

# The Method of Integrating Virtual Reality with Brainwave Sensor for an Interactive Math's Game

Erdhi Widyarto Nugroho  
Information System department  
Soegijapranata Catholic University  
Semarang, Indonesia  
erdhi@unika.ac.id

Bernardinus Harnadi  
Information System department  
Soegijapranata Catholic University  
Semarang, Indonesia  
bharnadi@unika.ac.id

**Abstract**— The implementation of the Virtual Reality (VR) on game is practical for in various fields, especially in the field of Education. The implementation of a mobile based VR game is example where the players of game feel as in the real world.

However, the VR game has the weakness on limited interaction of their player with the virtual environment created by the game. Currently, the interactions pass through the buttons on mobile phone and joysticks. For this reason, this research investigates the alternative media to control the virtual environment of the game using brain sensor. The prototype was created using “mindwave neurosky” as brain sensor and thinkgear as sensor drive to construct the experiment of mobile based virtual reality math game

This research tests three modes signal including meditation, attention and beta signal. A meditation signal was taken when the player open and close the eye. While attention and beta signals were taken when the player focuses. The result is some model to control the VR math game with brain sensor for child five or six year old's.

**Keywords**-component; Math Game; method; VR ; brainwave sensor;

## I. INTRODUCTION

In recent years, Information Technology has developed rapidly and contributed of changes in various fields, one of which is virtual reality technology. Virtual reality is a technology describing a three-dimensional environment simulated by a computer and someone can interact with the environment. In virtual reality, the environment is actually imitated and only existing in imagination.

Virtual reality or VR technology is a technology enabling users to interact with the environment virtually. Virtual reality technology is widely used in various fields, including medicine, education, architecture, entertainment. The Implementation of VR Technology in education and entertainment is VR Game. When virtual reality technology is applied in games, players will feel like they live in the game world.

According to Mark Zuckerberg, the founder of Facebook at the CES (Consumer Electronics Show) event on January 2016 in Vegas stated that technology will lead to virtual reality applications in the next 5-10 years [1]. Currently, developers and producers in Information Technology area are competing to develop VR technology such as Google, Facebook, Samsung, LG, Sony, and other IT companies. The effect of this competing can be estimated that the market will be flooded with these VR application products in the coming years.

The advantage of VR games is their players will feel in environment designed a virtually. The player feels

experiencing as he is in the game world itself. This experience is not found in other versions of games. However, the VR application has weaknesses, one of which is the interaction with the surrounding environment, or in other words the VR application requires an interface device connected to a VR device. The reason is VR devices are only a tool to see the surrounding environment virtually. Whereas to experience real feelings and other interactions are needed like the movements of the hands, and feet.

At the present several previous studies have used sensors to detect player movements conducted by Barmoutis in their research using Kinect sensors [2]. While Yulia, Conn, and Lee used the glove hand sensor in virtual 3D [3], [4], [5]. They use an accelerometer sensor and a gyroscope to detect hand movements. The studied was also done by Tangeldeen with the difference in the sensors was implemented for hand rehabilitation [6].

The sensors have several disadvantages, one of which is the players are not free to move because they are limited by the sensor area. In addition, some of these sensors cannot detect several movements such as the player's forward and backward motions. To overcome this weakness, brain control are used to interact with the VR world. The advantage of this sensor is it does not require a separate area and can detect player's forward and backward motions.

## II. RELATED ON WORK

In recent years, a large number of Brain Control Interfaces (BCI) systems have been developed to provide alternative communication tools for people with severe neuromuscular disorders. Hundreds of BCI studies have been published to promote the development or enhancement of methodologies of signal processing, development of new BCI paradigms or improvements of existing BCI, investigation of factors that influence the performance of BCI systems, and practical application of BCI technology [7].

Many of BCI applications are implemented in different areas, namely mental speller [8], [9], mouse control [10], [11], robot arm control [12], game applications [13], [14], navigation [15] , and brain-controlled smart home systems [16],[17].

BCI mobile phone applications have also been developed. One of the first mobile application projects used a prototype wireless Electroencephalography (EEG) headband with 4 electrodes targeting areas of hairless skin on the forehead [18]. This project connects nerve signals to cellphones to display visualization and to analyze the signals simplify. However, cellular devices are more used to a visual than a cellphones. Other EEG and wireless systems can be used with cellular phones. They consist of a bio-signal four-

line acquisition module and they are used as a telephone that do calling directly with 10 digit telephone numbers [19].

### III. LITERATURE REVIEW

#### A. Neurosky Mindwave Headset

The Mindwave Headset is a device manufactured by Neurosky Technologies [20]. This device consists of a headset, ear clip, and sensor arm (Fig. 1). This device can send signals using Bluetooth technology. The headset and ground electrodes are in the ear clip and the EEG electrodes are on the sensor arm, they are placed on the forehead above the eyes.

