representing historical moments in a compelling format, then, could be a fast and efficient teaching asset to make the audience interested in understanding more about them.

### 3.2. Learning through immersive play

The other main mode of the experience features a 6-hour game, where the player takes the role of Dr. Ethan Lynch, associate professor of maritime archaeology at the University of Nova Scotia. He receives funding of a mysterious investor and together with his PhD candidate, Jean Robinson, must use a submarine to dive on the place where the Titanic wreck is submerged. The objective is to collect documents and artifacts that slowly lets the player learn more facts about the sinking, the construction of the ship, and the passengers. The user is also able to look at the wreck of the ship's interior in detail.

The game is an investigative kind of puzzle. First, the player has to control the submarine and position themselves close to the shipwreck. After being well positioned, the user plays a ROV, a small remote-controlled robot that is able to pick up the objects spread out in the ship (e.g., "Fig. 3"). These items will be retrieved back to the submarine lab to be analyzed by the player.



Fig. 3 Submarine and ROV screens in <Titanic VR, 2018>.

Inside the lab, the user makes use of chemical materials to restore the artifacts, once restored they can be more closely analyzed and discussed about. The player will also receive calls from other people at the university, who will help reach conclusions about the new documents found. Another feature is adding upgrades to ROV, making it easier to search for the items. (e.g., "Fig. 4").



Fig. 4 Laboratory space in <Titanic VR, 2018>, the first image shows ROV and in the second the player is analyzing one of the documents restored.

Through these mechanics, the player gets a clearer picture of what happened in the past. It's like they are gathering the material to do a documental compilation themselves. Besides the main objects, there are other missions to complete such as recovering a ROV from the ocean, helping in the creation of a photomosaic and in the making a Documentary Film. This last one hovers on meta-documentary in that the game itself seems to be a mixed documentary experience. The user is "playing" what resembles a documentary and then has to actively consider that the artifacts found can be used to make one.

### 4. Tour mode, dark tourism and immersion

Besides the two main modes, <Titanic VR, 2018> has exploration modes and a tour. In the tour, the players are exploring the shipwreck along with a narrator that describes how each of the rooms were utilized, talks about the passengers and what happened in that fateful day. There are pictures of some of the places before they were destroyed, and when visiting them in the wreck, a picture of how they originally were appears on the screen. This description does make it sound like this mode specifically is more focused in a dark tourism aspect: a tour on a place associated with suffering and disaster.

Like the docugame <Chernobyl VR Project, 2016>, the game and tour mode in <Titanic VR, 2018> lets the player visit the site of a tragedy while learning more about it. But while <Chernobyl VR Project, 2016>'s experience is "characterized by constant shifts in representational and abstract modes of navigation" including surrealism, impressionism, and fantasy [7], <Titanic VR, 2018>, even though it reproduces everything with computer graphics, tries to maintain a strong level of "realism", imitating reality without abstractions. Much of this is due to its focused nature as an educational game above a form of documentary.

The RMS Titanic has already been represented in other two VR games: <Titanic: Honor and Glory> (under development), and <Fall of the Titanic, 2015>. In the first one, the player will be able to explore a realistic rendered Titanic while enjoying a mystery fictional story. The second one, also available without VR, has various modes such as <Titanic VR, 2018>, but with a different focus: the game puts the player in the shoes of someone trying to escape the sinking ship, as if it was a giant escape room. Another mode lets the player explore the ship freely, and there's a third one where the user can choose when the ship will sink and can watch it from afar from all angles possible. The interest for the event of the sinking itself is still strong even after 107 years later, and this new technology does help people immerse themselves. Nevertheless, it is the unification of spatial with emotional immersion that makes it easier to achieve full immersion status [8], so the use of VR alone won't make a large difference if the material presented isn't emotionally engaging as well, even when educational.

## 5. Conclusion

Describing <Titanic VR, 2018> only as a docugame seems limiting, but studying it as one makes it easier to understand its nuances. This edutainment experience essentially presents the user with a large variation of modes that makes it complicated to define all of them as a whole. Not all of them have game mechanics, one of them is in the past, and it does include fictional elements. However, animated documentaries and docugames as well both have those characteristics, while still being able to be documentary. <Titanic VR, 2018> is a mix of hybrid experiences that combined try to transmit a complete vision and understanding of the history of the ship. Considering this as basis for future projects about real historical events, the future of nonfiction, documentary, and journalism all have interesting prospects with virtual reality. While there should be reservation towards ethically appropriate approaches, this interdisciplinary form of immersing the user in history can be explored and structured to assist in a new form of raising awareness and of dealing with education.

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# Criticism and Re-discussion on Humanized Design

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## Abstract

Humanized design is a human-centered design, which emphasizes the center of design is human and human scale is the source of creation. This view reflects human's self-standing position of creation, but ignores the healthy development of the natural environment and cause a lot of destructive designs for the natural environment. In fact, human-scale design tends to focus on people's own convenience and enjoyment, lack of love for other species. At the same time, thinking of the satisfaction of people's physical and mental desires as the supreme rule of design, the price paid for this is the nature encounters irreversible damage or aggression. As senior creature, human should pay attention to the relationship between man and nature. Natural design should be the best choice of human's design in the future.

**Keywords:** *Humanized design; Criticism; Natural Design; Ecological Thinking*

## 1. Introduction

Humanized design is a common and fashionable design concept today. It not only requires design to serve for the people, but also requires all designs to highlight personality emotions and features. It causes the designs to be similar, and weaken the diversity of all species. Humanized design reflects human selfishness. Humans have caused great damage to the natural environment in order to satisfy people's desires. For the healthy development of man and nature, human beings should establish a natural design concept and fully develop it.

## 2. Research methods

### 2.1. Use qualitative research to discuss the concept of humanized design

In this study, the qualitative research is the one of main research methods. Through the qualitative research for humanized design, we will have more deeper and accurate understanding of humanized design.

Humanized design is a human-centered and people-oriented design. It is an emotional design in the artificial world. This kind of design let people become the dominant and beneficiary.

Serving for people is the primary importance of humanized design. If a design can't serve for human beings, it should not belongs to the humanized design. This service has risen the practical function of design to spiritual pleasure. Of course, it is only human's spiritual pleasure.

Convenience is one of important feature of humanized design, just as today's cashless payment can be popular because it is convenient. However, the cashless payment has gradually lost the concept of saving for human beings, and human beings have begun to fall into the traps of waste and uncontrolled consumption. It is the key point that the quality of life of cash and goods trade has completely disappeared, and payment has completely become the behind-the-scenes of electronic money symbols. Today, payment activities have become virtual and uncontrollable behavior by artificial intelligence which has increased the risk of family fund protection.

Highlighting human culture is an important purpose of humanized design. This purpose is fully to reflect people's cultural awareness and human emotional position in design, especially to express people's choices and attitudes in cultural positions. Respect for people is not wrong, but how do we reflect the respect for nature and the inexhaustible material properties of universe?

Highlighting humanity is the second important purpose of humanized design. This purpose is to make the product design fully reflect the good human-machine relationship and ergonomic requirements, so that the design products also have human emotions and build a better communication with people. The specific intention of doing this is to improve effective labor, increase production efficiency, prolong working hours, and increase the level of exploitation. In the end, it is to make people gradually paralyzed and declining in the case of not being tired. In fact, a variety of occupational diseases are more and more and the sub-health status of human beings are getting worse in high-tech prevailing today. It's why?

People-oriented is the standpoint of humanized design and the principle of modern design. People-oriented is the only core of the human design. The people have not only become the foundation of invention, but also become the origin of the natural universe. Because when we think of the artificial creation, we are no need to consider the universe, environment or the relationship between human beings and objects. Thinking of the artificial creation, we always just consider ourselves interests and happiness. This is humanized design, in other words, it is human selfishness.

In addition to qualitative analysis, researching methods of cases, comparison, and literature reading will be used by this paper.

## **2.2. Use cases study to discuss the relationship between people and universe**

In this part, the contents use two cases to discuss the relationship between people and cosmos. These cases are Da Vinci's painting Vitruvians and the production system of the Industrial Age.

Humanized design has a progressive conception than before, but at the same time, it also has enlarged the scale and spiritual emotions of human beings. In fact, mankind is never the scale of the universe. On the contrary, human beings are only a weak part of the universe, and human nature is nothing but a tiny part of attribute of heaven and earth. Da Vinci's painting Vitruvians revealed the relationship between man and the universe. The painting revealed the man body's ratio which was product of the universe, at the same time, Da Vinci wanted to tell us that human's spirit came from the universe, too.

The universe is not only specific to nature, but should be a complex of the natural and the artificial world. That is to say, the universe are the complex of the natural and social environment in which the designers are located. All designs come from the inspirations of the universe, all creations are inspired by the natural environment including the artificial environment. The universe, especially the natural world, is the body of design and the design is just the shadow form of universe in the human brain. If a new design product is produced by reference to the artificial world, it is just the shadow of shadow.

In the natural universe, people are never scales. In the artificial world, people are only partial scales.

Why is it that people are only partial scale in the artificial world? Because the artificial world has always been a man-made object of power scale, the preferences of the powers determine the design and production, determine the institution and rule, determine the history and thought. The human world created by the scale of the dominant class is definitely not the scale of the people, not even the scale of most persons. Even in the Industrial Age, the standard of industrialized products is not the standard of the public, but the industry standards established by the largest enterprises based on their own production capacities, research and development capabilities, and financial strengths. These industry standards must also closely cooperate with the government. First, do this can ensure the continued operation of the market and continued profit. Second, do this can ensure the integrity and precision operation of the tax system. Third, do this can provide the costs of maintaining power system of social. So the products of the industrial production and consumption era strictly follow the capital standards. The speech on the Internet is also monitored by the rights classes or is not the free expression of the true public sentiment. Therefore, the humanized design based on the "human scale" is not likely to exist, but it is a pseudo-proposition of theoretical hypothesis.

Livable is the demand of human beings. The so-called livable is to obtain the most suitable life and survival benefits with the least cost. In the cosmic environment, human can not only meet his own development needs, but also fully appreciate the comfort and safety provided by the universe. This is livable. Livable has three requirements. First, spend the smallest cost. Second, obtain the most appropriate income. Third, fully enjoy the charm of the universe.

Therefore, the scale of the relationship between man and the universe is actually controlled by the universe, not the self-improvement of human beings. The revenge on the destruction of the universe will not make humans feel comfortable and livable.

The oversized, super-high, cool design does not meet the "minimum cost" principle, nor will it get the "best income". The design beyond the cosmic scale will certainly not enable humans to truly enjoy the care of the universe. Integrated into natural design will make humans feel more comfortable.

Satisfying human livability and satisfying the fit of the universe are the best scale for human designs. It is no doubt that this scale can only be a balanced category.

Human damage to the universe is powerful and irreversible. Of course, the revenges on human come from the universe are also irreversible. In the design practice, the planning of this relationship scale is the one-dimensional understanding and grasp of human beings. The universe has been watching and feeling the provocation of human beings with tolerance and coldness. Where is the boundary of this relationship scale? We still can't confirm it so far. The Ancient Roman architect Vitruvius described the design in "Ten Books on Architecture": "I explained the characteristics of different places as accurately as possible, which are designed by nature according to the highest principles"<sup>[1]</sup>, "Nature and the wisdom of god designed these constellations and sketched their shapes on the sky"<sup>[2]</sup>. From these words, we can grasp that universe has designed nature principle, nature principle has further created the human and the artificial world. In Vitruvius's view, human's appearance, physique, including health and energy are the gifts of nature to human. Of course, the proportion of the human body and the relationship of various pieces are established by nature. It is not the result of studying of human beings.

### 2.3. Use Cases studies and comparing research to analyze natural design

The contents include two cases which are the Neolithic Human Face Fish Painted Pottery Basin and some houses of national minority of China. The contents also include the comparing analysis to natural design and humanized design.

Man is the product of the universe, and man is a part of the natural world. Therefore, human's culture, emotion and creation should be integrated into the natural environment in order to be suitable for survival and sustainable development. Humanized design can just be realized and immortalized by integrating into the nature, and the design is the most suitable or excellent design which just basing on the laws of nature. The laws of heaven and earth, the laws of nature are the scales of the universe. Natural design is the design which should be in line with the scale of the universe.

Natural design is the design conforms to the changing trend of the cosmos. This trend is the trend of natural change, it does not refer to the political situation or commercial interest of mankind. Natural design emphasizes the coordination, balance, and integration of the relationship between man and the cosmos. The Ancient China had been long understanding the principles of natural design, not only put forward the philosophy of integrating of human and nature, but also insisted on the natural design in design practiced. For example, the Neolithic Human Face Fish Painted Pottery Basin is Chinese representative cultural relics of primitive culture, there are strange patterns that integrate the human face and the fish body on the basin. Those patterns reveal the simple ideas of the Chinese ancestors who thought that people were from the evaluation of fish. Those patterns also mean that the ancestors thought that people can't multiply when they leave the fish and water. In short, people should be integrated with nature to survive. In the construction of Chinese dwellings, the design practices of taking shapes, materials, and methods from the universe are very prominent. Such as the bamboo houses of Dai people, board houses of Bourau, stone buildings of Tibetan, etc. These characteristic houses are designed according to the requirements of convenient living and adapting to the nature.<sup>[3]</sup> Natural design should be a philosophical concept, which expressed as a ecological three-dimensional integrated mode of art-society-nature<sup>[4]</sup>. Design services for society, society services for nature, nature enlighten and create better designs are the value and goal of the three-dimensional integrated mode.

The concept of humanized design reflects the limitations of human design theory and academic research. Humanized design is an arrogant and utilitarian concept. There is just the humanized design conforms to natural design is meaningful and valuable. Any design that violates the laws of heaven and earth or transcends the scale of universe is not a humanized design, because humanized design must be comply with the principles of cosmos.

Natural design has six characteristics: obeying the nature, studying from the nature, protecting the nature, serving the nature, assimilating into the nature, beautifying the nature. The design of human beings should first be designed for the nature, because there are too many other species between the heavens and the earth. Human's design should be responsible for all creatures, lives, and destiny, not hurting them. Modern artificial intelligence design, virtual reality design and various high-tech interactive design should respect and promote the concept of natural design, in order to create a new future.

### 3. Conclusion

Rather than highlighting the people-oriented design, it is better to emphasize the nature-based design,

that is, the natural design. The essence of natural design is humanitarian design. What is humanitarian? That is, the mankind love the nature, love other persons, love every specie of the world, including love themselves. Natural design reflects the design of human beings who love every life and respect the universe. Natural design no longer meets the utility of human beings as the first law, but the first principle is loves of human beings symbiosis with nature. In the future research, we need to further deepen the philosophical discussion on natural design and perfect the theoretical framework of natural design, at the same time, we should be strive to promote the practical activities of natural design.

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# Analysis of Brittle Fracture Special Effects in SF Films by Period

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## Abstract

In humans try to simplify work steps today to speed up the changing times technology innovation. In this paper, the definition of brittle materials, application technology application status breaking special effects, sci-fi movies fracture, three simple sorts, appearing through four different times in the movie scene broken, broken objects, the use of technology as well as the number of occurrences the statistics to draw conclusions. With the development of special effect technology, scenes of the special effect of brittle materials have achieved remarkable progress in terms of visual effect and the complexity and authenticity of the visual effect allowed the special effects of brittle materials to have a more relationship with visual impact.

*Keywords; SF Film, Brittleness, Fracture Effect,*

## 1. Introduction

In the trend of the fourth industrial revolution, researches by all scholars focus on automation, programming, and machines or robots that do jobs with less technological contents. In the same special effect field, Visual Effects (VFX) artist produces great and beautiful visual effects and at the same time, has continued making attempts to simplify the work process or bind up some steps of special effect to use them several times later. Of these special effects, the special effect of crushing is one of the special effects often seen, so it has a stunning visual experience. Since visual effects are complex and diverse, powerful computer memory support is needed, and will the crushing effect completely be replaced by an automated program in the present or the unknown future that emphasizes effectiveness and resource saving?

In a true world, bits and pieces of object basically belong to a chaotic system [1]. Subtle changes in initial conditions can transform all broken pieces and courses. Especially, the crushing of brittle materials is broken patterns often seen, which is widely used in films. This study discusses theories of the definition of brittle materials and analyzes the elements, including crushing scenes, crushing objects, and technologies in four films released in different years. Lastly, it can be intuitively shown through a graph that as the frequency of use of the special effect of crushing of brittle materials gradually increases with the development of special effect technology, it has become an important component in the field of special effect, which cannot be ignored.

## 2. Theoretical Discussion

This study is mainly concerned with brittle materials, of the special effects of crushing, briefly summarizes three aspects, including the definition of brittleness, the status of the application of special effects of crushing, and the application of crushing technology in SF films from the preceding studies and investigates the elements affecting the special effects of crushing, which cannot be ignored.

### 2.1. Brittle materials

Brittleness refers to a phenomenon in which an object is abruptly destroyed, showing little plastic deformation when it gets an impact load within an elastic limit (Fig. 1). Cracks rapidly spread in brittle materials since they are not transformed when cracks occur [2]. In contrast, cracks appear gradually in soft materials as they are transformed into a shape that consumes energy with ductile deformation when they are broken.



Fig. 1 This is a scene of crushing brittle material in real life.

As of the end of 2018, Gav and Dan showed “How fast does glass crack?” in a slow-motion method[5]. This experiment proved that crack of glass crushing due to an external force in the reality is delivered almost at a uniform speed and instantaneously to the entire glass (Fig. 2).



Fig. 2 Gav and Dan had test results on glass crushing.

## 2.2. Status of the application of special effects of crushing

Until now, researchers have mainly focused on two fields, including the film industry and game industry for the simulation of special effects of crushing in brittle materials. The film industry attaches extreme importance to realism. And yet, the one-frame screen can be rendered in the long term with a means of production, little considering the correlation of real-time quality. By the progress of post-production, realistic and real-time destruction effect can be made on the screen. However, it is not the case in the game industry. The game industry emphasizes the real-time quality and reciprocity of games. Thus, research in this direction sacrifices honesty, focusing more on real-time quality. However, studies in these two fields are interdependent and coexist, and with the advancement of technology and hardware, limitations of research in the two fields will decrease in the process of time.

## 2.3. Application of crushing technology in SF films

Today, when film production technology has been developed, special effects of crushing appearing on the screen are divided into two by the method of realization, which can be realized by the real explosion of gunpowder and CGI technology. Special effects through CGI are also divided into 2D and 3D. First, videos are edited with rank frame images as materials with the alpha channel by software like AE and NUKE. Second, the virtual smashing effect is created by combining techniques like modeling, dynamics, and pre-dyeing by software like MAYA and HOUDINI (Fig. 3). These production methods can simulate crushing effects with various kinds and their visual effects are also very similar to reality [3].

Emanuele Goffredo writes in his graduation thesis (2010), “For a magnificent visual effect, a broken object has continuously been one of the most popular effects in the production of films. The best directors always dream and like to show the amazing destruction in their film and encourage their staff to produce such destruction.” [4] Today when technologies are being developed, the crushing scenes people imagine can be realized by CGI technology; however, crushing in reality is a very complex reaction, since there is a development from the imitation of the reality with the existing CGI technology, more films gradually tend to choose a combination of the actual shooting with CGI.



Fig. 3 CGI technology used crushing scene.

### 3. Analysis of crushing scenes

This study would investigate visual characteristics bulging out, analyzing the crushing scenes in four films produced in different years through the elements, including the object of crushing, the kind of machinable materials and technological support.

#### 3.1. Star Wars: Episode I (1999)

In the film, *Star Wars: Episode I* (1999), the special effect VFX artist simulated a scene in which a plane crashed, using the RBD System of MAYA, keeping the plane on a chain for three months (Fig. 4). Many cracks in the slag are broken manually, using misfortune. The overall screen maintained a certain level; however, it takes much time, and effectiveness is low. In addition, the degree of precision in passive crushing is not high, so it has been expressed from a distant view. It is necessary to make the crushing of most metallic materials look like wastepaper based on the materials of the plane, and there was no texture.



Fig. 4 Crushing scene in <Star Wars: Episode I, 1999>.

#### 3.2. Spider Man 2 (2004)

The appearance of BlastCode, the plug-in for crushing in MAYA in 2003 has become a point with high improvement of efficiency based on the principle that changes a polygonal surface into a breakable object. Films often use it for pieces of glass, but it feels lacking details (Fig. 5).



Fig. 5 Crushing scene in <Spider Man 2, 2004>.

#### 3.3. 2012 (2009)

*2012*, released in 2009 is monumental. There has never been digitized crushing like this large scale in the previous films (Fig. 6). The same crushing scene in *Independence Day* (1996) was an explosion of a miniature with a high-speed camera. This film can calculate the destruction of a large-scale object very fast, though not totally accurate, using a bullet physical simulation engine. Its advantages include the wide crushing range and

the revelation of the lens in close proximity. Later, the software Houdini has become the core technology of film-level crushing by inserting a bullet physical simulation engine, instead of the existing engine from Version 12, and hundreds of Hollywood blockbusters benefit from that.



Fig. 6 Crushing scene in <2012, 2009>.

### 3.4. Maze Runner 2 (2015)

The human society is constantly advancing, and the finite-element method (FEM) has appeared. Normally 3D models consist of just the outer shell of an object, and techniques like voronoi fracturing "fake" internal matter by creating extra surfaces between pieces when needed. Bullet technology is fast, but it is a kind of simulation in the end, while the FEM technology is a technology actually applied to the field of structural process and moved to the field of special effects in films. The discarded city in *Maze Runner 2* released in 2015 used earnest FEM technology (Fig. 7). However, this technology is too dependent on the automation process. Thus, the film itself lacks power, so it is difficult to cause an infectious effect.



Fig. 7 Crushing scene in <Maze Runner 2, 2015>.

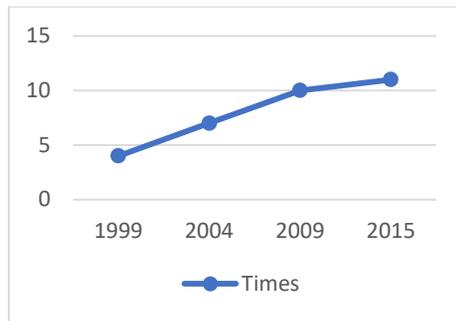
### 3.5. Findings

Star Wars: Episode I, released in 1999 proves that it has long been possible to produce film-level digital crushing scenes, and consequently, the problem is accuracy and complexity. If the parameters of each item are set up in detail, the actual breaking is in the form of the act between objects.

For almost 20 years, starting from 1999, the development of special effects of crushing is mainly based on the optimization of hardware and the reduction of manufacturing costs and difficulties. With the development of CGI technology, the rich imagination of mankind is maximized. The most troublesome thing in crushing is not the physical part but the visual part. The use of FEM technology created images of broken buildings as good as reality; however, it applied more bullet simulations for the present special effects of crushing, consuming time and memory (money), instead of drawing up the overall view to the next step. In the field of special effects in films, VFX artist's aestheticism is the key factor.

Table 1. Four film analysis charts

Title	Time	Object	Material type	Technical assistance	The number of occurrences
<Star Wars: Episode I>	1999	spaceship	Metal & Plastic	Boolean	4
<Spider Man 2>	2004	train window	Glass	BlastCode	7
<2012>	2009	Earth	Rock	Bullet	10
<Maze Runner2>	2015	Building Complex	Rock & Glass	FEM	11



#### 4. Conclusion

This study analyzed crushing scenes in four films by the unit of five years since 1999. Overall, the innovation of special effect technology in the films has brought about the visual effect and decreased production cost and production time. With the development of special effect technology, scenes of the special effect of brittle materials have achieved remarkable progress in terms of visual effect and the complexity and authenticity of the visual effect allowed the special effects of brittle materials to have a more relationship with visual impact.

What the computer calculates is eternally scientific; however, because of the artistic inspiration randomly produced like this, which cannot be calculated by the computer, human's artistic sense came to have an attraction that truly impresses the audience with the special effect of crushing.

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# **The Characteristics of Regeneration design of the Region with Historical Industrial Heritages and Culture - Focused on Taoxichuan in Jingdezhen -**

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## **Abstract**

This study aims at exploring the characteristics of the regeneration of Taoxichuan based on the Jingdezhen. Through the literature review of previous studies, the characteristics of Taoxichuan's regeneration are analyzed from three aspects: Physical environmental regeneration, regional cultural regeneration and socio-economic regeneration. Physical environmental regeneration includes an analysis of the spatial configuration and environment, the preservation and renovation of the existing buildings, and the transformation of interior space. Regional cultural regeneration includes an analysis of the history and culture of Jingdezhen ceramics, the preservation of ceramic factories with the historical and cultural Identity, Third, socio-economic regeneration means an analysis of the relationship among local colleges, local industries, participation of the residents and community activation. The findings were the following;

Through the regeneration of Industrial heritages's rehabilitation, preservation and renovation of interior space, the unique ceramic history and culture of Taoxichuan in Jingdezhen has been preserved and developed into museums, art gallery, shops, educational facilities, studios for artists and other service facilities such as hotels and cafeteria. With participation of related educational institutions, Tao Xichuan has become a ceramic culture complex with diverse functions of exhibition, communication, commerce, tourism on ceramic. Also, the increase of higher qualified artists and employment promoted the enthusiasm and affection of the residents on regional culture and resulted in success of physical, social and economical regeneration.

*Keywords-Historical, Industrial Heritages Region, JingDeZhen, Regeneration , Local Community*

## **1. Introduction**

### **1.1. Background and purpose**

In the late 1990s, with the rapid development of the global economy, globalization and informatization had a great impact on the development of cities and tertiary industries. Industrial parks incities experienced a reverse process, that is, industrial parks and infrastructure were transferred from urban centers to suburbs, resulting in large-scale industrial sites. As a special urban land, industrial site space has a good geographical advantage. Furthermore, as an important part of modern architectural cultural heritage, it has high humanistic and historical value. Besides, as the existing buildings in the industrial heritage area, the preservation and transformation of its industrial facilities and traces make the declining area become an exploitable resource, contributing to the improvement of the living quality of the surrounding people and the development of the regional economy.

In the 20th Century of China, industrial buildings were also the inevitable product of economicdevelopment and social transformation. For instance, Ancient Nanfeng Kiln in Foshan (Guangdongprovince), Qili Kiln Site in Ganzhou (Jiangxi province), “Ten Porcelain Factory” of Jingdezhen porcelain and some other representative industrial heritage areas can be reserved. This show that from the 1970s, Chinese people began to pay attention to the abandoned industrial architectural relics of historical significance and made efforts to protect and maintain their surrounding environment as well as the buildings and cultural relics themselves. Jingdezhen is the largest ceramic manufacturing area in Chinese history, which has lasted 2000 years. In the 1990s, many mechanical ceramic factories were phased out or relocated, and a large number of factories were left idle orabandoned, because of the reform of the economic structure and policy. However, the buildings and facilities of industrial sites completely recorded the changes in Chinese ceramic culture and industry.

The purpose of this research is to analyze the preservation and change of buildings and facilities in Taoxichuan, and also to find out the characteristics in the regeneration of the regional culture and community development.

Based on the results of the feature analysis of regeneration design of Taoxichuan in Jingdezhen, it is expected that this study can provide some basic information and direction with reference values for the regional regeneration design of the similarly specific industrial heritage.

## 1.2. Methods

First, through the literature survey, the concept, preservation mode and regeneration characteristics of industrial heritage area were comprehensively investigated, and the analysis framework of this paper was obtained by combining the previous studies.

Second, by collecting papers and historical materials related to Taoxichuan, its ceramic history and cultural changes in the past two thousand years were analyzed in detail.

Third, physical traces were conducted to observe and analyze the preservation status of Taoxichuan industrial heritage space, the usage and actual situation of local buildings. Then through the combination of historical data investigation and field analysis, the regeneration design of Taoxichuan were comprehensively analyzed from the aspects of the physical environment, regional culture and social economy.

Specifically, physical environmental regeneration includes the analysis of space composition and environment, the preservation and regeneration of buildings, and the protection and transformation of interior space. Regional cultural regeneration includes the analysis of the development and decline of Jingdezhen ceramic culture, the preservation and integrity of its ceramic factories. In terms of social economic regeneration, this paper not only analyzes the connection between Taoxichuan industrial heritage region with other areas, such as regional educational institutions, community industries, but also analyzes the impact of the participation of local residents and the activation of community.

## 2. theory

### 2.1. The concept and significance of industrial heritage regeneration

Before the creation of the concept of industrial heritage, this concept was usually expressed in some other words, such as cultural heritage, historical environment and modern historical environment (modern heritage), which are collectively referred to as the historical products of the times before and after the industrial revolution. Nowadays, industrial heritage refers to buildings with modern industrial functions and industrial facilities directly related to industrial life, which have unique historical value and social significance.

Through theoretical investigation and advance research on the regeneration of industrial heritage, there are different methods and standards for relevant researchers of industrial heritage, but they can be basically summarized into four types: overall preservation, partial preservation, deformation, and reconstruction and expansion.

### 2.2. The Characteristics and Importance of Industrial Heritage Regeneration

In the 21st Century, the new media that regards outdated industrial heritage and facilities as regeneration of the region is increasing rapidly. Each country advocates the need to use appropriate industrial heritage to seek the value creation of economic diversity from local space to larger regional domains. Through the investigation of the regeneration characteristics of industrial heritage (symbolic, economic, spatiality, creativity, cultural, regional, architectural) and the comprehensive arrangement of the previous research (Jeong Min-Joo, Lee Chan 2014), (Han Ah-reum, 2013), (Lee Byung Min, 2017), (Oh Soo-hyun, Seo Soo-mi, 2017), (Yoon Jiyong, Byun Chul, 2014), (Wang Fafu, Yoon Jiyong 2017), this paper selects three aspects of the physical environment, regional culture and social economy to analyze the regeneration design of Taoxichuan in Jingdezhen.

### 2.3. Summary of the Taoxichuan area of Jingdezhen city

#### 2.3.1. Selection of the area of Taoxichuan in Jingdezhen city

Jingdezhen is not only world-renowned for its ceramics, but also one of the eight official kilns in ancient China. During the period of the Republic of China, Jingdezhen, together with Foshan in Guangdong, Hankou in Hubei and Zhuxian in Henan, was called the four famous towns in China. Additionally, it is also one of the first 24 famous historical and cultural cities and the first-level open district announced by the State Council of China. Taoxichuan, formerly known as the state-owned Universal Porcelain Factory, is one of the first batches of industrial heritage in China. The transformed Taoxichuan is the first creative park of culture, recreation, tourism and experience with ceramic culture as the main body, which is called "Taoxichuan - China Square".

In November 2017, the Taoxichuan Museum won the “Innovation Award” in the Unesco Asia-Pacific Awards for Cultural Heritage Conservation. The award speech mentioned that “the new design of the museum and complex not only respects the form and scale of the original factory, butalso creates a new way of dialogue with the famous ceramic production equipment”.



Fig. 1 Before Taoxichuan regeneration Fig. 2 After Taoxichuan regeneration Fig. 3 overall effect

### 2.3.2. Regional development process of Taoxichuan in Jingdezhen City

With a history of more than 2,000 years, Jingdezhen had been the center of porcelain making in China since the Han Dynasty, and has gone through the Three Kingdoms, Wei, Jin, Northern and Southern Dynasties, Tang, Song, Yuan, Ming and Qing Dynasties. Jingdezhen ceramics were handmade until the 1950s. In 1958, Universal Porcelain Factory, the first new porcelain enterprisewith mechanized production in Jingdezhen, was officially established, leading the industrialization of the daily-use ceramic industry in this area and even the whole country. Since the 1990s, Jingdezhen Porcelain has undergone the impact of modern industry and the reform of state-owned enterprises in China. In specific, the “top ten porcelain factories” represented by Universal Porcelain Factory, such as Jianguo, Guangming, Dongfeng and Hongxing, also closed one after another, and gradually decayed and declined. The once noisy and bustling factory areas had gradually become desolate.

In 2012, Jingdezhen cooperated with Tsinghua Tongheng Historical City Conservation and Development Institute. They started to protect and regenerate the industrial heritage gathering area of Jingdezhen. The overall planning area of Taoxichuan includes five major ceramic factories, such as Hangtian and Weimin, as well as the old railway station and the national grain depot, with a total area of 1,000,000 square meters.



Fig. 4 Jingdezhen District Map Fig. 5 Taoxichuan District Bitmap Fig. 6 Taoxichuan floor plan

## 3. Analysis of the regeneration design characteristics of the Taoxichuan

In this study, the regeneration design features of Taoxichuan in Jingdezhen were analyzed from the aspects of the physical environment, regional culture and social economy after the comprehensive arrangement of the researching elements of the previous study.

Table 1. Tao Xichuan Recycling Design Characteristics Analysis Frame

type	content
physical environment	Space composition and environment
	Preservation and regeneration of buildings
regional culture	Renovation of indoor space
	The history and development of ceramic culture
social economy	Preservation and geographical identity of ceramic factories
	Contact of regional educational institutions
	Regional industry linkages
	Regional residents' participation and community activation

### 3.1. The characteristics of Physical and environmental regeneration design

Through literature survey and fieldwork, this study analyzes the physical environmental regeneration of Taoxichuan from three aspects – organization and environment of space, preservation and regeneration of buildings, and transformation of indoor space. The organization and environment of space are mainly based on roads, public squares, water space and some other areas. The preservation and regeneration of buildings are mainly about the restoration and redesign of building appearance and the analysis of the change of construction applications. The analysis of the renovation of interior space is about the protection of the internal structure and the renovation of space utilization.

Table 2. Physical environmental regeneration

type	content
Space composition and environment	The overall space of Taoxichuan is divided into functional secondary planning, public cultural square, and waterscape space.
Preservation and regeneration of buildings	The preservation and regeneration of buildings are divided into three types: overall preservation, partial preservation, and reconstruction and reconstruction.
Renovation of indoor space	The indoor space is divided into ceramic research institute, ceramic art display space, ceramic art commercial space and other service space.

### 3.2. The characteristics of Historical and cultural regeneration design

This study analyzes the historical and cultural regeneration of Taoxichuan, focusing on the development of the thousand-year ceramic culture, the preservation of the ceramic factory site and the historical and cultural integrity in Jingdezhen. The history of Jingdezhen's ceramic culture can be traced back to the Han Dynasty. The ceramic manufacturing industry lasted for a long time. Since the Tang Dynasty, Jingdezhen has become the largest supplier and exporter of royal porcelains in China and is still the representative city of China's ceramic industry. After the founding of the People's Republic of China, the government set up 12 ceramic factories to gather the industrial production of ceramics in Jingdezhen, which makes the industrial and historical value of the factory construction sites and facilities in this area particularly prominent.

Table 3. Historical and cultural regeneration

type	content
The history and development of ceramic culture	The history of ceramic culture in 2000 became a cultural symbol of Jingdezhen, and also retained the unique natural resources (kaolin), technical resources (millennial porcelain crafts) and human resources (urban ceramic culture).
Preservation and geographical identity of ceramic factories	The regeneration of Taoxichuan has retained 22 complete ceramic industrial plants from the 1950s to 1980s and kiln equipment of different ages. In addition, 219 sets of industrial equipment and facilities, such as chimneys, water towers, boiler rooms and dust removers, all provide industrial and aesthetic value for the transformation of these factories.

### 3.3. The characteristics of Historical and cultural regeneration design

Based on the connection of various educational institutions in Jingdezhen, the development of local industries, the participation of local residents and the activity of the community, this study analyzes the social economic regeneration of Taoxichuan. It is not only Jingdezhen owns the only ceramic university in China, but also many related educational institutions provide continuous talents for the innovative design and development of the ceramic industry. Through the reform of modern cultural innovation system, the ceramic industry has changed from a single functional production to a new cultural space integrating ceramic culture transmission, promotion, sales and experience. In the process of regeneration, Jingdezhen citizens and former workers have provided great help for the planning of space, preservation of buildings and integration of heritage resources. At the same time, after the opening of Taoxichuan, thousands of re-employment opportunities have been provided for former ceramic factory workers, which stimulates the development and activation of ceramics-related industries in the whole city.

Table 4. Social economic regeneration

type	content
Contact of regional educational institutions	The most concentrated ceramic professional colleges in the country: Jingdezhen Ceramic University (established in 1958), Jiangxi Ceramics Vocational Secondary School (established in 1983), Jingdezhen Ceramic Vocational and Technical College (2012). Since Taoxichuan was founded in 2012, 1,200 new job vacancies have been created, more than half of which are ceramic workers in the original factory.
Regional industry linkages	The outdoor market and the establishment of “Urban Space” are specially designed to provide free platforms for college students and migrant young entrepreneurs. This series of “employment & entrepreneurship” features provide support for the sustainable development of traditional skills and modern ceramics.
Regional residents' participation and community activation	In the process of regeneration, the government, enterprises, artists, community residents and educational institutions have jointly participated in the whole process. Not only has it played a positive role in ruins protection and industrial development of Taoxichuan, but also promoted the active development of the region and realized the regeneration of society and economy.

#### 4. Conclusion

This study investigates the unique historical and cultural changes of Taoxichuan porcelains in Jingdezhen and analyses the regional regeneration design characteristics of it. The analysis results are as follows:

Firstly, from the perspective of physical environmental regeneration, there is no obvious change in the whole architectural form, that is, it tries to retain the original form value, actively integrates into functional projects, and creates new integration value. Specifically, huge chimneys located in each square, pipes protruding outwards and tunnel ruins have become landscape decorations with strong cultural characteristics. In terms of space function, with ceramic culture as the theme, artists' studios, ceramics research institutes, ceramics exhibition space (art galleries and museums) and different service spaces (coffee shops, hotels, cafeterias) have been allocated. It is admitted that Taoxichuan has become an integrated cultural space of ceramics, creation, production, exhibition, sales and experience.

Secondly, from the perspective of historical cultural regeneration, the regional regeneration centered on ceramic culture provides an opportunity for Jingdezhen to establish brand value. The ancient pottery kilns and workshops of traditional ceramic firing have been remoulded by the museum, which not only retains the past shape, but also displays the ceramic production facilities and ceramic works of different periods, enhancing the cultural function. The irregular communication and exhibition of artists' and students' works strengthen the creative urban characteristics and enhance the overall cultural effect of the city.

Thirdly, from the perspective of social and economic regeneration, as a regional industry, the production, display, education and sales of ceramics have been integrated, and the participation spirit of residents has also been restored. This form of taking full advantage of “regional & academic (school) contact platform” not only promotes the participation of community, residents, students of ceramic college and potters, but also maximizes cultural resources.

The results show that the reasons for successful regeneration of Taoxichuan, which has a thousand-year ceramics culture base and a hundred-year ceramics industrial heritage, can be found from the following several factors: the preservation of large chimneys of ceramic kilns and other historical facilities, modern buildings and business streets with Bauhaus style, and modern museums and hotels built after 2000, which constitute a new brand image of regional coordinated development. Meanwhile, with the increase of new operating posts, this area is no longer just a porcelain production area, but developed into a prosperous complex cultural city. In this regard, cooperation among the government, schools, ceramic experts and community residents has played an important role, which organically links with the inflow of new population and brings about regional vitality. The case of Taoxichuan shows that the regeneration of the industrial heritage area does not rely solely on physical regeneration. Only by introducing modern art and commercial culture into the existing industrial heritage and building it together with the community can a unified regeneration design be formed.

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# From Technology-driven Design Development to Industry 4.0 Changing Design Trends

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## Abstract

Technology promotes the development of design in the process of promoting the development of human society. From the original creation behavior, to the birth of modern design civilization, and even today's industry 4.0, technology continues to promote the development and evolution of human design. Through the evolution of technology, it summarizes the basic laws that promote the development of design. On this basis, further reveal the trend of Industry 4.0 to change the future design.

*Keywords-component; Technological Revolution; Technological Development; Promoting Effects*

## 1. Introduction

In 2013, the Germany's Federal Ministry of Education & Research and the Federal Ministry of Economy & Technology took the lead in proposing the concept of "Industry 4.0" at Hannover Industrial Expo, which is marked by highly digital production, networking and self-organization of machines. Under the background of this technological innovation, this article reviews the mileage of design development promoted by industrial and predicts the changes of future design under the influence of industry 4.0.

## 2. The close interaction between technology, science and the development of design

As a purposeful creative activity, design has a very close relationship with technology. To understand this relationship plays a positive role in accurately understanding the technology's promoting design development. Initially, technology is an important method and means to accomplish the design purpose. From the understanding of "design" in modern sense, the creative process of design consists of three stages from the conception behavior to realization of its value: conception process, behavior process and realization process. This perfect combination of this three stages forms the basic meaning of "design" with modern significance.<sup>[1]</sup> Secondly, the technology expands ways of design, methods and means, improves the quality and efficiency of the design work, and gives birth to new design categories and design languages. In the 1950s the emergence and application of computer technology brings the reform of design is a classic example of technology promoting the development of design. In addition, the computer technology has also given birth to new design categories, design languages and even new aesthetic standards. For example, the emergence and rapid development of digital media art is driven by the development and promotion of computer and network technology. Finally, technology provides more creative possibilities for design. It can be said that technology is not only an important method and means to achieve design goals, but also a necessary condition to transform design ideas into design works (products) and an important obstacle to restrict design creativity.

## 3. Several historical stages of technology-driven design development

Since more than 200 years ago, the innovation speed of technology and productivity was dramatic. This earth-shaking change is due to the Industrial Revolution, which is also the starting point of the birth of modern design civilization that is recognized by the academic community. In order to have a more comprehensive



understanding of the driving effect of technology on design development, this paper takes the Industrial Revolution as a watershed to make a further discussion about the basic performance, symbolic changes and historical process of how technology was influencing design development in the two periods before and after the industrial revolution, in order to grasp its basic laws and characteristics.

### 3.1 Before the Industrial Revolution

The time before the Industrial Revolution is a very long period, which can be traced back to ancient times and is the gestation and exploration period of design. The first use of technology by human can be traced back to the manufacture of production tools in the Stone Age. With the help of certain grinding, carving, scraping and other technologies, natural resources are processed into simple production tools with clear purpose and show a preliminary feeling of function and shape. This should be the most primitive and simple "design" consciousness. Another turning point in technological progress is the use of fire, which is a turning point in the evolution of human technology. Fire has not only become a simple energy source with a wide range of uses, but more importantly, human beings have applied it to the processing of natural materials, using fire to change the material properties of natural materials, and through continuous practice, they have a deeper understanding of the properties and structure of materials. The carding of the influence of technology on design in the early stage of the industrial revolution aims at a more comprehensive understanding of the driving force of technological evolution on design after the Industrial Revolution, because it is the foundation and motivation for the emergence and development of modern Industrial Revolution.

### 3.2 After the Industrial Revolution

The period after the Industrial Revolution is a high-speed period of technological innovation and development. It is also the stages of the birth and development of modern design. The concept of industry 4.0 was first put forward in the draft report <Ensuring Germany's Future Industrial Base Status- Proposals for the Implementation of "Industry 4.0" in Future Plans ">submitted by the German Industrial Economic Union and its Industry 4.0 Working Group in October 2012. It was divided basing on different stages of industrial technology development. According to the current consensus, industry 1.0 is the era of steam engine (ending at the end of the 18th century), industry 2.0 is the era of electrification (starting in the early 20th century), industry 3.0 is the era of information (beginning in the 1970s), and industry 4.0 is the era of using information technology to promote industrial change, that is, the era of intelligence (beginning in 2011).<sup>[2]</sup>

Table 1. Several historical stages of technology-driven design development

	stage of development	General process	Main signs	Promoting Design Evolution Results
<b>Before the Industrial Revolution</b>	Stone Age	Began from 23 million years ago	Grinding technology.	The embryonic stage of design.
	Agricultural Age	Began from thousands of years ago	Pottery Burning and Smelting Technology.	Handicraft stage.
<b>After the Industrial Revolution</b>	Industry 1.0 (The Age of Steam Engines)	Ended at the end of the 18th century	Water power and steam engine.	The gestation stage of the birth of modern design.
	Industry 2.0 (Electrification Age)	Began in the early 20th century	Electricity and motors	Modern design was born and prospered
	Industry 3.0 (Information Age)	Began in the 1970s	Computer, Internet	Digital design
	industry 4.0 (Intelligent Times)	Estimated from the year of 2011 to 2025	Intelligence, network	Intelligent design

## 4. Changes of future design from industry 4.0

### 4.1. Core technical features of industry 4.0

Industry 4.0, as a current stage, is developed on the basis of the technological revolution of industrial 3.0 digital revolutions. Its core technologies include cloud computing, social media, Internet of Things, big data, analysis and optimization prediction.<sup>[3]</sup>These technologies are all developed with digital technologies including

computer software, hardware and network as the core, it can be seen that "speed and breadth" has become the first significant feature of industry 4.0. The second prominent feature of industry 4.0 is "synergy and integration". After different technologies are upgraded, synergy and integration will lead to innovative results beyond our imagination. For example, digital manufacturing technology can already interact with biology. Some designers and architects are combining computer design, additive manufacturing, material engineering and synthetic biology in order to create new systems to realize interactions among microorganisms, human bodies, consumer products and even houses. In this way, the objects they have created (or even "cultivated") have the ability to continuously change and adjust themselves (this is a typical feature of animals and plants).<sup>[4]</sup> Another remarkable feature of industry 4.0 is "short cycle and low cost". Since the first computer was born in the 20th century, the required technology has been continuously developing. The basic rule is that it starts slowly and then increases continuously. The computing capacity, storage capacity and network transmission capacity of computers have all experienced exponential growth. On the contrary, the corresponding costs have gradually decreased.

## 4.2. Changes of future design from industry 4.0

Industry 4.0, which is characterized by technological evolution, belongs to the ongoing and upcoming evolution. Its impetus to design development can only be based on its core technology and the overall characteristics of this technological innovation to predict its trend, specifically in the following three aspects:

First, the designers' role differentiation. The transformation of designers' role is a new change with the development of artificial intelligence. In the current intelligent design practice, a new designers' role "machine trainer" has begun to appear. Their design work is no longer required to provide a design result that meets the requirements, but is required to complete a process of how to design machines. According to the concept of "Generative design" put forward by Autodesk Company and the Autodesk Dreamcatcher tool developed by Autodesk Company, the role of the designer has changed fundamentally. Designers only need to input the design objectives, space requirements, materials, manufacturing methods and costs into the computer to quickly generate hundreds of design schemes, and the designers only need to make choices and decisions on them, or continuously recombine them until satisfactory design results are produced. (Figure 1).

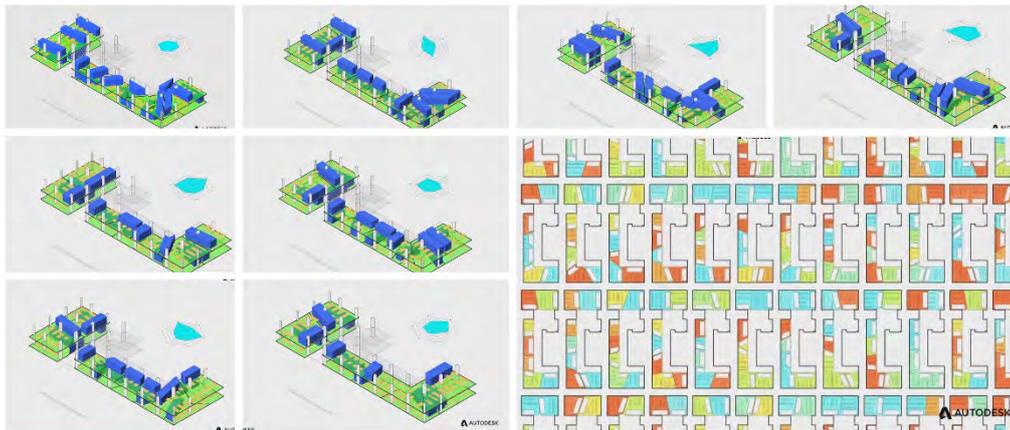


Figure 1 Source: <https://www.autodesk.com/solutions/generative-design>

Second, a brand-new design visual interfaces. The new visual interface greatly improves the visualization of the design process. This change is based on the development of simulation technology, virtual reality technology and embedded micro sensor technology. This new, instant and direct interactive visual interface has two important advantages. One is to cross the boundary between virtual and reality. It has changed our routine division of the boundary between the virtual world and the real world, making the virtual design scheme connect with the real world, so that the designer's ideas can be closer to the reality. This kind of real-time visual design makes the visual form of the virtual design work and the real environment appears, effectively avoiding unnecessary deviation from the scheme to the work in the traditional design process. Secondly, it crosses the boundary between professional and amateur. Designers can use lifelike virtual three-dimensional space to let customers feel the location, shape, proportion and scale of the space, and can also use easily available virtual product modeling to let customers experience changes in function and shape, effectively overcoming the difference in professional level between designers and ordinary customers and greatly improving the integrity of design information exchange. HoloLens, developed by Microsoft, is an attempt at a new visual interface. (Figure 2)



Figure 2 Source: <https://www.microsoft.com/en-us/hololens/developers>

Third, data acquisition and analysis become important design resources, which are based on the further improvement of computing capability and network transmission capability, as well as the change of miniaturization and low price of intelligent sensors. Through these technologies, designers can connect all items with the network, thus obtaining massive data through multiple channels and carrying out purposeful analysis, taking these data analysis results as important resources for design. For example, the regular upgrade of Apple's smart phone system is based on its access to global user information for analysis, correction and upgrading systems. At the same time, this information has become an important design resource for the research and development of new generation mobile phones. Tesla Motor, on the other hand, is a car developed based on data analysis technology. It senses the surrounding environment through many embedded sensors, analyzes the data, and then makes an automatic driving plan. At the same time, through network connectivity, upgrade and upgrade services like smart mobile phones.

## 5. Conclusion

Technology-driven design development is a long process covering several eras. This essay sorts out the changes that have taken place, have been taking place and are about to take place in the process of evolution, and tries to summarize the rules contained in its evolution and change process. Through the comparative analysis of Chart 1, it can be seen that technology promotes the development of design with faster change speed and shorter cycle. The degree of intelligence in design and the ability to innovate in design will also be greatly improved. Only by clearly understanding the rules of development can we attach importance to the coming of the industry 4.0 eras ideologically, make adequate preparations for the response, and thus to have a better welcome to future design.

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# A Study on Characteristics of the Non-permanent Exhibition Space's Sign System

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## Abstract

With the increasing demand of this world's economy, culture and art, people's communication around the world become more and more frequent. So, the traditional and fixed permanent exhibition has been unable to meet the needs of the current market. It is gradually transformed from a single listed form to a non-permanent exhibition integrating diverse forms, cutting-edge technology and intensive information. As an important part of the non-permanent exhibition space, the sign system has an important impact on visitors' experience satisfaction. But the research of it is still insufficient and many sign systems in non-permanent exhibition spaces cannot serve well. Therefore, in order to better use the sign system in the non-permanent exhibition space and improve the visitors' satisfaction of it, this paper will sort out the characteristics of the sign system of the non-permanent exhibition space by combining the theoretical investigation of the features of the non-permanent exhibition space with the current development situation of the sign system. This will provide theoretical support for the future development of sign system matching non-permanent exhibition space.

*Keywords-sign system; non-permanent exhibition space; characteristics*

## 1. Introduction

### 1.1. Research Background and Purpose

With the advent of the Fourth Industrial Revolution and the wide application of computer technology, multimedia technology, network technology and virtual reality technology, the concept and thinking mode of traditional exhibition space have undergone great changes. The emerging new technologies and the development of the non-permanent exhibition space have gradually expanded the field of permanent exhibition space. The modern traditional permanent exhibition space with a single listed form has gradually transformed into a non-permanent exhibition space integrating diverse forms, cutting-edge technology and intensive information.[1] Moreover, the sign system of a large space is also an important way to transmit information. With people's increasing demands on the living environment, a set of sound guidance system should be matched with the current environment while clearly conveying information. Furthermore, with the continuous application of digital technology and intelligent technology, the sign system with traditionally visual information will also incorporate auditory and tactile information in the signboard, making the sign system more humanized. This is also a new trend in the future development of the sign industry.[2]

However, compared with the research of exhibition space design, the study of the sign system of the non-permanent exhibition is insufficient and the design phase of it is in the initial stage. In reality, the design products of sign system are simple and unreasonable; some of them are even unmatched with the current content of the display. Therefore, in order to help the sign system can be applied better and improve the satisfaction of visitors in the non-permanent exhibition space, this paper will derive the characteristics of the non-permanent exhibition space's sign system from investigating the current situation of this kind of space and combining some features they already have. This paper can be expected to provide theoretical support for the development of the sign system that matched the non-permanent exhibition space.

### 1.2. Research Scope and Methods

Because the topic about permanent or non-permanent exhibition space is broad, before obtaining the features of the sign system of non-permanent exhibition space, this paper took literature research based on some

keywords, such as non-permanent exhibition, exhibition space and guiding system. Meanwhile, it also did fieldworks of temporary art exhibitions and design exhibitions held in BEXCO and F1963, two exhibition centers in Busan, from 2018 to 2019. Then by combining the theoretical previous research of characteristics of the sign system and non-permanent exhibition space with the inventory survey of them, the features of non-permanent exhibition’s sign system were gained.

## 2. Theoretical Investigation

### 2.1. The Non-permanent Exhibition Space

There are various exhibition designs. It can be divided into the permanent exhibition and the non-permanent exhibition in the perspective of time. Specifically, permanent exhibition mainly refers to museums, publicity halls and memorial halls, which have the nature of collecting and keeping information for a long time and promoting educational information. The non-permanent exhibition is also called temporary exhibition, which mainly includes special exhibition and seasonal exhibition. They display some themes or contents that cannot last for a long time within a short period.[3] For instance, as the following Fig.1, BEXCO the international exhibition and convention center, is not only a representative of non-permanent displays, but also a complex of holding a variety of international conferences, trade expos, art exchanges and design exhibitions.



Fig. 1 Busan BEXCO

Non-permanent exhibition space can hold some short-time activities aimed at exchanging information and publicizing technology, such as industrial display, fair, trade show and EXPO, in a special display space represented by the exhibition center.[4]

In the research of features of exhibition space, it has found that there are many factors can affect these characteristics, such as type of exhibition space, the purpose of it and techniques of how to display it, so the features of cannot be explained as a whole. For this purpose, this study took “non-permanent exhibition space” as the keyword and searched for high-related papers on academic databases such as RISS, Google Scholar, CNKI and Science Direct. Then the characteristics of non-permanent exhibition space were summarized in the following Table 1.

Table 1. the Prior Study of the Characteristics of Non-permanent Exhibition Space (Part)

Title	A Study of the Criteria to Plan Temporary Exhibition of Museum
Author	Wongil Kim(2019)
Characteristics	timeliness, variability, diversity, communication, transitivity
Title	Study on Expansion of Exhibition Space through Construction of Pavilion as Work of Art: Based on Young Architects Program
Author	Minhee Lee, Yongseup Hwang, Jooyun Kim(2017)
Characteristics	disposable, spatial, communication, information transmission, variability
Title	A Study on the Expandability of Meaning delivery of Exhibition Space Using Digital Art
Author	Hyunji Jung, Jaeun Yoon(2017)
Characteristics	participatory, reactiveness, creative, mobility, involvement, virtuality, interactivity, movability, information transmission

Title	Multi-Functional Design Strategy in National Exhibition and Convention Center
Author	Lingjuan Zhou(2016)
Characteristics	distributing, communication, universal, flexibility

After examining the above 10 papers, the characteristics can be summarized as short-term, variability, diversity, efficient and interactivity. Their concepts are shown in the following Table 2.

Table 2. Concepts of these Characteristics

Characteristic	Concept
Short-term	Short-term refers to that, at the time level, the non-permanent exhibition space is temporary or even “one-off” because its internal exhibition activities are limited by the planning cycle and other reasons.
Variability	Variability means, in the perspective of spatial structure, non-permanent exhibition space can be enlarged or shrunk according to different types of exhibition themes and requirements of spatial layout, with a flexible change of movement lines and free adjustment of space.
Diversity	Diversity means that at the level of display content and way, non-permanent display space has the characteristics of meeting the thoughts and psychological demands of different countries, nationalities, genders and occupations by using various display methods, scientific and technological equipment and interactive means.
Efficient	Efficient means that at the economic level, non-permanent exhibition space should improve the service efficiency of facilities and allocate the space of venues scientifically, realizing the economic sustainability and efficiency.
Interactivity	Transitive refers to that in the standpoint of interacting with visitors, the non-permanent exhibition space should be able to allow visitors to quickly understand and get familiar with the exhibition content and spatial layout within a short time, clearly conveying the hidden information.

## 2.2. The Sign System

The sign refers to a signal or way used to convey notice or instructions. As the basic unit of communication, the sign itself does not have the ability to form ideas or concepts but can realize infinite communication through combination.

The sign system is a fluidity system for guiding, which entrusts the guiding environment with order and makes it easier for users to understand and interact. Sign system design should consider the connection with the surroundings, facing more users as far as possible and pursuing aesthetic as a modeling in urban.[5]

In order to summarize and derive these characteristics of non-permanent exhibition space from various materials, this paper took “sign system” as the keyword and searched for highly related papers on academic databases such as RISS, Google Scholar, CNKI and Science Direct based on the research of normal sign system. Then the features were sorted out in the following Table 3.

Table 3. the Previous Research of the Characteristics of Sign System (Part)

Title	Sign System Research Suwon New Court Building for Customer
Author	Youchul Hwang, Younghee Kim(2019)
Characteristics	symbolic, identity, distinctiveness, identification, contemporaneity
Title	A Study on the Strategy for the Sign System Design Development in General Hospital- With Focus on the C Hospital
Author	Jongyoon Kim, Doseong Jeong(2018)
Characteristics	coordinate with the environment, functionality, aesthetic, efficiency
Title	A Study on Library Sign System: Focusing on the National Library of Korea

Author	Manho Choi, Taekyung Kim, Boil Kim(2017)
Characteristics	transitive, unity, symbolic, variability, compliance with disability laws and regulations
Title	A Study on Improving the Sign System for Foreigners: Focused on the Sign System at Multiplex Shopping Malls
Author	Hyein Kang(2017)
Characteristics	prompt, guidance, identification, readable, accuracy, associative, functionality, clarity, continuity, convenience, comfort

After investigating the above 10 pieces of literature, these features can be summarized as readability, simplicity, unity, continuity, conspicuous, guidance and aesthetics. Their concepts are displayed in the below Table 4.

Table 4. the Features of Sign System

Characteristic	Concept
Readability	In the sign, the font size is related to the position and distance of reading, and signs should be set in a place where it can be clearly read under any conditions.
Simplicity	The information and design required in the sign should be as simple and clear as possible and the intention can be clearly conveyed.
Unity	The sign system should be unified visually and functionally, and different indicators in the same environment should also be unified visually.
Continuity	Signs with leading effect should be located in a place where people require, and the guides are related to each other.
Conspicuous	The information of the sign is clear and conspicuous at any time, which can be noticed and understood by anyone.
Guidance	Signs convey information by themselves and guide users to reach the destination quickly and accurately from unfamiliar areas.
Aesthetics	While ensuring functions in text selection, color contrast and pattern innovation, the sign system should be in harmony with the environment and looks beautiful.

Therefore, through theoretical investigation, this study summarized the corresponding characteristics of the non-permanent exhibition space and the guide system, and further studied the characteristics of the guide system of the non-permanent exhibition space based on this.

### 3. The Sign System of Non-permanent Exhibition Space

#### 3.1. Concept

In various art exhibitions, trade fairs, commercial exhibitions, international conferences and other short-term activities of the integration of special display space, a set of exhibition space with the collocation of the guide system, is the non-permanent exhibition space's sign system.

#### 3.2. Current Situation Research

This paper chose BEXCO and F1963 as the fieldwork sites. According to the observation of "Gallery Exposition" held in April 2019 and "Regeneration exhibition" held in December 2018 at the sites, there is the analysis result in Table 5 below.

Table 5. the Site Inspection of BEXCO and F1963 in Busan

Non-permanent exhibition space	Sign System
BEXCO	
F1963	

### 3.3. Summary of Characteristic

By combining the outcome of the fieldwork with the result of the theoretical investigation, this paper summarized four characteristics of the sign system of non-permanent exhibition space, as shown in the following Table 6.

Table 6. the Characteristics of the Sign System of Non-permanent Exhibition Space

Characteristic	Content
Variability	In the space of the non-permanent exhibition, the sign system should be flexible, removable and strongly mobile, so as to resist the expansion and reduction of the space, usage changes and different displays changes at any time.
Unity	In the non-permanent exhibition space, the sign system should not only unify the vision and function, but also realize the visual unification of different signposts in this environment.
Interactivity	In the non-permanent display space, the sign system and users can realize information exchange within a short time at the interactive level, so that users can understand and get familiar with the space layout and exits as soon as possible.
Clarity	In the space of the non-permanent exhibition, the information conveyed by the whole sign system is clear. The text, color and pattern of it are readable, conspicuous and directive.

Under the environment of non-permanent exhibition space, the sign system should have unity, interactivity and clarity while having the special property of “variability”. Since all kinds of short-term activities held in the non-permanent exhibition space are basically “one-off”, thus reducing the frequency and duration of visitors’ viewing, it is an important condition for visitors to get familiar with the site quickly.

## 4. Conclusion

Because of the continuous development of exhibition space design in modern society, non-permanent exhibition space has become an indispensable place for people to communicate and amuse. Academically, the research in non-permanent exhibition space's sign system design is relatively weak. Therefore, in order to gain the features of the sign system of non-permanent exhibition space, this paper sorted out that non-permanent space has five characteristics: short-term, variability, diversity, efficiency and interactivity; and sign system has the readability, simplicity, unity, continuity, conspicuous, guidance and aesthetic features. After the fieldwork, it finally concluded that variability, unity, interactivity and clarity are four essential characteristics of the sign system of non-permanent exhibition space. However, this paper is insufficient in the current situation investigation and lack of detailed case analysis. In the future study, it will supplement the analysis content and make the derivation process more rigorous. In the end, it is hoped that this paper could provide theoretical support for developing a sign system matching with non-permanent exhibition space.

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## Oral Presentation 2 (Session OT1 ~ OT4)

15<sup>th</sup> August 2019

### Session OT1 - Digital Contents / Advanced Technology

14:00~16:00, Room # Park View2

Session Chair: Hyunjin Chun (Nanjing University of Aeronautics and Astronautics, China)

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| #1290 | “Visualization for noise labeling using deep learning,” Yu-Lim Shin and Eun-Jung Choi (Seoul Women’s University, Korea)  | 124 |
| #1276 | “Mathematical modeling of the layered detachment technology of a 3d model during 3d products printing,” Alexander Kholodilov, Elena Karachanskaya, Elena Faleeva and Roman Eschenko (Far Eastern State Transport University, Russia) | 127 |
| #1297 | “Next hop Selection via Machine Learning in a Cloud-based Vehicular Named Data Networks: An Architectural Perspective,” Lauren Ason and Syed Hassan Ahmed (Georgia Southern University, USA)   | 131 |
| #1283 | “UAV Path-planning in 3-Dimensional Space : A Brief Survey,” Yangru, Muhammad Toaha Raza Khan, Junho Seo and Dongkyun Kim (Kyungpook National University, Korea)   | 136 |
| #1271 | “Energy Trading from Solar Roof Top,” Ariya Phukfon and Suwannee Adsavakulchai (University of the Thai Chamber of Commerce, Thailand)  | 140 |
| #1218 | “Downtime prediction for refrigeration in gas separation plants,” Supaporn Bundasak, Kawisara Ueafuea and Kanokrut Bumrungwat (Kasetsart University, Thailand)   | 146 |
| #1302 | “Human Activity Recognition System using R,” Ajay Agarwal (KIET Group of Institutions, India); Amit Kumar Gupta and Vikas Goel (AKGEC, Uttar Pradesh); Mangal Sain (Dongseo University, Korea)                                       | 154 |

### Session OT2 - Foundation / Art and Design

14:00~16:00, Room # Park Place

Session Chair: HyunSeok Lee (Dongseo University, Korea)

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| #1186 | “A study on the Design Management System of Rural Complex based on Synergetics,” Boyu Du and Kwanseon Hong (Dongseo University, Korea)   | 159 |
| #1292 | “Interpretation of Cultural Landscape for Development of TOD - Focused on Yaowarat Chinatown in Bangkok, Thailand -,” Hyun Jin Chun (Nanjing University of Aeronautics and Astronautics, China and Chulalongkorn University, Thailand); Ariya Aruninta (Chulalongkorn University, Thailand)  | 165 |
| #1200 | “Emoticon Development Research on Product Users’ Emotion,” Chao Huang (Dongseo University, Korea)  | 169 |
| #1175 | “Toward Assessment for Language Learning: A Case Study in Thai Language Proficiency of Secondary and High School Learners,” Akkharawoot Takhom (National Electronics and Computer Technology, Thailand); Sasiporn Usanavasin (Sirindhorn International Institute of Technology, Thailand); Thepchai Supnithi (National Electronics and Computer Technology, Thailand); Thanaruk Theeramunkong (Sirindhorn International Institute of Technology, Thailand) | 174 |
| #1075 | “Analyzing the Semiotics of Chinese Animated Short Films: A Case Study on <Love Seeds, 2016>,” Lin Xiao and HyunSeok Lee (Dongseo University, Korea)   | 179 |
| #1207 | “An Ontology-based Study of Cultural Tourism Knowledge Management: A Case Study of Thai Wikipedia Articles.,” Kanchana Saengthongpattana, Kanyanut Kriengket, Pattama Krataithong and Thepchai Supnithi (National Electronics and Computer Technology Center (NECTEC), Thailand)   | 184 |

**Session OT3 - Culture Service****14:00~16:00, Room # Pine Groove****Session Chair: I Putu Agung Bayupati (Udayana University, Indonesia)**

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| #1147 | <b>“Mobile Data Collection and Analysis for Cultural Heritage Acquisition Supporting Community based Tourism,”</b> Watchira Buranasing, Thepchai.supnithi, Pattaraporn.meeklai, Phattarapol Jantarasena and Petchwadee Pattarathananan (National Electronics and Computer Technology Center, Thailand Science Park, Thailand) | 190 |
| #1221 | <b>“A Study on the Necessity of Standardization for SCRM,”</b> Hyohyun Son, Kwangjun Kim and Manhee Lee (Hannam University, Korea)  | 195 |
| #1169 | <b>“Recommendation system with limited time for visiting museum,”</b> La-or Kovavisaruch, Taweesak Sanpechuda, Krisada Chinda, Thitipong Wongsatho, Sodsai Wisadsud and Anuwat Chaiwongyen (National Electronics and Computer Technology Center, Thailand Science Park, Thailand)   | 199 |
| #1094 | <b>“Recognition of Korean Vowels using Bayesian Classification,”</b> Seong-Woo Kim, Kyung-Ae Cha and Se-Hyun Park* (Daegu University, Korea)  | 206 |
| #1277 | <b>“Developing Fangipani Identification for Android,”</b> Samuel Aprilus Efendi, I Putu Agung Bayupati and Ni Kadek Ayu Wirdiani (Udayana University, Indonesia)  | 209 |
| #1220 | <b>“Analysis of ICCT Research Trend using the ARTAS,”</b> Seungsoo Park and Manhee Lee (Hannam University, Korea)   | 216 |

**Session OT4 - Humanity / Social Science****14:00~16:00, Room # Orchid****Session Chair: Myoung Suk Kim (Seoul Women’s University, Korea)**

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| #1029 | <b>“Dimensions of Innovative Work Behavior: The Literature Survey,”</b> Peevara Parnitvitidkun, Khwanruedee Ponchaitiwat, Nongnit Chancharat (Khon Kaen University, Thailand)   | 222 |
| #1148 | <b>“New Momentum of Cultural Creation: Feeling from the Experience in Taiwan,”</b> Zhenkun Fan, Zisen Zheng and Qingtian Liu (Silla University, Korea)  | 226 |
| #1197 | <b>“Study on the Improvement for Taejongdae’s Tourism Signage System,”</b> Wang Jia (Dongseo University, Korea)   | 231 |
| #1275 | <b>“Effectiveness of training devices application for development of muscle corset strength,”</b> Anna Popova (Far Eastern State Transport University, Russia); Olga Snneider and Galina Skripnik (Far Eastern State Academy of Physical Culture, Russia) | 235 |
| #1300 | <b>“Community and Social Participation in Preserving Lanna Traditional Palm Leaf Manuscripts,”</b> Piyapat Jarusawat (Chiang Mai University, Thailand)  | 239 |
| #1301 | <b>“Disseminating Digitalization of Collaborative teaching: a strategy of Using Multimedia in Classroom,”</b> Deepanjali Mishra (KIT University Bhubaneswar, India); Mangal Sain Huang (Dongseo University, Korea)  | 242 |

# Visualization for noise labeling using deep learning

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## Abstract

As people get more interest in AI, deep learning has been used frequently too. To use deep learning, we need preprocessing about training data. There are some ways to visualize data by using binary, such as making coordinate. We have researched visualization with sound files, and analyze its visualized image. By its image, we will show visualization method and suggestion about its usage.

**Keywords-Deep-learning; Noise labeling; Noise classification; Pre-processing; Audio-visualization**

## 1. Introduction

As people's interest in AI has increased, deep-learning, which is one of AI's technique, has also been used frequently. There are typical ways of deep learning, for example CNN(Convolutional Neural Network) and RNN(Recurrent Neural Network), have to import data by image to model learn it. There are image pre-processing to make model's accuracy better[1] and not all the data is image, so there are pre-processing to make other file virtualizable. There are some ways about visualize binary files, such as using Sammon Mapping[2] and binary values. We can set binary values right into pixel value[3], or making coordinate of image.[4] Finally, if file to visualize is executable, we disassemble it and set its operation into pixel value.[5] In this paper, we research about virtualizing file with binary values and evaluate how it exactly work at deep learning.

## 2. Visualization Method

### 2.1. Method

We cut the binary data of the wave file by 2 bits to form a single pair of coordinates. A series of two bytes will be used as the  $\langle x, y \rangle$  coordinates, 1 byte for x value and 1 byte for y value. By moving one bytes, we can make a series of coordinates. After increasing the value corresponding to that coordinate it results the image of the wav file. With this method, the range of x, y becomes 0 to 256 how image becomes 256 bit bitmap. In this sound file, we only need visit-rate of each coordinate so we set R, G, B value equally. So final output of image will become grayscale image.

### 2.2. Result

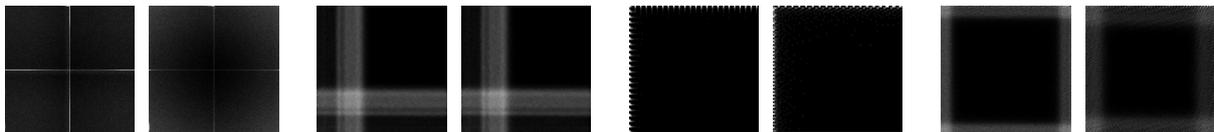


Figure 1.1 Wind    Figure 1.2 Bass Guitar    Figure 1.3 Rain(Enlarged)    Figure 1.4 Piano  
Fig. 1 Sample image of sound events

According to the Fig.1, You can see similar sets of images appearing for similar sound files. Although there are less similar images for the same event, the more similar the noise and the more similar the sound, the more similar the image was. As Fig2 shows, if image's appearance seems similar, its sound are similar too. Separately, we could see that the higher the feature was in a section, the more likely the white line was to appear in the image.

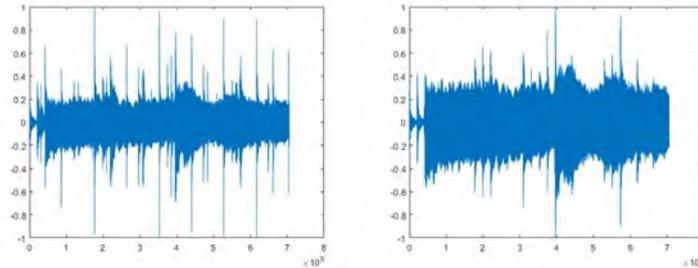


Fig. 2 Wave plot of Piano sounds (Fig 1.4)

### 3. Experimental Method

#### 3.1. Dataset Selection

We use dataset from Freesound General-Purpose Audio Tagging Challenge.[6] This data contains 20 sound classes, including manually-labeled data and real-world noisy data. In this paper, we use Bass guitar, Piano, rain and wind class to classify sound using CNN through image conversion. Each train sets has about 900 image files, and has about 100 files for each test sets.

#### 3.2. Performance Evaluation

The classification experiment was conducted using CNN, one of the deep learning techniques. We use Keras for pre-processing and TensorFlow for implementing model. After dividing the 256 bits image by folder according to the label and pre-processing it, we procedure to model learned it. The test set was placed in a separate folder, followed by a procedure to verify that the label predicted through the model was identical to the actual label. In train set, its accuracy turns out 93.7%, and in test set its accuracy turns out 91.3%.

Table 1. Experiment Result

Class	Correct	Incorrect	Accuracy
Bass guitar	106	5	96.3%
Piano	97	13	88.1%
Rain	45	15	75%
Wind	120	2	98.3%
Total	27	10	91.3%

### 4. Conclusion

To make models learned by CNN or RNN, it use image basically. But not all the files are image, there are some ways to visualize. We use coordinate which made by binary values to make image and it gets meaningful result about sound events. Also, CNN model learned by this image shows quite high accuracy of classifying sound events even though there was no additional pre-processing about sound files. With more qualified preprocessing about sounds, we could get more better accuracy through its image. By visualization, we can reduct noises mixed with human sound through event classification or detect situations through sounds mode better.

### Acknowledgment

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# Mathematical modeling of the layered detachment technology of a 3d model during 3d products printing

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## Abstract

Setting parameters of the outer contour and the internal filling of the three-dimensional model in preparation for 3D printing is an actual task. This task is related to prototyping with additive technologies. The solution to this problem is an implementation of an algorithm for filling the inner structure and execution of the external contour of a 3D model. This algorithm takes into account not only the possibility of an adaptive approach to the thickness of the layer for printing but of the layer thickness changing during filling for the bypass contour.

**Keywords-**3D printing, mathematical modeling, slicer program, additive production, FDM technology

## 1. Introduction

Industrial growth in different fields claims evolution of new technologies. Plastic materials are becoming a common part of many applications. It allows to improve technical and economical parameters of products using both a weight-saving and the factory labour hours. However, it saves both ferrous and nonferrous. The 3D modeling is new technology which solving the problems above.

At the present, 3D printing technologies of complex surfaces develop very intensively and it implies a requirement to research of the additive production methods for complex objects. We study the task of generating g-code which is a code in the programming language for numerical control machine. This code is based on a \*.stl file describing both the geometry of the printing model and the infill parameters.

The results of the 3D printing experience using FDM technology show that there exist cases when multiple layers have the same cross sections. Currently, a well-known software for g-code generation use filling cavities within the model by creating repetitive contours in a specific geometric shape.

We present an algorithm for filling the inner structure and execution of the external contour of the 3D model, taking into account not only a possibility of an adaptive approach to the thickness of the layer for printing but of the layer thickness changing during filling for the bypass contour. This algorithm includes the following main attributes: an increase in the strength characteristics of the printed object; a decrease in both printing time and accumulated residual filaments. Analysis of the 3D model is required before printing to determine the strong vertical surfaces of this model. This approach allows a decrease in the number of layers in this area. Increase in the strength characteristics is possible due to the use of the Voronoi grid shape. We use the \*.stl file that describes a 3D object of complex shape. We create a program which analyses the \*.stl file, allows changing the thickness of the layer and outline during filling using the 3D model, and calculates the internal structure.

