

# Program

Time	Conference Hall	103	104	402-1	402-2	408-1	408-2	Poster Area
Wednesday, September 15								
09:00-10:30	A1: Wireless, RF, and Network Technologies I	A2: Deep Learning-Based Multimedia Processing		A4: Artificial Intelligence Applications and Technologies in Internet of Things I	A5: Audio/Video Systems and Signal Processing I	A6: Innovation in Communication Technology I	A7: Advanced Computing Systems and Applications	
10:30-10:50	Coffee Break							
10:50-12:20	B1: Wireless, RF, and Network Technologies II	B2: Artificial Intelligence Models for Multimedia: Representation and Applications I	B3: Intelligent Multimedia Computing (10:20-12:20)	B4: Artificial Intelligence Applications and Technologies in Internet of Things II	B5: The Emerging Data-Driven Technologies for Smart Service Systems	B6: Innovation in Communication Technology II	B7: Computer Communications and Signal Processing for IoT I	
12:20-13:10	Lunch							
13:10-14:10	C1: GaN Based Converters for Powering 5G and Beyond	C2: Artificial Intelligence Models for Multimedia: Representation and Applications II	C3: Intelligent Circuits and Systems	C4: Artificial Intelligence Applications and Technologies in Internet of Things III	C5: Computer Networks, Sensor Technologies and Big Data Computing	C6: Smart Technologies, Management and Control for Energy Systems	C7: Computer Communications and Signal Processing for IoT II	Poster A
14:10-14:20	Opening Ceremony (Conference Hall)							
14:20-15:20	Keynote Speech I: Jyh-Ching Juang (Conference Hall)							
15:20-15:40	Coffee Break							
15:40-17:10	D1: Signal Processing for Communication, Radar, Optics, Circuit Design, AI and GPU	D2: Deep Learning Based Robotic Systems	D3: Advanced Circuits and Signal Processing Systems	D4: Communication and Human-Centered Information Systems for Internet Applications	D5: Audio/Video Systems and Signal Processing II & Consumer Systems for Healthcare and	D6: Smart Sensing Technologies & Applications for Human Health Promotion	D7: Computational Intelligence Techniques for Electronic Design Automation	Poster B

					Wellbeing			
17:10-18:10	Keynote Speech II: Yoshihiro Okada (Conference Hall)							
18:30-20:30	Welcome Reception (Discovery Hotel)							

## Thursday, September 16

09:00-10:30	<b>E1:</b> Intelligent Devices, Circuits, Systems, and Algorithms for Smart Lives	<b>E2:</b> Circuits and Systems for Intelligent Signal Processing Technology	<b>E3:</b> Advanced Machine Learning for Smart IoT Applications	<b>E4:</b> Advanced Cryptography and Its Applications	<b>E5:</b> Best Paper Competition	<b>E6:</b> Efficient Algorithm and Architecture Designs for Circuit and System	<b>E7:</b> QoS/QoE-Related Technologies for Future Communication Systems	Poster C
10:30-10:50	Coffee Break							
10:50-11:50	Keynote Speech III: Donald Y. C. Lie (Conference Hall)							
11:50-13:10	Lunch							
13:10-17:00	Tour							
17:30-21:00	Banquet (Four Points by Sheraton)							

## Friday, September 17

09:00-10:30	<b>F1:</b> Consumer IC Researches and Applications	<b>F2:</b> Human-Machine Interaction and User Experience I	<b>F3:</b> Machine Learning, Deep Learning and AI in CE I	<b>F4:</b> Biomedical Circuits and System Technology and Bioinformation Procession & Non-Invasive Biomedical Technology and Digital Health Care	<b>F5:</b> Energy Efficient Objects Detection for Smart Devices	<b>F6:</b> Artificial Intelligence of Things for the Consumer Technology	<b>F7:</b> Internet of Things, Internet of Everywhere, and Edge Computing	Poster D
10:30-10:50	Coffee Break							
10:50-11:50	Keynote Speech IV: Rong-Chung Liu (Conference Hall)							
11:50-13:10	Lunch							
13:10-14:40	<b>G1:</b> Automotive CE Applications & Application-Specific CE for Smart Cities	<b>G2:</b> Human-Machine Interaction and User Experience II & Sensors and Actuators	<b>G3:</b> Wearable Technology on the Health and Medical Electronics	<b>G4:</b> Consumer Electronics and Services for AIoT Technology and	<b>G5:</b> Machine Learning, Deep Learning and AI in CE II	<b>G6:</b> Security and Privacy of CE Hardware and Software Systems & Smartphone and Mobile		Poster E



Wednesday, September 15

Wednesday, September 15 9:00 - 10:30

A1: Wireless, RF, and Network Technologies I

Room: conference hall

Chair: Ming-Tien Wu (National Penghu University of Science and Technology, Taiwan)

**9:00 *Multibeam Radiations of Aperiodic Phased Array of Antennas Excited by Fisheye Lens BFN***

Su Hsuan Jui (Yuan Ze University, Taiwan); Hsi-Tseng Chou (National Taiwan University, Taiwan); Hao-Ju Huang (National Chung-Shan Institute of Science and Technology, Taiwan); Hsien-Kwei Ho (WavePro Technology Inc., Taiwan)

Multibeam (MB) radiations of antenna arrays need effective beamforming networks (BFNs). This paper presents a fisheye lens-based BFN (FL-BFN) by parallel-plate sandwiched substrates. It implements the beam and antenna excitation ports on the half-circular circumference and straight-line boundaries. The rule to determine the positions of antenna elements is shown for easy design. The performance is validated by using it to excite a Vivaldi antenna array. Measurements over a prototype were performed to validate its feasibility with good agreements. Index Terms-Antenna array, Beamforming network, Fisheye lens, Multi-beam radiation, Parallel-plate substrate.

**9:15 *5G MIMO Antenna with Isolation Effect for Handheld Device Applications***

Chao-Lun Liu, Ming-Tien Wu and Shu Min Tsai (National Penghu University of Science and Technology, Taiwan)

This paper proposes an array antenna design with eight antennas. Each antenna element is composed of an inverted F-shaped antenna. In addition to its broadband characteristics, it also includes an isolation design with each other. The frequency bands are 3.3-3.8GHz, 4.5-4.6GHz, 4.8-4.9GHz, the reflection coefficients of the eight antennas are all less than -10dB, and the coupling effect of these frequency bands are also less than -10dB.

**9:30 *Comparisons of Dielectric Characterization by Microstrip and Grounded Coplanar Waveguide Using Resonator Measurements***

Chien-Chang Huang, Wen-Tsao Fu and Kuan-Chien Cheng (Yuan Ze University, Taiwan)

This paper presents the dielectric characterization of RF printed circuit boards (PCBs), including dielectric constant (DK) and dissipation factor (DF), by microstrip and grounded coplanar waveguide (GCPW) using straight-line resonator measurements, and compares their performances up to millimeter wave regions. The resonant frequencies for different modes are acquired through the measured transmission coefficients, and the effective dielectric constants of the transmission lines (TLs) can be solved. The DK extraction then becomes an inverse problem where the TL propagation constant is calculated based on an initial DK using some empirical formulas with dispersion effects, and the iteration is proceeded until reaching the acceptable error between calculated value and the measured one. The DF can be estimated based on the solved DK with conductor loss including surface roughness. The proposed method is examined by the

RO3003 substrate in the frequency range of 18 GHz to 75 GHz.

### **9:45 Data Transmission Efficiency of the Nonorthogonal CSK-used Optical Code Division Multiple Access System**

Nobuyoshi Komuro (Chiba University, Japan); Hiromasa Habuchi (Ibaraki University, Japan)

This study evaluates the impact of the nonorthogonal Code Shift Keying (CSK)-used Optical Code Division Multiple Access (OCDMA) system on improving the data transmission efficiency of the Intensity Modulation Direct Detection (IM/DD) Optical Wireless Communications (OWCs). The proposed system systematically constructs nonorthogonal sequences. Simulation results show that the proposed system with optimum system parameters outperforms the conventional OCDMA systems. Our obtained results that the systematically constructed nonorthogonal code is useful for enhancing IM/DD OCDMA system performance is a helpful finding for future research approaches.

## A2: Deep Learning-Based Multimedia Processing

Room: 103

Chairs: Jieh-weih Hung (National Chi Nan University, Taiwan), Pei-Jun Lee (National Taiwan University of Science and Technology, Taiwan)

### **9:00 Infrared imagery super-resolution by using a generative adversarial network**

Trong-An Bui (National Chi Nan University, Taiwan); Pei-Jun Lee (National Taiwan University of Science and Technology, Taiwan); Kuan-Min Lee (VIPLab, National Chi-Nan University, Taiwan)

The thermal camera often has a limited spatial resolution compared to the RGB camera with typically provides megapixels of resolution. This study presents a super-resolution architecture for infrared (IR) imagery base on a generative adversarial network. The up-sampling in this proposed network's design generates a new super-resolution image by four times. Moreover, in this paper, generative network and discriminative models for IR images are presented. The small-object features in super-resolution IR images are shown in the simulation section with high quality.

### **9:15 Superpixel algorithm for objects tracking in satellite video**

Guo-Cheng Xu (National Chi Nan University, Taiwan); Pei-Jun Lee (National Taiwan University of Science and Technology, Taiwan); Trong-An Bui (National Chi Nan University, Taiwan)

Moving objects tracking in dynamic scenes is the most important study in satellite video processing. This paper's target is to propose an improved algorithm to track and detect the moving object. The object in the satellite image is a small size, and the ratio between the moving object and the whole frame is tiny. Because the satellite is continuously in motion, the motion vector of object has a high interfere with satellite motion. In order to obtain an identical motion vector for each object, this proposed algorithm presents the architecture based on a superpixel algorithm using simple linear iterative clustering (SLIC) before optical flow motion estimation. The simulation result shows the moving object labeling and prediction succeeded by using proposes algorithm.

### ***9:30 Face and Head Detection for Back View Cases Using Gradient Features and Learning Architecture***

Yi-Wei Tsai, Jian-Jiun Ding and De-Yan Lu (National Taiwan University, Taiwan)

Face detection is an important topic in computer vision. Although there were numerous face detection algorithms over the past decade, some challenging cases remain unresolved. In this paper, we focus on the images with back-view heads. First, features including the image gradient and chrominance are applied to selecting regions which may be hairs. Next, redundant bounding boxes are filtered out by a CNN-based regression model and non-maximum suppression. Finally, geometric information is used for further filtering. Simulations show that the proposed method improves the detection performance for back-view heads, which are hard to be addressed by state-of-the-art face detection methods.

### ***9:45 Integrating deep learning for 360-degree video applying to space user flow and behavior patterns***

Cheng-Yen Lin (National Taipei University of Technology, Taipei Tech, Taiwan);

Sheng-Ming Wang (National Taipei University of Technology, Taiwan)

Modern city means the densely populated and developed industrial and commercial areas. Based on the influence of different types of urban space, time, and industry categories, pedestrians will create different space use patterns. It has always been an important topic for the development of smart cities in the future to understand the user's behavior, movement line, direction, observation of different aggregation modes, and data collection in urban space. This study proposes to use 360 ° camera to capture videos of human space interaction in different spaces, and integrate data pre-processing, image optimization processing, and image recognition deep learning steps, trying to analyze human position in space, basic data reading, walking path and directional interpretation, and aggregation mode. It is hoped that through the collection and analysis of a large amount of data from 360 ° panoramic videos, we can develop an application system for real time and semi-automatic recognition of user characteristics and behavior patterns in cognitive space in the future.

### ***10:00 The effect of reducing the acoustic-frequency resolution for spectrograms used in deep denoising auto-encoder***

Yan-Tong Chen, Shu-Ting Tsai and Jieh-weih Hung (National Chi Nan University, Taiwan)

In this study, we investigate the effect of varying the acoustic-frequency resolution of the spectrogram for the input signals of the deep denoising auto-encoder (DDAE). DDAE is a well-known deep learning structure that learns the relationship between the noisy signal and the respective clean noise-free one. The most commonly used representative for the input signal used to train the DDAE might be the spectrogram, which is the ordered series of the short-time Fourier transform (STFT) of each frame for the input signal. In this paper, we attempt to reduce the acoustic-frequency resolution of the STFT to see its effect of the learned DDAE in terms of the quality and intelligibility of the output signals. The preliminary experimental results indicate that halving the input frequency points (i.e., reducing the frequency resolution by a factor of 2) provides the learned DDAE with almost the same speech quality and intelligibility, while it helps to down-scale the input feature as well as reduce the computation complexity of the DDAE.

# A4: Artificial Intelligence Applications and Technologies in Internet of Things I

Room: 402-1

Chairs: Wen-Hwa Liao (National Taipei University of Business, Taiwan), Jung-Kuei Chang (Tamkang University, Taiwan), Cheng-Chin Chien (Galaxy Software Services Corp., Taiwan), Chih-Yung Chang (Tamkang University, Taiwan)

## **9:00 Learning Pattern Discovery and Prediction using Decision Tree for SPOC**

### **Teaching**

Chunyan Yu and Qi Hui (Chuzhou University, China)

SPOC (Small Private Online courses) is a blended learning model using MOOC as online learning activity. Big data are generated in SPOC learning and reflect how the students learn. The main contributions of this study are: 1) proposing the DTC\_GF algorithm which selects different features to create a better decision tree. 2) improving the decision tree algorithm with Random Forest and CART. 3) applying the DTC\_GF algorithm to predict students' learning achievements—good or bad.

## **9:15 Design and Implementation of Intelligent Identification System of Meter System Based on OpenCV**

Tao Tao, Zijie Liu and Laibing Chen (Anhui University Of Technology, China); Funan Zhang and Yuan Liu (Anhui University of Technology, China)

For some pointer meters, they need regularly to be read the corresponding data and observed artificially in the process of the production and use. But there are many problems, such as large labor intensity, low production efficiency, low reliability, etc. Therefore, this article puts forward with the communication module to transmit data from the camera to the controller, and the controller bases on OpenCV image recognition algorithm to implement data processing. Finally, through the NB-IoT technology to transmit data, implement automatic control function.

## **9:30 Design and Implementation of Smart Home System Based on OneNet Cloud Platform**

Tao Tao (Anhui University Of Technology, China); Ren Lei and Funan Zhang (Anhui University of Technology, China); Hui Wang (Anhui University of Technology, China); Wang Xiao Lin (Anhui University of Technology, China)

Aiming at a series of problems such as waste of electricity resources, unsafe home environment, and high operating cost of hardware equipment in the traditional home scenario, a smart home system based on the OneNet platform was designed. The system uses CC2530 single-chip microcomputer as the main controller for basic household data processing and command control, and uses ESP8266 transmission module for data transmission. OneNet cloud platform analyzes household data uniformly and issues remote control commands. Early warning processing of the data. The test results show that the system effectively solves some problems existing in traditional home equipment, improves the overall operating efficiency of smart home equipment, and has broad application prospects.

## **9:45 Elder action recognition based on convolutional neural network and long short-**

### ***term memory***

Hsiao-Ting Tseng (National Central University, Taiwan); Chen-Chiung Hsieh and Ti-Yun Hsu (Tatung University, Taiwan)

To assist in the identification of possible dangerous situations in the elderly care situation, such as a fall. This study utilizes action recognition to detect and record elder daily movement. If there is any abnormality, the detection system will send out a warning for help. The accuracy is 87.5% for the elder action recognition that developed with CNN and LSTM.

### ***10:00 Emotion Recognition of the Elderly Living Alone Based on Deep Learning***

Haibao Chen, Yuyan Zhao and Shenghui Zhao (Chuzhou University, China)

The problem of the aging of the world's population is becoming more and more serious. Home care based on the Internet of Things technology is one of the solutions to the problem of elderly living alone. Elderly emotion recognition is an important challenge facing smart home care. To solve this problem, this paper proposes a deep learning based emotion recognition framework for the elderly living alone, composed of four deep learning networks, of which three deep learning networks process speech, text, and image data respectively. These data come from companion robots deployed in elderly homes is used as input data for the fourth deep learning network. Through the training of the annotated data set, an elderly emotion recognition model that can handle heterogeneous data (i.e., voice, text, and image data) is obtained.

## **A5: Audio/Video Systems and Signal Processing I**

Room: 402-2

Chair: Wei-Tyng Hong (Yuan Ze University, Taiwan)

### ***9:00 Detecting Test Audio Signal Automatically with Fourier Analysis and Pattern Recognition***

Luciana Rolim, Alexandre Uchoa and Rafael Giusti (Federal University of Amazonas, Brazil); Eulanda Santos (Universidade Federal do Amazonas - UFAM, Brazil);

Agemilson Pimentel, Caio Cruz and Ruan Belem (TPV Technology, Brazil); Andre de Souza Costa, Anderson de Jesus, Lucas Coimbra and Osmar R. A. Silva (ICTS, Brazil)

We investigate using signal detection techniques for testing the audio capability of television sets in an industrial production line with the objective of identifying defectives devices. Two approaches were investigated in this study: the first was based in searching for specific frequencies of sufficiently high magnitude, and the second on detecting specific patterns of alternating frequencies. The results suggest that the first approach is highly susceptible to noise, while the second overcomes this problem, detecting all patterns in the audio segments.