MindWave is mobile device and safe for measuring and producing EEG power spectrum (alpha waves, beta waves, etc.). The flashing power value measured by the Electromyography (EMG) Sensor is in the NeuroSky device. The MindWave Mobile Headset transfers data via Bluetooth. The Headset is non-invasive which will not cause pain in players who use headsets.



Fig. 1. headset Mindwave

The Mindwave headset is a single electrode, non-invasive, and a low-cost device. This tool transmits raw EEG signals, brain waves, blinking data, and other data using Bluetooth. This headset contains ThinkGear NeuroSky technology measuring and sampling EEG signals at a 512 Hz sampling frequency. Electrodes are placed in the Fp1 position like the 10/20 system.

#### B. Thinkgear - Application Programming Interface (API)

ThinkGear-API is software that is used to interact with NeuroSky Mobile devices. NeuroSky mobile must be connected to external devices such as desktop computers, servers, microcontrollers, cellphones, tablets, or devices that supports Bluetooth connections.

ThinkGear communication drivers can be \*.dll; \*.bundle, or \*.jar files depending on the programming language. A programmer can use the library to call functions in drivers using supporting programming languages such as C, C++, C#, Objective C, or Java. The research creates experiment using the Android platform. The platform needs library files are needs library file to develop application.

To develop an Android while application using a cell phone connected to mindwave. The Java language environment requires ThinkGear library to compiled into a .jar file. After attaching this library, developers can create applications using ThinkGear technology.

Usually, EEG signal processing and real-time classification algorithms are designed for complex

performance. Some of them use a combination of various classification methods for EEG classification. Mobile phones have limited resources with lower power efficiency, so it is impossible to implement and run them in the form of cellular applications. However, the ThinkGear Android API can reduce the complexity of managing connections and handle parsing of streaming data from an EEG headset. This convenient software interface supplies raw data and pre-process data. Software developers can receive values of concentration and relaxation normalized to the range of 0-100%. The muscle movements handling eye blinking are normalized in the same way. This is very convenient and helping to hinder analyzing raw data. Consequently the application of brain wave sensing applications need to import the library by adding the necessary settings and teardown functions, and making the object handler as a notification.

#### C. Virtual Reality (VR)

The term of Virtual reality (VR) was introduced by Jaron Lanier established a company involved in VR. Virtual reality is a computer technology connecting with the surrounding environment a virtual world in simulation with 3D images. VR is connected with players in real time and can be connected with other players. This technology is pseudo-natural immersion or players can move naturally so that movement in the real world is the same with the virtual world through components of sensors.

Some elements of Virtual Reality [21]:

- The virtual world, which is the content of a virtual medium can be screen play or script. through this element, players will experience the virtual world.
- Immersion, That is sensing existence in an environment. These immersions are divided into several types, namely mental immersion, physical immersion, and mentally immersion.
- Sensory feedback, that is information about cyberspace displayed to the player's senses. That sensory feedback can be visual, audio, or touch.
- Interactivity, That is a virtual world responding to user actions in real time.

### IV. DESIGNING

#### A. Designing flows

The design of the brain detection sensor for Virtual reality games is shown in Figure 2. The brain detection device in the form of neurosky Mindwave will provide signal raw data for mobile phones with VR games. Communication between neurosky Mindwave to mobile through a Bluetooth signal.

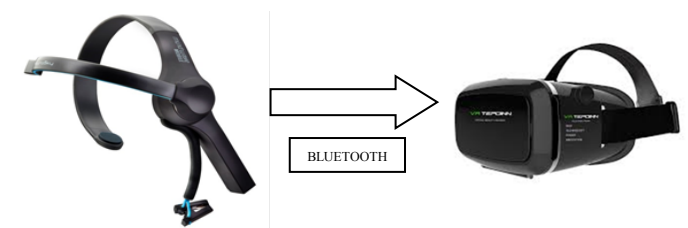


Fig. 2. The Designing of integrating VR with brain sensor (source: <http://developer.neurosky.com>)

Figure 3 shows a flowchart of integrating virtual reality with brain sensor in programming environment. The virtual game applied in this research was the addition and subtraction math game for five or six year old's. In this game, players will be escorted into a virtual world in which having several questions of addition and subtraction. When any questions are exist to be answered, the program will wait for input signal from the brain sensor. When the question is answered correctly, the score will increase by 10 and it will be decreased by 10 if it is wrong. When all questions have been answered, the total score will be added and then ranked.