## 2. Modeling a technology for slicing a 3D model for 3D printing

An actual question is how to print a thin-walled complex surface using the method of additive manufacturing taking into account both the lowest material consumption and the greatest strength. The relevance of this problem is the features of creation of shells and thin-walled structures, as well as the high cost of consumables and the imperfection of modern slicers technologies. Slicers are the programs for cutting a 3D model into layers for printing on a 3D printer [1]. Based on the above, the main tasks for research are as follows:

- to conduct a comparative analysis of the modern technologies of 3D printing, the physical and the software constituents of the technological process of 3D printing;

- to research into promising technique for solving the problem of the software component of 3D printing, primarily in the case of additive manufacturing using FDM technology;
- to develop a software for an adaptive approach to the layer thickness in 3D printing, that allows uploading the programming results in a format suitable for 3D printing.

We determined the object of our research as a result of the comparative analysis of modern software for 3D printing and the analysis of materials for 3D printing as the methodology of additive production using FDM technology. The subject of our research is studying the possibility of applying an adaptive approach to a dynamically defined layer thickness in 3D printing.

The choice of the object and subject of research is the lack of realizations of this approach in additive manufacturing and its practical significance and economic efficiency.

One of the most relevant directions of research is the almost total lack of tools in modern slicer programs for automatic increase in the speed-quality ratio and strength characteristics [2].

The 3D printing speed using FDM technology could be changed by increasing the following parameters of the 3D model [3]:

- 1) decrease in the percentage of filling;
- 2) decrease in the thickness of the outer wall;
- 3) increase in the thickness of the layer during execution of the contour;
- 4) increase in the amount of extruded plastic by increasing the speed of the extruder.

Unfortunately, decrease in both the percentage of filling and the thickness of the outer wall leads to the problems with strength characteristics, and increase in the extruder speed leads to a deterioration of the surface quality [4].

In such a way, we advance the possibility of increase in printing speed programmatically using an adaptive approach to the dynamically set layer thickness, depending on the complexity of the external contour of the model, which the extruder printer head passes.

### **3. The problem of statistically set layer thickness**

In the process of solving the problems arising when printing thin-walled structures, (shells, models with complex topologies, etc.) there is possibility to create a program code for a slicer in order to create 3D models without loss of time and loss of materials with the implementation of an engineering approach to g-code generation.

G-code generation algorithm requirements are as follows:

- the algorithm must be resistant to models with a complex topology;
- the generated “fill” of the model inside should be of varying density, so that the grid closer to the walls of the model or to the bottlenecks is denser, and for rest of the item is more spaced out;
- it can use an internal filling algorithm similar to the Voronoi grid shape.

If printing time is very long, this affects the printer badly. When heating and maintaining the temperature on the extruder for a long time, it becomes clogged, which has a negative effect on print quality, technical resources of the machine, etc. In addition, significantly more electricity is consumed. In the part of model where the profile does not change or changes smoothly, the elevated layer height does not affect the quality and technical parameters of printing. It should be noted that such elements as support blocks that should not be of high quality, therefore, they can be printed with a high printing layer.

The problem above is solved by increasing of the thickness of every layer. This increases the printing speed. But there are models whose structures have a different vertical profiles, which does not have a positive effect for any types of forms. The most probability for a fracture exists in the areas where the value of a section is subjected to strong change. It is possible for different cross-sections and for the same thickness of the layers.

There exist many slicers and programs for generating a 3D g-code. These programs allow bypassing the above mentioned limitations by generating supports and changing the type of padding.

All modern programs allow for specifying only the basic thickness of the layer, which does not change in the process of printing of the entire model.

These aspects imply the following problem: a long time period is spent on printing vertical sections and it leads to a do-or-die situation in the areas of sharp change of the section plane.

Thus, there exists a need for dynamic changing layers during slicing. Writing such a slicer program we should take into consideration the requirements based on the rules, standards and expectations of the initiator.

The results of programming are tested at all stages of work, from loading a model to 3D printing. Figure 4 shows the result of visual experimenting with printing thin-walled spheres, whose wall thickness is equal to the passage of one layer of an extruder.

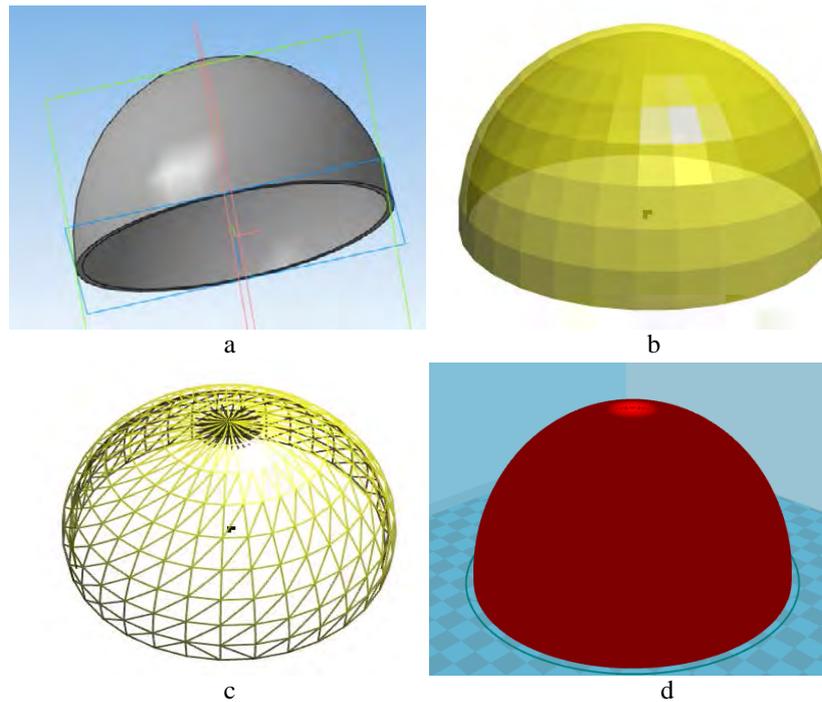


Fig.1 Printing thin-walled spheres: a - the development of a 3D model; b - model exported to \* .stl format; c - triangulation grid of the model; d - print results

#### 4. Research results

Studying the problems associated with 3D printing including the comparative analysis of slicer programs, comparing plastics for 3D printing using FDM technology, analyzing the g-code and the internal structure of models with different filling allows us to conclude that it is possible to create a software program that ensures implementing an adaptive approach to dynamically specified thickness of the layer which has good effect for the reduction of a time period of the 3D printing of the complex shape products.

The application is built modularly which creates possibility for further adding additional functionality. The minimization of the functionality reflects the intended behavior of the system. The main task of the application is layer-by-layer division of a model into layers (static or dynamic, taking into account the geometry of the model) with further saving to the file in g-code format for further 3D printing. This approach implies selection of an input data in a form of 3D model in \*.stl format; the definition of the type of slicing; the ability to create an internal fill grid and the survey of the extruder passage on each layer [5, 6].

#### 5. Conclusion

We have carried out comparative analysis of the modern software systems aimed at solving 3D printing problems and have analyzed practical applications of various 3D printing technologies.

The theoretical contribution of the research consists in the comparative analysis of the modern 3D printing technologies and an algorithm that takes into account a dynamic approach to the thickness of the printed layer [7].

According to the experimental data obtained, the reduction of time for printing of thin-walled structures is 20-30%, and the consumption of plastic yarn is reduced by 10-15%. Taking into account the statistics obtained in the enterprises, the major economic effect can be achieved by the companies using 3D printing technology to produce cases for devices, various mechanical components and using 3D printing to modeling industrial and civil architecture objects [8,9].

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# Next hop Selection via Machine Learning in a Cloud-based Vehicular Named Data Networks: An Architectural Perspective

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## Abstract

In recent years there has been a growth in connected vehicles. Vehicle to vehicle communication (V2V) enables vehicles to broadcast and receive information. The benefits of having connected vehicles enable applications in a wider span including safety, mobility, and saved money (i.e. less time spent in traffic/gas). Having said that, there are several challenges that connected vehicles face such as intermittent connectivity, network congestion, broadcast storms, etc. Broadcast storms occur when a given network system becomes flooded with broadcasting traffic and there are redundant connections. They cause problems such as redundant information being communicated and failure of communication. In this work, we propose a unique way of mitigating broadcast storm in the context of future Internet-based Vehicular Networks by using a cloud-based system. The connected vehicles will use a cloud-based system to select the best vehicle to exchange information with. This eliminates congestion, delay, and data/interest duplication and provides a larger range for a vehicle to request information from. In this proposed scheme the cloud system has a Neural Network as well as a database of information for the vehicles. This is set up by taking in several input values, processing it through the sigmoid function and returning an output that contains be the best vehicle.

*Keywords-component; formatting; style; styling; insert (key words)*

## 1. Introduction

Vehicle to vehicle communication (V2V) enables vehicles to broadcast and receive information. This provides benefits such as safety, mobility, and saved money (i.e. less time spent in traffic/ on gas) to the consumers. A future internet architecture used for communication between connected vehicles is Vehicular Named Data Networking (V-NDN). V-NDN allows vehicles to communicate on the basis of named data [1]. This V-NDN concept is information/content-centric as opposed to the traditional host-based. The current design uses unique ID's for data communications (such as IP addressing), however, V-NDN utilizes the content name instead of the device's name. Simulations have shown the use of V-NDN reduces traffic load as well as redundancy.

However, there are several challenges that connected vehicles face such as intermittent connectivity, network congestion, broadcast storms, etc. Due to the nature of how connected vehicles communicate, they frequently encounter the problem of these broadcasting storms. These storms occur when a given network system becomes flooded with broadcasting traffic and there are redundant connections. They cause problems such as redundant information being communicated and failure of communication.

Further, in vehicular communications, vehicles face the issue of limited connection time to other vehicles. Due to the nature of vehicles, their location is variable and will frequently move in and out of network range. This is due to the fundamental nature of how vehicles operate: they are moving at different velocities, change direction, stop, etc. Utilizing V-NDN for these connected vehicles can bring robustness to the content retrieval as we don't get into the complexities of exchanging IP addresses and handshaking verification processes and communicate directly with a pull-based strategy of NDN forwarding daemon.

This work is proposing a new architecture to combat these problems that occur in V2V communications through the utilization of an integrated neural network and cloud-based system in IaaS. Through connected vehicles utilizing this proposed cloud-based system to select which car best met its list of interests instead of epidemically forwarding the interest packet, this will mitigate congestion, delay, and data/interest duplication and provide a larger range for a vehicle to request information from.

## 2. Related Work

In the recent past, many research efforts have been made to mitigate broadcast storm problem in the Vehicular Named Data Networks (V-NDN). For instance, the authors in RUFs [2] presented a multi-decision criteria method to select only one forwarder within the vicinity of consumer vehicle. This work considers relative velocity, Interest Satisfaction Ratio (ISR), and a list of recently satisfied list (RSL) to select next forwarder hop.

Likewise, a new energy estimation scheme in [3] finds the vehicles that are able to participate in Data Dissemination. To do so, a connection probability is computed to identify stable connections and lastly, a Convolutional Neural Network is used to estimate the social relationship score among vehicles. The proposed scheme starts by screening vehicles for the residual energy so that they can maintain a stable and reliable connection. Furthermore, Weiner Process Model is used to estimate the connection probability among connected vehicles. In addition, CNN estimates the social relationship of the vehicles. Here, the social relationship refers to the vehicles with more diverse routes been recently followed and the number of distinct vehicles that were encountered via V2V communication. The simulation results show that the amount of data disseminated is directly proportional to the social score, energy level, and traffic density. Given that, the disconnection probability will increase with the increasing velocities of the vehicles in the network.

Moving ahead, the authors in [4] presented a distributed Interest forwarder selection scheme enabling relaying vehicles to choose forwarder(s) ahead independently. To achieve the given objective, the requesting vehicle,  $V_r$ , sends out an Interest packet containing its location, speed, and distance from the neighboring vehicles. The immediate neighbors to the consumer vehicle rank themselves as potential forwarders in both forward and backward direction. Such decisions allowed authors to select a vehicle in both the backward and forward direction.

Furthermore, in the paper named “CODIE” [5], the authors focused on controlling the flooding of data packets in V-NDN. The argument in this work is pretty solid and obvious that the Data packets typically carry more information than Interest packets and are significant as well as they carry the real required content. To be precise, CODIE was designed to mitigate the data broadcast storm problem. The simulation results analyzed challenges inherited by the wireless communications to the V-NDN type of networks and also shown that CODIE limits duplicate copies of data packets.

NDN [6] is utilized effectively in the scheme NDN-Q: An NDN query mechanism for efficient V2X data collection. The problem of collecting sufficient data from vehicles is addressed by placing more importance on the content as opposed to the vehicle's location. A response pattern is used where consumers request content using its name. Simulations of this proposed scheme showed that traffic load was considerably reduced. The problem of intermittent connectivity issues is further addressed in [7]. Information-Centric Networking (ICN) is used to solve this by using the content names. This provides the benefit of native support to mobility, in-network caching, nomadic networking, multicast, and efficient content dissemination. The ICN-based COoperative Caching solution (ICoC) uses partner-assisted and courier-assisted schemes for the information-centric caching. During simulations, ICoC improved start-up delay and playback freezing.

## 3. Proposed Architecture

In this section, we present a unique architecture of integrating machine learning and cloud computing to enhance the overall content retrieval mechanism initially proposed in RUFs[2]. Such a new approach can potentially benefit V2V communications utilizing the Infrastructure as a Service (IaaS) feature of Cloud computing. In this scheme, we have a requesting vehicle ( $V_R$ ) interested in retrieving some content ( $C_a$ ). To retrieve this content,  $V_R$  begins by forwarding an Interest Packet ( $i$ ) along with its speed, direction, and location to the cloud-system. To then locate a potential matched vehicle ( $V_{PM}$ ) for  $V_R$ , the cloud-system first normalizes the input values so that we are able to accurately obtain an output. After these inputs have been standardized, the cloud processes these inputs through a Neural Network. The Neural Network returns to  $V_R$  output in the form of a decision list (DL) containing MAC addresses of possible forwarder(s) of  $i$ , where MAC address can act as an ID due to its uniqueness globally.

This proposed cloud-based scheme can outperform a few state of the art schemes due to the fact that it mitigates the problem of broadcast storms by a clean-state design. Integrating Neural Network into a cloud to provide DL can definitely improve and make the process more flexible and reliable [8]. Contrary to the existing schemes, if the cloud is integrated, vehicles do not forward Interest packets epidemically towards the provider(s) and thus can lower the additional copies of Interest packets by forwarding them to the cloud utilizing the IaaS. To further enhance the overall performance, the Neural Network in the Cloud scheme provides a more accurate calculation of  $V_{PM}$ . The Neural Network will learn what a matched vehicle is by utilizing the resulting data from previous efforts such as the decision list from RUFs as training data.



Fig. 1. Illustration of the Proposed Scheme

The proposed scheme is achieved through a series of steps as discussed below:

*A: Bringing Neural Network to V-NDN:*

Before any retrieval starts, we assume that each vehicle is periodically sharing its speed, location, and moving direction using Basic Safety Messages (BSMs) as per the IEEE 802.16.4 protocol stack. Such information can help our proposed Cloud to take inputs for the Neural Networks, which can be used to generate DL in later stages. Later,  $V_R$  begins the content retrieval process by sending  $i$  as a first Interest packet to retrieve  $C_a$  to the Cloud.

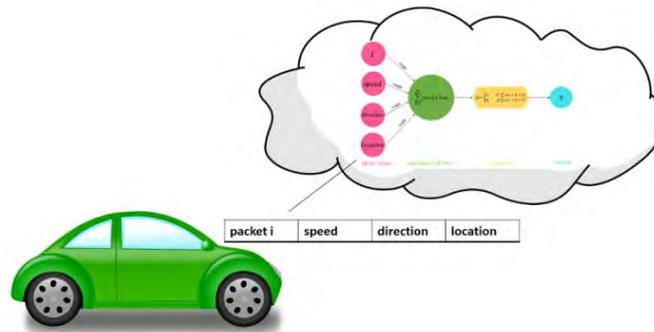


Fig. 2. Example of Request forwarded to Cloud-System

Neural Networks are made up of neurons with learnable weights and biases. In this step, the neurons will take an input, apply a weight to them, process these variables through a summation considering the biases, send them through the sigmoid activation function, and return an output of a ranked list of  $V_{PM}$ .

In the proposed architecture, the Neural Network takes the variables from  $V_R$  as input as well as the same variables from all the present vehicle in the region cover by Road Side Unit (RSU). As a matter of fact, in order to let the Neural Network provide us with accurate results, we need to train it on a data set simulated by us in our previous work [2]. Moreover, Feature Engineering [10] is used to extract features and train the algorithm using  $i$  and signal strength to pick the best vehicle that meets the Interest requirements. Hyperparameters, such as the number of layers and neurons in each layer will be adjusted based on the results found when building models on the training data. The Neural Network uses this to form an accurate  $DL$  of  $V_{PM}$  to be forwarded to  $V_R$ .

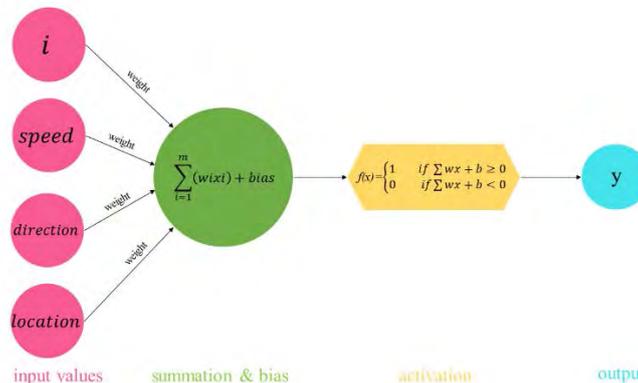


Fig. 3. Neural Network in Cloud

**B: Integrating Cloud into V-NDN:**

After the variables have been processed through the Neural Network, the Cloud then begins the process of locating matched vehicles for data forwarding. The Cloud requests from the connected vehicles in the general vicinity of  $V_R$  their content to see if it matches  $i$ , speed, direction, and location. The Cloud utilizes the information sent from  $V_R$  to then eliminate vehicles that are unable to fulfill  $i$ . The scheme also filters out vehicles that are too far away to communicate with. The vehicles that are remaining after the filtering process, then send their input values through the Neural Network as well.

Following are described in detail, the main steps involved in selecting a potential forwarder using the neural network and is evident from Fig. 3:

1.  $i$ , speed, direction, and location are the features while training the data.  $V_R$  forwards these to the cloud.

Below is an example of pseudocode from  $V_R$ :

```
#this is local to the car
procedure findBestVehicle(vehicle_id):
    #step 1: get a list of cars from cloud
    vehicle_list = getCloudCarList(interestPacket, location, speed, direction)
```

2. When the Cloud receives these inputs, Feature Scaling is used by the Cloud to standardize the inputs.

$$x' = \frac{x - \bar{x}}{\sigma} \tag{1}$$

In this equation,  $x$  is the original input value,  $\bar{x}$  is the average( $x$ ), and  $\sigma$  is the standard deviation. It is necessary to normalize the inputs due to the conflicting types of data.

3. The function then uses backpropagation to repeatedly adjust the weights as needed so that the Neural Network can obtain the most accurate output. Currently, we are assuming equal weights, however, they can be adjusted either application-wise or dynamically.
4. In the next step, since Cloud is collecting BSMs from all the neighboring vehicles, some vehicles will not be included in DL due to many factors including their large relevant distance, alleviated relevant speed with  $V_r$ . As such neighbors are almost of no help in keeping a reliable connection time and content retrieval. The pseudocode for this can be seen below:

```
#get the current distance for each vehicle
#step 2:
for (vehicle in vehicle_list):
    #get the distance of the current #vehicle and save it
    vehicle.distance = getDistance(vehicle, location)
    #sort the vehicles by distance
    sorted_vehicle_list = sort(vehicle_list, distance)
    #see which vehicle is closest, and #also is below the minimum threshold
    #for speed and direction
    for (vehicle in sorted_vehicle_list):
        #if the vehicle is going in about #your direction and about the same
        #speed, then return
        if (direction - vehicle.getDirection() < direction_threshold):
            if (speed - vehicle.getSpeed() < speed_threshold):
                return(vehicle)
```

5. After these vehicles have been processed, the output is given in the form of a Decision List ( $DL$ ). The vehicles are ranked in the  $DL$  and are displayed as a percentage, which is the satisfaction percentage seen in Table 1.

**C: Expected Outcomes:**

The data returned to  $V_R$  is a ranked list,  $DL$  of potential forwarders. The reasoning behind having a list of potential matched vehicles instead of just the ‘best’ matched vehicle is the risk that the ‘best’ vehicle from the returned list in [2] may move out of connectivity while transferring the requested information to the cloud. The data from  $V_{PM}$  may also be corrupted. Having multiple matched vehicles gives  $V_R$  the best opportunity to retrieve the content.

TABLE I: Returned Output from Cloud

Vehicle ID	Content	Satisfaction
$V_1$	$C_a$	91%
$V_2$	$C_a$	82%
$V_3$	$C_a$	76%
$V_4$	$C_a$	65%
$V_5$	$C_a$	43%



## 4. Conclusion

In this paper, the use of a Neural Network in a Cloud System is utilized to more effectively form a Decision List for a requesting vehicle to retrieve content from. We address the benefits of using a new integrated cloud-system and Neural Network instead of the current schemes that forward interest packets epidemically. The process began by a requesting vehicle forwarding its interest packet as well as speed, direction, and location to the Cloud. The cloud then normalizes the variables and processes it through a Neural Network. The Neural Network locates matched vehicles that the requesting vehicle could retrieve data from and returns this in the form of a Decision List.

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# UAV Path-planning in 3-Dimensional Space : A Brief Survey

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## Abstract

Aiming to the applications from security surveillance, military operational capabilities to the content and package delivery, unmanned aerial vehicles (UAVs) has a successfully created his space in the available technologies. One of the key problems that appear in the first place is the path planning of these unmanned flying robots that are necessary to perform the application-specific functionalities. In this manuscript with a brief survey, we investigate the state-of-the-art UAV path planning algorithms. The key path planning solutions are also highlighted and compared in the comprehensive table.

***Keywords-component; path planning; unmanned aerial vehicles (UAVs); multidimensional space.***

## 1. Introduction

In the past recent years, the unmanned aerial vehicles (UAVs) have been widely utilized in military or civilian fields e.g. surveillance, reconnaissance, search and rescue operations. The cost-efficient operational capabilities made scientists and researchers to investigate the topic in multidisciplinary scope. The increasing demands have brought in the focus on enhancing the intelligence and autonomy of UAVs.

UAVs can revive task information wirelessly far away from the operating base and based on the localization services like Global Positioning System (GPS) can arrive at the desired location. Once mounted with additional sensors and devices, UAVs can forward the on-sight data back to the operating base using satellite or ad hoc network. On the other hand, in the case of autonomous systems, UAV's can take instantaneous decisions intelligently without human intervention. UAVs can perform and operate in a stand-alone manner as well as in the form of a group of UAV's working together forming a swarm. Such UAV swarms are most efficient and optimal to perform tasks that can cause risk to human life loss.

One of the major challenges in UAVs operation is path planning and obstacle avoidance. UAV initiates its movement from its stationed location to the destination location. In midair, UAV has to manage the air drag that can result in strong resistance. In addition, UAV can face obstacles of different shapes and sizes like birds, trees, building and other flying objects. In order to complete the task successfully and efficiently, the UAV should not only detect the obstacle but should avoid it efficiently in a timely manner.

In this manuscript, we present a brief survey of the selected state of the art UAV path planning solutions. The rest of the manuscript is as Section 2 includes a summary of the selected UAV path planning approaches. In Section 3 we introduce the comparison of the selected schemes. Section 4 concludes our work.

## 2. UAV Path-planning Approaches

In this section, a brief description of selected UAV path planning solutions is provided.

### 2.1. Massive Autonomous UAV Path Planning: A Neural Network Based Mean-Field Game Theoretic Approach

Mean Field Game (MFG) learning control algorithm to enable the flying unmanned aerial vehicle (UAV) with real-time acceleration control in a distributed manner [1]. The work proposes the solution of three problems of the fastest travel from a source to a destination, low energy consumption and obstacle avoidance from the starting point to the destination during the flight respectively. Through training and development of Hamilton-Jacobi-Bellman (HJB) equation and Fokker-Plank-Kolmogorov (FPK) equation along with machine learning

(ML) models the problems were solved. The work considers a setup with natural wind interference in the outdoor environment.

## **2.2. Cooperative path planning with applications to target tracking and obstacle avoidance for multi-UAVs Theoretic Approach**

Flying Unmanned Aerial Vehicle (UAV) target tracking with obstacle avoidance is proposed in [2]. Multiple UAVs flying in 3D environment evaluate their turn rate using Lyapunov distance function and direct the UAVs to extend the converge to a desired limit period above the moving target. The speed of all UAVs is adjusted based on the Lyapunov phase function. Based on the traditional IFDS method, the distribution streamlines in the entire 3D space are obtained by modifying the parameters, thereby achieving the purpose of obstacle avoidance. This paper proposes to achieve better mission completion by combining Lyapunov Guidance Vector Field (LGVF) and Improved Interfered Fluid Dynamical System (IIFDS). The simulation analysis has been done in MATLAB software.

## **2.3. Massive UAV-to-Ground Communication and its Stable Movement Control: A Mean-Field Approach**

A real-time motion algorithm is proposed to make each node in the drone group fly at the same speed while avoiding collision [3]. The algorithm achieves the low energy consumption in the flight at the same time. The proposed solution is used for the drone swarms in urban emergency relief. This paper proposed an average field game theory drone flight algorithm. With the non-cooperative game between each drone and a single virtual agent reflects the collective control decisions of all drones. Then, the speed of a single drone is determined by solving a partial differential equation (PDE). The result of UAV motion is then obtained by solving another PDE called the Fokker-Planck-Kolmogorov (FPK) equation. The effectiveness of the proposed mean-field flocking algorithm is validated by simulation using the 3GPP air-to-ground channel model.

## **2.4. Multi-Objective Four-Dimensional Vehicle Motion Planning in Large Dynamic Environments**

Based on A\* search algorithm, a multi-step A\*(MSA\*) is proposed to control the flight path of the UAV in a multi-target 4-D (three spaces and one-time dimension) dynamic environment in [4]. MSA\* finds a cost-optimal solution using variable length, angle, and velocity trajectory segments. The solution presented in this paper is used to plan flight planning for a group of drones. A method of motion planning using a variable successor operator that finds the path with the lowest cost. The variable successor operator enables variable track length, angle and velocity track segments modelled using computer graphics inspired unit sequences. This provides an inherent tolerance to uncertainty based on the minimum distance between the orbit and cell sequence boundaries.

## **2.5. Multi-UAVs tracking target in urban environment by model predictive control and Improved Grey Wolf Optimizer**

Based on Model Predictive Control (MPC) and Improved Grey Wolf Optimizer (IGWO), a hybrid method for planning the optimal trajectory of multi-UAVs for target tracking in urban environments is proposed in [5]. First, objectively model the target tracking problem, especially considering the viscous area caused by LOS occlusion, body-fixed sensor coverage areas, restricted areas, and other constraints. Secondly, the centralized MPC method is used as the solution framework for the target tracking problem, and the future finite space-time UAV trajectory can be predicted and optimized in real time. Third, the Improved Grey Wolf Optimizer (IGWO) is used as a solver for MPC, a GWO-based approach that introduces some improved strategies, such as better performance. The simulations were carried out in MATLAB.

## **2.6. Path planning for solar-powered UAV in urban environment**

A solar drone (Solvay) path planning framework is proposed in [6]. The framework is divided into three parts. First, to avoid Sawyer from building obstacles, a natural-inspired path planning method called Interfering Fluid Dynamics (IFDS) was introduced. Secondly, in order to effectively solve the path planning problem, an intelligent optimization algorithm called Whale Optimization Algorithm (WOA) is chosen as the basic framework solver. Thirdly, to solve the problem of accurate modeling of solar energy in urban environment, two measures are taken: (1) a practical method for judging sunlight occlusion; (2) for some unreasonable aspects of solar energy production model, The ASHRAE Clear Sky model was used to correct and recalculate the solar irradiance calculation principle of the inclined surface. The solar drones proposed in this paper are used for working in urban environments with dense buildings. This paper is a research and proposed solution for a single drone. In order to avoid the obstacles of the building, the dynamic constraints and models are introduced into the IFDS for the defects that the traditional IFDS is not suitable for Solvay energy optimization calculation. A modified IFDS is proposed, called Restricted IFDS (RIFDS).

## 2.7. Three-Dimensional Path Planning for Uninhabited Combat Aerial Vehicle Based on Predator-Prey Pigeon-Inspired Optimization in Dynamic Environment

Aiming at the Uninhabited Combat Aerial Vehicle (UCAV) three-dimensional path planning problem in dynamic environment, Predator-fedo Pigeon Optimization algorithm (PPPIO) is proposed [7]. PPPIO is obtained by changing the corresponding parameters on the basis of pigeon optimization algorithm (PIO), and the corresponding route planning scheme is obtained through multiple iterative processes. Traditional Particle Swarm Optimization (PSO) and differential evolution (DE) path algorithms are very slow while the cost of the PIO algorithm is too high. The simulation results show that the PPPIO algorithm proposed in this paper overcomes these problems very well. Simulation has been performed in MATLAB software.

## 2.8. Three-dimensional unmanned aerial vehicle path planning using modified wolf pack search algorithm

Wolf Pack Search (WPS) algorithm was modified to calculate the quasi-optimal trajectory of a rotor-wing UAV in a complex three-dimensional (3D) space, including real and false 3D space in [8]. The solution proposed in this paper is to plan the optimal trajectories of multi-UAVs for target tracking in an outdoor environment. The solution proposed in this paper is applicable to the path selection of a single drone in a group of drones working in a group. In the path planning process, a Genetic Algorithm (GA) is applied to implement the WPS algorithm. Considering the dynamic characteristics of the vehicle, a path smoothing process based on a cubic B-spline curve is used to adapt the planned path to a fixed-wing drone.

## 3. Comparison

In this section, we briefly compares the papers surveyed in section 2. The table 1 shows the information of each papers' : 1) proposed algorithm, 2) which environment is focused on research, 3) whether the authors used single or multi-UAV, 4) did they simulated with program or tested with real environment with development & implementation, 5) year of publication.

Table 1. Comparison of surveyed papers

Reference No.	Proposed Algorithm	Environment	Single or Multi-UAV	Simulation	Year of Publication
[1]	MFG learning control algorithm	Outdoor	Multi-UAV	Real Environment	2019
[2]	LVGF, IIFDS	Complicated Environment with Obstacles	Multi-UAV	MATLAB	2016
[3]	Real-time Motion Algorithm	Urban	Multi-UAV	Simulation using 3GPP Air-to-Ground Channel Model	2019
[4]	MSA*	4-D Dynamic Environment	Multi-UAV	Monte Carlo Simulation	2010
[5]	Hybrid MPC and IGWO	Urban	Multi-UAV	MATLAB	2016
[6]	IFDS, WOA, RIFDS	Urban	Single	Simulation	2018
[7]	PPPIO	Dynamic environment	Single	MATLAB	2015
[8]	Improved Wolf Pack Search Algorithm	Outdoor	Multi-UAV	MATLAB	2017

## 4. Conclusion

In the manuscript, we present a brief survey of state-of-the-art UAV path planning algorithms. The path planning solutions are also compared in the form of a comprehensive table that also includes the operational

environment information. In future, we intend to extend the scope of the survey that will aid the interested researchers to investigate the topic.

## Acknowledgment

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# Energy Trading from Solar Roof Top

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## Abstract

This research has objective to study development process of peer-to peer base simulated energy trading from solar roof top which buyers and sellers can directly offer and purchase electricity energy in closed micro grid distribution system. In this study, to develop the web application for energy trading platform using Microsoft Azure as tool. In addition to develop the Solar Rooftop's IOT smart device using Arduino Micro Controller Board (MCB) to control relay switching gear for on-grid and off-grid functions and transmit machine status information to web application platform thru mobile frequency's Narrow Band IOT protocol .In conclusion, this study able to effectively simulate energy trading and feasible for further study in commercialization, whereas, necessary to deep-drive study in real environment and related other laws and regulations.

**Keywords-** *Simulated peer-to-peer energy trading; Solar roof top; Micro grid; Microsoft Azure; Arduino Micro Controller Board*

## 1. Introduction

Among major alternative energy type e.g .wind, geothermal, hydropower, ocean energy, biopower, etc., solar power is recognized as most suitable energy concerning low carbon emission, reliability and resilience especially in sunny area, ease for installation and maintenance as well as high cost-efficient driving it become most popular clean energy source [1]. While, the average price per watt dropped drastically for solar cells in the decades which the 1977 prices for crystalline silicon cells were about \$77 per watt, average spot prices in June 2014 were as low as \$0.36 per watt or 200 times less than almost forty years ago [4]. This price trend was seen as evidence supporting Swanson's law that states that the per-watt cost of solar cells and panels fall by 20% for every doubling of cumulative photovoltaic production [5]. Economist predicted that solar could contribute 20% of total electricity consumption by 2030 [6]. Meanwhile, the cost of energy storages trend to fall sharply than base line prediction since 2013 for 40 %with extent of mass production above \$300/kW base line prediction was \$500/kW(in 2020) [7]. With compound of both cheaper crystalline silicon cells and energy storages, its total cost predicts to reach hurdle to beat the conventional fuel base electricity by 2021 [8]. At the end of 2015, Thailand, with a total capacity of 2,500-2,800 MW, share exceeds 60% of total installed capacity in ASEAN [9] meaning it has more solar power capacity than all the rest of ASEAN countries combined targeting to reach 6,000 MW for reducing 65 % of gas-fired electricity mix to 40% by 2036 [10,11].

In order to develop the simulated peer-to-peer energy trading in micro grid from solar rooftop, in this study aims to develop a web application platform for sending electricity demand order and electricity supply transmission, so-called energy trading, using Microsoft Azure platform and Solar Rooftop's industrial IoT smart device using Arduino micro controller board to control relay switching gear for on-grid and off-grid functions and transmit machine status information to web application platform thru mobile frequency's Narrow Band (NB) IoT protocol

## 2. Research Methodology

The research framework based on the agile approach for each development phase which incrementally added to the total platform. New or updated features were added by rerunning small sprints .There are 4 development modules i.e .Client Tier, Application Tier, iIoT Devices Tier, and Wallet Tier as shown in Figure 1.

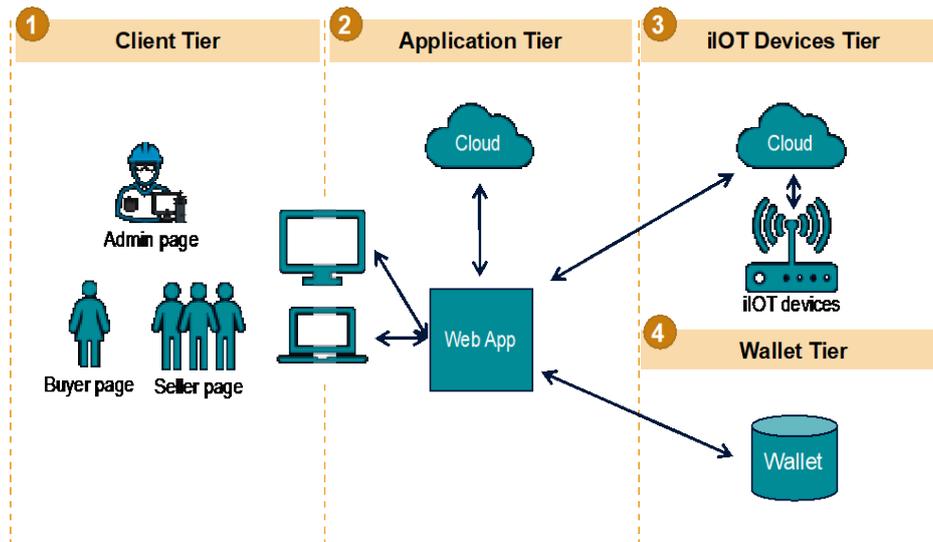


Figure 1 Development modules

From Figure 1, the activities of each module is following:

### 2.1. Client Tier

To develop the web application by designing the user interface (UI) for home page/ admin page including the marketplace, buyer and seller page and Grid operator page.

### 2.2. Application Tier

To develop the energy trading model and application programming interface (API) including all services.

### 2.3. IIOT Devices Tier

To develop switching gate control, electricity power measuring and the linkage between Arduino Micro Controller Board (MCB) and Narrow Band IOT (NB-IoT).

### 2.4. Wallet Tier

To develop the simulation of admin, buyer and seller wallet

## 3. Identify business requirement

Comparing to typical trading activities in other businesses, the energy trading has key different points in order to deliver business success as below;

- Electricity unit sale has 3 dimensions including electricity power (KWatt), frequency (Hz), and time (hr) while typical trading commodities have only 2 dimensions as size or volume and weight.
- Electricity is one of critical limited resources so that it has to control demand and supply of the market called Demand Side Operation (DSO) while typical trading commodities are controlled by demand and supply of the market in liberalized economic environment.
- Reliability and efficiency are highly required. The promptly Demand Response (DR) uses to measure quality of electricity supply so called the System Average Interruption Duration Index (SAIDI) and The System Average Interruption Frequency Index (SAIFI).
- In nowadays electricity energy system, the electricity is limited to wired transfer which have to involve public or private grid operators and regulators.
- Electricity market regulations may differ from countries to countries and markets to markets which regulators in Thailand have tightly centralized control over this market.

Hence, this study described not only business requirement but also relationship with grid operators and regulators .However, relevant web application features did not include .

### 3.1. Simulated energy trading

The simulated energy trading consists of single buyer and 2 sellers which both buyer and sellers possess at least one smart device that has functionality similar to smart meter.

### **3.2 Overall business requirement**

There are 5 steps in business requirement that the first one is to declare who is willing to buy and available to sell. 2. To do matching the demand and supply 3. To seek approval from operator 4. To start energy trading and 5. Finally process in energy trading.

## **4. Design the prototype**

In this study, there are six prototype as following:

### **4.1 Cloud platform selection**

To select the 4 key features as minimum requirement for the web application consist of Azure cloud service, Azure SQL database, web applications, and notification hub because it was very easy and efficient to develop frontend to backend application. While True Corp's NB IOT to connect with Google's IoT cloud thru CoAP because it was convenience to set up as well as high data transmission rate. Both cloud platforms made connection with API.

### **4.2 Programming language selection**

To select the computer programs as C#, Java Script, REST API, MSSQL, Node.JS, Microsoft.AspNet Core.Http, and Microsoft.EntityFrameworkCore.Metadata for developing the web application because it was easy to use with Microsoft Azure.

### **4.3 Micro controller board, Sensors and switch selection**

To select Arduino UNO R3 and Lambda Basic v1.3 for Micro controller board (MCB) because it has functionality and capability with high cost-efficient which Arduino IDE language was used for programming the MCB. For measuring electricity current, to select the ACS712 Current Sensor Module 30A Model Arduino compatible while selected 10A 1 Channel Arduino Compatible Relay switch because it is durable for electricity current used to simulate the energy trading.

### **4.4 Standard measurement device for sensors calibration**

To select multimeter Uni-T UT203 Digital Handheld Clamp Multimeter DMM DC/AC Volt Amp Tester Meter for calibrating the sensors.

### **4.5 Battery selection**

To select the battery cycle with the maximum's 12V 1.3AH, Charge controller Kranchana Electric's 30A 12V/24V, and Invertor Foyal's DC12v to AC 230V 2000W to simulate solar energy management device.

### **4.6 Wireless device selection**

To select the wireless data transmission device True Corp's NB IOT board (shield for Arduino) module Quectel BC95-B8 using 900 MHz band because Solar rooftop may be installed in remote area which difficult for maintenance which the NB IOT has wider coverage, lower power consumption, and longer longevity than typical LAN and Wi-Fi.

## **5. Development of the prototype platform**

### **5.1 Software development**

To develop the platform using the agile method for building up modules with small sprints starting from trading module and trading database to customer management module and e-wallet. An energy trading marketplace covers B2B, B2C and P2P method as well as in connectivity with iIoT devices for ensuring transparent, secure, fast and cheap transaction. eWallet platform is the platform for managing and settling payment for each transaction. Then used Swagger UI-API to simulate the smart devices as shown in Figure 2. By using MVC concept, researcher developed system architecture for platform development shown in Figure 3.

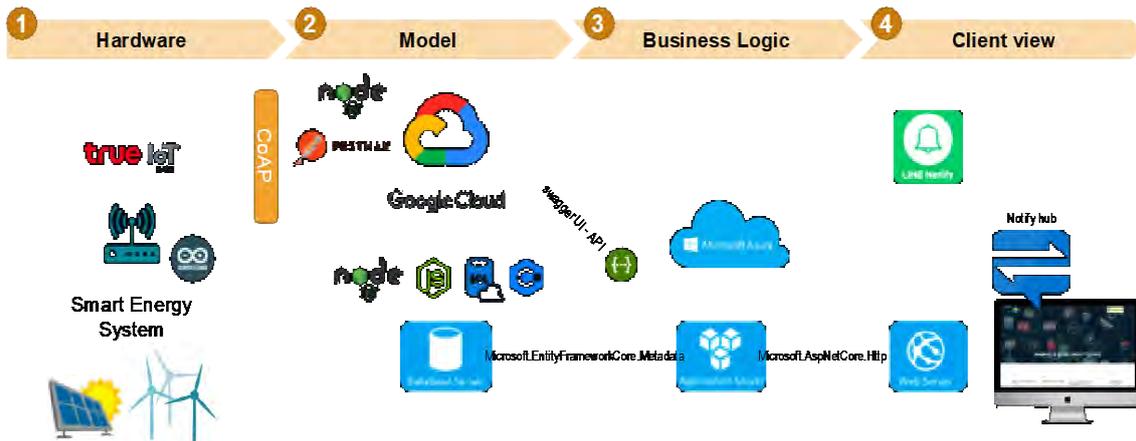


Figure 2 Platform development method

### 5.2 Hardware development

In order to simulate energy trading activity, prototype of 3 sellers and single buyer were developed shown in detail diagram as Figure 6 so called smart device. The smart device has functionality not only to control the switching relay but also able to send and receive information to software application necessary in energy trading activity. Hardware diagram was developed as shown in Figure 7.

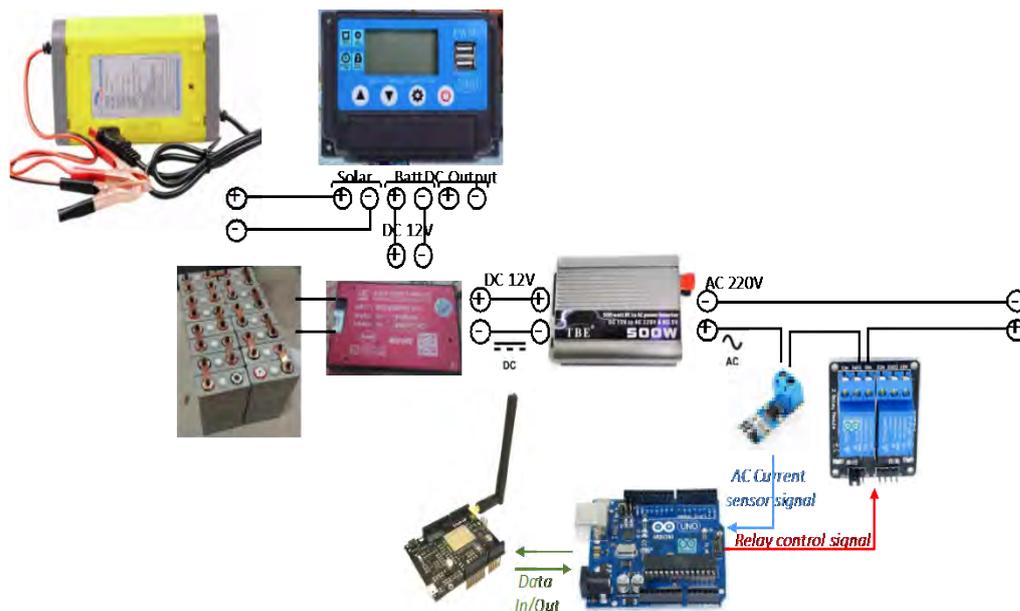


Figure 3 Hardware diagram

### 5.3 Connection between software and hardware platform

To test and retest the connection between software and hardware platform along the experiment while adjusting the connect along the way as well.

## 6. Results and discussion

6.1. **Web application** There are 6 functionalities for energy trading as following:

- The Home page provides Home/Login functionality while it also provides generic information of the project such as project concept, about us, and about energy trading.
- The User registration page provides the Register energy item functionality which buyer and seller have to provide individual /organization information e.g. name-surname, address, contact information, address,

GPS location as well as machine information e.g. smart meter serial number, inverter IP address, capacity etc.

- The Energy trading page provides Display/Browses energy trading, Select energy items, Order energy items, and Transfer energy functionalities which sellers can post to sell their energy capacity with proposed price per unit which buyers can select capacity to buy from whom at proposed unit price by issuing purchase order. The energy trading started to count down for transferring energy once both parties mutually agreed on the transaction.
- The Wallet page provides the Notify transfer completion and settle payment functionality which display individual account balance information and transaction ledger. The value amount represents Thai baht fiat currency which settlement of the trading executes with web application algorithm.
- The User transaction dashboard provides personal view of energy trading transaction's summary information.
- The Transaction history page provides the Notify transfer completion and settle payment functionality which display selling and purchasing transaction data.

### 6.2 Simulated energy transmission stage

Energy trading method occurs in real possible energy trading in micro grid which able to identify as 4 stages as shown in Figure 4.

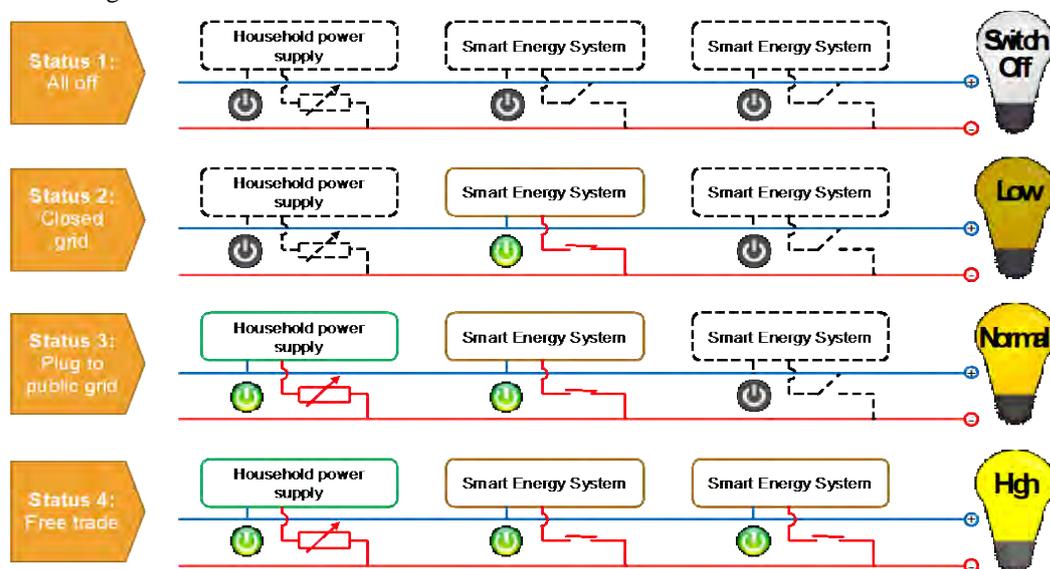


Figure 4 Simulated energy transmission stage

Stage 1 : All Off -

No electricity current supplied to the simulated system. Light was turned off.

Stage 2 : Closed grid (Off grid)

Electricity from single solar rooftop source supplied only to the simulated system. Light was turned on with low brightness.

Stage 3 : Plug to public grid (On-grid)

Electricity from single solar rooftop and public electricity distribution source supplied to the simulated system. Light was turned on with normal brightness.

Stage 4 : Free trade

Electricity from 2 solar rooftop and public electricity distribution source supplied to the simulated system. Light was turned on with high brightness.

### 6.3 Integration between hardware and software

The connection between web application and IoT smart device by choosing Enhanced Independently Self-Management Model enhanced the smart device to independently execute necessary command so that the smart device can operate based on self-reliance as well as reduce connection traffic and energy consumption.

## 6.4 Discussion

Command orders to control light bulb for turning on/off were synchronously sent to both experiment kits at the same time with 2 testing mode as normal and flashing mode. Researcher found that transmitted via NB IOT had longer responding time by approximately 1-2 seconds than others in normal mode. When testing with flashing mode, command order's responding time for all connection method took longer and longer so that researcher changed data storage from MCB's RAM to cloud then the issue solved.

## 7. Conclusion and recommendation

### 7.1 Conclusion

This study proposed agile method to develop energy trading platform using Microsoft Azure that able to offer peer-to-peer energy trading from sellers to buyers and industrial IOT that able to transmit solar rooftop and system data as well as receive command from platform to manage relay switch hardware via NB IOT .The proof of concept shows system capability to organize the energy trading from both software and hardware perspective which feasible to study further for commercialization while it still need to develop related software, hardware, and iIOT smart device to reach scalable system as well as explore legal constraints.After several trial, adjustment, and troubleshooting, the platform can successfully simulate energy trading using the web application and iIOT smart device.

### 7.2 Recommendation

This web application can able to explore further advance technology such as blockchain and machine learning for reaching smarter platform. In order to commercialization, the web application and iIoT smart device shall increase to be scalable platform with effective cyber resilience.

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# Downtime prediction for refrigeration in gas separation plants

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## Abstract

Predictive maintenance system for refrigeration in gas separation plants is a system developed to predict the life of the machine. To help facilitate the maintenance to be able to recognize the damage to the machine in advance by using sensor data attached to machines stored as databases since 2012 to date, every 5 minutes, analyze the damage history by time series graph. Then will take the time when the normal sensor data is made into the Relationship Model in which the engineering team of the GSP will select the sensor that is important as Target And will be able to find Predictor is obtained by doing the Matrix Correlation and modeling it. By choosing the model that is used to measure the accuracy of the model, the result is the Neuron Network that is most effective for data and forecasting. Finally, bring all models shown on the control panel so that the maintenance manager can monitor the forecast.

*Keywords- maintenance; machinery; forecast; gas separation plant; IBM Cognos*

## 1. Introduction

Refrigerant Unit B is an important part of the gas separation process in gas separation plants. If the machine in this part is lost and stopped all gas separation processes will not be able to continue working, which results in various disadvantages. For example, losing revenue from production the maintenance person cannot plan to prepare the equipment for maintenance. Causing the gas separation plant to lack credibility because the maintenance person cannot know in advance which part of the machine will lose and stop working the timing of repairs is a huge budget because sometimes the machine does not cause abnormal symptoms but has been repaired on schedule Predictions and maintenance schedules are the issues that maintenance personnel cannot plan.

GSP5 Refrigerant Unit B project will help operators and maintenance personnel can recognize the damage to the machine in advance by used big data from sensors of machinery within Rayong Gas Separation Plant that will be analyzed in statistics and was created as a model to forecast the damage to machines then the forecast was shown on the dashboard for the operators and maintenance personnel to know the forecast of machine damage, can plan for timely management and can check prevent and fix before losing the machine. Also, resulting in production which is also affecting the business of the Rayong Gas Separation Plant.

## 2. Related literature

In the preparation of a system for predicting the maintenance of refrigeration in a gas separation plant, Unit 5 has adopted the following principles of the theory used for research and development of predictive maintenance systems for refrigeration in gas separation plants Unit 5.

### 2.1 Neuron Network

Neural Networks is the creation of computers that simulate the methods of the human brain. Or make computers recognize and think in the same way as human neural networks To help computers listen to human language, understand, read, and recognize, which may be called “mechanical” neural networks or that is often referred to briefly as a network as one of the techniques of data mining, which is a mathematical model For information processing with connection-based calculation (Connection) to simulate the work of neural networks in the human brain With the objective of creating tools that are capable of learning pattern recognition and knowledge creation (Knowledge Extraction), as well as the ability in the human brain[2][8].

## 2.2 Time series

A time series is a set of quantitative data that is stored over a period of time, for example, the stock market index on a daily basis when trading is closed on a daily basis, Quarterly national revenue (GNP), revenue for each year of a company, etc. Time Series data is a collection of data that is collected over a period of time continuously, such as sales data collected. Continued for several months various national income data collected annually for several years, etc. Time series data may be in a manner that is annual, quarterly or monthly. Depending on the suitability for use because business information has changed over time Business leaders or organizations must find various development methods that can be used to make planning decisions about the consequences of any change in the operation Therefore, time series analysis has played a role in decision-making. One technique that helps to control current operations and to plan future needs is forecasting, in which many predictions can be made. Each method has the same goal: to predict future events.

## 2.3 R-matrix theory

A matrix or square is a square in which each box contains numbers or mathematical structures that can be added and multiplied by numbers. Can use matrix instead of linear equation systems Linear transformation and can store data that depends on the two initial variables. We can add, multiply, and split the matrix into multiple products of the matrix. The matrix is a very important concept of linear algebra. The matrix theory is a branch of linear algebra that focuses on matrix studies [6].

## 2.4 System development Tools

### 2.4.1 IBM SPSS Modeler:

IBM SPSS Modeler is a leader in visual data science and machine learning methods. Helps organizations create things and achieve the desired results quickly. Leading organizations around the world are using IBM SPSS Modeler for preparing and searching for data, predictive analysis, model management, deployment and machine learning to generate revenue from data assets as well as IBM SPSS Modeler It also gives organizations the right to access data and modern applications with complete algorithms and models that are ready to use immediately, Suitable for hybrid environments to meet regulatory and safety requirements.

### 2.4.2 Exaquantum:

Quantum is one of the most comprehensive data management systems for the industry. Quantum is able to receive data from every aspect of the process and convert it into easy-to-use and high-value data. Is a collection of Yokogawa plant historians, which have a central database that can retrieve and present to users throughout the organization, enabling them to achieve safe, reliable and optimal operations Quantum transforms data into actionable data, enabling smooth operation and optimization of work processes.

### 2.4.3 IBM Cognos:

IBM Cognos is software that helps to report data, combined with measurement analysis in the form of scorecards and dashboards. It also extends the capabilities with planning, modeling, simulation. Assuming, real-time monitoring and predictive analysis all of these results in the user being able to pull out the benefits from the insights within the organization effectively by being able to connect the data with the main stakeholders. To create a better understanding and help make better decisions in addition, IBM Cognos can also help organizations develop organizational culture. Which is a combination of many employees together, resulting in greater coordination efficiency, the core value of software is the ability to collect data completely. Covering all issues that users want to know and show the result in a format that is easy to understand this information can be connected to many related parties. Make the information correct and are consistent resulting in more efficient data analysis. The program is also designed to allow users to search and manage data freely, flexibly and without complexity. Enabling users to search and analyze data by themselves without having to use IT departments or analysts therefore suitable for all executives and employees who want to use software that can follow their ideas is not a software that they have to learn to use for a long time IBM Cognos allows users to answer important business questions[10].

## 3. Related research

Practical maintenance for centrifugal pumps in the pulp industry [1]. The pump is a device that helps transfer energy from the source of energy goes to the liquid to make the fluid move from one point to another with the position. Far more or higher at present, Thailand has used Pump in various activities There are many, such as household, agricultural and industrial sectors, in the industrial sector. There is a lot of pumps usage for example the petrochemical industry is used to transfer chemical substances in the production process, the oil industry to transfer oil from the production source to the storage source. Automotive industry used in cooling system cooling various heat Including the pulp industry used in Chemical and pulp loading [2].

The case study of this research is a pulp mill. In the production process, a large number of centrifugal pumps are used and given importance. With preventive maintenance to make centrifugal pumps can be used continuously However, still found that the occurrence of the problem of the centrifugal pump is shown in picture 1 and 2 When calculating the average time between Mean Time Between Failures (MTBF) in each production unit Found that the pre-renovation period was 392.57 hours to 1443.33 hours and the average time From the time of failure (Mean Time To Repair; MTTR) before the update is 25.92 minutes to 95 minutes. The relevant literature survey found that maintenance Forecasting can help to reduce the gap of preventive maintenance resulting in fewer crashes [3].

This research therefore focuses on preventing the occurrence of the incident. Failure of centrifugal pumps using maintenance Forecasting by forecasting for the appropriate time In checking the pump condition Create a check plan Vibration of the centrifugal pump That is appropriate And can make the pump effective Higher production By using the vibration value as The parameters that are related to the 3 main variables are the level of importance Lifetime And the workload of the pump [4][9]. Predictive maintenance is maintenance work by requiring activities to measure work conditions or analyze the deterioration of machinery and equipment with detection tools or test tools that can Analysis of the severity of the disorder can cause Can predict the chance of machine breakdown and determine the maintenance plan before the damage occurs Severe damage [5]. From the survey of literature related to maintenance Forecasting showed that vibration analysis was introduced. Used with pumps used in power plants by checking pump conditions with unstable time and analyzing the spectral graph of Vibration values can be obtained, for example, the pump has an indentation. The pump has a loose spot. Or bearing damage [5] Bringing vibration analysis results to be programmed to predict the type of damage that will occur to Machinery for greater convenience. Applying vibration measurement to machines in the oil industry which has divided the duration of the vibration measurement According to the working cycle of that machine and also the use of vibration measurement Used to analyze damage along with analysis Lubricant properties In Rotary Vane Air Compressor, which has the vibration value to be plotted To see trends in vibrations that increase or decrease [7].

#### 4. Method of operation

Forecasting system for refrigeration in gas separation plants. Unit 5 develops the system starting from collecting sensor data attached to the machine. There are totally 90 sensors, but only 41 sensors are useable because another 49 sensors have no data on Exaquantum.

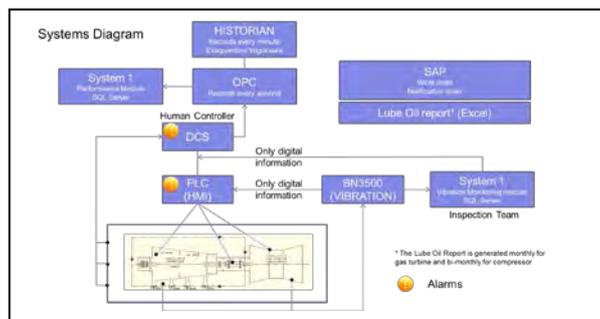


Fig. 1 Diagram of data from sensors

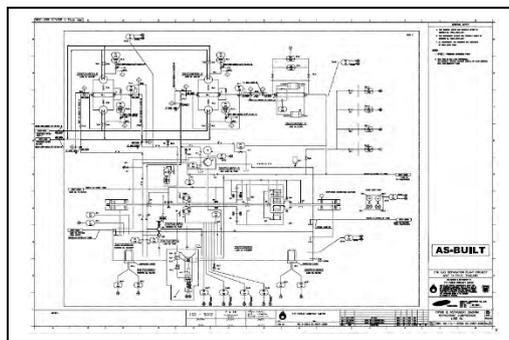


Fig. 2 Diagram of P&ID

By studying sensor data from surveying sensors in the gas separation plant, Unit 5 and studying the P&ID and Instrument List. Bring the sensor data of the machine to analyze from 2012 to the present had 65,535 rows by using the Time Series Plot according to the components of the machine in which the refrigeration is divided into.

The table lists various instruments such as pressure transmitters (PT-01 to PT-10), temperature sensors (TT-01 to TT-10), and flow meters (FI-01 to FI-10). It includes detailed technical data for each instrument, such as range, accuracy, and installation details.

Fig. 3 Picture List Instrument

Compressor, Motor, Gearbox, Lube Oil and Seal Gas in which Motor has no historical data. By the time the sensor data is abnormal, check with the engineering team of the gas separation plant whether caused by a broken machine or caused by shutting down the machine for maintenance. Which in this refrigeration machine has been confirmed that there has never been a broken machine history.

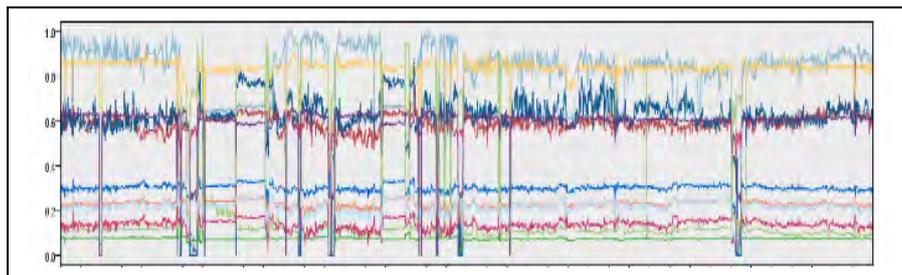


Fig. 4 Time series compressor chart

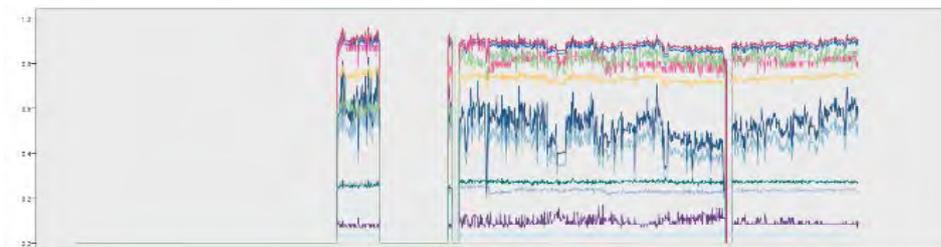


Fig. 5 Graph of time series Gearbox

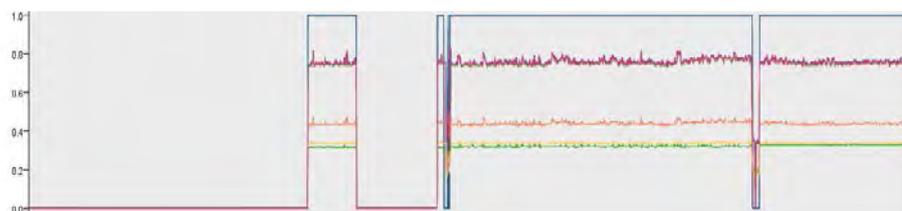


Fig. 6 Graph of time series Lube Oil

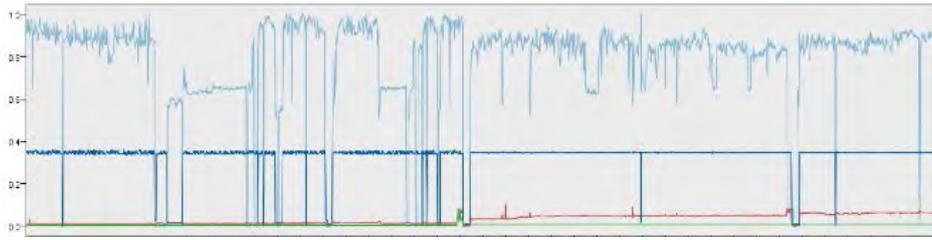


Fig. 7 Graph of time series Seal Ga

Then find the relationship of the sensor group. Select the sensor that is attached to the point that is important to the target by the engineering team of the gas separation plant, where all targets are divided according to the components. targets and checking for relationships that are related to other sensors and be used as a predictor by choosing a target value greater than 0.8.

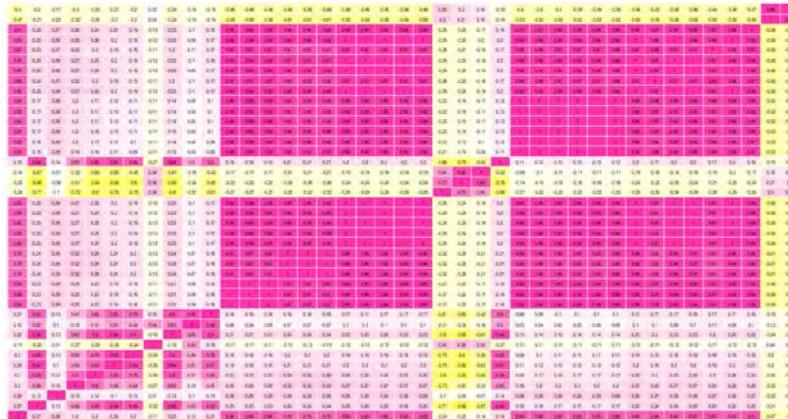


Fig. 8 Image of the relationship of the sensor

Then start the relationship model to check whether the predictor can predict the sensor that is target.

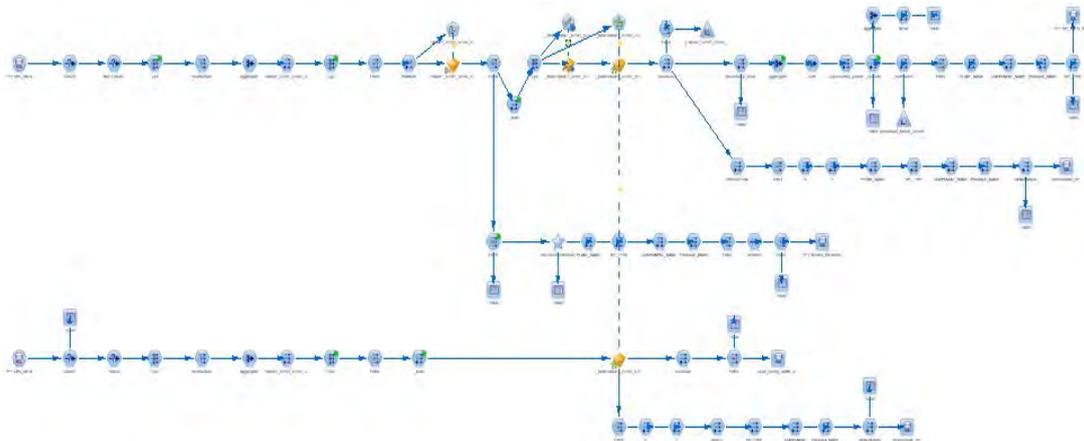


Fig. 9 Relationship Model

Once the model performance has been verified Found that the most suitable and accurate model is the Neuron Network, then records the data that the model predicted back to 2012 to the present as a history. And then pulling the value from the current database to test which users can check from the control panel of PTT Gas Separation Plant, Rayong.

### 5. Results

After collecting data and analyzing and creating models successfully will be set up as a control panel so that users can check the prediction results of the refrigeration unit in Gas Separation Unit 5, first, users must choose

the unit of the GSP Which has a total of 6 units. The Threshold Value shown will mean the health of the gas separation plant.



Fig. 10 The unit of the GSP



Fig. 11 The package page of the unit

When pressing down to the gas separation plant, the unit that the user wants to view the system information will show the package available in that gas separation plant. Select the package that users want to see information. Then click to go to that package. The system will display the health graph of the package. Show Alarm and can see in each part of the package from the left.

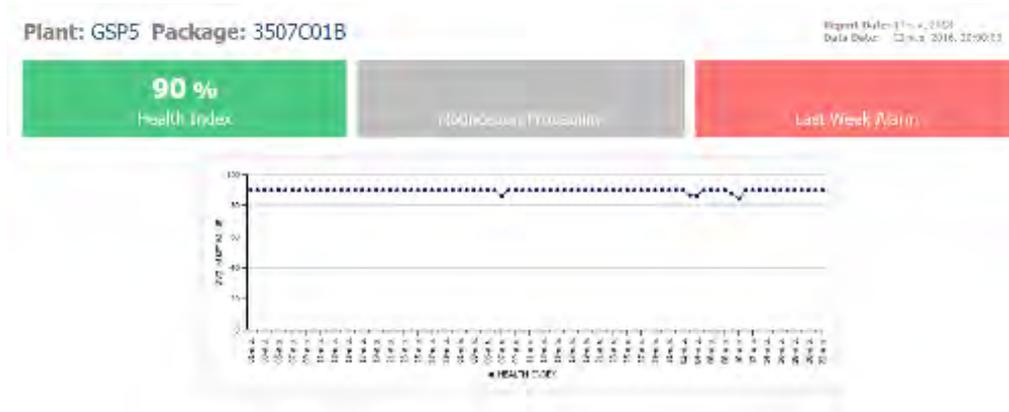


Fig. 12 An overview of the package



Fig. 13 The relationship of forecasting.

When users choose which part of the data to view the system will display the sensor pair derived from the Relationship Model, which can choose other pairs and choose the time interval from the left side. The deviation tells the health of that sensor. When pressing on the Model Prediction button, the system will show the page which the forecast is used, so that the maintenance technician will know the problem that comes from the sensor in any part.



Fig. 14 The name of the sensor used to predict

Table 1. ACCURACY MODEL. #LUBE OIL

LUBE OIL	MODEL	ACCURACY	MAV
PI102,PI03,PI104	NEURON NETWORK	25.3%	87%
TI113	NEURON NETWORK	28.5%	88.3%
TI114	NEURON NETWORK	24.6%	70.4%
TI115,TI116,TI117,TI118	NEURON NETWORK	62.5%	86.5%

## Acknowledgment

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## Human Activity Recognition System using R

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### Abstract

With the proliferation of ubiquitous computing, the desire to make everyday life smarter and easier is growing more and more. Human Activity Recognition (HAR) is the result of a similar motivation. By recognizing user activity, HAR enables a wide range of comprehensive IT applications. To contribute to the multifarious applications proposed by HAR, it is essential to plan the appropriate activities. The simplest of the problems of using the wrong data manipulation and the execution of the prediction using erroneous algorithms can interfere with the performance of the HAR system. R has proven to be a powerful and flexible tool for data mining and analysis. Here, we analyze the set of data extracted from UCI using R and become a subject of recognition of human activity. We are collecting 30 volunteers aged 19 to 48, each carrying a Smartphone at the waist, performing various activities and recording the data. Using the confusion matrix to apply the Support Vector Machine algorithm using the energy needed to perform activities, the frequency of each domain, etc., and display the results, standing, lying, or sitting. We classify the activities to be done. Its applications include surveillance systems, patient monitoring systems and various systems, including interaction between people and electronic devices. This document will drive future research in more productive areas.

**Keywords-** *Human Activity Recognition; R Tool; Smartphone; Support Vector Machine Algorithm;*

### 1. Introduction

The recognition of human activity plays an important role in dialogue and interpersonal relationships between humans. This is to provide information on the identity, personality and psychological state of the person. Human ability to recognize human activity is one of the subjects of scientific research in computer vision and machine learning [1]. The recognition of human activity (HAR) is an important task for Ambient Intelligence (AmI) systems because they are sensitive, responsive and adaptable [2]. It can recognize the human condition of human behavior and can be used as input to other systems. For example, in healthcare, you can detect abnormalities in individual movements and treat accordingly. It can be used to detect abnormal behavior on security and to prevent theft and other criminal acts.

Activity-based activity aims to understand the state of users and the environment using heterogeneous sensors. [3] When these sensors were attached to the subject's body, the ideal device for many tasks related to physiological signals was a cell phone. [4] In addition to basic phones, smart phones, the next generation of mobile phones, offer features such as multitasking and the deployment of various sensors. They follow the activities in a transparent manner, learn from them and then help us make better decisions for future actions. This is one of the important concepts on which Ambient Intelligence (AmI) relies. In this article, we plan to use smart phones with potential applications. Using an accelerometer and a gyroscope installed on the Smartphone, the data is recorded and used for analysis.

An easy-to-use graphical user interface helps users accomplish their tasks and improves the efficiency of expert users. R is a powerful statistical programming language that makes it easy to use the latest statistical methods using thousands of additional packages available on the R Archive Network (CRAN) full download server, [5] Use the R programming with. The user must find the name of the function that performs their task and remember the name and option of the name of the variable and the argument that gives it. The HAR dataset comes from the UCI archives and contains factors such as body acceleration and gravitational acceleration, which help to understand the movement in depth. [6] The details of the dataset will be explained later.

## 2. Related Work

Previous research on the recognition of human activity using accelerometers shows that it is possible to classify several attitudes and activities in real time. We developed a two-layer model combining a Gaussian mixing model and a first-order Markov model and classified activities such as sitting, walking, cycling and subway. [9] Only one 3-axis accelerometer installed on the cylinder was used. We classified the activities carried out in the carpentry workshop with an accuracy of 84.4% by combining the data of the three accelerometers and the two microphones placed at different places of the body. [10] They modeled most activities using a single hidden Gaussian Markov model. The number of hidden states modeling each activity was selected by visual inspection. Several classification algorithms of 20 types of physical activity were evaluated from data acquired using 5 biaxial accelerometers, and the overall recognition rate was 84%. [11]

Authors classify six different activities with an accelerometer and are commonly used to mount electronic devices with an accuracy of 16.7% to 92.8% depending on the position of the accelerometer. It is ranked in two different positions of the body and functions to use Camera-Ready paper in full size format, on A4 size or 8 1/2" x 11" (215.9 mm x 279.4 mm) paper. [12]

## 3. Motivation

Building a model to learn and analyze human movements in real time for evaluation is a difficult task. So we need research like this. Several approaches already exist to tackle the problem of recognition of human activity. Some use video, others portable sensors, such as an accelerometer, a digital compass, an angular speed sensor. The problem with these approaches is that it is expensive or requires fixed infrastructure. Therefore, smart phones use smart phones because they can easily use smart phones, which are relatively inexpensive and easy to use. R is open source; it is the first choice to analyze with more than 8000 packages. In addition, the social impact of this topic is great. If sports scientists and doctors can study personal movements that better understand their users and should help find new learning and new results. Therefore, it is essential in my aspect to study this subject and discover new discoveries for others.

## 4. Purpose

This Research is made to analyze the situation in real life. This provides a better approach for processing large data associated with different scenarios. The Human Activity Certified dataset specifically has the following objectives.

- Check the results to determine if the recognition is suitable for real life.
  - Introduce the main concept of human activity recognition and its application to real world problems such as surveillance systems and patient monitoring systems. Focuses specifically on the field of motor disorders.
  - To better understand user behavior in applications, imagine ways to contextualize physical activity.
- The main objective is to compare accuracy and identify the most appropriate classification model for an accurate analysis.

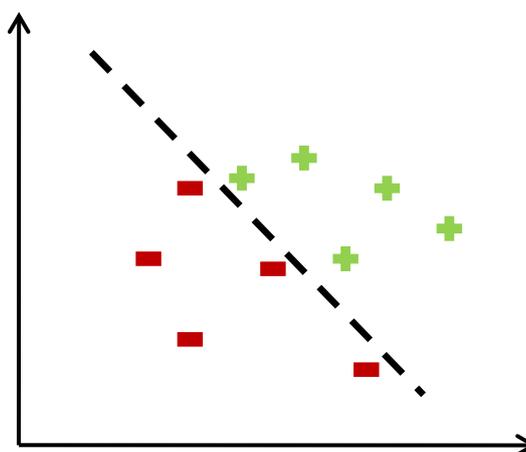


Fig. 1 Set of dataset.

Now it is divided into two parts, the train dataset and the test datasets as in figure 2. After studying the datasets, we download RStudio to perform the calculations for which we need to load the packages

## 5. Method

First, we have downloaded the dataset from the UCI website shown in figure 1.