### ***9:15 A Study on Speech Enhancement Using Deep Temporal Convolutional Neural Network***

Kuldeep Singh Rana (Yuan Zu University, Taiwan); Li-Wei Chen (National Yang Ming Chiao Tung University, Taiwan); Li-Hsin Tang (Yuan Zu University, Taiwan); Wei-Tyng Hong (Yuan Ze University, Taiwan)



More recently, the end-to-end and deep neural networking (DNN) architectures show the potential advantages of speech enhancement over various noise environments. However, the computational cost of such systems remains a matter of concern. Temporal convolutional networks (TCN) constructed with a deep stack of dilated convolution blocks is a tremendous achievement among these DNN-based approaches. TCN can retain the information of the long-range dependencies on temporal patterns while not bursting the computational resources. Inspired by the successful development of the TCN, we investigate the fully-convolutional time-domain network which adopted the dilated 1-D convolutional blocks to estimate the masking function. The mask function is being applied to the output of the encoder to obtain the enhanced speech signals. Our proposed neural model is trained on 300 hours of speech data, corrupted by multiple noise types, directly with an objective function for maximizing the scale-invariant signal-to-noise ratio (SI-SNR). The experimental results showed that the voice quality and SI-SNR can be improved. The average SI-SNR is significantly increased by 7.4 dB for the 5 hours of noisy testing speech. The proposed method enjoy their advantages on end-to-end speech enhancement with the resource-constrained system.

### **9:30 Adaptive Color Calibration for Digital Cameras**

Hsin-Yang Chen, Yi-Peng Hsu, Wei-Te Chang, Ji-Lun Ho, Yi-Fang Lee and Wen-Chung Kao (National Taiwan Normal University, Taiwan)

Color calibration has been widely studied in digital cameras, and the color accuracy with the traditional color matrix approach is sufficient for digital photography applications. However, the color accuracy for the camera applied to surveillance systems or robots should be further improved. This paper presents an adaptive color calibration. By modifying the color calibration function, applying particle swarm optimization, and applying two-stage color calibration, the proposed approach further improves the color accuracy compared with the traditional approach.

### **9:45 Noise Reduction System Applied to Machine Tools**

Wang Boli, Chen Poyi, Chi Junzhe, Xu BoJun, Yuan-Sun Chu and Ting-Chao Hou (National Chung Cheng University, Taiwan)

This paper designs a noise reduction system applied to sound measurement in machinery factories. This paper implements a noise reduction system suitable for machine tools, using Deep Neural Network (DNN) to learn the relationship between noise and target audio, and design Mask as the learning target of DNN to separate noise and target audio. Finally, after the audio with noise is processed by the noise reduction system using ORM as Mask in this thesis, the influence of noise on the target audio is successfully reduced. The STOI score is increased by about 0.3, and the PESQ is increased by about 1.2~1.8. Different types of noise and design different parameters make the system more adaptable to different environmental noises.

### **10:00 LDR to HDR Conversion Based on Histogram Extension**

Huei-Yung Lin, Liu Ya-Fan and Yi-Rung Lin (National Chung Cheng University, Taiwan)

We present a method of generating high dynamic range image. Our input is low dynamic range image. We transform an input image into HSI color space, separating the color and intensity information. Then dynamic range of intensity is extended from  $[0, 255]$  to  $[0, 1023]$  and a Butterworth filter is applied to the histogram which is set as the target histogram to generate a new image allocation. Cumulative distribution function curve of the histogram extends a fixed distance in each round and generates a new histogram which set as a target histogram. Finally, the image is combined with the color information and an inverse tone mapping operator is used to extend the LDR to HDR range.

### **10:15 *Detection and Recognition of Inframammary Fold on MLO-view Mammograms***

Yi-Chong Zeng (Institute for Information Industry, Taiwan)

As positioning issues occur during mammography, it degrades the mammogram quality and influences radiologists to screen breast lesions on the mammogram. Therefore, quality assessment is a significant task before mammogram screening. This paper introduces a method for the detection and recognition of inframammary fold on mediolateral-oblique-view mammograms. In the detection process, the proposed method computes pixel-wise curvatures to the contour of a breast. The pixels with the same signs of curvatures form several curves, and an inframammary fold is one of those curves with positive curvature. Subsequently, we compute two features based on the detected inframammary fold and develop a multi-decision framework-based classifier for inframammary fold recognition. The experiment results will demonstrate the proposed method outperforms the compared approaches.

## **A6: Innovation in Communication Technology I**

Room: 408-1

Chairs: Shyang-Yuh Wang (Chinese Culture University, Taiwan), Sheng-Tsung Tu (Ming Chuan University, Taiwan)

### **9:00 *The Utilization of Big Data Analysis on the Food Delivery Platforms in Taiwan***

Shyang-Yuh Wang and Yi Fang Li (Chinese Culture University, Taiwan); Sheng-Tsung Tu (Ming Chuan University, Taiwan); Yue-Nuo Yan and Yu-Chi Chen (Chinese Culture University, Taiwan); Chien-Hsing Chou (Tamkang University, Taiwan); Wei-Lin Chang (Aletheia University, Taiwan)

With the development of e-commerce, the Internet has become faster and more convenient. In 2020, COVID-19 has gradually spread globally, and it has caused an unprecedented blow to the catering industries. Based on the original food delivery service, Uber Eats and Foodpanda have gained new development opportunities. More and more people choose the food delivery services. Technologies have changed people's lives. In this research, the online sentiment analysis of big data is used to explore the current development and future market strategies of Uber Eats and Foodpanda in Taiwan.

### **9:15 *Utilizing Big Data to Analyze Current Online Payment Development in Taiwan***

Shyang-Yuh Wang, Yue-Nuo Yan and Yu-Ting Huang (Chinese Culture University, Taiwan); Yu-Sheng Su (National Taiwan Ocean University, Taiwan); Shih-Yin Huang (Chinese Culture University, Taiwan)

In 2020, the COVID-19 pandemic impacted global economic seriously, and people tried to avoid face-to-face commerce interactions as much as possible. It provided a good opportunity for the development of cashless mobile payment. This research utilized big data tools to analyze the online sentiment of the top three mobile payment platforms, including Line Pay, JKOPAY, and Alipay, which are currently the most popular mobile payment platforms in Taiwan. Besides, this article explored its existing market strategies and provided suggestions for the future operations of mobile payment.

### **9:30 *Design and Implement a Mobile Fitness Application based on Realtime Image Detection***

Hsien-Yu Kao and Yih-Jiun Lee (Chinese Culture University, Taiwan)

With the promotion of fitness, the number of people participating in sports has increased year by year. It also has increased the competition, attraction, and the development of fitness industries, in which businesses constantly evolve and refine their competency sets and solve problems and challenges effectively. At present, the mobile APP is the most extensive tool that is close to users. If it is fitted into the fitness industry, it draws the attention of consumers with reasonable and intelligent services and meets their needs. It is noted that the target customers of current fitness APPs on the market mostly are beginners and zero-based customers. The app specially designed for people with fitness foundations and professional fitness coaches is still missing. This research aims to solve the problem and design an application service for advanced users. With the involvement of the Python module, machine learning is involved in the application, which is built for Android phones and coded in the Java native code. The phone camera is used to identify images and human bones to determine whether the exercise is accurate. The exercise record is kept, and recommendation is provided. Afterward, a study to understand users' motivation and attitude is conducted. The purpose of the study is to design and develop a fitness app for advanced users with exclusive planning for effective workout control. Preliminary result shows the conceptual model and prototype of a mobile app for fitness industry. The app is in line with the concept of niche marketing and is able to apply to the fitness industries for commercial usage, such as student data management and industry competitiveness.

### **9:45 *Opinion Leaders in Internet Public Opinion: A Case Study on the Controversy of U.S. Pork Containing Ractopamine***

Sheng-Tsung Tu (Ming Chuan University, Taiwan)

The Taiwan government's decision to approve the import of U.S. pork containing ractopamine was instigated and followed by pressure from relevant interest groups; people's subsequent demands and reactions to this decision should also be carefully considered. This matter is no longer simply a food safety issue but a national political and economic issue. In this study, Sol-Idea was employed to collect relevant Internet public opinions, which were scrutinized by using nonreactive methods. Data collection commenced on August 28, 2020, the day when the government announced the lifting of the ban on U.S. pork containing ractopamine, and ended on December 31, 2020, the day before the policy took effect. By examining the communication of online opinion leaders their positions and behaviors on the matter of importing U.S. pork containing ractopamine were analyzed, in order to depict their active time periods online, and the sites they favored, and other behavioral patterns on the Internet.

## **A7: Advanced Computing Systems and Applications**

Room: 408-2

Chair: Masaru Fukushi (Yamaguchi University, Japan)

### **9:00 *Proposal of Long-Distance Goal Recognition Method Using Deep Learning in CanSat***

Miho Akiyama and Takuya Saito (Shonan Institute of Technology, Japan)

In this paper, we describe a method of improving recognition accuracy from a long distance of 10 m from

the goal using deep learning. Since we first applied Deep Learning image recognition to CanSat's goal guidance control, we have won the ARLISS 2019 World Contest with a distance of 0m to the goal. However, if the distance from the goal is 6 m or more, the goal recognition rate drops significantly, and there are problems that it takes time to recognize the goal and CanSat cannot find the goal. Therefore, in this study, we proposed a method to improve the goal recognition rate over a long distance of up to 10 m to the goal, and confirmed its effectiveness.

### **9:15 A Fault-Tolerant Routing Method Using Bus Functions in Two-dimensional Torus Network-on-Chips**

Taiki Tomita, Yota Kurokawa and Masaru Fukushi (Yamaguchi University, Japan)

This paper proposes a fault-tolerant routing method using bus functions for 2D torus NoCs. In the recent method called Passage-Y, packets can straightly pass through faulty nodes, but cannot make a turn, resulting in long detours. The idea for this problem is implementing bus functions to allow packets making a turn at faulty nodes. A token-ring is introduced to resolve conflicts of packets on the same bus. By applying this architecture to 2D torus NoCs, fault-tolerant dimension-order routing is realized. Experimental results indicate that the proposed method improves latency and throughput by about 79.8% and 21.6%, respectively, compared with Passage-Y.

### **9:30 A Development Support Tool for Fault-tolerant Routing Methods on Network-on-Chips**

Yota Kurokawa, Daiki Kajimoto and Masaru Fukushi (Yamaguchi University, Japan)

Toward the realization of dependable high-end consumer electronics products, it is indispensable to design an efficient fault-tolerant packet routing method to enhance the communication performance of Network-on-Chip (NoC) based many core processors. The development of fault-tolerant routing methods is not an easy task because each path depending on the source and destination of each packet and the location of failures. If support tools exist for this purpose, we think that the development of methods will progress. NoC simulators such as noxim and booksim have been developed, however there are few tools to support the development of routing methods. In this paper, we develop a tool to assist in the development of fault-tolerant routing methods.

### **9:45 Synchronization and Asymmetric Error Correction for Nanopore Sequencing**

Ryosuke Nakata and Haruhiko Kaneko (Tokyo Institute of Technology, Japan)

Nanopore sequencing is prone to synchronization and asymmetric substitution errors. Error correction coding suitable for correcting these errors is required to improve the reliability of DNA storage. This paper defines a channel model which can express both synchronization and asymmetric errors. We also show a concatenated coding using outer LDPC code and inner marker, and present a decoding algorithm based on a belief propagation on factor graph. Numerical results show that, for evaluated channel parameters, the error rate is minimized when the marker interval is 5 and the oversampling factor is 10.

### **10:00 Spacecraft 6-DoF Localization in a GPS denied Environment**

Chao-Chung Peng (National Cheng Kung University, Taiwan); Chen-Yu Chan, Jih-Hong Lin and Tung-Yun Hsieh (National Space Organization, Taiwan)

In this note, a prototype design of the navigation control system for an unmanned spacecraft in a planet is presented. In the process of automatic landing, the spacecraft must sense its location with the map data prepared in advance for localization and navigation. For spacecraft landing mission, selection of a place

with a gentle terrain suitable for landing and then complete it within an acceptable error will be taken as the first important target. However, in the lunar space environment, the sensors required by general aircraft such as the Global Position System (GPS), magnetometer, and barometer will all fail so that it is difficult to establish a heading and attitude reference system. Therefore, in order to achieve the spacecraft planet landing, the vehicle must have the capability of finding the location of itself through sensors and compare the characteristics of topography and landforms for localization. To this demand, in this study, a depth sensor is used as the information source for six degree of freedom (6-DoF) pose estimation. Its advantage is that it is not affected by the light source and has a high resolution for the depth information of the environment. In order to realize the concept of this research, a multi-axis motion platform is developed to simulate the motion of the spacecraft and the platform is also used as a pose reference to verify the feasibility of the proposed concept. Experiments have proved that the proposed localization algorithm can independently complete 6-DoF pose estimation without the assistance of external sensors, thereby achieving the goal of spacecraft localization and landing decision making.

### **10:15 *K-means based RANSAC Algorithm for ICP Registration of 3D Point Cloud with Dense Outliers***

Chao-Chung Peng (National Cheng Kung University, Taiwan)

In this work, a strategy for the 3D point cloud registration in the presence of multiple groups of outliers is addressed. Regarding to the point cloud registration, the iterative closed point (ICP) is a frequently used algorithm. Many related works have pointed out that robust point cloud matching can be achieved by using correspondence weight design or some other feature extraction techniques. However, it is interesting that whether it is possible to use traditional point-to-point ICP to deal with the point cloud registration in the presence of dense outlier clusters even without the aid of ICP weight design or point cloud feature extraction. To solve this question, a K-means based random sample consensus (RANSAC) strategy is presented. For a given data point clouds with high dense outliers, the K-means is firstly applied to cluster the point clouds. After that, the registration process cooperates with RANSAC's random cluster sampling for ICP matching, and calculates the sample with the highest matching score as the best candidate for point cloud matching. Here, we name this procedure as K-means based RANSAC ICP (KR-ICP). Through this point cloud registration strategy, the influence of multiple clusters of dense outliers on ICP registration can be avoided. Finally, this study verified the feasibility of this strategy via simulations. The proposed scheme can be extended to the related applications of point cloud initial pose alignment.

### **10:30 *Relaxing device requirements for non-linearity in Deep Neural Networks accelerators with Phase Change Memory***

Keisuke Kozu and Kazuteru Namba (Chiba University, Japan)

Analog circuits using non-volatile memory, such as Phase Change Memory (PCM), are expected as high-speed and low-power Deep Neural Networks (DNN) accelerators. This paper analyzes the relationship between the non-linearity of the non-volatile memory (NVM) and the number of Open Loop Turnings (OLT) executed before Closed Loop Turning (CLT). The non-linearity of the NVM is determined by the initial step  $\Delta G_0$ . For  $OLT = 50$ , the recognition rate of 0.975 is achieved for  $\Delta G_0 = 8\%$ . The analysis present that we achieve the same recognition rate as software even with highly non-linear NVM by inserting CLT before saturated NVM affects recognition accuracy.

Wednesday, September 15 10:30 - 10:50

Coffee Break

Wednesday, September 15 10:50 - 12:20

B1: Wireless, RF, and Network Technologies II

Room: conference hall

Chair: Hsin-lung Su (National Pingtung University, Taiwan)

**10:50 A Uniplanar Multi-Band S-shape Antenna for Smart Phone Applications**

Jia-Sheng Xu and Hsin-lung Su (National Pingtung University, Taiwan)

This article presents a uniplanar antenna covered LTE 900/2300/2500, DCS, PCS, UMTS, and WLAN-2.4 GHz bands for smart phone applications. The size of overall phone is 120 mm × 60 mm × 0.8 mm, and the size of the propose antenna is 26 mm × 10.5 mm. The propose antenna is composed of an inverted-L strip coupled feed strip, and a S-shape antenna connected with an inner inverted-L branch on the top and a bend strip shorting to ground.

**11:05 A Compact Multi-Bands Antenna for 4G Mobile Terminals**

Hsin-lung Su and Huan-Sheng Lyu (National Pingtung University, Taiwan)

A compact multi-bands antenna for the 4G mobile terminal applications is presented. The proposed antenna consists of a T shape feeding structure and an inverted F-shape radiation structure. Among them, the T shape feeding structure covers the WLAN2.4-GHz and LTE2600 bands; the inverted F-shape antenna covers the GSM850/900, LTE1800. A prototype was fabricated and measured on a FR4 substrate with an overall size of 135 mm × 55 mm × 0.8 mm and the size of antenna only has 55 mm × 8 mm × 0.8 mm. The measured efficiencies are above 40% at all work bands.