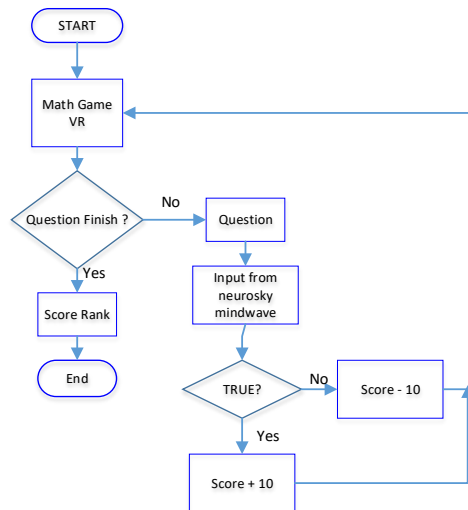


Fig. 3. Integrating virtual reality with brain sensor

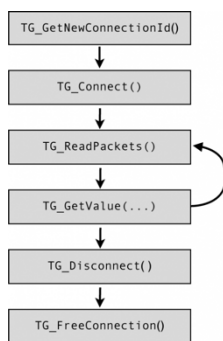


Fig. 4. The steps design neurosky brain sensor (source from <http://developer.neurosky.com>)

## V. DISCUSSION

The signal output of Neurosky Mindwave used as an input of VR game can be visualized by brainwave visualizer application. The application helps to detect the signal from Neurosky Mindwave. Figure 5 shows a visual and graphical display of visualization (Brainwave Visualization) that displaying each data sent by the headset.

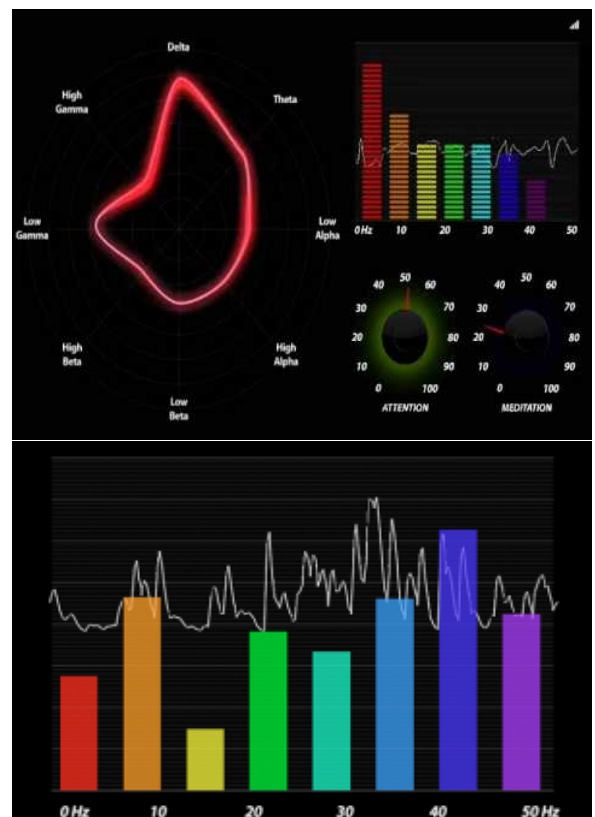


Fig. 5. Graphic of parameter brainwave sensor with Brainwave Visualization application(source from <http://developer.neurosky.com>)

The Brain Visualizer application can display several types of output data, namely Attention, Meditation, and 8 other types of brain signals (Delta signals, Theta, Low Alpha, High Alpha, Low Beta, High Beta, Low Gamma, and mid Gamma).

The next step is the selection of signals through testing. The selected signal is a signal can trigger the answer needed, namely the meditation signal and attention signal and beta signal. Meditation signals are chosen to represent the situation of closing eyes of the player. While the attention signal and beta signal are chosen to represent the state of the player when focusing his attention. The sampling of testing adjusted for who is play the game VR. This Game VR has been taken for children aged 5 and 6 years old. The results are shown in Figure 6.

Figure 6 (a) shows a graph of the meditation signal when the eyes are open and eyes are closed. The view of signal (1) represents the state when the eyes are closed and signal (2) represents the state of the eyes are opened. Whereas Figure 6 (b) views the attention signal when the player focuses on something. Signal (1) is an attention signal that representing the state of the player is focusing on something and signal (2) is a attention signal representing the state of the player not in focus. Both of graphs are viewed in Amplitude and time axis. Figure 6 (c) views the beta signal when the player focuses on something. Signal (1) is an beta signal that representing the state of the player is focusing on something and signal (2) is a beta signal representing the state of the player not in focus. Both of graphs are viewed in Amplitude and time axis.