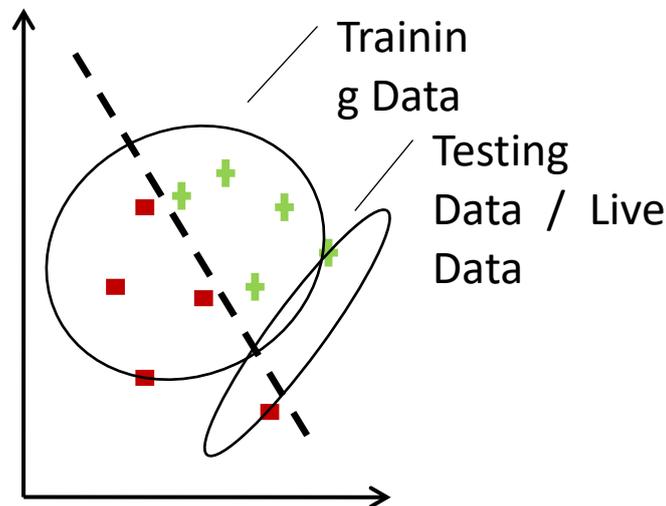


Fig. 2 Training data and testing data

The necessary packages are as follows.

- `library (ggplot2) # useful for drawing graphics in the Graphic Output section`
- `library (readr) # Helps read data from a dataset`
- `Library ("e1071") # Help to apply the SVM algorithm`

After downloading the package, run the following command to start importing data with RStudio. The train dataset includes 563 variables and 2947 observations, and the test dataset includes 563 variables and 7352 observations.

- `traindata.df <- read.csv (paste ("train.csv", sep = ""))`
- `testdata.df <- read.csv (paste ("test.csv", sep = ""))`

To see the dataset by using the `attach ()` command more clearly, you may make the objects in the data block accessible with fewer keywords, as follows:

- `attach (traindata.df) attach (testdata.df)`

To better understand the data, you may see the view and the general summary by using the following command, but you must first load the `psych` package from the available package using the `library (psych)` command.

- `see (traindata.df) described (traindata.df)`
- `see (testdata.df) describe (testdata.df)`

After a thorough review of the dataset, we combine the train and test data sets and create a single data set with a simple name for easy access.

The combined dataset includes 563 variables and 10299 observations.

- `Data <- rbind (traindata.df, testdata.df)`

Rename:

- `nameVec <- make.names (names (data), unique = TRUE)`
- `Name (data) <- nameVec`

The above procedure showed the beginning of the SVM model used to obtain the results. The second step is to subdivide the data in a ratio of 70: 30, with 70 being the training data set and the test data set.

- `traindata <- data [1: 7352,]`
- `testdata <- data [- c (1: 7352),]`

At this time, because of the large number of variables, reduce the dimensions of the dataset and consider only the main components. This step is called cleaning the data. This can be determined by plotting a graph that explains the relationship between the principal component and the cumulative dispersion. Different components of the variation are selected. As the graph example shows, the variable has variable variance up to the first 100 components, but all have static variance. We can see that only the first 100 components are selected.

Reduction of components:

- `pc <- prcomp (traindata [, - 563], center = TRUE, scale = TRUE)`
- `pc.var <- pc $ sdev ^ 2`
- `pc.pvar <- pc.var / sum (pc.var)`

Draw the graph:

- `coll = "red" graph (cumsum (pc.pvar), xlab = "main component", ylab = "cumulative variance ratio", type = 'b', main = "principal component ratio", col = "red ")`
- `Abline (h = 0.95)`
- `Abline (v = 100)`

## 6. Result

To display the calculation result above, create a confusion matrix. The confusion matrix is a table often used to describe the performance of a classification model of a series of test data whose actual values are known. The table displayed is as follows:

- `test.data $ activity = $ activity test data`
- `references <- test.data $ Activity`
- `t <- table (reference, result)`

```

> test.data$Activity=testdata$Activity
> references<-test.data$Activity
> t<-table(references,result)
> t

```

references	result					
	LAYING	SITTING	STANDING	WALKING	WALKING_DOWNSTAIRS	
LAYING	534	0	0	0		3
SITTING	4	419	63	0		4
STANDING	0	29	500	1		2
WALKING	0	0	0	477		19
WALKING_DOWNSTAIRS	0	0	0	3		409
WALKING_UPSTAIRS	0	0	0	21		23

references	result
	WALKING_UPSTAIRS
LAYING	0
SITTING	1
STANDING	0
WALKING	0
WALKING_DOWNSTAIRS	8
WALKING_UPSTAIRS	427

Fig. 3 Training data and testing data

The final step would be to Now to calculate the accuracy of the model, just to ensure that there is minimum error.

- `Accuracy <- (t[1,1]+t[2,2]+t[3,3]+t[4,4]+t[5,5]+t[6,6])/sum(t)`
- `AccuracyRate <- Accuracy*100`
- `c ("Accuracy", AccuracyRate)`

After running the accuracy command the final result comes out to be “93.8581608415338”. This ensures that we used the correct model and it can be implemented in our day-to-day lives.

## 7. Conclusion

We have analyzed the set of data extracted from UCI using R and become a subject of recognition of human activity. We found that the SVM algorithm is best suited to get the best results from the HAR dataset. We showed how to analyze the activities of the subject, from the recording of the activity to obtaining the result. This shows how doctors or supervisors can use this technique to investigate candidates and use them easily to solve problems. In addition, an accuracy of 93.8% indicates the suitability of the model and guarantees the best results of use.

We classify the activities to be done. Its applications include surveillance systems, patient monitoring systems and various systems, including interaction between people and electronic devices. This document will drive future research in more productive areas.

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# A study on the Design Management System of Rural Complex based on Synergetics

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## Abstract

Based on Synergetics, this paper constructs the order parameters framework of the design management system of rural complex, which is used to reflect the characteristics and law of the synergetic development process of the design management system of rural complex. Through the research on design management system, firstly the complex system is simplified into three subsystems: Strategic DM, Process DM and Implementation DM, and then from the perspective of urban design management system, the hierarchical structure is further constructed to explore the Order Parameters within the system. Through research, it is found that the order parameters affecting the synergetic development of rural complex design and management include six elements, namely law and policy, design strategy, design team establishment, organizational process, evaluation and decision, and project implementation. This paper demonstrates the objective laws and influencing factors of the design and management process of rural complex, providing technical and theoretical support for the synergetic development of rural complex design and management.

**Keywords-** *Rural Complex, design management; Synergetics; order parameters*

## 1. Introduction

With the acceleration of urbanization, the gap between urban and rural areas in China has further widened. In order to narrow the difference between urban and rural areas and achieve common prosperity, No. 1 Central Government Document in 2017 proposed to support conditional rural construction with farmers' cooperatives as the main carrier, allow farmers to fully participate in and benefit from rural complex integrating circular agriculture, creative agriculture, agricultural experience as a whole, develop pilot demonstration through comprehensive agricultural development channels [1]. As the realistic carrier of Howard Ebenezer's rural city and the product of urban planning strategy transformation, rural complex is of great significance to the transformation of urban-rural relationship from binary segmentation to urban-rural economic community.

Studying things requires not only discovering how they are structured, but also how the components work together [2]. Synergetics is the discipline to solve these problems. Synergetics was proposed by German physicist Herman Haken in 1975, as a discipline studying the self-organization laws among subsystems in the research system, synergetics is widely used in social science fields such as economics and management as a cross-sectional discipline [3]. The core concept of synergetics is the order parameter, which can be regarded as a macro-parameter representing the orderly state of the system in the process of evolution, measuring the synergetic efficiency of the subsystems [4]. Order parameters are generated from the subsystem and dominate the subsystem to operate in an orderly manner. Therefore, the exploration of order parameters in complex systems has become a key step in the study of system evolution. Using synergetics to study the internal synergetic mechanism and evolutionary characteristics of complex systems and to find out the order parameters in the design management system of rural complex will help deepen the recognition of the design management system of rural complex and broaden the research perspective.

Based on previous research, it is found that the current research on rural complex is still in the exploratory stage, focusing more on policy interpretation or emphasizing its important role in agricultural supply-side structural reform, while lacking the discussion on the content of rural complex design and management system. Therefore, through the analysis and derivation of basic theories, this study attempts to construct the order

parameters framework of the design and management system of rural complex, which can be used to reflect the characteristics and laws of the synergetic development process of the design and management system. At the same time, it provides technical and theoretical support from the perspective of synergetic development of design management system, providing a comprehensive basis for decision makers.

## 2. Methodology

This study is about the management system of rural complex design. Firstly, it studies the concept of rural complex and design management through literature review, so as to put forward the concept of rural complex design management. Secondly, based on the theory of synergetics order parameters and design management system, this paper tries to simplify the complex system and construct the order parameters framework of the design management system of rural complex hierarchically. The research object is developed based on the rural complex, the design management system, and the synergetic learning, and the scope of the research is limited.

## 3. Literature review

### 3.1 Rural Complex

Rural complex is a new comprehensive development mode which integrates modern agriculture, leisure tourism and rural community under the background of rural supply-side reform and the urban-rural integration pattern when China's industrialization and urbanization have reached a certain stage [5]. The model takes local agricultural characteristic resources as the core, integrates the functions of agricultural production space, resident living space, tourist viewing space and cultural landscape space, and realizes the integrated management of spatial planning, construction and operation. As a new ecological comprehensive planning area, rural complex focuses on promoting the diversification of industrial structure and the complex development of industrial functions. For the planning and construction of rural complex, this can not only promote the linkage of rural primary industry, secondary industry, and tertiary industry, but also have significance to the change of new urban-rural relationship.

### 3.2 The Design Management of Rural Complex

Design management is an operation process that integrates and redistributes the steps and participants involved in the whole design system, so as to maximize the design value. The focus of design management is to understand the strategic objectives of the organization, to understand how design can be part of the driving force of the objectives, and to use various means, tools, and personnel to plan requirements and effectively use the design to achieve the objectives [6].

From the perspective of design management, the operation mechanism of rural complex is discussed. The design and management of rural complex is the management and control of the whole process of the design and implementation of rural complex. Through the orderly organization and management of all participants and complex industrial chain in the design process, the efficient utilization and optimal development of space resources of rural complex can be realized.

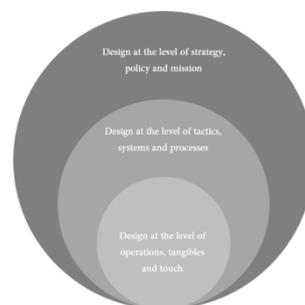


Fig. 1 Design management process

### 3.3 Synergetic and Order Parameters

Synergetics was first formally proposed by German physicist Herman Haken in 1975, which is used to study how complex systems far from equilibrium can achieve the orderly state of time, space and function through the synergy among the systems under the condition of external material or energy exchange [7]. Later, theories used to analyze and solve complex system problems are widely used in social sciences and management science. The key concept of synergetics is order parameter.

Order parameters are the key variables that reveal and determine the new structure, organization and function of a complex system, which are used to describe the overall behavior of the system. When the system is at the initial stage or close to the critical point of instability, the trend of the system's activities is jointly dominated by one or several order parameters in the system, so the order parameters have the ability to control the evolution process of complex systems.

#### **4. The Order Parameters Framework of the Design Management system of Rural Complex**

Rural complex being as a complex system of many factors interacting and cooperating, the single order parameter can hardly have a long-term effect on the whole system. Coordinate the mutual relations between the parties, coordinate the multi-dimensional internal structure, and finally form an overall, orderly and efficient management and operation system for the design of rural complex. Therefore, in order to avoid more elements restricting each other, give full play to its biggest joint collaboration between elements, gradually comb and build the structure of order parameters of rural complex design management system from the perspective of synergetics, so as to realize the synergetic development of rural complex design management system, making its society, economy, and maximize the value of space.

Kathryn Best (2006) argues that design management should be implemented at three levels: Strategic Design Management, Process Design Management and Implementation Design Management. Strategic DM refers to the overall policy task and design purpose determination. Process DM refers that design teams, processes, systems, business units, or functions enter the operation stage. Implementation DM refers to the implementation stage of products, services, experiences and other projects that consumers can get access to. Meanwhile, considering the similarity in content and nature between the design of rural complex and urban design, the design and management system of rural complex can obtain methodology basis from the research of urban design and management system. Therefore, the research on order parameters of rural complex design management system should be based on the synergetics theory and urban management design management system to build a hierarchy, including system, subsystem and order parameters.

##### **4.1 Strategic Design Management**

###### **4.1.1 Law and policy**

Based on the cognition of the synergetics theory, it finds that a complete synergetic management system needs a stable environment to guarantee. Therefore, it is necessary to establish perfect system guarantee and policy macro-control mechanism to eliminate various external unstable factors caused by system synergy [8]. Then the establishment of the guarantee mechanism of the design and management system of rural complex is a series of legal and policy guarantee measures for standardizing the design, management and operation activities of rural complex. At present, the urban and rural planning law and land management law have a relatively direct legal effect on urban and rural planning.

Macroeconomic regulation and control refers to the overall adjustment and control of the social economy by the government's policy measures, thus standardize the market operation to promote economic growth and achieve optimal allocation of resources. The policy macro-control mechanism for the design management of rural complex is mainly the policy planning and guidance documents formed by the government or the planning management department using funds, taxation or policy support, etc., to optimize the allocation of space resources of the complex.

###### **4.1.2 Design planning**

Considering that the rural complex is based on local cultural resources or agricultural-ecological resources, through the combination of agriculture and cultural creative industries and tourism and leisure industries, a comprehensive project of the linkage of rural primary industry, secondary industry, and tertiary industry is formed [9]. Therefore, at the level of design strategy, it is necessary to conduct a comprehensive survey on local natural resources, history and culture, and socio-economic background. Through data analysis and evaluation, it explores the intrinsic connection between design objects and the local environment and constraints, providing an objective basis for the establishment of design goals and the concept of the program.

Based on a large number of surveys, the constraints and expected development directions faced by the target areas are analyzed and the overall strategic objectives are established. And it builds a project design management system framework based on this, so as to lay the foundation of the target decision and guide the whole process. The main considerations in the process of establishing a target decision are project establishment reasons, project requirements, external constraints, and expected benefits. After determining the goal, a professional technical department is required to conduct a feasibility study. Considering that the purpose of the rural complex is to promote economic development and narrow the gap between urban and rural spatial value by

realizing the diversification of rural industrial structure, it is particularly important to analyze and evaluate the feasibility of economic benefits.

## **4.2 Process Design Management**

### **4.2.1 Design team establishment**

Due to the complexity of industrial chain of rural complex, the analysis, integration and utilization of its space need to involve land approval, economic investment and industrial operation, spatial planning and construction management. Therefore, the rural complex design team includes government officials, urban enterprises, design companies, real estate developers and local residents and other stakeholders. Different stakeholders have their own rights, responsibilities and interests in the whole system. Then how to cooperate with the design team to achieve the design goal, that is, the team's collaboration ability, is also what the design management system collaboration should be taken into account. An effective design team is usually composed of several members with excellent professional abilities, who have the technical skills required to cooperate well and achieve the desired goals. Therefore, the professional and technical ability of the team is the basis of achieving synergy among members.

### **4.2.2 Organizational process**

Organizational process is a design process that deconstructs the overall strategic goal into specific steps and has operability by properly organizing an planning the design process, taking into account regional characteristics, residents' needs, design aesthetics, management mechanism and other factors [10]. The design organizational process generally includes the establishment of the design goal, the conception of the conceptual scheme, the formulation of the design scheme and other links.

The goal establishment of design organizational process is different from the stage of design strategy. The stage of design strategy is mainly to grasp and determine the overall direction, while the stage of organization process is to further establish detailed and operable specific design goals for specific problems. According to the design objectives, and based on comprehensive survey data, conceptual scheme conception can be formed. After the design conception is completed, the design intention and concept are transformed into the content that can be evaluated and decided by experts or decision makers, which is mainly expressed in the form of text, drawing and multimedia. At the same time, the environmental, economic and social values generated by the project are comprehensively assessed.

## **4.3 Implementation Design Management**

### **4.3.1 Evaluation decision**

Design evaluation decision is to evaluate whether the design scheme meets the development needs of rural complex through objective comparison and judgment made by the evaluation subject according to the corresponding evaluation indexes according to the design scheme. It is a process of comprehensive judgment on the main content of the design project, the pros and cons of the scheme and the operability of the scheme. The complete evaluation decision-making process includes the selection of the participants and the formulation of the evaluation content. Among them, the participants in the evaluation and decision-making should reflect the interest demands of different levels, including government departments in charge, real estate investors, design companies, the public and experts and the expert team composed of scholars in various fields involved. The scientific rationality of the evaluation content can accurately predict the development of rural complex. Liu Wan (2006) believes that the urban design evaluation element system should reflect the overall interests of the city and the interests of the majority of residents, and predict the changes brought to the efficiency, environment, economy, society and culture of the city during the implementation process through scientific methods. On this basis, Wang Jianfeng (2016) further deepens the evaluation and decision-making factors into six aspects, including functional structure, spatial form, transportation system, environmental landscape, historic culture and policy incentives.

### **4.3.2 Project implementation**

Project implementation is a process of integrating the design into the overall intention of the environment and implementing it through the guidance and control of urban construction activities. For specific projects, through the concrete implementation of construction, the product of the process of materializing the design is the specific space and environment. Since the process of transforming design results into planning has not been institutionalized, it is difficult to implement the design results effectively, so as to guide the construction activities in the integrated body. Therefore, it is difficult for the implementation to achieve expectations. Then, how to translate the design as much as possible into the operational content of the project implementation, that is, the implementation effectiveness of the design, is also what the design management system should be considered at the project implementation level.

Since the legal status of the urban and rural planning law in the urban and rural overall planning system is not yet clear, the urban and rural planning management departments that control elements of some rural complex design do not have control authority.



Fig. 2 Rural Complex design management system

This research is based on Kathryn Best’s design management system and urban design management system. At the same time, it draws on the synergy theory to try to construct the order parameter framework of the rural complex design management system, which aims to reflect the characteristics and laws of the synergetic development process of the design management system. The final order parameters framework is arranged as shown in the following Table.1.

Table.1 The Design Management system of Rural Complex

Target Layer	Criteria Layer Subsystem	Secondary Criteria Layer	Indicator Layer Order parameters
Synergetic development of Rural Complex design management	Strategic Design Management	Law and policy	Systems guarantee effectiveness Ability of policy macro-control mechanism
		Design strategy	Comprehensive inquiry Strategic decision Feasibility analysis
	Process Design Management	Design team establishment	Team's collaboration ability Professional and technical ability
		Organizational process	Clarity of design objectives Conception of the conceptual scheme Project value assessment
	Implementation Design Management	Evaluation and decision	Selection of the participants Formulation of the evaluation content
		Project implementation	Implementation effectiveness of the design Planning approval process

## 6. Conclusions

The synergetic development of rural complex design management system relies on the coordination of strategic design management, process design management and implementation design management. Among them, strategic design management includes standardization and regulation of legal policies and planning and evaluation of overall design strategies. Process design management includes the formation of a professional design team and the organization of the design process. Implementation design management includes the selection of evaluation decision-making participants and the formulation of evaluation content, as well as the project implementation process under the constraints of the planning management department. Therefore, the instability of any subsystem will dominate the evolution process of the whole system. With the definition of order parameters in the design and management system of rural complex, the exploration of the degree to which the order parameters affect the whole system and the degree of synergy among the order parameters is of great significance to the realization of the synergetic development of the design management system of rural complex.

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# **Interpretation of Cultural Landscape for Development of TOD - Focused on Yaowarat Chinatown in Bangkok, Thailand –**

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## **Abstract**

As Asia's economy improves, the number of personal cars in big cities is increasing. As a result, air pollution is becoming serious in big cities. In Bangkok, the city is trying to solve the urban problem with a transit oriented development (TOD). This development is the basis for planning and developing various cultural contents in the surrounding areas. In this study, I analyze the cultural landscape of Yauwarat road in Bangkok's Chinatown for development of TOD system. This study aims to present the theoretical basis data on how to develop the TOD system through cultural landscape analysis.

***Keywords: Chinatown; Cultural Landscape; Development of TOD; Landscape planning***

## **1. Introduction**

As Asia's economy improves, the number of personal cars in big cities is increasing. As a result, air pollution is becoming serious in big cities. Also, traffic congestion is serious in the city center. In order to prevent environmental pollution and overcrowding in the downtown area, large cities in Asia are trying to solve the city problem with public transportation. Especially in Bangkok, the capital of Thailand, the city is trying to solve the urban problem through a transit oriented development (TOD). However, TOD is not just a public transport-oriented development. These developments lead to the development of the pedestrian-centeredness in this area. This development is the basis for planning and developing various cultural contents in the surrounding areas. Therefore, these cultural developments can be an important factor in improving the urban economy. Nevertheless, research about TOD system is largely biased in the transportation system. In this study, I analyze the cultural landscape of Yauwarat road in Bangkok's Chinatown for development of TOD system.

## **2. Research methods**

### **2.1. Research scope**

The scope of the study has a content and spatial scope. First of all, the scope of content is to interpret cultural landscape about space. The interpretation of the cultural landscape is not only for space but also for physical facilities located in space. Space can change its meaning because of user behavior. Thus, in this study, the cultural landscape of space is interpreted based on the behavior of the users. In addition, space is classified as outdoor space and interior space, and the outdoor space in this study is analyzed mainly. The scope of spatial is Yauwarat road in Bangkok's Chinatown. This area has distinct cultural properties compared to other areas. Therefore, this site is selected as the study site. The area is filled with Chinese style buildings, people of various nationalities, and various items. That's why the atmosphere in this space is so much more like China. The most central area is the area between Yauwarat and the Charoen Krung streets. The area is also numerous gold and silver shops, restaurants and old houses, including the Kaoh Market, which sells agricultural products, and the My Market, which sells medicinal

herbs and daily necessities. Some of the largest marketplaces in Bangkok are Woong Nakorn Kasem and Lang Krasuang in Bangkok's Chinatown.



Figure 1. Yaowarat Road in Bangkok's Chinatown

## 2.2. Research method

In this study, James P. Spradley's participation observation method was used to interpret the Yaowarat road's cultural landscape. The study analyzed the characteristics of streetscape of Yaowarat road. And, Ethnography is a research process in which the anthropologist closely observes, records, and engages in the daily life of another culture an experience labeled as the field work method and then writes accounts of this culture, emphasizing descriptive detail (Kim, Sung-kyun 1988; Chun, Hyun-jin. 2015; Chun, Hyun-jin. 2016). The method of this research was participant observation advanced by James Spradley to carry out lots of interviews according to James Spradley's theory (James P. Spradley 1979; Chun, Hyun-jin. 2015). And, the research process included several parts such as descriptive observation, domain analysis, focused observation, classification analysis, selective observation, and composition analysis (James P. Spradley 1979; Lee, Hee-Bong.1985; Chun, Hyun-jin 2015; Chun, Hyun-jin. 2016).

## 3. Cultural Landscape Analysis

### 3.1. History and Features of Chinatown

The Chinatown in Bangkok has a long history compared to Chinatown in other countries. The history of Bangkok's Chinatown is more than 100 years old. Merchants who lived in southern China during the Qing Dynasty came to Bangkok to trade with Thailand. At this time, Thailand was the time of King Rama I. During this time, the Chinese people moved to Thailand to form a Chinatown. Most of the Chinese residents in Chinatown were merchants. So they were mainly engaged in trade. And the Chinese had made money in Thailand and sent it to their families. The merchants of the Qing Dynasty exported pottery to Thailand, and the Thais exported rice and grain to China. In the early days of the Chinese settlement in Thailand, Chinatown was located next to the royal palace, but when King Lamar I of Thailand built the royal palace in its current location, the Chinese moved to the present Chinatown. The king of Thailand allowed people from other countries to live in Thailand. So, many foreigners lived in Thailand. This was learned through interviews with third-generation Chinese immigrants. As such, Thailand forms towns of various ethnic groups in each country. Bangkok has not only Chinatown, but also Japanese Town and Arab Town. Thailand is a place where the cultures of various countries converge. Chinatown is also a place where Chinese culture and Thai culture merge, and Chinatown has a special culture in Thailand. There are various Chinese-style jewelry shops and Chinese-style restaurants in Chinatown, and there are also all kinds of tea and herbal medicine ingredients on sale in Chinatown. From the main road, Yaowarat road, there are many alleys on either side. And there are many different shops in these alleyways. The landscape of this area is very similar to that of China. So, this Chinatown is China in Thailand.

### 3.2. Domain Analysis of Space and Facilities.

First, domain analysis was performed on the space and facilities. When a street space was analyzed, the street space was divided into three spaces. These three spaces were roadways, sidewalks, and shops. In this study, roadway and sidewalk were mainly studied because the outdoor space was mainly studied. First of all, various facilities such as chairs and stands were located in the road space as well as vehicles. And various facilities such as chairs, stands, cooking utensils, and so on were also located in the sidewalk space.

### 3.3. Interpretation of Space

Various items were located in the road and sidewalk space, as shown by the domain analysis. These items were made by a street vendor in the road and sidewalk space. Therefore, classification analysis and component analysis were performed on the street vendor. Through these analyses, the meaning of space was interpreted. Street vendors can be divided into two types. The first type was a vendor installed by store at the entrance of the store. These store vendors were installed for the purpose of displaying items in the sidewalk space. The Chinese have a culture of observing goods when they are purchased. So by setting up the product in the sidewalk space, the shopkeeper made an advertising effect on the product. The second type was the street vendor that an individual has installed in the sidewalk space. These types were divided into two types according to the method of installing a street vendor. The first was located in front of the store if it was not in business at the store. The second was to install a street vendor with a certain space between the store and the street vendor if the store was doing business. In such cases, commercial activity with customers was generally done in road space. Due to this phenomenon, the sidewalk space was transformed into a space for commercial activities and cooking, and the road space was transformed into a space for commercial activities.



Figure 2. Street Space of Yaowarat Road

### 3.4. A Proposal of Street Design for the Development of TOD

This area is the center of Thailand and has a large floating population. Traffic congestion in this area is very serious as there are many vehicles coming in. There is also a significant shortage of parking spaces in this area. TOD development is to reduce the use of personal cars and develop urban planning focused on the public transportation. Due to this development purpose, various public transportation facilities, including subways, will be introduced to this space. However, the introduction of such public transportation facilities alone cannot solve the problem of this space. Because the current transportation system is becoming a situation where many people engage in illegal activities by occupying sidewalk and road space. The characteristics of this commercial activity are the cultural characteristics of the Chinese people. In addition, the introduction of public transportation facilities such as subways will create more floating population of the space. Then the space will be even smaller and the illegal activities of the streets will increase. So there needs to be a change in the road system in this area. The current road system consists of a building, a sidewalk, and a road space. To develop the TOD, the space will have to be divided into buildings, commercial spaces, a sidewalk and road spaces. So we should turn illegal commerce into a legal place of commerce. And by reducing road space, it will have the effect of reducing vehicle inflow.

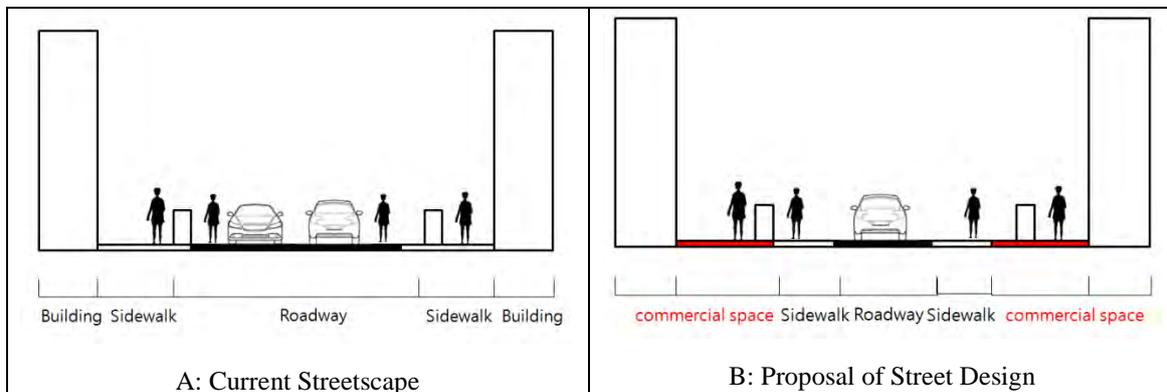


Figure 3. A Proposal of Street Design for the Development of TOD

#### 4. Conclusion

In Bangkok, the city is trying to solve the urban problem with a transit oriented development (TOD). This development is the basis for planning and developing various cultural contents in the surrounding areas. In this study, I am going to analyze the cultural landscape of Yauwarat road in Bangkok's Chinatown for development of TOD system. Looking at the results of the study, these spaces formed a unique cultural landscape, combining Chinese immigrants' behavior. Although the results of this thesis are not direct, it can be a theoretical basis how to develop the TOD system through cultural landscape analysis.

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# Emoticon Development Research on Product Users' Emotion

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## Abstract

In the social context of the rapid development of the Fourth Industrial Revolution, more and more products begin to emphasize user experience and user emotion. The emotional design thus has become an important research topic as a medium for emotional information exchange between users and products. However, in the field of product design, the research on users' emotional visualization is of poor practicality and insufficient application. Therefore, in order to analyze users' emotions more conveniently and accurately in the form of data in product design, this paper visualizes the user's emotions and develops a set of emoticons exclusive to user's emotions. Specifically, 32 emotion types are derived through literature research, and another 12 emotion types are derived through a questionnaire survey of 366 objects whom Korean and Chinese general product users. Then 12 emoticons were developed and matched for the 12 emotion types. It is expected that this paper will become the basic theoretical data of emotional design visualization of product design.

*Keywords-Product user; emoticon; emotional design*

## 1. Introduction

### 1.1. Background and Purpose of Research

Many new technologies and products have emerged in this intelligent society that is undergoing the Fourth Industrial Revolution. The increasing number of products have begun to pay more attention to emotional communication and emotional interaction between products and users. In product design, how to materialize and visualize abstract emotions is becoming an increasingly important research topic. However, the research on users' emotional visualization has not been widely applied in the field of product design. Therefore, the purpose of this paper is visualizing the emotions of product users and developing a set of emoticons of them.

### 1.2. Method and Scope of Research

In order to develop a series of emotional expressions for product users, this study collects and classifies various emotional vocabularies through literature review, extracting 16 types of positive emotion and 16 types of negative emotion. Through the questionnaire of Chinese and Korean users, it then derives 8 types of positive emotions and 4 types of negative emotions that users may express in the process of contact with products. Consequently, 12 emoticons are developed on the basis of the Facial Action Coding System 2002.

## 2. Theoretical Review

### 2.1. Definition of Emotion

In the daily conversations, the words emotion, mood, affect and feeling are often mixed to use. In the field of emotion research, the study of defining the words emotion, mood, affect and feeling is still the hot topic. Explicitly, the mood is distinguished from emotion in intensity and duration. The mood is low in intensity but wide in scope. It can last for a long time without specific target, purpose and focus. Emotion, by contrast, begins and ends very quickly.[1]

## 3. The Development Process of Emotional Types of Users

### 3.1. The Collection of Emotional Vocabularies

This paper collects a variety of emotional vocabularies in order to understand users' different emotions when they use the products. In many academic information retrieval websites such as RISS, Google Scholar, CNKI and Science Direct, "emotional words" and "product emotional vocabularies" are used as keywords to search, and 15 papers with high relevance are selected and sorted out as follows.

Table 1. Previous Studies on Emotional Words(part)

Title	The experience of positive emotion is associated with the automatic processing of positive emotional words
Author	Gregory P. Strauss & Daniel N. Allen
Source	The Journal of Positive Psychology, July 2006; 1(3) p.159
Positive	Glory, Honor, Joy, Lively, Love, Smile
Negative	Angry, Enemy, Hatred, Mad, Rage, Stern, Anxious, Nervous, Restless, Tense, Uneasy, Urgent, Cry, Gloom, Grief, Hopeless, Sad, Tragic
Title	Framework of Product Experience
Author	Pieter Desmet, Paul Hekkert
Source	International Journal of Design Vol.1, No.1, p.14, 2007
Positive	inspiration, desire, love, fascination, admiration, joyfulness, satisfaction, softened, relaxed
Negative	boredom, sadness, isolation, disappointment, contempt, jealousy, irritation, disgust, alarm
Title	Measuring emotion: Development and application of an instrument to measure emotional responses to products
Author	Pieter Desmet
Source	Funology. Springer, Dordrecht, 2003
Positive	desire, pleasant surprise, inspiration, amusement, admiration, satisfaction, fascination
Negative	indignation, contempt, disgust, unpleasant surprise, dissatisfaction, disappointment, boredom

As shown in table 1, there are 156 positive emotional words and 176 negative emotional words extracted from the relevant literature. After deleting repetitive or similar words, 16 positive emotional words and 16 negative emotional words were selected out of 332 emotional words. The first group is joy, like, excited, satisfaction, amazing, friendly, inspiring, relaxed, desire, interested, hopeful, innovative, calm, admiring, proud and fascination. Another is sad, disappointment, nervous, boredom, angry, disgust, tired, fear, useless, contempt, anxious, jealousy, shame, confusion, unpleasant surprise and insignificant.

### 3.2. The Questionnaire of Different Types of Product Emotions

Based on these emotional vocabularies extracted from the theoretical investigation, a questionnaire survey on product emotional types was conducted among the general product users in China and South Korea within 24 days from 26th February to 21st March 2019. This questionnaire uses 32 emotional words and Likert Scale. By filling in these 366 questionnaires offline and online and excluding those with insufficient information, there are 364 valid questionnaires collected and analyzed.

Table 2. The Outline of the Questionnaire

Categories	Contents
Purpose	Investigate the emotion types of product users
Survey Time	26th Feb. - 21st Mar. 2019
Methods	Offline & Online

Quantity	3 basic information questions & 32 emotional types questions Total of 35 questions
Type	Single-Choice Questions
Respondent	240 Chinese product users & 126 Korean product users
Result	364 valid questionnaires

(1) A Reliability and Validity Analysis

If the KMO value is small, it is unreliable as a variable of factor analysis. Generally, it is very reliable and valid when the KMO value above 0.90 but cannot be used as a variable below 0.5. In this research, the KMO value is 0.909, exceeding 0.70, based on the factor analysis of 32 emotional types questions, so this can ensure its reliability. Furthermore, there is also a reliability analysis of these 32 questions. The result shows that the Cronbach's  $\alpha$  value is 0.922, which can guarantee its reliability and validity.

Table 3. KMO and Bartlett test (32 questions)

Kaiser-Meyer-Olkin measurement of standard type relevance		.909
Bartlett' KMO test	Approximation chi-square	6820.384
	Degree of freedom	496
	Significance probability	.000

Table 4. Reliability Statistics(32 questions)

No.	Contents	Cronbach's $\alpha$	Number of Items
4-19	Positive emotional types	.919	16
20-35	Negative emotional types	.931	16

(2) An Analysis of Mean and Standard Deviation

In order to obtain the possible emotional types of users in the process of contact with products, the mean and standard deviation of the questionnaire results are analyzed, as shown in Table 3 below. It is shown that the mean of all positive emotional types is above 3 scores, in which the maximum is 4.11 get by Desire, and the minimum is 3.2 get by Proud. On the other hand, the mean above 3 scores in negative emotional types is Boredom(3.06), Confusion(3.03), Disgust(3.02) and Disappointment(3.01). Therefore, it can be known that product users are more likely to have positive emotions than negative ones when they use products.

Table 5. The Analysis Results of Mean and Standard Deviation

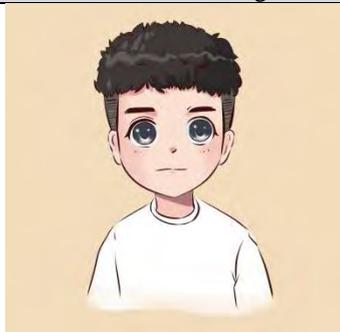
Emotional Types	Total	Mean	Standard Deviation	N	Emotional Types	Total	Mean	Standard Deviation	N
Joy	1410	3.87	.921	364	Sad	897	2.46	.985	364
Like	1468	4.03	.855	364	Disappointment	1095	3.01	1.170	364
Excited	1344	3.69	.976	364	Nervous	967	2.66	1.045	364
Satisfaction	1405	3.86	.909	364	Boredom	1113	3.06	1.176	364
Amazing	1313	3.61	1.027	364	Angry	927	2.55	1.104	364
Friendly	1215	3.34	1.033	364	Disgust	1099	3.02	1.239	364

Inspiring	1184	3.25	1.151	364	Tired	1084	2.98	1.113	364
Relaxed	1356	3.73	.980	364	Fear	919	2.52	1.129	364
Desire	1495	4.11	1.008	364	Useless	1088	2.99	1.135	364
Interested	1419	3.90	.933	364	Contempt	877	2.41	1.058	364
Hopeful	1238	3.40	1.022	364	Anxious	966	2.65	1.086	364
Innovative	1270	3.49	.961	364	Jealousy	815	2.24	1.029	364
Calm	1199	3.29	.976	364	Shame	788	2.16	1.007	364
Admiring	1194	3.28	1.113	364	Confusion	1103	3.03	1.158	364
Proud	1166	3.20	1.102	364	Unpleasant surprise	919	2.52	1.092	364
Fascination	1270	3.49	1.010	364	Insignificant	1077	2.96	1.028	364

#### 4. The Emoticon Development

According to the questionnaire results, it gets 8 positive emotional types and 4 negative emotional types. Positive ones are desire, like, interested, joy, satisfaction, relaxed, excited and amazing. Negative ones are boredom, confusion, disgust and disappointment. Therefore, this study initially develops the expressionless image before getting these 12 emotional expressions. The expressionless image and characteristics are shown in the following Table 6.

Table 6. Expressionless Image

Emoticon image	Body Part	Features
	head	The hair does not cover the facial features and the head positions in neutral.
	eyebrow	They are flat and horizontal.
	eye	The eyes are open and looking straight ahead, without wrinkles around them. The pupils are not dilating or narrowing.
	nose	No wrinkles.
	mouth	The mouth is closed and horizontal.
	hand	No hand gestures.

In terms of the principles of the Facial Action Coding System (2002), this expressionless image is developed. First, the character’s hair does not cover the facial features and the head positions in neutral. Second, there are no wrinkles around the character’s eyes and eyebrows. The eyes open and look straight ahead. The pupils are not dilating or narrowing. Third, the character’s nose and mouth are wrinkle-free under normal conditions. Fourth, the hands have no movements. Consequently, 12 emoticons are developed based on the expressionless image and the Action Unit of Facial Action Coding System (2002).

Table 7. Ultimate Emoticons(12)

Emoticon image	Emotional type
	Desire
	Like
	Interested
	Joy

Emoticon image				
Emotional type	Satisfaction	Relaxed	Excited	Amazing
Emoticon image				
Emotional type	Boredom	Confusion	Disgust	Disappointment

## 5. Conclusion

While more and more new technologies and products are emerging and developing, product users' emotions have been got more concern in product design. However, the research of users' emotional visualization is not widely applied in the practice of product design. Therefore, for purpose of deriving the emotional types of customers and creating a set of emoticons, this paper collected 332 emotional words through documentary research and extracted 16 types of positive emotions and 16 negative ones of after screening and classifying. Then there are another 12 types of emotion were derived from the questionnaire participated by 366 respondents from China and Korea. They are desire, like, interested, joy, satisfaction, relaxed, excited, amazing, boredom, confusion, disgust and disappointment. Ultimately, a set of emoticons of product users were developed on the basis of principles of Facial Action Coding System(2002). It is expected that this paper will become the basic theoretical data of emotional design visualization of product design.

## Acknowledgment

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# Toward Assessment for Language Learning: A Case Study in Thai Language Proficiency of Secondary and High School Learners

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## Abstract

This study introduces a Thai-language Learning Assessment (TLA) system that can be used to evaluate the secondary and high school learners' level of understanding in Thai language. In this work, the assessment was done by 253 learners who have a major in Thai language and teach Thai language to secondary and high school students in Thailand. The TLA provides a supportive online-learning environment and Thai language proficiency tests in six dimensions that are important for Thai language teachers. The six dimensions include 1) correctness in terms of pronunciation and word choice selection, 2) writing skill, 3) reading skill, 4) sentence structure and grammars, 5) understanding of language and culture. The results from this study show that the TLA system can enhance learners to determine their understanding both the language and culture through the analytical modules, and their feedbacks improve the language-learning system.

*Keywords-component; Assessment for Language Learning, Thai Language, Online Test*

## 1. Introduction

Languages and dialects are used as a medium of communication, helping people to understand each other. Each national language has a unique structure and characteristics that reflect the nation's culture. The study aims to assess an understanding of national-language learners. Therefore, a system for language learning provides supportive services for helping learners in self-evaluation in their language proficiency and improvement of the communicative capability.

The language-learning system provides agent services utilizing best practices in psychometrics allowing learners to produce the assessments of the learner's skills and knowledge in a particular language. In this work, we use Thai language as our case study and test our system with 253 Thai language teachers from secondary and high schools in Thailand. An approach to system development is an iterative waterfall model in the following processes: requirement analysis, design, and tests with use cases representing learning activities. The objectives of this study are as follows: 1) to understand the online learning and testing requirements for Thai language proficiency test, 2) to design and develop an effective online-learning and testing system for Thai language, and 3) to understand Thai language proficiency levels of Thai language school teachers. The knowledge that we gain from this research can be provided as recommendations for improving the learning contents and activities of Thai language in schools.

The rest of this paper is organized as follows. Section 2 describes the importance of Thai language learning requirements, trends, and issues of language-learning systems. Section 3 introduces a system design of the language-learning system and data manipulation. Section 4 then demonstrates a case study in Thai language proficiency of secondary and high school learners. Finally, Section 5 discusses significant issues and conclude the important points of this study.

## 2. Thai Language-Learning Systems

### 2.1 Thai Language

Language is not only words but also pronunciations, tone, and dialects. All of these parts of a language are shaped by culture and nation history. In the case of Thai language, learning and understanding the language is not only learn how to communicate but also learn nation history, tradition, and culture of society. The value of Thai culture is reflected by the language used in conversation, song, poem, children's play lyrics, lullaby, riddles, folk music, and folk literature. Thus, to learn and understand the language is very important. To help learners to learn Thai language more effectively, we introduce the Thai-language Learning Assessment System (TLA).

### 2.2 Trends and Issues of Language-Learning Systems

Language testing [1] is an essential major in the educational system. Each major has a different curriculum and a compulsory language subject. National-language learning mainly focuses on various criteria, including pronunciation, word choice, sentence structure and grammar, reading, and writing. The benefits of achieving those criteria help learners to communicate in a better understanding. Besides, not only the learning criteria can improve the communication skills of the learner, an understanding of Thai language encourages can be accumulated and inherited a national identity and a cultural property to the next generation.

In order to understand both language and culture, computer and technology can be exploited for teaching and learning purposes. In this work, we aim to help learners to enhance their understanding of Thai language by providing an online Thai-Language Learning Assessment (TLA) System. Alderson [2] advised that “Computers can be used at all stages in the test development and administration process—test delivery, test construction, test compilation, response capture, test scoring, result calculation and delivery, test analysis and storing tests and details of candidates.”

For these reasons, this work aims to enhance the language-learning process by integrating learning resource into IT systems and supporting learners to understand their performance and suitability.

### 3. System Design of the TLA System

The system overview of TLA system, as illustrated in Fig.1 presents modules supporting four user’s types: a system admin, teachers, learners, and academic experts. The system consists of five essential modules and the instruction is as follows.

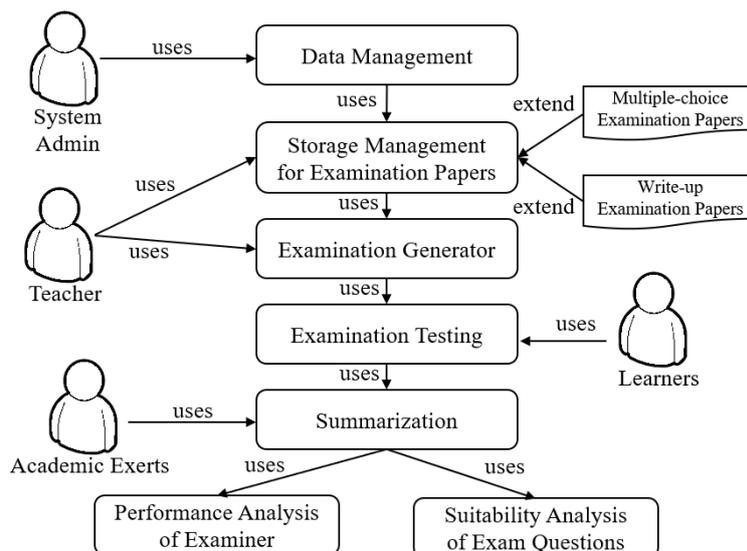


Fig.1 System Overview of the Thai-language Learning Assessment (TLA) system.

Starting with *data management*, the first module provides a service of data manipulation consisting of two submodules to manage and generate learning resources in the system: a managing resource agent and a generating data agent. The first agent is managing the paper-based learning resource,

including insert, update, and delete data, and the second agent is generating the prepared data and store into system storage. Next, the second module is *storage management* collecting two groups of examination papers: multiple choice exams and write-up exams. The third module is then *examination generator* that prepares a process of the examination by generating the learning resources and setting criteria of assessments. After that, the language learners can *test examination* in the fourth module. Finally, they can check the result in the fifth module that presents the *summary result* in two parts of analysis: performance and suitability.

#### 4. A Case Study in Thai Language Proficiency of Secondary and High School Learners

##### 4.1 Sampling and Data Collection

The paper-based examination resource is 30 datasets of Thai language and culture for secondary and high school learners. The assessment was done by 253 learners who have a major in Thai language and teach Thai language to secondary and high school students in Thailand.

##### 4.2 A System for Thai-language Assessment

As aforementioned in the previous section, the supporting module of the TLA system facilitates users to work with examination processes. The system users can categorize examination criteria for identifying scores in each question and analytical points. In this work, 45 question identities belong to different criteria, as shown in Table 1.

Table 1. Question identities of six criteria for identifying scores of the language learners

Criteria	Question Identity
Pronunciation	vowels   consonants   trio   double letters   single letters   tonal tones   tonal diversion   syllable   section spelling   dead syllable
Word Choice	words and meanings   types and functions of words   synonyms, synonyms, synonyms, synonyms   words from foreign languages   dictionary
Sentence structure and grammar	words   composition   repetition   overlapping   words   words   sentences   concise / proverbs   types of sentences   ambiguous sentences   sentences using foreign language structures   marking and use of punctuation
Understanding of language and culture	language level (timely and personal)   language showing views   persuasive language   royal language   idioms: motto / quotes / proverbs / gnome
Reading	reading comprehension / essence / summary   analytical reading   reading literature (literary / social values)
Writing	spelling   reasoning   sorting   report

As shown in Figure 2, the summarization module generates the learning result into two parts: (1) summary of recent examination and (2) a percentage of correctness. First, a summary part shows the learners name, examination date, duration, correctness scored, percentage, rank, and level of learners. The second part illustrates six criteria consisting of pronunciation, word choice, writing, reading, sentence structure and grammar, and understanding of language and culture.

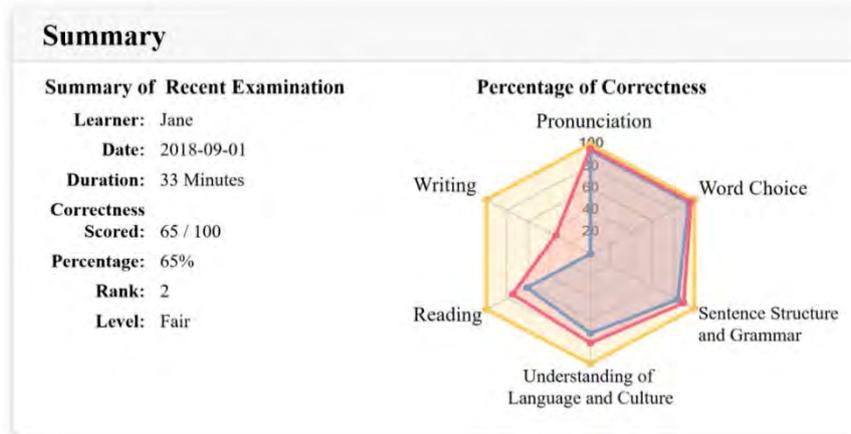


Fig.2 Excerpt of the summarization module from learner’s performance analysis.

### 5.3 Result

The LTA system assessed the 253 Thai language learners from secondary and high school on February 20-28, 2019. Fig.3 shows the assessed result that the three major criteria have high scores, including punctuation, word choice, sentence structure, and grammar, except for writing criteria. The criterion in the understanding of language and culture has a lower score than the major criteria.

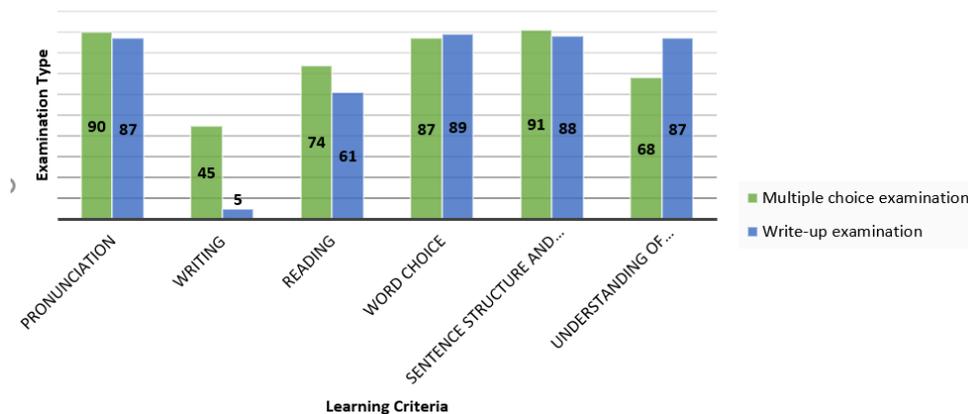


Fig.3 Examination analysis of Thai language learning system with six criteria.

## 5. Discussion and Conclusion

This research study presents the Thai-language Learning Assessment (TLA) system. The TLA system provides a supportive learning environment for Thai learners comprising of the five main modules: data management, 2) storage management for examination papers, 3) examination generator, 4) examination testing, and 5) summarization. The system provided the components to work with 25 datasets of Thai language learning for the secondary school.

The system assessed the 253 learners, and the result elucidates an understanding of Thai language learners considering their correctness with six essential criteria. Although the studying result showed that their language-learning were improved and developed, successes and limitations are discussed and determined regarding the issues of language testing in Thailand [1]. In success perspective, the learning impact [3], [4] can be considered into two perspectives: learners and education systems. The language learners can absorb the culture in each question, including cultural information, and the system can be the medium for integrating cultural knowledge. Next, the learners who aim to admit the higher education can test their knowledge and understanding through various questions based on language and culture.

On the other hand, standardized tests are the future challenge of the TLA system. This work used the national examination papers of secondary and high school. The score measurement and questions need to be standardized at a national level. The use of standardized test needs to clarify the curriculum

of all secondary and high schools. For example, the problematic part of score calculation is writing criteria, especially in the 'reasoning' identity that depend on a proper understanding of learners.

Therefore, the working result presents that the TLA system can enhance Thai language learners. The analytical module can use to determine that they can understand both the language and culture. Using the system can improve the language-learning skills. Analyzing their feedbacks can help us to improve quality in designing a better supportive examination system.

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# Analyzing the Semiotics of Chinese Animated Short Films: A Case Study on <Love Seeds, 2016>

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## Abstract

In recent years, Chinese elements have constituted the extensive and profound national characteristic culture of China, and as a kind of manifestation pattern of synthetic arts, animation is one of the major communication means of mass media, and of great influence. With the connotative semiotics theory of semiology as theoretical basis, and with the 4 series cartoons of “Choir of Chinese Poems”, one of the local cultural projects of 800 years of Jiading, Shanghai as examples, which are namely animation short films of <The Lunar New Year, 2015>, <Love Seeds, 2016>, <A Traveler's Lament, 2017> and <Rain in the West Lake, 2017>, all possessing Chinese elements. The communication of content, symbolization and functions of Chinese elements in animation short films were analyzed in this thesis to explore the development direction of Chinese traditional cultures in cartoons, which have a profound significance on the spread of Chinese traditional culture.

*Keywords-Chinese traditional elements, animation short film, Choir of Chinese Poems, symbolization*

## 1. Introduction

With the development of media technologies, animation, as one of the most important media of mass communications, has become an indispensable part of people's life. In animation production, application of traditional elements of different countries varied with different national features, e.g. animation films with traditional elements like <Monkey King: Hero Is Back, 2015>,< Big fish Begonia, 2016>,< Kuiba, 2011-2014> , < White Snake, 2019>, etc. emerged in endlessly, which laid foundation for the prosperity of film market. There were also animation short films like <Bao, 2018> , <Valley of White Birds, 2017> , < First Bloom, 2017>, <Choir of Chinese Poems, 2015-2018> and <The Six, 2018>, etc. that entered the next round of competition or won the award in the international animation film festivals like “In Competition unit” of Annecy International Animation Film Festival, the Tokyo International Animation Fair, etc.

Animation short films with Chinese traditional elements have been paid close attention to in all kinds of international animation film festivals. It was because domestic animations still followed the Chinese traditional esthetic styles in cultural symbols and story motif, which had distinct contemporary characteristics on ideology and value judgment [1]. While there have been few researches on application analysis of Chinese traditional elements in animation short films through the connotative semiotics theory of semiology, so with connotative semiotics of semiology as theoretical basis, successful cases of animation short films with Chinese traditional elements were analyzed in this research, which would be helpful for the creators to grasp the context of Chinese traditional elements and to think about the new patterns for the development of animation short films with Chinese traditional elements.

## 2. Theoretical Research

### 2.1. Theoretical basis

#### 2.1.1 Connotative semiotics semiology

Semiologist Roland Barthes made an in-depth statement based on the “signifier” and “signified” put forward by Saussure. He believes that meaning means the process of combining signifier and signifier that is integrated

with the finger, and the product of the act is the symbol. The symbolic process that makes it full of meaning is the meaning, that is, the way we give meaning to things to understand the world. He put forward RC, namely the connotative semiotics theory with integration of the ERC opinion of Louis Trolle Hjelmslev. The connotative semiotics system contains 3 basic elements, namely the signifier, signified and signification functions, Roland Barthes approved the relationship between signifier and signified established by Saussure and he regarded the process from signifier to signified and its symbolic function as a new “signifier” that could form a secondary signification with a new signified, which was the secondary symbol system, i.e. the connotative semiotics (Fig. 1). All signification combinations include an expression level signifier (E1) and a content level signifier (C1), while connotative semiotics corresponds to the relationship between the two levels (R1). In Figure 1, the combination of signifier E pointing to signified C through the intermediate signification behavior R is a symbol.

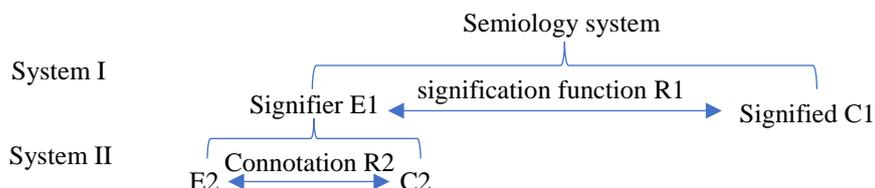


Fig. 1 : Connotative semiotics

**2.1.2 Chinese elements**

“All cultural achievements gradually formed during the processes of fusion, evolution and development of Chinese nation, created and inherited by Chinese people, reflect the humanistic spirits and folk-custom mentalities and with Chinese peculiarities are Chinese elements, including tangible material symbols and intangible spiritual contents, namely the material and spiritual cultural elements,” [2] Chinese elements are manifestation patterns of Chinese cultures, which embody the regional characteristics and value of China. Chinese elements are mainly expressed on the material and spiritual levels, of which material level is the extension of Chinese elements, and spiritual level is the connotation of them, and neither of the 2 factors is dispensable. In conclusion, Chinese element symbols can be analyzed on the following 3 aspects, namely the visual element, the audio element and the traditional cultural thought element.

**2.2 Relationship between Chinese traditional elements and symbols**

Linguistician Saussure introduced the concepts of “signifier” and “signified” and the function of “signification” into semiology of the language sign, and through constant development of semiology, the concepts of signifier, signified and signification have been gradually improved. Signifier refers to a visualized physical world; signified refers to the connotative meaning of symbols, and signification is the process in which signifier and signified constitute the symbols. With the constant expansion of applied range of semiology, its system becomes increasingly complete, so film semiology has been generated and gradually applied to the fields of films and animation films. Chinese traditional elements constitute the Chinese traditional cultures, elements and symbols are closely linked to each other, and traditional elements will have the features of symbols and form various symbolic patterns when given to form signs and symbols, which are of more complicated connotative meanings. Integrated with the opinions of Louis Trolle Hjelmslev, Roland Barthes put forward the connotative semiotics theory to provide theoretical basis for the explanation of more complicated cultural information with deeper levels. The unscrambling process of audiences on surface and deep cultural connotations of Chinese elements and symbols when they are watching the animation films constitutes the connotative semiotics. For example, in A Traveller's Lament, The Chinese character "Quiet" in the dream of a male protagonist, which embodies the wishes of Confucian scholars in the imperial examination era for high school. It is also the symbol of ancient imperial examination culture in China (Fig. 2).

	E2	R2	C2 Chinese characters, a person who is head and shoulders above others , the symbol of ancient imperial examination high school in China, imply that the examination passed.
	E1 Kui	R1	C1 Chinese Characters, the brightest and best
			Constructing connotation between C1 and C2

Fig. 2 : Connotation’s Constructing

### 3. Empirical analysis on *Love Seeds*, the series animation short film of ‘Choir of Chinese Poems’

#### 3.1 Analysis on connotative semiotics of Chinese traditional elements and symbols in the animation short film *Love Seeds*

Application of Chinese elements in animation films experienced a stage from superficial application of symbols to connotative expression, expression of Chinese culture is connotative and shows the deep-seated thoughts and emotions in a restraining form. In *Love Seeds*, the “red bean ” was taken as the reliance to represent a sad and beautiful love story that happened in Qing Dynasty, in which Wang Chutong, a celebrity of Jiading and Liuniang, who were childhood sweethearts, fell in love with each other and pledged their love with an red bean but did not have the luck to stay together. Connotative semiotics itself is a complete system that contains signifier, signified and signification functions. Researches on each of the cultural system cannot exist without researches on the 3 elements.

Seen from the visual features, symbols are not only a kind of visual artistic manifestation, but also the cultural connotations hidden inside of symbols. Through the rhetorical device of empathizing, the creator changed traditional cultures and national spirits into symbols, which became the symbol system with a common language environment towards the audiences and could effectively complete information transmission and communication. e.g. the typical Chinese cultural codes like oiled paper umbrella, moon-shaped fan, paper-cutting butterfly, bridal sedan chair, red bridal veil and plamer, etc. that occurred in the short film all actively took part in the narrations of the stories in the Chinese-style animation.

In the character design, Chinese traditional elements not only played the role of atmosphere fostering, they were also granted with symbolic meanings. Ancient Chinese people usually grant natural images for people’s moralities and made them become symbols, in the traditional Auspicious Painting, there was the so-called “sequence diagram” to express the 5 kinds of relationships among people, which were all detailed signification processes as well as the generative process with significance of symbol [3]. The costume design of Wang Chutong, the hero, was tended to be with the characteristics of figures in Qing Dynasty, and his hair style was the long plait modeling of Qing Dynasty; during the times of the hero from child to adult, there had been no obvious change in the hair style or costume, which were with blue as accordatura and with singular costumes; such design embodied that the family circumstance of the hero was poor on one hand, and symbolized the simple and honest intellectual image of the hero incisively and vividly on the other hand. The image of chief actress Liuniang was a child of a rich family, the costume of whom was designed into traditional upper outer garment with skirt, and the hair style was double coils; a wisp of hair was at her forehead in the cradle, which embodied the smartness of a maiden. Red was the main accordatura of her costumes, and the colors were partially dimmed on the whole; the characters young of age was relatively bright; after growing up, she took an embroidered fan by hand, which showed her gentle personality; every word and action of her was strictly ruled when she went out, which she could not revolt, and this showed the forbearing personality of the chief actress and her desire for free love. Detailed descriptions were given to the fan in the film, the symbol of which was taken as the signification of mildness and beautifulness of women in southern China and the character personality of the chief actress, which was with lively spirit and charm.

It is a trend for the development of domestic animations to apply national characteristic symbols of Chinese traditional cultures into animation creations, and a set of unique presentation techniques was opened up by the animations on the aspects of audio-visual languages and narrative expressions integrated with the changes in features of the times and aesthetic demands. Chinese traditional cultures are of deep and broad connotations, and they are also extensive and profound, which are practices and summaries on Chinese traditional culture through historical precipitations and changes, embody a unique artistic realm and finally show a poetic space with fusion of feelings and natural settings, complementation of the false and the true as well as endless life charm.

Small towns of southern China occurred in the scene design mainly. The descriptions on scenes of the southern China were incisive and vivid, including the description on memorial gates, constructions, small bridges over flowing streams, lanterns and couplets hung by the doors of houses in the alley on a rainy day and the building groups of the whole town of southern China, etc. The overall style of frame composing was unified, the composition of pictures was fulfilled without any magnificent rendering, and changes in the tonality of scenes lay the groundwork for the emotions of the chief actor and chief actress.

In the design of music, the background music played a perfect subsidiary role in the whole short film, with the start of vendors’ hawking, the continuous patter of raindrops and the bright background music, it came to the scenes containing all kinds of interesting episodes of the hero and heroine. The temperaments of musical instruments lie flute and Guzheng were mainly adopted in the short film, which better met the features of ancient charms and styles of the short film. With the coordination of music and scenes, people could change their mind as the scenes changed, with the charms of Chinese style all around. E.g. when Liuniang was about to be married, Wang Chutong sat at the doorway of Liuniang’s house and cried sadly, when the mournful music

started, which was thrilling and brought people into the sad atmosphere; the song of red bean was at the end of the animation, which was of melodious tunes and lyrics.

Seen from the aspect of traditional cultural thoughts, the creator applied the doctrine of the mean by the Confucian School to establish the culture of “benevolence” and “etiquette”, which contained a slight pity, their emotions were kept restraint from the beginning to the end to show the tragic love in the short film (Fig. 3).

Time	Movie screen	Chinese elements	Symbol analysis		
00:34		Vigna angularis	E2	R2	C2 The male protagonist recalls his love story when he was young.
			E1 Vigna angularis	R1	C1 Acacia, red beans in Wang Wei's ancient poems
00:39		Vigna angularis	E2	R2	C2 Pure and innocent childhood time.
			E1 Vigna angularis	R1	C1 Vigna angularis
06:43		Vigna angularis	E2	R2	C2 Missing the male protagonist.
			E1 Vigna angularis	R1	C1 Adenanthera pavonina
06:27		Building	E2	R2	C2 The difference of housing construction implies the gap between rich and poor between male and female protagonists.
			E1 Building	R1	C1 Jiading Ancient City in Qing Dynasty
07:12 07:29		Boor	E2	R2	C2 The male and female protagonists are separated by a door, the male protagonist does not knock on the door, and the heroine does not open the door. This door implies a social hierarchy that cannot be crossed, and the Chinese marriage concept of “Perfect match”.
			E1 Boor	R1	C1 Ancient Chinese architecture

Fig. 3 : Connotation’s Constructing in *Love Seeds*

### 3.2 Expected conclusion

In the short film, the creator took the alleys of southern China in rainy days as the environmental background and special foundation of the whole story, with which the emotive expression of figures reached an artistic state of “emotions fused in scenes and conceptions blended with images”, with the small town on a rainy day, pink walls and grey tiles, a red umbrella, a bowl of red bean porridge, a red bean hairpin and a passage of the past events through which the flexible aestheticism could be felt, and audiences could feel the unique and deep Chinese story in the long river of history as time went by. The expression technique with Chinese style is of rich implications and can arouse the sense of national pride and mission of the audiences, and through such kind of unique expression on the artistic conception, envisions and imaginations of audiences can be set free. Those Chinese element symbols are both the carrier of cultural meanings and contents and the representation of national cultural spirits, which have connotative semiotics function, can arouse the approval and emotional resonance of audiences and bring deeper and broader artistic spaces for the audiences to imagine.

### 4. Conclusion and suggestions

In conclusion, with the series animation of “Choir of Chinese Poems” as example, the Chinese elements of the short film were extracted in this thesis, and the connotative semiotics theory of semiology was used to

analyze the symbolic meanings hidden in the Chinese traditional symbols. The creator conducted a deep exploitation on the Chinese elements and combined the poetic culture and animation together; the national-style expressive technique was adopted to express the rich emotions and connotations to the audiences, thus spreading the Chinese traditional cultures. Nowadays, Chinese animations show a reemerging trend, so we must stick to the inheritance and development of Chinese elements, try different "Chinese styles" and "national styles" to manifest and expand the range of audience and create works with more international influence to make the Chinese animations the focus of the world cultures once again.

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# An Ontology-based Study of Cultural Tourism Knowledge Management: A Case Study of Thai Wikipedia Articles.

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## Abstract

As Thai Wikipedia has had several Thai cultural tourism articles, it is beneficial for cultural knowledge collection and analysis. This research proposes the ontology-based management of Thai cultural tourism knowledge. The ontology and knowledge are created by applying DBpedia and OAM tool for data mapping and representing lists of tourism attractions as various user condition. We found that the ontology approach supports the semantic search, expresses the interrelationship of Thai cultural tourism articles, and shows the URLs of all related Wikipedia articles to access more details.

**Keywords-** *Thai cultural tourism; ontology; knowledge management; semantic search; articles relation*

## 1. Introduction

In Thailand, there are many interesting cultural tourist attractions. Information about those places is also increasing more especially online. Wikipedia [1], the online big data source allowing users to create their own articles, is a large online resource for searching this because it has many articles in several domains, including Thai cultural tourist attractions. Tourists and anyone interested, therefore, can access the information by keyword searching in Wikipedia.

Besides, consisting of contents, pictures, and infoboxes that can be arranged in data structure, Wikipedia data can be managed for easier and more convenient search by applying with ontology. Ontology [2] is the technology for collecting and representing hierarchical knowledge to support the searching of the interrelating data. It represents domain-specific knowledge, and the ontology creation could be applied to different objectives, such as the recommendation system, the smart environment, and the tourist service. The research on the automatic recognition activities of daily living, for example, proposed the ontology-based framework [3]. This research based on the class expression learning algorithms and two datasets with five different ontologies. The ontologies used data mining technique to recognize and combine the entities in the ontology to find the best expressions activities.

For tourism ontology, several studies have tried to design ontologies for the tourist service [4] [5]. S. Mikhailov, *et al.* [6] proposed a tourist ontology for a tourist trip planning system. This ontology had a lot of information: tourists, tourists' profiles and preferences, cities and their attractions, tourist routes and contexts. An example of classes was User, Profile, Preferences subclass, User interacts with class Service and an estimated tourist route with the class Attraction\_route. For Thai tourism, S. Khruahong, *et al.* [7] designed an ontology of Thai travel industry to support tourists' decisions such as attractive places, hotels, and restaurants. The concept set of ontology considered local information of culture, law and festival based on the lists of words from Web channels documents. Besides, to manage information about the place domain is quite important for tourism to tell the locations of tourist attractions. K. Saengthongpattana, *et al.* [8] proposed the ontology on Thai Wikipedia for article quality classification. The articles with the place domain provided information about architecture, locations and the main purposes of the places. To sum up, the ontologies about tourism and places are studied widely.

Moreover, one of the most well-known ontology-based knowledge is DBpedia [9] which represents a crowd-sourced community effort to structured information from Wikipedia and makes this information available on the

web. DBpedia provides a description of 4.0 million of things such as people and places, with different language editions, e.g. France, Japanese, and Indonesia [10]; however, some languages such as Thai, Chinese, and Vietnamese are not included yet.

For our research, we created Thai cultural tourism ontology from the infoboxes of Thai Wikipedia articles and reused the ontology of DBpedia to search cultural tourism information correctly as specified conditions. Furthermore, the data with ontology-based relation structures can be the knowledge representatives of Thai cultural tourism information.

## 2. Framework

In this section, we described the framework aiming to supports the semantic search of Thai cultural tourism based on Thai Wikipedia articles. Our framework consisted of two main components which were data preprocessing and ontology process. (see Fig. 1)

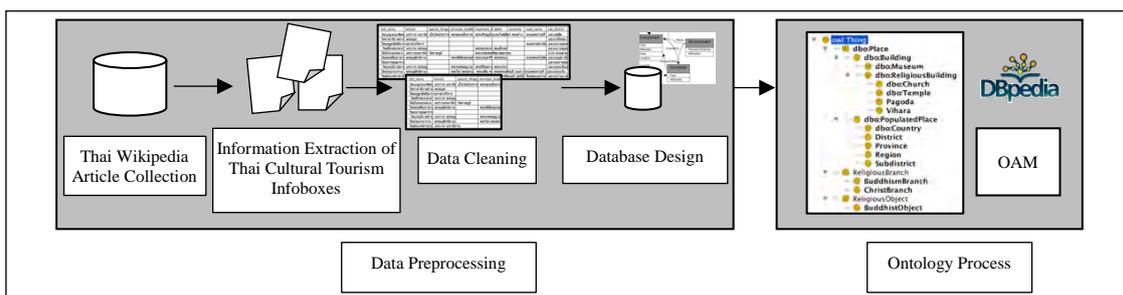


Fig. 1 A framework of cultural tourism knowledge study based on ontology

For the first main component, data preprocessing, we firstly collected Thai Wikipedia articles about Thai cultural tourism by using the MediaWiki API [11] to retrieve a list of all the tourist attractions, pages, titles, and infobox templates associated with that domain. We found that there are 2,098 tourist attractions in the list [12], but only 785 tourist attractions are created into Wikipedia articles, and 276 articles are about cultural tourist attractions. So, we collected those 276 articles.

The second step of data preprocessing was to extract information from the Thai cultural tourism infoboxes of the collected articles. The information of the infoboxes was chosen to be our data because the infoboxes consist of general fields or information of articles in any domains, and are also kept in templates structurally to represent terms of knowledge for any domains; on the contrary, Wikipedia templates, the standard ways of recording information, are numerous and various to support any types or domains of Wikipedia data, e.g. sports, countries, and scientists. So, the information of the infobox templates were quite appropriate. Related to Thai cultural tourism, only few infobox names, e.g. Buddhist Place, Museum, Buddhist Object, Cultural Heritage, and Church, were found despite over 104 names of all infoboxes in all Thai Wikipedia pages. Interestingly, the infobox of Buddhist places was found most [13]. For instance, the article named *Wat Phra Chetuphon Wimon Mangkhalaram* has the infobox of the Buddhist place, which represents general information about this temple (see Fig. 2 (a)). Then, information of each field in the infobox as shown in Fig. 2 (a) would be kept in the format of Wikicode as in Fig. 2 (b). After that, the data in the Wikicode format was separated information, attributes and values of each field into the database for the ontology class and its properties (see Fig. 2 (c)).

Then, the data was cleaned in the cleaning step. It was found that it was inconsistent and lacked attribute values in some infoboxes.

Afterwards, we did the database design step. The class identification by matching names and attributes of infoboxes was performed, and the database was obtained. For the knowledge base creation, the database was integrated with the ontology to create the knowledge base in the RDF (Resource Description Framework) format by using Ontology Application Management (OAM) framework [14].

However, the ontology process, the second main component of the framework, is thoroughly introduced in the next section.

## 3. Thai Cultural Tourism Ontology

This section describes the ontology modeling of Thai cultural tourism including scopes and requirements. Then, we discuss how to design and develop the ontology.

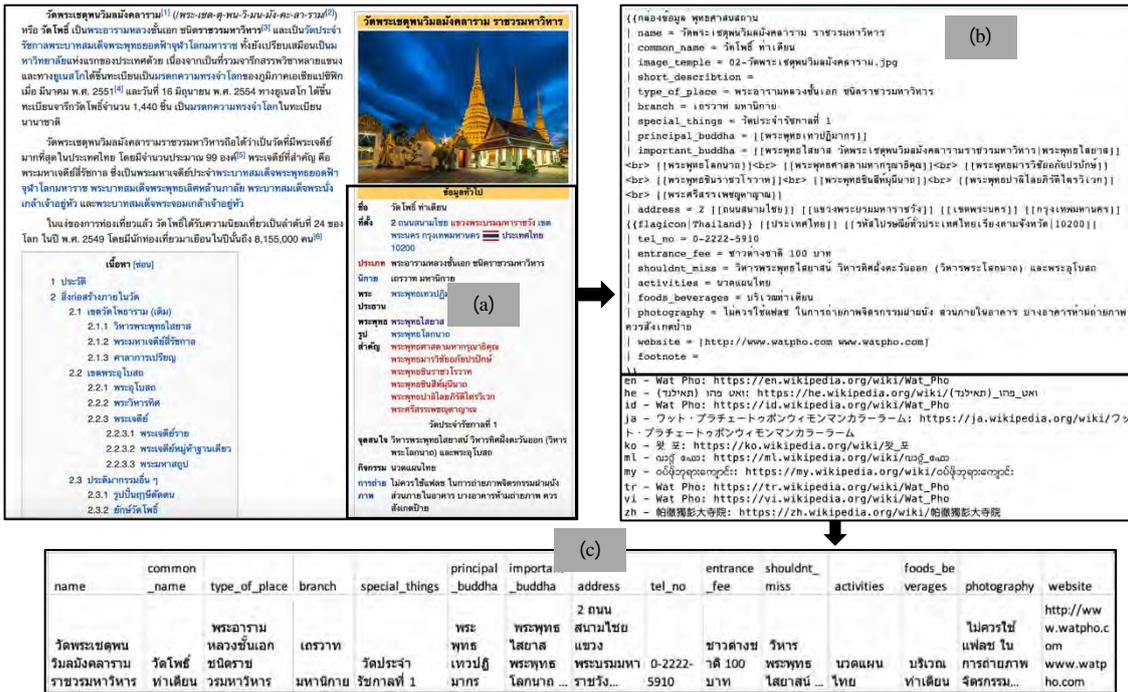


Fig. 2 Example of infoboxes that related to Thai cultural tourism.

### 3.1 Ontology Requirements

In this work, we intended to leverage infoboxes and Thai Wikipedia articles by developing an ontology to facilitate the semantic search of Thai cultural tourism, which based on Thai Wikipedia articles. The proposed ontology was focused on the process of converting infoboxes which related Thai cultural tourism into ontology structure. Thus, the classes and relationships of the ontology were designed to be models as following:

- The ontology should support the Thai cultural tourism attractions and necessary information for tourists, such as names, descriptions, locations, events, prohibitions, car parks and travel information.
- Thai cultural attractions were categorized into different groups of places. In this study, we focused on the group of temples and museums as well as the objects collected of each place, such as principal Buddha images, important Buddha images and others religious objects.
- Some infoboxes and Thai Wikipedia articles could refer to others articles in different languages, so the ontology should support to collect the links of articles in several languages.