**11:20 Power Saving Method using Compressed Sensing Technique for IoT-based Time-series Environment Monitoring System**

Sorato Mochizuki and Nobuyoshi Komuro (Chiba University, Japan)

This paper proposes a power-saving method for time series environment monitoring wireless sensor networks (WSNs) system using the compressed sensing technique. The data reconstruction of compressed sensing is complex, but the compression process itself is simple. While sensor nodes have limited resources, servers have abundant resources. Therefore, the sensor nodes compress the environmental data measured in time series, and the server reconstructs the compressed environmental data. In the environmental data collection phase, the sensor nodes transmit environmental measurement data using compressed sensing to save energy at the sensor nodes. The server reconstructs the received environmental data. This study develops the ZigBee WSN based time series indoor environment data collection system. Then we investigate the impact of compressed sensing technology on WSNs. The experimental results show that for sensors with dynamically varying sleep periods, when the compression ratio is set to 20% or less, the power consumption is reduced by 20% with a decision coefficient of 0.7 or higher, confirming the effectiveness of the proposed method.

### **11:35 *Vector Spectrum Analyzer using USRP and Matlab applied to Wi-Fi Signals***

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Agemilson Pimentel (TPV Technology, Brazil); Cláudio Henrique Albuquerque Rodrigues (Grupos ICTS, Brazil)

The acquisition of sophisticated vector signal analyzer (VSA) may be a limiting factor for the execution of R&D projects due to prohibitive cost for some applications. In this work, conducted by three partners (UFAM/CETELI, ICTS and ENVISION/TPV), we propose a signal reception framework that uses the 802.11n standard to display measures of interest in order to analyze Wi-Fi signals cost-effectively. As result, four possible measurements were obtained: (i) transmission spectrum mask; (ii) spectral flatness; (iii) transmitter constellation error; (iv) transmitter modulation accuracy (EVM). The results indicates that this approach is a feasible VSA solution for R&D projects with budget limitations.

## **B2: Artificial Intelligence Models for Multimedia: Representation and Applications I**

Room: 103

Chairs: Li-Wei Kang (National Taiwan Normal University, Taiwan), Jia-Ching Wang (National Central University, Taiwan)

### **10:50 *Age Estimation Model Using Multi-Class Architecture and Adaptive Regression Models***

Min Chen Hsu, Jian-Jiun Ding and De-Yan Lu (National Taiwan University, Taiwan)

Age estimation is important in computer vision and surveillance systems. In this paper, we apply a two-stage and multi-class learning-based architecture to perform age estimation. First, the concepts of combining loss functions and domain adaptation are introduced to optimize the extracted features. Then, through a dual classification method, the input image is roughly classified into 10 classes. Then, a variety of regression models are integrated to obtain the final prediction results. Different classes apply different regression models. Simulations show that the proposed algorithm outperforms many well-known methods in age estimation.

### **11:05 *Deep Residual and Deep Dense Attentions in English Chinese Translation***

Yi-Xing Lin, Kai-Wen Liang, Chih-Hsuan Yang and Jia-Ching Wang (National Central University, Taiwan)

Neural Machine Translation (NMT) with attention mechanism has achieved impressively improvement for automated translation. However, such models may lose information during multiple times of attention representations. This paper focuses on dealing with the over-attention problem. In our English-Chinese translation experimental results, the proposed model reduces the error rate of information in output sentences about 0.5%.

### **11:20 *Evaluation of Attention Mechanisms on Text to Speech***

Yi-Xing Lin, Kai-Wen Liang, Bing-Jhih Huang and Jia-Ching Wang (National Central University, Taiwan)

Attention mechanisms have been widely used in sequence to sequence tasks. Among those tasks, attention-based neural text to speech synthesis with monotonic property has shown a powerful ability to generate natural speech. This paper introduces three different attention mechanisms designed to utilize the strict monotonic property and evaluates them in a multi-speaker TTS task.

### **11:35 Voice Activity Detection by Joint MRCG and MFCC Features with Robustness Detection based GRU Networks**

Rong Zhang, Pin-Hsuan Li, Kai-Wen Liang and Pao-Chi Chang (National Central University, Taiwan)

In this paper, we proposed a Voice activity detection (VAD) model based on recurrent neural network(RNN) with joint MRCG and MFCC features. The system consists of two layers of gated recurrent unit (GRU) and beat the traditional methods in accuracy in our experiments.

### **11:50 Generative Adversarial Networks-based Face Hallucination with Identity-Preserving**

Chia-Hung Yeh (National Sun Yat-Sen University, Taiwan); Daniel Chiu and Li-Wei Kang (National Taiwan Normal University, Taiwan); Chih-Chung Hsu (National Cheng Kung University, Taiwan); Chen Lo (National Taiwan Normal University, Taiwan)

This paper presents a novel generative adversarial networks-based face hallucination framework for producing high-resolution face images from very low-resolution (LR) ones. We propose a multi-scale generator architecture with multi-scale loss functions for different upscaling factors and a triplet-based identity preserving loss for extracting multi-scale identity-aware facial representations. Experimental results have verified that our method can well super-resolve very LR face images (e.g., 8×8) quantitatively and qualitatively.

## **B3: Intelligent Multimedia Computing (10:20-12:20)**

Room: 104

Chairs: Chih-Yang Lin (Yuan Ze University, Taiwan), Kuan-Hsien Liu (National Taichung University of Science and Technology, Taiwan), Tsung-Jung Liu (National Chung Hsing University, Taiwan)

### **10:50 Evaluation of Data Augmentation on Surface Defect Detection**

Isack Farady (Yuan Ze University, Taiwan & Mercu Buana University, Indonesia); Chih-Yang Lin (Yuan Ze University, Taiwan); Fityanul Akhyar (Telkom University & Yuan Ze University, Taiwan); John sahaya rani Alex (Vellore Institute of Technology, Chennai, India); Roshini R (Vellore Institute of Technology, India)

In this paper, we have investigated and benchmarked the augmentation approach of image augmentation to increase or give a different result in detection accuracy compared to the basic method without augmentation. We explored two different methods of pixel-wise operations: pixel domain manipulation and spatial domain transformation to analyze the effect of increasing data for typical defect detection problems. We used two object detection models Faster R-CNN and Cascade R-CNN on top of ResNet-50 as our baseline models. To gain accuracy, we found that the effectiveness of data augmentation for defect



detection is influenced by network complexity and the surface defect properties.

### **11:05 Automatic Door Detection of Convenient Stores based on Association Relations**

Kanatip Prompol and Chih-Yang Lin (Yuan Ze University, Taiwan); Somchoke Ruengittinun (Kasetsart University & Faculty of Science, Thailand); Hui-Fuang Ng (University Tunku Abdul Rahman, Malaysia); Timothy Shih (National Central University, Taiwan)

Although deep learning-based object detection models such as YOLOv4 performs with high accuracy and high frame rate, it was unable to distinguish between glass doors and glass walls of a convenience store. In this paper, we introduce a method that incorporates YOLOv4 and the association relations between objects in the scene to enhance the accuracy and robustness of door entrance detection of convenient stores.

### **11:20 Robust 3D Authentication on Point Clouds with Random Sampling and Sequential Dependency**

Cheng-You Ying, Pin-Hua Huang and Yuan-Yu Tsai (Asia University, Taiwan)

This study integrates random sampling and sequential dependency to propose a robust 3D authentication algorithm on point clouds. First, the random sampling technique generates lots of virtual points distributed within the bounding volume of the input point cloud. For be robust against the point removal attacks, the proposed algorithm generates the authentication code for the processing point from the spatial relationship between the previous processed point and its corresponding virtual points. Finally, parts of the authentication code are embedded by adjusting the length between the processing point to the center of its corresponding virtual points. The feasibility is demonstrated by extensive experiments with high embedding capacity and low visual distortion. The robustness can be also effectively raised.

### **11:35 Impact of Investor Sentiment on Stock Returns Using Fine-tune BERT**

Chien-Cheng Lee and Hung-Chun Huang (Yuan Ze University, Taiwan); Chunli Tsai (Taiwan)

In this paper, we explore the impact of investor sentiment on stock returns. We fine-tune the BERT language model to derive investor sentiment from messages posted on social media platform StockTwits. Apple Inc. (AAPL) stock is selected in this investigation because it has more significance in statistics based on its tremendous messages on StockTwits. A linear regression model is constructed to investigate the relationship between investor sentiment and stock returns. The experimental results show that there is a positive correlation between stock returns and investor sentiment. The investor sentiment can impact the Apple Inc. stock return.

### **11:50 Evaluation of Face Recognition with Wearing Mask or Not**

Amornthep Rojanasarit and Chih-Yang Lin (Yuan Ze University, Taiwan); Somchoke Ruengittinun (Kasetsart University & Faculty of Science, Thailand); Kuan-Ju Chen (University of Guam, USA); Chi-Wen Lung (Asia University, Taiwan)

Due to the COVID-19 pandemic, wearing a mask is one thing that we can see in daily life. When everyone wears a mask in daily life that exactly has some effect on the face recognition system. The recognition system has to consider the face as input first to memorize the face of who he or she is. Normally, the memorization process always has to use only a clear facial face. That means wearing a mask makes the system confuse the face behind the mask. In this work, we design a framework for a face recognition system

to increase the accuracy of recognition with the face that wearing a mask. The system can also classify the face that is wearing a mask or not.

### **12:05 DETECTORS++: The Robust Baseline for a Defect Detection System**

Fityanul Akhyar (Telkom University & Yuan Ze University, Taiwan); Chih-Yang Lin (Yuan Ze University, Taiwan); Gagan S Kathiresan (Vellore Institute of Technology, India); Bharath Surianarayanan (New York University, USA); Chao-Yung Hsu (China Steel Corporation, Taiwan)

Focusing on the task of steel surface defect localization, this study employs the latest state-of-the-art RCNN family, Cascade RCNN, on top of the current FPN model called DetectoRS-ResNext. The baseline was tested individually using Side Aware Boundary Localization (SABL) plus pixel domain augmentation to obtain the precision of predictions. Trained on a well-known real-world dataset, Severstal, our proposal achieves a mAP of 82.5% which offers the potential to serve as a high-quality defect detection baseline.

### **12:20 Facial Age Estimation by Learning Label Distribution CNN**

Kuan-Hsien Liu (National Taichung University of Science and Technology, Taiwan); Chun-Te Chang (National Chung Hsing University); Tsung-Jung Liu (National Chung Hsing University, Taiwan)

In this paper, we propose a new deep convolutional neural networks based architecture with learning label distributions for human facial age estimation. Our proposed method first takes the Xception model with the use of data augmentation, and then Label Distribution Learning (LDL) is adopted for age encoding, KLD is used in loss function, and dropout is considered at fully connected layers. Finally, it takes the expected value of the model output as the solution in estimating ages. The IMDB-WIKI dataset is used as our pretraining dataset and the training set of APPA-REAL dataset is used to fine-tune our proposed model. In the experiment, the state-of-the-art results of MAE 3.09, 2.78, and 3.628 years are attained on MORPH-II, FG-NET, and APPA-REAL datasets, respectively.

### **12:35 WBTP-VTON: Whole Body and Texture Preservation based Virtual Try-On Network**

Huang-Wei Shen, Tsung-Jung Liu and Chi-Mao Fan (National Chung Hsing University, Taiwan); Kuan-Hsien Liu (National Taichung University of Science and Technology, Taiwan)

Image-based virtual clothes try-on systems are becoming more and more popular. However, many challenges are waiting to be solved. Therefore, we propose a new fully learnable method, called the whole body and texture preservation based virtual try-on network (WBTP-VTON) to guide the virtual attempt to deal with all practical challenges in this area. First, the WBTP-VTON template conversion is used to transform the target clothing and pants (or skirts) according to the body shape of the target person using a method called Geometric Matching Module (GMM). The second part is to synthesize the final image and make the generated results more realistic. Finally, we use try-on modules and synthetic masks to combine the deformed clothes and the final image to ensure image smoothness. After experimenting on a large data set, it is proved that our WBTP-VTON method has advanced virtual try-on performance.

# B4: Artificial Intelligence Applications and Technologies in Internet of Things II

Room: 402-1

Chairs: Wen-Hwa Liao (National Taipei University of Business, Taiwan), Jung-Kuei Chang (Tamkang University, Taiwan), Cheng-Chin Chien (Galaxy Software Services Corp., Taiwan), Chih-Yung Chang (Tamkang University, Taiwan)

## **10:50 Data Segmentation Methods for Activity Recognition in Ambient Assisted Living**

Yuyan Zhao, Haibao Chen, Jie Chen and Shenghui Zhao (Chuzhou University, China)

The segmentation of sensor data plays an important role in the Recognition of the activities of daily living. In this paper, we summarize the state of the art of data stream segmentation in the past five years and divide them into four categories, i.e., change point detection based method, semantics based method, window based method, and deep learning-based methods. The summary shows that there are relatively few studies on segmentation using deep learning methods. Besides, there is a lack of a general platform, which can be used in comparing different methods.

## **11:05 Discovering Behavior Patterns of Solitary Elderly Based on Machine Learning**

Lin Liu, Shenghui Zhao and Haibao Chen (Chuzhou University, China); Jinjun Liu (Hefei University of Technology, China)

Discovering routine behavior patterns of the solitary elderly can provide the elderly with better assisted living services. This paper presents a method based on time, path and area association restriction, to calculate the distance between the solitary elderly daily behavior patterns and then discover the routine behavior patterns.

## **11:20 Software and Hardware Integration System Design with Fruit Identification for Smart Electronic Scale Applications**

Wei-Yu Zhu, Wing-Kwong Wong, S M Salahuddin Morsalin, Szu-Hong Wang and Ming-Hwa Sheu (National Yunlin University of Science & Technology, Taiwan)

In this paper, a smart electronic scale system is proposed for weighing application, including software and hardware integrated design. In the hardware architecture, the smart electronic scale combines weight sensor, touch display, label printer, and a display that show price information. And the embedded system contains AI accelerator, which performs deep learning object recognition from camera raw data for real-time application. In the software system, introduced AI technology to recognize the image of the weighing object in order to improve the convenience of the end-user operator. The system combined with the Internet of Things, allows customer identify to understand sales records with purchase and sales manage more simply and clearly.

## **11:35 Dynamic sample selection method based on classification prediction**

Wang Xingfu and Pengfei Xie (University of Science and Technology of China, China)

Recent research has shown that sample selection in the training phase is crucial for improving the accuracy of object detection. For a long time, we always use manually designed IoU threshold to filter out low-

quality candidates, but recently some work shows that dynamic sample selection is better for training an object detector. In our paper, we present a new adaptive dynamic sample selection strategy based on both IoU and Classification prediction. Our experiment applies in PASCAL VOC dataset, without any whistle, achieved 84% mAP. Also, our method doesn't require any extra computation, which can guarantee high speed in the testing phase.

### **11:50 Behavior Recognition Algorithm Using Unsupervised Learning for Home Elderly**

Cuijuan Shang (Chuzhou University, China); Chih-Yung Chang (Tamkang University, Taiwan)

The behavior recognition is an important issue in homecare and has received lots of attention. This paper proposed a behavior recognition algorithm (BRA) which applies unsupervised learning on sensor data collected for the elderly living alone. The proposed BRA consists of three phases, including Regular Action Discovery, Behavior Discovery and Behavior Matching. Plenty of experiments show that the proposed BRA exhibits good performances in terms of the recall and precision.

## **B5: The Emerging Data-Driven Technologies for Smart Service Systems**

Room: 402-2

Chair: Hsin-Han Chiang (National Taiwan Normal University, Taiwan)

### **10:50 Design and Implementation of Smart Agricultural Systems Based on Networked PLC and Mobile App**

Chen Chiu and Jin-Shyan Lee (National Taipei University of Technology, Taiwan); Hsin-Han Chiang (National Taiwan Normal University, Taiwan)

With economic development and changes in the industrial environment in the world, it is necessary to build an automated production line in the modern factory. Because of the excellent functions and high stability of the programmable logic controller (PLC), it is mainly used to integrated control systems to control devices. e.g., sensors, servo motors, and pressure systems. This paper combines PLC, mobile App, and Arduino modules to create a fully automated agricultural technology.

### **11:05 Traffic Agent Trajectory Prediction Using a Time Sequence Deep Learning Model with Trajectory Mapping for Autonomous Driving**

Pei-Yun Hsu, Mei-Lin Huang, Wei-Yen Wabg and Hsin-Han Chiang (National Taiwan Normal University, Taiwan)

The trajectory prediction of traffic agents plays an important role regarding to the safety of autonomous driving. Structured by gate recurrent unit (GRU), this paper proposes a new predict model with the combination of trajectory mapping method. The experimental results show that the proposed model can feasibly predict the future trajectories of the surrounding traffic agents in a mixed flow including vehicles, cyclists, and pedestrians.