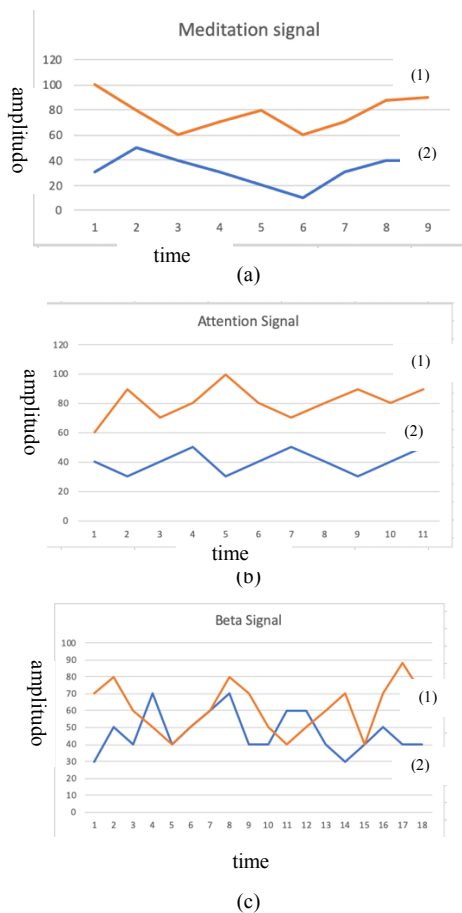


Fig. 6. (a) the graphic of meditation signal when closed eyes (1) and open eyes(2). (b) the graphic of attention signal when focusing sometimes (1) and not focusing sometimes (2).(c) the graphic of beta signal focusing sometimes (1) and not focusing sometimes (2).

TABLE I. THE AVERAGE OF BRAINWAVE SIGNAL

Average Amplitude	Signal	Condition
32.22	Meditation signal	Open eyes
77.55	Meditation signal	Closed eyes
40	Attention signal	Not focusing
80.9	Attention signal	Focusing
47.22	Beta Signal	Not focusing
61	Beta Signal	Focusing

From table 1, shows that the average meditation signal and attention signal have more range than beta signals. that it is easier to use meditation signals and attention signals than beta signals. In the practice, Meditation signals have more easier than attention signal because the players are children aged 5 and 6 years who are easier to close their eyes than focus on something. The next testing is the detection of brain signals and the results are shown in Table 2. Table II shows that when player choose the right answer, he will close his eyes for a moment about 1 second.

TABLE II. THE METHOD OF DETECTION BRAINWAVE SIGNAL

Signal meditation	time	Condition VR Game
< 60	$\infty$	idle
> 70	1-2 second	Choosing the answer

The math VR game is made using unity game engine. the player choose menus and answers of question using meditation signal. To detect meditation signal, Unity game engine need think gear library. There is a procedure for reading meditation signal :

- connecting

```
int handleID = ThinkGear.TG_GetNewConnectionId();
int connectStatus = ThinkGear.TG_Connect(handleID,
    "/dev/tty.MindSet",
    ThinkGear.BAUD_9600,
    ThinkGear.STREAM_PACKETS);
```

- reading data

```
float meditation = ThinkGear.TG_GetValue(handleID,
    ThinkGear.DATA_MEDITATION);
```

- disconnecting

```
ThinkGear.TG_Disconnect(handleID);
```

The last testing uses a VR game application. On each question asked on the screen, the player was helped to focus on choosing the answer he wanted and then closing his eyes for a moment. Then proceed with the other questions. Figure 7 shows the questions, the answers, and the total score of games.

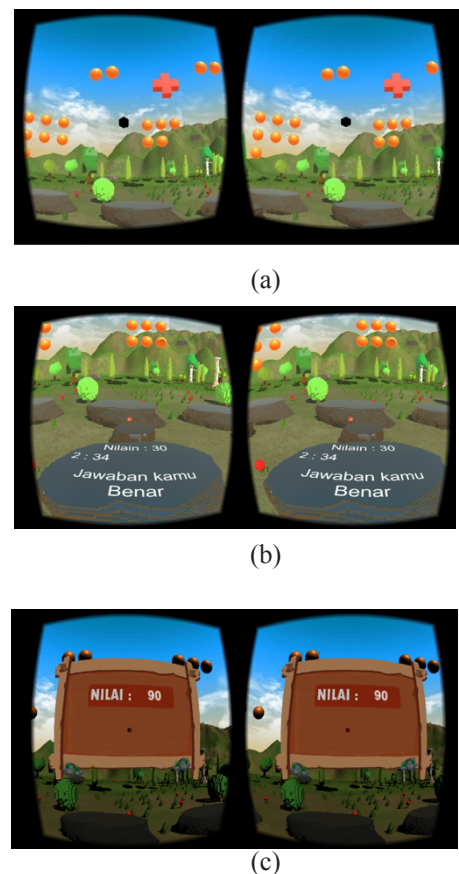


Fig. 7. (a) the questions on VR Game,(b) the answer on VR Game (c) Total Score of the game

## VI. CONCLUSION

Detection of brain signals is used to select answers from the questions given in VR games. The choosing of answers is helped by the focus point in the game. The player is a child aged 5 and 6 years. That is why the signal used in brain detection is meditation signal and Meditation signal used when the player can choose the answer by closing their eyes for a moment.