### 3.2 Ontology Design and Development

Our developed ontology reused standard vocabularies of DBpedia and extended some classes to support Thai Wikipedia articles. We designed and developed ontology based on the infoboxes and Thai Wikipedia articles which related Thai cultural tourism. The challenges in this process are that the attributes of each group are different, have no standard, and can be Thai or English languages. For example, in the group “Temple”, the attributes about public transport are represented in English and can be categorized into three groups: “pass\_buses”, “pass\_boats”, and “pass\_rails”; on the contrary, there is only one attribute about public transport in the group “Museum” that is “การคมนาคม” (transportation) represented in Thai language. To deal with these problems, we proposed the steps of ontology development as following:

First, we explored the common meaning of attributes of the different infoboxes and tried to collect data in the same schema – full names, descriptions, locations and websites, etc.

Second, we considered special attributes of each group and added these attributes into the schema.

Finally, we designed the ontology following the schema and ontology requirement in the section 3.1.

#### 3.2.1 Class Hierarchy

This section describes four main top classes of our ontology including dbo: Place, Object, Art, and ReligiousBranch as shown in Figure 3 (a).

(1) **dbo:Place**: This is the main class of our ontology. We reused standard vocabularies of DBpedia [15] and followed the class hierarchies from DBpedia to represent the building (dbo:Building) and the location of the cultural place (dbo:PopulatedPlace). We also extended specific classes, such as Vihara and Pagoda in dbo:ReligiousBuilding class.

- (2) **Object**: This class is used for describing the object that can be categorized into several groups. In this case study, we focused on the objects in the temples and museums.
- (3) **Art**: Most of the objects in temples and museums have been described about art styles, so this class is used for categorizing the groups of art.
- (4) **ReligiousBranch**: This class is used for describing the branch of each religious.

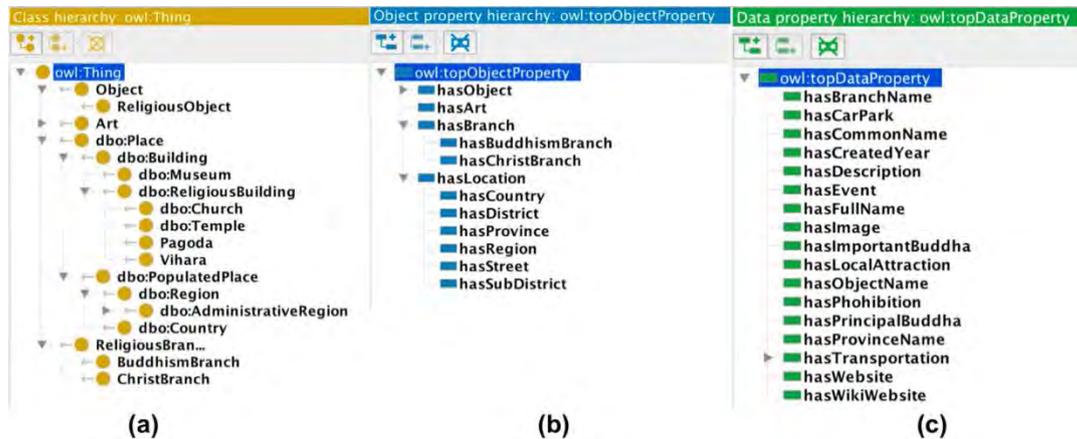


Fig. 3 Class hierarchy (a), Object Properties (b) and Data Properties (c) of the Thai cultural tourism ontology

### 3.2.2 Object Properties

We defined four object properties that are essential to identify the relationships between the classes including hasObject, hasArt, hasLocation, and hasBranch. as shown in Figure 3 (b).

- (1) **hasObject**: This property describes the relation from Place to Object.
- (2) **hasArt**: This property describes the relation from Object to Art.
- (3) **hasLocation**: This property describes the relation from Place to Location. The sub-properties of this property consist of hasCountry, hasProvince, hasDistrict, hasSubdistrict, hasStreet and hasRegion
- (4) **hasBranch**: This property describes the relation from Place to ReligiousBranch.

### 3.2.3 Data Properties

Fig. 3 (c) shows the data properties using in our ontology. These properties are used for representing the literal values of each class, such as hasFullName, hasDescription, hasImage, hasWebsite, and hasWikiWebsite.

### 3.3 Ontology Usage

In this case study, our ontology can be used for developing the semantic search of Thai cultural tourism. Not only querying the necessity of cultural tourism information for Thai and foreign tourists, our ontology can also be used for giving the related information of traveling as the example below.

```

Select ?fullname ?description ?principal_buddha ?important_buddha
?carpark ?transport
From <http://lst.nectec.or.th/ontology/wiki_culture>
Where {
  ?s a wiki_th:Temple .
  ?s wiki_th:hasFullName ?fullname .
  ?s wiki_th:hasDescription ?description .
  ?s wiki_th:hasProvince ?p.
  ?p wiki_th:hasProvinceName "กรุงเทพมหานคร".
  ?s wiki_th:hasCarPark ?carpark.
  ?s wiki_th:byBus ?transport .
  OPTIONAL {
    ?s wiki_th:hasPrincipalBuddha ?principal_buddha .
    ?s wiki_th:hasImportantBuddha ?important_buddha .
  }
}
    
```

Fig. 4 The example of SPARQL query

fullname	description	principal_buddha	important_buddha	carpark	transport
วัดปฐมบรมาราม ราชวรวิหาร	ด้านหน้าพระอุโบสถวัดปฐมบรมาราม	พระโส (พระสาณ)	พระเสริม พระแสน	จอดรถภายในวัดได้	2 15 16 25 40 45 48 54 73 79 204 79 ฯลฯ
วัดเบญจมบพิตรดุสิตวนาราม ราชวรวิหาร	มุมมองพระอุโบสถ วัดเบญจมบพิตร จากด้าน หลัง	พระพุทธชินราช (จำลอง)	พระผาง	บริเวณหน้าวัด	5 16 23 50 70 72 99 201 503 505 509
วัดเบญจมบพิตรดุสิตวนาราม ราชวรวิหาร	มุมมองพระอุโบสถ วัดเบญจมบพิตร จากด้าน หลัง	พระพุทธชินราช (จำลอง)	พระศรีกัญชัยบรมโพธิสัตว์	บริเวณหน้าวัด	5 16 23 50 70 72 99 201 503 505 509
วัดราชาธิวาสราชวรวิหาร	พระอุโบสถวัดราชาธิวาสราชวรวิหาร				
วัดสระเกศราชวรมหาวิหาร	ภูเขาทองวัดสระเกศ เห็นวัดราชนัดดารามอยู่ทางด้านซ้าย				5 16 23 50 70 72 99 201 503 505 509

Fig. 5 The example of SPARQL result

According to Fig. 4 and 5, the examples of SPARQL query and SPARQL result are showed. The example of SPARQL query presents that we can combine the standard vocabularies of DBpedia into our ontology. The examples of SPARQL result refer to the retrieval of all temples information in “กรุงเทพมหานคร” (Bangkok) province. It presents the necessary information for cultural tourism, such as temple names, descriptions, transportation information and religious objects of each temple (eg. principal Buddha images and important Buddha images). Moreover, our ontology provides the articles in several languages that can help foreign tourists learn more information and understand the Thai culture clearer. For example, the article of temple “Wat Benchamabophit” has many languages, such as Chinese language via <https://zh.wikipedia.org/wiki/雲石寺>, or Burmese language via <https://my.wikipedia.org/wiki/ပုဉ္ဏမဝဝိတုတတုဝိတုကျောင်းတော်>.

#### 4. Discussion

Although it indicated that our designed ontology could present any information despite complicated conditions, the result might not be able to display completely. It was found that several complicated conditions were specified for information retrieval, as in Fig. 4, and then, the consequence could display all of specified information i.e. temple names, descriptions, religious objects: principal Buddha images and important Buddha images, transportation information: car parks and bus lines. However, the result might not be showed completely for every entry because of the completeness of infoboxes in Wikipedia. According to the result of SPARQL query in 3.3, as in Fig. 5, the full information of the first three temples was displayed, but only some information – temple full names, descriptions or bus lines – of the last two temples was displayed. The phenomena occurred because the former users who created the last two temples might not fully fill information in every fields of the infoboxes. Nevertheless, this made users to know that the infoboxes of which articles had to be edited. It would help Wikipedia articles be improved more perfectly. Regardless of incomplete information display, it was very helpful for developing infoboxes in Wikipedia.

#### 5. Conclusion and future work

According to our framework, Thai cultural tourism ontology, we found that the ontology approach supports the semantic search and expresses the interrelationship of Thai cultural tourism articles. Also, the search results show the URLs of all related Wikipedia articles to access more details.

For our future work, we plan to create the ontology semiautomatically with Wikipedia's infoboxes and linguist's expertise. It is beneficial to develop and complete our full ontology, search Thai tourism articles correctly as user requirements, and design the comprehensive templates of tourism Wikipedia articles. Furthermore, the ontology is going to use for collaborating with the DBpedia ontology standard and creating Thai DBpedia.

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# Mobile Data Collection and Analysis for Cultural Heritage Acquisition Supporting Community based Tourism

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## Abstract

Cultural Heritage is the way of life of people's group that can pass from the generation to generation. In recent years, online data collection has become an important issue. Mobile data collection is the method of collecting data by using a mobile device, such as a smartphone or tablet. It is a combination of data, mobile technology, and user behavior tracking. This paper present the mobile data collection work with the cultural management web application. We Use the API to handle the interaction between mobile applications and database, in the same way, the website communicates with the database. The data collected are metadata, multimedia, location data. We track user behavior, that can show the direction of travel of the user and the time the location information was recorded. We use data for visualization and analytics for supporting the communities based tourism. We discovery the similarity of cultural materials and their relation to creating the concept of cultural routes.

*Keywords; cultural heritage, data collection, digital archive, mobile application,cultural route*

## 1. Introduction

Cultural Heritage [1][2] is the way of life of people's group that can pass from the generation to generation. It is knowledgeable about understanding the history of society. Digital preservation [3] is the technology to preserve knowledge in digital format. In general, the process of transforming the cultural heritage knowledge into the digital format are the collection, digitization, data management, data integration and analysis, and data visualization. The collection is to collect objects or stories and classify them, that can show the basic information about the categories and the numbers of objects. Digitization is to digitize from analog to digital format such as taking a digital photo, scanning, recording the digital media. Data management is to archive them in the metadata standard. Data integration is integrating the data from various data sources. Data visualization is how to visualize the data into the visualization form such as website, mobile application.

This paper focus on data acquisition because it is the important step for collecting, digitizing and managing information. The old fashion data collection method is using hand writing note. There are some pain points about data validation and different format. In recent years, the online data collection has become an important issue. Most of data acquisition apply content management system or develop web application for data collection. It is more comfortable than paper work, but the collector must have enough resources such as camera, tripod, sound recorder etc. and user should have digitization and some technology skills.

Mobile data collection is the method for collecting data by using a mobile device. It is a combination of data, mobile technology, and user behavior tracking. There are various techniques for mobile data collection. Z.S.Mohamed-Ghouse et.al.[4] present Artefact Mobile Data Model (AMDM), a spatial data model was developed applying the relational database management system (RDBMS) technique. The data model was implemented in a mobile database environment. Kyaw Hlwan Moe [5] present the mobile application for field data collection. The purpose of this project is to gain a better understanding of the usability requirements for a mobile field data collection application. Jayanti Khutwad [6] present an android application for collecting Geospatial Data and using SQLite to store the data. The data captured from the application present on Google Maps using Google Maps API v3.

This paper introduces an approach to developing mobile data collection. We present the architecture for collection data. The main challenge remains to design the architecture of mobile data collection. We visualize and analytic for discovering the concept of cultural routes using the similarity of cultural materials and their relationship. The remaining of the paper is organized as follows. Section 2 gives an overview of the data collection model. Session 3 shows the data analysis, and Section 4 shows the conclusion and discussion of future directions.

## 2. System Overview

### 2.1. Cultural Heritage Data Collection Framework

Our framework consists of four components: input terminals; cultural bank; API and application. Figure 1. shows the System design of the data collection framework. The framework allows collecting data from mobile devices and a personal computer or laptop devices, in addition to harvest the data from external data sources. We integrate data into Cultural Bank and provide API for a software developer for developing the innovation.

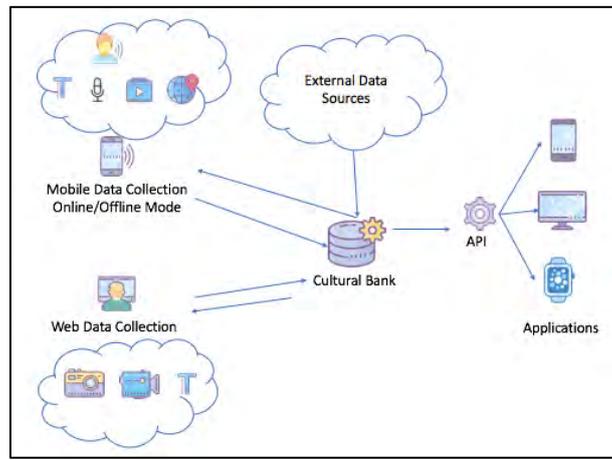


Fig. 1 The System design of data collection framework.

### 2.2. System Design of Mobile Data Collection

The mobile data collection application can work with the cultural management web application. We develop an API to handle the interaction between mobile applications and database, in the same way, the website communicates with the database. We send JSON data for displaying the result on the mobile application. Figure 2. shows the methods and components of mobile data collection, and Figure 3. shows the screens of a mobile data collection application for cultural materials.

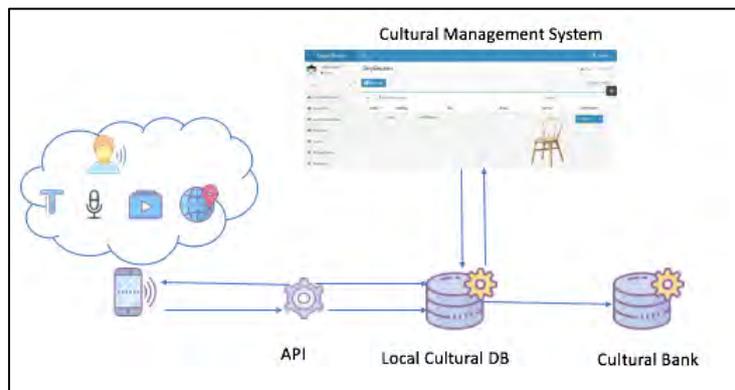


Figure 2. The methods and components of mobile data collection.

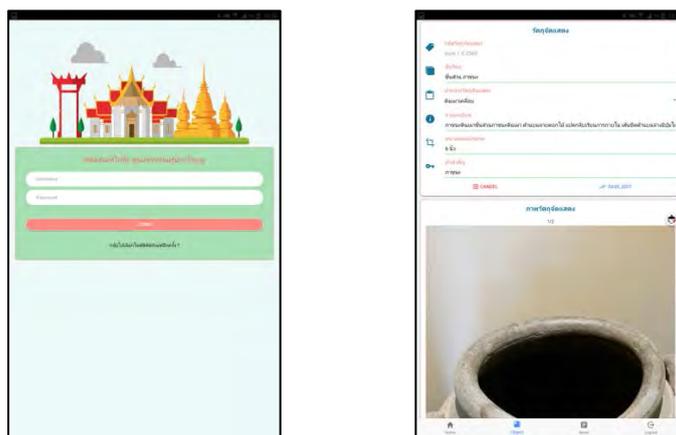


Figure 3. Mobile data collection application.

### 2.3. Dataset

The data collection can be categorized as follows:

- Metadata Standard: We use the categories for the description of works of art (CDWA) metadata standard [7] for describing the cultural material based on the categories for the description of works of art and cultural objects. We add on some elements such as latitude, longitude, and source. Table 1. show the metadata standard of data collection.

Table 1. Metadata standard of data collection.

1. Object Work Type	15. Indexing Subject
2 Title	16. Classification
3. Display Creator	17. Description/Descriptive Note
4. Indexing Creator	18. Inscriptions
5. Display Measurements	19. Related works
6. Indexing Measurements	20. Rights for works
7. Display Materials/Techniques	21. Record
8. Indexing Material/Technique	22. Resources
9. Display State/Edition	23. Latitude
10. Style	24. Longitude
11. Culture	25. Source
12. Display Creation Date	26. URL
13. Indexing Dates	27. Pictures
14. Location/Repository	28. Creative Common

- Location Data: The location data are information that a mobile device provides about the current position as the latitude, longitude. It can show the direction of travel of the user and the time the location information was recorded.

- Multimedia data: The multimedia data refers to data that consist of various media types such as text, audio, video, images.

### 2.3. Data Tracking

Data tracking refers to the activities in when user collect the data both online and offline data collection. This paper, we focus on location tracking and time tracking.

Location tracking: It is an important function, that is very valuable to historical archiving for recording and representing the temporary or permanent location of cultural materials. The first release, our mobile data

collection support the temporary location of cultural materials, that is the location at which cultural materials usually are located when they are collected or not in use for some purpose or undergoing treatment. Figure 4. shows the location tracking for cultural heritage material. It can record the new location as a log history when moving the cultural materials to the permanent location.

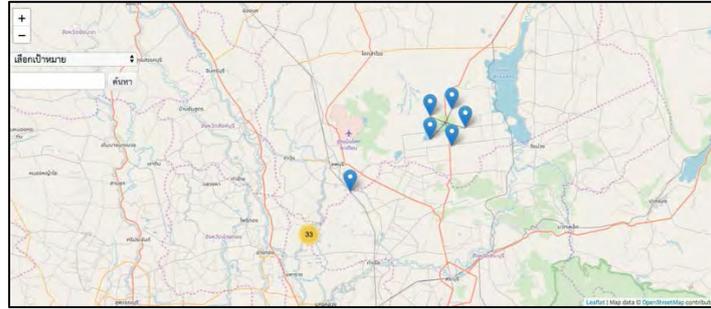


Figure 4. Location tracking for cultural heritage materials.

Time tracking: Time tracking function is part of the historical story. It is important for recording and representing the time of cultural materials, that is recorded according to a calendar used at the time. Figure 5. shows time tracking for cultural heritage materials.

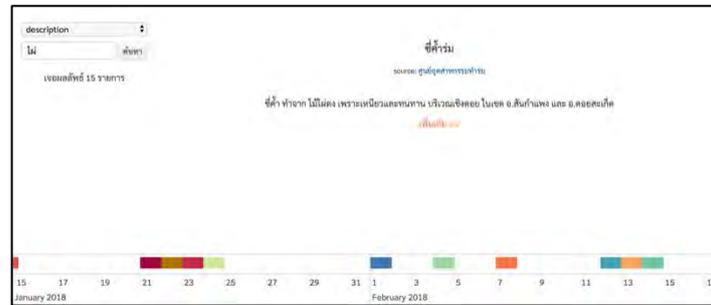


Figure 5. Time tracking for cultural heritage materials.

**2.4. Data Visualization**

The cultural data from location and time tracking function can be the large cultural heritage collections. There is massive content from galleries, libraries, archives, and museums. We get the data visualizations from cultural materials location and when it recorded. This visualization can be search and filter by the elements such as provinces, category. Figure 6. shows a data visualization of cultural materials.



Figure 6. Data visualization of cultural materials.

**3. Data Analysis**

The data from mobile data collection methods are entered directly into the digital form and recorded into the database. It can reduce the time of pre-processing and ready for analysis. The data is recorded in a cultural

management system. We focus on clustering of cultural material data for supporting community-based tourism (CBT) [8]. We extracted the values of following features: title, category, description, date of creation, province, latitude, longitude, source, creator. We discover the similarity of cultural materials related to each other distributed around the area, as shown in Figure 7. We develop a cultural route for traveling by using the similarity of cultural materials and the distance between them. We discover the different concept of a cultural route, for example; the same creator who created the cultural materials, the similarity cultural materials found in the same era.



Figure 7. [Left] The data visualization of the similarity of cultural materials. [Right] The visualization of the related cultural materials distributed around the area.

#### 4. Conclusion and Future Work

This paper present the architecture of mobile data collection work with cultural management web application. Using the API to handle interaction between mobile applications and database, in the same way the website communicates with the database. The data collected are metadata, multimedia, location data. We track user behavior, that can show the direction of travel of the user and the time the location information was recorded. We use data for visualization and analytics for supporting the communities based tourism. We discover the similarity cultural materials and their relation for create the concept of cultural routes. Future work we approach increase the performance of mobile data collection application and discovery more concept of cultural routes.

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# A Study on the Necessity of Standardization for SCRM

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## Abstract

The entire process from the development, manufacture and distribution of IT products to consumers is called the supply chain. Recently, malicious codes have been infiltrated into this process, and attackers are devising new supply chain attacks, such as planting small chips. Therefore, the importance of supply chain security has begun to be emphasized, and each country is implementing a supply chain risk management system. However, based on our assessment on status of supply chain management, we found that there exist simple guidelines for them, but the quality of supply chain manual is very poor. In this paper, we present the necessity of supply chain risk management through supply chain attack, emphasize the current state of supply chain management in each country and conclude that standardization of supply chain risk management system is necessary.

**Keywords-** *ICT; Supply Chain Risk Management; Supply Chain Attack; SCRM;*

## 1. Introduction

With the advent of the information age, demand for IT products is increasing in all fields, and supply is becoming more active. At the same time, cyber-attacks on IT products are constantly occurring. Many security experts have identified supply chain attacks as one of the serious cyber-attacks in 2019[1][2][3][4]. This attack can occur during the entire process of delivering the IT product from the supplier to the consumer through the development and manufacturing process, and the attacker steals information by modifying the hardware or software in this process. Recent CCleaner program tampering and spy chip cases are examples of the risks and impacts of supply chain attacks[1][5][6].

In order to prevent and respond to supply chain attacks, countries have begun to prepare supply chain security measures. The United States issued NIST SP 800-161 based on information security guidelines and supply chain background knowledge published by NIST, which provides guidelines for supply chain risk management[7]. The UK's National Cyber Security Center (NCSC) issues supply chain security guidance to ensure effective control and oversight of the supply chain[8]. The Australian Cyber Security Center (ACSC) provides the Information Security Manual (ISM), which specifies cyber security guidelines to protect IT products from cyber threats[9]. In this way, guidelines for supply chain management and control are being developed for each country, but supply chain management and verification systems are missing. Therefore, it is necessary to formulate an international supply chain management system, and to prepare common measures in the global era where IT products are manufactured and supplied by each country.

This paper is composed as follows. Chapter 2 introduces examples of global supply chain attacks and highlights the importance of supply chain security. Chapter 3 introduces the US, UK and Australia supply chain management systems. Chapter 4 then presents a need to standardize the international supply chain management system by comparing and analyzing the supply chain management systems mentioned above. Finally, Chapter 5 concludes this paper and suggests the need for an international common supply chain management framework as a recommendation for future research directions.

## 2. Example of Supply Chain Attack

### 2.1. CCleaner

In October 2017, Avast's CCleaner program, which is used by more than two million people globally, was tampered with malicious code[3][5]. The attacker seems to have hacked Avast's download server and inserted malicious code into the CCleaner program. As a result, the corrupted CCleaner installation file was distributed

to users. Users who used CCleaner downloaded or updated version 5.33 and were infected with malicious code through a modified program. This attack penetrated the development and deployment stages of the software supply chain process and spread malicious code worldwide. In the end, many users who used this software were unwittingly exposed to attack through trusted and received update files without knowing it was a malicious file.

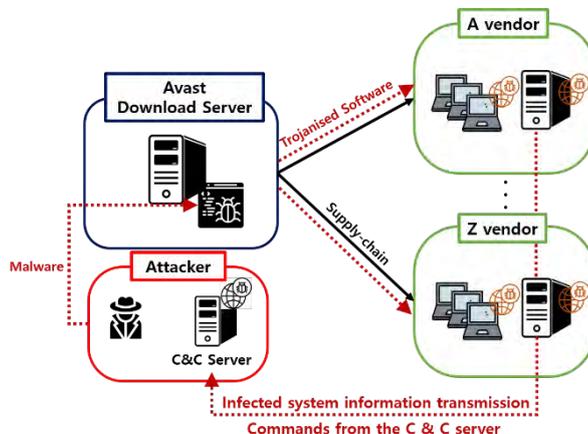


Fig. 1 CCleaner Supply Chain Attack Process

## 2.2. Spychip

The spy chip case reported in Bloomberg in October 2018 is a super microchip spy chip found on a server motherboard[6]. This was the case of an attack on the hardware supply chain, which reported that China had taken away confidential data from the US government and businesses. The spy chip appears to have been found in parts manufactured by Supermicro's Chinese subcontractor, and it has been reported that an attacker was randomly planted during the hardware manufacturing process. This attack could be supplied to the consumer without being discovered by placing a microchip that implements the backdoor function on the motherboard. As such, it is difficult to identify whether an attack is caused by a hardware supply chain attack, and it is known that the ripple effect is more significant because it is very difficult to follow up the problem product by collecting and reviewing the entire problem product. However, the case has been temporarily terminated by the US government and companies that have been found to be affected, including Supermicro, the maker of the product, denying the existence of spy chips and hacking.

## 3. SCRM from Major Countries

### 3.1. United States of America

The United States provides guidelines for supply chain risk management, using the NIST SP 800-161 document issued by NIST as its primary guideline. In addition, a new task force has been established to provide more systematic measures to respond to supply chain risk management.

#### 3.1.1 NIST SP 800-161

Issued in April 2015, NIST SP 800-161 provides guidance for identifying, evaluating and mitigating ICT supply chain risks[7]. This document is based on the existing standardized practice in various fields, and is to implement ICT supply chain risk management. Therefore, ICT supply chain risk management suggests that the ICT supply chain risk management process should be established and operated for each company or organization based on the risk management process in Fig. 2.

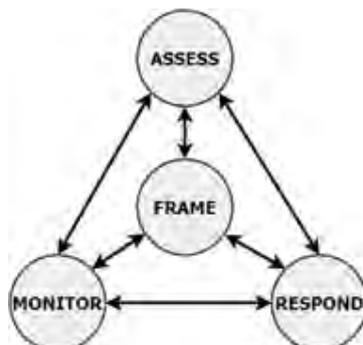


Fig. 2 Risk Management Process[7]

This process is a continuous and repetitive step around the Frame, Assess, Respond, and Monitor elements. First, it is necessary to make risk-based decisions and build frames according to the current state of the information system or ICT supply chain infrastructure. After that, the risk is assessed by examining the lethality, threat, vulnerability, and influence of the product. Based on the degree of discrimination, mitigation and countermeasures shall be prepared to take measures against the risk. Once the risk response is completed, continuous monitoring will be available to respond to and improve the risks that may occur in each step of the risk management process.

### 3.1.2 ICT supply chain risk management task force

In July 2018, the Department of Homeland security (DHS) created a Task Force for ICT supply chain risk management[10]. Eight government agencies and 26 private companies jointly participate in the development and distribution of supply chain risk management functions for federal agencies[11]. This Task Force, the first public-private partnership in the United States, published four major plans in addition to creating and managing an existing supply chain risk management list across government and industry[12]. First step is to develop a common framework for sharing supply chain risk information between government and industry, and identify processes and standards for threat-based assessment of ICT provision, products and services. In addition, market identification and evaluation criteria are established through the cataloging of qualified bidders and manufacturers. Final step is to create a policy recommendation to encourage ICT purchases from authorized distributors and manufacturers of products.

### 3.2 United Kingdom

The UK provides advice on supply chain security by publishing practical guidelines for protecting the national infrastructure through the supply chain security guidance issued by the NCSC[8]. The Supply chain security guidance, issued in January 2018, provides guidance on how to securely control and manage the supply chain, including security principles and examples of attacks. This guides the attack methods that can occur in the organization through 4 cases of supply chain attacks. It emphasizes that supply chain attacks are constantly evolving and encourages continuous security improvement. It also provides assessment elements and specific examples, such as identifying the full scope of the supply chain to assess supply chain security and identifying vendor security mechanisms. The Supply Chain Management Practice Assessment will guide readers through additional factors that can be applied to procurement and contracting with suppliers after security assessment. Finally, they proposed 12 principles of supply chain security. These principles mean that people need to understand and recognize the risks from the supply chain. In addition, to establish control of supply chain security, it is necessary to clarify the security need to the supplier and set minimum security requirements. Finally, it states that people should also be aware of suppliers' supply chain management arrangements and encouraging them to continue to improve security in the supply chain.

In addition to these guidelines, the UK also operates Cyber Essentials, which protects organizations from cyber-attacks through a cybersecurity certification scheme[13]. This increases confidence in products by showing users that information is protected from cyber-attacks. This system was developed in collaboration with the Small Business Information Security (IASME) Consortium and the Information Security Forum (ISF) and the British Standards Institute (BSI). The UK Government is committed to protecting all sensitive information. This certification is absolutely necessary.

### 3.3 Australia

The Australian Cyber Security Center (ACSC) has released the Information Security Manual (ISM), which specifies cyber security guidelines to protect IT products from cyber threats[9]. In particular, this manual specifies security requirements for risk management when outsourcing IT technology or cloud services. However, there are no published documents on specific systems and policies for SRCM of other IT products.

## 4. Implication

We have analyzed supply chain risk management for the US, UK and Australia. All of these countries provide guidance on considerations, examples, and points to the supply chain. The United States is proposing a combination of ICT supply chain risk management in an existing system called the risk management process, and the UK provides a guide to supply chain security to raise awareness of supply chain security and increase its capacity to evaluate. Australia specifies risk management requirements for IT and cloud services only in the information security manual, not in the manual for the supply chain. Thus, each country is aware of the importance of supply chain security and has established guidelines for managing it. However, they all make recommendations and proposals, and can confirm that they have not established verification and certification processes for supply chain security. In other countries, only the overall guideline for information security is applied and the manual on supply chain security is insufficient [14][15][16].

As a result, it is necessary to standardize international supply chain security verification applicable to all countries by exemplifying supply chain security cases currently under way in each country. Like the supply chain attack case introduced in Chapter 2, the supply chain is exposed to a variety of attack threats. Therefore, if systematic verification and authentication are required between supply chain processes, it is expected that it will be possible to secure the security of the combined IT products through the supply network even though this is a rather complicated procedure.

## 5. Conclusion

In the current era where security incidents are constantly occurring, supply chain attacks are becoming an important issue. This is because the attack is carried out and spread through the supply chain, and the damage is bigger and spread rapidly. This paper emphasizes the importance of supply chain security by introducing supply chain attack cases. In order to prevent this, we have introduced the present situation of supply chain risk management in USA, UK and Australia.

As a result, it was confirmed that each country is prepared through information security and supply chain security guideline. However, there is a limit to maintaining supply chain security through recommendations and guidelines only. Therefore, it is necessary to standardize international verification of supply chain security so that common verification and certification of supply chain security can be performed internationally. We expect to improve security of supply chain through this.

Future research will identify the supply chain security status of more countries and compare them. This requires the development of a framework for a standardized supply chain management framework. Therefore, it is necessary to prepare and manage the possible risks and countermeasures against them in the supply chain case.

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## Recommendation system with limited time for visiting museum

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### Abstract

Most tourists visiting several places in one day. Time becomes an essential issue during travel. How long should we stay in each place? The museum is considered one of the tourist spots that face the same issue. Recommendation system in the museum is not the same as the e-commerce that the owner has some knowledge about the user and suggest the item to the user. There is still room to explore the recommendation system in the museum. Recently there are many algorithms to recommend items such as social filtering which is use the recommendation from the k nearest similar user to a visitor. Our paper proposed the recommendation system that deploys social filtering as well as the content based using TF-IDF. There is a cold start problem which is when new users entering into the system. Our proposed method deploys the statistical based to recommend the visitor. We have a pilot test at Chao samphraya national museum and received positive feedback on the recommendation system.

*Keywords-recommendation system; mobile application; museum;*

### 1. Introduction

Tourist visiting multiple places is the common behavior. Then there is a drawback too, how long we should spend in each place. The museum is also a tourist spot that visitor has to face on spending time. If a visitor has only 30 mins what should they see in the museum? Recommend system is widely used in e-commerce however, recently it has been deployed in the Museum area. Unlike most e-commerce system that the buyer knows the customer by collecting data while they are on the website. A museum needs to have another way to received feedback from the visitor to improve the recommendation system. With the ability of the smartphone and the internet, these activities can be done.

Since the arrival of the smartphone, there is more tool for the researcher to interact with the visitor. [1] design a recommendation system for tourism in Macau by using the available online map, user's stated preferences, user's visit history, official spot rating, and all user's feedback. They proposed a genetic algorithm that has a list of a tourist spot and then runs fittest for each list and updated list if it's fittest below the threshold. However, this design needs to consider more factors include travel time from one place to another. [2] points out that there is a cold start problem with the recommendation system. Where there is no prior information about the visitor before entering the system. Then they derived the lifestyle based on psychology and sociology into 3 clusters. When the new user enters the system then they will choose the cluster and received the recommendation according to the chosen cluster. [3] also proposed an intelligent recommendation based on visiting style. They divided visiting style into 4 types and using the parameter such as maximum crowd capacity, crowd tolerance, maximum available time, walking speed time spend each exhibit and quality of experience to simulate the recommendation and results shows that some types have improved the quality of experience than the others. [4] applies an online recommendation system to the audio guide user in the museum by collecting the visitor behavior from an interactive device. This device collects the position and duration of each artwork and also allows a visitor to interact with a device when they "like" the artwork. [5] uses real data to evaluate several recommendation systems. The results show that social filtering with item based is the best solution.

There is much more to explore the recommended system in the museum, our project work on using the social filtering technique [2] with the classic content-based recommendation. For the cold start problem, we deploy statistical information from the visitor log to recommend to a visitor. We have implemented the algorithm in the mobile application "Museum Pool" and test it at the museum. We have positive feedback from the museum-goer.

This paper is organized as follows, section 2 summaries the proposed method for recommendation systems. Section 3 is the system design and section 4 is the results and discussion. Finally, conclusion and future work.

## 2. Recommendation system

### 2.1. Social Filtering

Social Filtering (SF) recommending idea is based on social network analysis by exploiting the central hypothesis of social recommendation. That is the connected entities (visitor or Point of Interest (POI)) are similar in some way and thus share tastes or attributes [5]. As shown in fig. 1 the visitor 1 share the common interest with visitor 2 since there is at least 2 POI that both visitors visited. In this scenario, we call social filter visitor based. While we take a look at the POI point of view, item A and item D must be something in common since they have been visited by 2 visitors. We called this scenario as a social filter item based.



Fig. 1 Show visitor and POI graph according to SF.

Let  $a$  be any active user who seeks a recommendation,  $u$  be any other visitor. Asymmetric cosine similarity [5] is used to define the similarity between them:

$$Sim_{asymcos}(a, u) = \frac{r_a \cdot r_u}{\|r_a\|^{2\alpha} \times \|r_u\|^{2(1-\alpha)}} \quad (1)$$

Where  $r_a$  is row vector of matrix R corresponding to visitor  $a$ .

$r_a \cdot r_u = \sum_{i=1}^C r_{ai} \cdot r_{ui}$  is the dot product of vector  $r_a$  and  $r_u$  C is the number of POI.

$\| \cdot \|$  is the Euclidian norm and  $\alpha$  is a real number in  $[0,1]$ .

The same for the exhibit item, let  $i$  be any active item,  $j$  be any other item. Asymmetric cosine similarity [5] is used to define the similarity between them:

$$Sim_{asymcos}(i, j) = \frac{r_i \cdot r_j}{\|r_i\|^{2\alpha} \times \|r_j\|^{2(1-\alpha)}} \quad (2)$$

Where  $r_i$  is a Column vector of matrix R corresponding to item  $i$ .

$r_i \cdot r_j = \sum_{u=1}^L r_{iu} \cdot r_{ju}$  is the dot product of vector  $r_i$  and  $r_j$  L is the number of visitors.

$\| \cdot \|$  is the Euclidian norm and  $\alpha$  is a real number in  $[0,1]$ .

### 2.2. Content based

Another recommendation system that we deployed is the content based recommendation. This technique requires to find a similar keyword in the item description and group together. We deploy TF-IDF or TF-IDF term frequency-inverse document frequency to find the keyword in the description. It is a numerical statistic that reflects how important a word is to a document in a collection or corpus.[6] It is often used as a weighting factor in searches of information retrieval, text mining, and user modeling. The equation for TF-IDF is very straight forward as below.

$$TF - IDF = \frac{f(\text{term}, \text{document})}{\sum_{\text{term}' \in \text{document}} \text{term}' \text{document}} \quad (3)$$

However, it is a challenging task to apply this technique into a Thai document. Since Thai sentence does not separate each word. Therefore, this method requires a good dictionary that can separate each Thai word correctly.

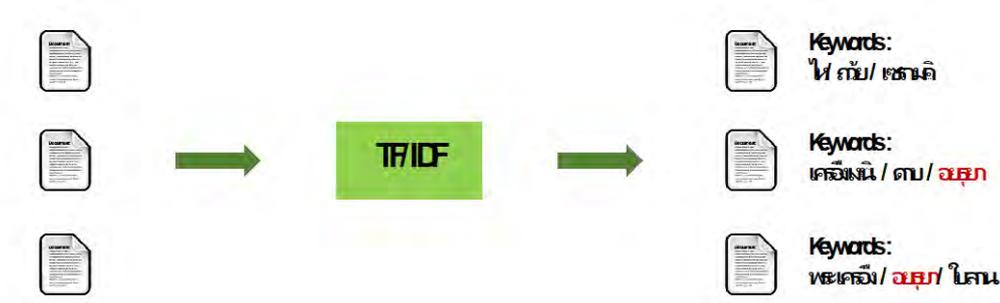


Fig. 2 shows how to extract the keyword from the item description by using TF-IDF.

**2.3. Statistical based**

This method assumes that we have a visitor log which includes time spent, frequency of each POI. With this information in hand, we can simply recommend the POI that has the most visited or the POI that have the longest spend time.

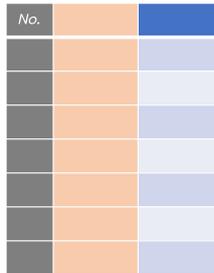


Fig. 3 shows how to deploy statistical information into a recommendation.

**3. System Design**

We have implemented a mobile application called “Museum Pool” [7] which is based on the idea that one mobile for all museums in the network. We launched this application in August 2017 and now there are 15 museums in the network include the museum in Thailand and Myanmar. When the visitor is located within museum boundaries, their mobile connects to the server to acquire further details such as floor plans and media items. QR codes or Bluetooth or NFC (Near field Communication) are used as the primary tool for visitors to access information from server and displays. By this application, we can track the visitor while in the museum.

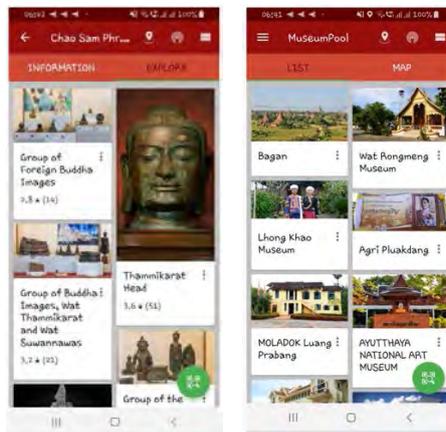


Fig. 4 Museum Pool mobile application.

We proposed a recommendation system for visitors that have limited time. This recommendation system consists of 3 techniques as mention in section 2. If the visitor is a new user, then we create a recommendation list according to the statistically based recommendation system. If the visitor already used this application, then we have prior information about visitor preference. Therefore, we create a recommendation list according to SF based and content based.

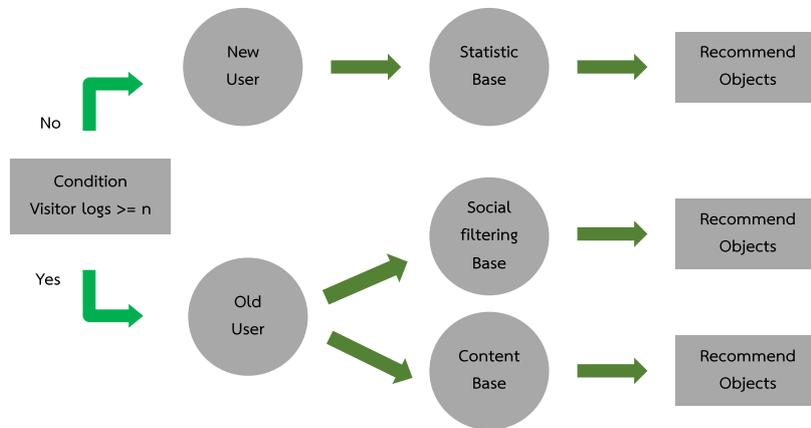


Fig. 5 the proposed recommendation system for museum-goers.

Before we hand out the recommendation list, we have to rearrange this list based on the distant again. From the database, we know the location of the item in each floor plan. We used this information to arrange the recommendation list.

Recommend Objects

<input type="checkbox"/> Next object to visit	Direction	distance	Angle in degree
<input type="checkbox"/> พระพุทธปรืดสว่างอารมณ์ (๑)	พระพุทธปรืดสว่างอารมณ์ (๒) --> พระพุทธปรืดสว่างอารมณ์ (๑)	123.01625908798	0.064011833920711
<input type="checkbox"/> พระพุทธปรืดนางคุก	พระพุทธปรืดสว่างอารมณ์ (๑) --> พระพุทธปรืดนางคุก	552.00362317652	0.54884103769235
<input type="checkbox"/> ธรรมาสน์	พระพุทธปรืดนางคุก --> ธรรมาสน์	661.59957678342	0.37295962816757
<input type="checkbox"/> พระพุทธปรืดหน้าพระเมรุ (๒)	ธรรมาสน์ --> พระพุทธปรืดหน้าพระเมรุ (๒)	546.63058824036	0.17137951887945
<input type="checkbox"/> มานปรืดพระศรีสรรเพชญ์ (3)	พระพุทธปรืดหน้าพระเมรุ (๒) --> มานปรืดพระศรีสรรเพชญ์ (3)	365.27386985658	0.17921103937063
<input type="checkbox"/> มานปรืดสิงหคุดหาขาง	มานปรืดพระศรีสรรเพชญ์ (3) --> มานปรืดสิงหคุดหาขาง	100.49875621121	0.12173923214574
<input type="checkbox"/> มานปรืดพระศรีสรรเพชญ์ (1)	มานปรืดสิงหคุดหาขาง --> มานปรืดพระศรีสรรเพชญ์ (1)	386.37417097938	0.42506445687189
<input type="checkbox"/> ครุฑโขนเรือ	มานปรืดพระศรีสรรเพชญ์ (1) --> ครุฑโขนเรือ	142.6884718539	0.11672507852862

Fig. 6 shows the distance between each recommended item.

The final step will be listing the recommendation items suitable for the time constraint. We understand that a visitor might not have the whole day spend in the museum. Since we have the audio time of each exhibit item, we know the time spend at each POI. Therefore, we list the item that has to see with limited time according to visitor preference.

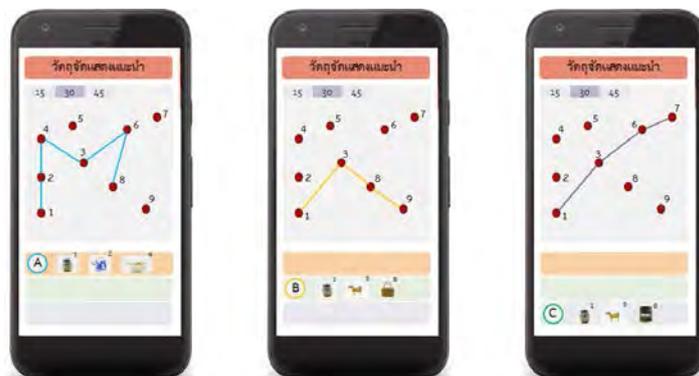


Fig. 7 shows the recommend routed for 3 techniques under 30 minutes.

### 4. Results and Discussion

We choose Chao samphraya national museum as the test site. We implement the recommendation system based on 3 methods in mobile application and show the list to the visitor based on their choosing time.

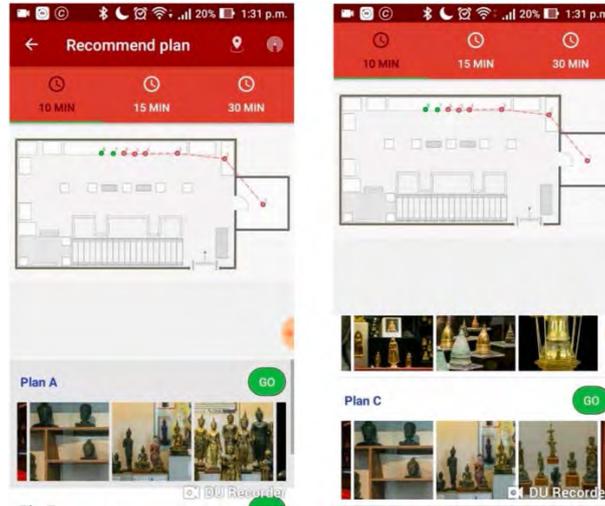


Fig. 8 shows mobile application with the recommendation list with 15 minutes.

We hand out the questionnaire about our recommendation system to the visitor. There are 52 respondents, 67% are female and 33% are male. 77% of the respondents' age is under 20, 19 % is between 20-50 and 4 % is above 50. In terms of education, 67% is at the primary school level, 27% is a bachelor's degree level, 2% is the diploma level.



Fig. 8 shows how often the visitor visit museum and how long do they spend time in the museum.

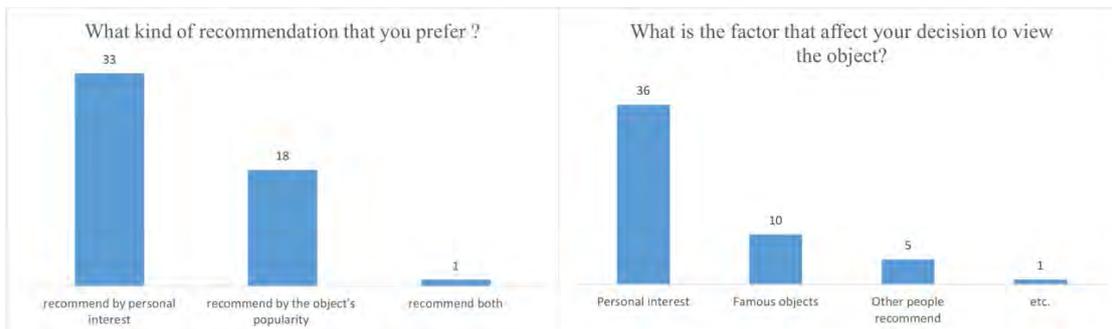


Fig. 9 shows the preference that the visitor expects.

From the collected data, age under 20 years old is the majority to visit the museum. They visit 2-3 times a year and mostly spend 15-30 minutes at the museum. They prefer to see a thing in their interest. After they used our mobile application, we ask them to answer some questions about the application.

Table 1 survey results after using a mobile application.

Description	Very satisfied	Satisfied	Neutral	Dissatisfied
1. You want to know about exhibit item in the museum	21	27	4	
2. You need the recommendation that serves your interest.	18	29	4	1
3. It is more convenient to walk around the museum by using a recommendation system.	36	13	3	
4. You are satisfied with the recommendation system.	33	19		
5. You visit the recommend objects that are shown in our recommendation system.	21	26	5	
6. The information in the application is clear and easy to understand.	26	22	4	
7. The recommendation system helps you manage your time.	33	15	4	
8. You prefer to get the information from the application rather than asking the museum staff.	22	29	1	
9. You would like to recommend this application for other people.	19	26	7	
10. You want other tourist attractions to use this application.	37	13	2	
Total	51.15%	42.12%	6.44%	0.19%

The survey results after using the mobile application show positive feedback about 93% satisfied with the recommendation system.

## 5. Conclusion

Time spent at the museum is always the issue for a visitor. With limited time, yet, they would like to see all the interesting pieces in the museum. The most museum has limited staff therefore; it is difficult to have the curator accompany the visitor. However, with the advent of the smartphone, visitors can have more information. The recommendation system in the museum area is not like in the e-commerce area, it has the potential to explore more. In this paper, we applied multiple recommendation techniques to recommend visitors with limited time. We considered the cold start problem and we use the statistically based recommendation for the new user. We deploy social filtering item based and user based as well as the content-based recommendation. We track and record the choice of visitor and adapt the more suitable choice for the visitor. We perform a survey at the Chao Phraya national museum about our recommendation system on the mobile application and we received positive feedback. The future work will be navigation indoor according to the recommendation list. This is also a challenging area.

## Acknowledgment

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# Recognition of Korean Vowels using Bayesian Classification

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## Abstract

In this paper, we developed the system of distinguishing five Korean vowels in human lip shape using Bayesian classifier. In order to extract the feature vectors from lips shape, we use the Haar-cascade algorithm which detects the face objects such as eyes, nose and mouth. Through implementing the designed model into application, we conducted a study to distinguish five different pronunciations accurately using only images without any voice information.

**Keywords-** *Bayesian classifier; Korean vowel pronunciations; Haar-objects;*

## 1. Introduction

Research on human pronunciations in video is used for automated personalization services. Above all, the main technique for recognizing the pronunciation of a person's face based on the image is mouth-shape detection. We can distinguish a person's pronunciation through mouth shape [1-2], and the method is to extract the shape of the mouth and voice from the image and then recognize the word or pronunciation as the intersection of shape and sound information [3]. However, the combination of mouth shape and voice has a disadvantage that the recognition rate varies greatly depending on the amount of information and the quality of voice information. Therefore, we distinguished five Korean pronunciations of human mouth shape in the image information without voice.

In this paper, the study was conducted to identify pronunciation through Bayesian classifier by detecting the mouth in the human face and then using the distance between the upper lip and lower lip, or the around the jaw and mouth, and so on. To obtain the objects(lips, jaw and mouth shape) on a person's face, we use the Haar-Cascades algorithm which detects the locations of the eyes, nose and mouth on the face. And, we calculate the difference in position between the lips or between the mouth and the jaw by assigning a feature points to the found facial information. Finally, the calculated distance difference information value is used as an attribute to learn from the Bayesian classifier, and the relevant pronunciation is distinguished and displayed on the screen.

## 2. Related research

### 2.1. Haar-Cascades algorithm

Haar-Cascades is an algorithm that analyzes the patterns shown in an object to find the object and detects the human face area using Haar-like feature algorithm developed by Viola, Jones [5]. Characteristic values can be obtained by the difference between the sum of brightness of the white part of the feature obtained by navigating the image in a sliding window with the different features set.

### 2.2. Naive Bayesian classifiers

Bayesian theory classifies a random value into a certain class, on the premise that other attributes are independent based on one attribute value. The effect of the corresponding attribute value on each class is measured to classify which class the attribute set belongs to.

In this paper, the pronunciation of 'A', 'I', 'U', 'E' and 'O' can be defined in one class each. And the characteristic vector extracted from the human face can be classified into one of the five classes.

### 3. Recognition of vowels pronunciation

The face features defined in dlib [6] detected in the frontal face of the person detected by the Haar Cascades algorithm are applied to the Bayesian classifier. As shown in Fig. 1, the attributes used in the Bayesian classification machine were set by the six attributes: [Mx] Horizontal length of mouth, [My] Vertical length of mouth, [La] Thickness of the upper lip, [Lb] Thickness of the lower lip, [Fx] Chin horizontal length and [Fy] Chin vertical length.

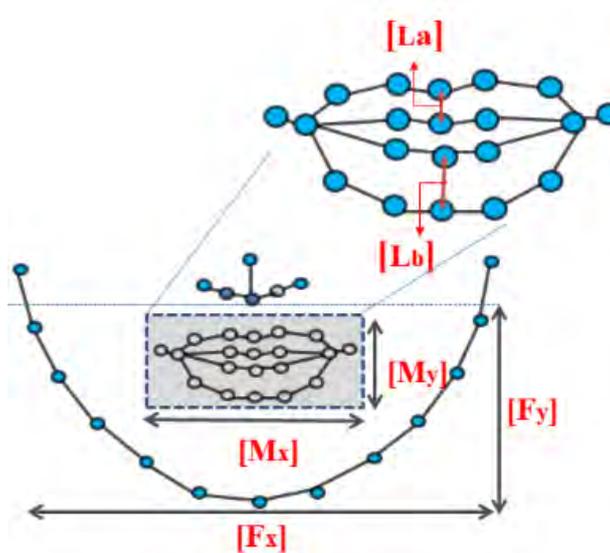


Fig. 1 Face feature points and attributes

Bayesian theory can be represented by the formula shown in equation (1), where  $P(C_i|X)$  is the probability that  $C_i$  will occur, assuming that an event  $X$  occurs, called conditional probability.  $P(C_i)$  and  $P(X)$  are the probability that each  $C_i$  and  $X$  event will occur, which is called pre-probability and assumes that they do not have any information about each other. Here  $C_i$  means five Korean vowel pronunciations 'A', 'I', 'U', 'E' and 'O'. And,  $X$  is the value of six attribute which characterize the mouth shape of the corresponding pronunciation.

$$P(C_i|X) = \frac{P(C_i)P(X|C_i)}{P(X)}, i = 0, 1, \dots, n \quad (1)$$

$$X = [M_x, M_y, L_a, L_b, F_x, F_y]$$

$$C_0 = A, C_1 = I, C_2 = U, C_3 = E, C_4 = O$$

### 4. Development and Experiment Results

The proposed system was implemented with Python and OpenCV. A total of 500 video data were used for the input data used in the study, using images of men and women in their late 20s and early 30s and men and women in their late 50s. The image data consist of five front faces with five pronunciations, each of 'A', 'I', 'U', 'E' and 'O'. To implement the system, first locate the human face area with the Haar-Cascades classifier algorithm in the input image. In subsequent work, each feature point is found on the face with the cut image and the distance between the feature points is calculated, without using the entire image. Next, we figure out the value of the attribute as a tuple, and then assign the class value to the stored tuple. These 500 images are collected from the attribution table and class data for that image and are used as learning data to apply to the Naive Bayesian classifier. The table below shows the attribution values from image extracted by class, which are measured by pixel numbers.

The experimental result shows the accuracy of each pronunciation was 91%, 84%, 68%, 80%, and 79% corresponding to the vowels 'A', 'I', 'U', 'E' and 'O'. In total, 500 data were tested randomly using data in the training phase, and 200 data were used for pronunciation recognition phase. The experiment showed an overall 80% pronunciation recognition rate, the 'A' pronunciation was the highest at 91%, and the 'I' pronunciation was the second highest at 84%. The lowest recognition rate is 'O' pronunciation, because 'A' and 'I' attribute values are different from other classes. However, in the case of 'U' and 'O' pronunciation, 'O' is sometimes misunderstood as 'U' because the attribution values are similar to each other.

Fig. 2 shows the result of extracting each pronunciation from the real-time image for each frame. The extracted pronunciation is printed on the upper part of the image and information about the image is shown below. The image is a 30-second image consisting of five 'A', 'I', 'U', 'E' and 'O' pronunciations of 30 seconds, and, as a result, the correct pronunciation for each shape of mouth was seen on the screen.



Fig. 2 Snapshots of the Pronunciation detection results

## 5. Conclusion

In this paper, unlike using the existing pronunciation detection method, image and voice information, a system was implemented to detect a person's face in real-time images using only images and distinguish five Korean vowels pronunciation according to the shape of the mouth. Since each of the five pronunciation classes has different mouth shapes, the advantages are that it is easy to extract the attribute for each class and apply it to Bayesian classifier. The research will help research such as automatic caption generation for the hearing impaired in the future. We will also add directionality to each attribute value to increase the accuracy of values with similar attributes, such as 'U' and 'O' pronunciations.

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## Developing Frangipani Identification for Android

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### Abstract

Since ancient times, Hinduism, especially the Balinese people, have used Frangipani flowers as a means of worshipping and decoration in traditional ceremonies. Frangipani flowers consist of different types, shapes and colors. Frangipani flowers have a characteristic in form of petals and a gradient of colors that determine their identity. Identification of Frangipani flower images was carried out to determine differences in types of Frangipani flowers based on the shape of the petals and gradient of colors. The identification process in this study uses the Canny Edge and HSV method. This research consists of five main stages. They are acquisition, pre-processing, feature extraction, image matching, and the last is decision making. The average success rate of those methods in identifying Frangipani flower images is 74.09% with an error rate of 24.9%.

**Keywords:** *Computer Vision, Frangipani, Android, Hue Saturation Value, Color Histogram, Invariant Moments, Euclidean Distance.*

### 1. Introduction

Nowadays, many Balinese cannot recognise variants of frangipani flowers (Jepun in Balinese) especially the youth. In every yard on the “Island of the Gods (Bali Island)”, the flowers used for religious ceremony always thrive. One of the uses of Frangipani flowers is as a means of religious ceremonies of Hindus in Bali. The oil produced from Frangipani flowers can also be used as an ingredient for making perfumes.

Frangipani flowers are also popular in Indian society. Almost all parts of Frangipani plants have uses, namely the fruit part is used as food, and can be used as an aid for abortion. The root can be used to clean the urethra from mucus. The sap part can be used to treat toothaches and cavities. The flower part can be consumed to reduce cough symptoms. [1]

Today’s the Balinese, especially the younger generation, is less interested in knowing their own culture in detail, therefore efforts are needed to provide solutions so that they remain familiar and interested in Balinese culture and their knick-knacks. Many studies have been carried out on Balinese culture, such as research [2] discussing the android-based identification of traditional Balinese banten using the HSV method to recognize the colors and Canny Edge Detection to recognize the shape of banten, both of which are used in the decision making. Research [3] discusses the identification of traditional Balinese birthday ceremonies using Android-based Augmented Reality using markers to display educational information using a 3D model. Some of these studies show examples of the identification of Balinese culture, but there is still no research on the identification of Frangipani Flowers.

As mentioned above, the daily lives of Balinese people cannot be separated from the use of Flowers, one of which is Frangipani Flower. This study focusses on the development of technology in order to preserve the local culture. The use of image processing technology is a solution that can be used to introduce the culture that is owned by Hindus in Bali. The current media introduction that is very effective and easy to use by many people, namely with an Android-based smartphone, the making of Android Application of Frangipani Identification can help people recognize various types of Frangipani by using digital image technology with Android-based making access to information obtained easier. Introduction to Frangipani Flowers uses several methods and

several features that are used to identify each type, which will then be displayed to the user. In addition to identification, there are also other feature choices ((in Android's Menu) that can be used by the user, namely a list of information from each type of Frangipani flower that contains information on the location, function and benefits of each Frangipani flower.

Colors and shapes can be used as the main features to recognize various types of Frangipanis, both of these features can be identified using the HSV method and Invariant Moment. HSV is used because the HSV color space has a separate value between the color (chroma) and the intensity (luma) where H (Hue) is a color value while S (Saturation) and V (Value) are color intensity values. Invariant Moment is used to reduce the Acquisition needs to match the rotational position in the reference data. Research using the HSV Method has been done a lot as in research [3] utilizing the HSV method to detect the texture of an image. The use of HSV method is used to determine the success rate of the application in detecting a texture if it is changed to HSV color. The results obtained were the success rate for recognizing textures in the image using the HSV method was 81% with a truth accuracy rate of 75%, Research [5] also explains that Android applications are able to detect objects in images loaded from cellular galleries, based on color, shape, or features. Images are processed in the HSV color domain for better color detection. Circular shapes can be detected using Circular Hough Transform and other shapes detected using the Douglas-Peucker algorithm. Based on experimental results, the application is able to detect eleven different colors, detect two dimensional shapes including circles, rectangles, triangles, and squares, and correctly match the local features of objects and image views for various conditions. Identification of features with the HSV method using color parameter as reference in recognizing Frangipani Flowers. The use of HSV is better than of the RGB color space because it has more space making it easier to classify colors from Frangipani. Form features can be identified using the Invariant Moment Method. Other studies that have succeeded in using Invariant Moment, such as research [6], use Invariant Moment based on Polynomials for classification of an image and incorporation of the KNN Method for pattern recognition. image recognition technique by analysing how fast the calculation efficiency of each Invariant value from each of the different images, research [7] discusses other functions of frangipani flowers, namely by extracting core oil from frangipanis and using it as medicine and aroma therapy .

## 2. Research Schematic

Android System of Frangipani Identification is an application that can recognize various types of frangipanis and provide brief information about the flowers from an Android device. Users simply input in the form of frangipani flower images, input is done through the smartphone device camera or from the gallery. The entire application process is carried out in an Android device. The following is an overview of the application:

Figure 1 shows the frangipani identification process, there are several steps that are carried out in order to identify a frangipani flower, first, data acquisition in the form of images inputted by the user and the source of the image can be from the camera or gallery and cropping is done to take the required images. The cropping process is done by the user by dragging the frame with fixed ratio. There are two separate processes after the image obtained has been cropped, namely the process of taking the shape features and to take color features. The process of taking shape features starts with a pre-processing which aim to improve image quality by reducing noise using the Median Filter method, the Median Filter method changes each pixel in the image to be closer to its "neighbour" pixels, the median filter method is one of the most effective methods for image noise reduction. The stages of shape pre-processing are to prepare images for easier processing, images are converted to grayscale by using grayscale filter. Shape identification process after the pre-processing stage is continued with image conversion using the Canny Edge method, the Canny Edge method serves to get the edges of the image and convert the image to binary, the edges of the object make it easier to identify the shape features as the shapes can be identified by using the edge's pattern. The next step is extracting the features from the shape using the Invariant Moment method, the Invariant Moment method can extract the shape and produce 7 key point values that will be stored in the database.

The process of taking color features is done by a segmentation process to separate the required image information with those that are not needed using the HSV method, this process begins by determining the color values that are often found in the objects such as red, yellow, white, and grey. Unspecified colors will not be used in the extraction process. Color feature extraction from the results of segmentation using the Color

Histogram method, the Color Histogram method serves to extract color features based on the Hue, Saturation and Value values to be stored in the database.

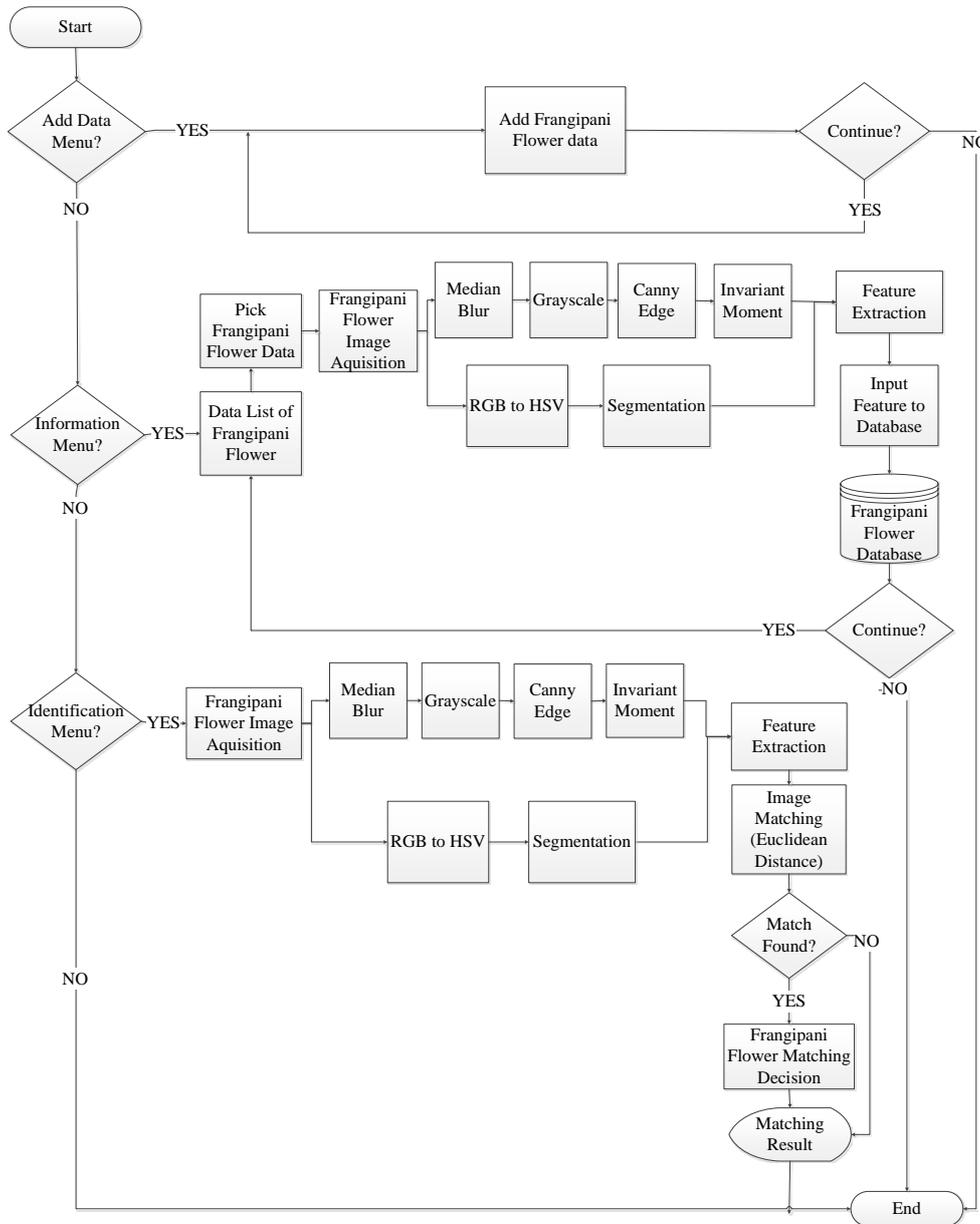


Figure 1 Application Overview

The process of taking color features is done by a segmentation process to separate the required image information with those that are not needed using the HSV method, this process begins by determining the color values that are often found in the objects such as red, yellow, white, and grey. Unspecified colors will not be used in the extraction process. Color feature extraction from the results of segmentation using the Color Histogram method, the Color Histogram method serves to extract color features based on the Hue, Saturation and Value values to be stored in the database.

The two features that have been obtained are inputted into the histogram to be stored in the database. The histogram data in the database and the histograms on the test data will be matched using the Euclidean Distance method, the Euclidean Distance method is a method that can be used to compare the similarities of 2 different dataset, if the results of the calculation are close to 0 or equal to 0 the data are more similar. Data matching results will be the decision of the shape and color decisions possessed by the image. Both the results of the color

and shape decisions will be combined so as to produce a final decision which is the result of identification of frangipani flowers according to their type.

Frangipani is a flower that has more than 100 types and has unique features that vary by type. This difference in features makes diversity in the reference data. The type of Frangipanis used in this study can be seen in Table 1.

**Table 1:** List of Frangipanis (Jepun)

Jepun Name	Shape and Colour Composition
<i>Jepun Moonlight</i>	Five rounded petals with pointy edge, light-yellow center, white middle, white edge
<i>Jepun Thai Pink</i>	Five rounded petals with pointy edge, orange center, pink edge
<i>Jepun Madame Poni</i>	Five hard slender petals with crooked edge, orange center, Purple middle, white edge
<i>Jepun Kimo</i>	Five rounded petals with pointy edge, yellow center, pink edge, white stripes
<i>Jepun Black Tiger</i>	Five fan-shaped petals, dark red with black spot
<i>Jepun Cendana</i>	Five rounded petals with pointy edge, yellow center, yellow middle, slight white edge
<i>Jepun Maroon</i>	Five rounded petals with crooked edge, light red center, dark red edge
<i>Jepun Obtusa White</i>	Five rounded petals with big wide edge, yellow center, white middle, white edge
<i>Jepun Leopard</i>	Five rounded petals with pointy edge, dark red center, white middle, pink edge, dark red stipes

The Android-based Frangipani Identification System uses several stages and methods to obtain identification results. The HSV and Invariant Moment methods have an important function to recognize Frangipani by using color and shape features as reference data to obtain the appropriate identification results. HSV (Hue Saturation Value) shows color space in the form of three main components, namely hue, saturation and value. Hue is an angle from 0 to 360 degrees. Usually 0 is red, 60 degrees is yellow, 120 degrees is green, 180 degrees is cyan, 240 degrees is blue, and 300 degrees is magenta. Saturation of a color is a measure of how much pure is the color. Saturation is usually worth 0% to 100%. Value, also called intensity, is a measure of how much brightness a color or how much light comes from a color. Value values from 0% to 100%. HSV plays a role in the segmentation process using a predetermined color reference value, so it will separate the information needed and not needed. Color feature extraction stage using the Color Histogram method by calculating the color appearance value in the image obtained by calculating the number of pixels from each part of the color range. The histogram undergoes normalization by dividing the value from the grey level by the number of pixels in the image. The Invariant Moment method is used to extract frangipani shape features. Invariant Moment is a method of taking characteristics of an object. Characteristics taken can be in the form of positions, areas, angles that produce 7 values of Hu Moment Invariants. Euclidean Distance is used for matching between reference data and test data. Euclidean Distance is a method for calculating the distance between two vector points.

### 3. Result and Discussion

Android-based Frangipani Identification System is designed on the Android platform and uses the OpenCV library. The application will run properly when the device has the OpenCV Manager installed to perform functions in the Library. There is a main process in the application to identify the type of Frangipani and display the results of identification to the User. The identification process is done by input via gallery or camera. The results of the introduction are displayed to the User along with information from recognized Frangipani types.

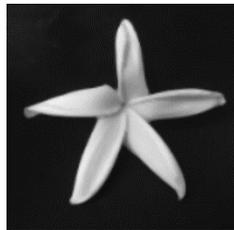
Image acquisition is done using an Android device's camera, it can also take images that already exist in the gallery. The media used has been conditioned, namely the black background with a retrieval distance of 20cm,

this aims to get the image as closely as possible with the reference data to reduce matching errors. After the image is obtained, the next process is cropping to reduce unnecessary background, this is done by dragging the frame with fixed ratio. The image obtained converts the resolution to 150x150 pixels for data uniformity purposes.



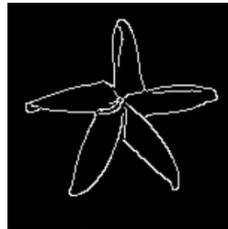
**Figure 2** Cropped RGB Image

Figure 2 is an image that has gone through the cropping process carried out by the user on the application and has a resolution of 150x150 pixels. The next process is a median filter process, this process aims to reduce noise by matching pixels with neighboring pixels so that the pixel value's difference is not too far away. The next shape feature extraction process is the grayscale process to prepare the image to be binary.



**Figure 3** Grayscale Image

Figure 3 is a conversion image from RGB color space to Grayscale color space which is done by searching for the average of the three RGB values.



**Figure 4** Canny Edge Image

Figure 4 is an edge detection image that is carried out using the canny edge detection method to get the shape of the frangipani flower. The resulting edge is very much determined by the threshold value, if it is too small then there will be no edge, if it is too large, there will be more noise(s).

**Table 3:** Invariant Moments Value

Moment	Value
<i>Mom1</i>	0.008866088240320273
<i>Mom2</i>	2.1444178348241786E-7
<i>Mom3</i>	3.394082437511613E-9
<i>Mom4</i>	5.506405124111635E-9
<i>Mom5</i>	2.1402096727260973E-17
<i>Mom6</i>	2.4179721689221084E-12
<i>Mom7</i>	-1.0421894310234941E-17

Table 3 is the result of the moment calculation in the image of figure 4, the moment is used to reduce the object's angle error when shooting so that when the image is taken upside down ( $180^\circ$ ), the image can still be identified.



**Figure 5** Segmented Image

Figure 5 is a segmented image of figure 2, this process aims to eliminate the background so that it does not become a value of calculation and is considered a characteristic of the frangipani flower. After the segmentation process, the color value of the image can be taken as appeared in table 4.

**Table 4:** HSV Percentage

Colour	Percentage
<i>Red</i>	0.0 %
<i>Yellow</i>	7.52 %
<i>White</i>	0.76 %
<i>Grey</i>	8.96 %

Table 4 is the percentage of the HSV color values contained in figure 5. The values in Table 3 and Table 4 are then entered into the histogram. The stored histogram is a feature of a Frangipani flower, after feature extraction, the calculation data similarity phase will be performed with the test data in the database using the Euclidian Distance method. The process of calculating Euclidean Distance will produce a value where the smaller the value, then the more similar the reference data with the test data. The following is the result of the Frangipani type recognition of 54 data used as test data using the HSV method and Invariant Moment.

**Table 5:** Recognition Result of Frangipani

No.	Frangipani Name	Sample Total	Recognized	Unrecognized
1	<i>Jepun Moonlight</i>	6	4	2
2	<i>Jepun Thai Pink</i>	6	6	0
3	<i>Jepun Madame Poni</i>	6	5	1
4	<i>Jepun Kimo</i>	6	4	2
5	<i>Jepun Black Tiger</i>	6	3	3
6	<i>Jepun Cendana</i>	6	6	0
7	<i>Jepun Maroon</i>	6	3	3
8	<i>Jepun Obtusa White</i>	6	6	0
9	<i>Jepun Leopard</i>	6	3	3
<b>Success Rate</b>			<b>74,07%</b>	<b>25,9%</b>

Table 5 shows the results of identification by combining shape and color features resulting in identification success of 74.07% and identification failure of 25.9%. Frangipani type can be identified based on decision from the results of the identification method. Combining both shape and color features will result in better identification results.

#### 4. Conclusion

Frangipani Type Identification System is an application that can recognize various types of Frangipani. The making of the applications using the HSV method, Color Histogram, Invariant Moment and Eudiclian Distance to identify various types of Frangipani with a recognized percentage of 74.07% and not recognized by 25.9%. The results of the identification are very dependent on light and Acquisition because it can affect the detection of shape and color features of the image.

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# Analysis of ICCT Research Trend using the ARTAS

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## Abstract

Trend analysis provides an overall understanding of what is being studied and contributes to the prediction of future events. There are some research trend studies in various fields, but there was no case of analyzing papers from International conference on culture technology (ICCT). For this purpose, we analyzed the ICCT research trend by modifying ARTAS proposed and implemented in our previous study. Through our analysis, we showed that ARTAS can be easily applied to various fields. We have collected and analyzed papers in the ICCT 2017 and ICCT 2018 proceedings that are available online. According to our analysis, main topics of the first ICCT held in 2017 are Virtual Reality (VR), augmented reality, and artificial intelligence. In 2018, main topics are design thinking, usability evaluation of VR game, and artificial intelligence. We expect that research on artificial intelligence and VR will continue in the future.

*Keywords-trend analysis; text network analysis; natural language processing; text mining;*

## 1. Introduction

Trend analysis is a method of extracting and analyzing key topics from text data in a specific field to help present overall trends or predict future events [1]. Trend analysis is performed through text mining. Text mining is a text analysis technique that combines various techniques such as language identification, natural language processing, and visualization to extract new patterns or useful information from unstructured text data [2]. Trend analysis is used in various fields where large volume of text data such as papers, patents, and news articles are accumulated, and there are some commercial services providing trend analysis [3, 4].

Google Trends uses Google search engine users' search logs to provide real-time, popular search queries by country and region [3]. It also provides a graph that allows you to easily compare the interest of multiple search terms. Naver DataLab in Korea analyzes search engine logs and provides popular search keywords in various fields such as fashion, cosmetics, digital, food, health, etc [4]. In addition, it provides a detailed view of the ranking and trend of search keywords in terms of age and time. Finally, it provides small business owners with useful information such as the ranking of business interests, popular areas by business type, and card usage statistics.