### **11:20 An Automated Cardiac Ventricle Segmentation on CMR images Using Grey-Level Mask R-CNN**

Hsiao-Chi Li and Kuan-Yu Chen (Fu Jen Catholic University, Taiwan); Shih-Hsien Sung (National Yang-Ming University, Taiwan); Chun-Ku Chen (Taipei Veterans General Hospital, Taiwan)

Myocardial fibrosis is a pathological change in the progress of modern heart disease. It is mainly characterized by dysregulation or marked increase of collagen volume in myocardial components. The physiological mechanism of fibrosis in different pathologies is very diverse. It has been proved that the use of MRI for the detection of heart failure patients can provide accurate measurements of left ventricle and right ventricle and assessment of myocardial function, but the accurate segmentation of myocardial contour is still an important prerequisite for the detection of fibrosis. This study uses Mask R-CNN on the ACDC challenge Database to repeatedly adjust the characteristics of the boundary of the Bounding box, and separately divided the left ventricular area and the right ventricular area. The proposed method can achieve up to 95% hit rate with 0.89 IoU.

### **11:35 Method for Detecting Boar Abdominal Characteristics based on Deep Learning**

Chia-Yun Li (National Sun Yat-sen University, Taiwan); I-Hsi Kao (University of California, Berkeley, USA); Jau-Woei Perng and Yun-Chu Tsai (National Sun Yat-sen University, Taiwan); Wei-Wen Chen and Chung-Li Tai (Industrial Technology Research Institute, Taiwan); Chiao-Chien Chu and Ming-Che Wu (Livestock Research Institute, Council of Agriculture, Executive Yuan, Taiwan)

Numerous applications of machine vision exist in animal husbandry research. In this study, we proposed an effective method for detecting boar nipples. This research began with collecting boar abdominal videos during the monthly breeding competition in July 2020 to build a database and then detecting boar nipples via two various neural networks: single shot detector and faster region-based convolutional neural networks. The comparisons showed that the single shot detector achieved better results than the faster region-based convolutional neural networks.

## **B6: Innovation in Communication Technology II**

Room: 408-1

Chairs: Shyang-Yuh Wang (Chinese Culture University, Taiwan), Sheng-Tsung Tu (Ming Chuan University, Taiwan)

### **10:50 Measurement and Analysis of IC EMI synchronous signal**

Wei-Sheng Liu (FCU, Taiwan); Sung-Yu Yeh (Feng Cha University, Taiwan); You-Cheng Li (FCU, Taiwan)

In many cases, the analysis of Electromagnetic Interference (EMI) analyzing in frequency domain is very important. However, in the digital era, examples of analysis in the time domain is getting more attentions. In time domain, the signals should be carefully captured within the same time interval. Otherwise, the correlation between the signals cannot be compared. Therefore, it is very important to capture the signal synchronously. Thus, the accurate synchronous cutting of different signals is very important procedure for

time domain signal acquisition. But it will be affected by noise and cannot be cut accurately. So we propose a new method for such issue. We create an ideal square wave based on the synchronous cutting signal so that the synchronous cutting is not affected by noise.

### ***11:05 Using Machine Vision Based of Preventive Maintenance and Management of Historic Buildings***

Wei-Yu Chen (Chinese Culture University & Tatung University, Taiwan); Chih-Wen Cheng (Chinese Culture University, Taiwan)

The 921 earthquake occurred in Taiwan in 1988. At that time, more than 700 old buildings were not designated as "historical sites." They were damaged in the earthquake without proper maintenance and management. This was a great impact on the national culture. Therefore, the government began to rescue cultural assets with high historical, artistic or scientific value, and registered and managed valuable historical buildings with reference to relevant foreign management methods, hoping to make up for regrets. However, it is not easy for the civilians who are the owners of private cultural assets to assist in maintenance and management if they do not have the professional knowledge and skills of maintenance and management. In view of this, this research applies machine vision technology in information technology to build a machine learning database to deal with the destruction of old buildings and provide owners, managers and enthusiasts of cultural assets. The non-destructive inspection method of image shooting can find a solution and contact relevant units for processing, which greatly reduces the difficulty of maintenance and management and increases the public's attention to the preservation of private cultural assets.

### ***11:20 Using AI on Improving the Performance of Streaming Video and Audio***

Hsing-Tung Ho (Kun Shan University, Taiwan); Wei-Yu Chen (Chinese Culture University & Tatung University, Taiwan)

The COVID-19 epidemic in 2020 has caused countries around the world to lock down cities and countries one after another. Consumers cannot go out to participate in entertainment activities, and most of them turn to watching online video and audio streaming videos to pass the time. With limited bandwidth, a large number of users watch videos on the Internet in an instant, which can easily cause "stuttering" in video playback. In order to solve this problem, the platform industry responded by reducing the resolution of the video. In view of this, this research uses a cloud service platform to build a marginal server for streaming video and audio, collecting past user behaviors, bandwidth traffic, and corresponding strategies for artificial intelligence management strategy training, so as to achieve bandwidth management automation and improve the smoothness of watching the video.

### ***11:35 Analyze the Audience's Perception of YouTube Online Video Advertisements***

Chun Ting Chang (Chinese Culture University, Taiwan); Oi-Ki Wong (The University of Hong Kong, Taiwan); Shyang-Yuh Wang (Chinese Culture University, Taiwan)

Nowadays, algorithms have been widely used in online marketing. Taking YouTube advertising as an example, its advertising has widely used algorithmic technology to promote the appropriate online video advertisements to audiences, in order to catch their attention. The viewers' perception of YouTube online video advertisements, and the effectiveness of the online video advertisements, are worthy and meaningful for research. This study retrieved 243 valid questionnaires. The results were found that most respondents (60.4%, n=146) are depressed and impatient with YouTube online video advertisements because they are always inserted at the wrong timing. Respondents also represented that YouTube advertising does

not reach their interests and habits. It was determined that YouTube online video advertisements can effectively catch the audience's attention but can't satisfy them. Furthermore, repeated viewing of the same advertisement can deepen the viewer's impression of products or brand services, thus produce certain benefits. This study recommends that advertisers should adopt appropriate types of advertisements. YouTube can further review the algorithm system to avoid excessive repetition of the same advertisement and improve the breakpoints of online video advertisements through AI.

## B7: Computer Communications and Signal Processing for IoT I

Room: 408-2

Chairs: Pingguo Huang (Gifu Shotoku Gakuen University, Japan), Yutaka Ishibashi (Nagoya Institute of Technology, Japan), Takashi Okuda (Aichi Prefectural University, Japan)

### **10:50 *Passivity of a Dynamic Environment in Telecontrol Systems***

Tho Duc Ho and Takanori Miyoshi (Nagaoka University of Technology, Japan)

In this brief note, we will show that the dynamic environment presenting in telecontrol systems is passive regardless of the number of contacts and contacts' stiffness if it is modeled as a network of connected spring-mass elements.

### **11:05 *Toward the optimal control of haptic communication - Introduction of force prediction to collaborative work -***

Hitoshi Watanabe (Tokyo University of Science & Faculty of Engineering, Japan);  
Yujin Sato, Tomoyuki Hirano and Daiki Inoue (Tokyo University of Science, Japan);  
Pingguo Huang (Gifu Shotoku Gakuen University, Japan); Yutaka Ishibashi (Nagoya Institute of Technology, Japan)

This paper investigates a method to improve operability and stability of cooperative work using haptic communication under communication delay. The operability improvement of haptic communication is generalized to find the appropriate conversion of the signals exchanged between the master and the slave. This paper proposes a method to improve the operability by feedback of the predicted value of reaction force and evaluates the effect theoretically and experimentally.

### **11:20 *Evaluating effect of interference on MAC delay in densely deployed IEEE 802.11ad based In-vehicle communications***

Takumi Shiohara (Nagoya University, Japan); Takayuki Nishio (Tokyo Institute of Technology, Japan); Tutomu Murase (Nagoya University, Japan)

This paper evaluates MAC-layer delay of IEEE 802.11ad based In-vehicle communications, where strong interference from multiple devices on own and other vehicles could occur stochastically due to beamforming. The wide frequency bandwidth of IEEE 802.11ad is expected to enable ultra-low latency in-vehicle communications. However, the beamforming of IEEE 802.11ad causes strong interference and could degrade the delay performance. To investigate the impact of the beamforming interference on delay performance, we conducted network simulations using ns3. The results show that a control method, fixed contention window (CW), achieved the maximum delay of 2 msec, whereas conventional control method,

Distributed Coordination Function (DCF), did larger delay of 12 msec.

### **11:35 *Fatigue Estimation using Nonlinear Disturbance Observer for Tele-Rehabilitation System with Electrical Stimulation***

Yasunori Kawai, Futoshi Sugimoto and Kenshin Fujie (National Institute of Technology, Ishikawa College, Japan); Hiroyuki Kawai (Kanazawa Institute of Technology, Japan); Takanori Miyoshi (Nagaoka University of Technology, Japan)

This paper considers a muscle fatigue estimation using a nonlinear disturbance observer for a tele-rehabilitation system with an electrical stimulation. The main contribution is to apply the nonlinear disturbance observer to detect the muscle fatigue. First, the patient's knee joint model is proposed. Next, the nonlinear disturbance observer is derived by using the knee joint model. Finally, the experiment of the tele-rehabilitation with the constant time delay is implemented. Though the range of the patient's knee angle is same, the force provided by the physical therapist is increased. Then the magnitude of the estimated disturbance is increased in the negative direction. Therefore, the muscle fatigue can be estimated by using the proposed nonlinear disturbance observer.

### **11:50 *Robot Position Control Using Force Information by Neural Network in Remote Robot Systems***

Xianzhi Wang (Nagoya Institute of Technology, Japan); Pingguo Huang (Gifu Shotoku Gakuen University, Japan); Yutaka Ishibashi (Nagoya Institute of Technology, Japan); Takashi Okuda (Aichi Prefectural University, Japan)

This paper constructs a neural network model to improve the efficiency of the robot position control using force information, which was proposed as Quality of Service (QoS) control previously, for cooperative work between two remote robot systems with force feedback. Simulation results show that the neural network model is effective.

Wednesday, September 15 12:20 - 13:10

Lunch

Wednesday, September 15 13:10 - 14:10

Poster A

Room: poster area

### ***Descriptor Sampling VLSI Design Based on BRIEF Algorithm for Surrounding View Application***

Jr-Yu Lin, He-Sheng Chou, Kun-Ze Su, Shih-Yao Ke and Wen-Shen Lo (Chung Yuan Christian University, Taiwan); Chiung-An Chen (Ming Chi University of Technology, Taiwan); Shih-Lun Chen (Chung Yuan Christian University, Taiwan)

This paper presents a new descriptor sampling method based on Binary Robust Independent Elementary Features (BRIEF). The proposed method is divided into several steps, split blocks, sampling, and descriptor construction. The proposed descriptor sampling method is realized by Very Large-Scale Integration (VLSI)



technique. The usage of the split blocks keeps average accuracy attaining 88.01% and reduces 75% gate counts by using the same sampling model to construct descriptions. Comparing with previous studies, this design shows lower hardware cost and higher accuracy.

### ***An Efficient Data Hiding Method for AMBTC Compressed Images***

You-An Wang (NTUT, Taiwan); Ming-Chih Chiu (Corextek, Taiwan); Shih-Che Chien and Feng-Chia Chang (National Chung-Shan Institute of Science and Technology, Taiwan); Kai-Lung Hua (National Taiwan University of Science and Technology, Taiwan)

Data hiding techniques aim to embed the hidden data into digitalized carriers. In this paper, we present an efficient data hiding method for the Absolute Moment Block Truncation Coding (AMBTC) compressed images. The first step of the proposed method is performing the traditional AMBTC method, which is followed by an inner-block switching strategy and a quality improvement method. From the experiments, we demonstrate that the data capacity of this work is large, and meanwhile, the visual quality of the output stego image is satisfactory.

### ***Forward Vehicle Detection Based on Thermal Vision and Convolutional Neural Network for Autonomous Vehicles***

Yu-Quan Wang (National Taiwan University of Science and Technology, Taiwan); Ping-Han Chen (National Taipei University of Technology, Taiwan); Sin-Ye Jhong (National Cheng Kung University, Taiwan); Kuan-Ming Yen and Yung-Yao Chen (National Taiwan University of Science and Technology, Taiwan)

In this study, we present a forward nighttime on-road vehicle detection system using far infrared thermal imaging. The proposed vehicle detection system integrates deep convolution neural network, expert system and Kalman filter to increase the robustness of the system performance. In addition, according to the on-road physical properties, we design the tracking area and warning area to reduce the searching region. From the experimental results, the proposed method demonstrates high detection accuracy and high performance.

### ***AI in eHealth: Diagnosis of Parkinson's Disease with Augmented Reality***

Ching-Han Lin and Shan-Bin Chan (NTUST, Taiwan); Yuan-Chun Lai (Open AI Fab Inc., Taiwan); Wen-Long Liang (Jorjin Technologies Inc., Taiwan); Ming-Shih Huang (Open AI Fab Inc., Taiwan); Yung-Yao Chen (National Taiwan University of Science and Technology, Taiwan)

In this paper, we present the AI+AR Parkinson's disease recognition system. The proposed recognition system integrates the AI prediction model and AR model to increase the interactive experience with the user. Then we develop Restful APIs as a communication bridge to exchange data between the AR model and the AI model. Besides, according to the high energy consumption problems of AR glasses, we design an architecture that combines the two models which can reduce the energy consumption of the AR model. This architecture helps the development of AI models in eHealth.

### ***A Similarity Calculation Method for Originality Evaluation***

Li Changbao and Xuelin Liu (North China Institute of Computing Technology, China);

Zhongliang Ai (China Justice Big Data Service Platform, China); Kewen Lu, Zhonglin Liu and Yawei Su (North China Institute of Computing Technology, China)

In this paper, we propose a similarity calculation method, which can get the similarity score between a document and a document library from the aspect of originality evaluation. Compared with the traditional similarity evaluation method, this method can find the similarity in multi-source combination and rewriting behavior, which can improve the recognition in originality evaluation.

### ***A DRL based Real-time Computing Load Scheduling Method***

Kewen Lu and Xuelin Liu (North China Institute of Computing Technology, China); Zhongliang Ai (China Justice Big Data Service Platform, China); Zhonglin Liu (North China Institute of Computing Technology, China); Dan Tao and Lou Shuqin (Beijing Jiaotong University, China)

In this paper, we propose a real-time computing load scheduling method based on deep reinforcement learning (DRL). Firstly, we formulate the problem as a multi-agent competition for limited resources where every agent acts in its own interest. Secondly, we study to design a decentralized algorithm for load scheduling, so that data access servers can independently determine their load scheduling strategy. Finally, a series of simulation results show that our proposal significantly outperforms existing solutions.

### ***Green Coffee Beans Classification Using Attention-Based Features and Knowledge Transfer***

Po-Yen Yang (The Hong Kong University of Science and Technology, China); Sin-Ye Jhong (National Cheng Kung University, Taiwan); Chih-Hsien Hsia (National Ilan University, Taiwan)

In recent years, people's need for coffee beans has skyrocketed, which results in automatic coffee beans quality recognition being highlighted by researchers. In this study, a Convolutional Neural Networks (CNN)-based method which has the advantage of having high local feature extraction performance was presented. The experimental results show that the proposed method could be effectively utilized to perform green coffee beans recognition it achieved an F1-score of about 97%.

### ***Music Mood Classification System for Streaming Platform Analysis via Deep Learning Based Feature Extraction***

Yu-Chia Chen and Zih-Ching Chen (National Taiwan University, Taiwan); Chih-Hsien Hsia (National Ilan University, Taiwan)

The proliferation of smartphones and the Internet has led to the growth of streaming music services [1]. Streaming music services that provide vast libraries of songs have changed the way music lovers listen and leave a digital footprint when they are listening to the music. Music can arouse the emotional feelings of the listeners, thus providing emotional rewards for the listeners and achieving a physiological adjustment effect. In general, the paper of music mood is based on the melody, rhythm, timbre, and other features of music. However, the lyrics of a song also provides information that helps the listener to have a higher level of understanding of the emotion expressed by the music. In this work, we focus on Spotify, which is the world's biggest music streaming platform. Using the information retrieved from the web crawler, we obtain the data which contains the audio features of the song from the Spotify playlist, while analyzing the audio feature and the lyrics through semantic analysis.

### ***A Fully Self-locking/Interlocking Switch Circuit Using Signal Mutual Control***

Hsin-Chuan Chen and Wenbin Cheng (University of Electronic Science and Technology of China, Zhongshan Institute, China)

In many industry applications, the self-locking and interlocking switches are usually used to control electrical equipment or applied to automation control. The electronic self-locking /interlocking switches can improve the disadvantages of the conventional self-locking/interlocking switches using relay types; however, they can not achieve the real interlocking state when two push buttons are pressed at the same time. In this paper, a fully self-locking/interlocking electronic switch circuit based on MOSFET is proposed to solve the above problem by using a technology of signal mutual control.