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# CERTIFICATE OF CONTRIBUTIONS

ERDHI WIDYARTO NUGROHO AND BERNARDINUS HARNADI

ENTITLED

THE METHOD OF INTEGRATING VIRTUAL REALITY WITH BRAINWAVE SENSOR FOR AN INTERACTIVE MATH'S GAME

HAS CONTRIBUTED TO

2019-16<sup>TH</sup> INTERNATIONAL JOINT CONFERENCE ON COMPUTER SCIENCE AND SOFTWARE ENGINEERING (JCSSE)

JULY 10-12, 2019

AMARI PATTAYA HOTELS, PATTAYA, THAILAND

*U. Neammanee.*

KRITSANA NEAMMANEE, PH.D.  
DEPARTMENT OF MATHEMATICS  
AND COMPUTER SCIENCE, FACULTY OF SCIENCE,  
CHULALONGKORN UNIVERSITY  
HONORARY COMMITTEE

*L. L.*

CHIDCHANOK LURSINSAP, PH.D.  
DEPARTMENT OF MATHEMATICS  
AND COMPUTER SCIENCE, FACULTY OF SCIENCE,  
CHULALONGKORN UNIVERSITY  
GENERAL CHAIR

*K. Chinnasarn*

KRISANA CHINNASARN, PH.D.  
FACULTY OF INFORMATICS,  
BURAPHA UNIVERSITY  
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The 16<sup>th</sup> International Joint Conference on Computer Science  
and Software Engineering

July 10 - 12, 2019  
Amari Pattaya, Chonburi, Thailand.

ISBN 978-1-7281-0719-9





**2019**  
July 10-12  
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<b>July 10, 2019</b>	<b>13.00-16.00</b>	<b>Registration</b>	
	<b>16.30-17.30</b>	<b>Local Organizing &amp; Technical Program Committee Meeting</b>	
	<b>17:30-20:30</b>	<b>Welcome Reception for Keynote Speakers</b>	
<b>July 11, 2019</b>	<b>08.00-09.00</b>	<b>Registration</b>	
	<b>09.00-09.25</b>	<b>Opening Ceremony</b>	
	<b>09.25-10.10</b>	<b>Keynote-I</b>	<b>Matching Next-Gen HPC with Target Applications</b> Professor Dr. Pascal Bouvry, University of Luxembourg, Luxembourg
	<b>10.10-10.30</b>	<b>Break</b>	
	<b>10.30-11.15</b>	<b>Keynote-II</b>	<b>Business Transformation with Blockchain</b> By Professor Dr.Dusit Niyato, School of Computer Science and Engineering and, by courtesy School of Physical & Mathematical Sciences, at the Nanyang Technological University Singapore
	<b>11.15-12.00</b>	<b>Keynote-III</b>	<b>Technology in Travel Business</b> By Mr. Chamreon Visavachaipan, Chief Executive Officer, Jetour (Thailand) Co., Ltd.
	<b>12.00-13.00</b>	<b>Lunch &amp; Free Discussion</b>	



July 11, 2019		PaperID	Meeting room I Regular: Machine Learning and Computational Intelligence Chair: Assoc. Prof. Dr. Rajalida Lipikorn and TBA	PaperID	Meeting room II Regular: Intelligent Applications Chair: Asst. Prof. Dr. Kingkarn Sookhanaphibarn and TBA	PaperID	Meeting room III Steering Committee Meeting	
	13.00-13.20	1570528326	Development of Behavior Monitoring System for Honeybees in Hive Using RFID sensors and Image Processing; By Shinya Takahashi, Koji Hashimoto and Sasaki Maeda (Fukuoka University, Japan); Yujie Li (Fukuoka University); Naoyuki Tsuruta and Hiroyuki Ai (Fukuoka University, Japan)	1570542774	IVAA: Intelligent Vehicle Accident Analysis System; By Kundjanasith Thonglek (○Nara Institute of Science and Technology, Japan); ○ Norawit Uraileertprasert (Vidyasirimedhi Institute of Science and Technology, Thailand); Patchara Pattiyathane and Chantana Chantrapornchai (Kasetsart University, Thailand)	-	-	
	13.20-13.40	1570536960	Analysis and Prediction of Temporal Twitter Popularity Using Dynamic Time Warping; By Rattasit Sermsai and Sirisup Laohakiat (Srinakharinwirot University, Thailand)	1570542836	DATA++: An Automated Tool for Intelligent Data Augmentation Using Wikidata; By Waran Taveekarn, Chatchanin Yimudom and Supisara Sukkanta (Mahidol University, Thailand); Steven Lynden (National Institute of Advanced Industrial Science and Technology (AIST), Japan); Suppawong Tuarob (Mahidol University, Thailand)	-	-	
	13.40-14.00	1570537018	Text Generation for Imbalanced Text Classification; By Suphamongkol Akkaradamrongrat, Pompimon Kachamas and Sukree Sinthupinyo (Chulalongkorn University, Thailand)	1570542940	Multi-Paths Generation for Structural Rule Quests; By Thongtham Chongmesuk and Vishnu Kotrajaras (Chulalongkorn University, Thailand)	-	-	
	14.00-14.20	1570537322	Information Extraction based on Named Entity for Tourism Corpus; By Chantana Chantrapornchai (Kasetsart University, Thailand); Apsit Tunsakul (Kasetsart University, Thailand)	1570542954	Kiddy Manner: A Game-Based Mobile Application for Children Learning Thai Social Etiquette; By Songsri Tangsripairoj, Mathawee Sukkhet, Jidapa Sumanotham and Benya Yusuk (Faculty of ICT, Mahidol University, Thailand)	-	-	
	14.20-14.40		Break					