Meanwhile, it is very important to predict which research will decline or come in the future. Accordingly, several studies are underway to identify research trends and to predict future research topics by extracting topics from specific field papers and applying various text mining techniques [5–7]. Hurtado, J.L. et al. proposed to automatically predict research trends in data mining and machine learning related topics by using association analysis and ensemble prediction [5]. Shakiba, M. et al. proposed an analytical method that extracts and analyzes key topics from text data in a specific field to present overall trends or predict future events. They collected papers related to Radio-Frequency Identification (RFID) among SCI and SSCI papers, and selected 100 papers that were cited the most, classified them into 4 categories, finally providing a research and development roadmap for future research area [6]. Kondo, T. et al. proposed an approach to consider the terms written after a specific expression such as "using" or "is based on" in the title of the paper as a technical term in the field of the thesis, and constructed a technology trend mapping system for specific research fields [7].

Although there are trend analysis studies in various fields, there is no case that analyzed the research trend of ICCT. Therefore, we modified the Automatic Research Trend Analysis System (ARTAS), an information security research trend analysis system developed in our previous research, and conducted the ICCT research trend analysis and explain the results. To this end, we collected 180 papers from ICCT proceedings 2017 and

2018, and utilized all texts except the references section. In addition, we used keywords written by the authors to extract the main topics of the paper.

According to our trend analysis, main topics in 2017 are virtual reality and augmented reality planning, deep learning based interactive art, VR game content and framework, and emotion recognition based psychotherapy. In 2018, personalized service and speech recognition technology based on artificial intelligence, effects of artificial intelligence technology on design field, influence of creativity on environment, and problems of modern design technology were mostly studied. Based on the overall analysis, we anticipate that future research on artificial intelligence and virtual reality will continue.

The remainder of this paper is organized as follows. Section 2 describes network analysis and research related to ARTAS. Section 3 presents and describes the trend analysis results. Finally, Section 4 presents conclusions.

## 2. ARTAS

ARTAS is an information security research trend analysis system developed by our previous research [8]. This system consists of a data crawler module, a data analysis module, and a user interface module. All of these modules are automated, allowing to analyze trends very quickly. In addition, because the system configuration is simple, it can be modified to suit other analysis targets other than information security. When one adds a keyword to a data analysis module, the keyword is extracted from the analysis data, and keywords consisting of several words can be extracted. Therefore, we modified the data analysis module of ARTAS to develop an analyzer suitable for ICCT research trend analysis.

We collected 646 research topics from the keyword list of the papers and added them to the data analysis module. These topics are extracted from the 180 papers we collected. Topics extracted in this way are generated as final results through network analysis. Network analysis is a method of analyzing the structure and change process of network graphs by showing the relationships among related entities as nodes and links. The network graph consists of nodes that are objects to be analyzed, and links that represent the relationships between the nodes [9]. In other words, it is an analytical technique that focuses on the mutual relation of each object so that it is possible to analyze the relation between key keywords in a large amount of unstructured data. This analysis method was applied to ARTAS because it is suitable for analysis of research trends.

There are examples of analyzing research trends using this network analysis approach [10–12]. Cho has conducted a network analysis of the titles of the papers published in the field of information science to derive the relationship between research topics [10]. Choi et al. has analyzed the core research that is emerging in popularity through network analysis of abstracts of papers published in Korean administrative journals [11]. Duvvuru et al. collected the papers published in the European Journal of Operational Research and applied network analysis to visualize the changes in research trends over time [12].

## 3. Results

This chapter describes the results of research trend analysis conducted using ARTAS. We analyzed 92 papers published in the ICCT in 2017 and 88 papers published in 2018. The final result as shown in Fig. 1. The nodes represent the extracted keywords, and the edges represent the number of co-occurrence count of connected nodes in the same paper. That is, if an edge is thick, it means that the relationship between the two nodes connected is very strong. Through this analysis, we can see the overall research trend by looking at the relationship of keywords. We also described the trend analysis results in more detail by looking at the papers related to the extracted keywords.

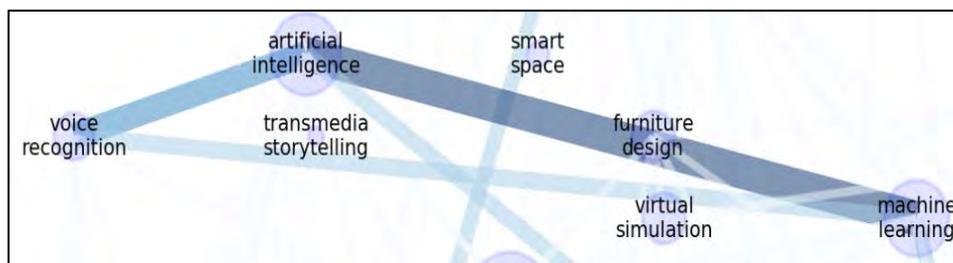


Fig. 1 Example of trend analysis results.

### 3.1. ICCT 2017

The final result of ICCT 2017 research trend analysis is shown in Fig. 2. Table 1 shows the title of the papers from which the most important keyword pairs and keyword pairs were extracted.



- virtual reality, augmented reality: Na et al. analyzed the recent trends of virtual reality, augmented reality, mixed reality, and applied ICT to education [13]. Do proposed a new structure concept for augmented reality based on transparent liquid crystal displays [14]. Yulia et al. discussed the development of an interactive augmented reality for children learning about animal life [15].
- machine learning, neural networks, artificial intelligence, deep learning: Nakashima et al. described a project to produce interactive art with deep coloring and creative expression [16]. Yu et al. applied and improved the AdaBoost learning algorithm for wheelchair navigation [17].
- game engine, virtual reality: Gao et al. described techniques that enable interaction with characters in VR [18]. Park et al. have designed VR content for Earth Science Education [19]. Qu et al. proposed a content creation workflow that can be referenced by people who want to create VR content based on head mounted displays and game engines [20].
- neural network, computer vision: Munawar et al. developed a video-based fire detection system [21]. Ahmed et al. developed an automated weed control system that uses pattern recognition to identify weeds [22].
- face detection, emotion recognition: Yu et al. proposed a color therapy method that recommends appropriate color combinations and pictures based on the emotional state of the patient [23]. Also, they developed a system that estimates the user's emotional state and provides appropriate colors for smart bulbs [24]. Lee et al. constructed a face recognition model using Naïve Bayesian classifier for emotion recognition [25].

### 3.1. ICCT 2018

The final result of ICCT 2018 research trend analysis is shown in Fig. 3. Table 2 shows the title of the papers from which the most important keyword pairs and keyword pairs were extracted.

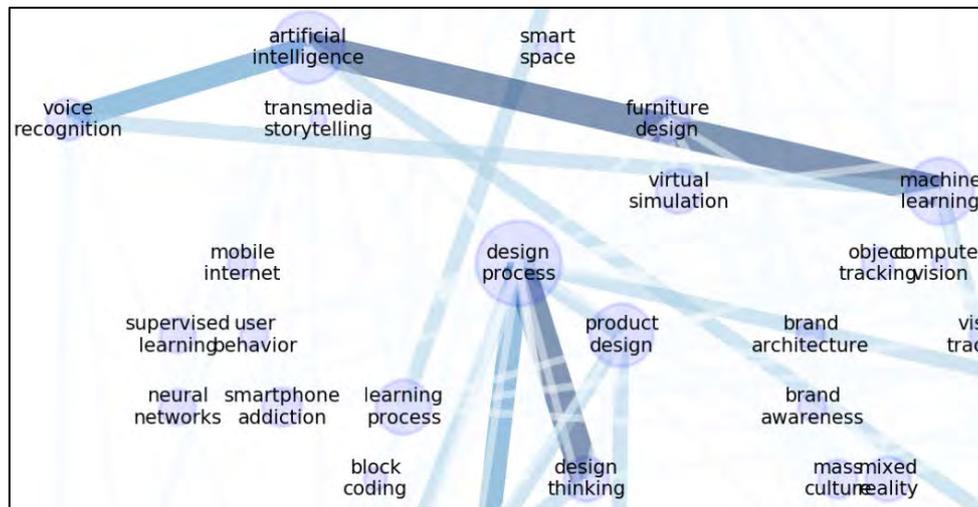


Fig. 1 ICCT 2018 research trend analysis results.

Table 2. Important keywords of security conference in 2018

Keywords	Related paper's title
artificial intelligence, machine learning, voice recognition	- Analysis of Artificial Intelligence Speech Recognition Technology [26] - Artificial Intelligence as Designers: Assistants or Substitutes? [27]
design process, design thinking	- Gathering creativity from different specializations in an educational institution: A proposal to design school [28] - New design innovation and technology are creating new problems in our community [29]
usability evaluation, virtual reality, VR game	- Usability Evaluation of Locomotion Technology for Expansion of Space in Virtual Reality Game [30] - Evaluation of Framework System for Making Safety Training VR Simulation [31]

- artificial intelligence, machine learning: Lee et al. introduced the trend of personalized service and speech recognition technology based on artificial intelligence and proposed future development direction [26]. Ma discussed how artificial intelligence technology can contribute to the field of design and what changes in the job of the designer are taking place [27].

- design process, design thinking: Han emphasized the importance of the environment to creativity through practical industry case studies [28]. Liu discussed the reasons and solutions for the analysis of social problems caused by modern design technology [29].

- usability evaluation, virtual reality: Ding et al. Conducted a VR game with two exercise techniques and compared and evaluated usability through simulator sickness questionnaire and Slater-Usoh-Steed method [30]. Xie et al. Proposed and evaluated a system framework for generating VR safety training simulations [31].

## 4. Conclusion

In this paper, we modified ARTAS, an information security research trend analysis system, to analyze the research trend of ICCT. We analyzed the papers published in the ICCT from 2017 to 2018 using modified ARTAS. The main contributions of this study are as follows. First, we have demonstrated that ARTAS which we developed in previous study can be applied to various research fields. Therefore, we can apply ARTAS to a wide range of fields such as politics, society, and economy, thereby making a significant contribution to governments and institutions that need to establish diverse policies.

Second, we analyzed the research trends of ICCT, and the research trends by year are as follows. In 2017, virtual reality and augmented reality planning, deep learning based interactive art, VR game content and framework, and emotion recognition based psychotherapy were mainly studied. In 2018, personalized service and speech recognition technology based on artificial intelligence, effects of artificial intelligence technology on design field, influence of creativity on environment, and problems of modern design technology were mostly studied. Based on the overall analysis, we anticipate that future research on artificial intelligence and VR will continue.

Currently, we are doing research to predict keywords that are likely to be studied in the future. To do this, we will be conducting experiments to apply the edge prediction algorithm, one of the network analysis techniques. Edge prediction algorithms can predict nodes that are likely to be connected in the future on a network graph. However, since there are many types of these algorithms, it is necessary to select the best algorithm for each field. Therefore, we will add to ARTAS the ability to select and apply an appropriate prediction algorithm to the analysis. In addition, we will add data sources such as SNS real-time data and patent data to more accurately analyze and forecast research trends.

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# Dimensions of Innovative Work Behavior: The Literature Survey

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## Abstract

There is a pressing need for a better understanding on the dimensions of innovative work behavior for information technology (IT) helpdesk support staff in IT service industry. Thus, this paper aims to explore related documents published between 1994 and 2019. The literature survey finds six dimensions: opportunity exploration, idea generation, idea investigation, idea promotion, championing, and idea realization. The results help to expand the knowledge in this field and can be applied to assist industry in surviving the transition era.

**Keywords-***Innovative Work Behavior, IT helpdesk support, Literature survey*

## 1. Introduction

In today's rigorously competitive markets and complex situations, service firms must continuously renew their processes and develop their new and valuable opportunities through innovation to remain their competitiveness and stay viable. In particular, IT has become a critical tool, enabling service firms to expand profit expectations, controlling the information required by the business, and supporting the working process for users [1] through IT helpdesk support staff. They can solve technical problems, assist in conducting day-to-day operations, and add value to their organization by helping to reduce costs [2].

Through a systematic existing literature review, an employee's innovative work behaviors are abstract and difficult to measure [3]. Their dimensions can be found in both manufacturing and service industries [18, 19, 21-23]. In the manufacturing industry, innovative work behavior is an essential key asset for the success of inventory management in a fast-changing business environment. Similarly, this behavior in the service industry is an integral part of the best responsiveness for changing customer needs in today's highly competitive economic [4].

In general, definitions and dimensions of innovative work behaviors are applied and developed in each different context [5-10]. Most of the empirical studies have centered around the work of Scott and Bruce (1994) and Janssen (2000) [5, 7, 11-15]. Nevertheless, the IT service industry has obtained less scholarly attention than manufacturing or hospitality industries [1, 16, 17]. In other words, the dimensions of IT helpdesk support have remained an unpopular research concept among scholars and practitioners.

Thus, the purpose of this literature survey is to investigate the dimensions of innovative work behavior of IT helpdesk support staff in IT service industry. As a result, executives of IT service firms can identify valuable strategies to create value for their employees, to build sustainable competitive advantage, and to stay viable.

## 2. Research Methodology

Nowadays modern organizations need their IT helpdesk support staff to be extra productive and effective. To illustrate the complexity of this research problem, the literature survey considers the basic question: What are the key components of innovative work behavior for IT helpdesk support staff in IT service industry? Thus, the literature survey helps to gain an understanding and an update of the current state-of-the-art knowledge on the dimensions of innovative work behavior in the service industry, particularly in the IT service industry.

To carry out this literature survey, the three-step process proposed by Urbach, Smolnik, and Riempp (2009) was employed. The first step is to select literature sources; the second step is to define a time frame for analysis; and the last step is to select papers to be reviewed [18].

First, the source selection is to identify all relevant research or academic articles in numerous top electronics databases: JSTOR, Oxford, Cambridge, Emerald, Wiley, SpringerLink, Taylor & Francis, Science Direct,

Sagepub, MDPI and IEEE Xplore, for example, the Academy of Management Journal, the Academy of Management Review and Journal of Organizational Behavior from JSTOR database, Journal of Consumer Research in Oxford database, Journal of Management & Organization in Cambridge database, Journal of Service Management in Emerald database, the Journal of Creative Behavior and Human Resource Management in Wiley database, IEEE Transactions on Engineering Management in IEEE Xplore database and Administrative Science Quarterly from Sagepub.

Second, the time frame selection is to find available online articles published between January of 1994 and March of 2019 through keywords: “innovative behavior” or “innovative work behavior”, within “service” or “IT service” industry, and the unit of analysis: individual level. As a result, more than 110 papers related to the innovative work behavior research were found, including journals from eleven main electronic databases.

Last, the article selection is to choose useful articles from reliable sources, an appropriate time frame, and related keywords to develop the dimensions of IT helpdesk support innovative work behavior at staff level in the IT service industry.

### 3. Summary of the Dimensions of Innovative Work Behavior

In this literature survey, innovative work behavior has been defined differently by various researchers. To verify its definition, most studies have applied definitions from existing literature [6-8] or adapted them to their own context [9, 10]. Based on the studies and literature review, several researchers have used the definition of innovative work behavior from Scott & Bruce (1994) [11, 13, 19] and Janssen (2000) [6, 12, 15].

First, Scott & Bruce (1994) defined innovative work behavior as “the production or adoption of useful ideas and idea implementation and begins with problem recognition and the generation of ideas or solutions” [19, 20] and “individuals can be expected to be involved in any combination of these behaviors at any one time” [21]. Based on Scott and Bruce (1994), some researchers further defined innovative work behavior as an employee’s ability to generate new ideas and then implement them to benefit individuals, their group or their organization in solving the workflow problems [19, 20, 22], resulting in higher efficiency and effectiveness [19, 21].

Janssen (2000) defined innovative work behavior as “the intentional creation, introduction, and application of new ideas within a work role, group or organization, in order to benefit role performance, the group or the organization” and divided innovative work behavior into three types: idea generation, idea promotion, and idea realization [23, 24]. This definition has a similar focus on employees’ intentional effort to generate beneficially novel outcomes at work [14, 23, 24].

According to Farr and Ford (1990), innovative work behavior was defined as workplace behaviors aiming to achieve the initiation and intentional introduction of new and useful ideas, processes, products or procedures within a work role, group or organization [25]. Thus, it is likely to identify new techniques, then use them with monitoring cost, leading to more effectiveness, higher productivity and success in the organization [26].

Other researchers defined innovative work behavior as employees’ skills to solve users’ work problems by generating new ideas or solutions and reconfiguring known approaches into innovating alternatives [27] reflecting all relevant features of superior success [28]. On the other hand, a few studies have noted that creativity is only related to generating new ideas, while innovation is related not only to generating new ideas or new knowledge but also to adopting them to solve new problems for the organization [13, 15].

To explain the dimensions of innovative work behavior, management studies have described innovative work behavior as a process with multiple stages. Previous research has often identified the dimensions of innovative work behavior as an idea generation only [22] which insufficiently captured its richness and potential multidimensionality [26]. After one-dimensional measures with limited items, many researchers developed a multiple dimensional measure [25] which categorized innovative work behavior as idea generation, idea promotion and idea realization [14]. First, employees recognize a problem and generate new ideas and solutions. Then, employees promote and build support for their ideas and solutions. After that, employees realize and apply them for the benefit of their work role, workgroup or organization [29].

Other researchers divided innovative work behavior at the workplace into two dimensions: initiation and implementation. Initially, employees generate ideas by identifying potential opportunities in solving problems. Then, they implement those ideas before introducing them to other employees [30].

Moreover, some scholars added new potential dimensions to innovative work behavior, namely the exploration, generation, championing, and implementation of ideas. First, employees explore alternative ways to improve current products, services or processes. Next, they generate some solutions to solve existing problems for better performance. After that, employees champion their new ideas in the organization. Next, they implement their ideas in working processes [25].

In summary, the literature survey revealed six dimensions of IT helpdesk support innovative work behavior for the IT service industry: opportunity exploration, idea generation, idea investigation, idea promotion, championing, and idea realization.

First, opportunity exploration is the beginning process to explore new ideas or alternatives creating opportunities for products or services to stand out in current competitive markets [25] and highly innovative work processes [31]. The dimension consists of finding opportunities, recognizing them, and gathering information [26].

Second, idea generation is a process that an employee recognizes a problem and generates new ideas either adopted or novel in the organization [14, 30]. They are useful to improve work efficiency [25] or produce favorable opportunities [31]. This dimension is composed of generating ideas and solutions, producing opportunities, and linking data with information [26].

Third, idea investigation is a process to find feasible ideas for problem-solving and opinion-evaluating. The dimension includes setting, testing/evaluating ideas, and solving problems [26].

Fourth, idea promotion is a part of job responsibilities for an employee to find ways to promote his or her solutions and ideas [14, 29] through sponsors and alliances with necessary influence and authority [23, 24].

Fifth, championing is a process in introducing innovative ideas, bringing them to life, mobilizing time, money and people to start the implementation process [26], taking the risk to support new ideas or solutions to their work role [25] and persuading others to accept new ideas or solutions so that they can be implemented [31].

The final dimension is idea realization [14]. It is a process that employees realize potential solutions and ideas and apply them to a work role, a group, or an organization [30] for better task performance [29]. After that, they produce a prototype of the new ideas for productive use [25]. In general, innovative work behavior is rewarded by favorable performance evaluations [31] because of employees' intention to improve existing processes and procedures [26].

#### 4. Conclusions

Innovation cannot be created without employees [32] who adapt their skills, expertise and knowledge to launch useful ideas for problem-solving, resulting in organizational goal achievement [27]. As human resources are valuable assets, the dimensions of innovative work behavior play key roles in responding to user requirements and determining business success [32]. To conclude, there are six dimensions of innovative work behavior: opportunity exploration, idea generation, idea investigation, idea promotion, championing, and idea realization. These dimensions can be very useful for IT helpdesk support staff whose behavior is a valuable tool in promoting organization to stay viable in the long-term business operations.

#### 5. Contributions

This literature survey intended to expand the knowledge of innovative work behavior which can be used to set related policies. Regarding theoretical contribution, this paper has attempted to summarize some of the key dimensions of innovative work behavior [14, 22, 25, 26, 31] to improve our understanding of IT helpdesk support staff and add more benefits to the literature related to management research. Regarding managerial contribution, executives can utilize the dimensions of innovative work behavior to identify suitable strategies for the recruitment and training of IT helpdesk support staff. Hopefully, they will be able to provide users with technical assistance related to computer systems, hardware or software and to serve as the first point of contact [27]. Additionally, the IT industry can use innovative work behavior as a strategic tool to enhance its competitive advantages for superior business operations in the future.

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# **New Momentum of Cultural Creation: Feeling from the Experience in Taiwan**

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## **Abstract**

Starting from the characteristics of cultural creation and the background of the development of cultural creation industry in Taiwan, the paper expounds the current situation of the development of cultural creation industry in Taiwan. Taking the Taiwanese Cultural Expo 2019 as the main axis, combining with the experience of Taiwanese cultural creation, the paper analyzes the performance of cultural creation from four perspectives: daily life, urban development, science and technology, and cultural heritage. The development of cultural creation industries in Taiwan has its specific regional and industrial characteristics. Because of its sustainable work in policy guarantee, platform construction and group cultivation, the cultural creation industries, whether from the perspective of creators or consumers, have a better industrial and social cognitive foundation. The propositions of the cultivation of cultural creation soil and the benign development of industry need to be constantly considered and promoted in the new momentum strategy of cultural creation.

**Keywords-** *Cultural Creation, New Momentum, Taiwan Cultural Expo*

## **1. Introduction**

Cultural creation, as one of the manifestations of cultural industry, has become an important link in the industrial structure of a country. The concept of cultural innovation is a new concept of cultural development formed in the vigorous rise of contemporary cultural industry and creative economy. Its foundation lies in "Wen", that is, culture, and its key lies in "Chuang", that is, creative transformation and innovative development. The development of Taiwan's cultural industry originated from the "local" reconstruction movement in the 1990s. In 1995, Chen Qinan, then deputy chairman of Taiwan's "Cultural Construction Council", put forward the local development strategy of "Cultural Industrialization and Industrial Culturalization". In 1999, Taiwan's "Cultural Construction Council" promoted the plan of "revitalizing local cultural industries and revitalizing community industries", emphasizing the development of cultural industries with local characteristics based on local culture and society. In 2010, Taiwan's "Legislative Yuan" passed the "Law on the Development of Cultural and Creative Industries", which defined cultural and creative industries as "industries that derive from creative or cultural accumulation and use of intellectual property rights, can create wealth and employment opportunities, promote the aesthetic quality of the whole people and improve the living environment of the people", and reclassified them into 15 specific industries in 4 major fields.

Based on this background, the Taiwan Cultural Expo (with the full name "Taiwan Culture Creative Design Fair") was born in 2010, in recent years, with "Boost Cultural Content Force" and "Build Industry Ecological System" as the goal, by the beginning of a "single pavilion, predominantly commodity trade show model", by 2014 transformed into "Cultural Conceptual Approach Exhibition", and put forward the "City Is Show, Show Is life" concept. With the theme of "Culture On the Move- Culture moving", this exhibition creates a new imagination of Culture through a dynamic experiment across tradition and innovation, and across the local and the world. This paper will take 2019 Taiwan Cultural Expo as the main axis, and combine the views and feelings of Taiwan cultural and innovation to provide a glimpse.

## 2. Cultural Creation as a new momentum in urban development

Professor Terry N. Clark, at Department of Sociology, University of Chicago, leading the new Chicago school proposed a scenario model of urban growth and development. The scene mode focuses on the impact of citizen's participation in culture and art, consumption and entertainment on urban economic and social development. They believe that after a certain stage of urban development (post-industrial period), the original growth mode is restricted, and the civic participation of culture and art becomes crucial to urban growth and development. The development of cities lays more emphasis on cultural consumption and the intervention of creative class. The communication of urban image gradually transitions from tangible image features to cultural immersive multi-dimensional experience, which has an important impact on the design and communication of cultural creation.

In the 2019 Taiwan Cultural Expo Hua Shan theme area, the "Editing Local" theme exhibition, from the perspective of topography and geomorphology, memorial ceremonies, diet culture, and so on, at The same time combining display modes such as experience, interactive display, fully with the traditional print media, issued 4 theme-based publications: The Local. The Place, which all-roundly display unique style and features of four cities: Tao Yuan, Tai Nan, Ping Dong, Tai Dong. As a kind of cultural and creative behavior promoted by the city, this exhibition leads the creativity with the concept, and gets through the diversified communication channels of physical display, immersive scene, product derivative and behavior experience. Cultural creation is no longer the embodiment of a single object or behavior, but the comprehensive expression of a certain social relationship. (Fig. 1)



Fig. 1: "Editing Local" theme exhibition- Tai Nan

Affected by the historical environment, the Juan Cun (military dependents' village) has become a unique urban form in Taiwan. The term usually refers to the houses built by the Kuomintang government, which lost the civil war between the Kuomintang and the Communist Party from 1949 to the 1960s, to shelter troops and their families who were forced to migrate from mainland China to Taiwan. "Rainbow Juan Cun" is one of the few existing villages located in Nan Tun district of Taichung City. It is named because of its contrasting colors and graffiti with distinct themes. As a special spatial cultural creation product, it has become a hot spot of attention on the Internet and tourism. It is the change of existing form caused by the infusion of culture and innovation that ensures the integrity of "Rainbow Juan Cun". Huang Yongfu, a 90-year-old veteran, took up his paintbrush because of "boredom" and turned the alleys and streets of the village into natural canvases, painting all kinds of beautiful rainbow lines and cute animals on them to brighten up the village. "Rainbow Juan Cun" is a spontaneous artistic activity of ordinary people. This artistic creation is as excellent as the public art activities held by the general government, which gives a vivid inspiration to the vigorous "city building movement" nowadays. (Fig. 2)



Fig. 2: Corner of Rainbow Juan Cun

### 3. Cultural Creation as a new momentum in science and technology

In the age of information and data, technology is represented by the integration of traditional "low technology" and modern "high technology". Low-tec refers to mature or traditional technologies. James Wallbank declared in his Lowtech Manifesto that "low technology is a technology of the masses", a technology mastered by a broad mass of people and intended to serve the masses. High-tec, on the other hand, represents the cutting-edge and representative achievements of science and technology in a specific period, and is the embodiment of advanced productivity and economic development. Both have relativity and interconnectedness. Steam engine and electricity represent the high technology during the industrial revolution, but obviously do not represent the modern high technology. In the era of mobile Internet, wave after wave of technology is ushered in, and high and low technologies are changing at an unprecedented speed. Today's high technologies that are still in the experimental stage will become mature and low-skilled technologies for the public in the future. High technology and low technology are defined conceptually without distinction. Low technology is not a representative of being backward or obsolete. On the contrary, the traditional mature "low technology" reflects the sustainable development of science and technology, which can make full use of limited resources, respect nature, and reflect cultural and regional characteristics.

Cultural and creative brands such as "Do as Clay Likes", "Mr. Leaf", "Different Material" make an issue of the material. "Do as Clay Likes" uses material technology to reprocess construction concrete waste into a synthetic material, and then processes new shapes such as flowerpot, ashtray and clock plate. "Mr. Leaf" mined the texture of leaves, combined with leather, to produce luggage with vein texture; "Different Materials" also start from the overturn of traditional thinking, reprocess raw materials such as marble, cement, iron, slate, etc., extract their surface texture and combine it with leather to produce products with strong visual and tactile contrast such as marble handbags and iron wallets (Fig.3).



Fig.3: Mr. Leaf, Different Material

In the theme exhibition of "Editing Local - Pingdong", the creators use programming and mechanical principles, combining screen's regular stir formed by leaves with holographic projection to form a dynamic picture of comprehensive interaction of light, shadow and sound. Here, traditional regional culture and modern science and technology are perfectly combined (Fig. 4).

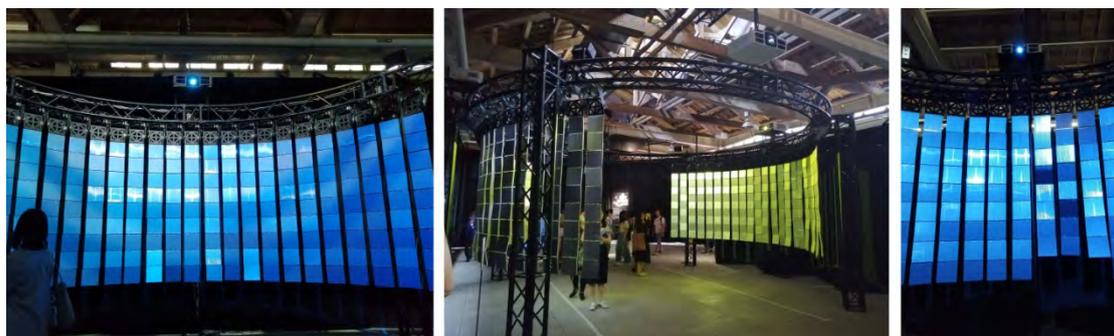


Fig. 4: Editing Local - the main unit of Pingdong

The theme exhibition of "Evolution Stage" in Hua Shan Cultural Concept Exhibition Area starts with the theme of "Culture On the Move" with the beginning of the creative display of stage art, breaks the boundary between exhibition and performance, and organizes the exhibition with "performance" and "Documentary" as two main axes. Regardless of the foreground and background, the exhibition is the performance field. From the cultural progressive behind each performance, we can see the real dynamic of contemporary Taiwanese culture. The exhibition uses technical means to make cultural and creative expression no longer limited to the single

dimension, such as text, image, product and space, and realize the comprehensive expression relying on urban scene and appealing for urban cultural value (Fig.5).



Fig. 5: The theme exhibition of "Evolution Stage"

#### 4. Cultural Creation as a new momentum in cultural inheritance

The realization of cultural and creative value is reflected in the effective mode of communication, which has the rules of commercial operation and the particularity of operation due to its cultural characteristics. A survey of this exhibition shows that many cultural and creative brands are initially developed based on cultural and creative cultural characteristics, looking for a clear cultural context suitable for their own development, and then discussing the path of business model when the time is right. In my communication with the founder of brand "Tao Shi", I learned that there are too many original designers in Taiwan who spend years focusing on creation while waiting for the opportunity to be recognized by the business. Many brands are lost in this process, and these who attend the exhibition are persistent. It can be seen that there are obvious differences in the understanding of cultural creation between the two sides of the straits, which are highlighted in the way of thinking. One way of thinking is the product thinking of cultural creation, which focuses on the results of business and emphasizes that culture serves products. The outstanding characteristic is the short-term realization of cultural and creative value. Creation is often subject to the popular elements of a certain period, with some grafting and copying of low-creativity work. This approach does not preclude the success of some people with a keen sense of business, but will soon fall into the bottleneck of weakness; another way of thinking is cultural and creative thinking, which focuses on the process of cultural and artistic immersion and emphasizes that products serve culture. In such a process, the development of a cultural and creative brand is always sustainable, and the value of cultural and creative is gradually revealed through a systematic and long creative process. Such an approach requires merchants to pay a certain amount of time and capital cost. However, with the improvement of safeguard measures such as industrial policies, intellectual property, cultural and creative value will present a "Matthew effect" with full staying power and strong desire. At the same time, due to the internal driving force of culture and art, cultural and creative products are not only tangible physical forms, but also may be derived into a space, an image and a behavior. Therefore, the new momentum of cultural creation in terms of "cultural" characteristics should be analyzed in a strategic perspective, carefully analyzed with the deep value of culture, to stimulate its vitality of innovation and inheritance, which makes culture become an important force for sustainable social development and promoting human civilization while stimulating visual value.

The design hotel "Home Hotel" in Taiwan is committed to promoting regional culture. It cooperates with the long-term creative brand "Hai Zai" to overturn the definition of traditional hotel. It not only provides accommodation for guests, but also conveys the brand concept and inherits regional culture as a cultural and creative platform. After planning "13 Rooms & its Time and Space Adventures" in 2018, they launched "13 Rooms/Parallel Universes" in April 2019 at the "Home Hotel" Da'an store. In collaboration with the new generation of creative groups in Taiwan, the exhibition creates 13 spaces and three hidden secret rooms by hand, gathering cross-field energy such as craft, smell, music and characters, subverting the real world with creation, and breaking the sensory vision of creators and the public with infinite imagination. "Thirteen Rooms/Parallel Universe" records the inner world sketched by the creators with the brush strokes of art. It is they who make business more artistic and art more living, and it is the feelings of culture that permeate the current world (Fig. 6).



Fig. 6: The theme exhibition of 13 Rooms/Parallel Universes

"Newspaper Times" is an old newspaper cultural revival movement initiated by United Daily News. It creates a licensing service platform with stories and creative ideas by providing image authorization of historical photos for the cultural entrepreneurship circle, and shows the innovative consciousness of traditional media communication and cultural cohesion of new media communication. Through the reproduction of pictures and texts of old newspapers, cultural and creative behaviors are initiated. Such a cross-temporal cultural relay enables people to inherit the culture of a specific period in the process of recalling time, and stimulates people's emotions of each era (FIG. 7).



FIG. 7 "Newspaper Times"

## 5. Conclusion

China's mainland economy started relatively late and its industrial structure has a relatively short development process, but it has strong economic advantage of backwardness. In particular, the development of emerging business types has taken the lead. For this reason, we should seize the responsibility and opportunity of "Cultural Renaissance" in the process of rapid economic development, and use innovative thinking to re-examine the time-honored traditional civilization and stimulate its social value. At the same time, we should take the initiative to judge the trend of cultural and creative development from a strategic perspective, and gather the value of new technologies such as mobile Internet and intelligent manufacturing to traditional business forms. In the process of activating cultural creation new momentum, attention should be paid to the safeguard measures of cultural and creative industry, such as policy, park service, copyright protection. Meanwhile, a platform should be built for the integration of personnel training, industry and education, and industry and local, so that cultural and creative industry can continuously expand its width and depth based on the public demand in the process of stimulating social value. The development of cultural and creative industry in Taiwan has its specific regional characteristics and industrial characteristics. Due to its sustainable work in policy guarantee, platform building, group cultivation and other aspects, the cultural and creative industry has a good industrial foundation and social cognition foundation from the perspective of creators and consumers. The cultivation of cultural and creative soil and the benign development of industry need to be constantly considered and promoted in the strategy of cultural creation new momentum.

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## Effectiveness of training devices application for development of muscle corset strength

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### Abstract

In the connection with the problem of the development of strength abilities of youth in the physical culture activity the necessity of perfection of physical preparedness appeared with application of training devices which provide increasing of quality in fulfilment exercises. The article presents information on methods of strength abilities development at youth with application patented training devices “Gymnastic Roller” and “Device for control of technique of physical exercises”. There is the description of these devices too. Besides the results of the pedagogical experiment on approbation of the worked out methods are presented as well.

*Keywords - Strength abilities; muscle corset; training device; control of technique of physical exercises*

### 1. Introduction

Physical status of a man is considered to be one of the objective indicators of health condition of population including into itself physical development and physical preparedness. Many specialist that the majority you of school age have reduced level of physical preparedness doesn't correspond to the demands of school program, on physical culture, as well as readiness for military service. It is necessary to note that large school loads are the reasons of such a situation and deficient of motor activity and weakness of muscle corset.

Meanwhile specialist point it out that one of the important tasks of physical education of 16-17 year old youth is development of their strength abilities. The most favorable periods for development of strength at youth is considered age from 14 till 17-18 years old. Quota of muscle mass inside general mass makes approximately till 14-15 years old - 33%, and till 17-18 years old - 45% [1]. During strength training muscle mass can increase till half from general muscle mass of the body. Besides, there are some published works in which methodics on development physical qualities of senior schoolchildren must offer extremely various means and mobile training devices for supporting interest of schoolchildren to the lesson and for raising effectiveness of carving out individual tasks. It is obvious that traditional means and approaches to physical training of youth at schools are not so gold at the decision of the tasks of development of strength abilities.

According to the results of the inspection of schoolchildren model levels of development of muscle groups of the body of 15-17 years old youth were worked out. It is determined that variation of the results of development of muscles of the trunk of 15-17 years old youth is high, but 25,4% schoolchildren have index of development of strength abilities is lower average level. The most significant average increase in the development of this physical quality is observed from 15 till 17 years old (30%), but after 17 years old the pace of its development is reduced till 18%. On the fundamentals of the received facts methodics of the development of abilities of the 15-17 year old youth was worked out, which was directed to the increase of their physical preparedness and morpho-functional development. The main peculiarities of the methodics of strength abilities development of youth are the use of training devices.

## 2. Technical Description of training Devices

The training device for control of body position of a man at fulfillment of physical exercises is worked out with the purpose of more qualitative understanding by schoolchildren technique of exercises for development of abilities and more exact fulfillment of the load.

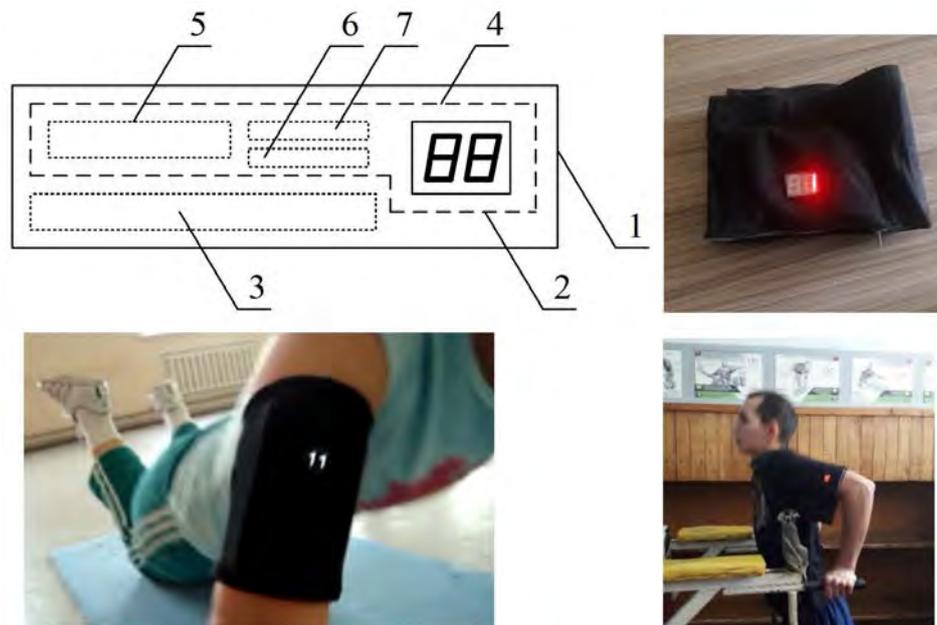


Fig. 1 Device for control of position of bone - muscle system of a man at fulfillment of physical exercises

Present device (Fig. 1) has housing 1, furnished with digital display 2, power supply 3, plate 4 inside it with sensor of slope 5, meter 6, decoder 7. There is also cuff with vertical and horizontal pockets [2].

Device works in the following way. Taking into consideration the physical exercise.

Character, device is attached on the body of the person (when lifting the trunk from lying position to sitting position the device is fixed on the chest, when bending and extension arms at emphasis lying - on the shoulder (upper-arm), when knees-bend - on the back surface of hip, when lifting legs in hand on the horizontal bar - on ankle).

Cuff is fixed on the body with the help of adhesive plaster, then a sensor is put into in one of the pockets of a cuff, after this one can begin fulfillment of exercises.

The number of qualitative exercises is depicted on the figure indicator panel of information.

The training device provides motive visuality. Also the use of the other training device "Gymnastics roller" (Fig 2) is used in this methodics which is intended for development of, muscle power of a trunk [3]. Device consists of two wheels 2 and 3 established on axis (1), one ring for changing diameter of one of the wheels 2, 3.

Earth wheel 2, 3 for increasing the line of contact of a roller with movement surface is displaced from the centre of axis 1 to the same distance, providing possibility of its rotation around the axis 1, and fixed hard on the axis 1.

The line length of a roller contact with the movement surface is equal to the wide of its two wheels and the distance between them.

Axis 1 has the length of 30-40 sm and fulfilled with the handless in the ends of gymnastic roller is furnished with from one to three rings 4 of different thickness.

Using the roller it is possible to fulfil exercises on movement roller on straight from position of support standing on the knees till the lying position hands up from source position support, standing on knees, catch by hands axis handles 1 of gymnastic roller, longitudinal axis of a learner is perpendicular to movement surface.

When fulfilling the exercises the roller is moving on the surface of movement forward on straight in the direction of longitudinal axis of a learner. The distance between supports is increasing and a learner passes from the position of support standing on knees into the support lying on the knees. When fulfilling such an exercise the body of a man is in the condition of stable equilibrium because of length of the contract of roller and surface of movement. It leads to prevention of fall of it on side and possibility frequentative repetition of exercise. Also it is possible to fulfill exercises to the left and to the right. For fulfill exercise on one wheel, for example wheel 2, the wheel 4 of thick 1sm is installed.

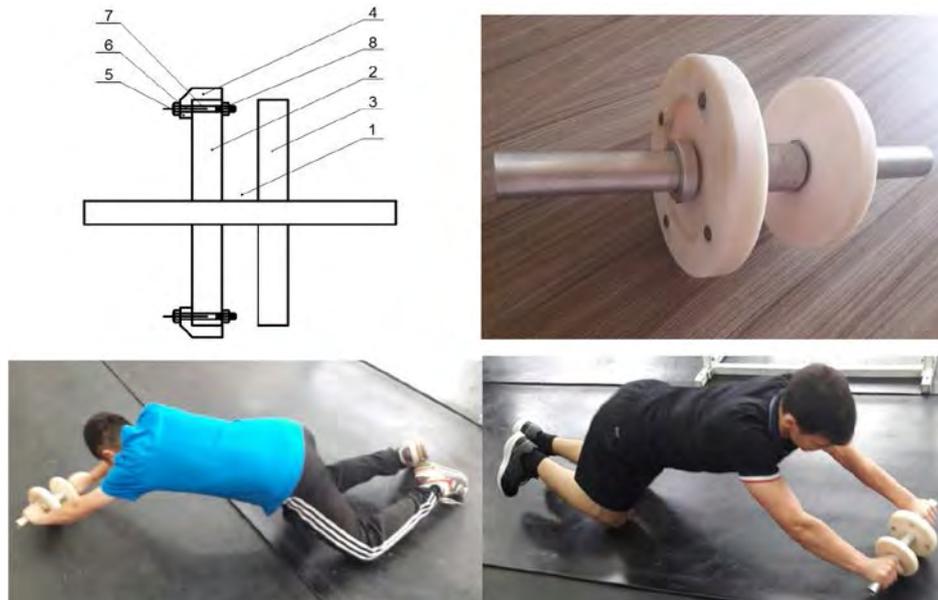


Fig. 2 'Gymnastics Roller'

Beginning to fulfill exercise the roller is directed forward along an arc, for example, to the right at an angle  $15^{\circ}$ - $20^{\circ}$ . At such a movement muscle tension in the left half of the trunk of a man is much more than right one. If to direct a roller forward along an arc to the right or to the left at an angle  $30^{\circ}$ - $35^{\circ}$ , general tension of muscles of right and left half of the body of a man significantly increases. The more thick rings are chosen for increasing the level of difficulty of fulfillment of motive action in the following exercises.

### 3. Organization of the Experiment

Training lessons are foreseen (60 minutes) in this methodics. Preparatory and final parts decide classical tasks but the main part realizes development of strength abilities.

In this division of the main part of the lessons for schoolchildren. Circular training was held including complex of exercises for development strength and endurance of different muscle groups with the use of training device and without them.

For definition of effectiveness of worked out methodics for additional lessons for senior schoolchildren with use of training device the experiment. The period of pedagogical experiment lasted during 3 months. The number of investigated people is 48 pupils. In each group there were 24 youth of school age. In the control group and experimental group physical education was held according to general school program [1]. Training lessons on the development of strength of muscle corset were held 3 times a week, but control group practiced without using of training devices.

Before this experiment the groups were comparatively similar in composition and level of preparedness.

### 4. Results and their Discussions

After the experiment the growth of indicators in both groups were noted with advantages in experimental group. So the analyses of morpho-functional characteristics at the end of experiment revealed considerable changes for sure inside the groups-control and experimental - especially indicator of life capacity of lungs where average index is 15%, rehabilitative time after load 13%, hand strength - 14,4%.

The experimental results give us the reason to judge about favourable influence of motor regime, offered by the authors in worked out methodics on functional system of senior schoolchildren body.

The analyses of the results of growth of body muscles revealed that in the experimental group pulling up on high crossbar turned up more significant (36%), than in the control group (27%). Besides schoolchildren in control exercises for muscle group of right and left sides showed significant increase for sure, increase is 33%, but in control group increase is equal to 14%. The same tendency is marked in the indicators of muscle group of stomach and back (Fig 3).

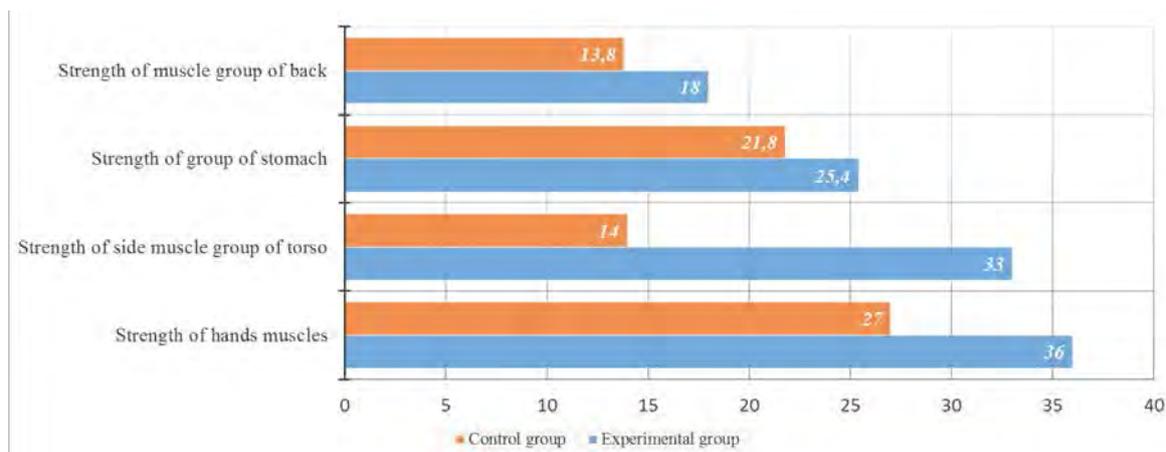


Fig. 3 Indicators of growth of muscle groups of torso in the process of pedagogical experiment (%)

#### 4. Conclusion

Analyzing the data, It is possible to say that methodics of use training devices for development of strength abilities renders more effective impact on development strength abilities at senior schoolchildren. At the same time this methodics promotes improvement indicators of morpho-functional development at young men.

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# Study on the Improvement for Taejongdae’s Tourism Signage System

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## Abstract

Signage systems are visually oriented information systems, consisting of signs, maps, arrows, pictograms and different typographic elements [1]. The standardized use of the tourist signage system has become increasingly important with the development of tourism [2], and the function of the tourist signage system is not only guiding directions and tourist route, but also creating an effective role in maintaining the administrative order of tourist sites, beautifying the image of scenic area and creating a cultural atmosphere.

The purpose of this study is to identify existing problems in Taejongdae's signage system with case analysis and on-site investigation, and present optimum proposal focusing on the design of Taejongdae's signage system.

**Keywords-** Signage System; Taejongdae; Tourism;

## 1. Introduction of Tourist Signage System

Signage is the basic unit of information communication, in other words, signage is used to be a medium in the process of passing the information to person [3]. It implies the visual and direct means of communication helping people to understand the living environment and make a reasonable decision in life.

The signage system for modern society has been expanded from the simply delivering messages to gradually satisfying the various needs of users. Compared tourist signage with commercial signage, tourist signage system should design as an interconnection system, and it ensures the accurate meaning of the space which is understood to tourists and could certainly lead from the origin to the destination. Through the on-site investigation [4], there are four kinds of signage system commonly used in scenic spots.

Table 1. Classification of Signage System installed in Taejongdae

Class	Example
Guide Sign	Restroom, parking lots, hiking trails, kiosks, pay phone, drinking tables, buildings
Regulatory Sign	Prohibition, regulation, caution and warning
Definition Sign	Attraction, architecture, history, heritage, monument
Comprehensive Sign	Tourist information, comprehensive map, location and direction

## 2. Case Analysis for Tourist Signage System

Table 2. Nanshan Park Signage System



Status for Comprehensive Sign

Status for Guide Sign

As shown in Table 2, the signage brands are made of wooden material with green background and yellow direction. Due to the combination of materials and colors, the whole signage system is harmony with the environment park especially for natural atmosphere. And the direction sign is three-dimensional design which is convenience for tourist to identify.

Table 3. Kawabata Garden Plaza (川場田園プラザ) Signage System

			
Status for Comprehensive Sign	Status for Guide Sign	Status for Guide Sign	Status for Definition Sign

As shown in Table 3, the original signage facilities are adjusted with the characteristics of corrugated board. The inspiration of the signage design comes from the friendly renovation materials in ChuanChang Orchard, with the free bending characteristic for corrugated board, the surface of the signage brand is wrapped up in low-cost materials and has a unique visual experience. Due to the shades of corrugated board and the white printing, the signage system presents simple and the information is clear, and there is a sense of harmony with the surrounding rural landscape.

Through the analysis of Nanshan Park and Kawabata Garden Plaza, there are two key points in tourist signage design, the first one is considering the reasonable information design attracting the attention from the visitor and delivering the correct message, the second one is focusing on the surrounding view creating an integration atmosphere.

### 3. Tourist Signage System for Taejongdae

#### 3.1. Analysis for Taejongdae's Signage System

Table 3. Status for Comprehensive Sign

Status for Comprehensive Sign	
Form	Ununiform and different forms
Material	Wood, plastic, stainless, etc
Design	Some materials are reflected in light, which causes problems with readability.
Language	Design style is unified, and map drawing is not clear
Information design	Korean and English are the majority, and sometimes there is no English.
Lighting facility	The amount of information is high, the letters are small, and the important information is not clear.
	Unavailable

Table 4. Status for Definition Sign

Status for Definition Sign	
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Form	Ununiform and different forms
Material	Wood, stone, plastic, stainless, etc
Design	Design style is unified
Language	Most texts are Korean, and sometimes there are Chinese and English on the sign.
Information design	The amount of information is high, the letters are small, and the important information is not clear.
Lighting facility	Unavailable

Table 5. Status for Definition Sign

Status for Guide Sign	
Form	Ununiform and different forms
Material	Made up of stainless steel, acrylic, etc. in various forms
Design	Ununiform design style, non-uniform orientation color and inaccurate display position. Writing for graphics and logs is not the same.
Language	Korean and English
Information design	The amount of information is high, the letters are small, and the important information is not clear.

Table 6. Status for Regulatory Sign

Status for Regulatory Sign	
Form	Ununiform and different forms
Material	Composed of a variety of shapes, such as plastic, wood, stone, stainless steel, etc
Design	Warning display and presented icon are not the same design
Language	Korean and English
Information design	The text-to-speech edition is relatively disorderly.

### 3.2. Analysis

After examining the status of the tourist signage system for Taejongdae, the following problems are found. First, the omission of current location information makes tourists easily lose their way. Second, the language of the guide sign system is not uniform, most of brands writ in Korean and English, some of them print Chinese and Japanese. Third, the material, shape and design style are not uniform, and some materials prevent visitors from acquiring information. Fourth, it is difficult to identify the information from the guide brand when it prints too small and hides in the thick growth of grass. Fifth, the expression of directional arrow is easy to cause ambiguity

### 3.3. Improvement for Taejongdae's Tourism Signage System

According to the analysis above, the improved signage system mainly uses Taejongdae's natural environment as design elements, such as cliffs, coastline and grotesque rocks, and the LOGO design fully considers about the natural of landscape. In order to unify the design style of the signage system, the main materials of the guide brand are wood and environment friendly plastic, and the main color is blue implying the ocean, using wave-shaped patterns to represent waves. Signs indicating direction are yellow attending to attract tourists' attention.

There is the current location mark in the guide brand, and the information is used in Korean, English, Chinese, and Japanese.

Table 7. Improvement for Taejongdae's Tourism Signage System

Comprehensive Sign	Guide Sign	Regulatory Sign	Definition Sign

#### 4. Conclusion

During the research of Taejongdae's tourism signage system, it is found that the design style is not uniform, which not only brings difficulty to tourists acquiring information, but also seriously affects the beauty of the scenic area. Secondly, the information design of some indicators is not prominent, the prompt function is not perfect, and the signage system lacks the characteristics of Taejongdae caused disharmony with the natural scenery.

In this study, through the analysis of the signage system of Taejongdae, finding out the existing problems and putting forward the improvement for the signage system. And the improvements contain adding characteristic elements of Taejongdae and fully considering the tourists' requirement of the direction information, it unifies the design style and enhances the aesthetic and usability of the signage system.

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# Community and Social Participation in Preserving Lanna Traditional Palm Leaf Manuscripts

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## Abstract

The community is the key to preservation of Lanna traditional palm leaf manuscripts retained at the community's temple. Such palm leaf manuscripts are ancient documents embodying the cultural uniqueness of Lanna culture. The belief in good merit helps motivating people in supporting preservation. However, it is found that the level efficiency of management in each community is different. The objective of this study is to develop sustainable social participation.

*Keywords-community participation; palm leaf manuscript; Lanna culture; leader*

## 1. Introduction

Community is the key to the preservation of Lanna (Northern Thailand) traditional palm leaf manuscripts retained at the community's temple. These palm leaf manuscripts are ancient documents capturing the cultural uniqueness of Lanna culture. In this study, the behavior of Lanna communities were analyzed. It was found that the abbots or the monks as well as the representatives of the villagers are the key persons to retain palm leaf manuscripts which are kept at the community temples. Community participation regarding the palm leaf manuscript were achieved through the community festive activities and traditions.

## 2. Background

### 2.1. Lanna palm leaf manuscript and community involvement

In the past, the preservation and the management of the palm leaf manuscript was the sole responsibility of the cultural units of the government at both local and national level. This was because it requires the specific knowledge and experience in order to study, preserve and publicize the palm leaf manuscript on which the Lanna traditional language was written. Also, everything regarding to the palm leaf manuscript must be done under the permission and participation from all parties in the community i.e. the abbot or the monks, the community committees and the people who has been involved in the community's activities.

Belief in the power of earning merit helps connecting people to the manuscripts. However, it is found that the efficiency level of management in each community is different. The objectives of this study is to develop a model of sustainable social participation. The value towards the palm leaf manuscript, role of people in the community, preservation methods and community management were studied.

### 2.2. Palm leaf manuscript with Library, Archive and Museum

The theory of community participation: from Library, Archive and Museum (LAM) is used in this study. In terms of Library theory, it draws on the literature on community-focused information services [1]. The concepts of participatory archiving [7] and community archiving [2, 3] may also be relevant. The concept of indigenous curation [4, 5] from the Museum world is relevant. The IAP spectrum of public participation from the International Association for Public Participation is also used in this study [6].

## 3. Methodology

This is interview-based qualitative research. Semi-structured or guided interviews and participatory action research applied. According to the data collection and field study, there are six temples in Lanna communities

where the palm leaf manuscripts are kept. Six communities in Lanna as case study are 1) Wat Patumdon, Chiang Mai, 2) Wat Nongnguek, Lamphun, 3) Wat Pongsanok, Lampang, 4) Wat Sungmen, Phrae, 5) Wat Laihin, Lamphun, and 6) Wat Banhongluang, Lamphun. Thematic analysis was used for analyze data by using Nvivo.

## 4. Findings

### 4.1. Elements of successful manage palm leaf manuscript

It was also that the key persons who are involved in the palm leaf manuscript preservation, were 4 groups of people; 1) the abbots who are looking after palm leaf manuscript; 2) the representatives of the villagers; 3) Community members who have participated in the temples' activities; and 4) scholars for example the researchers, the librarians, the government officers from the cultural units/ the universities/ other organizations.

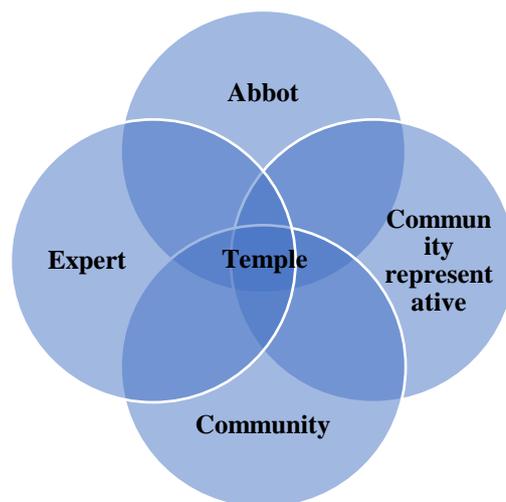


Fig.1 Role of community participation for the management of palm leaf manuscript

### 4.2. Factors of successful management

According to data collected at Wat Sungmen, Wat Pongsanok and Wat Banhongluang, it is found that the idea to retain and manage the palm leaf manuscript was originally initiated from the abbot and the monks in the temples. In addition, participation and financial support came from people in the communities through traditional activities such as TakTham tradition and giving wrappers of palm leaf manuscript to the temples in Wat Pongsanok and Wat Banhongluang. The scholars and the outsiders also support the preservation by giving the knowledge and trainings, as the speakers or the volunteers, to the communities. For Wat Patumdon, Chiang Mai, Wat Nongnguek, Lamphun, and Wat Laihin, Lamphun. The preservation and management of the palm leaf manuscripts is also carried out by the people in the communities who have valued the importance of the manuscripts. After receiving the permission from the abbot or the keeper, the speakers were invited to educate the people in the communities.

Wat Sungmen offers an example of best practice of the preservation and the management of the palm leaf preservation through the participation of all parties – the abbot, the monks, the keepers, the temple committees, the volunteers as well as the scholars and the outsiders from other organizations. Activities such as photos exhibitions, data base and the transliteration and translation of the palm leaf manuscripts, has been conducted continuously. Wat Sungmen is one of the place that has the most palm leaf manuscripts in the northern part of Thailand. Community participation is gained from everyone in the community since the villagers know that the palm leaf manuscripts are most valued. The preserving activities and the traditions regarding the palm leaf manuscripts are conducted all year round. The belief in good merit is the great motivation to gain the participation from people in the community. The reputation of the temple is recognized in both local and national level.

In this study, it is found that the way to sustainably reserve and manage the information in the palm leaf manuscript is to rely on the social participation from both the insiders in the community and the outsiders. It is very important that the abbot or the monks in the community temple have to start concerning on the importance of the palm leaf manuscripts. Then people in the community is one of the key to drive the preserving activities. In some communities, community members are in charge when the drives from the temple are lacked.

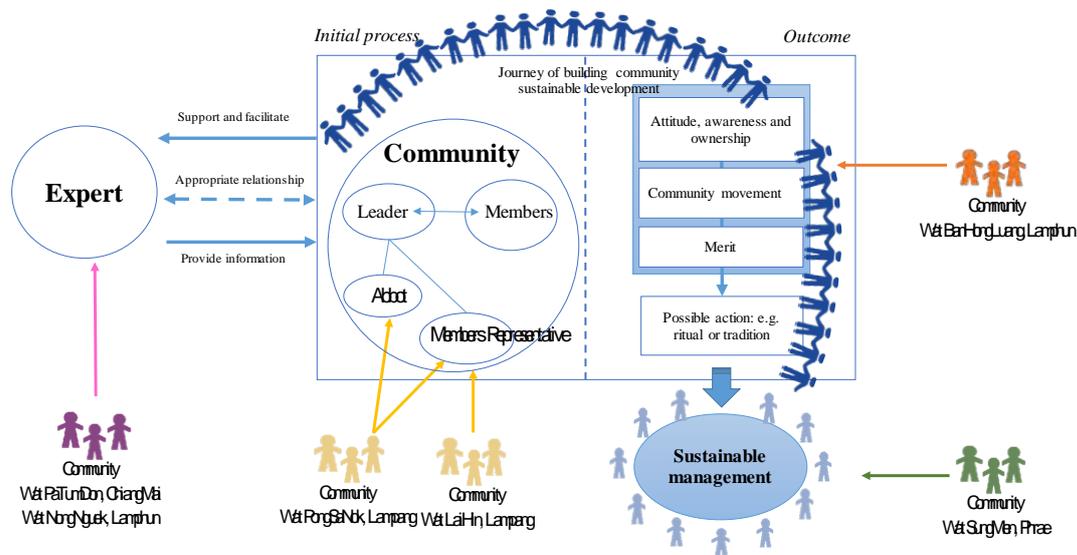


Fig. 2 Framework palm leaf manuscript management base on community participation

## 5. Conclusion

If people in the community know how to preserve the palm leaf manuscripts properly, they could perform the preservation by themselves and call for support from everyone in the community. The knowledge and experiences from each villager can help preserving the palm leaf manuscripts in the community. The support from the outsiders would also be available to request. It is found that only the contribution from the outsiders may successfully preserve the palm leaf manuscript but without the concern from people in the community, the preservation would not be sustainable. As a result, the true sustainability to reserve the palm leaf manuscripts must be built by the members in the community. Therefore, community management by and for the community will lead to the truly sustainable management for palm leaf manuscripts.

## Acknowledgment

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# Disseminating Digitalization of Collaborative teaching: a strategy of Using Multimedia in Classroom

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## Abstract

The concept of collaborative learning considered to be different from that of individual learning by the fact that versatile productivity in a creative and atmosphere of mass accountability causes more benefit. This mode which takes place through interaction and exchanging ideas among students of different learning levels benefit from this method of learning strategy and it promotes a very positive and amicable causing harmony among all the students. This article reveals the learning in positive interdependence of a face to face sitting setting. The multiple outcomes studied so far throw light on three major aspects; positive relationship, achievement productivity and psychological health as the advantages of collaborative learning. It is a learning atmosphere in togetherness to accomplish certain objectives. One's excellence is mutually brought to passerby others performance and achievement. The knowledge, skill and resources of an individual are seen multiplied copiously in a group presentation, in comparison to an individual endeavor. Pluralism and diversity among different talents authorize a positive thwack on every partaker on the basis of social psychology and classroom interactions. The positive impact of collaborative learning in various studies is appraised by the improvements of personal attributes ignoring irrelevant failures and drawbacks in a leading-edge ambience. "Individual learning in an isolated atmosphere may demonstrate a paucity of creative, cognitive, moral reasoning, on the contrary, be supplemented by a variety of cultural and ethnic backgrounds, cooperation supplanting competition. That being the case this paper would be a critical analysis of the collaborative learning strategies and challenges subjugated in this domain". [1]

**Keywords:** *Collaboration, teaching, learning, multimedia, digitization, methodology.*

## 1. Introduction

Collaboration is a promising mode of human engagement and that has Collaborative learning is an educational approach to teaching and learning that brings in the inculcation of learners' endeavor to accomplish a task, resolve a complication or innovate something new. The benefits of collaborative learning are proliferated with sundry advantages of social, psychological, academic and assessments of the learners. Here the children come together to deal among themselves, exchanging their impressions and intentions through their multiplied abilities, resources, skills and contributions. As Cohen, S., & Willis, T stated, It creates a stronger social support system .There takes place a sharing of potentiality and acceptance of responsibility among different members for the group's common action. [2] The underlying essence of collaborative learning is based upon concurrent manifestation of propensities through cooperation by group members, in contrast to competition in which individuals bet other group members. The three possibilities the learners have in a collaborative learning may be; either they promote by collaboration, obstruct by competition or remain neutral to each other by individualistically effort to attain success. This can happen anywhere in a gathering of common goal. The technique of collaborative learning is applicable in the classroom, with community groups, within families, as a way of living and dealing with other people. "From the point of cognitivism in psychology or functionalism in philosophy it can be learnt that collaborative learning ambience is much more impactive on the children than an individual learning situation". [3] For a collaborative learning, efforts need to be more productive than competitive or individualistic methods become a twenty-first-century trend. As per Austin comments, "The growing demand of 'thinking together' and 'working together' on various critical issues has been rampant". [4] The shift away has caused to stress on from individual attempts to team work and from autonomy to community.

The idea of collaborative learning, the grouping and pairing of learners intending to achieve a learning goal has been widely researched and championed. The term collaborative learning refers to an instruction method in which learners at various performance levels work together in small groups intending a common goal. The learners take responsibility for one another's learning as well as their own. Thus, the performance of one learner helps the other's performance. [5]

## 2. Advantages of collaborative learning

Collaborative learning provides scope for promoting interaction aiming the group goal through individual accountability and personal responsibility. The interpersonal relationship and group skills become distinctively improved. In a collaborative learning milieu, learners burgeon responsibility for one another. Socially the learners fit themselves to understand diversity and cooperate overtly. Other than this psychologically they become calm and stable keeping all anxieties aside fostering their self-esteem and expressing in an ensemble. Academically they get their critical thinking and problem solving skill inflated. Their active participation in the learning process improves the class result as a whole. They grow a positive slant towards the teacher. It helps to develop learning communities within classes and institutions. Since students get actively involved in interacting with each other regularly in an instructed mode, they get scope to understand their differences and learn how to set right social problems which may appear (It creates a stronger social support system). Collaborative learning induces learners' motivation in a specific curriculum. Through alteration of student teacher assessment techniques it makes learning more open and wide.

Collaborative learning is a free and independent learning. The mandate imposition and restrictive guidelines may make the learning virtually nonexistent. The ambience with ample scope for reflection and autonomy paves the way of collaborative learning convenient. As rightly stated by Cohen collaborative learning ameliorates social interaction skills. Collaborative learning medium provides students with opportunities to analyze, synthesize, evaluate and create ideas cooperatively. The informal setting facilitates discussion and interaction. This group interaction helps students to learn from each other's scholarship, skills, and experiences. The students go beyond mere statements of opinion by giving reasons for their judgments and reflecting upon the criteria employed in making these judgments. Thus, each opinion is subject to careful scrutiny in a group.

The focus on social and emotional aspects as benefits of collaborative learning is as important as the cognitive part. The most interesting part of this learning process is the decreased amount of anxiety and nervousness for solving a problem or taking a decision is seen paramount due to shared responsibility. Sense of humor also plays a significant role to reduce anxiety. In a happy emotion the learners take active part to opine their own critical appreciation through group under the facilitation of the teacher. This involves constructing and controlling meaningful learning experiences and stimulating students' thinking through real world problems.

## 3. Analysis of an Effective Collaboration Teaching

To make the art of collaboration effective, the educators have to take thoughtful considerations for its smooth execution. In many good schools collaboration schedules are made in order to have a planned sharing of the teachers for a common achievement of the school. Successful teaching partnership stimulates the best professional skills and practices for the holistic development of the children through the implementation of teaching methodologies.

Collaboration is a wonderful teaching tool. Teachers here find the scope to evaluate and differentiate instruction for students more distinctly and they can learn new instructional craftsmanship from one another to expand their teaching repertory. Cooperative teaching experiences also provide mutual support and assistance for planning and implementing lessons, assessing students' progress, sharing professional concerns, and addressing students' learning needs. Most importantly, teaming allows more opportunities for students to understand and connect with content thereby maximizing individual learning potential. Considering different ways of team teaching which can be used effectively in the classroom, it is anonymously accepted as a popular instructional model. Collaborative teaching allows teachers to impart information to a broader range of learners using approaches that spark students' imaginations while supporting individual learning.

## 4. Collaborative learning as a quality in teachers

Good teachers are no more than good learners. They are emerging practitioners. They venture to grow their knowledge through the input of the expertise of their compeers locally and globally, physically or virtually by social media. The professional growth, innovations in teaching, the students' achievement are laid on the teachers' interconnection and intercommunication. "The monthly sharing meetings, weekly staff meetings, professional learning community (PLC) with other members such as department head, content experts, subject

specific resource persons, are held on the purpose. The advice, suggestions, reciprocity of thoughts and plans impact and promote positively each other." [6] Veteran teachers can render as a worldly wise professionals for the novice and the newbie teachers flicker exhilaration among the veterans. In this connection at least a likeminded colleague is highly required even through technology for the multiplicity of the productivity.

## 5. Ways of Teaching Collaborations

The term collaborative learning refers to an instruction method in which learners at various performance levels work together in small groups towards a common goal. The learners are responsible for one another's learning as well as their own. Thus, the success of one learner helps other students to be successful. Students can become involved in developing curriculum and class procedures (Kort, M.S., 1992). Students are often asked to assess themselves, their groups, and class procedures (Meier, M. & Panitz, and T.1996). The high level of interaction and interdependence among group members leads to deep rather than surface learning (Entwistle, N. & Tait, H., 1993). Collaborative learning is student centered, leading to an emphasis on learning as well as teaching and to more student ownership of responsibility for that learning (Lowman, J., 1987). Collaborative teaching styles are now-a-days used in wide varieties. Such as;

- a) **Leading, Observing and Assisting** –After the new content is presented by the lead teacher, the co-lead teachers lead the discussion, observe it and assist wherever there is a need of interference.
- b) **Teaching and Re-teaching** – The lead teacher delivers new material through different activities, while the co-instructor reviews previous information and skills for longer retention purposes.
- c) **Simultaneous Teaching** – The class is divided into smaller groups and teachers present the same material to different groups at the same time.
- d) **Instructional Stations** – Students rotate between several stations to receive new instructions and participate on different activities monitored by teachers.
- e) **Supplementary Teaching** – in this style one teacher deals and gives instruction to the majority of learners, the other takes a small group aside to work on different basic instructional goals of literacy skills.
- f) **Co-teaching Rotation** – Here the teachers present new information rotating between presentations and scaffold roles during the lesson.

Different variables of collaborative learning process may include group composition such as homogenous or heterogeneous groups, the selection and size of groups, role of teacher as a facilitator, structure of groups, preferences in concern to gender and ethnicity, learning styles and strategies, psychoanalysis of the group discussion etc are to be minutely taken into consideration.

## 6. Review of Literature

Collaborative learning was originated from Lev Vygotsky's zone of proximal development theory. In this theory the significance of learning through interaction and communication with others has been highlighted than the learning through independent effort. The gap between things a child can do and can't do is made up by collaborative learning. According to Gokhale (1995)," individuals are able to achieve higher levels of learning and retain more information when they work in a group rather than working individually. Collaborative learning is useful for both the facilitator and the learner as it accelerates the learning through its motivating atmosphere" [7]. Both being group learning mechanism, collaborative learning differs from cooperative learning by having a mutual, coordinated effort of members unlike a shared responsibility imposed on each member in the latter. In other words, while collaborative learning deals with the construction of interaction; cooperative learning deals with its philosophy.

Most of the time, collaborative learning is seen being used as an umbrella term for a variety of approaches through interdependent learning activities. Many have found this to be beneficial in helping students learn effectively and efficiently than by learning independently, thus having positive attitude about learning and being growing into more engaged and thoughtful learners.

When compared to more traditional methods where students non-interactively receive information from a teacher, in this method of learning, lower-ability students work better in mixed groups and medium-ability students do better in homogeneous groups. "For higher ability students of course it may not be so useful.

Research says that discussion-based practices, improved comprehension of the text and critical-thinking skills for students across ethnic and socioeconomic backgrounds are found enhanced through this learning." [8] The popularity of collaborative learning in the classroom has increased over the last decade. Web technologies create learner-centered learning environments with individual inducement. Collaboration becomes highly necessary day by day. There is implication for a lot of future work, in order to have collaborative learning highly effective. Some of the unsolved problems that may be identified are cultural diversity, and accordingly a lack of awareness of cultural norms, geographical distance and time zone differences, and member seclusion in virtual set, generation intermissions and age contrasts in the acceptance of collaboration tools, lack of aids and appliances for learners, lack of learners' awareness about efficacious collaboration processes and schedule, lack of learners' application skills and knowledge about collaboration tools. It is undoubtedly significant to consider the interactive processes among pupils, but the most critical part is the construction of new knowledge obtained through joint work.

## 7. Use of multimedia in collaborative learning

Technology plays an important role in collaborative learning. The last ten years' details show that internet has provided a good space for groups to communicate adequately. Virtual learning groups have been useful to allow people to communicate with far distant people. Research has been conducted on how technology has helped to increase the potential of collaborative learning, to build an online learning environment model but since this research was conducted the Internet has fattened extensively and the new software has changed these means of communication.

Here are some examples of the way technology becomes increasingly integrated with collaborative learning. Collaborative networked learning occurs via electronic dialogue between self-directed co-learners and learners and experts. Learners are directed towards a common purpose and are accountable to one another for their success.[9] Collaborative networked learning occurs in interactive groups where participants actively communicate and negotiate learning with each other within a contextual framework which may be facilitated by an online coach, expert, and mentor or group leader.

Computer-supported collaborative learning (CSCL) is a relatively new educational paradigm within collaborative learning which uses technology in a learning environment to help mediate and support group interactions in a collaborative learning context. CSCL systems use technology to control and monitor interactions, to regulate tasks, rules, and roles, and to mediate the acquisition of new knowledge. Wikipedia is an example of how collaborative learning tools have been extremely beneficial in both the classroom and workplace setting. They are able to change based on how groups think and are able to form into a coherent idea based on the needs of the Wikipedia user. Collaborative learning in virtual worlds by its nature provides an excellent opportunity for collaborative learning.

Educational organizations can employ groups to get the work done. "Collaborative models in group work paradigm can be guessed from the large scale professionals' interest in the modern trend of business. Same thing being applicable to educational sphere, the advents of this learning approach is to be analysed. Extensive research on it either face-to-face or computer supported has thrived the skate-holders in the past ten years. This approach to education being multidisciplinary and non-competitive in nature, it sensibly embraces a multitude of theoretical and practical accounts of opportunities and problems. This learning concept has been vastly researched and advocated as an instructional method of exchanging ideas. The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus they grow into critical thinkers.

Most of the studies in collaborative learning have been done in non-technical disciplines. Students are exposed to think creatively, solve problems, and make decisions as the education network among the learners, functions like both as series and parallel connection of electricity in a circuit. As Slavin (1989) says, for effective collaborative learning, two important things must be "group goals" and "individual accountability". As explained, students are capable of exhibiting at higher intellectual levels when asked to work in collaborative situations in comparison to when asked to work individually. Group miscellany in terms of expertise and experience contributes positively to the learning process.[10]. Bruner (1985) discovers that cooperative learning methods improve problem-solving strategies because the students are tackled with different demonstrations of the given situation. The group support system enables the learners to internalize both exterior knowledge and interior critical thinking skills and to convert them into contrivances for intellectual functioning.

Today's kids of 'digital generation' and students of 'smart class' are quite competent with the technologies of various authoring programs; such as Microsoft Word, PowerPoint, Microsoft's Photo Story 3, Windows XP, Apple Computer's iMovie, digital camera, video-cam recorder and scanner, computer microphones and digital voice recorders to make their collaborative learning lively hundred times, only needing the proper channelization of their potentialities. Use of audio visual aids and group presentations through it makes the learning interesting, long lasting and enlightens the upcoming generations with extensive learning outcomes.

About collaborative learning it is proved of leading to self-management Students are skilled to be prepared to complete the assignments and work together within their groups understanding the matter that they plan to contribute to their groups. [11] They are, moreover, given time to process group behaviors such as examining with each other to ensure homework assignments not only to be completed but understood. These interactions help students learn self- management techniques. As Cooper says, Collaborative learning provides the teacher with many opportunities to observe students interacting, explaining their reasoning, asking questions and discussing their ideas and concepts . These are more comprehensive assessment methods than relying on written exams only (Cross, K.P. & Angelo, T.A., 1993). Johnsons (1990) further delineates, in a learning situation, student goal achievements are positively corresponded; students perceive that they can reach learning goals if the other students in the learning group also outstretch their goals. In this way, students solicit outcomes that are beneficial to all those with whom they are collaboratively linked. When individuals wedged they are more likely to surrender, but groups are often likely to find ways to keep on. Collaborative learning provides many opportunities for alternate forms of student assessment (Panitz, T. & Panitz,P., 1996). Collaborative learning minimizes classroom anxiety, as it always creates new and unfamiliar situations for the students. [12] The students observe that the teacher has the ability to evaluate how students think as well as what they know. Through the interactions in collaborative learning process, with students during each class, the teacher achieves a better understanding of each student's learning style and strategy , how he/she performs and an opportunity is created whereby the teacher may provide extra guidance and counseling to the students.