### ***Quality enhancement for point cloud using morphology methods***

Hong-Bin Bu (National Taipei University of Technology, Taiwan); Ching-Hsuan Lin (Chung Yuan Christian University, Taiwan); Chi-Fu Liang and Ting-Lan Lin (National Taipei University of Technology, Taiwan); Yih-Shyh Chiou (Chung Yuan Christian University, Taiwan)

Point cloud become a popular multimedia format. However, due to the massive amount of data, it is necessary to compress the point cloud. After compression, the number of points in the reconstructed point cloud will be reduced due to the quantization or downsampling in the compression process, which may introduce holes in the three-dimensional image. In this paper, we utilize the mathematical morphology to fill the holes in the reconstructed image. The results show that holes are filled with better subjective and objective quality metrics.

### ***Degradation Level Estimation of Road Structures via Attention Branch Network with Text Data***

Naoki Ogawa, Keisuke Maeda, Takahiro Ogawa and Miki Haseyama (Hokkaido University, Japan)

This paper presents degradation level estimation of road structures via attention branch network using text data. The proposed method introduces a module for processing text data containing information related to distresses into attention branch network that achieves high performance due to an attention mechanism based on visual features. Using both the text features extracted from text data and visual features extracted from distress images realizes the performance improvement of degradation level estimation. The effectiveness of the proposed method is shown in experiments using distress images and their text data obtained from actual inspections of road structures.

### ***Development of Fuzzy-Logic-Based Controllers for Energy Conservation in Human-Electric Bikes***

Jhen-Hong Dai and Jin-Shyan Lee (National Taipei University of Technology, Taiwan)

With the emphasis on sustainable design principles, a lot of studies have begun to develop electric pedal-assisted bikes. In this paper, a fuzzy-logic-based controller has been proposed with the consideration of road situations by further using a slope sensor. Finally, simulation results show that the developed approach outperforms other current ones in terms of both comfortable riding speeds and energy consumptions.

# C1: GaN Based Converters for Powering 5G and Beyond

Room: conference hall

Chair: Chin Hsia (National Central University, Taiwan)

## **13:10 High Voltage GaN Driver using EED Architecture**

Wen-Hao Fan (National Central University, Taiwan)

This article proposes a novel driver architecture applied in GaN power transistors, suitable for high-speed and high-voltage half-bridge or full-bridge drivers. The overall circuit design uses only E-mode and D-mode GaN transistors. The driver of the high-side circuit employs the EED structure (E-mode/E-mode/D-mode), and therefore, the gate of the highside transistor can be directly driven by the low-voltage signal without using the traditional level-shifters, simplifying the design. The low-side driver employs the architecture of stacking two E-mode devices to isolate output high-voltage pulses from low-side drive signals to prevent false triggering of the low-side driver. The simulation result shows that the circuit can efficiently drive the half-bridge and LLC converter, generating a high-voltage pulse wave with switching signal amplitude larger than 380Vpp and the desirable operation frequency of faster than 1 MHz. The rise and fall times of the high-voltage pulse waves are 43.2nsec and 43.7nsec, respectively.

## **13:25 Level-shifter-less High-side Power Driver**

Li-Jie Huang (National Central University, Taiwan)

This paper proposes a novel high-end driver, which can directly drive the high-end switch from a low-voltage pulse signal without a level conversion circuit, which can effectively reduce the complexity of the drive circuit design. The performance of the driver has been verified by being integrated into a high-voltage buck converter. Preliminary simulation results show that when the input voltage is 24 to 36V and the operating switching frequency is 1 MHz, the output of the buck converter can maintain a stable 5V with a ripple voltage of less than 0.6 mV.

## **13:40 Parameter Analysis of the Output Filter for Switching Buck Converter in Wideband Envelope Modulator**

Deng-Fong Lu (National Central University, Taiwan)

The paper compares the performance of different output filter designs used in high-speed switching power converters in envelope tracking power supplies. A GaN-based driver capable of achieving high switching frequency and high efficiency realizes the switching power converter. The influence of LCR and LCLR filters on the envelope signal at the output of the power supply is analyzed. Experiments show that, compared to the LCR filter, the LCLR filter can reduce the output ripple current from the switching power converter, and corresponding the low-frequency noise generated by the charging and discharging of the inductor, maintaining a stable envelope voltage output. In addition, smaller passive components can be designed for the LCLR filters to achieve the required ripple voltage, reducing the overall size and improving the response time of the switching power converter.

## **13:55 Comparison of Sliding Mode Functions for the High-Frequency Switching Power Converters**

Chin Hsia (Chang Gung University, Taiwan); Hong Yih Tseng (EpiPower Microelectronics Co. Ltd., Taiwan)

In this paper, four sliding mode control surfaces are designed to optimize the performance of the controller for switching power supplies. The influence of the on-resistance change in the switching power supply and the designed sliding function on the system settling time and stability is analyzed. This article takes the switching buck converter as an example to verify and compare the proposed sliding mode control surfaces.

## C2: Artificial Intelligence Models for Multimedia: Representation and Applications II

Room: 103

Chair: Li-Wei Kang (National Taiwan Normal University, Taiwan)

### **13:10 Query by singing and humming system based on combined DTW and Linear Scaling**

Kai-Wen Liang, Hsin Cheng Lee, Yen-Ting Lai and Pao-Chi Chang (National Central University, Taiwan)

In this paper, a query by singing and humming system based on combined Dynamic Time Warping (DTW) and Linear Scaling is proposed. The proposed system adopts the existing techniques to estimate the query's fundamental frequency and applied DTW to adjust the result to retrieve the objective. LS is employed in the process to scale down the pitch sequence in order to reduce the computation time. Experimental results show that our system reaches MRR 0.958 which is much higher than other works and performs better in the larger dataset as well.

### **13:25 User Background Information-Aware Music Recommendation with Reinforcement Learning-Based Knowledge Graph Exploration**

Keigo Sakurai, Ren Togo, Takahiro Ogawa and Miki Haseyama (Hokkaido University, Japan)

We propose a new reinforcement learning-based music recommendation method that takes into account users' background information. Although conventional methods using a knowledge graph based on collaborative filtering can provide recommendations with high accuracy, they suffer from the cold-start problem. The proposed method solves this problem by introducing users' background information such as countries and age groups into the knowledge graph and can achieve higher recommendation performance. The advantage of the proposed method is that our method can take users' cultural backgrounds into account in the task of music recommendation. We confirmed the effectiveness of the proposed method by comparing it with conventional methods including a state-of-the-art method.

### **13:40 The Development and Implementation of a Smartphone Based Archery Analysis System**

Jian-Shiun Peng, Yi-Jui Chen, Wei-Yang Lin, Hsin-Chin Chen and Chien-Nan Liao (National Chung Cheng University, Taiwan)

In this paper, we propose a smartphone based system for analyzing archery images. The front-end of our proposed system is a smartphone APP. The user can use the APP to take a photo of archery target and browse the analysis results. The back-end of our proposed system is responsible for detecting arrows in the archery image and determine the resulting score. The main advantage of our APP as opposed to the

existing archery APPs is that it can automatically determine archery score without manual input. We have conducted experiments using images provided by the archery team of National Chung Cheng University, Taiwan. The results demonstrate the potential of using our proposed system in archery training.

### **13:55 A Retention-Error Mitigation Method on TLC NAND Flash Memory for CE Storage Systems**

Chin-Hsien Wu, Yi-Lun Lan, Wei-Hao Wu and Chi-Yen Yang (National Taiwan University of Science and Technology, Taiwan)

Since NAND flash memory has limited P/E cycles, it could be unusable after exceeding the limited P/E cycles, and the main reason is the wear-out phenomenon in the flash memory cell. Under the influence of this phenomenon, any data can only be safely stored in the flash memory for a limited time (i.e., the retention time). As the retention time increases, the retention error rate continues to rise, and the final retention error rate could exceed the ECC (error correction code) capability. Since the retention error is the main error of NAND flash memory and its error rate is dependent on different stored states, some mitigation methods for retention errors are proposed. In the paper, we propose a retention-error mitigation method on TLC NAND flash memory for consumer electronics (CE). According to the experimental results, we can efficiently reduce the retention error rate.

## C3: Intelligent Circuits and Systems

Room: 104

Chair: Chang-Ming Wu (Chung Yuan Christian University, Taiwan)

### **13:10 Reduced-Complexity Quasi-Reversible BCH Decoders for Data Storage Systems**

Chong-Dao Lee (I-Shou University, Taiwan)

Error-correcting codes, including Bose-Chaudhuri-Hocquenghem (BCH) codes, low-density parity-check codes, and Reed-Solomon codes have been widely applied to magnetic and data storage systems. Recently, a new subclass of BCH codes was proposed and called quasi-reversible BCH codes. This paper proposes the new error-locator polynomial, which is a sparse polynomial, requires the less finite field additions as well as multiplications, and is able to reduce time delay. Finally, the algebraic decoding algorithm for quasi-reversible BCH codes to correct up to six errors is developed.

### **13:25 Improved Deep Learning in Citrus Canker Recognition System Based on FPGA**

Chang-Ming Wu (Chung Yuan Christian University, Taiwan)

This paper constructs a recognition system for citrus canker. And use deep learning technology. This technology can easily add new diseases and pests for identification. In addition, combined with hardware accelerators. In order to reduce storage capacity and memory bandwidth, a deeply separable convolution operation was implemented on FPGA to speed up the recognition speed, and images obtained by a webcam were used to identify citrus with canker disease.

### **13:40 Block-Based Compression for Reducing Indexing Cost of DNN Accelerators**

Yui-Kai Weng, Shih-Hsu Huang and Hsu-Yu Kao (Chung Yuan Christian University, Taiwan)

Sparse compression is often used in DNN (deep neural network) accelerators to reduce the data traffic of

convolutional computation. As the quantization technique greatly reduces the data bit-width, the indexing cost may account for a large proportion of data traffic after sparse compression. In this paper, we point out the similarity of feature maps in different channels. Based on this observation, we propose a block-based compression approach to reduce the indexing cost. Benchmark data show that the proposed approach can reduce 21.1% indexing cost.

### **13:55 *Hardware Implementation for Fending off Side-Channel Attacks***

Yi-Liang Hong, Yui-Kai Weng and Shih-Hsu Huang (Chung Yuan Christian University, Taiwan)

Side-channel attacks (SCAs) are to obtain physical information (e.g., time information, power consumption, electromagnetic leakage) from the physical implementation of a cryptosystem for further cracking the cryptosystem. In this paper, we study the protection to SCAs for the Advanced Encryption Standard (AES) cryptosystem. We add extra circuits (components) to the AES circuit to produce almost equal power consumption (for different key values) without affecting the encryption results. Experimental results show that the approach works well in practice.

## C4: Artificial Intelligence Applications and Technologies in Internet of Things III

Room: 402-1

Chairs: Wen-Hwa Liao (National Taipei University of Business, Taiwan), Jung-Kuei Chang (Tamkang University, Taiwan), Cheng-Chin Chien (Galaxy Software Services Corp., Taiwan), Chih-Yung Chang (Tamkang University, Taiwan)

### **13:10 *uHealth: Smart Clothing Enabled Intelligent Ubiquitous Health Monitoring System***

Aiguo Wang (Foshan University & School of Electronic Information Engineering, China); Huancheng Liu, Huihui Chen and Chundi Zheng (Foshan University, China); Guilin Chen (Chuzhou University, China)

The development of Internet of Things and artificial intelligence has greatly advanced the design and implementation of remote monitoring systems for intelligent healthcare services, of which the sensing and data analysis components play central roles. To this end, we propose a smart clothing-based ubiquitous health monitoring system, called uHealth, to collect physiological signals and behavioral data of the users and to support high-level applications. Specifically, we here introduce the design of smart clothing and illustrate the architecture of uHealth and its key components.

### **13:25 *Distributed Multi-Dimensional Scaling Localization Algorithm Based on Improved Centralized Matrix***

Fei Cheng, Ping Zhang, Qi Zhou, Xinjing Qin and Tao Liu (Anhui Polytechnic University, China)

A distributed multi-dimensional scaling (MDS) algorithm based on improved centralized matrix was proposed to solve the error accumulation problem in existing distributed MDS algorithms which merge the local maps to a global one. After clustering the nodes according to the number of hops, the proposed

algorithm designs suitable centralized matrices for each cluster to restrain the error caused by multi-hop distance estimate, and facilitate the following iterative fusion of the local maps. Simulation results show that the proposed algorithm further reduces the merge error and improves the overall positioning accuracy.

### **13:40 Construction Strategy of Enterprise Security Management Blockchain based on Capsule Network and Situation Awareness**

Boheng Li (Southeast University, China)

In order to solve the problems in enterprise security management, such as the data is easy to be tampered and the security perception information cannot be fully identified, a " machine, human, environment " capsule perception network is constructed through edge perception devices. On this basis, we propose a capsule perception network based on edge awareness, deploy local security situation awareness machine to sense the local security situation of enterprise production, realize the global security situation awareness of enterprise production through industrial Ethernet and cloud computing, and finally enter the enterprise security management blockchain. It provides guarantee for scientific decision-making of enterprise safety production.

## C5: Computer Networks, Sensor Technologies and Big Data Computing

Room: 402-2

Chairs: Tin-Yu Wu (National Ilan University, Taiwan), Dan Tao (Beijing Jiaotong University, China)

### **13:10 Power Generate Trend Prediction with Machine Learning on Independent Green Energy Smart Power Monitoring and Big Data Collection and Analysis System**

Tey Fu Jie, Sheng-Po Lin and Tin-Yu Wu (National Ilan University, Taiwan)

In recent years, demands of wind and solar hybrid systems have been increasing, which is quite suitable for building the Independent micro smart electric grid but the disadvantage that needs to be overcome is the problem of unstable power supply in renewable energy. Therefore, the system in this paper will solve the problem by building a monitoring system to collect data and analysis for a period before sending the analysis result to the user. These accurately estimated recommendations on the number of power units required for the balance of power supply and demand can allow users to monitor the devices status in real time, or as a consider upgrading the capacity of the unit to provide a basis for a stable power supply/or as a basic for consider upgrading the capacity of the unit to provide a stable power supply.

### **13:25 Managing TCP Congestion Control of Smartphones toward Advanced Control**

Natsuki Katsumata, Kouto Miyazawa and Saneyasu Yamaguchi (Kogakuin University, Japan)

A communication throughput is an important performance of a smartphone, in particular for big data applications. The output speed is controlled by its congestion control algorithm that is running in its kernel space. One of the promising methods for improving congestion control is congestion control via deep learning. However, most of all the deep learning systems run in the userspace, and the congestion control algorithm runs in the kernel space. For achieving this, managing the congestion control behavior in the kernel space from userspace is necessary. In this paper, we propose a system in which a userspace process



can set the congestion window size in the kernel space of the Linux kernel by focusing on the Android operating system. We then present system evaluations and show that the proposed system can suitably manage the congestion control behavior in the operating system. The proposed system monitors the congestion window size in the kernel space and transmits it to the userspace via /proc filesystem. Similarly, this transmits a value specified by a userspace process to the kernel space and applies the value to the congestion window size.

### **13:40 POI recommendation model based on Attention-based Gated Recurrent Unit Network**

Jinxi Wu, Yi Yao, Ruiming Fan and Dan Tao (Beijing Jiaotong University, China)

Point-of-Interest (POI) recommendation is one of the main functions in Location-based Social Networks (LBSNs). At present, some POI recommendation models couldn't effectively capture users' complex information and their recommendation performances are not good enough. Motivated by this, we propose a kind of POI recommendation model which is based on Attention-based Gated Recurrent Unit Network (Att-GRU). Firstly, we adopt the Gated Recurrent Unit (GRU) network to learn the complex sequential transition patterns from users' check-in behavior. Secondly, we extract user's preferences by using the target-guided attention mechanism. Finally, we conduct extensive experiments on a real-world LBSN dataset, and the experimental results demonstrate that our proposed Att-GRU based POI recommendation model has better performance than those of other mainstream ones in some evaluation criteria.

### **13:55 Children's Implicit Authentication based on Gesture Feature for Smartphone**

Xinxian Zhang, Jiangyang Lan, Ruihan Li and Dan Tao (Beijing Jiaotong University, China)

This paper proposes a gesture feature based implicit authentication scheme for children. 8 kinds of embedded sensors, e.g. accelerator, gyroscope, gravimeter, are used to record the gesture data of users using smartphone, and 30 groups of sophisticated gesture features are extracted from total 156 groups for model training. Finally, based on a real-world dataset including gesture data from 32 adults and 27 children, a series of experiments are performed, and the effectiveness of our proposed solution is testified.