July 11, 2019	PaperID	<b>Meeting room I</b> <b>Regular: Machine Learning and Computational Intelligence</b> <b>Chair: Assoc. Prof. Dr. Nagul Cooharajanone and TBA</b>	PaperID	<b>Meeting room II</b> <b>Regular: Machine Learning and Computational Intelligence</b> <b>Chair: Asst. Prof. Dr. Komate Amphawan and TBA</b>	PaperID	<b>Meeting room III</b> <b>Regular: Internet of Things and Intelligent Computer Networks and Applications</b> <b>Chair: Assoc. Prof. Dr. Peraphon Sophatsathit and Dr. Pichet Wayalun</b>
	14.40-15.00 1570537371	Cross-Category Product Recommender System based on Multi-Criteria Rating using Diversity and Novelty Evaluation; By Saranya Maneeroj (Chulalongkorn University, Thailand); Pongsakorn Jirachanchaisiri, Chanisara Suksomjit and Apirom Zatloukal (Chulalongkorn University, Thailand)	1570543067	Speech-to-Thai Sign language conversion for Thai deaf: a case study of crime news; By Nattapol Namyang, Jarukit Lumpaolertwilai and Suphakant Phimoltares (Chulalongkorn University, Thailand)	1570542673	The Control Model for Environmental Factor Effecting on Growth of St. John's wort; By Narongsak Lekbangpong (Faculty of Science and Industrial Technology Prince of Songkla University, Surat Thani Campus, Thailand); Jirapond Muangprathub (Faculty of Science and Industrial Technology, Prince of Songkla University & Suratthani Campus, Thailand); Theera Srisawat (Faculty of Science and Industrial Technology Prince of Songkla University, Surat Thani Campus, Thailand); Apirat Wanichsombat (Faculty of Science and Industrial Technology Prince of Songkla University, Surat Thani Campus, Thailand)
	15.00-15.20 1570538865	Physically-Based Modelling and Simulation of Track-based Main Battle Tank System for a realistic 3D Game; By Yodthong Rodkaew (UTCC, Thailand)	1570543079	Semi-Automatic Word-Aligned Tool for Thai-Vietnamese Parallel Corpus Construction; By Dang Ngoc Chuong (KhonKaen University Thailand, Thailand); Pusadee Seresangtakul (Khon Kaen University, Thailand)	1570543106	A low-cost RTK device with cloud-based application for RTK survey solution; By Sittha Saisawan (Naresuan University, Thailand); Duangduen Asavasuthirakul (Naresuan University, Thailand); Antony Harfield (Naresuan University, Thailand); Prasert Wiangsukphaiboon (Nakra Microtek, Thailand)
	15.20-15.40 1570539829	Vehicle Logo Detection Using Sliding Windows with Sobel Edge Features and Recognition Using SIFT Features; By Pakorn Watanachaturaporn (King Mongkut's Institute of Technology Ladkrabang & Faculty of Engineering, Thailand); Jatupon Benjaprakairat (King Mongkut's Institute of Technology Ladkrabang, Thailand)	1570547250	Graph Clustering with K-Nearest Neighbor Constraints; By Wararat Jakawat (Prince of Songkla University, Thailand); Raywat Makkhongkaew (Business, Thailand)	1570527283	Development of Reliable Wireless Communication System for Secure Blockchain-based Energy Trading; By Zhuoxian Huang (Energy Research Institute @ NTU, Singapore); Kongrath Suankaewmanee (Nayang Technological University, Singapore); Jiawen Kang (Nanyang Technological University & Guangdong University of Technology, Singapore); Dusit Niyato (Nanyang Technological University, Singapore); Pei Sin Ng (Energy Research Institute @ NTU, Singapore)