## 8. Conclusion:

Collaborative learning compared with competitive and individualistic efforts, has numerous benefits and typically results in higher achievement and greater productivity, more caring, supportive, and committed relationships; and greater psychological health, social competence, and self-esteem. Therefore Collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers. In all situations where people come together in groups, it suggests a way of dealing with people which respects and highlights individual group members' abilities and contributions. There is a sharing of authority and acceptance of responsibility among group members for the groups' actions. The underlying premise of collaborative learning is based upon consensus building through cooperation by group members, in contrast to competition in which individuals best other group members. A natural tendency to socialize with the students on a professional level is created by collaborative approach. Students often have difficulties outside of class. Openings can lead to a discussion of these problems by the teacher and student in a nonthreatening way and additional support from other student services units in such areas can be a beneficial by-product.

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# Poster Presentation(Session PT1 ~ PT4)

15<sup>th</sup> August 2019

## Poster Session PT1 - Digital Contents - I

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# Design of Components for Adaptable Game Server

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## Abstract

This paper shows how to design a game server that is adaptable and re-buildable with components. In order to support adaptability by function, the server is composed of three layers; network layer, user layer and database layer. In order to ensure the independence between the layers, each layer communicate each other via message queue. In this structure, each layer can be composed of arbitrary threads. The network layer uses IOCP, which shows the best performance on the Windows platform, and it can handle up to 5,000 simultaneous connections on a typical entry-level computer, despite having built with a single-threaded user layer.

*Keywords-Layered Server Architecture, IOCP, Server Components*

## 1. Introduction

In designing and implementing a game server, it is important to prepare and maintain reusable code. When reusable server components are prepared, components can be assembled as a block, and servers with desired functions can be configured. A reusable component means rather than a function or class, the combination of functions and classes that make up a specific feature of the server. To be able to reuse a component, a standard environment in which the component operates well is required.

The basic structure of the game server can be designed to minimize the cost of components combining. Because there are many similar parts irrespective of the genre of the game are exist, we can design common game server structure. When the components which follows the server design are prepared, the server building cost can be saved. In addition, these components should be configured so that they can easily be extended when the devices are to be extended in parallel.

This paper proposes and implements a scalable server architecture that minimizes the cost of components combining.

## 2. Layered Architecture

The game server receives packets from multiple clients. It maintains information about all connected clients, processes requests related to the game, and handles work between clients when necessary. Also, performs the function of storing the game progress information of the client into the database.

Based on the core functions of the game server, we can define three layers. The network layer can exchange packets with the client, the user layer process user information, and the database layer process the database request. Since each layer must be independently expandable or maintainable, the structure should be designed so as to minimize dependency between layers.

For this purpose, it is possible to design a server with three layers as shown in the Fig 1. To reduce the dependency between layers, each layer cannot refer to each other, and only communicates through a message queue.

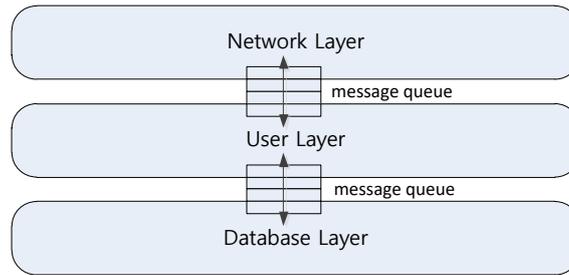


Fig 1. Layered Architecture

### 2.1. Network Layer

On Windows platforms, the best way to send and receive packets using sockets is to use IOCP. And since the socket accept call is a blocking call, it is necessary to process this part in a thread. If the connection handling function of the socket creates and returns a socket for a new connection, it will be associated with the IOCP. If a socket is associated with an IOCP, the IO for the socket can be notified via the IOCP. The way to receive IOCP notification of Windows platform is to call IOCP event wait function for registered port of IOCP. Each IOCP worker thread finds client information for completion of IO, construct the packet by deserializing the packet for each IO, and puts the constructed packet into the queue of the corresponding user.

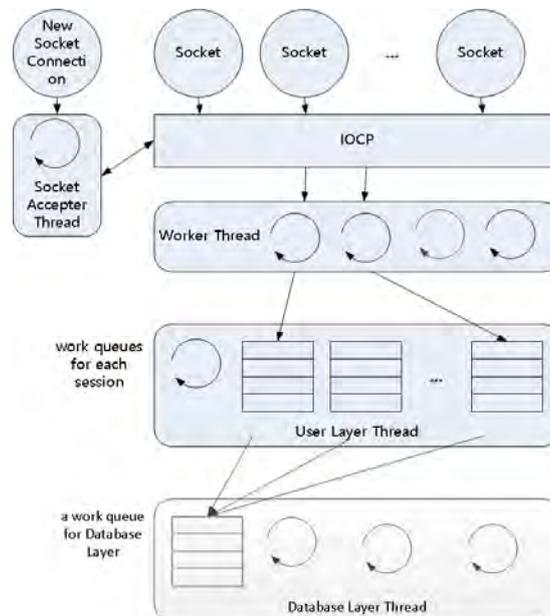


Fig 2. Layered Game Server Structure with Components

### 2.2. User Layer

A user layer can be built in a multi-threaded or single-threaded, depending on the operating mode of the game. First, we need to build components operating in a single thread environment, and, by writing user distribution manager, we can write the scalable user layer.

At the user layer, each user has its own message queue. And in the multi-threaded environment, may have a message queue that is shared for communication between a group of users within the user layer. The user layer has a loop that processes user requests, and this loop operates on an individual user basis. If a user needs of different user information, you should use the consistent API to get user information, regardless of the target user is belonging to same thread or not. If the user needs to process the database, it sends and receives information through the database message queue.

### 2.3. Database Layer

The database layer is responsible for processing messages to the database. For maximum performance, multiple DB message processing threads are running, and each thread's messages are independent of other threads. Since dependencies between messages are all handled at the user layer, there is no dependency between messages at the database layer. Fig 2. Represents the interaction of these three layers.

### 3. Components of Layers

A component consists of classes for special functions and thread classes.

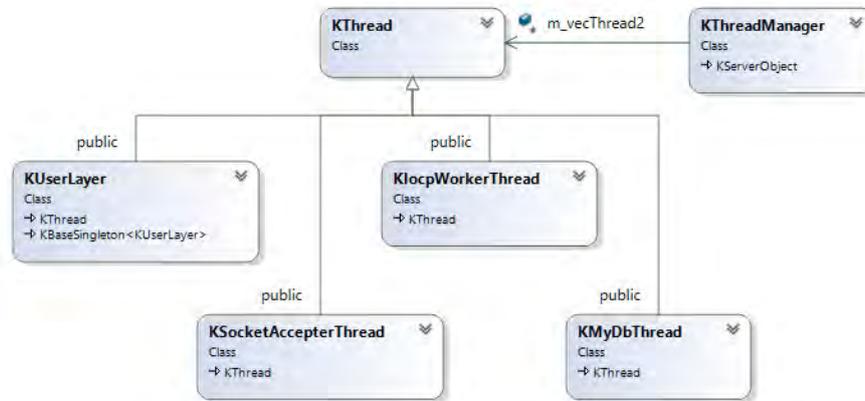


Fig 3. Class Hierarchy of threads in Game Server

#### 3.1. Thread Implementation

We define the class KThread for the common operation of multiple threads. You can inherit KThread to implement a specific thread. For network layer socket connections, we define class KSocketAcceptorThread. For the IOCP working thread in the network layer, we define class KIoCPWorkerThread. We define class KUserThread to handle the work of the user layer. We also define the class KMyDbThread that processes database messages at the database layer. Each thread has reference information about the thread manager that manages it. If the thread is not managed by the manager, the reference to KThreadManager is NULL.

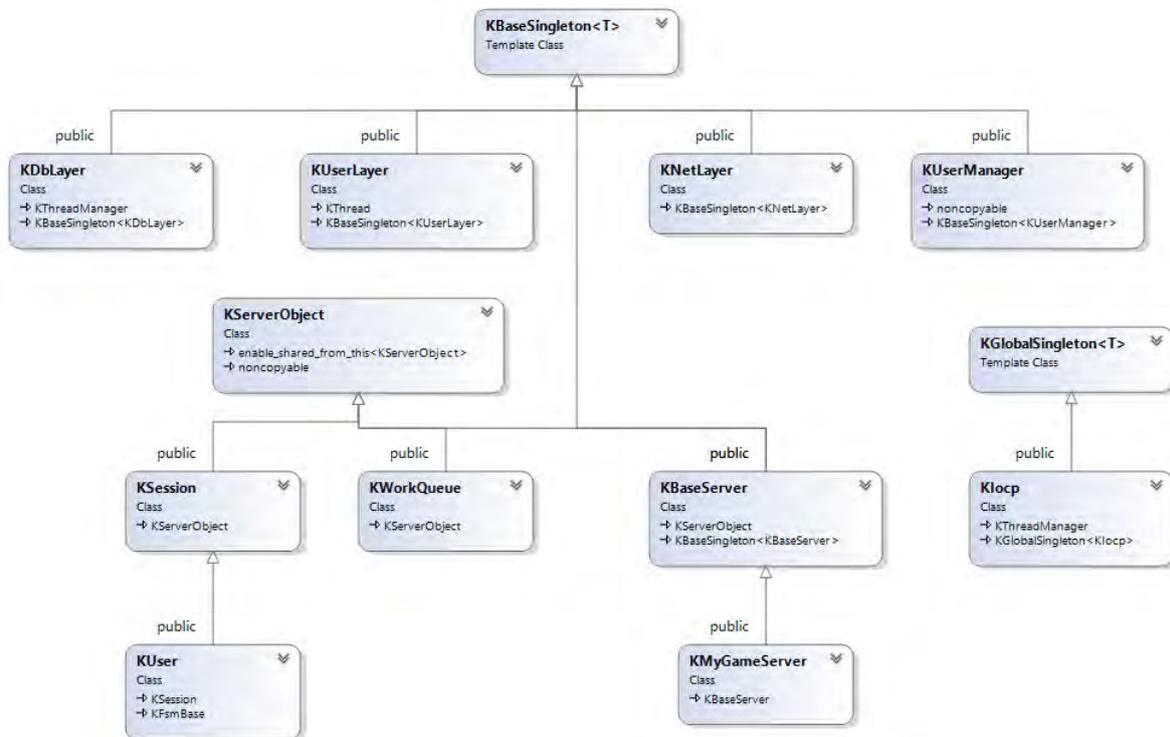


Fig 4. Class Hierarchy of Layers of Game Server

#### 3.2. Layer Implementation

The network layer, the user layer, and the database layer all exist as a single instance. We implemented the KNetLayer, KUserLayer, and KDbLayer layers by inheriting from KBaseSingleton for the functionality of a singleton. The class KUser is created for each client connection, and class KUser inherits from class KSession

because it has socket connection information. At the user level, users belonging to the same thread group are managed by one KUserManager.

This structural information is managed by a server object of class KBaseServer. The class KIoCP, which is responsible for the IOCP function, is only accessed at the network layer. KIoCP is a singleton, but with some implementation trick, other layer cannot access the instance of class KIoCP.

The queue for message communication in each thread is implemented as a class KWorkQueue, and a class object that requires message communication has a work queue.

#### 4. Implementation and Test

We measured the performance of the game server on a typical entry level computer.

We created a test client that connects to the server and performed a load test. The server implemented on the Windows platform showed reliable performance up to 5,000 client connections. Every time the client grows, the memory requirement grows linearly, but CPU usage does not change much.

Table 1. Test Result

# of Clients	Memory(Unit: Mega)	Cpu(%)
1000	4,196	81
2000	4,697	81
3000	5,202	82
4000	5,708	83
5000	6,310	83

#### 5. Conclusion

In this paper, we divided the basic components of game server into three layers. We implemented the required functions in each layer and send and receive information through message queues so that each layer can be independently expanded. This implementation showed that the game server can handle up to 5,000 concurrent connections even though the user layer was implemented as a single thread.

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# A Study on the Design of the Taejongdae Tourist Information Mobile Application in Busan

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## Abstract

Through the method of on-site visit, it is found that foreign tourists have complicated and inconvenient experience in using the tourist information Application(APP) when visiting Taejongdae in South Korea. Centered on Chinese tourists, this study sorted out the information of map, sightseeing place, shopping and language through case analysis of 4 representative tourism APPs. Aiming at these four elements of APPs, the paper will submit an APP design plan used by Chinese tourists for visiting Taejongdae, which is proposed to improve the tourists' experience.

*Keywords: Taejongdae, APP, tourists' experience, APP design plan*

## 1. Introduction

Through field investigation, this study understands the history, regional characteristics and tourism information of Taejongdae. The survey found that many foreign tourists consult and search for relevant information at the tourist service center of Taejongdae. After visitors scan the QR- code provided in the scenic spot, the interface directly jumps to the website of all parks in Busan. This is a cumbersome and inconvenient experience for foreign tourists. According to the website data of Korea travel commune, this study sets the experience of Chinese tourists as the object of improvement. Through case analysis of representative tourism APPs, this study sorted out map information, sightseeing place information, shopping information and language information, which are four elements in the design of tourism APPs as to improvement the sightseeing experience of Chinese tourists. Through these four elements, this study aims to propose a design scheme for the mobile phone APP used by Chinese tourists for sightseeing in Taejongdae of South Korea, so as to improve the sightseeing experience of Chinese tourists in Taejongdae.

## 2. Research background

### 2.1. Investigation of Taejongdae

#### 2.1.1. Introduction of Taejongdae

Taejongdae is one of the most representative scenic spots along the rocky coast of Busan, located at the southernmost tip of "Shadow Island". Featured tourist attractions include Yeongdo Lighthouse, Statue of Mother and Children, Observation Deck, Taejongs Temple, etc. In 1969, Taejongdae terrace was designated as a tourist attraction. Until now, Taejongdae has become one of the special tourist destinations in South Korea, and the number of domestic and foreign tourists received each year has gradually increased. "Taking Taejongdae University as an example, there were 5,500 people visiting every day on the weekend, but this year there were 7,000 people visiting every day during the Mid-Autumn festival holiday, an increase of about 27 percent," said a person with Busan tourism commune. [1]

#### 2.1.2. Taejongdae development process and tourism policy

One of the most famous scenic spots in Busan, the name "Shadow Island Taejongdae " dates back to the Silla era. It is recorded in the records of Donglai government in the Korean period: "This is named after the place where King of Silla shot arrows. When the drought is severe, the ceremony of praying for rain is held here.[2] Taejongdae was designated as a tourist destination by the ministry of transport in 1969. In 1989, it had its own

tourism website. In 2005, Taejongdae was awarded the 17th Korea cultural heritage award, and the following year, Taejongdae amusement park implemented free and open tourism policy. In 2016, Busan tourism company released several Danubi Circular trains in the scenic area, which are favored by tourists for their lightweight and cute appearance and are one of the famous Taejongdae facilities.



Fig. 1 Taejongdae recommended tourist route map[3]

In addition, the Taejongdae scenic spot provides tourists a QR-code of scenic spot information, which can be scanned by mobile phone. And each scenic spot inside Taejongdae station will provide its own QR-code at the entrance. The analysis in table 1 below.

Table1. Taejongdae Tourist Mobile Information

Types	The Park Guides Mobile APP	Attraction QR-Code Commentary
Performance Method		
Interface Information		
Description	After scanning, the interface shows information websites of many parks in Busan (level 1 interface). The information module of Taejongdae park should be selected to reach the secondary interface, which is the historical information and tourism information .	There will be QR scanning signs at the entrance of each attraction in Taejongdae scenic area. The interface after scanning is the basic information of the scenic spot.

### 2.1.3. Research object

According to the data of the number of inbound visitors to major countries in South Korea in January 2019 from the Korea travel agency, the number of Chinese citizens visiting South Korea in one month was 392,814, an increase of 28.7% over the previous month. Chinese topped the list of foreign visitors to South Korea. Specific data are shown in table 2. Therefore, this study centers on Chinese tourists and aims to provide "more convenient and clearer" tourism APP information for tourists in Taejongdae park.

Table 2. Number of arrivals by major countries in Korea in January 2019  
( Korea Tourism Organization )

Country	Number(people)	Increase or Decrease(%)
China	392,814	28.7
Japan	206,526	23.6
Thailand	41,334	-8.0
Malaysia	22,065	-0.2

## 2.2. Tourism APP

### 2.2.1. The concept of tourism APP

APPs are developed differently according to different systems. The early major Mobile phone systems are as follows: Symbian(Nokia), iOS(Apple), Windows Mobile (Microsoft), Android (Android). According to data from research firm Gartner [4], 99.9% of smartphones sold globally in 2017 are based on Android or iOS platforms. Therefore, this paper selects travel APPs under Android or iOS systems as research objects to make the research results more comprehensive and universal.

As for the theoretical definition, Gerard and Gretzel[5] define tourism APP as an application that USES mobile intelligent devices to obtain information, products and services required by tourism. Mao Chencheng [6] thinks that tourism APP is a program installed on mobile intelligent terminals to solve tourism problems. Therefore, tourism APPs are the applications used for tourism purpose.

### 2.2.2. Types of tourism APPs

Tourism APP include many services. Although different scholars have different criteria for classification of types, many researches are conducted from the perspective of functions. The research results of Peng Lina & Zhang Wenjian [7] show that there are five types of tourism APPs, including travel information service, travel schedule plan, travel reservation, travel map and social sharing. Mao Chencheng (2013) classified the types of mobile applications based on 6 tourism-related factors. He divided mobile apps into tools (travel essentials, tips, etc.), strategies (travel guides, strategies, etc.) and social sharing (travel-related communication).

## 3. Case analysis of tourism APPs

### 3.1. Shanghai Disney Resort APP

The Shanghai Disney resort, the first in mainland China, received an average of 55,600 visitors in a single day during its 18-day opening in 2016. As a result, Shanghai Disney resort has become one of the most representative parks in mainland China. Secondly, the exclusive APP of Shanghai Disney resort is also provided in the scenic spot, which is a service-oriented application providing tourists with sightseeing information. Its main function is to provide the latest news of the Disney resort, provide tourists with information about the shops in the resort, and check and buy tickets.

### 3.2 Beijing Forbidden City community (故宫社区) APP

"Forbidden City community(故宫社区) APP launched by the Palace Museum of China in 2017. This APP integrates more than 10 kinds of related cultural resources and services, including information, tour guide, architecture, collection, exhibition, culture and innovation. APP is divided into the pattern of "upper palace and lower city", that is, the top is an official information platform to provide services and information to everyone, and the bottom is a user content platform. This way reflects the relationship between users and museums. In the community, there is a growth system, which is an ecological thing, including the urban planning system, economic system, task system, time system and so on.

### 3.3. HanYouWang(韩游网) APP

韩游网 is a famous new e-commerce online tourism website in China, and China's leading platform for Korean tourism information and product reservation, including Korean tourism strategy, hotel reservation, ticket reservation for scenic spots, WiFi reservation in South Korea, business coupons and other core businesses.

Table 3. Comparison of the functions of three representative tourism APP cases

Case	Map information		Time information	Scenic spots information		Traffic information	Shopping information	Language transformation	Food information
	Map	Present position		Introduction	Route				
Shanghai Disney Resort APP	○	○	○	○	○		○	○	
故宫 APP				○				○	
韩游网 APP	○	○		○	○	○	○		○

#### 4. Conclusion

Based on the typical examples in chapter 3 and the APPs function analysis in Table 3, map information, sightseeing place information, shopping information and language information are obtained, which are the four elements in the design of tourism APP. These elements will be applied in the subsequent APP design of Taejongdae park.

Figure 2 below is the information structure diagram of the tourism APP of Taejongdae park, hoping to provide help for the design of Taejongdae park tourism APP in the future.

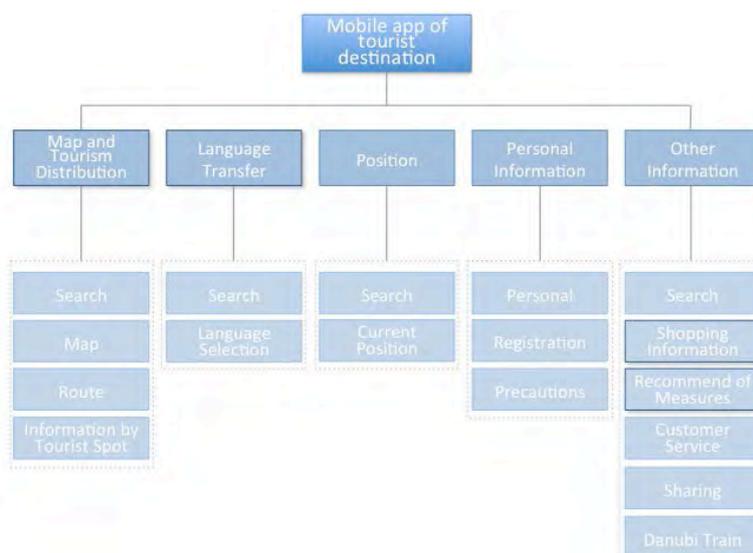


Fig. 2 Information structure diagram of the tourism APP of Taejongdae park

#### Acknowledgment

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# Study on the Motivation and Completion of K-MOOC Animation Course - The Characters of Convergence in Animated Films

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## Abstract

Since K-MOOC was launched in 2015, research has been underway to increase the number of people completing courses. However, there is insufficient research into the analysis of factors that increase the completion rate of courses in a particular field. This study collected data from learners of the <The Characters of Convergence in Animated Films> class conducted in November 2018 and March 2019, respectively, and also collected data on students and their motivation to learn. The study found that the highest rate of completion was given by a group of learners who were motivated to earn credits, followed by completion due to recommendation by a specific group and individual. This suggests the need for learners' support measures aimed at earning credits in MOOC courses related to animation theory.

**Keywords-** *K-MOOC; Learning Motive; Online Lifelong education; Animation course*

## 1. Introduction

### 1.1. Research Purpose

MOOC, short for Massive Open Online Course, is a new type of education platform that has unveiled university lectures to anyone without time or that has space constraints. In 2011, Professor Sebastian Thrun of Stanford University in the U.S. began to allow the public to take the <Introduction to Artificial Intelligence> course. The system was introduced to Korea only in 2015 under the name K-MOOC. As of 2018, it has gathered 87 participating institutions, 500 courses and a cumulative 696,185 applicants.

However, the completion rate remains only at 10% [1]. Various studies have been attempted to understand how to increase this low completion rate, and have led to the conclusion that age levels, number of logins, bulletin board posts, motivation to participate with interest in learning itself, and interest in excellent courses (textbooks and instructors) have a significant effect on the increase in completion rate [2]. Nevertheless, the majority of the research on the increase in the rate of completion are macro-examinations of the entire user platform, so the research on motivation for courses in specific categories is insufficient. Therefore, in this paper, we will study the relationship between learning motives and the completion rate, focusing on the Arts and Culture MOOC course <The Characters of Convergence in Animated Films >.

### 1.2 Methods and hypotheses

This study targeted 759 learners in the K-MOOC <The Characters of Convergence in Animated Films> course, which ran twice: from Nov. 16, 2018 to Jan. 3, 2019, and from March 18, 2019 to May 11, 2019. The learning motivation data submitted at sign-up is categorized through an operational definition and the result is cross-analyzed with the list of final certificates issued. The hypothesis for this is as follows.

Hypothesis: Learning motivation and complete rate are interrelated.

## 2. The main issue

### 2.1. Theoretical considerations and operational definitions of learning motives

The motivation for learning participation is defined differently among scholars, but the most frequently used types are the three types presented by Houle (1961), which were classified as learning-orientation, purpose-orientation, and activity-orientation [3]. Morstein & Smart then approached Houle's research in a different direction and presented learning motivation factors by subdividing it into external expectations: professional progress, social relationships, escape/activation, social welfare and cognitive interests [4].

Based on Houle's types, this study classified the lifestyle learning types of Morstein & Smart, and categorized the learning motivation as shown in "Table. 1" by those standards.

Table 1 Learning Motives Classification

Houle's typologies	Morstein & Smart typologies	Learning Motives Category
Purpose-orientation	External expectations	Recommendation of organizations (schools) and individuals
		Interest in professors
	Professional advancement	To get lifetime education credit
		For career development
Activity-orientation	Social relationship	To interact with other learners
	Escape/stimulation	-
	Social welfare	For social contribution
Goal-orientation	Cognitive interest	Desire for learning (knowledge exploration)
		Interest in subjects
		Interest in new learning types

Table 2 Learning motivation Frequency analysis

Learning Motives Category	Frequency of response	Percentage (%)
Recommendation of organizations (schools) and individuals	50	6.6
Interest in professors	6	0.8
To get lifetime education credit	14	1.9
For career development	17	2.3
To explore possibilities	29	3.8
To interact with other learners	0	0
For social contribution	0	0
Desire for learning (knowledge exploration)	239	31.7
Interest in subjects	35	4.6
Interest in new learning types	15	2.0
Total	406	53.8
Missing value	349	46.2

## 2.2. Case Analysis

### 2.2.1. Demographic characteristics

This study analyzed 755 people’s data, excluding data from 4 learners who left the course. Among them, 233 were men (30.9%), 506 were women (60.7%), and 16 were undefined (2.1%). In the age distribution, 231 people (30.6%) were in their teenage years, 384 people (50.9%) were in their 20s, 68 people (9.0%) were in their 30s and 33 people (4.4%) were in the 40s, with the average age being 23.6 years.

### 2.2.2. Learning motivation characteristics

Learners' responses were coded based on the learning motivation categorized in this study. There were 406 responses to the motive, and non-responses were treated as missing and excluded from the analysis. The statistical results are therefore given in “Table 2”.

239 (31.7%) students responded with “Desire for learning (knowledge exploration)”, and no respondents said they study for exchange with other learners or social contribution

### 2.2.3. Cross-analysis result

Before analyzing the learning motivation, a certificate issuer variable was created to indicate whether the course was completed or not. In addition, a cross-analysis of whether or not the learning was completed was conducted using SPSS 25.0. The analysis was performed based on the responses of 44 out of 68 students who issued the certificate, excluding 24 who did not fill in the learning motivation survey.

The resulting results were shown in [Table 3].

			Comple tion	No Comple tion	
Learning motivation	The recommendation of groups (schools) and individuals	Frequency	12	38	50
		% within learning motivation	24.0%	76.0%	100.0%
	Interest in professors	Frequency	0	6	6
		% within learning motivation	0.0%	100.0%	100.0%
	To get lifetime education credit	Frequency	4	10	14
		% within learning motivation	28.6%	71.4%	100.0%
	For career development	Frequency	2	15	17
		% within learning motivation	11.8%	88.2%	100.0%
	To explore possibilities	Frequency	0	29	29
		% within learning motivation	0.0%	100.0%	100.0%
	Desire for learning (knowledge exploration)	Frequency	21	218	239
		% within learning motivation	8.8%	91.2%	100.0%
	Interest in subjects	Frequency	5	30	35
		% within learning motivation	14.3%	85.7%	100.0%
	Interest in new learning types	Frequency	0	15	15
		% within learning motivation	0.0%	100.0%	100.0%

	Frequency	44	362	406
Total	% within learning motivation	10.8%	89.2%	100.0%

In addition, a chi-square test to verify the relationship between these two variables showed that the hypothesis can be adopted because it is  $p < 0.05$ , as shown in [Table 4]. Therefore, there is a significant relationship between learning motivation and the rate of completion.

Table 4 Chi-square test

Chi-square test			
	Value	d	Asymp.Sig
Pearson Chi-square test	21.206a	8	.007
Likelihood Ratio	23.477	8	.003
Linear-by-Linear	7.712	1	.005
N of Valid Cases	406		

### 3. Conclusion

This study analyzed whether learning motivation affected the learner's rate of completion in the K-MOOC course <The Characters of Convergence in Animated Films >. The results were as follows:

First, the most frequent group to issue certificates are learners with a “desire to explore knowledge”, that reached 21 certificates. However, the group with the highest percentage of students who have completed the test was the group that aims to “obtain credits” with a 28.6 percent rate within the group showed. This shows that the rate of completion increases when the inflow of learners with the aim of obtaining credit for the Academic credit bank system increases.

Second, it is effective to assign individual tasks rather than discussion and group assignments as students that need more credit are older than ordinary college students and are often more cautious in their learning situations [5]. Based on the <The Characters of Convergence in Animated Films> course, it can be seen that it is more effective to arrange personal submission reports and have individual scoring assignments.

Therefore, it can be predicted that considering individualized learning strategies according to the learning motivation distribution during MOOC lectures is an important factor for increasing the number of students.

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# Research on Manufacturing Engineering of Timing for Adjusting Motion Capture Data

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## Abstract

The development of CG technology can not only show an appearance very close to real man, but also show the digital actor with cartoon style. Therefore, the motion of the role should also show in a variety of styles. This paper proposes a production project with cartoon style. In the pre-production stage of the spacing reset stage of pose, the timing of the animation of cartoon characters is set through spacing's performance and such timing data is used in motion capture data. After applying timing to animation, we suggest to clean up the motion capture. Future research will attempt to develop and test the plug-in for automatic conversion of pose spacing of motion capture data after setting up the data in the editing tool.

*Keywords-motion capture; digital actor; CG animation; Limited style*

## 1. The performance methods of digital actor

There are two kinds of performance methods of digital actors using motion capture. One is to directly show the motions of actors in an extremely authentic way, the other is to exaggerate the motions of actors through spacing regulation. Extremely authentic performances usually occur in movies when digital actors are needed to replace real actors with digital double technology. Exaggerated performances usually occur when there is need of motion performance of digital actors in cartoon-style animations with Toon shading, science fiction works or feature films. Because motion capture will output every frame of the motions of actual actors, it is not easy to transform spacing pose into exaggerated timing. If you want to change the data, then the changed motion will have unexpected results. For example, the movement can't be connected naturally where there is a sense of breakage, or the pose makes people feel awkward. Every correction of the data obtained from joint linkage must take the whole body into consideration. Because the correction of partial data may destroy the balance of the whole body. In this paper, in order to correct the spacing pose timing of motion capture data, we propose a production process that can effectively modify the existing Editing project.

## 2. Cartoon Style Animation

In the past, in order to find a way to make exaggerated motion with cartoon style using motion capture data, we tried to find rule from the curves in the curve editor. Because it was impossible to determine the key pose with the peak point or extreme point of the curve, we studied the key pose and the holding interval spacing before and after the key point in order to make rapid cartoon style motions. Although this method can relatively reduce the spacing of repetitive motions and achieve rapid motion, each expert had a different idea about the key frame of key pose. After repeated feedback of spacing, the holding interval of motion capture was modified repeatedly and many realistic motions disappeared. In addition, just like the previous questions, the time of interaction between the interactional roles is different so it needs different processing methods. In order to solve these problems, it might become a solution to use the existing visual storyboard production methods of 2D, 3D and CG animation.

When making 2D cartoons, people would refer to the performance of the actor to make visual storyboard. In the past, Disney's Snow White, 1959, which was known as the earliest animated film leading commercial success, also shot the actual performance of the actors so that the animators could refer to these scenes or imitate them in the way of rotoscoping. Now there are many animated cartoons like Figure 1, you could easily find the

comparison videos of animated character motion timing whether it is authentic or exaggerated on YouTube. In order to show the exaggerated timing, the video shot on the spot uses video editing tools to edit video with sometimes rapid motion and sometimes slow motion, which can be used as a reference for the timing of motion in animation production. You can try to use motion capture data to show animation with Limited Style.



Figure 1. An example of making animations of human and animal using the reference video shot on spot

### 3. Application

In this paper, we use the Time Remapping function in Adobe Premier to adjust the spacing of poses to try to show the exaggerated animation with cartoon style and then compare the performance data with the motion capture data to see if there is same result or not.

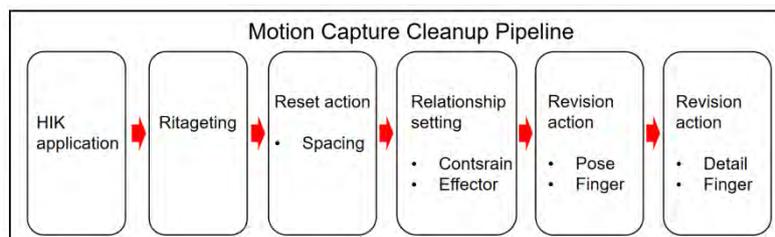


Figure 2. Conceived pipeline

Motion capture data for testing consists of 120 frames of various heavy-stroke motions. Make playblast video of motion capture file instead of the video of the actor's performance. Figure 3 is a maya file using HIK, with 24 frames per second and 120 frames in total. Import the playblast video into the editing tool in Adobe Premier and set 24fps which is the same as Maya. Switch the time code of Adobe Premier to frame-by-frame, then we can know the appropriate frame position for timing.



Figure 3. A maya file about various heavy-stroke motions

It is suggested to adjust the spacing of the pose of roles according to each frame in the editing tool in Adobe Premier and mark the frames before and after necessary pose. Then mark the beginning and ending frames of the original footage. As shown in above figure of Figure 4, the kit value is applied in Time Rimapping interval in Adobe Premier. Then, as shown in the below figure of Figure 4, move the interval from 150 to 200 quickly to show the motion with cartoon style. After clicking the Play button to confirm the animation shown in Premier, you can mark the beginning and ending frames of footage if confirmed by the customer. You can see a total of 120 frames of images are reduced to 84 frames.

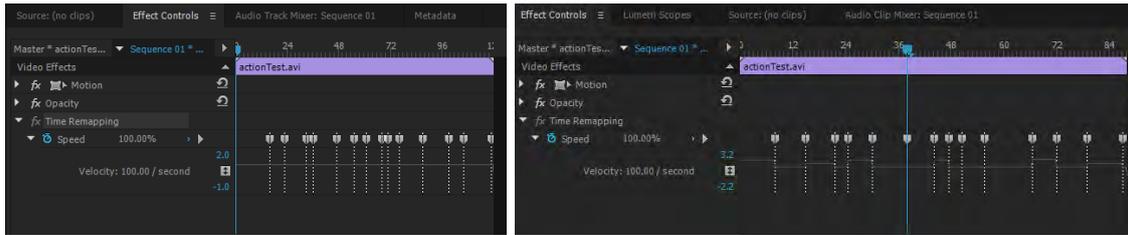
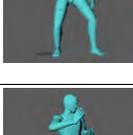
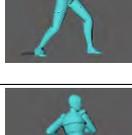
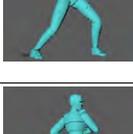
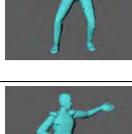
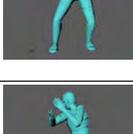
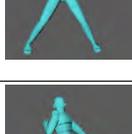
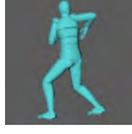


Figure 4. Modified footage with the editing tool in Premier and the original footage

Table 1. Limited time remapping table of motion capture data

Action		Start frame	Image	End frame	Image
Right hand punch attack	Original footage	0		16	
	Modified footage	0		8	
Right hand rotation attack	Original footage	23		33	
	Modified footage	15		21	
Left hand rotation attack	Original footage	36		47	
	Modified footage	25		30	
Left hand punch attack	Original footage	47		55	
	Modified footage	30		38	
Torso rotation right hand attack	Original footage	61		68	
	Modified footage	44		48	
Right elbow attack	Original footage	71		76	
	Modified footage	51		56	
Torso spinning right hand attack	Original footage	87		99	
	Modified footage	67		72	
Basic posture	Original footage	106		120	

Because spacing is determined by two-dimensional images, now you can try to convert spacing to HIK in three-dimensional maya. Motion capture data exists on joints, so if you want to change timing effectively, you need to save the Motion data under every statements with one curve, just like the Time Warp curve in Motion builder. If you import the Motion data of the role into Time editor of maya, you can easily cut and paste the data

using a clip to display Motion capture data. If you want to change the timing, you can cut the motion clip of the Time editor according to the beginning and ending frames of the original footage as shown in Table 1, and adjust the footage timing to correct scale as shown in Figure 5.

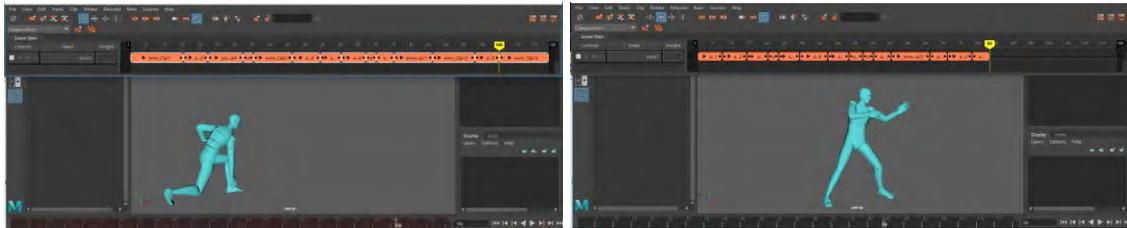


Figure 5. Edit with time editor

#### 4. Conclusion

At present, the maneuverability of the motion capture data modification in China is still very low. We can't easily edit and organize the motion capture data of digital actors. Motion capture data always need additional processes such as modification and deformation, but the corresponding procedures and preparations are not perfect. As a result, there are some problems which may be considered to be costly and labor-intensive work so as to be avoided. there will be some very difficult problems in the actual data cleaning of the scenes whether it's riding a horse, throwing things or simulating the situation of loosening clothes. Most of the problems arise from the setting of the interaction between objects. The relationship set before work may make the project easier or more difficult, so it is more important to consider the sequence of production processes before work starts.

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# Analysis on Chinese people's Preference of Emoticon Character "Kakao Friends" and "LINE Friends"

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## Abstract

Emoticon character is a kind of creative content with the expression of humanity and sensibility that helps people get rid of boredom by means of simplicity and exaggeration. With the widespread use of SNS, emoticon character have received more and more attention in recent years. Wherein, Kakao friends and Line friends are two of the emoticon characters successfully commercialized both in South Korea and abroad. These emoticons have high brand awareness among young people in China, even though they have no opportunity to use it. Nevertheless, it was found that no one has so far analyzed the Chinese people's Preference on Kakao Friends and Line Friends in Korean. Therefore, this research attempts to investigate the preferences of Chinese people based on the theory of emoticon character expression type. Detailed data on the preferences of Chinese 80s and 90s will be analyzed through the method of questionnaires. The research findings indicated that personified commodity characters were highly preferred by Chinese people and ranked 1<sup>st</sup>. Realistic animal characters and personified animal characters followed and ranked 2<sup>nd</sup> and 3<sup>rd</sup> respectively whereas realistic figures like James(L8) and Boss(L10) showed the lowest rate of preference. This result was differed from the preference of Koreans and may help designers and marketers become more targeted on derivative commodities producing and selling in Chinese market.

**Keywords-** *preferences; emoticon character; Kakao Friends; Line Friends; Chinese*

## 1. Introduction

Nowadays, emoticon characters have evolved into a popular culture in the digital age because they were widely used as a medium for emotional semantic transmission when confusion might be caused by the distortion of text messages on SNS. They also have spawned new emoticon business around the world. For instance, emoticon characters of SNS application Line and Kakao talk were loved by many young people in China with its strengths in design and effective marketing. In order to cater to the Chinese market, Kakao Friends through collaboration with tourist agencies, websites, and retail seller MINISO to develop customized commodities for Chinese. Line Friends get in touch with customers through 12 theme shops distributed in twelve cities of China. Customer preferences for characters are directly related to their purchasing willingness<sup>[1]</sup>. Better understanding of people's preference also has benefit on brand expansion and strategic management<sup>[2]</sup>.

So, what is the Chinese people's preference for these characters? Among the researches on the preference of SNS emotion characters in Korean, we did not find a survey on the preference of foreigners, probably due to language and geographical restrictions, Korean scholars have no way to conduct an empirical investigation on them. Therefore, the purpose of this study is doing research on the preferences of Chinese 80s and 90s for these two emoticon characters through questionnaire based on the language advantage and the comprehension of Chinese cultures. The research result may help designers and marketers become more targeted on OSMU (One Source Multi Use)<sup>[3]</sup> and derivative commodities producing based on Chinese consumer's favorites.

## 2. Theory Background

According to the standard Korean language dictionary of the National Institute of Korean Language, emoticons are a combination of words like Emotion and Icon, which are used to convey emotions or feelings with pictorial characters made from a combination of letters, symbols and numbers on computer or mobile phone<sup>[4]</sup>. Later, emoticon was used to refine the word 'pictogram', refers to symbols that express emotions

using characters. According to the color dictionary, character is a positive visual symbol, such as a fictitious character or animal that represents a particular brand [5]. From the above concepts, it could be summarized that the emoticon character has the same feature as character.

The definition of Preference was normalized according to “the extent to which one person likes a character” [6]. Before questionnaire designing, Combined the previous theoretical background, this research standardized several variables of preference follow Mackenzie, Lutz and Belch (1986) : “Do you think this character is good?” “Do you think this character is favorable?” “Do you think this character is likable?” [7].

### 3. Research Design and Methodology

In this study, Chinese young people of 80s and 90s who known emoticon characters of Kakao Talk and line were selected for analysis. The questionnaire survey was conducted on 8 types of kakao friends and 11 types of line friends characters. The foregoing three questions were measured on a seven-point recertification scale and averaged to calculate the Mean of each emoticon character.

In order to verify the appropriateness and reliability, 13 Chinese students who are familiar with these expression characters were selected as the subjects for preliminary survey and then. Then a modified and improved formal questionnaire survey was conducted on more than 100 Chinese people and was carried out for 15 days from May 20, 2019 to June 5, 2019. Reliability analysis and Mean-analysis were performed to verify the relationship of variables and the significance of our research by using SPS21.0.

First of all, All emoticon characters are classified for statistical analysis(depicted in Table 2) .

Table 2. Expression type classification of character

K =kakao Friends, L=Line Friends											
Number	K1	K2	K3	K4	k5	k6	k7	K8			
Kakao Friends											
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
Line Friends											

### 4. Result analysis

Table 3. Reliability analysis result

Variable	Cronbach's alpha
Good	.935
Favorable	.932
Likable	.932
.989(N/114)	

It can be seen from the below table 3 that the Cronbach's Alpha is 0.989, which is greater than 0.9, thus indicating that the reliability of the research data is high and can be used for further analysis.

Next, reference surveys were conducted for each emoticon character and the corresponding details are shown in Table 4 below.

Table 4. Preference Scores of each Emoticon Character

character	Classification	Preference Factor 1	Preference Factor 2	Preference Factor 3	Mean	Ranking list
<b>Kakao Friends</b>	K1	 5.38	5.62	5.38	5.46	3
	K2	 5.77	5.46	5.46	5.56	1
	K3	 5.31	5.15	5.23	5.23	4

	K4		4.08	3.85	3.69	3.87	8
	K5		5.62	5.62	5.38	5.54	2
	K6		5	4.92	4.54	4.82	6
	K7		4.92	5	4.85	4.92	5
	K8		4.46	4.46	3.77	4.23	7
<b>Line Friends</b>	L1		6.08	5.92	5.77	5.92	2
	L2		6	6	5.92	5.97	1
	L3		5.15	4.92	4.77	4.95	3
	L4		4.69	4.62	4.62	4.64	6
	L5		5	4.85	4.46	4.77	5
	L6		4.62	4.46	4.38	4.49	9
	L7		4.85	4.54	4.46	4.62	7
	L8		4.54	4.31	4.15	4.33	11
	L9		4.85	4.92	4.77	4.85	4
	L10		4.77	4.38	4.38	4.51	8
	L11		4.54	4.46	4.38	4.46	10

Results display that in Kakao Friends, Apeach (L2) was the most favorable one. Frodo(K5) ranked 2nd, Ryan(K1) ranked 3rd, Rabbit Muzi (K3)ranked 4th, and the crocodile Con(k4) was the least popular one. In Line Friends, Rabbit Cony(L2) was the most favorable one, Brown (L1) was the second one, Duck Sally(L3) was the third one and Miss Cat Jessica (L9) ranked fourth. Otherwise, James(L8) and Boss(L10), the panda Pangyo(L6) and the caterpillar Edward(L11) were the four unfavorable characters for Chinese people.

What was more, Feminine characters such as Apeach (K2) and Muzi(K3) were also highly preferred. The shapes of these two items were the favorite shapes of female responders. The Peach looks like an imaginative bottom and the shape of pickled radish looks like a rabbit, which makes girls can't help loving. In this questionnaire, female responders were more numerous than male, and their scores for characters were generally higher than those of male responders. However, figure characters James(L8) and Boss(L10) showed low ratio, which can be inferred from the fact that they show the limits of their cuteness and behavior. Green crocodiles were unpopular both because of their sinister nature and their featureless design and heavy color, respondents said.

## 5. Conclusion from cultural aspect

The most favorite realistic characters were animals, especially LINE friends characters Brown (L1) and Cony(L2). The two characters' scores were much higher than others. In fact, these two emoticon characters were indeed very popular among young people in China. Also, Chinese love kakao friends Ryan, Apeach and Frodo these three characters far more than any other among kakao friends. It was also because Chinese people were so familiar with the three characters, even though the software was not available in China. The results of the survey were consistent with the real situation. Actually, kakao friends and Line friends have become representatives of popular kidult culture of Japan and South Korea.

According to the cultural theory of Geert Hofstede, China is country that success oriented and driven, with highly collectivist culture, holding a polarized subordinate-superior relationship. Chinese are adaptable and entrepreneurial. These national cultural characteristics of China can be proved from the consumer's preference survey. In the interview, many people said that they chose their favorite character only because the character is loved by many other people. In fact, many people even don't think there is any obvious difference between the design of two bears Ryan and Brown of Kakao friends and line friend character. Brown's score is much higher than that of Ryan because respondents are more familiar with line friends through the 12 theme stores in China,.

Meanwhile, china has the culture of weak uncertainty avoidance. it means that one group does not regard other groups as dangerous Compared with a culture of strong uncertainty avoidance of Korea,. Based on this, china is a relatively open, dynamic, and emerging markets where especially suitable for new products like kakao friends Niniz and Line friends BT21 entering.

Cultural factors at the gender level are also shown in the survey results. The survey results show that young female respondents in China evaluates the character higher than male overall, and Apeach is the most popular character among Chinese respondents. The results of the survey are consistent with the strategic development of Kakao friends. In the newly opened store in Japan last year, more than 90% of these customers are women. The peach-related products were the main theme products, and were sold out on the first day of opening. In China, retail store Miniso also cooperated with Kakao to develop Apeach-themed cosmetic, which is very popular among young Chinese girls in 2019.

In the future, company Kakao and LINE could present the direction of new product design according to the strategy of segmentation by gender in the character market, Hope this research will contribute to the creation of various emoticons that can stimulate the human sensibility in the future for Kakao talk and Line.

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# An Analysis of the Public Facilities of Dadaepo Beach

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## Abstract

With the development of social economy and the accelerated pace of urbanization, people's demand for outdoor activities and close to nature is increasing. As a carrier connecting the city and nature, the bathing beach has become an important place for people to relax and entertain. The increasing number of visitors to the beach highlights the importance of public facilities, so the optimization of existing public facilities is a necessary condition for improving the quality of leisure and tourism. Based on the principle of "systematization", "functionality" and "humanization" of public facilities design, this paper analyses the public facilities of Dadaepo Beach and proposes suggestions for improvement and optimization.

**Keywords:** *bathing beach, public facilities, humanized design*

## 1. Introduction

Busan is a coastal city located in the southeastern part of Korea, which has a mild climate and abundant tourism resources such as bathing beaches. Therefore, it has become a world-famous leisure and tourism resort. The increasing number of visitors to the bathing beach has increased the utilization of public facilities and highlighted the existing problems of public facilities. Solving these problems is a necessary condition for improving the quality of leisure and tourism. Therefore, this paper finds out the concept and design principles of public facilities through literature review, and then conducts a field investigation of the public facilities of Qingdao Shilaoren Bathing Beach and Dadaepo Bathing Beach. By analyzing the differences between them, a suggestion for the improvement and optimization of public facilities of Dadaepo Beach will be provided.

## 2. The concept of the public facility

The term "public facility" was coined in the United Kingdom, and the English language was "Street Furniture", abbreviated as "SF". Similar vocabulary is "Urban Furniture"; It is called "Urban Element" in Europe; It is interpreted as "Furniture for Pedestrian Streets" or "Devices of the Road" in Japan, also known as "Street"; In German it is called "the Facilities of the Street" and in French it is called "Urban Furniture" or "urban components" [1]. Rob Krier [2], a Luxembourg designer, argued that: "Public facilities are open and urban-accessible facilities that are perceptible for people in the city, which has geometric characteristics and aesthetic quality, including public, semi-public facilities for internal use" [3]. It is argued that "Street Furniture", also known as "Urban Furniture", generally refers to facilities installed on streets, roads and many public places for various needs. The setup and design of these facilities often have a considerable impact on traffic safety, public safety, and the convenience of mass life in public spaces [4].

## 3. The design principle of the public facility

### 3.1. Systematic Principle

The public facility system is designed to meet the needs of people's leisure life for systematic use. Josep Maria Serra, a Spanish architect, explained the design concept of urban elements in his book <Urban Elements: Furniture and Microarchitecture>. He believed that "public facilities should not only consider the material, shape, details and other content of the individual, but also pay attention to its own 'systematization'". When designing public facilities, according to the environment in which public facilities are located, it is necessary to understand the relationship between natural environment and human environment, recognize people's

reasonable demands for public facilities, consider the use effect of public facilities in the space environment, and then establish the overall concept of “system”.

Table 1. Classification table of public facilities in bathing beaches

Categories	Leisure Service Facilities	Transportation Service Facilities	Health Service Facilities	Information Service Facilities	Safety Service Facilities
Names of Facility	Seats	Street lamps	Moving trash cans	Radio Stations	Treatment rooms
	Entertainment fitness facilities	Blind guides	Public lavatories	Message boards	Police stations
	Lighting lamps and lanterns	Traffic signs		Guide boards	Rescue watchtowers
	Public water fountains	Guideposts			
	Kiosk	Walkways			
	Pavilions	Bus shelters			
	Telephone booths	Barricades			
		Bicycle parking facilities			
		Barrier-free Accesses			

### 3.2. Functional Principle

The purpose of public facilities is to meet the needs of public life, so they are most functional. The famous Japanese designer Kenya Hara in his book <Design of Design> said: “Design basically has no self-expression motivation; Its foothold is more focused on society. It is the essence of design to solve the common problems faced by most people in society” [5]. The famous Danish urban designer Jan Gehl [6] emphasized in his book <Life between Buildings> that “the goal of urban construction is to provide a pleasant living environment, which must meet human needs that are not only material”. Therefore, the design gist of public facilities is “people-oriented”, which not only requires advanced technical and technological performance to meet the basic use function, but also should consider the comfort level in the use process.

### 3.3. Humanization Principle

In the field of public facility design, “humanized design” is a design method centering on the public and aiming at satisfying people’s physiological and psychological needs. Victor Joseph Papanek, an American design theorist, presented a viewpoint on humanized design in his work <Design for the Real World> that “design should serve the broad masses of people, not only for the healthy, but also for the disabled”. Another two experts Elizabeth Burton and Lynne Mitchell, from the School of Architecture of Oxford Brookes University, believed that “the scope of accessibility design in public places should not be limited to people with an established perceptual impairment or motor disorders. Alzheimer’s patients also need to be respected by society”. They are also the authors of book < Inclusive Urban Design: Streets for Life >. The design of public facilities should be considered from the perspective of the elderly and the disabled so as to provide convenience for people to the maximum extent and meet the universal and different needs, which is the essence of humanized design.

## 4. Investigation and analysis of public facilities in bathing beach

According to the systematic principle of public facilities, this paper makes a comparative analysis of the public facilities of Qingdao Shilaoren Bathing Beach and Dadaepo Beach, and then analyzes the existing public facilities from the functional and humanized principles of public facilities design. Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it is cited. Do not put footnotes in the reference list.

### 4.1. The systematization of public facilities

The public facilities system of the bathing beach mainly includes leisure service facilities, transportation service facilities, health service facilities, information service facilities and safety service facilities. For

comparison of public facilities between Qingdao Shilaoren Bathing Beach and Dadaepo Beach, see the table below.

Table 2. Public facilities comparison table

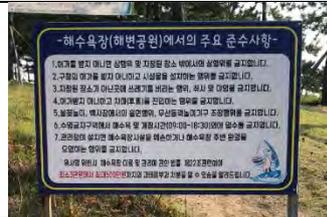
Categories	Sequence Numbers	Names of Facility	Shilaoren Bathing Beach	Dadaepo Bathing Beach
Leisure Service Facilities	1	Seats	●	●
	2	Entertainment fitness facilities	●	●
	3	Lighting lamps and lanterns	●	●
	4	Public water fountains	●	●
	5	Kiosk	●	●
	6	Pavilions	●	●
	7	Telephone booths	●	●
Transportation Service Facilities	1	Street lamps	●	●
	2	Blind guides	●	○
	3	Traffic signs	●	●
	4	Guideposts	●	●
	5	Walkways	●	●
	6	Bus shelters	●	●
	7	Barricades	●	●
	8	Bicycle parking facilities	●	●
Health Service Facilities	9	Barrier-free Accesses	●	○
	1	Moving trash cans	●	○
Information Service Facilities	2	Public lavatories	●	●
	1	Radio Stations	●	○
	2	Message boards	●	●
Safety Service Facilities	3	Guide boards	●	●
	1	Treatment rooms	●	●
	2	Police stations	●	●
	3	Rescue watchtowers	●	○

It is found from the above chart that the public facilities of Dadaepo Beach are not “systematic”, and there are no barrier-free accesses, blind accesses, moving garbage cans, rescue watchtowers and broadcasting stations.

**4.2. The functionality of public facilities**

The main function of public facilities is to meet people’s living needs, improve people’s comfort in using them, and obtain physical relaxation and psychological pleasure. After this investigation, the recreational seats, garbage cans and information tips of Dadaepo Beach are slightly inadequate in functionality.

Table 3. Dadaepo Public Facilities Functional Analysis Form

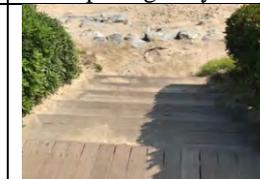
Seats	trash cans	information signs
		
The leisure seat has no sunscreen and rain-proof function, resulting in reduced usage.	The garbage can is too far away from the bathing beach, reducing its usability.	There are no multilingual information signs in the bathing beach, which brings inconvenience to foreign tourists.

**4.3. The humanized design of public facilities**

When designing public facilities in a bathing beach, it will be better to take into account the broader perspective of the disabled, the blind, the elderly and pregnant women, so as to ensure that the disabled can use

the facilities as normal people. According to the field survey, the following problems are found in the public facilities of Dadaepo Beach, as shown in the following table.

Table 4. Dadaepo public facilities humanized design analysis table

Toilet entrance	toilet	passageway	pedestrian walkway
			
There was no gentle slope at the entrance of the public toilet.	There is no handrail for the disabled in the toilet.	There is no barrier-free access at the passageway of the bathing beach.	There is no blind path on the pedestrian walkway.

## 5. Conclusion

Taking the principle of public facilities as the standard, this study investigated the current situation of public facilities in Qingdao Shilaoren Bathing Beach and Dadaepo Beach. In a word, the establishment rate of public facilities in Dadaepo Beach is incomplete according to the survey results. This paper then evaluates the public facilities of Dadaepo Beach from three aspects: systematization, functionality and humanization, and draws the following conclusions:

Firstly, in terms of the system, there is a lack of barrier-free passage, blind path, moving garbage can, rescue watchtower, broadcasting station and other facilities, which causes inconvenience to tourists and reduces the safety guarantee.

Secondly, from the perspective of functionality, public facilities have not specifically considered practical functions and comfort level. In specific, the rest seats have not been considered in terms of sunshine, shade, wind and other factors, and also lack of comfort. Common facilities such as garbage cans and water fountains should be set nearby and can be seen by potential users.

Thirdly, in the point of view of humanization, the lack of barrier-free accesses and blind paths has brought a lot of inconvenience to the vulnerable groups.

## Acknowledgment

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# A study of The "Anti-Hero" Narration----Base on Chinese Realistic Themes Films

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## Abstract

In early Chinese films, born in well-off families, most of the heroes are generally handsome and noble, which are in line with Chinese traditional values. In recent years, with the integration of multiple media, Chinese films have shown a trend of changing from hero narration to anti-hero narration, making the most of the function that the media has on reflecting social issues. The realistic theme films have abandoned the heroic attributes of being noble and sacred in the form of anti-hero, truly representing the real life and giving a new definition of heroes, which is challenging the traditional images of heroes as well as enrich and broaden the true meaning of heroes. Therefore, based on the definition of "anti-hero" in literary theory and the theory of Greimas' Action, this paper is going to analyze Chinese realistic films from three aspects: expression of anti-hero image, the characteristics of anti-hero, the value and significance of anti-hero narration.

**Keywords:** *anti-hero; heroic complex; cultural construction*

## 1. Introduction

In 2018, mainstream Chinese realism films have shown unlimited potential and outstanding achievements in both commercial and artistic heights, becoming the mainstream of the film industry and triggering a chain reaction between various media report. The development of multi-values in modern society and the deep improvement of media integration has contributed to the expression of "anti-heroism" in realistic films. Paying attention to and spreading social change and social mainstream by using "anti-heroism" creation method in realistic films such as *Dying to Survive* fits the realism spirit and realism creation method advocated by Marxist literary aesthetics. Therefore, the "anti-heroism" characters are more in line with the public aesthetics, close to reality, and better enough to guide the audience to interpret the aesthetic significance of human nature from the narration. It can not only express the mainstream cultural values of the society and the future, but also can gain universal recognition and broad resonance. At the same time, the main characters in the film are set at the bottom of the society, and the ordinary nobodies also reconstruct the "hero complex" of the people, which arouses a more resonant feeling in audience's heart in the process of watching and thus generates the subjective meaning of the call for realistic culture. Therefore, the analysis of the "anti-hero" narration in the realistic film has practical cultural significance. This article will analyze the 2018 Chinese realistic masterpiece *Dying to Survive* which has gained public praise in both commercial and artistic effects to expound the artistic charm of "anti-hero" narration exerted in present Chinese society of media integration.

## 2. Definition of "anti-hero"

"Hero is the unity of the sense of history and times, the unity of the collective spirit and the personal charm. It reflects the cultural consciousness and value system of a country and a nation. It expresses the pursuit of social justice through lofty spiritual worship. It is one of the most tenacious

spiritual symbol." The anti-hero goes to the opposite side of the hero and is the deconstruction of the hero in the traditional ideal. When civilian life enters the core of art and becomes the protagonist, it indicates the decline of individual heroism, the disappearance of a tall and full image or concept. In the book *Key words of Western literary theory*, the anti-hero are divided into four categories: ordinary people who are positive and upward, people who are awakened from illusion, modern people who lose their conviction, and those who are wild. Therefore, "anti-hero" is a concept corresponding to "hero", a role in film, drama or novel. The reason why nobodies described in whatever theme films are often more able to impress people is that people are more eager to see the image of life close to their real life in art works to obtain the emotional resonance of empathy. We must also make it clear that anti-hero is not a villain. An anti-hero can be a protagonist or an important supporting role, who has a heroic temperament and a heroic sentiment to make a heroic act.

From the definition of "anti-hero" put forward by theoretical scholars, we can see that the anti-hero image reflects the value and strength of ordinary people. The traditional heroes are too perfect, so many high-ranking heroes show the brilliance of humanity without the weakness of ordinary humanity. On the contrary, when "anti-heroes" face difficulties, they will show the same anxiety and fear as ordinary people. This kind of life-like reaction is more realistic and contagious than that of traditional hero. In the film character setting, "anti-hero" makes the civilians gain an independent and distinct personality status, which marks the liberation of ordinary human beings. They have left the mother of hero and started ordinary life. Therefore, the appearance of anti-heroes in realistic movies boldly adjusts the proportion of good and evil, good and bad in human nature, and moves closer to the true human nature. The presentation of the anti-hero image also promotes the artistic pursuit of the real world, rather than simply pursues the freshness of the spectacle. The adoption of anti-hero images in films is in exchange for the expression of the self and the transcendence of the self. In this sense, "anti-hero" is an affirmation of the lives and beliefs of ordinary people.

### 3. Analysis of the Characteristics of "anti-hero" in Realistic films

We use Greimas Action Theory to analyze the characteristics of "anti-hero". First of all, we need to understand that according to Propp's research on the fairy tale narrative procedure, Greimas is divided into four structural stages: the stage of desire or desire, the stage of ability to realize desire, the stage of achievement, and the stage of reward. These four narrative procedures form the basis of the theoretical analysis of Greimas action. [4] Greimas extends the concept of "action element" in depth. The action element is a structural unit with multiple functions, which can explain between characters and characters, between characters and events. According to Greimas, "the action element is the product of the predicable combination, and it exists in every micro world", so this concept is very important, can analyze the literary narrative discourse, can simplify the analysis methods and means, and has generality and operability. Greimas proposes 6 groups of 3 pairs of opposite categories, namely object and subject, recipient and sender, obstacle and helper. These three sets of "action elements" constitute three pairs of opposing relationships: desire and pursuit (subject and object), communication (sender and receiver), help or hindrance (helper and opponent). [5] The structural relationship between these six elements is as follows:

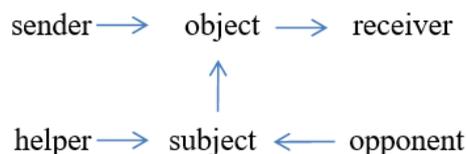


Fig. 1 Greimas' Action

Figure 1 The relationship between the Greimas' Action elements. The three pairs are as follows:  
 (1) The relationship between subject and object. The subject refers to the existence of desires or desires, and is the object of shaping the narrative works, usually the master. The object refers to the existence of the subject's desire or desire, and is the object pursued by the subject. The

relationship between subject and object is the teleological relationship, that is, the subject produces "desire" or "wish", and thus begins to search and discover the object. [6]

- (2) The relationship between sender and receiver. The sender refers to the purpose action or power that the subject pursues, and receiver refers to the recipient of the information sent by the sender.
- (3) The relationship between helper and opponent. Helpers refer to factors that help the subject achieve their desires, which help, promote or facilitate the realization of wishes. Opponents refer to factors that hinder the subject from realizing desires, which create obstacles that hinder or detrimental to the realization of wishes. The object is between sender and receiver. It is the content of communication, the assistant and opponent are the projection points of the subject.

We set the subject as "anti-hero" according to the action element diagram of Gremais, and the corresponding object is the existence of "anti-hero" desire, which is the object pursued by the subject. It is worth mentioning that the object in the "anti-hero" narrative will change with the development of film narrative. We use "*Dying to Survive*" as an example. Cheng Yong, a subject in the film, is a small boss trapped in a middle-aged crisis. He faces business mismanagement, broken family, and his father's illness, which all come from real life. The problem of dilemma. The "anti-hero" Cheng Yong is the narrative center and the main body. The first object is to solve the problem of his cruel personal destiny, social reality, and the lack of affectionate love. Life forced him to embark on the road of smuggling Indian generic drugs. That is purely for money and benefits. However, in the final object of the film, the change has been made. Cheng Yong chose to post hundreds of thousands of dollars per month for the patient to purchase, realizing the reversal of the hero value shaping respecting life and selfless dedication.

The issuer refers to the change, from the subject itself to the leukemia person Lu benefiting from drug trafficking requests, to the leukemia patient group. The recipient refers to a single mother, an old pastor, a rural patient who has left home, and a leukemia patient group.

The relationship between helper and opponent. Helper refer to the police, leukemia patients, ordinary people in all kinds of society. Opponent refer to the reality of the current existence of society.

We use the action element diagram of Gremais to sort out the "anti-hero" to sum up . The first, object experience from the individual's vital interests to the collective interests along with the development of the plot. The second, complete the reversal of the subject through the change of the object. The third, sender and receiver will be converted into helpers. This change in the relationship of action elements is also in line with Barthes: The action meta-pattern, like any structural model, does not lie in its standard form (the pattern of six action elements), but in its adaptation to regular changes. (lack, confuse, multiply, replace), so that one can expect to produce a typology of the narrative action element. It can be said that in the narrative structure of the action mode, the desire, the ability, the achievement of the goal and the completion of the heroic behavior are generated. The modes of action do not exist in isolation, and the logical relationship between them is based on the thinking of the social reality system. The actions in the action mode are triggered by this.

#### 4. The ripple effect of the "anti-hero" narrative after the media fusion

Every character in the film "*Dying to Survive*" does not show excessive greed and evil thoughts, especially the male protagonist Cheng Yong also makes his humanity and personality sublimate into "reverse" in the heroic action of salvation of others. *Dying to Survive* transcends the ugly phenomena of cruelty, materialism, ignorance and human distortion in real life." The life situation of the small person created the realistic image of "anti-hero" Cheng Yong, which caused many people to resonate and pass an optimistic and positive attitude and spirit. The story carries out the most sincere care from the people's life, and shapes the story of the "anti-hero" human nature. The audience creates a high-level aesthetic feeling and deep "intuitive intuition" in the two-way penetration of the meaning between the subject and the object.

These fates and endings, based on the real human transformation and social development of anti-hero, not only constitute the driving force of narration and the challenge of the role, but also mobilize the emotional experience of the audience in real life, expressing the relationship between the film and the reality. So the strongest emotional agreement between the film and reality is established. The

audience produce a real emotional identity through the understanding of the film characters in the process of watching the movie. The ordinary little characters in the eyes of the audience have constantly established heroic traits, performing "anti-hero" dances on the fate stage, and accusing them of emotions and declaring war on their lives with a unique identity. The protagonist in this kind of realism film is no longer a hero in Hollywood films. He is no longer devoted to the narration of heroic culture. Instead, he focuses on the difficult realistic survival dilemma of the small people at the bottom of the society, trying to devalue the value and focus on anti-hero. That is no longer to fantasize, beautify, worship heroes, and no longer whitewash the peace, but to expose the mask of political hypocrisy, so that the social injustice, human indifference and cruelty can be truly presented, so that the people at the bottom of the society the passion and despair of life are naturally revealed. Obviously, the descriptive narrative technique of the film makes the time of the passing of time - the image naturally presented. It is not deliberately rendered, nor exaggerated, but in the silence, evokes the audience's deep concern and understanding of life. That is, everything is thrown into the world, and no one can become the master of time and life.

## 5. Conclusion

From the start of reality, portraying humanity, shaping characters, and designing the fate of characters has been unified in this real power, thus making the anti-heroes in these works become mainstream realism. Film art is an important medium of communication for mainstream culture. Then it is more and more important to shape the new hero image to be recognized by the world through the integration of multiple media. The construction of the "anti-hero" surface meaning is personal value. Compared with the classic hero image, it pays more attention to the universal emotions of the characters themselves, and transmits a new spiritual world in highlighting personal values, so that the masses will have a strong recognition of the grassroots heroes in the film while being amused by life and being shocked by loftiness, thus reinventing its own individual value. The ordinary people take the burden of the family and the responsibility of the society, and continue to convey optimistic and positive attitude to the audience. The humanization of "anti-hero" can convey the core socialist spirit and value core in the subtle influence, and it is the concern for the tough national spirit and universal emotion. In the current media fusion, the anti-hero deconstructs the heroism, letting the society participate in the return to the original life, and presents the audience with a complete, rich and multi-faceted new character image. In the communication environment of media integration, cultural construction gradually presents a variety of situations, respects people's choices and values, values the shaping of emotions, and plays the role of film art in recreating the reflection of society in this environment.

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# Comparison of Volumetric Lighting Rendering Based on CPU and GPU

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## Abstract

Atmospheric scattering is the most common and indispensable physical phenomenon in nature. If it doesn't exist, then the sun is shining and the rest is dark. It can make the sky appear blue during the day and orange in the evening; make the near objects appear clear and the distant objects appear blurred. At the same time it is also the principle of volumetric lighting generation, so it is very important to simulate this effect in a virtual scene. In 3D scenes, the GPU engine is generally used in real-time rendering due to its fast rendering speed. With the development of computer technology and the advancement of rendering technology, GPUs are increasingly being used for offline rendering, and the rendering quality is constantly improving. This paper compares the rendering effects and speed of CPU and GPU, and proposes an improved method to optimize GPU volumetric lighting rendering.

**Keywords-** *Atmospheric scattering; Volumetric lighting; CPU; GPU; Rendering*

## 1. Introduction

Atmospheric scattering produces many effects, such as sky color, optical axis, fog, etc. These effects increase the realism of the image. Volumetric lighting is also generated by atmospheric scattering. Whether in film and television, in advertising or in games, volumetric lighting plays an important role. Using volumetric lighting in film and television can tell stories, create an atmosphere, and produce dramatic effects. Enhance immersion in the game and evoke a sense of reality. Therefore, rendering volumetric lighting effects is very important. In a virtual 3D scene, you can combine the light and fog effects to simulate volumetric lighting effects, create an atmosphere and enhance the authenticity and distance of the scene. In the rendering field, most offline renderers support CPU rendering, but because the CPU takes up a lot of space, and there are complex logic, the GPU rendering method appears. Compared to the CPU, the GPU has more advantages in graphics rendering and rendering technology is more efficient. More and more renderers are now working on GPU rendering. This paper uses the ray marching method to render the volumetric lighting effect, compares the rendering effect and speed of different methods of CPU and GPU, and proposes improvement measures to improve the rendering quality of GPU.

## 2. Atmospheric scattering

Atmospheric scattering is a natural phenomenon that analyzes the amount of light particles scattered in the atmosphere. Realistic visual effects can be achieved by simulating sky colors, fog, clouds, volumetric lighting and shadows. The main reason for this is the interaction of light with molecules and aerosols in the air. Light is affected by atmospheric molecules in the atmosphere, and after repeated attenuation and scattering, it eventually reaches the human eye. The scattering of light by molecules in the air is called Rayleigh scattering; the scattering of light by aerosols is called Mie scattering.

### 2.1. Rayleigh scattering

It is often seen that the sky is blue and red-orange at sunrise and sunset. This optical phenomenon is interpreted as Rayleigh scattering. Rayleigh scattering is the scattering of light by air molecules. The wavelength of light is different and the degree of scattering produced is also different. During the day, the sun passes

through the atmosphere and Rayleigh scattering with the air molecules. The intensity of Rayleigh scattering is inversely proportional to the fourth power of the wavelength. That is, the shorter the wavelength, the stronger the scattering intensity. Since the blue wavelength is shorter than the red wavelength, the air molecules scatter blue more than red, so the sky appears blue. The sky is red-orange at sunrise and sunset because the sun's rays need to travel long distances before reaching the observer's eyes. Due to the long distance of the propagation path, the short-wavelength blue light is mostly scattered after reaching the observer's eye, and the long-wavelength red light still exists, so the sky will appear red-orange.

## **2.2. Mie scattering**

When the atmosphere is cloudy or cloudy, some dust particles will appear in the atmosphere, making the sky appear grayish white, which is caused by Mie scattering. Mie scattering is the scattering caused by particles whose diameter is comparable to the wavelength of the incident light. It is mainly caused by particles in the atmosphere, such as smoke, dust, aerosols, and the like. Unlike Rayleigh scattering, the scattered light intensity of Mie scattering is independent of the wavelength of the incident light and is generated when there are particles in the air that are larger than the wavelength of the incident light.

## **3. Rendering engine**

The rendering engine is the basic component in 3D production, used to calculate rendering and produce realistic images. The general rendering engine is divided into two major categories: CPU and GPU. When rendering graphics, you can take advantage of the central processing unit (CPU) and graphics processing unit (GPU) to improve performance. As one of the most popular renderers, V-Ray is widely used to create realistic 3D graphics. It supports rendering of both CPU and GPU engines.

### **3.1. Based on CPU rendering**

The CPU, the central processor, consists of several cores optimized for serial tasks. The advantage is that it uses RAM memory, which can easily scale to more than 64 GB even for a normal personal computer, and can be applied to any type of processor. It scales well with clock speeds and core counts, and can even span multiple physical CPUs in a single workstation. It is also the mainstream way of offline rendering. But compared to GPUs, CPUs can only perform tens to hundreds of operations simultaneously. Use the CPU to perform ray tracing and rendering in the V-Ray renderer.

### **3.2. Based on GPU rendering**

The Graphics Processing Unit (GPU) is a microprocessor that runs graphics operations on personal computers, workstations, game consoles, and some mobile devices such as tablets, smartphones, and more. Using GPU rendering acceleration can increase the graphics loading speed, reduce the burden on the CPU processor, and make the system run more smoothly. Therefore, when processing specific data in parallel, the GPU is faster than the CPU rendering. Using GPUs in 3D rendering speeds up the rendering of graphics, but the logic is simple and good at handling some simple algorithms. Therefore, it is generally used in the game field of speed pursuit for real-time rendering. For offline rendering that pursues the real world of simulated physics, CPUs are typically used for rendering. In recent years, with the continuous improvement of GPU computing power, more and more have been applied to offline rendering. In the field of graphics rendering, whether it is film and television animation, architecture, or CG advertising, GPUs bring an efficient rendering solution due to the advantages of rendering acceleration. As the availability of GPU-accelerated rendering continues to increase, more and more renderers are beginning to support GPU rendering, such as V-Ray, Arnold.

## **4. Experiment**

### **4.1. Setup**

Rendering a volumetric lighting effect in a 3D scene can be divided into two parts. One is the sky rendering, the other is the atmospheric fog rendering, and finally the occlusion shadow is added to obtain the volumetric lighting effect. This paper uses Maya and the V-Ray renderer to create and render volumetric lighting effects.

### **4.2. V-Ray sky and sun system**

V-Ray sky and sun systems show the real world of the sky and the sun, and two simultaneous use can get more realistic lighting effects. Take the evening time as an example. Use the Hosek sky model to simulate the sky and adjust the value of the Intensity multiplier to 0.03. Leave the default values for the other values (Figure 1). Using vray-sun to simulate sunlight, the sun's altitude is adjusted to 25 degrees to simulate the evening

illumination. The Intensity multiplier is adjusted to 0.03, the Turbidity is adjusted to 13.463, and the Ozone is adjusted to 0.063. Other values remain at their default values (Figure 2).



Fig. 1 V-Ray sky setting



Fig. 2 V-Ray sun setting

### 4.3. Environmental fog

V-Ray Environment fog can simulate atmospheric effects such as fog and dust. And adjust the properties by using 3D texture maps. The fog height value is set to 52.632 depending on the height of the scene, the fog distance is set to 147.369, and the fog density is set to 0.793 (Figure 3). To simulate a more realistic fog effect, use the ray marching algorithm in V-Ray Environment fog.