## **C6: Smart Technologies, Management and Control for Energy Systems**

Room: 408-1

Chair: Saher Javaid (Japan Advanced Institute of Science and Technology (JAIST), Japan)

### **13:10 Admission Control Scheme with Balancing Power Negotiation Algorithm for Home Energy Management and Control System**

Yuto Lim (Japan Advanced Institute of Science and Technology (JAIST) & School of Information Science, Japan); Satsuki Takano (JAIST, Japan); Saher Javaid (Japan Advanced Institute of Science and Technology (JAIST), Japan); Yasuo Tan (Japan Advanced Institute of Science and Technology & National Institute of Information and Communications Technology, Japan)

Balancing the power supplies and power demands in smart home environment is key issue of today

home energy management system (HEMS). In this paper, HEMS with a controller, named home energy management and control system that incorporates with admission control scheme is proposed to ensure the household power use efficiently. With introduction of "Quality of Energy Service", this paper presents a balancing power negotiation algorithm for the controller to leverage the peak power usage and guarantee the balance in between the power renewable supplies and power demands of all home appliances in the timely manner. Numerical simulation results reveal that the proposed BPN algorithm can efficiently balance the household power use in both Summer and Winter seasons.

### **13:25 *The Magnetic Field and Coupling Between Coils in Wireless Charging System for 3C Electronics***

Shen Shou Max Chung (National Penghu University of Science and Technology, Taiwan); Shih-Chung Tuan (Oriental Institute of Technology, Taiwan)

Wireless charging has become a new necessity in 3C electronics, and the trend is aiming for larger area, longer distance, and higher power charging. Among all the wireless charging standards, Qi standard is becoming a dominant one. In this article we simulate the magnetic field in Qi standard like coils and their mutual coupling coefficient with Multi-Level-Fast-Multipole-Method (MLFMM) with a commercial EM software. We found as the charging frequency increases, generally the magnetic field intensity increases but the volume it encloses decreases. More layer of coils not necessarily increases the magnetic field strength. The perfect alignment of two coils is not really as important as generally conceived.

### **13:40 *Storage Minimization Considering System Conditions of Power Flow System***

Saher Javaid (Japan Advanced Institute of Science and Technology (JAIST), Japan); Kaneko Mineo (Japan Advanced Institute of Science and Technology, Japan); Yasuo Tan (Japan Advanced Institute of Science and Technology & National Institute of Information and Communications Technology, Japan)

The economy and reliability of a power system can be increased by allocating the energy storage capacity of power storage devices in renewable resources integration. To reduce the effects of power fluctuations caused by fluctuating power devices, energy storage systems are highly encouraged. However, due to the physical constraints of power devices, the power balance may not be achieved. This paper proposes an optimization problem which minimizes storages capacity based on system conditions. Finally, Linear Programming Solver in MATLAB environment is used to find the solution of the proposed optimization problem.

## **C7: Computer Communications and Signal Processing for IoT II**

Room: 408-2

Chairs: Takashi Okuda (Aichi Prefectural University, Japan), Yutaka Ishibashi (Nagoya Institute of Technology, Japan), Pingguo Huang (Gifu Shotoku Gakuen University, Japan)

### **13:10 *Performance analysis of service architectures applying queueing systems***

Mikio Katsu and Takashi Okuda (Aichi Prefectural University, Japan)

Services are becoming more and more diverse. In this paper, we perform architecture analysis of various

services applying queuing systems. We analyze response time of three typed queuing systems by considering different service time distributions . As a result, we can show that there are areas that differ from the conventional evaluation.

**13:25 QoE Assessment of Cooperative Work in Networked Virtual Environment with Haptics**

Khaing Zar Win and Su Thandar Aung (University of Computer Studies, Yangon, Myanmar); Yutaka Ishibashi (Nagoya Institute of Technology, Japan); Khin Than Mya (University of Computer Studies, Yangon, Myanmar)

This paper examines influences of the network delay on haptic cooperative work in a networked virtual environment by QoE (Quality of Experience) subjective and objective assessment. As the work, two users cooperatively carry an object in a networked maze system by using haptic interface devices. Assessment results demonstrate that as the network delay becomes larger, MOS (Mean Opinion Score) as a subjective measure becomes higher. We also clarify the relations between MOS and several objective measures by regression analysis.

**13:40 Effect of Position Follow-up Control for Hand Delivery between Remote Robot Systems with Force Feedback**

Luozhang Li and Yutaka Ishibashi (Nagoya Institute of Technology, Japan); Pingguo Huang (Gifu Shotoku Gakuen University, Japan); Yuichiro Tateiwa (Nagoya Institute of Technology, Japan)

In this paper, we handle cooperative work between two remote robot systems with force feedback. We also examine the effect of the position follow-up control by experiment in the systems where stabilization control and QoS control are carried out together. Experimental results illustrate that the position follow-up control can suppress the force largely.

Wednesday, September 15 14:10 - 14:20

Opening Ceremony (Conference Hall)

Wednesday, September 15 14:20 - 15:20

Keynote Speech I: Jyh-Ching Juang (Conference Hall)

Chair: Pei-Jun Lee (National Taiwan University of Science and Technology, Taiwan)

Wednesday, September 15 15:20 - 15:40

Coffee Break

Wednesday, September 15 15:40 - 17:10

Poster B

Room: poster area

Chair: Chih-Hsien Hsia (National Ilan University, Taiwan)

### ***Enhance Face Recognition Using Time-series Face Images***

Han Tung Chen, Guan Ying Peng, Kai Chi Chang, Jia Yi Lin, Yi-Hsin Chen, Yu Kai Lin and Chao-Yi. Huang (National Yunlin University of Science and Technology, Taiwan); Jong-Chen Chen (National YunLin University of Science and Technology, Taiwan)

In recent years, with the gradual development of computer vision-related technologies, the face recognition-related technology has gradually become one of the mainstream security system options. In this study, we use MTCNN[1] for preprocessing and LRCNs[2] network structure and time-series face image data to try to solve the problem of unrecognizable user due to face blocking or face angle, when a frame is unrecognizable, we can still compare the user's characteristics with other frames and determine their identity.

### ***Analyze the subordination structure between domain-specific vocabulary and meaning with the Word2Vec training process***

Keng-Jung Pai, Chin-Hung Kuo, Jia-Wei Peng and Chao-Yi. Huang (National Yunlin University of Science and Technology, Taiwan); Jong-Chen Chen (National YunLin University of Science and Technology, Taiwan); Cheng-Yen Wu (National Yunlin University of Science and Technology, Taiwan)

Words are used to express the meaning that an expressor wants to express, and when humans use words to express themselves, they must have a purpose for expressing the meaning they want to express. Words are organized and ordered to form readable and representable words. Word2vec is based on the relationship between the occurrence of words before and after the text, similar to the human habit of using words. Therefore, we use word2vec to train word subgroups to analyze the subordination structure when words express meaning. A single word2vec model has only a fixed word vector space and can only rely on a single word vector similarity for clustering. And words that are more similar will disperse more slowly during the training process. By observing this phenomenon, we can provide a basis for clustering. In order to group words that are more similar in semantic meaning.

### ***A research of Hartmann-Shack Wavefront Aberration measurement system validation technology***

Ching-Huang Lin (National Yunlin University of Science and Technology, Taiwan); Hsuan-Fu Wang (Chung Chou University of Science and Technology, Taiwan)

This study based on Hartmann-Shack system to provide a non-contact system measuring Wavefront Aberration. Hartmann-Shack system set by optical component can realize that changing optical component to adjust the system. At the end, comparing the aberration of normal lens between the simulation by ZEMAX software and calculation by Zernike polynomials the non-contact system. To ensure the stability of system.

### ***Development of a Smart Multifunctional Visitor Identification System***

Chih-Chen Chen, Ren-Guang Lue and Tsung-Hsien Hsieh (Hwa Hsia University of Technology, Taiwan); Yu-Luen Chen (National Taipei University of Education, Taiwan); Hsuan Fu Wang (National Yunlin University of Science and Technology, Taiwan); Chi-Pan Hwang (National Changhua University of Education, Taiwan)

People with impaired physical function will encounter inconveniences in their daily life, due to their own defects. Therefore, it will be benefits of their self-esteem, value and self-confidence to reduce the difficulty they encounter or increase the convenience of physical actions. The development of a smart multifunctional visitor-identification system, our article proposes, will help the daily life of the hearing impaired, the visually impaired, the elderly, etc. When there are guests visiting, it is very likely that due to their hearing, vision, or mobility impairments, they will not be able to know that someone is coming or make a timely response, which results in their regrets of missing the visitor and even delaying important works. Our article establishes a mechanism to remind residents whether there are guests visiting through related electronic devices for range finding, identification, etc. A vibrating bracelet (or ring) and a flashing light bar are worn on the resident's wrist (or neck), that is, to remind the resident by means of vibration and light bar flashing. Other related hardware aspects include LED dot matrix modules, voice broadcast, and infrared door locks; LED dot matrix modules are used to display the current date, time, and visitor information, and the voice broadcast will play the speakers of the visiting guests. The LED dot matrix module can provide information about visiting guests for the hearing impaired or residents with reduced mobility, and the voice broadcast can provide information about the visiting guests for the visually impaired or residents with reduced mobility. If the resident completes the identification of the visiting guest and wants to open the door lock, he can use infrared light wave to open the door lock. This is a convenient and safe way for residents with limited mobility or the elderly.

### ***An Embedded All Digital Temperature Sensor with Adjustable Sensitivity***

Po-Hui Yang (National Yunlin University of Science and Technology, Taiwan); Hsin-Wei Dong and Kaun-Chi Huang (National Yunlin University Science and Technology, Taiwan)

In this paper, a linear digital temperature-sensitivity-dependent pulse width adjustable sensitivity full-digital embedded temperature sensor is proposed. The synchronously adjusted circuit will not change the temperature sensor's resolution when the temperature sensitivity is adjusted. The circuitry proposed in this paper is designed in CMOS 90nm process. The measurement temperature range is 0°C~100°C, the adjustable temperature sensitivity range is 32k-pulse/°C ~ 250k-pulse/°C, the temperature resolution is maintained at 0.1°C, and the minimum power consumption is about 110μW. And the temperature sensitivity setting function is verified by a 25k Logic Element FPGA.

### ***Overview on Physical Layer Security in Low Earth Orbit (LEO) Satellite System***

Cheng-Ying Yang (University of Taipei, Taiwan); Min-Shiang Hwang (Asia University, Taiwan); Chin-En Yen (Chaoyang University of Technology, Taiwan); Jenq-Foung JF Yao (Georgia Colge & State University, USA)

Based on Shannon's Theory, positive secrecy capacity could support secure communication. The LEO satellite system is proposed for internet service. The issues of privacy and security become progressively important in internet applications. Conventionally, the security scheme is applied to the higher-network layer. However, the fundamental ability of the physical layer to provide secure transmission. This work leads the encryption to code and to analyze the security rate in the LEO system. The coding scheme with memory aided could provide a positive secrecy capacity of the system.

### ***Secrecy Rate Analysis in The Cooperative Communication System***

Jong-Shin Chen (Chaoyang University of Technology, Taiwan); Cheng-Ying Yang (University of Taipei, Taiwan); Min-Shiang Hwang (Asia University, Taiwan); Jenq-

Foung JF Yao (Georgia Colge & State University, USA)

With the assistance of relays, cooperative communication provides the benefits of spatial diversity to improve the system performance. It could be prospective for the application of wireless networks. The issue of security is highly requested for personal privacy in the internet. With applying this cooperative system to internet service, security is critically requested. Usually, in the higher layer networks, it adopts an encryption to approach the security request. However, a complex encryption spends a lot of computer resource. It is not practical for Internet of things (IoT) application which has a limited computing resource. Shannon perfect secrecy illustrates the secure communication could be implemented on the physical layer. Assuming the relays in the system is the eavesdroppers, this paper provides the secrecy analysis for the cooperative system and gives a theoretical solution. With an appropriate assignment of relay, the results show that the cooperative system could provide a secure communication if the number of available relays is larger than that of eavesdroppers. A proper choosing the relays to transmit the information could be the important issue in the cooperative communication system.

### ***Enhanced Image Quality Assessment Based on Halftoning Metrics***

Jing-Ming Guo and S Sankarasrinivasan (National Taiwan University of Science and Technology, Taiwan)

The digital halftoning is widely adopted in printing applications to obtain a high-quality printing output with optimal ink usage. The technique comprises of transforming a continuous tone grayscale image into its approximate binary image. On the other hand, image quality assessment deals with estimating the perceptual quality of the degraded image. The paper deals with exploitation of ordered dithering technique of the halftoning, to improve the performance of the existing image quality indices. The widely used full reference image quality metrics such as Peak Signal to Noise Ratio (PSNR) and Structural Similarity Index (SSIM) are considered for this paper. The main objective aims to improve the correlation coefficient between the widely used IQM and Human Visual System (HVS). Moreover, the computation demand of the existing indices is also reduced significantly. The well-known LIVE image quality database is used to validate the performance of the proposed approach. To perform correlation analysis, Pearson, Spearman and Kendall correlation coefficients are used. From experimental analysis, it can be validated that the proposed IQM performs with improved accuracy and less computational demand.

### ***Modified Attention Spatial Convolution Model for Skin Lesion Segmentation***

Phuong Le, Yi-Chiung Hsu and Jia-Ching Wang (National Central University, Taiwan)

Melanoma is one of three skin cancer types and the main reason for almost all skin cancer deaths. The computer-aided diagnosis is the best method to automatically segment the skin lesion such as melanoma. In this paper, a modified attention spatial convolution (mASC) was designed to perform the skin lesion segmentation effectively. The superiority in skin lesion segmentation of the proposed mASC model was demonstrated by comparing with several recent models in the Skin Lesion Analysis Towards Melanoma Detection Challenge dataset.

### ***Identification System of Fish Freshness Based on Deep Learning***

Shu Min Tsai and Yung-Cheng Yao (National Penghu University of Science and Technology, Taiwan)

Fish is rich in high-protein, multi-vitamins, low-calorie, and other nutritional value. It is an indispensable delicacy. How to choose fresh fish is a difficult work. Although experts suggest three observation points for choosing fresh fish: 1. Fish Eyes: clear and moisturizing; 2. Fish gills: bright red; 3. Fish scale mucus:

mucus with transparent bubbles. But these descriptions are too vague and there are no clear figures, causing consumers to buy stale fish. This paper proposes an identification system of fish freshness using deep learning method. Consumers can use the APP designed by this research, take pictures, upload picture images to the cloud database through the system, and perform model testing through the cloud database. The system returns freshness indicators to APP users, so that consumers can know the freshness of the currently purchased fish.

### ***Automatic Incremental Training of Object Detection by Using GAN for River Level Monitoring***

Kuei-Chung Chang, Shih-Hong Lin, Jun-Wei Huang and Yi-Fong Wu (Feng Chia University, Taiwan)

Terrain problems have caused floods to occur frequently, which will cause flooding, landslides, destroying facilities and casualties in Taiwan. With the growth of machine performance and the gradual completion of training data, object recognition approaches based on convolutional neural network (CNN) have performed well in various disaster monitoring systems. However, in the actual domain, as time goes by, changes in the background, viewpoint, and environment caused by weather and time conditions will cause the model to be inaccurate for the outdoor CCTVs. In this paper, we proposed an automatic incremental training approach combined with deep convolutional generative adversarial network (DCGAN) to greatly reduce the time and labor cost of model retraining. The experimental results show that the proposed approach can effectively reduce labeling effort and achieve the recall closing to the model with manually labeled and training by human.

### ***Reversible and Robust Watermarking Technique***

I-Hui Pan (Air Command and Staff College, National Defense University)

We propose a reversible watermarking technique based on prediction-error embedding of color images. Then, lossless or lossy watermark extraction is used. In the lossless algorithm, we use the parameters of the predicted model and the location map to improve the quality of the stego image and restore the cover image. During lossy watermark extraction, two-dimensional linear discriminant analysis and two-dimensional principal component analysis are applied. We combine reversible information hiding and watermarking schemes. Experimental results have shown the embedded watermark can be extracted lossless. In addition, it can efficiently withstand various attacks.

### ***Towards Personalized Real-time Cardiodynamic Status Monitoring: Multi-scale Modeling of the Heart Sound***

Tung Jing Fang (National Taipei University of Technology, Taiwan)

Cardiovascular diseases have been known as one of the diseases with an increasing number over the years and great intensity that led to enormous concern being attracted to a non-invasive heart sound detection technology. Knowledge in heart auscultation steadily becomes a pivotal work in this modern technology era. Moreover, in the presence of multiple scales of mathematical analysis allowing the stimulation on how the cardiac function at the whole-organ scope, this causes interest to developed monitoring of the cardio-dynamics activity on both patients and non-patients to measure their health status. In this study, we developed heart sound sensing with a cardio-dynamics recording system as a multi-scale model of the heart role, which allowed us to explore whether it can contribute to a new comprehension of health care of patients in a large population. We are mostly focusing on several aspects such as the concept of heart sounds and the link between cardiovascular dynamic and heart sounds; some technologies related to the

processing and analysis of heart sound signals, containing segmentation, denoising, feature extraction also classification; and the deep learning algorithm employment in the heart sound managing and processing. In the beginning, we found that the estimation of the model parameters from heart sound with cardiac function at the whole organ scale and prognosis scores were very consistent. Since the employed multi-scale mathematical system is predictive. So here in this paper, we further illustrate the potential of the system upon the individualized planning of cardiac health and treatment in a case of cardiovascular disease.