July 11, 2019	PaperID	Meeting room I Regular: Machine Learning and Computational Intelligence Chair: Assoc. Prof. Dr. Nagul Cooharojananone and TBA	PaperID	Meeting room II Regular: Machine Learning and Computational Intelligence Chair: Asst. Prof. Dr. Komate Amphawan and TBA	PaperID	Meeting room III Regular: Internet of Things and Intelligent Computer Networks and Applications Chair: Assoc. Prof. Dr. Peraphon Sophatsathit and Dr. Pichet Wayalun	
	15.40-16.00	1570541149	Fake News Detection System using Article Abstraction; By Kyeong-hwan Kim and Chang-Seong Jeong (Korea University, Korea)	1570547316	Optimizing a Number of Overlapping Items for Equating Estimated Item Parameters; By Sarunya Deachnatee (Thammasat University, Thailand)	1570542701	An In-Memory Checkpoint-Restart Mechanism for a Cluster of Virtual Machines; By Jumpol Yaothanee and Kasidit Chanchio (Thammasat University, Thailand)
	16.00-16.20	1570542302	An Individual Local Mean-based 2DPCA for Face Recognition under Illumination Effects; By Kangsadan Hancherngchai (Naresuan University, Thailand); Taravichet Titijaronroj (King Mongkut's Institute of Technology Ladkrabang, Thailand); Jaratsri Rungrattanaubol (Naresuan University, Thailand)	1570547403	Region-Focus Training: Boosting Accuracy for Deep-Learning Image Segmentation; By Chanok Pathompatai and Pinyo Taeprasartsit (Silpakorn University, Thailand)	1570547233	Enhanced DDoS Detection using Hybrid Genetic Algorithm and Decision Tree for SDN; By Parinya Preamthaisong, Anucha Auyporntrakool, Phet Aimtongkham, Titaya Sriwuttisap and Chakchai So-In (Khon Kaen University, Thailand)
	16.20-16.40	1570542304	Modified Scale-Space Analysis in Frequency Domain Based on Adaptive Multiscale Gaussian Filter for Saliency Detection; By Jenjira Jaemsiri (Naresuan University, Thailand); Taravichet Titijaronroj (King Mongkut's Institute of Technology Ladkrabang, Thailand); Jaratsri Rungrattanaubol (Naresuan University, Thailand)	-	-	-	-
16.40-17.30	Free discussion						
17.30-20:30	Welcome Reception / Banquet						

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	09.00-09.20	1570542305	Seven Segment Display Detection and Recognition using Predefined HSV Color Slicing Technique; By Sorawee Popayorn (Naresuan University, Thailand); Taravichet Titijaroonroj (King Mongkut's Institute of Technology Ladkrabang, Thailand); Thanathorn Phoka and Wansuree Massagram (Naresuan University, Thailand)	1570537927	Thai Handwriting beautification; By Supawan Tasanaprasert (KMITL, Thailand); Karun Tonmaithong (Ladkrabang, Thailand)	1570542506	An Image-Based Vocabulary Learning System Based on Multi-Agent System; By Preecha Tangworakitthaworn (Mahidol University, Thailand)
	09.20-09.40	1570542312	Quantitative Trading Machine Learning Using Differential Evolution Algorithm; By Chukiat Worasucheeep (King Mongkut's University of Technology Thonburi, Thailand)	1570528296	Discovering Factors Associated with Online Gaming Behaviors; By Bernardinus Hamadi (Soegijapranata Catholic University, Indonesia)	1570542924	Software defect detection based on selected complexity metrics using fuzzy association rule mining and defective module oversampling; By Mohammad Naufal (Universitas Surabaya, Indonesia); Selvia Kusuma (Institut Teknologi Sepuluh Nopember, Indonesia)
	09.40-10.00	1570542529	Ensemble CNN and MLP with Nurse Notes for Intensive Care Unit Mortality; By Aye Hnin Khine (Prince of Songkla University, Thailand); Wiphada Wettayaprasit (Prince of Songkla University & Faculty of Science, Thailand); Jarunee Duangsuwan (Prince of Songkla University, Thailand)	1570529455	Enhancing a Keyword Search Using Segmentation and Similarity Measure Algorithms: A Case Study of Phuket Attractions; By Kitsiri Chochiang (Prince of Songkla University, Phuket Campus, Thailand); Witaya Khuanwilai (Prince of Songkla University, Thailand)	1570546325	Automatic Question Generation With Classification Based On Mind Map; By Selvia Kusuma (Institut Teknologi Sepuluh Nopember, Indonesia); Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia); Chastine Faticah (Institut Teknologi Sepuluh Nopember, Indonesia); Mohammad Naufal (Universitas Surabaya, Indonesia)