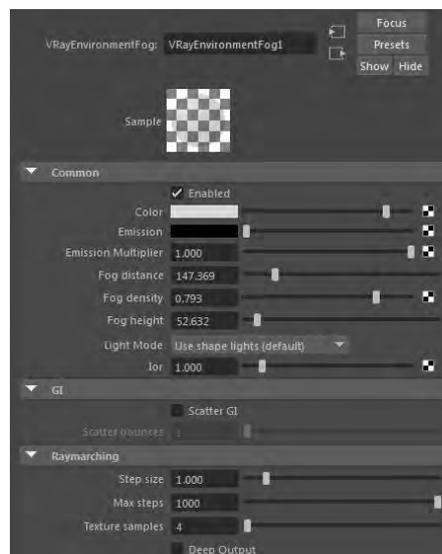


Fig. 3 V-Ray Environment fog setting

## 5. Result

In order to improve the rendering efficiency, add denoiser to the rendering element and use the progressive image sampler to render. Progressive sampling is the continuous projection of a sample to a pixel that is needed until that pixel reaches the target threshold (noise threshold). Set the noise threshold to 1, 0.5, 0.1, 0.05, and 0.01, and use the CPU and GPU engine to render them, compare their rendering time and effects (Table 1). From the table, using CPU rendering, the smaller the noise threshold, the smoother the surface, the sharper the image, and the longer the rendering time. With GPU rendering, the smaller the noise threshold, the less noise, the sharper the image, and the longer the rendering time. Compared to the CPU, the GPU renders faster, the anti-aliasing effect is more obvious, the shadow rendering is more clear, but the noise generated by the highlights is more.

Table 1. CPU and GPU rendering effects and time comparison

	CPU		GPU	
Noise threshold	Rendering	Time	Rendering	Time
1		2m6.4s		1m48.2s
0.5		2m10.8s		1m50.6s
0.1		2m19.7s		2m9.2s
0.05		2m22.6s		2m10s
0.01		2m28.6s		2m10.4s

In order to improve the GPU rendering effect, remove the problem of high light and noise during rendering, and adjust the rendering settings. Set the noise threshold to 0.01, and set the value of Max.rensper time (min) in Image sampler to 2. Use the GPU engine to render, the noise in the highlight portion is eliminated, and the shadow is sharper (Figure 4).

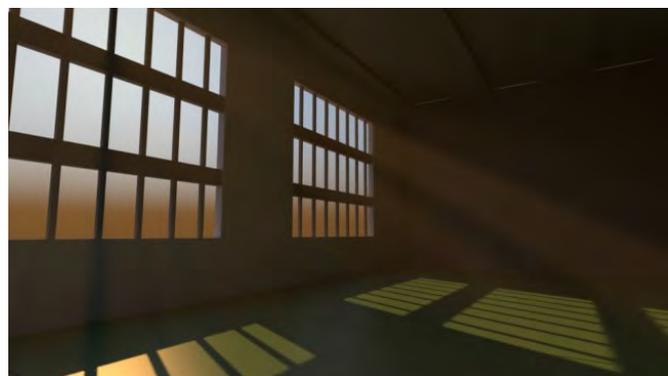


Fig. 4 GPU optimized rendering

## 6. Conclusion

This paper describes the principles of atmospheric scattering and volumetric lighting generation, and introduces two ways of computing rendering, based on CPU and GPU rendering. Render volumetric lighting effects using ray marching in 3D indoor scenes. This effect is achieved by combining the V-Ray sky and sun system with atmospheric fog and occlusion shadows. And use the progressive sampler to render in the CPU and GPU engine respectively, compare the rendering effect and rendering time of the two. The experimental results show that compared to the CPU, using the GPU to render volumetric lighting faster, less time, anti-aliasing and shadow effect is better than the CPU, but in the highlights will be more noise than the CPU. In order to optimize the volumetric lighting rendering effect, change the target value to get an image with no noise and a clearer shadow. In order to get a more realistic indoor lighting effect, the scene will be rendered in combination with other light sources in the future work.

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# Comparison of Rendering Platform based on Hair Rendering

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## Abstract

In recent years, more and more attention has been paid to the realization of virtual roles in VR and AR fields, and hair is the basic element of digital role models. However, emulational hair rendering has always been a big challenge in CG field. The diversity of hair morphology increases the difficulty of hair modeling. The interaction between hair also makes the dynamic simulation of hair more complicated. Different rendering platforms also vary the final rendering outcome of hair. In hair rendering, the three renderers V-ray, Arnold and Redshift are the most commonly used offline rendering platforms for 3D artists in recent years. The three renderers can realize the real effect of hair rendering, but the rendering results will naturally vary according to the lighting systems and materials of the three renderers. Therefore, in this study, the different lighting effects and materials of the three rendering platforms are tested, and the lighting environment of the lights and material information are unified. Under the condition of uniform lighting environment and materials, the effects of the three renderers on the rendering speed and rendering quality of hair are tested through actual hair rendering. The final results of the three renderers are compared, and suggestions on the optimal hair rendering and the conversion mode between platforms are put forward.

**Keywords-** *Hair rendering; Lighting environment; shader*

## 1. Introduction

Virtual characters are indispensable in animation, games, movies and other fields. Hair is one of the most fundamental elements of digital characters, and the modeling of hair is also an important way to show the personality of characters. For example, in recent years, some animated films such as Brave.2012 and Moana.2016, personalized hair styles vividly conveyed the distinctive personality of the protagonist. Therefore the simulation and rendering of hair in CG is also an important topic worthy of studying.

In the offline renderer, global illumination is an important factor that affects the hair rendering outcome and speed. In 1968, Arthur Appel [1] proposed the theory of ray casting, which laid the foundation for ray tracing. In 1979, Turner Whitted [7] proposed ray tracing on the basis of ray casting. On the basis of this research, Kajiya further established the theory of rendering equation in 1986 [3], and introduced the rendering equation into graphics for the first time. In the same year, Kajiya [5] proposed the idea of path tracking algorithm, which opened up the field of global illumination based on Monte Carlo method. Many global illumination algorithms that followed were based on Kajiya rendering equation.

In 1989, Kajiya and Kay introduced a method of simulating and rendering hair using texture and phenomenological hair beam illumination [4]. Each hair was regarded as an infinitely thin cylinder, and the diffuse reflection and highlight of hair are calculated based on the three-dimensional vector representing the direction of hair. In 1997, Goldman [2] improved the model based on Kajiya's research and made the model incline to forward or backward scattering by adding a factor, thus simulating translucency. On this basis, in 2003, Marschner [6] proposed a physical light scattering model based on uential, which successfully transformed the aesthetic nuances into analysis models, mentionable the capturing of the highlights of double-sided mirrors, as shown in the following fig. 1. At present, the rendering of hair is still simulated on the basis of Marschner, so as to obtain realistic hair effect. V-ray, Arnold and Redshift studied in this paper all calculate on the basis of this theory to realize vivid rendering of hair.

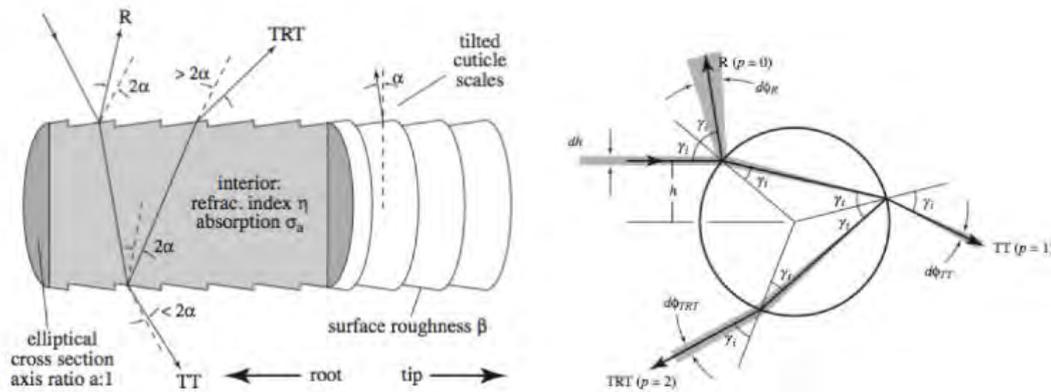


Fig. 1

V-ray provides a variety of global lighting methods, so it is more flexible when selecting rendering schemes. It can choose either fast and efficient rendering schemes or high-quality rendering schemes. Arnold is different from the conventional renderer. It is a movie-level rendering engine based on physical algorithms. Arnold's design framework can be easily integrated into the existing production process. Differing from V-ray and Arnold, Redshift is the world's first fully GPU-based accelerated bias-allowing renderer, which does not pursue physical real rendering results but optimizes rendering speed as much as possible. Because the rendering methods of the three rendering platforms V-ray, Arnold and Redshift are different, the rendering results for the same fur model are different. Therefore, this paper mainly discusses the comparison of rendering speed and rendering quality between different rendering platforms for the same hair model, and puts forward suggestions on the optimal hair rendering method and the conversion mode between the platforms.

## 2. Experiment

Since the three renderers V-ray, Arnold and Redshift perform global illumination based on different algorithms, and the lighting system and materials of each renderer are different, the rendering outcome and rendering speed of hair are also different. In order to compare the hair tests in the same environment, our research starts with the light and material part to make the light environment and material texture of the three renderers similar to each other, thus comparing the different outcome of the hair of different renderers on rendering outcome and rendering speed on the basis of the same light and material.

### 2.1. Create a unified lighting environment

Arnold is physics-based global lighting, and has its unique GI algorithm in the rendering process. It is most convenient to test based on Arnold test results. V-ray provides a variety of global lighting methods, which need to be tested from four different GI methods: Brute Force, Irradiance map, Light cache, Photon map. Redshift is an algorithm based on ray tracing. It also needs to test Brute Force, Irradiance cache and Photon map respectively to obtain the rendering method with the most similar lighting rendering results with Arnold.

In the test environment, the light positions of the three renderers are made consistent with the camera positions, and the Area light is used for testing, and the rendered image size is set at  $1024 \times 1024$ . The rendering effects of different GI modes of the three renderers were tested under a unified lighting environment. The results in fig.2 below shows that Arnold GI, brute force mode of V-ray and brute force mode of redshift are based on physical rendering, and the rendering results are the closest to each other.

In order to further verify the accuracy of this result, we tested the lighting effects of the same scene in different HDRI environments, including indoor and outdoor environments, and output RAW format image. We evaluated the basic RGB information in the selected areas, thus obtaining the following RGB information. The result is shown in fig.3 .

In the above tests, we focus on the different performances of diffuse reflection global illumination in Arnold, V-ray Arnold, V-ray, redshift. Seeing from the results, different renderers will inevitably produce different rendering styles and effects, but they are not completely inconsistent. We can get a similar result as far as we can: Arnold GI, brute force mode of V-ray and brute force mode of redshift can basically achieve the close rendering results when rendering the same scene. This is also the basis for us to study and test the rendering outcome of different renderers' hair materials.

Render Tool	GI	Noise type	Ray calculate	TIME (S)	result
Arnold	Arnold GI	noise	Unbiased	25	
V-ray	Irradiance Map	flicker	Biased	34.6	
V-ray	Light Cache	flicker	Biased	8.6	
V-ray	Brute Force	noise	Unbiased	28.6	
V-ray	Photon Map	Flicker	Biased	22.7	
Redshift	Irradiance Cache	flicker	Unbiased	0.15	
Redshift	Brute Force	noise	Unbiased	0.13	
Redshift	Photon Map	flicker	Unbiased	0.09	

Fig. 2 Simulation of sphere under different GI algorithm in Arnold, V-Ray and Redshift respectively

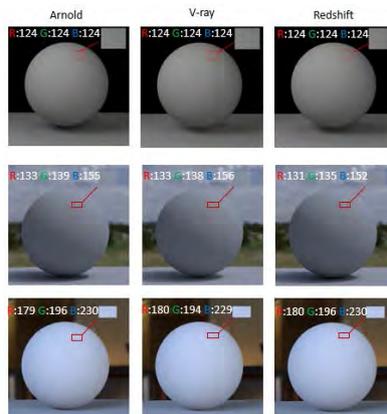


Fig. 3 In order to test the hair of each renderer more objectively, we unified the lighting environment first Arnold Render image (L), V-ray Render Image(M), Redshift Render Image(R).

## 2.2. Unification of Hair Materials for Different Renderers

In hair rendering, lighting, materials, sampling and other factors determine the rendering time and outcome. Based on the different renderers under the unified lighting environment and hair model, the rendering outcome will vary from one material to another. Differences such as self shadow, depthshadow, sss, etc. will exist. Therefore, based on the unified lighting environment and the same model in section 2.1, the effects of basic hair materials of Aistandderhair, Vraymtl hair and Redshift hair renderers on hair rendering are compared respectively. The properties of materials are also tested, so as to make the rendering of three different materials as uniform as possible. As shown in fig.4.

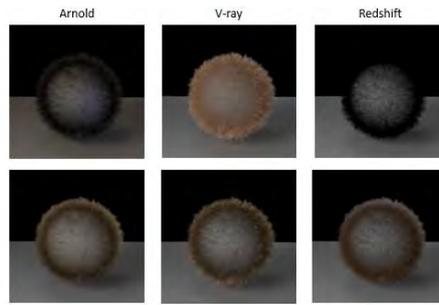


Fig. 4 The above figure shows the effect of the basic material attributes rendered in Arnold, V-Ray and Redshift from left to right and from top to bottom respectively, as well as the uniformed rendering outcome of the three renderer materials through testing.

By observing the overall distribution of black, white and grey, it can be seen that the rendering effects of these three different materials have basically reached unity.

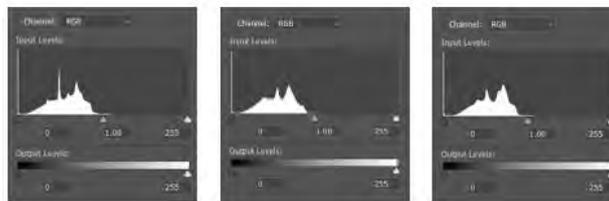


Fig.5. From left to right, the above figure is the Level curve graph of Arnold, V-Ray and Redshift respectively.

From the above tests, we can know that the basic hair materials of V-ray, Arnold and Redshift are different. The basic hair materials of V-ray are base color and Roughness, while Arnold and Redshift do not carry any color and illumination information. Through the test, the base color and roughness effects of the three renderers can be made similar, so as to obtain as similar rendering effects as possible. As shown in Fig.5, although the hair shaders used by different renderers are different, the material effects can be made as uniform as possible by adjusting the material properties. The parameters of the experimental results are applied to the hair rendering in the next chapter.

### 3. Comparison of Renderers

In the final stage, it is the process for three different renderers to apply the hair material. Since all three renderers can support Xgen rendering well, we make a hair test model of 60654primitives using Xgen. As shown in fig. 6.



Fig.6 From left to right are guide curve, primitive, rendering..

According to the test results in chapters 2.1 and 2.2, the rendering speed and rendering effect of the same hair model of the three renderers are compared on the basis of the same lighting environment and material as uniform as possible, as shown in Fig.5. Arnold's Path Tracing bi-directive ray tracing method calculates not only the light emitted by camera but also the shadow ray. The rendering of hair is realized based on PBR algorithm. Both V-ray and redshift calculate light based on Ray tracing, but compared with V-ray, redshift supports GPU rendering. The speed advantage is greater than that of the other two renderers.

Render	Arnold	V-ray	Redshift
Hardware	Inter (R) Xeon (R) CPUE5-1650v2, 32GB		
Shader	Aistanderhair	VrayMtlhair	redshifthair
Sampling	Camera: 6	Min Subdivs: 1	Min Subdivs: 4
	Diffuse: 4		
	Specular: 4	Max Subdivs: 24	Max Subdivs: 64
	Transmission: 2		
	SSS: 2		
Volume Indirect: 2			
Rendering time	15m56s	16m23.6s	6m33s
Noise Type	Noise	Noise	Noise

Fig.7 comparison of rendering outcomes between v-ray, Arnold and Redshift.

In the stage of testing of uniform lighting environment and hair material, the hair is tested and rendered in Arnold, V-ray and Redshift respectively. Seeing from the test results, Arnold's final effect is better than V-ray and Redshift, the effect is the most realistic, but it takes relative a longer time. V-ray provides different GI algorithms and high-end Ray Tracing results. It can render excellent images on fur and SSS, but the rendering takes the longest time. Redshift, as a biase-allowing renderer, pays more attention to rendering speed and rendering results, which are not as realistic as Arnold and V-ray. As shown in Fig. 8.



Fig.8 shows the rendering outcomes of the same curly hair model in Arnold, V-ray and Redshift from left to right respectively.

#### 4. Conclusion

Hair rendering is always a difficult problem. Through the above tests, we know that the realisticness and cost of hair will inevitably be affected by changing different rendering platforms. This study has shown you the test results of hair on different platforms and the optimal rendering scheme. For this reason, we have the following three conclusions. First, the lighting systems among the platforms can be unified. The lighting factors affecting hair quality can be completely unified. Secondly, on this basis, we further test Arnold, V-ray and Redshift with the basic hair materials. By analyzing the rendering outcomes, we have found the possibility of seamless conversion between the platforms. Thirdly, through hair rendering to test the models, on the basis of quantitative research in various stages of experiments, the rendering results of realistic hair of general virtual characters are obtained.

In this study, on the premise of strictly controlling the influencing factors of each stage, the possibility of mutual conversion among the major renderers is confirmed, which provides a reference for selecting the most cost-effective hair rendering platform for projects.

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# Simulation Analysis of the Facial Effect of VRay \_ SSS Material Using VRay \_ SSS Material

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## Abstract

Along with the steady improvement of the economy, the gaming industry has promoted the development of the game industry, and the demand for the characters is increasing. In this paper, the role of facial makeup plays a role in researching and exploring the role of characters in the overall exhibition of characters. This paper introduces the meaning of SSS material, discusses the application of SSS material in the existing game, and discusses the corresponding parameters of SSS material. With the development of the process of facial makeup, the character of the characters ' faces is more delicate and realistic, with the constant development of network technology, which is becoming more and more convenient.it is also necessary to innovate continuously and improve the quality of the game. It is also necessary to improve the quality of the game. This paper expounds on the meaning of SSS material and discusses the corresponding parameter modulation and mapping methods of SSS material. Make more delicate and realistic characters in one's face. The main innovation in the article is to design the characters of the VRay\_SSS material ball. Using Vray Rendezvous, the results show that the new method and process are obtained.

**Keywords-General-general game; Role mask production; Vray; Vray \_SSS Material**

## 1. SSS Material and Vray Shipwright Dispenser

### 1.1. The concept of SSS material ball

SSS-material is one of the most commonly used materials in a professional rendering. This paper uses VrayFastSSS 2 Material ball balls with VrayFastSSS 2. The SSS name is used to indicate scattering, reflection, and refraction when a beam of light is irradiated onto an object, and the object is absorbed by absorption, reflection, and refraction. A few lights displaces from the surface of the body, causing the object to appear in a translucent state. For example, the palm and the veins of the palm can be dimly visible. This is the SSS material, which can be used to produce similar objects such as candles, jade, and skin. As shown in Fig. 1.



Fig. 1 Three SSS of Figure 1 SSS Material

### 1.2. Introduction of Vray Shadows

Vray is the most popular engine in the industry. This engine provides the kernel of Rhino, Sketch up and Vray for many excellent modeling software, including Rhino, Sketch up and Vray. Not only that, but Vray also offers a single rendezvous program.it allows users to refrigerate the operation of various pictures. This paper makes material for Vray Function Scattering, The distribution function of the surface reflects the distribution function. Within the object, the scattering of light is anisotropic, but the direction of scattering can be adjusted through the direction of the incident. This material can be adjusted directly to reflect the reflection of the refraction

reflection and the reflection of the mirror. The material consists of three layers: Mirror reflector (SPECULAR LAYER), diffused reflection (Diffuse layer) and subsurface-scattering. When a single scattering incident occurs in an object within the first time, multiple scattering occurs in the light of the second or more resistances in the body.

## 2. Comparison of VRay\_SSS Material Adjusting and Traditional Rendering Formulation

### 2.1. Contamination in traditional production process

Taxiway making of traditional manufacturing processes: After completing the Diffuses Map. Human skin and muscle causes light red blood beneath their own yellow skin because of the causes of blood vessels and muscle muscles. The layering effect of this layer is based on the original Diffusion Map. Get Sub-Sub face Color Map [Sub-Sub face Color Map: Sub subsurface scattering chart] to control the overall color of the secondary surface. Based on this diagram, the color of the overall colors tends to light a brighter hue so that it can be controlled by the highlight of the atlas, which enables light to produce more scattering of light, thereby allowing the material to be more visible. Since the role of female characters in the case is female role in the case, it can be more penetrating than the surface of the surface, so that the skin is more penetrating. As shown in Fig. 2, (a) is the effect of diffuse map effect, (b) as Sub-Sub face Color Map effect.

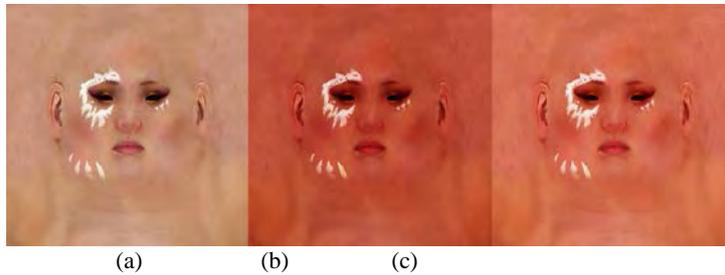
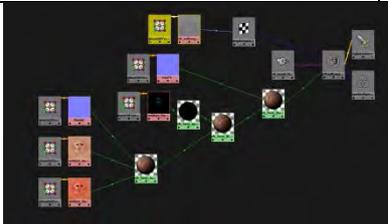
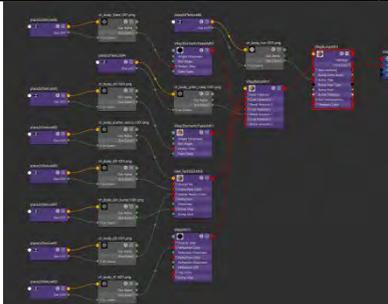


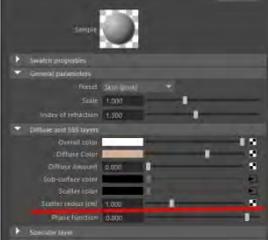
Fig. 2 Diffuse map、Sub-sub face color map、Scatter color map Show off

### 2.2. Comparison of new production processes and traditional processes

Unlike conventional processes, unlike conventional processes, the new process flow is created in the treatment of the face scattering effect. Under this diagram, the parameter modulation can be saved in the process of the process and can be used to determine the extent of the scattering range.in addition to normalizing make; the displacement may add a real change in the texture effect of the NORMAL MAP. Thereby making the texture more real.it takes a lot of time to create Displacement Map in Zbrush software.it is not possible to determine the production level of each CG staff, which uses Zbrush's high-distribution materials to the model. This method can be used to deal with small details of artificial engraving that can be repaired in Photoshop, where it can be repaired, and then the method of making it easier for humans to produce a better effect.

Table1. Material Connection to iPhone

	Material Connection Mode	Difference
Traditional production process		Using a Vray Blend material to adjust the model of the model, the texture detail and the normal map texture are used.
New production process		The new process is not only evident in the treatment of Displace map, but also increase the scope of the Scatter _ radius _ map, which controls the scattering scope, which makes the scattering field more controllable and intuitive.

<p>Traditional production process</p>		<p>Using Scatter Radius scattering radius, the scattering effect is determined by adjusting and radiating tests.</p>
<p>New production process</p>		<p>In the new process, a Scatter Radius map allows the scattering effect of the scatter back to control and intuitive effects.</p>

### 3. The Application of SSS Material to Remount characters in Chinese and foreign game characters

The first person in the world, on May 24, 2016, is the first person to play a game of "Wang" in the global market, and the game is not only played by players but also gives players a fresh sense of rhythm and beauty. For example, the initial skin game of the role is a normal European model of a girl, with little freckles on her face, with a touch of pink powder on her face. March 01, 2016. The character of the Kang Fu movie, which has been developed by Trenching North Pole, is a classic feature of the traditional Chinese style.



Fig. 3 roles vacuum show



Fig. 4 The role of facial makeup in the Ming Dynasty

### 5. Conclusion

SSS is an important component of 3 D game characters, which can make characters more realistic and add more attraction to players. Based on analyzing the definition of SSS material, the paper analyzes the parameters of SSS material, and analyses the parameters of SSS material. AR technology is a real-time to calculate the location and angle of the camera image, and the technology, video, and 3 D model of the camera. This technique aims to link virtual worlds onto the real world and interact with them. Through this facial rendering process, it is possible to offer a new look at the role of a star or animation in the past, and in May of 2017, When the anniversary of Teresa Teng's death, the Japanese TBS TV station broadcasted the holly exhibition of Teresa Teng's concert in Tokyo.

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## **A Study on the Universal Design in the Cultural Space - Center around the Busan Museum-**

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### **Abstract**

Through the analysis of the various types of public spaces in Busan Museum, it is hoped to grasp the relationship between the public space of this museum and its universal design, discover the development trend of public space design, and propose the universal design direction for future public space. First, through literature review, the author has comprehensively understood and researched the concepts and evaluation elements of universal design, museum spatial Configuration and function, museum spatial Configuration and universal design, and other relevant paper analysis, so as to provide a practical theoretical basis for this paper. Second, through the on-site investigation to take pictures of the public space at Busan Museum, the author has used the pictorial analysis technique to analyze the spatial Configuration and function. Third, the author has analyzed the current status of the universal design elements in Busan Museum.

*Keywords- museum; public space; Universal design*

### **1. Introduction**

#### **1.1. Research Background and Objectives**

With the rapid development of modern society, the income level of citizens has continuously increased, so has their demand for quality of life. Such phenomenon has led to the spreading of cultural industry all over the country at a very fast speed. So people could access to more and more cultural spaces and facilities in daily life.

The universal design aims to make it as easy as possible for everyone including not only the elderly, the disabled, the children, but also the pregnant women, ordinary people, foreigners, etc., which are majority of people instead of a specific group of people. In other words, the design is not created for people with certain disability, but for more people to use easily.

In order to emphasize the importance of this universal design for the urban environment, the culture of urban people and the changes in everyday life, this paper has discussed the current status of the universal design in Busan Museum by taking its public space as the subject. Through the analysis of the various types of public spaces in Busan Museum, it is hoped to grasp the relationship between the public space of this museum and its universal design, discover the development trend of public space design, and propose the universal design direction for future public space.

#### **1.2. Research Method and Scope**

The specific methodology is as follows:

First, through literature review, the author has comprehensively understood and researched the concepts and evaluation elements of universal design, museum spatial Configuration and function, museum spatial Configuration and universal design, and other relevant paper analysis, so as to provide a practical theoretical basis for this paper. Through the prior research and analysis, the author has comprehensively considered the characteristics of the universal design, knowing the five evaluation elements of equality, convenience, security, information and cognition and accessibility.

Second, through the on-site investigation to take pictures of the public space at Busan Museum, the author has used the pictorial analysis technique to analyze the spatial Configuration and function. Through preliminary research and literature review, the author has selected the evaluation projects related to universal design, including the repetitive survey projects in each space, and conduct field surveys. Pictures of on-site investigations were taken on June 2, 2019 during on-site visit.

Third, the author has analyzed the current status of the universal design elements in Busan Museum.

## 2. Theoretical Investigation

### 2.1. Universal Design Concepts and Evaluation Literature Review Factors

The definition of the universal design was proposed by Professor Ronald L. Mace of the University of North Carolina in the 1980s, and the term "universal design" was officially used in 1985. He believes that universal design means that "any product or environmental space is designed to be as consistent as possible for everyone to use easily, regardless of the user's age, physical condition or capability."

It can be seen that the universal design is different from the barrier-free design. The core of the universal design is to expand the target group from the vulnerable groups such as the elderly, children, pregnant women, and the disabled to all groups of people, thus avoiding the vulnerable groups being treated differently and reflecting the "people-oriented" design objective, which enables everyone to equally participate in all social activities. The universal design is the development and sublimation of humanized design in the new era, reflecting the democratic concept of equality, no prejudice, no discrimination and respect for individual rights advocated by civilized society.

Table 1. Main Papers Concerned with the Universal Design

Title	Author	Years	Source
A Study on the Design of Convenience Facilities which considers the Feature of Universal Design	Park, Jung-Wook	2007	Kookmin University
A Study on Application of Universal design Principles to Cultural Centers in Local Areas	Oh, han-Ohk	2010	Korean Institute of Interior design
A Study on the Property of Universal Design in Pedestrian Space	Feng, li	2012	Sangmyung University
A study on universal design in public cultural facilities	Ha,Seung-A	2014	Hanyang University
Development of Evaluation Tool and Guidelines of Space Design for Applying the Concept of Universal Design	Oh, han-Ohk	2015	Korean Institute of Interior design
Study on the Universal Design for an exhibition space	Lee, Ji-eun	2016	Hanyang University
A study on the Universal Design in Cultural Center	Kwon, Bit-Na	2017	chonnam university

On the basis of the above-mentioned prior research, first, the author has considered the acceptable design in the Universal design 4 principles, the fair use in the Universal Design 7 principles, and the fair use in the PPP principle as the feature of acceptability. With the focus of Korean papers that study the evaluation characteristics of general design, the author has reorganized the evaluation elements of global design and selected the five evaluation elements of fairness, convenience, security, information and cognition, and accessibility on this basis. In the sub-study, the five evaluation elements of the universal design have been borrowed in order to analyze the design characteristics of the public space.

Table 2. Re-organization for the Evaluation Elements of Universal Design

Universal design 4 principles	Universal design 7 principles	PPP 9 principles	Recombination of evaluation elements of universal design
Adaptable Design	Equitable Use	Care for fair use	equality
	Flexibility in Use	Ensure flexibility in use	convenience
Supportive Design	Simple and Intuitive Use	Pursue simple and clear use	
	Low Physical Effort	Care for quality and aesthetics	
Safety-Oriented Design	Tolerance for Error	Care for health and environment	security
		Reduce body burden	
		Accept accident prevention and misuse	

-	Perceptible nformation	Informational care for all feelings	Information· cognition
Accessible Design	Size and Space for Approach and Use	Ensure easy-to-use space and conditions	accessibility

### 2.2. Museum Spatial Configuration and Function

The conceptual changes in the space and function of museums, which are ineligible for museum planning, stem from the cultural objects and human beings, that is, the relationship between museum, materials and museum staff, as well as the relationship between exhibits and the general public.

Table 3. Various Spatial Configuration of the Museum

Spatial Configuration	Function
Entry Area	Close to the exhibition area and ready to show the visit function.
Convenience Area	Serve as rest and leisure space with a variety of service functions.
Mobile Area	Have the function of moving horizontally or vertically.
Display Area	Include the general exhibition area and the auxiliary exhibition area, and enable the visitors to explore and participate in the exhibitions in the related fields.
Education Area	Have a variety of procedural functions, such as education and lectures, achieve all types of intellectual realizations, and connect to the mass media.
Collection and Storage Area	Serve as a space for managing collections and have functions of collection, storage, processing, maintenance, etc.
Research and Management Area	Take the exhibits as basis and carry out educational research activities and general affairs management for understanding various phenomena
Maintenance and Management Area	Have functions of maintenance, repair and operation management of buildings

### 2.2. Analysis of the previous studies about the Universal Design in the Museum Spatial Configuration

Table 4. Project Selection in the Museum Spatial Configuration

Project		Sub-project of Public Space in the the previous studies					Survey Project
		A	B	C	D	E	
Entry and Moving Space	Parking Space	●	●	●	●		●
	Main Entrance and Exit	●	●	●	●	●	●
	Horizontal Movement	●	●	●	●		●
	Vertical Movement	●	●	●	●	●	●
Exhibition Space	Exhibition Hall	●	●	●	●	●	●
	Video Display Hall	●	●	●	●	●	●
Educational Space	Information Service		●	●			●
	Experiential Learning Room	●	●				●
Service Space	Facility Guide	●	●	●	●	●	●
	Storage	●		●	●		●
	Lounge	●		●	●	●	●

Through the organization of the papers that study the spatial Configuration of public spaces, it is found that there are parking space, main entrance, and horizontal and vertical Moving Spaces in the entrance and Moving Space; there are facilities guide, storage service, lounge, drinking fountain stand and toilet in the service space; there are exhibit room and video display room in the display space; and there are experience room and information service room in the educational space.

Drinking Fountain Stand		●	●		●	●
Toilet	●	●	●	●	●	●

Explanatory notes : A.Bit-Na Kwon(2017) B.Ha,Seung-A(2014) C.Jean,So-yul(2015)  
D.Lee, Ji-eun (2016) E.Oh , Chan-Ohk(2015)

### 3. The Spatial Configuration and Exhibits Contents in Busan Museum

#### 3.1. Summary

The Busan Museum is a public museum operated by the Busan Metropolitan Municipality in the form of a public institution. It can be divided into a comprehensive museum and a historical museum that comprehensively displays the historical and cultural relics of Busan. Like most local museums, the Busan Museum makes use of local features to showcase local history and traditional culture. It aims to play the role of social education. It was opened on July 11, 1978, newly built and reopened in 2002 with the new look of the Busan Museum.

#### 3.2. Spatial Configuration and Exhibits

Master the parking space, main entrance, facility guide, storage, lounge, drinking fountain stand, toilet, exhibition room, image display, information service, horizontal and vertical movement and other information of the project.

Table 5. Analysis of spatial Configuration of Busan Museum

Spatial Configuration		Contents
Entry and Moving Space	Parking Space	The parking space is set in a small square outside the museum. There are parking spaces for bicycle, general vehicle and pregnant women. Some parking spaces for vehicles are occupied due to the lack of parking space for motorcycles.
	Main Entrance and Exit	Compared with the healthy or blind person, the wheelchair users may feel inconvenient because it is difficult for them to open and close the door.
	Horizontal Movement	There is a direction guide in the middle of the passageway, which is used to improve the affinity but fails to indicate the direction for the visually impaired.
	Vertical Movement	There is no Braille sign in the elevator internal/external operation buttons. The wheelchair users are difficult to turn around in the narrow elevator, which could only be loaded with no more than 2 people (low affinity).
Exhibition Space	Exhibition Hall	The protruding corners of the exhibit may cause a safety accident. The description of exhibits is not clear enough to convey the information.
	Video Display Hall	Enhances the viewer's interest in the exhibits with the provision of media presentations, so as to enhance the viewer's sensory (auditory, visual, etc.) experience and deepen the memory.
Educational Space	Information Service	There is a service desk at the entrance of every major public space, with the multi-language museum brochures and exhibition guide maps to facilitate people to understand the spatial arrangement.
	Experiential Learning Room	The Experiential Learning Room must be booked in advance. If you do not make an advance reservation, you cannot experience it in time.
Service Space	Facility Guide	The media on the main introduction facility is equipped with a Braille display panel and voice service. However, there are only simple text logos without Braille signs and voice prompts on other guide facilities.
	Storage	The storage cabinet is only placed at the main entrance of the museum, which could only be accessed through steps and inconvenient for the disabled. There is no guide for the storage service.

	Lounge	Although there is lounge in the exhibition space, it is inconvenient for wheelchair users and blind people to use due to the insufficient responsibility.
	Drinking Fountain Stand	The drinking fountain is only set at the main entrance of the museum, and the hot water is not available due to its damaged function.
	Toilet	The installation of automatic doors in disabled toilets improves the ease of use for the disabled users. The edge of the bathroom's sink is sharp and angular, and the blind can't see the arrangement of toilet, which may cause injury during touch.

### 3.3 Analysis on the Current Application of Universal Design in Busan Museum

Table 6. Analysis of the Current Status for Each Element of Universal Design

Project	Evaluation Elements of Universal Design				
	Equality	Convenience	Security	Information and Cognition	Accessibility
Entry and Moving Space					
	The entrance space is wide and easily accessed by the disabled people in wheelchairs.	The disabled parking lot is close to the main entrance with easy and quick access.	The lighting facilities are insufficient in the passageway, so people may be easily hurt in the dim space.	There is only button without texts or Braille signs in the elevator, which is inconvenient for the blind.	There is no ramp but only the stairs set in the entrance space, which is not easily accessed by the disabled.
Exhibition Space					
	The video display hall is set with seats for ordinary people. The surrounding open space is convenient for wheelchair users.	The overall viewing route of the exhibition space is planned reasonably, so that the visitors can conveniently visit the space instead of going through repeated route.	The counter of the exhibition hall is made of glass with clear edges. People are easily hurt during touch.	The description in the exhibition hall is presented in the form of both text and visual scene, which increases the methods for the viewers to obtain information.	The display stand and text description are far away from the glass partition, and it is not convenient for people to read the introduction materials of the exhibits.
Educational Space					
	The cultural experience of Korean suit needs to be reserved in advance, and the experience is only available for two people at a time.	The information desk is arranged with guide book in four languages to provide museum space information. And there are also service staff to provide assistance.	There is a partition leading to the inner place of the experience learning room, but it has a large interface with the ground and people are easily tripped over.	There are illustrations of experience project in the form of text and picture on the wall, so that people can easily know the operation steps.	The exhibition space could only be accessed with slippers, and it is difficult for disabled people with injuries in legs to experience here.
Service Space					

	<p>The storage room is only arranged in the main entrance of the entire museum, so it is almost impossible for the disabled unable to access through stairs to use.</p>	<p>The door of the special toilet for the disabled person is installed with electric induction equipment, so the disabled person who uses the wheelchair can easily enter the internal space.</p>	<p>The edge of the toilet sink is sharp and the user will get hurt during use.</p>	<p>The media facility with introduction function is equipped with Braille brochures and panels, as well as voice information.</p>	<p>The lounge is set with wooden long seat in three layers, which can provide a temporary learning space for teachers and students.</p>
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### 3.4. Summary



Fig.1 Entry and Moving Space

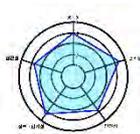


Fig.2 Exhibition Space

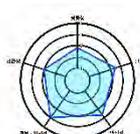


Fig.3 Educational Space

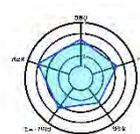


Fig.4 Service Space

For the current status of the public space in the Busan Museum, the five evaluation elements of the universal concept including equality, convenience, security, information cognition, and accessibility are taken as the basis to analyze the entry and Moving Space, display space, educational space, and service space etc. The results of this study are as follows.

First, entry and Moving Space: a variety of media applications are used to ensure various visitors safely and conveniently access the parking lot or related facilities. An effective flow line tour system should be established to minimize the visitor fatigue. And the lighting index of the Moving Space should be emphasized to prevent the injury to the viewer due to the poor line of sight.

Second, the exhibition space: effective display methods are adopted to respond to the behavior of different viewers, so as to easily understand and use the various information related to the exhibition, systematically plan the exhibition hall, rest and other facilities, and minimize visitors' physical fatigue.

Third, the educational space: the learning space and style should be taken into consideration so that all users can participate in various learning activities of the museum. For example, the tables and chairs which could become obstacles to wheelchair movement should be minimized, and the information media that can facilitate learning activities should be provided for the visually and audibly impacted people.

Fourth, the service space: the complexity and inconvenience of each public service-related space should be eliminated, so that visitors can safely and conveniently access and utilize the facilities associated with public services. For example, the height of toilet sink is not suitable for children, and the edge may cause injury to them.

### 4. Conclusion

The result shows that the elements of accessibility, convenience, information and cognition are the most widely used in the public space with universal design in Busan Museum. However, due to lack of safety and equality, the arrangement of a variety of public space should be developed and researched. That is, it is necessary to improve the safety and equality of the universal design.

This study is limited to the public space of the museum and investigates the current status of universal design. In the future research, on the basis of the understanding of the museum public space, it is necessary to understand the current situation of other functional spaces, evaluate the universal design conforming to various functions and characteristics, and propose a more specific and systematic universal design improvement plan for the environmental improvement.

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# A Study on Depth Perception and Method for Maximizing Immersive 3D Animated Dialogue Scenes

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## Abstract

Many previous researches on animation depth have focused on expressions for a sense of space through depth. Depth in animation is not only utilized for expressing sense of space but it also demonstrates animation's unique characteristics in combination with various camerawork and direction which are generally used in films. Varied direction through these differences in depth is particularly used better in 3D animations than live-action films. It has enabled direction exclusively for 3D animations beyond existing quasi live-action films and movie-like animations through freer camerawork with virtual camera and direction techniques within a program used to produce 3D animations. The purpose of this study is to find out about the use of depth of camera and screen in 3D animation development and to study the characteristic production of 3D animation obtained from the use of different depth by reproducing the scene.

**Keywords-** *3D Animation Camera Work, Depth Of Field, 3D MAYA, Cam*

## 1. Introduction

Recently 3D animation utilizes diverse expressions and direction to describe feelings and psychology even more realistic than live-action films and appeals to audience's psychological receptivity. While 3D animation featured more realistic direction in its rapid growth in 1990s, its directivity has sought improved receptivity of audience since 2000 through more natural scene direction.[1]

According to Arnheim, human's act to 'watch' does not merely mean perceiving something with eyes but thinking of what he perceived and then accepting it. In other words, human's watching something is not to perceive it as it appears to be but it is of different forms depending on one's cognitive ability and circumstances.[2]

As aforementioned, realistic expression is not received by recipients as it is but can be interpreted differently depending on a recipient's thinking, circumstances and experiences. Thus, 3D animation has also been improved with focus on how to direct it as realistically as possible and how naturally the audience would receive it. Since the movie 'Avatar' gained massive popularity, 3D animation movies have been produced with the focus on more realistic and vivid scenes but the audience was rather critical. Such directivity for development reduced fun of a film with overconcentration on visual aspects and it was attributed to unsatisfactory direction that could be solely applied to 3D animation.[3] It is not merely applied to visual direction but it also affects overall narrative development of a work. The same goes for the depth, an existing technique used to create a sense of space.

Depth of field refers to as a range of focuses formed within a certain distance from a subject's front and back when focusing on the subject using a photographic lens. It is to technically realize the phenomenon that when a man concentrates visual perception on a subject, surroundings of that subject are blurred. Depth not only enables more realistic sense of space but also facilitates direction as if human eyes were actually looking and has been utilized in fields of visual media such as photography, image, etc. This is used in the aspect of various production dialogues where more than two people appear in the animation, and the change of focus is very meaningful as a study to increase the immersion feeling in the viewpoint of the viewer who perceives the actual story due to the effect that the screen adds depth feeling. In terms of functional and technical aspects of depth representation, Z-depth (Z-Depth), which is one of the features of 3D animation, has become more expressive, and deeper studies have been conducted on the depth of scene synthesis.

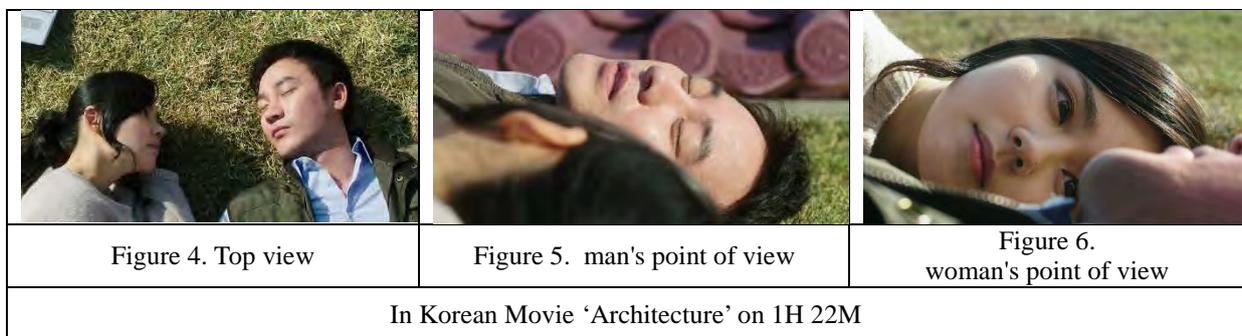
As Z axis, one of 3D animation features, becomes expressible, more profound researches have been conducted upon depth.

This research is to examine methods for directing depth used as narrative expressions beyond mere formation of sense of space by utilizing depth in 3D animation. In addition, various reproductions using the depths used in film are reproduced by using the camera of AUTODESK MAYA, a 3D animation production program. Through this, the depth expression of only 3D animation is studied.

## 2. Related Researchers

According to a study on audience's emotional receptivity depending on depth difference[4], it is found that each viewer had different preferences for emotional words with depth difference. It is also found that emotions of each recipient vary with depth difference.

It suggests that depth difference can be utilized for narrative purposes beyond its mere depiction for sense of space. In a representative case of a dialogue scene directed through 'over the shoulder,' changed depth even with a fixed camera can alter audience's focus. 3D animation also utilizes direction applied to existing films this way. In addition to changed depth, direction with camerawork and positioning can create various depths as intended by a director.[4]

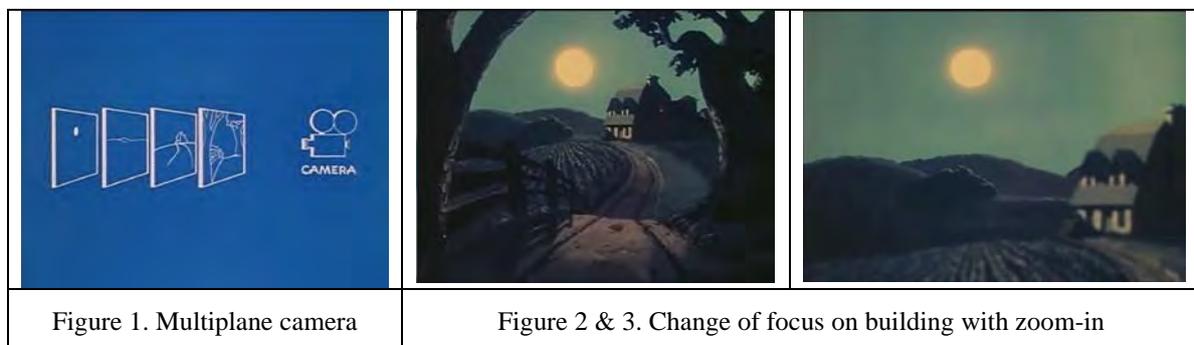


### 2.1. Direction utilizing depth in animation

Methods applied for 3D effect in existing 2D animations include image overlapping and utilization of colors, lights and darks.[1] With the change on production method into 3D animation, however, a new notion of Z axis(Z-Depth) has become available, which facilitates freer direction of animation with virtual camera and consequently makes animation more solid and absorbing.

#### 2.1.1. Case of creating sense of space in 2D animation using depth

2D animation created sense of space in different ways. To take a typical example, Disney has utilized sense of space with a multiplane camera.[5] Multiple planes are placed on equipment demonstrated in Figure 1 below at a certain distance and a camera shots these planes to create sense of space. While the camera zooms in the background of the plane furthest from the camera, the focus on plane closest to the camera naturally blurs and it creates sense of space as in a film. (Figure 2, 3)



Other than this, there have been numerous efforts to create sense of space in 2D animations like adjusting background color and chroma to give perspective on a scene. In spite of these efforts, however, there were limits to express natural perspective as in a live-action film and many difficulties for narrative utilization.

### 2.1.2. Direction using depth in 3D animation

With the advent of digital animation production, 3D animation programs have been utilized, which has brought about significant changes. The first is availability of Z axis(Z-Depth). It is 3D animation’s unique feature that becomes available with depth adjustment function.

This feature enables to create much more realistic depth in 3D animation compared to that of existing 2D animation. In addition, virtual camera also facilitates camerawork and framing freer than live-action film. With these aspects, multiple limitations in live action (financial and technical limits including lens, auxiliary camera equipment) are overcome and direction can be done in a very free way.[7][8]

First of all, depth is adjusted differently for the front, middle, back and distant views, which makes it possible to utilize cinematic direction. Furthermore, even camerawork with numerous limitations in real-world setting can be done much more easily in virtual space, which now exclusively features 3D animations.

However, 3D animation camera also has shortcomings. Focuses in a film are naturally formed with different lenses but it is necessary to set focus depths one by one in 3D animation. These drawbacks cause to take much labor for direction utilizing depth in 3D animation than in film direction.

### 2.2. Depth of film production

The expression using the depth of the film not only expresses the depth feeling but also allows the viewer to naturally transfer to the character in the movie more naturally while giving the identification due to the natural depth processing of the lens. The picture below is a scene of the movie 'Architecture'. This scene shows two character as a whole, then switches the camera to the point of view of the two character and induces the audience to naturally identify with the characters.

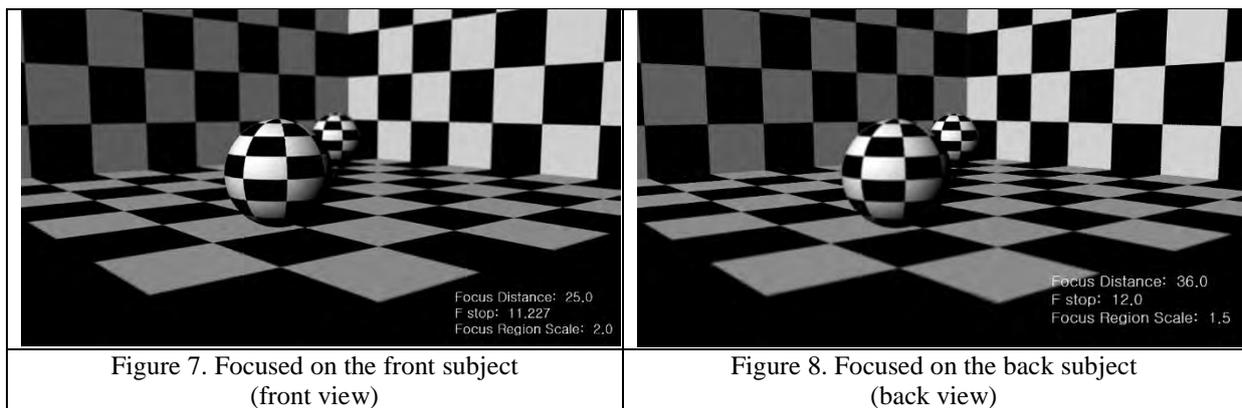
In this way, the depth of the film and camera walking are not only a sense of space but also the emotions of the characters, and also serve as a more narrative direction. [10]

## 3. Depth direction utilizing 3D MAYA

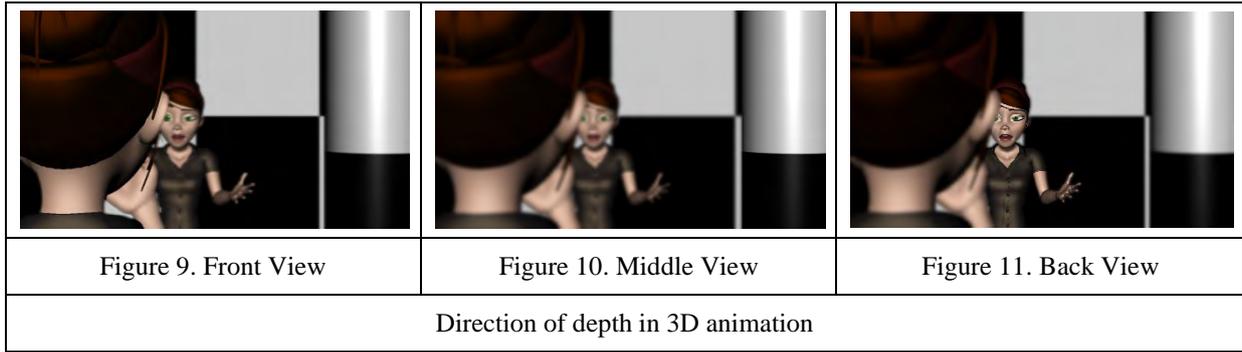
Using AUTODESK MAYA, the most widely used program for 3D animation, this study attempts to express depth of 3D animation; examine changes with different depths and; realize those changes. Thus, this study places more than two subjects abreast on a field premade, sets camera angle and utilizes depth of field function supported by MAYA. Camera direction such as facing each other and standing side by side does not have any difference in Z axis between the two subjects and consequently, depth adjustment is not meaningful in these cases.

Thus, this study applies a so-called ‘over the shoulder,’ one of camera techniques that is often used when multiple subjects speak to one another face to face in order to compare differences in adjusting depth of field with a fixed camera and a moving one.

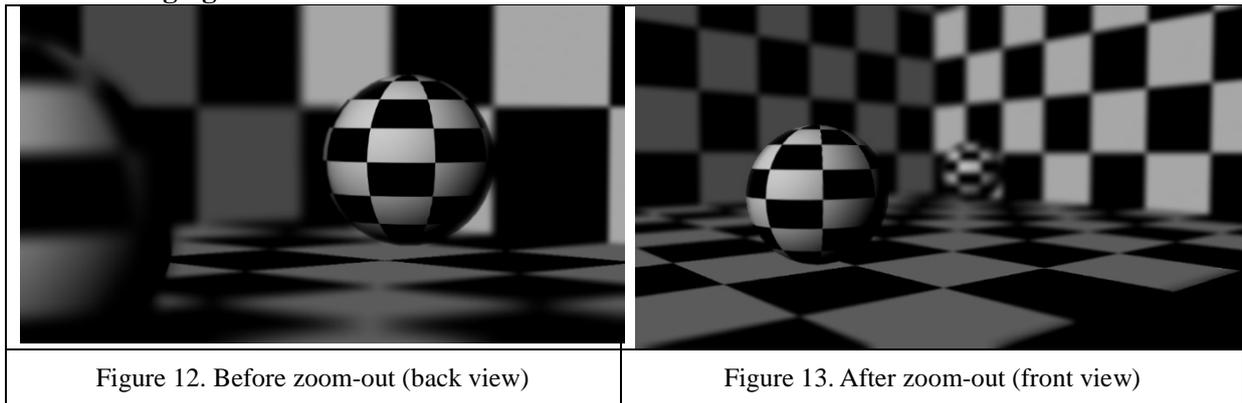
### 3.1. Direction of depth in 3D animation with fixed camera



When giving different depths to two subjects while camera focuses on the front and the distant view, the difference can be easily made by solely using ‘depth of field’ function within Attribute Editor of camera shape. Focal distance can be adjusted with ‘Focus Distance’ value; ‘F stop’ value for aperture and; ‘Focus Region Scale’ for focal area. For shots with a fixed camera, adjusting a few values alone can create focuses and depths as necessary.



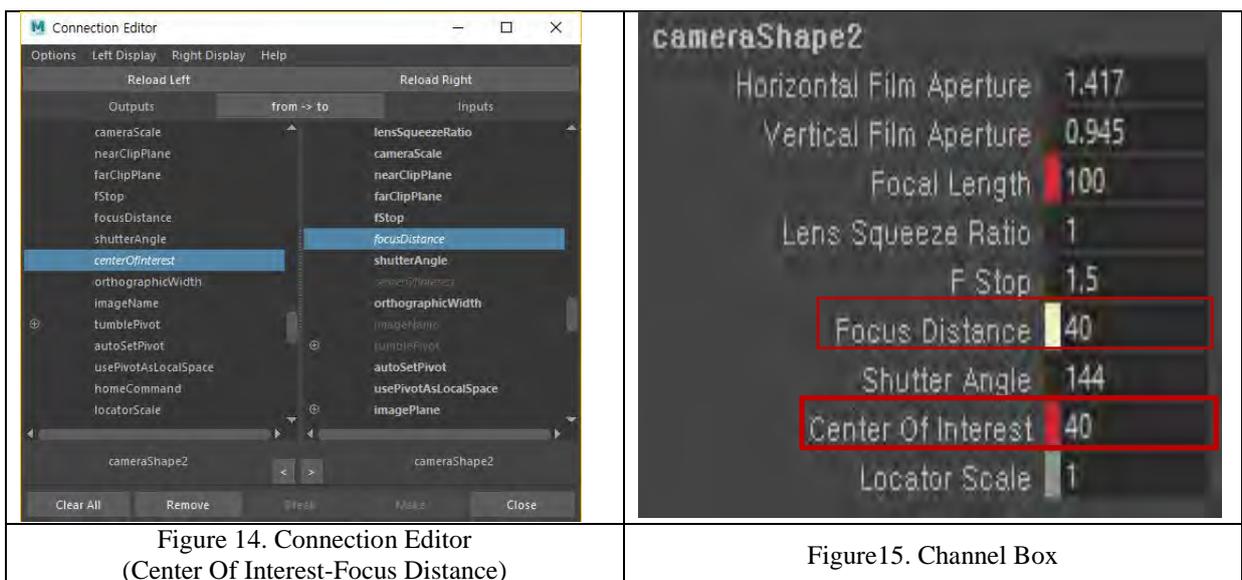
### 3.1.1. Changing focal distance with zoom-out



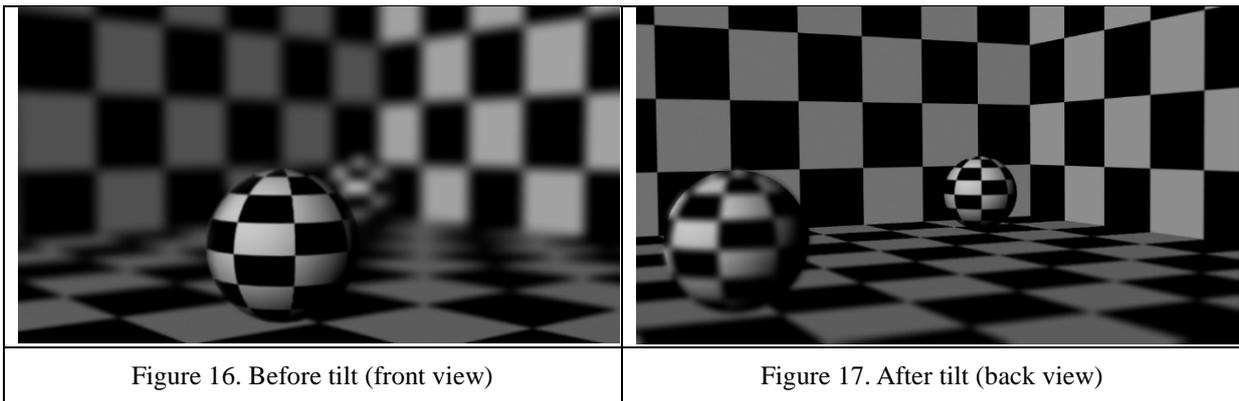
This study attempts zoom-out-like effect by adjusting Focal length value while the camera is fixed. As it is to actually change the camera’s focal distance along with wider view angle, it is different from zoom-out done by moving a camera.

### 3.2. Direction of depth in 3D animation on moving camera

While camera is moving, focal coordinate is also moving along with the camera’s coordinate and thus, it is hard to focus on a subject. This study connects ‘center of interest’ and ‘focus distance’ using Connection Editor to make the focal center and focal distant fit and facilitate depth adjustment and then attempts to focus yet again. In the picture below, you will see a yellow box in front of Focus Distance. This indicates that the ‘Focus Distance’ is connected somewhere and that it is well connected to the current ‘center of interest’.



### 3.2.1. Changing focal distance while tilting camera



Changing focuses while tilting two subjects, this study makes a shot as if two subjects are confronted. This shot can draw the audience's attention more to B as the viewpoint is changed from the front view to the back view.

## 4. Conclusion

This study has examined depth expression and its realization in 3D animation including how to utilize depth in 3D animation with AUTODESK MAYA's camera and to realize narrative direction in 3D animation through depth adjustment used in conventional camerawork. It is found that these techniques enable direction freer than live action in combination with positioning and camerawork. Most of direction is based on classic techniques of film direction. Future animation should seek its development toward direction beyond the classical techniques through researches on 3D animation's own camera, depth and direction. Hopefully, this study will be able to contribute to development of 3D animation directing.

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# A design an educational data mining framework for kindergarten free choice activities

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## Abstract

Educational Data Mining(EDM) is a discipline where you develop a way to better understand students by analyzing large amounts of data generated in an educational environment. In this paper, we propose a platform to support personalized learning for young children by analyzing the data that can be produced through free choice activities in kindergarten. The proposed platform utilizes smart devices to collect data produced by children's play planning, performance and evaluation, and to store data through the cloud system.

***Keywords; Educational Data Mining(EDM), Free choice activites, Cloud System***

## 1. Introduction

Data mining is the process of discovering useful information from machine learning, statistics and database systems on a large scale of data[1]. Data mining has been applied to a variety of fields, and in recent years there has been increasing interest in the field of training data mining, which allows students to better understand the data generated in the educational environment. Educational Data Mining(EDM) is a discipline where you develop a way to better understand students by analyzing large amounts of data generated in an educational environment[2].

In Korea, the kindergarten curriculum runs four to five hours a day. Free choice activities are running more than an hour a day[3]. The free choice activity is a curriculum that allows children to choose play, build and implement a play plan, and then evaluate the experience. Observations of individual children during free choice activity hours are important information on children developmental level, intimacy with peers, and social skills[4]. However, in the present educational field, only the clinical observation of the teacher is used to analyze the play form and activity of the children. In the present kindergarten education field where the ratio of teacher to children is high, there is a limit to objectively and precisely grasp the activity patterns of all the individual children in the class. Therefore, there is a need for a platform that can obtain and analyze objective and quantitative data on children activities during free choice time.

We propose a platform to perform educational data mining by collecting educational activity analysis data for free choice activity operation. Through the proposed platform, it is possible to utilize the teachers so that they can grasp the characteristics of individual children 's activities.

## 2. System Model

### 2.1. Traditional free choice activities

Figure 1 is an activity paper for the current Free Choice activities. The children individually write their plans and assessments on the activity paper. Each week, paper-type activities are provided. It is necessary to spend a lot of time and effort to create activity statistics for individual children in paper form.



Fig. 1 Traditional free choice activities

## 2.2. Proposed free choice activities

Figure 2 shows the system diagram. Figure 2 shows the system diagram. When the teacher runs the Free Choice Activity(FCA) app, the apps that are in the cloud run on tabs that are mobile devices. After school, the children plan their activity area in the FCA app.

Children actually play in the planned activity area. The children perform the evaluation in the FCA app for the planned play area. FCA app allow children to plan and evaluate what is stored on the cloud. The teacher analyzes the data collected on the cloud and uses it as a consultation with parents.

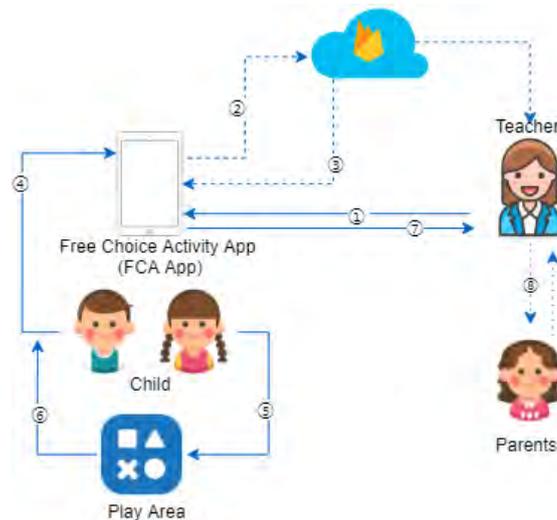


Fig. 2 System Diagram

Figure 3 is a detailed flowchart of the FCA app. The data collected through the FCA app allows the teacher to easily identify the state of the children at any time. The FCA app has the following features.

- It is easy to understand the characteristics of each child's activities. It is easy to understand the interest and interest of children and the advantages of children.
- The characteristics of individual children can be grasped and utilized as support materials for educational counseling with parents.
- It is possible to provide educational feedback to identify problems and complementary points in the classroom 's educational environment by identifying characteristics of play activities of young children.
- Using media to plan and evaluate free choice activities can stimulate interest and interest in children 's free choice activities.

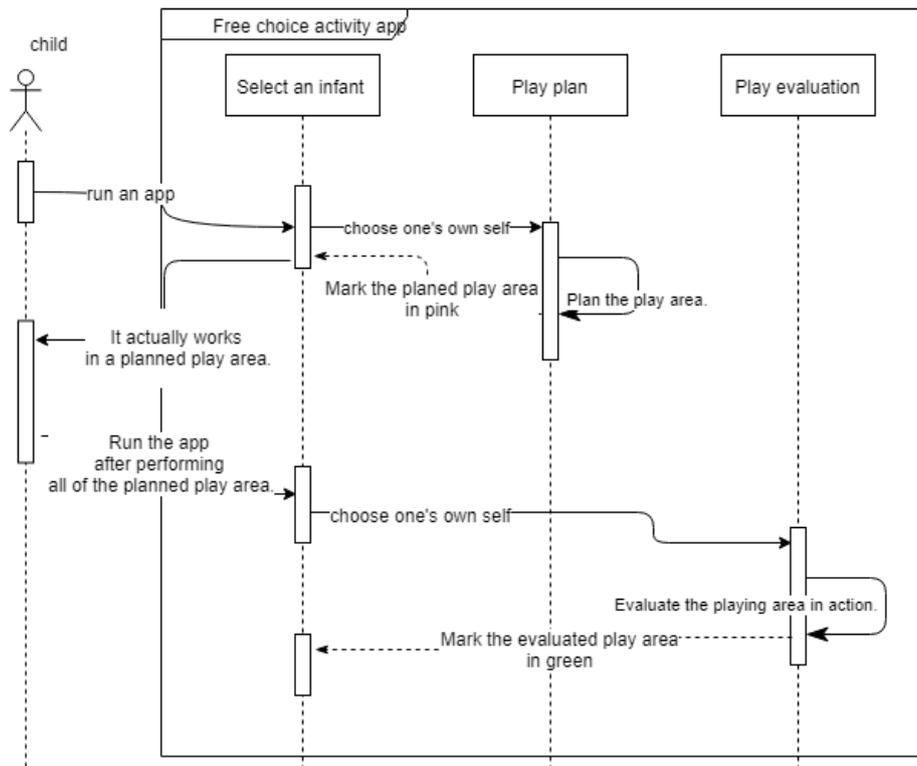


Fig. 3 FCA app

### 3. Conclusion

In this paper, we proposed a platform to analyze play activities of young children. The proposed platform generates data that can be analyzed by training data mining technique. It will be practically useful data that will enable low-skilled teachers to understand the child and can be used as a consultation with parents. Also, it is also expected to be used as an educational environment improvement data.

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# S4AI: Block-based AI Coding

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## Abstract

Along with the development in artificial intelligence (AI), AI in coding education has become particularly important. However, there are few AI platforms or tools for teaching in the field of education and the lack of teaching tools will hinder the way to carry out early education of AI. The challenge that this study attempts to address is to provide teenagers with a tool to get to the AI field as early as possible to understand the concept of AI. The remedy for this problem is to develop a Scratch-based coding education tool that combines speech synthesis, speech recognition and object detection in the field of AI.

**Keywords:** *Artificial Intelligence; Scratch; Education*

## 1. Introduction

According to Technavio's latest market research report, the AI market in the US education industry is expected to grow at a compound annual rate of nearly 48% during the 2018-2022 period [1]. Therefore, people should realize the importance of the combination of AI and education and actively carry out early education of AI. At this time, the platform or tool for AI education is essential. However, AI technology is relatively rare in coding education and there is no suitable tool and educational environment. In this paper, we will introduce a tool based on Scratch combined with AI technology - S4AI. Its most prominent feature is to provide users with a set of programming instructions composed of the building block system. Users can learn to program and get in touch with the AI domain without a programming language foundation.

## 2. Related Works

Blockly is a graphical programming language designed to teach beginners how to code. With its visual blocks, people can learn coding concepts without using complex syntax. Blockly is open source and can export code. Users can export block-based programming to common language programming, adjusting Blockly to suit needs by adding custom blocks to the API or removing unwanted blocks and functions. So, the S4AI we mentioned in this paper is designed with Blockly as the programming environment.

Scratch is a visual programming language and online platform that allows young learners to create their own programs, interactive stories, games, and animations. For beginners, Scratch has very low learning and usage threshold and is a very successful teaching tool. Now the children's programming Scratch software is popular in various countries, according to the understanding that more than a million children in the United States have learned Scratch.

Artificial Intelligence (AI) refers to a broad field of science encompassing not only computer science but also psychology, philosophy, linguistics and other areas [2]. Machines with cognitive functions such as perception, learning, reasoning and problem solving are considered to be AI. The main AI technologies used in teenager education are speech synthesis, speech recognition and object detection.

The idea of an AI course for children goes back to the Logo's early days. After decades of efforts, AI technology provides a smarter tool for teaching, thereby improving teaching effectiveness. Moreover, some

artificial intelligence platforms or tools bring a new experience of intelligent learning to learners. For example the Machine Learning for Kids website, eCraft2Learn and Google AIY Project.

### 3. S4AI Design and Implementation

We use Blockly as the programming environment to integrate Blockly as a code editor into HTML and JavaScript-based web applications, and add Scratch 3.0-based AI function blocks to design the programming activity platform - S4AI. Speech synthesis, speech recognition and object detection in AI function blocks are the core functions of the S4AI block.

#### 3.1. Speech Synthesis

Speech synthesis is the technology involved in converting written text into audible human speech. The Speech Synthesis API is supported by all popular browsers. As shown in Fig. 1, we referenced the ResponsiveVoice API and created speech synthesis blocks in S4AI.

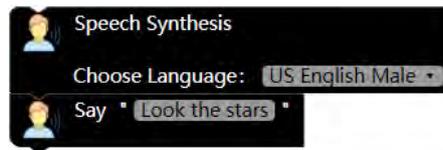


Fig. 1 Speech Synthesis Blocks

#### 3.2 Speech Recognition

Speech recognition technology is a high technology that enables machines to convert speech signals into corresponding texts or commands through the process of recognition and understanding. In Fig. 2 and Fig .3, this block will allow the user to enter what they want to say, and then authorize the page request to turn on the microphone and the user to start speaking. Once the user stops talking, the computer returns the captured audio as a JavaScript object. If the computer receives the "Please go move" command, the kitten will move two hundred steps to the left.



Fig. 2 Speech Recognition Blocks

#### 3.3. Object Detection

Object detection not only recognizes the existing objects on a given image and gives their category, but also needs to give their locations through bounding boxes. In S4AI, we reference the YOLO algorithm for real-time object detection. YOLO has the characteristics of high precision and fast detection, which can be applied to real-time object detection. YOLO algorithm can divide the picture into different regions, then give the boundary prediction and the probability of each region, and assign weights to all boundaries according to the probability as shown in Fig . 3[3].



Fig. 3 Object Detection with YOLO



Fig. 4 Simple Object Detection Experiment

As shown in Fig. 4, real-time object detection is carried out immediately by starting the camera, and the class name, boundary box and recognition rate used to identify the image are given. If the object in the image is recognized at the same rate as that in the block, the computer will automatically say what is entered

#### 4. Conclusion

The application of artificial intelligence technology in education has become a trend. As an educational tool with AI function, S4AI can help young students to access the field of artificial intelligence and receive early education of AI. We hope to bring the ever-improving S4AI into the classroom so that more students can experience the charm of artificial intelligence in practice.

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# Secure Payment Mechanism Based on Blockchain for Fueling Vehicles in Smart City

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## Abstract

The recent advancement in information technology, and interest in intensifying the smart city, various technologies companies, car manufacturers have introduced numerous features for improving user's privacy and comfort. The emerging of blockchain technology, such as smart contract, introduced a new interface that provides secure, append-only communication for machine-to-machine application without a central administrator. In this paper, we proposed a blockchain based secure payment mechanism for refueling gasoline in smart vehicles. The design platform is capable of storing records related to payment transaction, car management, and gasoline pump. By using smart contract, we effectively address the issue of transparency, trust, and longevity in IoT based application.

**Keywords-Internet of Things; Blockchain; Machine-to-Machine; Vehicles Fueling; Smart Contract; Secure Payment**

## 1. Introduction

The emerging IoT technology plays a vital role in enhancing the lifestyle of users in a various field of life, i.e., healthcare, transport, and business etc. The IoT devices are harnessed to connect the user with provided services around the world through the Internet. According to Cisco and Ericsson, it has been

predicted 100 billion IoT devices by 2020. With the increasing scale and complexity of the IoT devices, the security and privacy monitoring task of the IoT has become more and more difficult.

Nowadays the IoT application depend on machine-to-machine communication that doesn't required human intervention in order to automate the tasks, commit transaction, and distribute information. However, there are many shortcomings in these application (e.g., banking, eCommerce, localization, and motoring systems etc.) in terms of user privacy, trust, longevity. Many systems have been developed in order to overcomes these problems using different blockchain technologies (e.g., ethereum, bitcoins, and hyperledger fabric etc.).

In this paper, we present a blockchain-based payment mechanism for fueling gasoline in smart vehicles in which user information, along with bank details, and smart vehicle information, e.g., gasoline consumption, etc., are stored and shared efficiently in a secured permissioned chain of network across different franchises of gasoline pump. The rest of the paper is divided into 5 part, which follows: Section 2 explained the state-of-art related work on payment mechanism for fueling smart vehicles. And section 3 concludes the paper.

## 2. Methodology

In this section we discussed the detailed of how refueling is achieved while securing the user's information. With the smart payment mechanism smart contract system, a car user is able to transfer refueling information to a supplier (i.e., smart pump) and agree on preliminary amount of gasoline and pricing. The data are used to assign technical tasks to the pump manager at the smart pump, enabling car driver to request necessary volume of gasoline directly from operator. An online application gets sent to the car user's bank to reserve the necessary funds, then the refueling process commences. Follow-up financial reports detailing the refueling application are then sent to commercial services department of both the fuel supplier (i.e., smart pump) and car user. Smart contracts significantly increase the speed of the financial transactions and reduce the labor costs for both airlines and suppliers. They enable car user to carry out immediate payment processing directly at the time of refueling without bank guarantees, mitigating financial risks of all parties.

### 3. Conclusion

In this paper, we propose a novel blockchain-based payment mechanism for secure payment of gasoline in smart vehicle. In order to provide the secure payment transaction for refueling we have used smart contract. The proposed system is a proof-of-concept application that keep track of individual payment record of refueling using blockchain technology in a decentralized way.

### Acknowledgment

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# Design of Binary Visualization for Malware Classification

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## Abstract

Recently, as the Internet has become more popular, our lives have become convenient, but side effects have arisen due to DDoS attacks, personal information leakage, and hacking. Most side effects are caused by malware. Therefore, it is important to classify malware correctly and quickly. As a result, there is an increasing tendency to classify malware by images from malware binary file. This paper compares the results of RGB and CMYK image generation.

**Keywords:** *malware classification, feature extraction, rgb, cmyk, image generation*

## 1. Introduction

Recently, Artificial intelligence technologies such as Deep Learning and Machine Learning are receiving a lot of attention. As the Internet becomes more popular and the number of variants of malware increases very rapidly, various methods are being studied for malicious code classification. According to Symantec report [3], the number of variants of malware increased by 36% from 317 million in 2014 to 431 million in 2015. The number of variants increases, but according to Sonic Wall report [4], the number of malwares collected decreased 6.25% from 64 million to 60 million. The number of types of malware is decreasing, but variants of malware are increasing. So accurate classification of malware is becoming more important. Classification of malware is basically based on similarity of malware. Malware in the same family have a high degree of similarity because they have similar characteristics of the library and compiler used. In particular, the reuse of libraries and functions has a high degree of similarity between binary. Therefore, by applying deep learning to the information security field, we should respond to cyber-attacks and prepare for attacks by detecting or classifying malware.

In this method, there is a way to learn the unique patterns or signatures of malware and detect malware based on signatures [2]. It creates malware into image file and extracts features. Usually, RGB is used a lot when creating binary file from malware as an image. Based on previously extracted feature data, it is trained using the deep learning model. It trains the deep learning model using features of different malicious codes and then determines whether the detection target is malicious or not. If it is a malware, it will classify the family of malware [2].