### ***An RSSI-Based Device-Free Localization System for Smart Wards***

Yu-siang Feng (National Central University, Taiwan); Hsiao-Yu Liu and Mei-Hui Hsieh (Landseed International Hospital, Taiwan); Hsiao-Chun Fung, Chan-Yi Chang, Chi-Cheng Yu and Chih-Wei Huang (National Central University, Taiwan)

Patient monitoring during hospitalization and in-time assistance are essential tasks. However, it is always challenging for medical personnel to efficiently monitor duties, especially under raising attention to privacy issues. Advances in device-free localization (DFL) technologies and the evolution of machine learning technologies made localization more accurate than ever. We take advantage of easily accessible Wi-Fi signals around the wards and perform privacy-preserving localization on patients using multi-scale convolutional neural network (CNN) and long short-term memory (LSTM) models. The results demonstrate high localization accuracy. Also, the system can be extended for emergent event detection, enabling medical personnel to react promptly.

## **D1: Signal Processing for Communication, Radar, Optics, Circuit Design, AI and GPU**

Room: conference hall

Chair: Hsuan Fu Wang (National Yunlin University of Science and Technology, Taiwan)

### ***15:40 The Efficacy of Radar Absorption Material on the Radar Cross Section Reduction of Simple Shapes***

Shen Shou Max Chung (National Penghu University of Science and Technology, Taiwan); Shih-Chung Tuan (Oriental Institute of Technology, Taiwan)

Radar Absorption Material (RAM) can absorb microwave, therefore is useful in assuring Electromagnetic Compatibility (EMC) for consumer electronics or achieving RF stealth for military platform. The specification of RAM is usually described in return loss per unit distance; however, the Radar Cross Section (RCS) is a more complicated function of frequency, shape, material, and incident angle. In this article we demonstrate the efficacy of RAM on the RCS of a simple square metal plate with Multi Level Fast Multipole Method (MLFMM) simulation for 3 GHz microwave at 30° incident angle with different thickness of RAM, and found the RCS reduction can be as large as -15 dBsm.

### ***15:55 Autonomously Vehicle Network PIDs Parsing to Support Threat Monitoring and Early Warning Research***

Chi-Pan Hwang and Huang Yu-Wei (National Changhua University of Education, Taiwan); Hsuan-Fu Wang (National Yunlin University of Science and Technology)



The CAN Bus Messages are mostly customized on various types of vehicles. A PID-CAN-Bus-Message-Pairs parser has been designed to analyze those customized CAN Bus message stream from vehicle network. It is composed of a downstream module and an upstream module. The downstream module works for vehicle dynamic behavior fusion and real-time CAN Bus message acquisition. The upstream module gets fused vehicle dynamic behavior and real-time CAN Bus messages from downlink module to autonomously parse out the parameter identify codes which are subsequently stored to serve as the basis for autonomous driving and vehicle network information security protection research.

### **16:10 A study of Wavefront Aberration Measurement Technology based on Centroid Calculation**

Ching-Huang Lin (National Yunlin University of Science and Technology, Taiwan);  
Hsuan-Fu Wang (Chung Chou University of Science and Technology, Taiwan)

The basic structure of the Shack-Hartmann wavefront sensor (SHWFS) is a microlens array and a set of sensors. Some conditions before the light enters the sensor from the imaging system cause the pixels to sense uneven light and generate a lot of noise in the image. Therefore, a set of noise filtering methods is needed to reduce the influence of noise in the image. Theoretically, the strongest point of the laser spot can be regarded as the center of mass of the laser spot. In this study, the best focus is used to capture the image. Perform image processing and use the program to evaluate various weights and thresholds to obtain centroid coordinates. The centroid control group will be used as an unaffected standard reference in the future. After that, the system adds an experimental group that changes the light wave front to perform quality control. The calculation of the wavefront value obtained by evaluating the position of the light spot, Zernike coefficient and Zemax can be used to verify the accuracy of the calculated wavefront aberration.

## D2: Deep Learning Based Robotic Systems

Room: 103

Chair: Chen-Chien Hsu (National Taiwan Normal University, Taiwan)

### **15:40 FoodTemi: The AI-Oriented Catering Service Robot**

Chuan-Fu Hung, Yang Lin, Hao-Jheng Ciou, Wei-Yen Wabg and Hsin-Han Chiang  
(National Taiwan Normal University, Taiwan)

This study develops a catering service robot system for a self-serviced restaurant. The overall system integrates the Dobot arm, a linear motion robot, and Temi mobile robot. By ordering the drinks via the panel on robots, the Dobot arm and linear motion robot will prepare for the beverage. When the meal is ready, FoodTemi will automatically fetch and deliver the meal to the customer.

### **15:55 In-Box Picking System Design for Six-Axis Robot Arm**

Ching-Chang Wong, Ren-Jie Chen, Sheng-Kai Yang, Shao-Yu Chien, Shang-Wen Wong and Chun-An Yeh (Tamkang University, Taiwan)

This paper designs and implements an in-box picking system for a six-axis robot arm. For the randomly stacked objects in the box, the system combined with a visual algorithm and a collision avoidance algorithm allows the robot arm to autonomously complete the picking and placing of the objects in the box. This paper discusses the problems at the system level, which uses object detection algorithms and point cloud data to deal with object classification and matching problems, and uses a collision avoidance

algorithm to prevent the robot arm from colliding with the box. Finally, an actual test is presented to illustrate the proposed system can indeed complete the actual operation.

### **16:10 Deep Learning Image-to-Image Translation for Animation**

Jacky Baltes (National Taiwan Normal University & University of Manitoba, Taiwan);  
Carolina Rutili de Lima (National Taiwan Normal University, Taiwan)

This paper presents a novel application for animation of cartoon characters. The system consists of two components: (a) a generative adversarial network that is trained to generate comic characters from edge images, and (b) an edge detector that takes input from portraits and then generates comic characters based on the resulting edge images.

### **16:25 Robotic Grasping Strategies Based on Classification of Orientation State of Objects**

Jui An Lin and Chen-Chien Hsu (National Taiwan Normal University, Taiwan)

Robotic grasping has been studied for years, but still has lots of room for improvement due to its requirement of sufficient robustness to achieve a high success rate. This paper proposes grasping strategies that produce reliable grasping poses without human labeling. All the training and testing processes are performed in a simulation environment. We then further evaluate the quality of the grasping strategy produced by the system. High success rate result shows its potential of application in industrial production lines, helping the robot arms perform high-quality grasping with picking or similar tasks.

### **16:40 A Lightweight Fine-Grained Action Recognition Network for Basketball Foul Detection**

Cheng-Hung Lin, Min-Yen Tsai and Po-Yung Chou (National Taiwan Normal University, Taiwan)

In recent years, deep neural networks for action recognition has attracted extensive attention because of its wide range of applications such as anomaly behavior detection in smart surveillance system. Among the proposed deep learning models, 3DCNN works very well in the action classification of large data sets, including UCF-101, HMDB-51, and Kinetics. However, for the classification of fine-grained actions, current action recognition models still need improvement. The fine-grained action means that the difference from the normal action is very small, and the time of occurrence is extremely short and difficult to distinguish. For example, in the basketball game, the foul action is a kind of fine-grained actions. Foul action recognition is very challenging because fouls in basketball games are always instantaneous and very similar to normal actions. In this paper, we propose a lightweight fine-grained action recognition model for basketball foul detection. Compared with other action recognition models such as two-stream model, 3DCNN, our proposed network has a better effect on this subtle classification task, and is lighter in parameters. The visualized foul feature distribution is concentrated in a few frames that supports our initial hypothesis that fouls always happen instantaneously. Finally, the output of this research can be used to assist in training basketball referees.

### **16:55 Automatic Data Acquisition of Indoor Environment Using the Autonomous Mobile Robot**

Chieh Lin, Pei-Che Hsieh, Sih-Han Wang and Hsin-Han Chiang (National Taiwan Normal University, Taiwan)

This paper presents the design and implementation of an autonomous mobile robot (AMR) with its solutions for combining the AMR and multi-source wireless instruments to achieve automated data verification and acquisition under indoor environments. In our development, the AMR can communicate with test instruments like oscilloscopes or mobile devices and control them. While site survey process with the map which was built in advance, the AMR can automatically navigate in accordance with planned routes and collect data that user needed such as geomagnetism or channel state information in the indoor environment.

## D3: Advanced Circuits and Signal Processing Systems

Room: 104

Chair: Po-Yu Kuo (National Yunlin University of Science & Technology, Taiwan)

### **15:40 Receiver Front-End of Continuous-Time Sigma-Delta Modulator for Medical Intubation Wireless Applications**

Wen Cheng Lai (National Taiwan University of Science and Technology, Taiwan)

The proposed receiver front-end consists of a low noise amplifier (LNA) with the differential feedback inverter configuration, a harmonic rejection mixer with three Gilbert mixer paths, analog PGA, Gm-C loop filter, voltage-controlled oscillator (VCO) and continuous-time  $\Sigma\Delta$  modulator with DWA Technology. The receiver front-end used detection of oxygen sensor to control oxygen generator then send signal to doctor and health could center for medical intubation wireless applications.

### **15:55 Circuits Design Low-Phase Noise Colpitts VCO with Gm-Boosting**

Wen Cheng Lai (National Taiwan University of Science and Technology, Taiwan)

This paper proposes a low voltage, wide tuning range, and low phase noise voltage-controlled oscillator (VCO) adopting colpitts architecture and using gm boosting technique for 5.8 GHz applications. Measured results of the Colpitts VCO circuit exhibit the tuning range of 5.29 to 6.07 GHz as well as phase noise of -123.4 dBc/Hz at 1 MHz frequency offset and output power of -6.67dBm under 5.73 GHz. The power consumption of the core circuit is 4.7mW from supply voltage of 1V. The proposed overall chip (die size = 0.6 x 0.6 ) is fabricated in tsmc 0.18 $\mu$ m CMOS 1P6M process.

### **16:10 Analysis of the Performance Impact on Dynamic Comparator for Analog to Digital Converter Under Process Mismatch**

Po-Yu Kuo (National Yunlin University of Science & Technology, Taiwan); Mao-Jung Huang (National Yunlin University of Science and Technology, Taiwan)

In recent years, with the progress of the CMOS process technology, the speed of transistor has increased dramatically. Thus, the speed of Analog-to-Digital Converter (ADC) also improved, even up to the frequency of GHz. In Analog-to-Digital Converter, the dynamic comparator and sample-and-hold circuit are generally used. In this paper, the Monte Carlo method is used to analyze the performance impact of the dynamic comparator under process mismatches and to examine the yield of dynamic comparator over different voltage differences.

### **16:25 *Direct Computation of Discrete Cosine Transform Algorithm and Its Hardware Architecture Design for Mel-scale Frequency Cepstral Coefficients***

Shin-Chi Lai (Nanhua University, Taiwan); Ying-Hsiu Hung (National Yunlin University of Science and Technology, Taiwan); Yu-Syuan Jhang (National Yunlin University of Science & Technology, Taiwan); Yi-Chang Zhu (Nanhua University, Taiwan); Ming-Hwa Sheu (National Yunlin University of Science & Technology, Taiwan); Wen-Ho Juang (Nanhua University)

This paper presents an improved direct computation of DCT algorithm by using unique-group cosine coefficients to calculate all DCT bins for Mel-scale frequency cepstral coefficients (MFCC) feature extraction. Compared with the traditional method of direct computation, the number of cosine coefficients for the proposed algorithm can be greatly reduced by 85.42%, but the numbers of additions and multiplications would be increased by 134% and 218%, respectively. Based on the advantages of simple structure and easy control, the proposed design would be a new solution for future applications in the whole hardware design of MFCC.

### **16:40 *Font-End Integrated Circuit Design for Plant Physiological Sensing***

En-Chi Yang and Ming-Jie Lee (National Yunlin University of Science and Technology, Taiwan); Wen-Ho Juang (Nanhua University); Ming-Hwa Sheu (National Yunlin University of Science & Technology, Taiwan); Shin-Chi Lai (Nanhua University, Taiwan)

This paper presents a photosensing circuit design to measure plant bioelectricity impedance, through electrochemical impedance spectroscopy (EIS) system to analyze plant physiological changes. The proposed Font-End IC (FE IC) design composed of Tunable Bandpass instrumentation amplifier (TB-IA) and Binary-Weight Programmable gain amplifier (BW-PGA). The TB-IA is designed by configurable capacitor feedback and cross coupling two-stage gain amplifiers for the adjustment of bandpass frequency. The BW-PGA achieves programmable gain by changing the effective transconductance of the input stage and provides linear-in dB gain and fine dB gain steps. Firstly, the prototype is implemented by discrete components. Next, based on 0.18 $\mu$ m CMOS technology, the core size of FE chip is realized with 0.3 mm<sup>2</sup> area. Under operation voltage 1V, the cut-off of low frequency can be adjusted between 525 Hz to 6.25kHz, and the programmable gain range can have 44.9 dB to 55.2 dB. It will be suitable for measuring various biopotential signals in the future.

### **16:55 *Investigation on Error-Tolerability Enhancement of Videos via Re-Encoding for Computer Vision: A Case Study on Object Detection***

Tong-Yu Hsieh and Jun-Tsung Wu (National Sun Yat-sen University, Taiwan)

Run-time video re-encoding via adjusting the Group of Pictures (GOP) size has been shown to be able to effectively enhance the error-tolerability of videos. However, this study was done by focusing on the human visual system's perception to video errors. In this paper we investigate on this issue by taking machine's tolerability of errors into consideration. Objection detection carried out by yolov3 is employed as a case study. In this study, errors are injected into a benchmark video to generate more than 100,000 erroneous videos, and then yolov3 is employed to evaluate the quality (acceptability) of these videos. The results demonstrate that video re-encoding can have higher application efficiency (e.g., larger GOP size) for computer vision, mainly because that the error-tolerability of machines is larger than that of humans.

This can lead to better video encoding efficiency (smaller video size) and lower implementation cost for re-encoding.

## D4: Communication and Human-Centered Information Systems for Internet Applications

Room: 402-1

Chairs: Nobuo Funabiki (Okayama University, Japan), Shinji Sugawara (Chiba Institute of Technology, Japan), Wen-Chung Kao (National Taiwan Normal University, Taiwan)

### **15:40 *Statistical Language Models for Spelling Error Detection with Web Search New Word Acquisition***

Jui-Feng Yeh (National Chiayi University, Chiayi City, Taiwan); Guan-Huei Wu, Song-Yi Wang, Chan-Kun Yeh and Yao-Yi Wang (National Chiayi University, Taiwan)

This paper proposed a statistical language models with internet based new word acquisition for spelling error detection and correction. The statistical language models are composed of off-line and online n-grams. The content in internet is regarded as a large dynamic knowledge resource that is updated by the online users over the world. Due to the word various in internet with rapid renew capability; it is useful for new lexicon learning. The proposed approach can achieve significant improvement in spelling checking. Combining these research manners, the proposed approach is able to achieve the goals of confirming, improving the detection rate of typos. For evaluation, a news dataset with ten categories is gathered as test data. Experimental results show that the proposed approach combining internet web searching outperforms traditional N-gram models, especially for the words that are out-of-vocabulary such as transliteration either in precision rate and recall rate.

### **15:55 *Applications of Grammar-Concept Understanding and Value Trace Problems to Novice Students for C Programming Learning***

Nobuo Funabiki, Xiqin Lu, San Hay Mar Shwe, Ei Ei Htet and Htoo Htoo Sandi Kyaw (Okayama University, Japan); Kiyoshi Ueda (Nihon University, Japan); Wen-Chung Kao (National Taiwan Normal University, Taiwan)

Currently, C programming is educated as the first programming language in many information technology (IT) or computer science (CS) departments in universities. To assist self-study of students through code reading, we have proposed the grammar-concept understanding problem (GUP) and the value trace problem (VTP). A GUP instance asks the keyword in a given source code that corresponds to the grammar concept described in the question. A VTP instance asks the value of an important variable or message in the code. In both ones, the correctness of any answer is marked through string matching with the correct one. In this paper, we present the application of GUP and VTP instances to first-year undergraduate students taking a C programming course in the computer science department at College of Engineering, Nihon University. The same instances are assigned to be solved several times during the course. The results observe the progress of the correct answer rate in both problem types as the course elapsed and confirm the effectiveness in study of novice students

### **16:10 *Evaluations of Fingerprint-based Indoor Positioning System Using IEEE***

#### **802.15.4**

Pradini Puspitaningayu, Nobuo Funabiki, Kazushi Hamazaki and Minoru Kuribayashi (Okayama University, Japan); Wen-Chung Kao (National Taiwan Normal University, Taiwan)

Nowadays, indoor positioning systems (IPS) have gained popularity for offering location-based services. Previously, we have proposed the fingerprint-based indoor positioning system using IEEE 802.15.4. By limiting the positioning resolution by one room, it can detect the current position accurately. However, this detection was only performed at one time, thus the accuracy has not been observed. In this paper, we present experimental evaluations of the implemented system when it runs for a long time on two floors with 15 rooms of #2 Engineering Building in Okayama University. The results show that it achieves 93.41% and 91.83% average accuracy of the correct room detection on each floor.