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	10.00-10.20	1570542534	Convolutional Neural Networks Using MobileNet for Skin Lesion Classification; By Wannipa Sae-Lim (Prince of Songkla University, Thailand); Wiphada Wettayaprasit (Prince of Songkla University & Faculty of Science, Thailand); Pattara Aiyarak (Faculty of Science, Prince of Songkla University, Thailand)	1570542789	An Information Integration System to Continuing of Care Case study Nongsung Hospital, Mukdahan THAILAND; By Pranithan Klangrapunt (Khonkaen University & Nongsung Hospital, Thailand); Pusadee Seresangtakul (Khon Kaen University, Thailand)	1570547008	User Story Extraction from Online News for Software Requirements Elicitation: A Conceptual Model; By Indra Kharisma Raharjana (Institut Teknologi Sepuluh Nopember & Universitas Airlangga, Indonesia); Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia); Chastine Fatchah (Institut Teknologi Sepuluh Nopember, Indonesia)
	10.20-10.40	1570542693	A Hotel Hybrid Recommendation Method based on Context-Driven using Latent Dirichlet Allocation; By Weraphat Nimchayanan (Chulalongkorn University, Thailand); Saranya Maneeroj (Chulalongkorn University, Thailand)	1570537320	ARCode: Augmented Reality Application for Learning Elementary Computer Programming; By Sirawit Sittiyuno and Kornchawal Chaipah (Khon Kaen University, Thailand)	1570547291	Sequence Diagram Similarity Measurement: A Different Approach; By Evi Triandini (STMIK STIKOM Bali, Indonesia); Reza Fauzan (Institut Teknologi Sepuluh Nopember & Politeknik Negeri Banjarmasin, Indonesia); Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia); Siti Rochimah (Institut Teknologi Sepuluh Nopember, Indonesia)
	10.40-11.00		Break				

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	11.40-12.00	1570542740	Thai Sign Language Recognition Using 3D Convolutional Neural Networks; By Nutisa Sripairojthikoon (King Mongkut's University of Technology Thonburi, Thailand); Jaturon Hansomboon (KMUTT, Thailand)	1570546542	A DIFF-Based Indoor Positioning System Using Fingerprinting Technique and K-Means Clustering Algorithm; By Apichon Anuwatkun (The Electrical Engineering Graduate Program, Faculty of Engineering, MUT, Thailand); Jirapat Sangthong (Telecommunication Engineering, Faculty of Engineering, Mahanakorn University of Technology, Thailand); Sommart Sang-Ngern (Mahanakorn University of Technology, Thailand)	1570547324	A Linear-time Algorithm for Optimal Tree Completion; By Nonthaphat Wongwattanakij and Chawin Aiemvaravutigul (Kasetsart University, Thailand)
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	13.40-14.00	1570543029	An Open-source Based Automatic Car Detection System using IoT; By Assadarat Khurat (Faculty of Information and Communication Technology, Mahidol University, Thailand); Nappaphol Siriphun (Mahidol University, Thailand); Jiratchaya Saingthong and Jirapat Sriwiphasathit (Faculty of Information and Communication Technology, Mahidol University, Thailand)	1570542908	WhatTheHealth: An Android Application for Consumers of Healthy Food; By Songsri Tangsripairoj, Nonthpat Wongkham, Bongkotmanee Leelalerkiat and Sarun Chuenpukdi (Faculty of ICT, Mahidol University, Thailand)	1570543027	Impacts of Camera Frame Pacing for Video Recording on Time-Related Applications; By Nattapong Tangjui and Pinyo Taeprasartsit (Silpakorn University, Thailand)
	14.00-14.20	1570543035	Natural Language Contents Evaluation System for Detecting Fake News using Deep Learning; By Yechan Ahn and Chang-Seong Jeong (Korea University, Korea)	1570542745	Moving object detection using integrated spatial and motion-based method; By Manit Chansuparp and Kulsawasd Jitkajornwanich (King Mongkut's Institute of Technology Ladkrabang, Thailand)	1570543053	IoT-based Seven Segment Display Reader with Chessboard Calibration and Template Determination; By Wansuree Massagram and Thanathorn Phoka (Naresuan University, Thailand)
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	15.00-15.20	1570543082	Classification of Anger Voice in Call Center Dialog; By Widakorn Saewong (Chulalongkorn University, Thailand); Janjao Mongkolnavin (Chulalongkorn Business School, Chulalongkorn University, Thailand)	1570543074	Condition Based Maintenance for Data Center Operations Management; By Montri Wiboonrat (Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand)	1570547314	Eye-Tracking Based Visualizations and Metrics Analysis for Individual Eye Movement Patterns; By Rasa Bhattarai (King Mongkut's Institute of Technology, Ladkrabang, Thailand)
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