However, malware creators are disabling signature-based malware detection techniques by converting it into data using packing. Despite the development of commercial vaccines, damage from malware is continuously increasing. Therefore, there is a need for a method to accurately detect and respond to malware. This paper compares the RGB image, which is often used for features that classify malware, and the new method, CMYK image.

## 2. Relevant Research

### 2.1. Malware detection method

The existing approach to the analysis of malware begins with the configuration of signatures through binary signature extraction in malware. Static analysis breaks down code and explores the control flow of executable file to detect malware patterns. On the other hand, dynamic analysis is mainly operated by executing binary code in virtual environment. An action report is generated that characterizes the executable based on the execution trace [9,10].

Machine learning based malware detection is to learn learning models from normal files and malware, and then to detect malware with learned models. In the learning phase, the learning model is optimized for malware detection by learning feature information (strings, commands, byte information, etc.) and labels(normal/malware) of files [2].

## 2.2. Malware image

Traditional classification techniques require the decomposition or execution of malware, but the image classification method does not require anything. Using malware binary as an image will improve the accuracy of classification in terms of performance. It is said that it is most appropriate to visualize malware byte codes as grayscale images. Also, many malware families and variant family families are said to have very similar images in the layout and texture, belonging to the same family.

## 2.3. Explanation of other papers

In the paper 'Malware analysis method using visualization of binary files [5]', in the malware binary, each byte was converted into one pixel of an 8-bit-gray-scale image to generate feature information. The generated image feature information is applied to CNN(Convolutional neural network) which is a deep learning algorithm used for image recognition to classify malware.

'Visualized Malware Classification Based-on Coevolutionary Neural Network [6]' converted each byte in malware binary into one pixel of an 8-bit gray-scale image in the same ways [5] to generate image feature information. Malware were classified by applying GIST feature analysis used for image character recognition to image feature information.

The proposed studies use RGB to generate images. In contrast, this study attempts to compare images generated with RGB and CMYK.

## 3. Binary Visualization

### 3.1. RGB, CMYK Difference

In order to create an image, there are some color modes of the image that must be set when creating a new file. The RGB color model is an additive color model in which red, green and blue light are added together in various ways to reproduce a broad array of colors [7]. The name of the RGB comes from the initials of the three additive primary colors, red, green, and blue. The CMYK color model is a subtractive color model, based on the CMY color model, used in color printing, and is also used to describe the printing process itself [8]. The name of the CMYK comes from the initials of the four inks that used in some color printing, cyan, magenta, yellow, and black.

RGB is an additive mixture method, and the more colors are added, the brighter the color. In contrast to RGB, CMYK becomes darker as colors get mixed. The advantage of RGB color is that colors are expressed more brighter than CMYK, and more colors can be expressed.

### 3.2. Description of extracted image

To generate images for malware binary, pillow image library was used. The image generated by the type of files are shown below. Fig1 was generated using RGB, and Fig2 was generated using CMYK. The files used for imaging are text(txt), uncompressed audio(wav), video(mp4), and encrypted compressed file(zip) form the left.

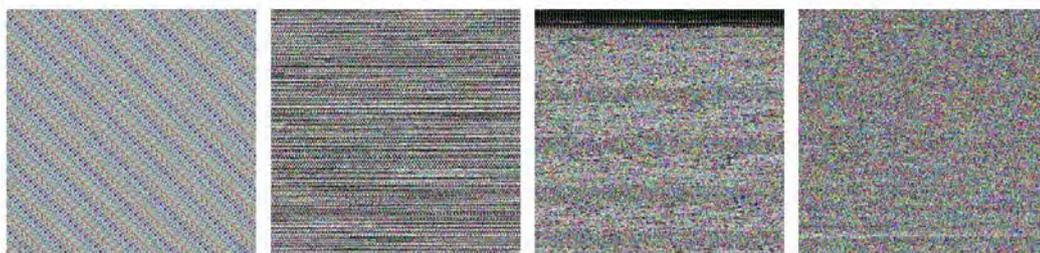


Fig. 1 Binary visualization results by file type using RGB.

We can see the significant differences depending on the type of file through Fig1 and Fig2. You can also see that the image files generated by RGB and CMYK are different. You can see that the file generated with CMYK is more clearly visible to the naked eye. Fig3 show that if you have same type of file, you can see similar images. This means that malware imaging can be used to classify malware into families.

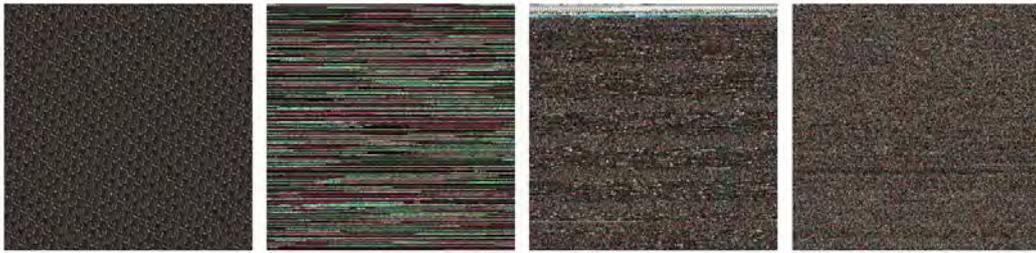


Fig. 2 Binary visualization results by file type using CMYK.



Fig. 3 Binary visualization results by wav file using CMYK.

#### 4. Conclusion

This paper suggest that we try to use CMYK image generation method as a feature instead of RGB image generation method for malware classification using malware visualization and machine learning. In related research, the method of classification of image-based malware are being studied, but additional processes are required to learn new malware or to extract feature points. Visual comparison of images generated by CMYK was clearer than those created by RGB. Through this, image generation through CMYK can increase efficiency of malware analysis. Feature extraction through image visualization becomes more important as deep learning is applied to the information security filed. If more accurate features are found, the accuracy and detection rate of malware detection will evolve.

#### Acknowledgment

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# Network Intrusion Detection using Machine Learning Techniques

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## Abstract

Machine learning is becoming a prevalent technology for information security. Traditional security solutions that employ rule-based detection algorithms are no longer enough to detect advanced attacks. Attackers are getting smarter and incapacitate security solutions by exploiting unknown vulnerabilities. It is very challenging to develop advanced solutions for attacks with unpredictable or unexpected patterns. Employing machine learning techniques, we can detect various attacks based on mathematical and statistical models. We employ machine learning techniques for intrusion detection. We train an intrusion dataset using three different types of Naive Bayes classifiers and then evaluate their performances. Furthermore, we find out important features that are highly relevant to network intrusion.

**Keywords-***Intrusion Detection; Machine Learning; Naïve Bayes classifier; KDD cup 1999*

## 1. Introduction

Zero-day attacks and advance persistent threats (APT) are well-known attacks as sophisticated and advanced attacks. Attackers are getting smarter and exploit unknown vulnerabilities. It is challenging to predict behaviors of advanced attacks due to unexpected patterns. Machine learning is becoming a prevalent way of modeling security techniques based on statistical and mathematical algorithms rather than rule-based algorithms. We employ machine learning techniques to detect network intrusion. We use KDD cup 1999(KDD)[1], the most widely used dataset for the evaluation of intrusion detection systems(IDS). We train KDD using several types of Naïve Bayes classifiers and then evaluate their accuracies. In addition, we analyze the dataset using a Random Forest classifier to find out important features in intrusion detection. The remainder of this paper is organized as follows. We train KDD using Naïve Bayes classifiers and evaluate the machine learning models in Section 2. Section 3 derives the important features based on the Random Forest algorithm. Finally, the conclusion is in Section 4.

## 2. Training and testing KDD cup 1999

KDD is a dataset published by Defense Advanced Research Projects Agency(DARPA) and is used for IDS evaluation. KDD consists of 41 network parameters including duration, type of protocols and the number of bytes coming into a destination server. KDD also provides 36 types of labeled attacks such as Neptune, Smurf, and Satan. We use 10 percent of KDD dataset (total 494,021 number of data) and divide the dataset into two categories, 'normal' and 'attack.' We train the dataset using three types of Naïve Bayes classifiers, a Gaussian Naïve Bayes classifier, Bernoulli Naïve Bayes classifier, and Multinomial Naïve Bayes classifier. Table 1 shows our experimental results.

Table 1. Experimental results of three different types of a Naïve Bayes classifier

Classifiers	Gaussian Naïve Bayes	Bernoulli Naïve Bayes	Multinomial Naïve Bayes
Accuracy	0.92	0.98	0.96
Cross validation mean score	0.98	0.98	0.92
F1-score (normal)	0.95	0.99	0.97
F1-score (attack)	0.83	0.95	0.88

Table 1 shows that the Bernoulli Naïve Bayes classifier has the highest performance in all aspects. The performance of Multinomial Naïve Bayes is the next.

### 3. Analysis of Important Features

In order to find out important features among 41 network parameters of KDD, we train and evaluate the dataset using a Random Forest classifier. Fig. 1 shows one of our experimental results. We repeat the experiment 10 times in order to get more accurate results. Based on the average value of the results, the size of downloaded data(*dst\_bytes*), the size of transferred data from source(*src\_bytes*), and the status of login(*logged\_in*) are the top three most important features in classifying ‘normal’ and ‘attack.’ In addition, the number of connections to the same host destination(*count*), the number of connections having the same destination IP address(*dst\_host\_count*), and the number of connections to the same destination port(*srv\_count*) are the next important features.

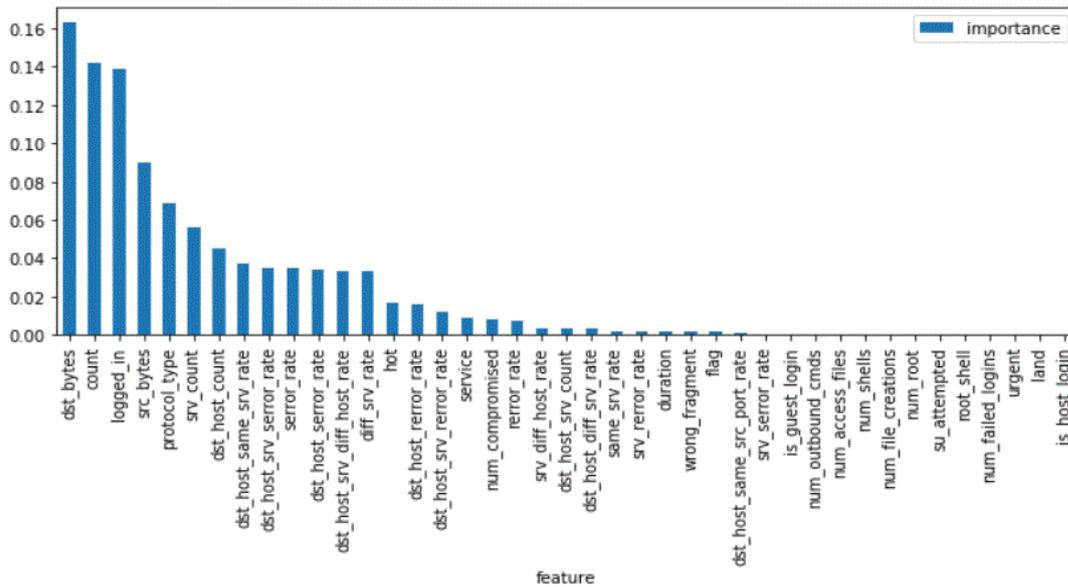


Fig. 1 One of experimental results of analyzing important features based on Random Forest

### 4. Conclusion

We employ machine learning techniques to analyze KDD cup 1999 dataset which is one of the most widely used dataset for intrusion detection. We have trained more than 490,000 number of data using three different types of Naïve Bayes classifiers and then evaluated their performances. The experimental results show that a Bernoulli Naïve Bayes classifier has the higher performance than that of Gaussian Naïve Bayes and Multinomial Naïve Bayes. Furthermore, we have derived ‘*dst\_bytes*’, ‘*count*’, and ‘*logged\_in*’ as the most important features based on a Random Forest algorithm. As future work, further experiments with various intrusion datasets as well as machine learning algorithms will be addressed.

### Acknowledgment

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# A Study on speech recognition based on stereo files using MFCC

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## Abstract

In this paper, we introduce how to recognize a person's voice in a wav file and predict a person's position. The voice of a person recorded in different locations is selected by angle and taught by artificial intelligence. We use the recorded wav file via stereo microphones and first determine if there is a human voice. If a voice is recognized, we extract the characteristics of the wav file using MFCC and then use the logistic regression model to predict the angle at which the voice is heard.

*Keywords-component; MFCC, AI, WAV and speech recognition*

## 1. Introduction

MFCC (Mel Frequency Central Cooperative) is the most widely used feature value for speech and music recognition. [2] It divides the input sound into several frames and then extracts the feature of the sound to that frame. Therefore, we can distinguish sound files by type by comparing feature using MFCC. We extract MFCC values from sound files recorded in various locations and then use AI technology to learn them. And we introduce how to find out what angle a particular music file was recorded. Using the logistic regression model, we predict the angle. [3]

## 2. WAV file speech recognition

### 2.1. Dataset

WAV(Waveform Audio File Format) is the most commonly used sound file type in Windows. we used 50 wav files in this project. We used stereo microphones for these files and recorded a person's voice(Korean) with noise at four different angles: 0°, 60°, 120°, and 180°. These sound files are 16 bit, Stereo type, and all have different file sizes. 16 bit means bits per sample, which are transmitted by two bytes, and stereo means 2 channels in sound files, and when used earphones, the sound on the left and right is played differently.

### 2.2. Speech recognition

We used IBM's speech to text API, which is supported in Korean, to distinguish whether there is a human voice in the file. [4][6] The prepared dataset is recorded in Korean and is a 16KHz Broadband model, so it changed the API settings correctly. If we insert a sound file using curl command, we can get the results in json format. The results include the probability that the voice would have been correctly predicted and the predicted sentence. If there are a lot of noise in the sound file, it is difficult to recognize the voice well. So we use python to remove the noise. [5] In this project, we only need to know whether the file has a voice or not. Therefore, we only checked for results regardless of the expected sentence.

### 2.3. Voice direction detection

The voice direction is divided into four angles: 0°, 60°, 120°, and 180°. Dataset are stereo type that can only be distinguished from left to right, so we do not distinguish front-to-back, such as 240° and 300°. A file recorded at 0° is where the voice on the left is perceived to be louder than the right. First, we separated the sound file from each other, so there are two files per file, totaling 100 sound files. And we create 50 new dataset by connecting the right voice file to the left voice file. Then we extract the feature values using MFCC from the preprocessed file. [1] Logistic regression is used to classify the extracted MFCC values by angle. The results are

as follows. When we train 35 files and test 15 files, it correctly predict 11 out of 15. And When we train 40 files and test 10 files, it can predict all 10 correctly.

Table 1. When we trained 35 files

답	60	120	120	180	180	0	60	60	120	120	180	0	60	120	180
예측	60	120	60	0	0	0	60	60	120	120	180	0	60	120	0

Table 2. When we trained 40 files

답	0	60	60	120	120	180	0	60	120	180
예측	0	60	60	120	120	180	0	60	120	180

### 3. Conclusion

This study shows that by learning MFCC values using artificial intelligence, we can predict which direction a person's voice was heard. And to increase accuracy, We found that noise reduction should be ensured so that human voices are recognized properly, and that we needed to prepare more dataset. Afterwards, the angles will be subdivided into eight or more so that you can predict the direction in more detail.

### Acknowledgment

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# Development of a Prototype for a Dementia Therapy AI Robot

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## Abstract

The population of elderly people suffering from dementia keeps increasing. As a result, some advanced interactive therapeutic robots for the purpose of psychotherapy for elderly people have been implemented. However, they are not easily accessible for elderly people and often extremely expensive for them. Therefore, the purpose of this research is to develop a prototype for an affordable dementia therapy AI robot that not only provides dementia therapy through interaction with users but also assesses the user's dementia status. This paper presents development procedures for both hardware and software with regard to a prototype for a dementia therapy AI robot. The hardware part consists of three components: 1) 7-inch touch screen LCD connected to a Raspberry Pi 3.0, 2) AMK voice kit (AI Makers Kit) from KT Corporation for converting the analog voice signal to a digital one, Raspberry Pi for the activating program, and a speaker and mic, and 3) three omni wheels and motors, with three ultrasonic sensors. A graphic user interface using Python tkinter was also developed to allow a cohesive interaction between the robot and the user. In conclusion, research findings and recommendations for future improvement of the robot were summarized.

**Keywords-component; Artificial Intelligence; Therapy robot; Dementia; Prototype**

## 1. Introduction

According to the Central Dementia Center's announcement, about 10% of the total elderly population in South Korea is suffering from dementia and it is projected to increase even more. (Cho and Cho 2018) As the percentage of elderly people living alone increases, elderly depression is also increasing and it has been shown to be related to dementia. In fact, Cherbuin et al. (2015) found in their study that late-life depression increased the risk of dementia twofold. Another study conducted by Saczynski et al. (2010) further concluded that depression was correlated to an increased risk for dementia and Alzheimer's disease for both older men and women. To solve this problem, many therapies and devices have been and are still being researched and developed. These so-called therapy robots have already been proven to be effective in the past. Soler et al. (2015) summarized the results of a study done by other researchers, which found that companion type robots had a positive effect on patients in terms of psychological and physiological parameters. Two successfully implemented examples of advanced interactive therapeutic robots for the purpose of psychotherapy for elderly people include the robot 'PARO' from Japan and 'Jennie' from the USA. However, there is still no robot that is easily accessible and affordable to senior citizens to check symptoms of dementia at home. Therefore, the purpose of this research is to develop a prototype for an affordable dementia therapy AI robot that not only provides dementia therapy through interaction with users but also assesses the user's dementia status.

## 2. Hardware Part of the Therapy Robot

### 2.1. Robot Head: LCD Display

The robot head is primarily composed of a 7-inch touch screen LCD connected to a Raspberry Pi 3.0 as it is the appropriate size at an affordable price. The touch screen is an important component to interact with users answering the questions. This LCD is encased by a laser-cut wooden enclosure. Figure 1 shows the dementia therapy AI robot prototype with a 7-inch LCD display.



a) Prototype of the robot



b) 7-inch touch screen LCD attached on the robot

Fig. 1 Dementia Therapy AI Robot Prototype with LCD display

## 2.2. Robot Body: Voice Recognition and Output

The robot body is also covered by a wooden enclosure with a cutout for the camera. In addition, there is a voice recognition and output feature, which was developed using an AMK voice kit (AI Makers Kit) from KT Corporation for converting the analog voice signal to a digital one, Raspberry Pi for the activating program, and a speaker and mic. By using these features, a powerful speech recognition function can be implemented at an affordable cost. Figure 2 shows an example of KT's AI Makers Kit used for the Robot.



Fig. 2 KT's AI Makers Kit for the Robot

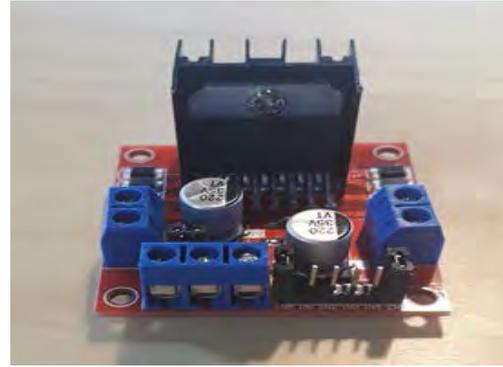
## 2.3. Robot Base: Driving Components

The robot base uses an autonomous driving function to allow the robot to roam any area freely.

Consisting of three omni wheels and motors, the robot's maneuverability can be maximized while still maintaining traction and stability. Three ultrasonic sensors (HC-SR04) were placed at the three planes of the robot to measure the distance between the robot and any potential obstacles. Using Arduino to control the motor speed and direction in relation to its distance from obstacles, the robot can effectively navigate around flat surfaces. Since the vast majority of Korean houses have a hardwood surface, carpet and other more rugged surfaces have not been tested. Most existing robots are limited in movement and can often only stay in one place; however, the proposed robot can move freely, allowing for more frequent interactions with users. Figure 3 shows a photo of three Omni Wheels and Motors and a photo of a Motor Driver.



a) Three Omni Wheels and Motors



b) Motor Driver (L298N)

Fig. 3 Three Omni Wheels and Motors with Motor Driver

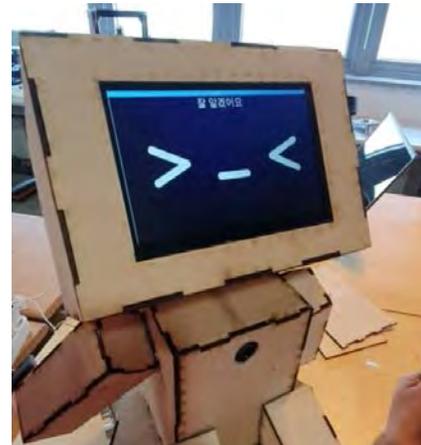
### 3. Software Part of the Therapy Robot

#### 3.1. Robot Head: LCD Display

To develop a cohesive interaction between the robot and users, a graphic user interface (GUI) was implemented. The GUI was made with the Python tkinter library, a powerful yet simple tool that was used to display different facial expressions depending on the user's actions. Figure 4 shows two examples of facial and text expressions made using the GUI.



a) GUI for Happy Face



b) GUI for Frowny Face

Fig. 4 Example GUIs for Facial and Text Expression

#### 3.2. Robot Body: Voice Recognition and Output

A whole program in the robot was made with Python. The voice recognition and output run by communication with AMK and sever of KT. When AMK conveys digital voice signal to the server, the server converts it to text and conveys it to the AMK. When AMK conveys text to the server, the server converts it to a sound file and conveys it to the AMK. The process of voice recognition and output is done on the same principle as above. Because the voice recognition and output are not run on the robot but on the server, it can still maintain a powerful performance even if the performance of hardware is low.

The main function of this robot consists of the following process. First, when users call the robot using specific call words, it asks a question that is randomly chosen from the pre-entered question list. After that, it listens and saves the answer. When requesting the robot to analyze, it shows the error rate graph for each question based on a saved answer. Figure 5 illustrates the robot's main function as a flowchart.

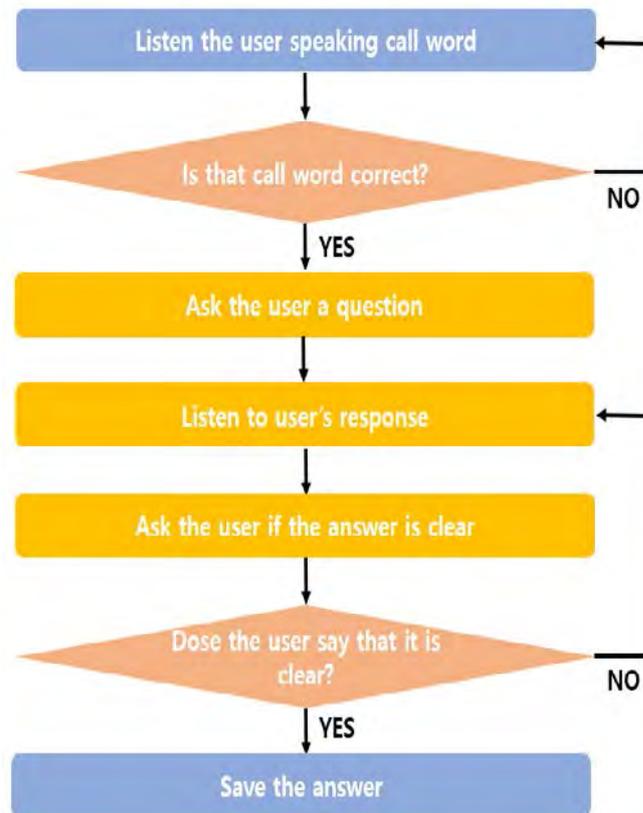


Fig. 5 Flowchart of the Robots's Main Function

### 3.3. Robot Base: Driving Components

The autonomous driving function is implemented with a simple algorithm. When the robot drives forward, if the ultrasonic sensors recognize obstacles within a specific distance, it moves backward and turns to another direction away from the obstacle. By repeating the process outlined above, the robot can drive autonomously.

## 4. Findings for Improvement

### 4.1. Hardware

Overall, the developed prototype robot was working as expected. However, the quality of the built-in microphone in AMK was lacking, so there were some difficulties in the accuracy of speech recognition. For future reference, using a microphone with better performance is expected to increase the accuracy of speech recognition.

For the convenience of this specific development, this development was made by separating the driving part and the dementia recognition part using AMK. For the improvement of the developed robot, it would be better if it is developed with just one single board.

Raspberry Pi was used as the CPU of the AMK board. There were issues of receiving data from the KT server due to its computation processing capacity as well as occasional communication problems. Therefore, more accurate devices using a higher performance CPU such as Raspberry Pi 4.0 should be used to enhance the future development of the prototype robot.

### 4.2. Software

In this prototype development phase, one of the questions registered by the user was selected randomly, and analyzed to judge whether or not the user's response was correct. In the future, if developed using the deep learning algorithm, it is possible for us to give more weight to certain questions and adjust the frequency of questions accordingly.

The autonomous navigation software in this study was designed to avoid obstacles. For fully autonomous driving capabilities in future prototypes, features such as autonomous navigation software through deep learning, improved navigation between obstacles, and human reorganization could be added.

## 5. Conclusions and Recommendations for Future Study

A Prototype for a Dementia Therapy AI Robot hardware and software was successfully developed and it is easily accessible for elderly people and affordable for them. At some point, the developed prototype robot was working as expected. However, several issues have been identified during this study.

First, the quality of the built-in microphone in AMK was poor and it caused some difficulties in the accuracy of speech recognition. Second, using Raspberry Pi, there was some issues of receiving data from the KT server due to its computation processing capacity as well as occasional communication problems. These issues can be easily solved by using a higher performance CPU such as Raspberry Pi 4.0 to enhance the accuracy. Third, the autonomous navigation function is very limited in this study. For fully autonomous driving capabilities in future prototypes, improved navigation between obstacles, and human reorganization should be added using a computer vision deep learning algorithm.

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# An Empirical Study on Factors of Fintech Acceptance in Indonesia

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## Abstract

With the world average economic growth rate at 3%, Indonesia has a high economic growth rate of 5.2%. Indonesian Fintech transaction value is also expected to increase, and the fintech industry in Indonesia will gradually change the lives of Indonesians. The goal of the study is to analyze the factors that influence Indonesian's acceptance of Fintech services. There is little research on the factors influencing acceptance of Fintech service in developing countries. This study tests the applicability of TAM (Technology Acceptance Model) to consumers in developing countries and find some institutional factors unique to developing countries.

*Keywords- Fintech, Indonesia, TAM, Developing Countries*

## 1. Introduction

There are many researches on the factors influencing acceptance of new technology such as Fintech in developed countries because new technologies are invented and introduced in advanced countries first. But there are little researches about the consumers in developing countries though Fintech is already introduced and expanding very fast. In this paper we explored the institutional factors influencing acceptance of Fintech in Indonesia and try to find general factors specific to technology acceptance in developing countries.

## 2. Literature Review

### 2.1. Fintech Industry in Indonesia

In Indonesia, fintech industry is an industry that needs to be noted. Indonesia's population is on a steady rise, while its Internet user rate is also on the rise [1]-[2]. Fintech trading volume in Indonesia has also increased, with a forecast of \$37.15 billion in 2022[3]. According to the survey, the proportion of fintech service users provided by start-up in 2017 was 15.02%, but it increased to 35.27% in 2018[4]. In this paper we focus on third-party mobile payment which means to pay for goods and services or transfer asset using a mobile device.

### 2.2. Technology Acceptance Model (TAM)

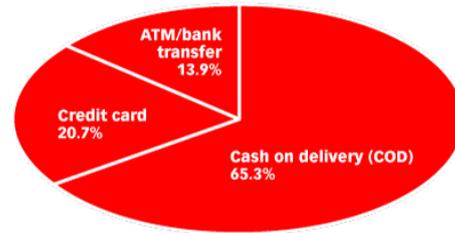
Technology Acceptance Model(TAM) insists that user's acceptance of new IT technology is determined by user's 'Intention to Use' that is influenced by 'Perceived Usefulness' and 'Ease of Use' [5]-[6]. After TAM was introduced, there are many researches on factors influencing PU such as trust, risk, compatibility, social influence so on,

## 3. Research model and Hypotheses

### 3.1 Institutional Environment in Indonesia Fintech industry



**Digital Purchase Share in Indonesia, by Payment Method, Feb 2017**  
% of total tracked by aCommerce



Note: represents activity on aCommerce's platform, broader industry metrics may vary; 0% of digital purchases were completed by digital buyers using a debit card or credit card on delivery (CCOD); numbers may not add up to 100% due to rounding  
Source: aCommerce as cited by ecommerceIQ, March 29, 2017  
225598 [www.eMarketer.com](http://www.eMarketer.com)

Fig. 1. Financial inclusion factors(left)

Fig. 2. Digital Purchase share in Indonesia by payment method, Feb 2017(right)

Table 1. IT Infra structures in Indonesia

Category	2017	2018	2019
Internet users (penetration rate)	132.7 million (51%)	132.7 million (50%)	150.0(56%)
smartphone usage	47%	60%	60%
Average internet speed via mobile connection (world average)	10,988 kbps	9.82 Mbps	10.53 Mbps (25.08)
Average internet speed via fixed connection (world average)	6,398 kbps	13.79 Mbps	15. 52 Mbps (54.33)
Mobile connectivity index – Mobile infrastructure score		41.39	42.67
Mobile connectivity index – overall		52.71	61.12

In Indonesia, 49% of the adults has bank account and only 2.4% has a credit card. Only 11% purchases and pay bills online [7]. About 70% of adults receiving private sector wages reported they earn only cash as private sector wages in 2016. About 80% of adults receiving payments from self-employment earned only cash payments from self-employment in 2016[8]. This situations imply that institutional environments such as low bank account ownership, cash payment dominance are important factors to understand fintech acceptance in Indonesia. Level of IT intra structures in Indonesia also need to be considered in modeling to

### 3.2. Research model and Hypothesis

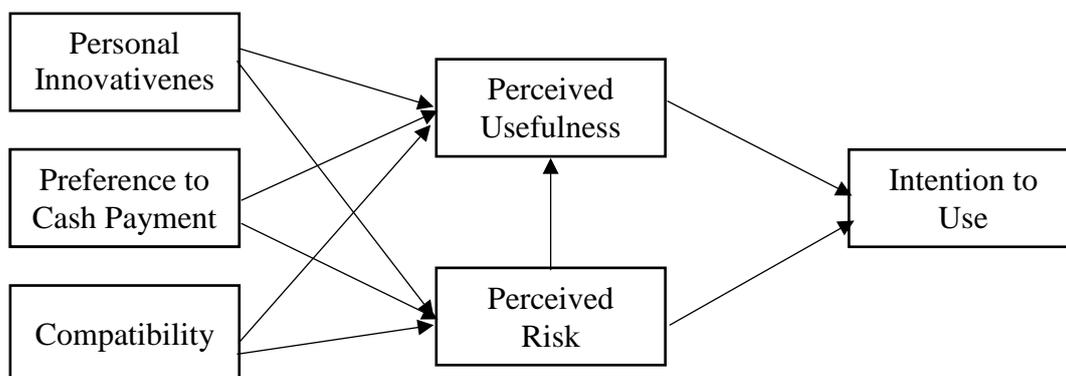


Fig. 3. Redesigned Technology Acceptance Model (TAM)

Hypotheses	Definition
Personal Innovativeness	Degree of willingness to use new IT technology
Preference to Cash Payment	Preference or habit of case payment
Compatibility	Degree of consistence and compatibility of Fintech and user's values, current needs, present life style
Perceived Usefulness	Perceived usefulness of using Fintech Service
Perceived Risks	Perceived risks related to using Fintech like privacy exposure, financial loss, poor function

#### 4. Methodology

To test the research model, survey questionnaire will be developed based on the TAM model and investigated with structured equation model.

#### Acknowledgment

"This research was supported by the MIST(Ministry of Science and ICT), Korea, under the National Program for Excellence in SW supervised by the IITP(Institute for Information & communications Technology Promotion)"(2016-0-00022)

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## Medical Education using IT device to Increase Learning Satisfaction: Feasibility Testing among Patients

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### Abstract

Many doctors and nurses incorporate tablet computers into patient care to improve patients' understanding about medical process. This study implemented and evaluated a theory-driven, interactive, tablet PC app with three educational components: hospital environment, anesthesia process, and postoperative care. For the patients admitted in a university hospital to have surgeries (n=29), we assessed their satisfaction about the app using a structured self-report instrument. Satisfaction level was measured  $40.66 \pm 3.94$  on average (out of 45.00) with no significant differences depending on age, gender, education, and previous experience except underlying diseases. Our results point out the significance of IT device applied patient education and its potential use in public health promotion.

*Keywords-medical education; tablet computer app; evaluation study*

## 1. Introduction

IT devices have become a popular tool among physicians and nurses in various health care settings. Based on a systematic review of 1,616 recently published studies, Kho et al (2006) found that up to 70% of medical staffs have incorporated tablet PCs into patient care activities [1]. Many researchers reported that educating patients using tablet PCs was more cost effective compared to conventional education [2]. Conventional education at medical settings is often time intensive and requires a trained specialist and a suitable location but education using tablet PCs has merits of portability. In some environments, a personal computer and desktop computer is less accessible and less convenient than a tablet PC, so a simple tablet PC is preferred. The popularity of tablet PC is also came from the merit of a touch-screen interface. For the most part, tablet PCs are designed to offer some of the computing features of a notebook or other portable PC, but with less bulk and weight, a longer battery life and a quicker start-up.

Many software developers reported the strength of educational app in terms of learning outcomes [1]. However, few focused evaluating the satisfaction from consumers' side using a theory based structured survey instrument. Also little is known whether the consumer's satisfaction depend on their characteristics such as age, gender, and educational background.

This paper seeks for evaluating an iPad app developed for patient education. The development process and its educational content was described in detail elsewhere [3]. We provided participants with pre-operative education using the iPad app and directed to self-report their satisfaction about the education. We analyzed the satisfaction score to investigate whether the participant's response was different depending on their characteristics.

## 2. System Design and Evaluation Method

### 2.1. Our Tablet PC Education App

The system to evaluate is basically an educational material to show patients multimedia contents including text, images, diagrams and movie clips [3]. It illustrates general information about the prospecting surgery procedures and the operating room environment, position of the body which patients need to try during spinal anesthesia, and benefits and potential risks of anesthesia. The multimedia content was created using various

multimedia authoring tools. All presentations allow users to zoom in so as to focus on important content. Fig. 1 is an example of the actual multimedia content screen of our education application.



Fig. 1 Sample screen of our tablet PC education app

## 2.2. Evaluation Method

A prospective randomized experiment was undertaken at a single university hospital (Eulji University Hospital No-Won Eulji Hospital located in the northeast of Seoul, the capital city of South Korea), to evaluate educational outcomes. Patient recruitment occurred from July 1<sup>st</sup>, 2017 to January 1<sup>st</sup>, 2018, and limited to adult patients (aged 17 and over) prospecting Urological surgeries under spinal anesthesia. The patients were offered enrollment in the study at their first or second day of inpatient admission. Patients were excluded if they had an auditory, visual, or cognitive disorder that would preclude them from participating in our experiment requiring reading and watching education material, or if they were unwilling to give informed consent to participate in the study. Approval was obtained from the university ethics board before commencement of the study. All patients provided written informed consent before participating.

After recruited (n=29), patients first answered a questionnaire assessing baseline information (demographic information and medical information). Patients then participated in tablet-PC education assisted by a trained nurse one day prior to surgery. After scheduled surgeries done, they completed a set of structured survey questionnaire to measure their satisfaction about the pre-operative education implemented.

## 2.3. Definition of Learning Satisfaction

Theoretically, learning refers to a set of formal curriculum, the design of organizational and intentional learning activities, and the interaction between the environment, organization, programs, and learners [4]. Satisfaction is the generic favor or non-favorable feeling of the customer who is provided with the service. This is the customer's emotions that are felt by providing a set of formal curriculum [5]. We defined learning satisfaction as the score measured by the Korean version of Learning Satisfaction Survey Instrument modified by Lim Ok - Soon (2001) and Kim, Eun - jung (2014) [6,7]. The survey instrument has 9 questionnaires with 5-Likert scale (very satisfied, satisfied, good, fair, and poorly satisfied). The total score ranges from 9 to 45 points. 0.91 (out of 1.00) was the reliability of this survey measured using Crombach's alpha.

## 3. Evaluation Results and Conclusion

This study is a descriptive evaluation study of randomly selected experimental group (n=30) to investigate the effect of tablet PC-based medical education on learning satisfaction. The results are as follows.

### 3.1. General Characteristics

General characteristics of participants are as follows. The mean age of twenty nine participants was  $53.20 \pm 13.87$  years. The distribution of gender between the male and female subjects are 20 (66.7%) and 10 (33.3%). The composition of educational background are 4 elementary school completed (13.3%), 6 middle school (20.0%), 10 high school (33.3%), and 10 college or higher (33.3%). Regarding previous surgery experience, 23 (76.7%) were experienced. 17 participants (56.7%) had a chronic disease at present.

### 3.2. Learning Satisfaction

We assessed the satisfaction about the tablet PC app using a structured self-report instrument with 3 itemized questions (content, design, and value of education material). Regarding the content of education material, 14 (48.3%) people answered as 'good' and 'satisfied', 15 (51.7%) as 'very satisfied'. Regarding the design of

education material, 2 (6.9%) answered as ‘good’, 11 (37.9%) as ‘satisfied’, 16 (37.9%) as ‘very satisfied’ for the question, “overall consistency of contents was maintained.” Other responses are presented in Table 1.

Table 1. Satisfaction with the Education using Tablet PC-based App

Questionnaire	Category	Response	
Content of education materials	was easy to understand.	Poor, Fair, Good	0(0%)
		Satisfied	14(48.3%)
		Very satisfied	15(51.7%)
	proper to the questions I had.	Poor, Fair	0(0%)
		Satisfied	11(37.9%)
		Very satisfied	18(62.1%)
	was helpful to relieve anxiety	Poor, Fair	0(0%)
		Good	1(3.4%)
		Satisfied	17(58.6%)
Very satisfied		11(37.9%)	
Design of Education Materials	Overall consistency in the contents was maintained	Poor, Fair	0(0%)
		Good	2(6.9%)
		Satisfied	11(37.9%)
		Very satisfied	16(55.2%)
	Screen composition and color scheme are appropriate.	Poor, Fair	0(0%)
		Good	2(6.9%)
		Satisfied	12(41.4%)
		Very satisfied	15(51.7%)
	The font size was appropriate.	Poor, Fair	0(0%)
		Good	1(3.4%)
		Satisfied	10(34.5%)
		Very satisfied	18(62.1%)
Value as Education Strategy	Educational resources helped self-learning	Poor, Fair	0(0%)
		Good	1(3.4%)
		Satisfied	13(44.8%)
		Very satisfied	15(51.7%)
	This App education was more interesting than the education with paper material	Poor, Fair	0(0%)
		Good	2(6.9%)
		Satisfied	9(31%)
		Very satisfied	18(62.1%)
	This App education has a potential as effective future educational strategy for patients and families.	Poor, Fair	0(0%)
		Good	1(3.4%)
		Satisfied	9(31%)
		Very satisfied	19(65.5%)

### 3.3. Learning Satisfaction by participant’s general characteristics

Table 2. Satisfaction with Tablet PC-based Education by General Characteristics

Variables	Categories	Mean±SD	t	p
Total		40.66±3.94		
Gender	Male (n=20)	40.8±3.97	0.29	0.774
	Female (n=9)	40.33±4.09		
Previous surgery experience	Yes (n=23)	40.73±3.79	0.17	0.865
	No (n=6)	40.43±4.69		
Underlying chronic diseases	Yes (n=17)	41.94±3.53	2.24	0.034
	No (n=12)	38.83±3.90		

Table 2 shows that satisfaction level was measured  $40.66 \pm 3.94$  on average (out of 45.00) with no significant differences depending on age, gender, education, and previous experience. We found that people with underlying diseases ( $41.94 \pm 3.53$ ) had higher satisfaction level by about 3.00 points compared to healthy patients ( $38.83 \pm 3.90$ ), which is statistically significant ( $t = 0.68, p = 0.034$ ).

### 3.4. Conclusion

We provided 30 patients in a university hospital with table PC-based education with information on hospital environment and treatment process. Patients' satisfaction level was measured  $40.66 \pm 3.94$  on average (out of 45.00) with no significant differences depending on age, gender, education, and previous experience except underlying diseases. Our results point out the significance of IT device applied patient education and its potential use in public health promotion

### Acknowledgment

This paper was supported by the MIST(Ministry of Science and ICT), Korea, under the National Program for Excellence in SW supervised by the IITP(Institute for Information & communications Technology Promotion)"(2016-0-00022).

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## Cross-Border E-commerce Industry Trend in China: a Case Study on NetEase's Kaola

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### Abstract

International Transaction by individuals are very popular in China. In this paper we will examine the international transaction industry in China and investigate NetEase's Kaola, one of the dominant platform of international transaction by individuals in terms of its strategy and success factors.

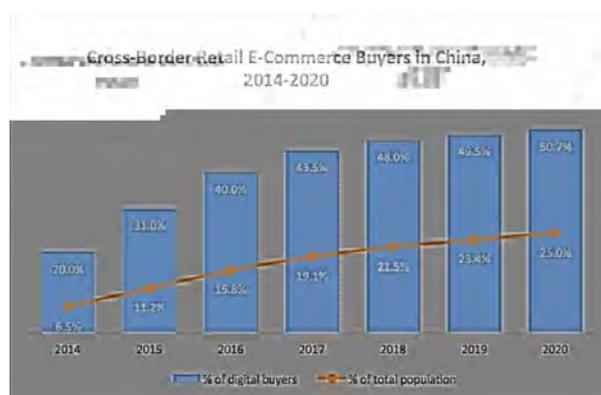
**Keywords-***Cross border e-commerce by individuals; NetEase's Kaola; China*

### 1. Introduction

As more and more Chinese people shop imported goods online, cross-border e-commerce has grown rapidly in China in recent years. In 2018, China's retail imports of cross-border e-commerce reached 78.6 billion yuan, about 11.7 billion U.S. dollars, and a 39.8% rise year on year. Now a days, the middle-class consumers in China is becoming more important. Their understanding and demand for online shopping have reached a higher level. NetEase's Kaola is a China's leading cross-border e-commerce platform. It provides a platform for international brands to sell their products securely to Chinese consumers and for Chinese consumers to purchase safe, high-quality international premium goods in a convenient way.

### 2. Chinese cross-border e-commerce industry

#### 2.1. Size and Growth Rate



China's e-commerce market is the largest in the world and already represents more than 40% of the total global e-commerce spending. In 2018, China's Singles' day set a new record with 27% growth compared to 2017. In the next four years Chinese online sales are expected to reach US \$1.8 trillion which will be more than double the size of the US market.

China's ministry of commerce reported that cross-border e-commerce reached 6.5 trillion yuan in 2016, which accounted for nearly 20% of all of China's foreign trade. It also projects that it will grow at annually at around 30% in the next few years. A survey in the China Daily reported that more than 15 percent of the Chinese population had purchased goods from abroad in 2016, and spent an average of \$473 each on cross-border

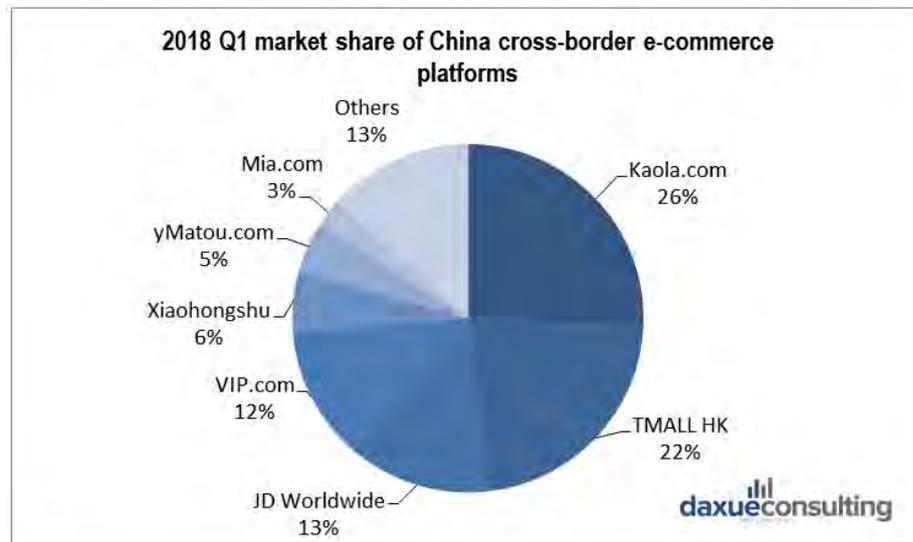
purchases. With the e-commerce market in China expected to double in the next 5 years, there is clearly a significant opportunity for cross-border e-retailers in China.

### 2.2. Cross-Border E-commerce Platforms

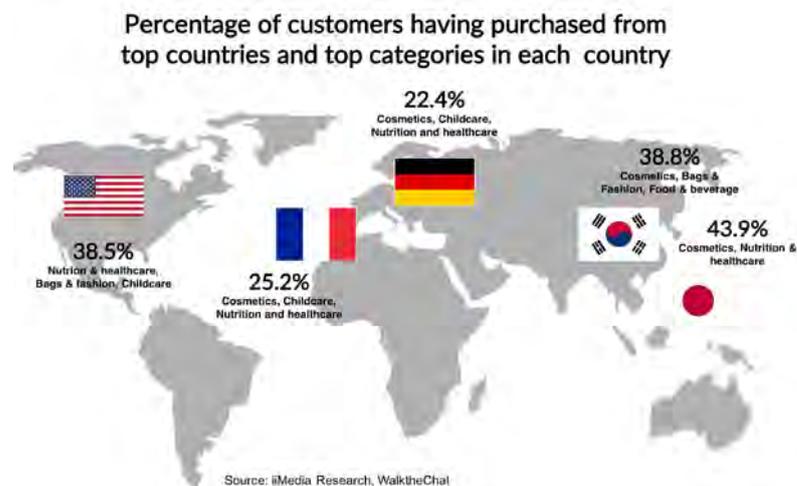
Currently, there are more than a dozen different Cross-Border e-commerce platforms in China covering every product category. Each of these platforms have become highly popular among Chinese consumers and offer distinct benefits to overseas e-retailers. By market share the most popular platform is Kaola.com, followed by the well-known titans of E-commerce in China, T-Mall, JD, and VIP.com. In 2016, the platform was ranked first in the survey on users' satisfaction of Chinese cross-border e-commerce self-operating platforms. In 2018 Q1, Kaola.com kept the largest market share (26%) among China's cross-border e-commerce platforms.

TMall Global is the child platform of TMall which is ultimately all own and operated by Alibaba Group. While nationally TMall is the leading e-commerce website, TMall Global places second place in terms of market share compared to Kaola.com. TMall Global has the most significantly special application process. TMall global do not accept any application for setting up stores on their platform, instead, it is done only by inviting. TMall global will actively look for international brands that are in demand or urgent need by the consumer and the market.

JD Worldwide also was known as Joybuy.com is the brainchild of JD.com, the second largest eCommerce website in China. The company was founded by Liu Qiangdong back in 1998 but it wasn't 2004 that JD.com official went online. In terms of logistics, JD Worldwide is far more superior to those of other platforms. JD operates its own logistics company with one unifying logistic system that ensures efficient shipping and delivery of any products sold on JD.



### 2.3. Consumption trend



The fast development of the Chinese market combined with a large and growing digital user and consumer base has contributed to a rapidly growth of domestic online sales as well as cross-border e-commerce. In part, the concerns about the safety problems of domestic products have pushed consumers to look abroad for brands with a strong reputation and quality. Furthermore, Chinese consumers are becoming more aware of international brands, which reflects increased demand for overseas products. High-quality food, cosmetics, health-care, baby products and electronics are on top of the list of Chinese online consumers.

The top 5 countries exporting to China through Cross-Border e-commerce are Japan, US, South Korea, Germany, and Australia. Japanese and Korean exports were made up of mostly cosmetics and serums. Western countries were more popular for their baby products, food, and vitamins/supplements.

Of these product categories, the most popular products were cosmetics and baby products. This is primarily due to the fact that domestic products are considered to be of inferior quality and relatively similar in price for these particular categories.

#### **2.4. Government policy of cross-border e-commerce platform**

From Jan. 1, 2019, the annual quota on cross-border e-commerce purchases for individual buyers will rise to 26,000 yuan (about 3,741 U.S. dollars) from 20,000 yuan, according to a meeting of the State Council. The tax-free limits on single transactions will increase to 5,000 yuan from 2,000. The new policy will be applied to cross-border e-commerce pilot zones in another 22 cities including Beijing, Nanjing and Shenyang. With the annual transaction limit raised and more taxable items added into the list, consumers can buy more high-end goods through cross-border e-commerce. Cross-border e-commerce operators can expand their activities while more choices will be available for consumers.

### **3. Case Study of NetEase's Kaola**

#### **3.1. Company**

Kaola is owned by NetEase Inc. which provides online services focused on content, community, and commerce. Launched in 2015, NetEase's Kaola is the largest cross-border retailing e-commerce platform in China with a 26% market share in 2018 according to iiMedia Research. Kaola accounts for the majority of NetEase's e-commerce sales. Kaola provides a large range of products in baby and maternal care, healthcare, beauty, and cosmetics, with a fast delivery service. At present, the competitiveness of NetEase's Kaola comes from the cost-effectiveness of products. Also, NetEase had used its advantage of having resources in news and gaming sectors to drive customers onto the platform.

#### **3.2. Success Factors**

The biggest group of Chinese internet users are in their 30s, which is a golden time for retailers since they have the greatest spending power. Kaola focuses on high-end products. Also, while other players mainly sell through marketplaces, kaola's strategy focuses on selling featured products directly to shoppers. This business model enables consumers to purchase products at better prices and to save time in making their selection.

While enhancing its dominant position in the cross-border e-commerce market, NetEase's Kaola is targeting the entire high-quality e-commerce market. With the growing trend of consumption upgrades among the rising middle class in China, high-quality e-commerce service is in growing demand. However, the incumbent business model in China has not yet effectively capitalized on this opportunity. NetEase's Kaola is designed to fill this gap in the market.

NetEase has operated its news portal 163.com for about 20 years. News portal and other online businesses offer kaola a convenient and effective channel for marketing overseas products to Chinese consumers. Since Kaola.com is a proprietary trading platform, their main method of cooperation will be to purchase directly from the brand. Because Kaola.com mostly handle their own operations in terms of selling and logistics, Kaola can greatly reduce delivery time. Before, Chinese consumers often waited 15 days to 20 days after placing their orders from an overseas e-retailer to receive delivery. Now, Kaola's shipping only takes one to three days because they operate warehouses in several free-trade zones and in different overseas locations. (China has created free-trade zones in several cities where imported goods can be stored without going through customs, then sent through an expedited customs process when ordered by an online shopper). In 2018, they started to use an automated warehouse covering 250,000 square meters to increase their logistics advantage.

NetEase's Kaola's competitive edge lies in its unique business model. It establishes strong relationships with international brands and directly purchases most of its inventory from brands overseas, bypassing intermediaries and local distributors to lower costs, the benefit of which is passed down to consumers. In addition, NetEase's Kaola provides a one-stop solution for foreign manufacturers to enter the China's complex market. By handling cross-border logistics, warehousing, online operations and after-sales services, NetEase's Kaola enables foreign manufacturers to reach Chinese consumers on a broader and faster scale.

## 4. Conclusion

According to a research report recently released by the Boston Consulting Group, about 27% of the world's total consumption growth by 2021 will occur in major economies, bolstered by the rising income level, the growing upper-middle-class and affluent families. Among these economies, China's consumption level will see an increase of nearly US\$2 trillion by 2021, driven by the growth of upper-middle-class' consumption capacity.

The promising growth prospects for China's high-quality e-commerce market presents huge opportunities for NetEase's Kaola, especially in the case that the platform continues to focus on providing the right product with the right price and high quality along with excellent shopping experience, to maintain its market leading position. Using this efficient distribution channel, Korean Brand enter China market effectively.

## Acknowledgment

"This research was supported by the MIST(Ministry of Science and ICT), Korea, under the National Program for Excellence in SW supervised by the IITP(Institute for Information & communications Technology Promotion)"(2016-0-00022)

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## **A study on the production of the Theory of Virtuality in Animation : Focusing on Oscar Best Animated Scenes**

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### **Abstract**

The film theory promotes the process that the public view film as an art while the animated theory also needs to be researched wisely. In animation aesthetics, it is very key to research animation mise-en-scene based on visual features. Although abundant mise-en-scene of domestic animation is researched, there are few researches on in-depth analysis of its characteristics. In order to judge the artistry of animation, it is necessary to emphasize the visual features of animation and focus on the mise-en-scene to analyze depth the visual artistry of animation. The mise-en-scene can enrich the characters' emotions and effectively convey animation content and scene performance. Through this method, the mise-en-scene in animated movies is closely related to the philosophical viewpoint of Chinese theory of virtuality and reality. In Chinese classical aesthetics theory, the theory of virtuality and reality and virtuality and reality combination are the core of thought. The research on the correlation between the method of mise-en-scene and the theory of virtuality and reality is indispensable.

***Keywords-mise-en-scene ; the theory of virtuality;the virtuality and reality combination; animation movie***

### **1. Introduction**

This thesis researches the effect of the theory of virtuality and reality on the mise-en-scene of animated films. It is necessary to define the theory of virtuality and reality and virtuality and reality combination, and to find the correlation between virtuality and reality combination and mise-en-scene in animated films. Therefore, this thesis chooses the works that have won the Oscar Best Animated Scenes Award as the analysis object, -Oscar is the most representative film festival in the world-, and the research involved the following three steps: First, The thesis, academic journal, literature, newspaper, magazine and network information about domestic and foreign mise-en-scene and the theory of virtuality and reality are researched. Second, by analyzing the factors and methods of mise-en-scene and puts forward the theoretical basis and development of the theory of virtuality and reality. Third, according to other expressions of the theory of virtuality and reality to analyze the difference of the mise-en-scene factors and methods.

The purpose of this research is to analyze the correlation between the theory of virtuality and reality and the mise-en-scene. It is also hoped that the result can become the basic material of film production and application of mise-en-scene in the future, and can become a reference of the diversified media creation, such as the VR film, and the research of mise-en-scene.

### **2. Theoretical Background**

The theory of virtuality is the core of the ancient art dialectic philosophy and it is one of the key principles of Chinese classical aesthetics. Author in 1) studied the theory of virtuality in the traditional arts and concluded

1) Zong Baihua, Artistic Conception, Beijing: Peking University Press, 1999, 67p-88p

that juxtaposing truth and fiction is an important aesthetic characteristic in the field of art. And the juxtaposing truth and fiction is regarded as the core of the theory of virtuality referring to the aesthetic characteristics that arise at the boundary between 'truth' and 'fiction'.

The advanced philosophers explained their philosophical thoughts through artworks. Conversely, their philosophical thoughts had a profound impact on the development of later arts. The relationship between 'truth' and 'fiction' were brought up by advanced philosophers in China. For example, even though the original voice of clock bell and chime stone could already bring the beauty, the ancient artisan did not simply make a frame of 'gouyu', and instead the whole instrument was regarded as an unified image to design. In detail, the beast shapes such as a tiger or a leopard was placed under a drum, which makes people see the shapes of tiger or leopard while listening to the drums. The fictional combination of shape and sound in people's brain makes them think the tiger or leopard was barking. Furthermore, the carving of tiger or leopard on this instrument became more vibrant and the sound of the drum was shaped. Especially, the appeal of the whole artwork impressed on audiences can be doubled. They thought that the image created by an artist was "the truth" and people's imagination was "the fiction". And the boundary of the shape created by "the truth" and "the fiction" was the combination of the truth and the false.

**Summary of the Development Process :**

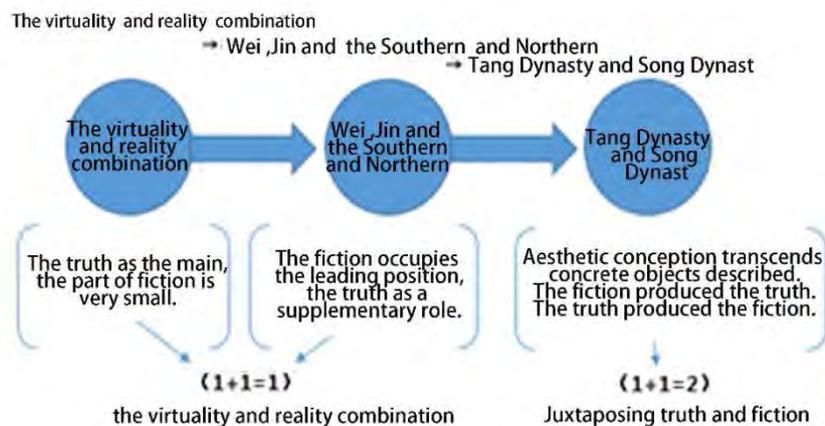


Fig. 1 The Origin and Development of "the truth and the fiction"

(The theory of virtuality form of expression)

### 3. Theoretical Study On Mise-en-scene

#### 3.1 Definition Of Mise-en-scene

The word scene scheduling comes from the French word "Mi se-en-scene", meaning "put in the right place" or "put in the scene". At first the word was used only for stage plays. It is an important means of stage rehearsal and performance to guide the performers to deal with the change of their position on stage. At the same time, the director conveys to the audience a unique language through his own artistic conception and using the method of scene scheduling through the ideological content, story plot, character, environment and rhythm of the script. Drawing on the experience of stage play, the film regards Mi se- en- scene as the main elements of its works. 2

The director considers three factors when trying to Mise- en- scene. They are respectively: Narrative Elements, Dramatic Elements, Picture Elements. Three different scenario scheduling expressions are derived from those three factors: Contrastive mise-en-scene, Deep mise-en-scene, Repetitive mise-en-scene.

Contrastive mise-en-scene (Main expressions of	Contrastive techniques are often used by contrasting and comparing different events or images in a distinct and opposite way. It can make the characteristics of both sides or one side of the contrast more prominent, and
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<sup>2</sup> "Application Strategy of Film Advertisement Mise- en- scene"

Narrative Elements)	make them more vivid to show their own personality and characteristics.
Deep mise-en-scene (Main expressions of Dramatic Elements)	Using a single lens to schedule the characters in depth. Changing scenery can not only show the complex relationship between characters at different levels, but also convey more information.
Repetitive mise-en-scene (Main expressions of Picture Elements)	After repeated, it can play a role of emphasizing and highlighting the special meaning of something.

Fig. 2 Main factors and expressions of Animation mise-en-scene.

#### 4. Case Study

Oscar is the most representative film festival in the world. This thesis chooses the works that have won the Oscar Best Animated Scenes Award as the analysis object, which strengthens the persuasion and representation of the research theory, and shows the widespread application of the theory of virtuality and reality and the virtuality and reality combination in the film. The scenes expressed by the theory of virtuality and reality in this thesis are selected as the scene needed in the research and are compared and analyzed.

Table 1. Analysis of animation movie scenes

Classification	expression form of mise-en-scene	A scene relating to a scene using mise-en-scene technique A 'truth' part of juxtaposing truth and fiction	Scene using mise-en-scene technique A 'fiction' part of the virtuality and reality combination
Spider-Man: Into the Spider-Verse (2018)	Repetitive mise-en-scene And Contrastive Scene	  <p>A scene describes the camera moves with the character in "Spider-Man". The 'truth' is repetitive action.</p>	  <p>In contrast, the action is static and the darkness is bright. Warm colours are also cold colours.</p>
Coco (2017)	Deep mise-en-scene		

		Movement through an actor or camera is the 'truth' other modelling factors.	Through the change of composition, light and shadow, color, environment and atmosphere, character action and other modelling factors. Give the lens the ideological meaning and narrative function.
Zootopia (2016)	Repetitive mise-en-scene	 <p>There were a lot of repetitions. A scene repeat the same or similar actor scheduling and shot scheduling</p>	 <p>Through repeated repetition, it can play the role of emphasizing and suggesting the special meaning of something.</p>

Table 2. Analysis of animation movie scenes

The elements of a scene	Narrative elements	Dramatic elements	Picture Elements
The fiction	Small part	The emotional part of the scene	The opposite or emphasized part extends beyond the picture.
The truth	The actual picture describing the event.	Small part	Through composition, view, light and shadow present the actual scene.
Expression form of mise-en-scene	Contrastive Mise-en-scene	Deep Mise-en-scene	Repetitive Mise-en-scene
The theory of virtuality form of expression	The virtuality and reality combination	The virtuality and reality combination	The juxtaposing truth and fiction

### 5. Conclusion

The mise-en-scene is used as a unique form of film-making and emphasizes the authenticity of the lens, which is an artistic expression contrary to film editing. The Chinese animation production and animation education in the film art expression has not been fully concerned now. Combining the practice and exploration, referring to the existing mise-en-scene theory and excellent movies, more and more Chinese animation enthusiasts pay attention to the mise-en-scene, and take the theory of virtuality and reality as the theoretical basis to practice, to better understand it, to skilled use the animation creation, to innovate and to overcome the bottleneck of Chinese animation.

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# A Study on the Digital Creation of Marine Life Paintings in 『JASANEOBO』 in the Joseon Dynasty Using the Korean Painting Technique

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## Abstract

In this study, we have studied a method to supplement knowledge transfer of 『JASANEOBO』 which is high value as a book of marine biology in the Joseon Dynasty. It does not include illustrations but depicts the marine lives, which is a pity for knowledge transfer. Therefore we suggested ways to make and apply marine life paintings using Korean painting techniques to enhance cultural value while modernizing this "Jasaneobo".

**Keywords-** Jasaneobo, Korean Painting Technique, Marine Life, Digital Convergence Contents

## 1. Introduction

Written by Jeong Yak-jeon (1758-1816) in the late 1814's Chosun Dynasty, the "Jasaneobo" has been highly evaluated as the first systematic marine biology book in Korea. Jeong Yak-jeon has been extensively living in Heuksan Island, observing in the surrounding seas, and collecting various knowledge about 155 species of marine life which were communicated through residents in detail in three volumes. At the beginning of writing the book, Jeong Yak-jeon asked his younger brother Jung Yak-Yong, who had a deep friendship, discussed the concept of marine biology plan that includes illustrations. However, according to his brother's worries about putting the illustration in the book, finally, the "Jasaneobo" does not include the illustration, and described the form of all marine life in the text, came out. Though there is speculation that it would be difficult to find a person who paints pictures well at the time, it can not be said that it is irrelevant to the cultural background of the times when paintings are highly appreciated. However, it is regrettable that the inclusion of pictures for the delicate delivery of knowledge has increased understanding.

Recently, a variety of modern commentary about "Jasaneobo" is released. Many books include pictures of marine life that are not included in the original "Jasaneobo". Most of the books, however, are mostly contained in the form of precise descriptions or photographs to convey the actual appearance of the marine life. We are going to add illustrations to assist the explanations of 155 kinds of marine life to be similar to the original plan of Jeong Yak-jeon. In this study, we propose a method to include illustrations that include Korean culture and Korean drawing technique, when embodying various digital convergence contents based on a book rather than just an illustration printed book.

## 2. Literature Research

Since the 16th century, iconography has been a critical method of knowledge transfer to systematization of biological knowledge, both east and west. Even if the description is very detailed, it is practically impossible to visually reproduce and understand the creatures that have never seen before. Indeed, some of the marine life depicted in "Jasaneobo" is difficult to pinpoint equally what they are today. On the other hand, there is a marine biology book called "Ryukyuanbo chestnut fish scales(栗氏魚譜)" written by Kurimototanshu Kurihontansu 栗本丹洲 (1756 ~ 1834) in Japan. This book has many similarities in including detailed observations and knowledge of local people as well as asset lore. However, it has a large role in accurately conveying the knowledge of marine biology not only at that time but also in modern times, by drawing a detailed picture of the form of the creature described in the text.

Korean cultural characteristics permeate various fields, but in the field of visual contents, it is a fact that many people use unconscious Western Painting Techniques. Korean Painting Techniques have distinct characteristics in materials, effects, and approaches compared with Western painting. First of all, Western paintings are painted using flat brushes that can spread colorful oil colors on canbers. Korean paintings are using pointed brushes that can draw ink and coloring on flower paper or silk. The differences in these material characteristics reveal many differences in the effective representation of the picture. In the case of western painting, the brilliant chromatic color gives an opaque feeling and bright and clear effect. On the other hand, Korean paintings are expressed transparently so that they are permeated with soft, calm, and somewhat subdued,

### 3. Research Contents

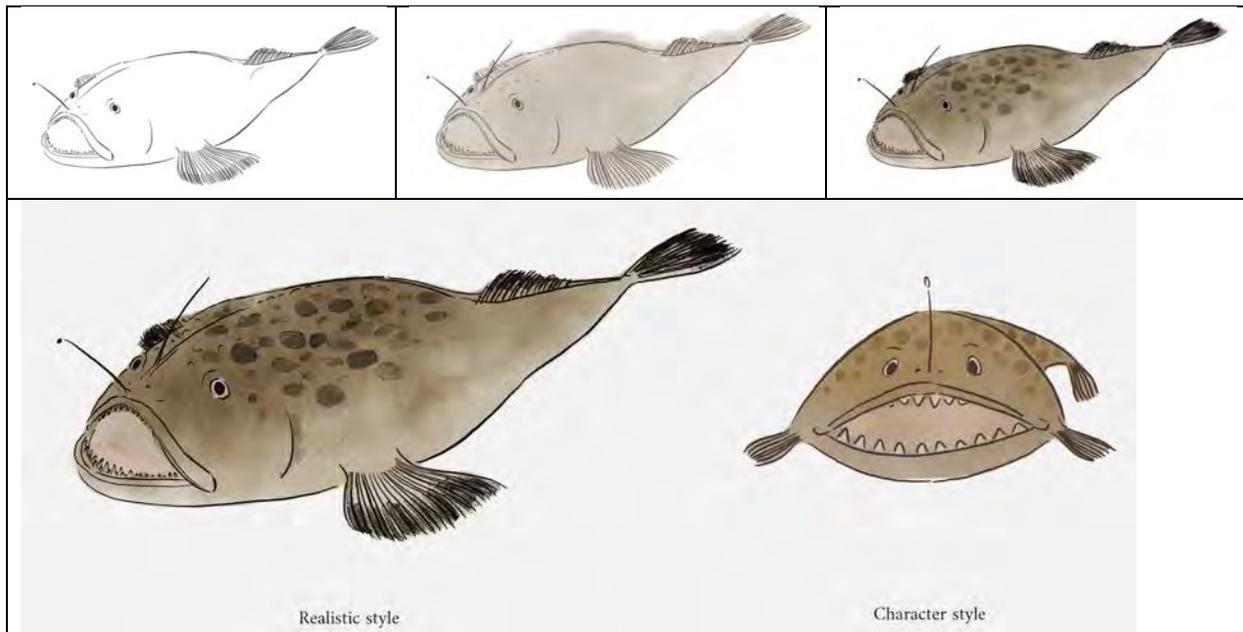
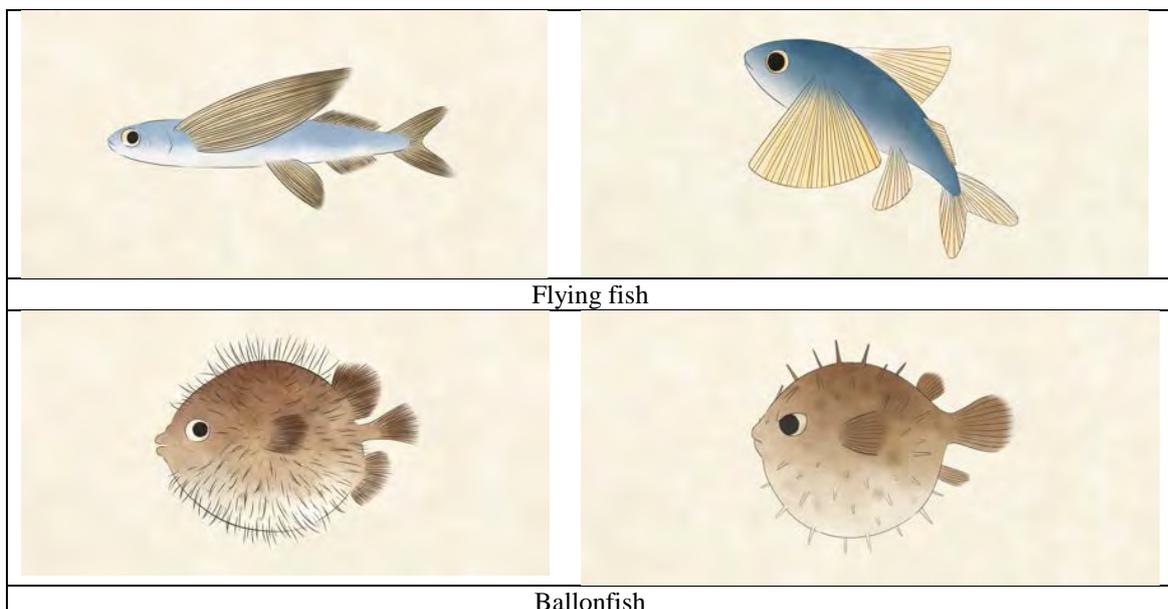


Figure1. Establishing Illustration style of marine biology production using a Korean painting technique

In this study, 155 images of marine creatures in “Jasaneobo” were made into an illustration using Korean painting techniques, and they can be used as a source of various digital contents. For this purpose, the outline of the marine creature is drawn, and the color is slightly desaturation of the ink or coloring material so that it looks like transparent and superimposed. In addition to the fact that it is a realistic expression, it also has a characterized style that can expand to children's contents.



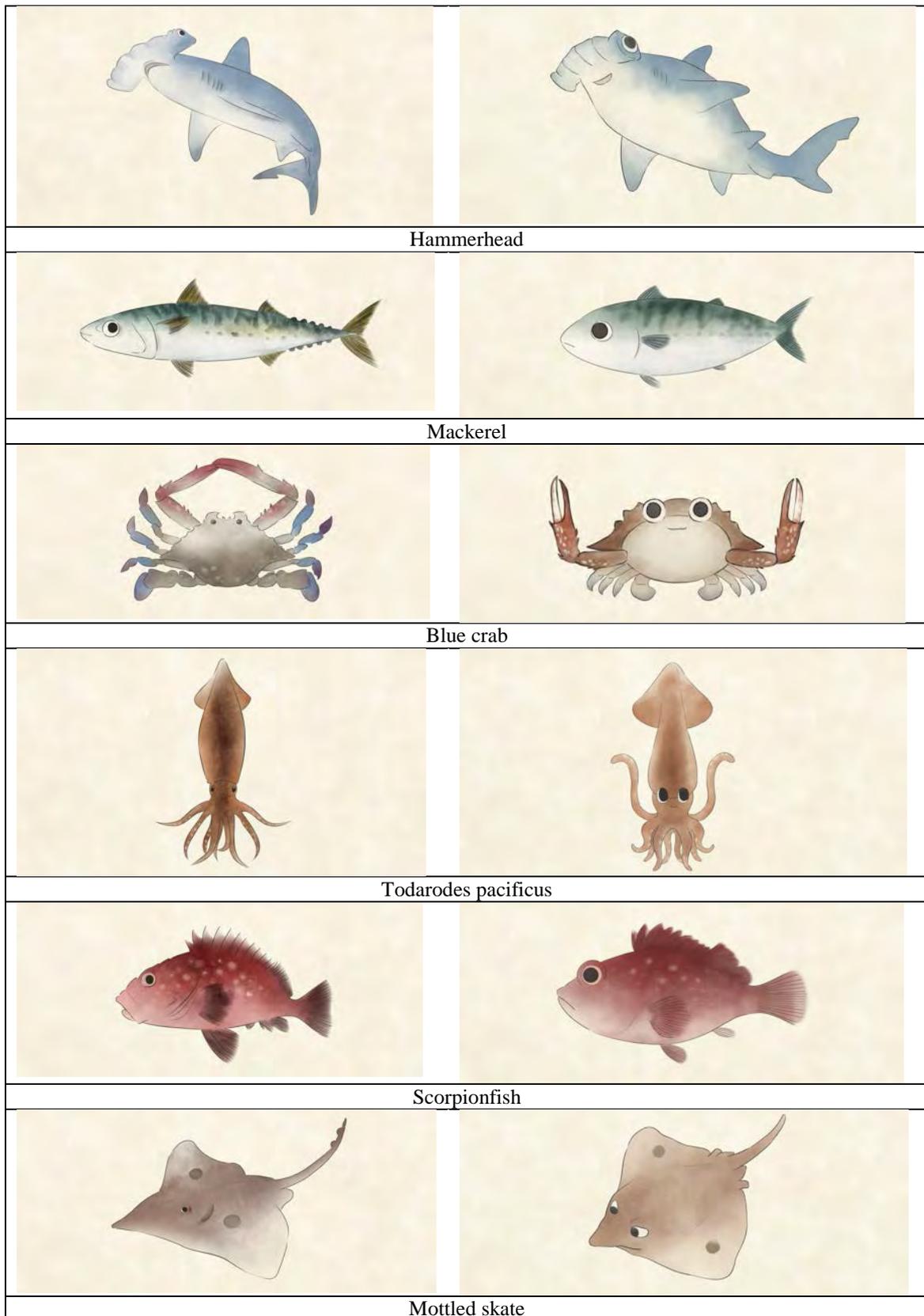


Figure 2. Production of marine bio-illustration of “Jasaneobo” using a Korean painting technique

It is necessary to utilize the marine creatures drawn by Korean painting technique as various digital contents. To do this, it is needed to create a Korean atmosphere in terms of the emotional aspects of 3D contents by using the textures of the Korean painting techniques presented above, even if we produce 3D graphics. Figure 3 can be an example of 3D marine biological modeling mapping the characteristics of Korean technique to a texture.

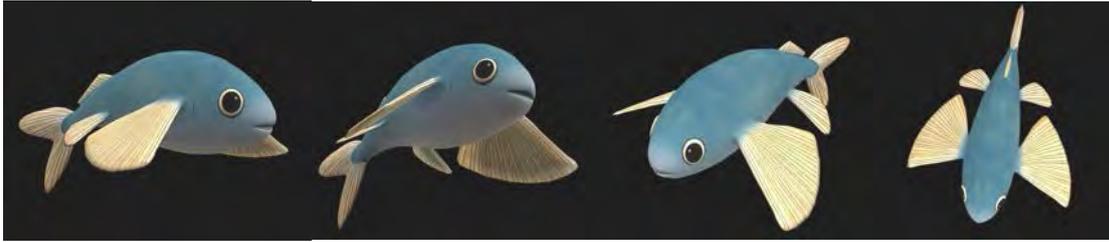


Figure 3. An Example of Marine Biological Modeling Using Texture of Korean Method

#### 4. Conclusion

In this study, we proposed an illustration technique applying Korean painting technique as a method to visualize the knowledge of marine life of “Jasaneobo.” The illustration of marine creatures made in this way are presented with realistic expressions and characterized expressions so that they can use for various purposes and targets. It can be interpreted as extending the visual data of marine life to various digital convergence contents of modernity which are not included in “Jasaneobo” .

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