#### **16:25 Highly Reliable Redundant Data Allocation Method for High Availability Distributed Clusters**

Kiyoshi Ueda and Syuhei Matsumoto (Nihon University, Japan)

For core systems such as session control servers provided by a telecommunications carrier, we have been studying the distributed cluster architecture that could control system performance flexibly. It is required to maintain data even in disasters. In this paper, we propose methods to control data redundancy that does not cause data loss even in the case of a large-scale disaster. We evaluated our proposed methods by computer simulation.

#### **16:40 Adaptation to Changes in the Number of Users in P2P Content Sharing System Using Dynamic Fog**

Takuya Itokazu and Shinji Sugawara (Chiba Institute of Technology, Japan)

This paper proposes a novel Peer-to-Peer based content sharing system using Dynamic Fog for the purpose of reducing the network load and the load on the Fog servers. Dynamic Fog is a system in which multiple mobile terminals are dynamically assembled to have a Fog server function, aiming to replace a normal Fog server. The effectiveness of Dynamic Fog is evaluated and discussed by using computer simulations.

#### **16:55 On Application of Botnet Defense System to IoT Systems Including Private Networks**

Shingo Yamaguchi (Yamaguchi University, Japan)

This paper proposes a strategy of Botnet Defense System (BDS) for IoT systems including private networks. Malicious bots like OMG turn IoT devices into proxy servers and enable bots to invade private networks. The BDS builds a white-hat botnet and uses it to fight malicious bots. If the white-hat bots can invade the private networks in the same way as OMG, the BDS can indirectly access inside the private networks through the white-hat botnet. To operate the white-hat bots, we developed the strategy by combining the existing basic strategies. We did simulation the strategy with agent-oriented Petri net and confirmed the effect of the strategy.

**17:10 High-speed High-resolution Image Capture by Using Phase-shift  
Photographing for Periodic Motion of Machine Element**

Kazuyuki Kojima and Hiroyuki Sato (Shonan Institute of Technology, Japan)

This paper describes an improvement of our proposed pseudo-high-speed high-resolution photographing method. We have been developing the method by using phase-shift photographing with a typical consumer camera instead of using an industrial high-speed camera whose installation cost is much higher than that of the consumer camera. In our previous work, we confirmed our method enables high-speed photographing even using the consumer camera. However, due to the weakness of an image sensor, shutter speed could not be increased, and then motion blur appeared in the captured image. Even if the shutter speed can be increased, captured images are so dark not enough to recognize a target object. In this paper, we solve this problem by overlaying multiple images captured at the same phase timing.

**D5: Audio/Video Systems and Signal Processing II & Consumer Systems  
for Healthcare and Wellbeing**

Room: 402-2

Chair: Shih-Miao Huang (National Formosa University, Taiwan)

**15:40 Quality of Experience evaluation of 4k Video Streaming using Referenced  
Metrics**

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Agemilson Pimentel (TPV Technology, Brazil); Cláudio Henrique Albuquerque Rodrigues (Grupos ICTS, Brazil)

In this work, conducted by three partners (UFAM/CETELI, ICTS and ENVISION/TPV), we created practical experiment scenarios, showing the viability of creating 4k video QoE assessment scenarios, using off-the-shelf computers equipped with GPU, software free and transmission in WiFi networks. In the evaluation, we used a set of 7 metrics of QoE verifying that videos transmitted via WiFi have QoE similar to the original video, not transmitted.

**15:55 Assessing Quality of Experience of 4k Video Streams Using No-Referenced  
Metrics**

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Agemilson Pimentel (TPV Technology, Brazil); Cláudio Henrique Albuquerque Rodrigues (Grupos ICTS, Brazil)

In this work, conducted by three partners (UFAM/CETELI, ICTS and ENVISION/TPV), we developed practical experiment scenarios, showing the viability of creating QoE assessment scenarios for 4k videos, using off-the-shelf computers equipped with GPU, software free and transmission over WiFi networks. We evaluated a set of 4 unreferenced QoE metrics, noting that videos transmitted via WiFi have QoE similar to the original, untranslated video.

### **16:10 A theoretical-practical model for 4k multimedia system for wireless communication by light**

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Agemilson Pimentel (TPV Technology, Brazil); Cláudio Henrique Albuquerque Rodrigues (Grupos ICTS, Brazil)

In recent years, the number of Wi-fi networks has been growing and the coexistence of Wi-fi networks can produce interference causing connection difficulties. Light communication is getting more popular with a large numbers of studies. In this work conducted by three partners (UFAM/CETELI, ICTS and ENVISION/TPV), we propose a multimedia model for wireless communication using light. This propose is based in off-the-shelf devices in the current market to establish an operational model of multimedia transmission for videos in 4k . In addition, modeling for the communication channel is addressed.

### **16:25 Development of an ADHD Chair to Promote Safe Fidgeting While Monitoring Symptoms**

Kuo-Chen Huang and Nan-Ching Tai (National Taipei University of Technology, Taiwan)

This paper presents a design concept and a prototype of a school chair that promotes fidgeting for students with attention deficit hyperactivity disorder (ADHD) and an accelerometer sensor that aims to provide a detailed understanding of the behavior of ADHD students in a class. Furthermore, a mobile application is proposed to reschedule weekly classes of ADHD students based on the data collected from the ADHD chair. Hence, a better learning environment can be provided for all the students in the classroom.

### **16:40 Sleep Stage Prediction Based on Monotonous Sensing Data Using Convolutional Neural Network**

Yi-Chong Zeng (Institute for Information Industry, Taiwan)

This paper introduces a method to predict sleep stages based on monotonous sensing data. The challenges are the sensing data is spare and the lack of accurate measures in sleep stages. We achieve two contributions in this work: developing data augmentation for one-dimensional sensing data, integrating classifier training with synchronization in sleep stage prediction. The proposed method refers to multiple measures of a wearable band as the references. Furthermore, we compute two-dimensional feature maps to augment sensing data for improving information diversity. Afterward, this method trains a convolutional neural network (CNN)-based model for classifying sensing data and then predicts sleep stages. The experiment results demonstrate that our method outperforms the previous works.

### **16:55 Development of A Wearable Device of Measuring Viewing Distances in Smartphone Use**

Shih-Miao Huang (National Formosa University, Taiwan)

A WDMD, a glasses-like device, was created to measure the viewing distances of reading on smartphones to alarm uses when their eyes are too close to the phone displays. It is consisted of a Micro-controller (Arduino Nano board based on the ATmega328), an ultrasonic sensor (HC-SR04), a MicroSD card adaptor compatible with Arduino, two 3v-coin batteries to offer the electric power, and an SD card to store the distance data. The HC-SR04 is rotated downward about 31 degrees for measuring the viewing distances of most populations because the lines of human viewing sights were not perpendicular to the mobile phones.



An experiment was performed subsequently to test the precision of the WDMD. The outcomes showed that the final WDMD could measure the distances with better precision because errors were less than 0.43 cm.

### **17:10 *The Efficacy of Heart Spectrum Blood Pressure Monitor: A Study of Bus Drivers***

Ya-Ling Kao (National Penghu University of Science and Technology, Taiwan); Yu-Kuang Chen (Doe Li Technology, Taiwan); Jai-Tsung Hong (National Kaohsiung University of Science and Technology, Taiwan)

Driving a bus is a stressful job, and may result in aberrant behaviors or health problems. The Heart Spectrum Blood Pressure Monitor is used to measure cardiovascular pressure change with fast Fourier transform (FFT) analysis to obtain heart rate frequency variability and accurate blood pressure data among bus drivers. The results indicate that the Heart Spectrum Blood Pressure Monitor can be effectively applied for Atrial fibrillation (AF) detection. This study not only establishes the link between health and work environment but also facilitates in assessing the adverse impacts that may be expected.

## D6: Smart Sensing Technologies & Applications for Human Health Promotion

Room: 408-1

Chair: Wan-Jung Chang (Southern Taiwan University of Science and Technology, Taiwan)

### **15:40 *Glass-based fluorescent immunobiosensor used for urea albumin fast detection***

Lien-Chiang Hung, Zhi-You Lin, Wan-Jung Chang and Ying-Nien Chou (Southern Taiwan University of Science and Technology, Taiwan)

In this study we develop a novel immunofluorescence sensing chip of the glass substrate, which applied for rapid detection of Proteinuria. This bio-chip was designed with simple glass substrate as a chip carrier to specifically capture human serum albumin (HSA) through sandwich ELISA immunosensing method. Furthermore, the addition of fluorescent antibodies could enhance the signal of the fluorescence detection. In this experiment, we use 3-aminopropyltrimethylhydrosilane (APTES) to modify the glass surface with self-assembled monomer technology. The water contact angle increases as the higher packing density of the APTES monolayer. When the packing density reached 80% to 90% the water contact angle would gain maximum value. According to the results, the optimized condition for the dense monolayer film is the monomer concentration at 1mM, while the solution reacted at 70oC for 3 min. The primary antibody of human serum albumin (HSA) was firstly immobilized on the APTES-surface through the oxidation-induced nucleophilic addition reaction between the aldehyde group of antibody and amine group on the glass surface. The established bio-chip was then measured in the fluorescence spectroscopy with an excitation light at 290 nm and an emission peak was found at 421 nm. The concentration of HSA is 20 µg/ml would observe emission at 430 nm. Therefore, we have developed an accurate, rapid and low-cost Proteinuria detection technology, which is much higher than the signal intensity of the general sandwich ELISA method. It has the opportunity to replace the traditional radiological examination or the more time consumed indirect urine examination, which could become a new type of kidney disease detection method.

### **15:55 *Efficient muscle signal collection system of wireless body sensor network based on EMG***

Shih Hsiung Lee and Hou-Chuan Tseng (National Kaohsiung University of Science and Technology, Taiwan)

With the development of wearable devices and wireless communication technology, the physiological information of muscle signals has become a part of researcher's interest. In recent years, whether in fitness or medical care issues, the activities of users' motion tracking and effectiveness evaluation have become important research topics. The Electromyography (EMG) signal can be used to measure the responsive signal of the muscle following the action. Therefore, this paper proposed an efficient wireless body sensor network system for muscle signal collection based on EMG.

### **16:10 *The GaAs-based p-i-n photodetector using in glucose detection***

Jun Jia Liu, Jie-Si Jheng, Yu-Zung Chiou and Chun-Kai Wang (Southern Taiwan University of Science and Technology, Taiwan)

In this study, we designed a structure of GaAs-based band-pass PD to use in glucose measurement. That had high EQE (84.63%) and short FWHM (74 nm) in 3V, limiting the absorbed range in a specific range and remove other noise influences. The glucose measurement was designed as a scattering method, which composition of an IR light-emitting diode (LED) and a GaAs-based band-pass PD. Even with reduced glucose concentration from 3 % to 1 %, the result still exhibited a stable trend correspond to high glucose concentration.

### **16:25 *A Hair Volume Analysis System Using Deep Learning and Image Processing Technologies***

Ming-Che Chen, Wan-Jung Chang, Xiao Yu-Xiang, Zi-Xuan Zhang, Yi-Chan Chiu and Jian-Ping Su (Southern Taiwan University of Science and Technology, Taiwan)

This paper proposes a hair volume analysis system, which applies deep learning and image processing approaches. The proposed system is comprised of a mobile device, a Cloud Web-Service (CWS) platform, and a Cloud AI image processing (Cloud-AI) server. Furthermore, the proposed system can analyze the hair volume in a hairy scalp photo by detecting the areas of hairy pores (i.e., the hair follicle pores with hairs), and counting the number of hair shafts within these areas and evaluating the ratio of thick/thin hair shafts. The experimental results demonstrate that the proposed system can provide hair volume analysis with the accuracy of the detection of hairy pore areas reached up to 95%.

### **16:40 *An Interactive Modular System and Interface for Laerdal Little Anne™ Manikin in CPR Training***

Yang-Kun Ou, Wan-Jung Chang and Tzu-Hsuan Lin (Southern Taiwan University of Science and Technology, Taiwan)

We have developed an interactive CPR training system in which modular electronic components are placed inside Laerdal Little Anne™ manikin to generate and analyze data, in turn to provide CPR training feedback via a pictorial interface.

### **16:55 A Mobile Application-Based Learning Aid Developer for Teaching Visually Impaired Students**

Bien Grenier Sasing, Aaron Raymond A. See, Welsey Daniel Advincula and Yeou-Jiunn Chen (Southern Taiwan University of Science and Technology, Taiwan)

The process of educating visually impaired and blind (VIB) students is quite complex, from the creation of engaging educational materials to its development as it requires time, skill, and versatility. Current educational materials for the VIB also lack interactivity, which reduces students' autonomy. This can be solved by providing an unsophisticated mobile APP that can quickly develop tactile learning aids. In this paper, a mobile application is developed to provide an accessible interface that can be used by either the teacher or the student. It utilizes computer vision, gesture-based inputs, and audio accessibility features with the ability to take pictures sent to the cloud database to determine the object, develop 3D images as tactile photos with braille language words. The file will then be converted to a printable format and printed for use as a tactile learning aid. For future development, an additional voice-command system for navigating the user interface and more filter options is considered.

## D7: Computational Intelligence Techniques for Electronic Design Automation

Room: 408-2

Chairs: Genggeng Liu (Fuzhou University, China), Wenzhong Guo (Fuzhou University, China)

### **15:40 An optimized 3D Astar algorithm for multi-layer PCB automatic routing**

Haiyun Li (Wuhan University Of Technology, China); Ning Xu (Wuhan University of Technology, China); Genggeng Liu (Fuzhou University, China); Jixin Zhang (Hubei University of Technology, China)

Printed circuit board (PCB) automatic routing is a multi-objective optimization problem that involves higher routability, shorter wire length, less via count, and so on. Some algorithms have been proposed for PCB automatic routing. However, existing methods cannot meet the various electrical constraints in industry. In this work, we propose an optimized 3D Astar algorithm which takes real constraints into account for multi-layer PCB automatic routing. Our 3D Astar algorithm extends the search dimension of traditional Astar algorithm to 3D and improve the distance function. To verify the performance of the proposed algorithm, experiments are carried out on the benchmark based on real PCB designs. Experimental results show that our proposed algorithm achieves more than 95% routability and has a significant improvement in terms of via count compared with traditional 3D Astar algorithm.

### **15:55 DDM: Delay driven layer assignment algorithm based on deployment mechanism**

Bao Chenpeng and Chen Zhen (China, China)

This paper proposes a delay driven layer assignment algorithm which selects the routing layer by setting a wire segment deployment mechanism. The proposed algorithm mainly includes an improved segment weighting strategy and a via constraint strategy. The proposed algorithm could reduce via count while optimizing delay, and provide a better global routing result for guiding the following detail routing.

**16:10 High-Level Synthesis Considering Cache Minimization for Continuous-flow Microfluidic Biochips**

Hongxing Lin and Hongbin Huang (Fuzhou University, China); Chen Zhen (China, China)

Continuous-flow microfluidic biochips have attracted much attention in the EDA community due to their miniaturized size and execution efficiency. However, cache actually becomes a bottleneck of the performance of biochips. In this paper, we consider minimizing the number of caches and cache units in the high-level synthesis to effectively utilize the resources of continuous-flow microfluidic biochips. Experimental results demonstrate that the proposed algorithm can greatly reduce the number of caches and cache units.

**16:25 High-Level Synthesis for Continuous-Flow Microfluidic Biochips Considering Flow-Channel-Intersection Optimization**

Hongbin Huang and Hongxing Lin (Fuzhou University, China); Chen Zhen (China, China)

Flow-channel-intersection optimization is one of the important goals in physical design, which affects the design complexity of the flow layer and the control layer. To this end, an effective high-level synthesis based on particle swarm optimization is proposed for continuous-flow microfluidic biochips in this paper. This method considers both the completion time of the bioassay and the number of flow-channel intersections in the high-level synthesis for the first time. The proposed method estimates the completion time of the bioassay and the number of flow-channel intersections by list scheduling and the connection relationship between components. Through effective iterative updating, a high-quality high-level synthesis considering flow-channel-intersection optimization is obtained.

Wednesday, September 15 17:10 - 18:10

Keynote Speech II: Yoshihiro Okada (Conference Hall)

Chair: Wen-Chung Kao (National Taiwan Normal University, Taiwan)

Wednesday, September 15 18:30 - 20:30

Welcome Reception (Discovery Hotel)

Thursday, September 16

Thursday, September 16 9:00 - 10:30

Poster C

Room: poster area

Chairs: Yen-Lin Chen (National Taipei University of Technology, Taiwan), Yu-Cheng Fan (National Taipei University of Technology, Taiwan)

## ***High-Order Sychrosqueezing Transforms and Its Application for Highly Accurate Animal Voice Analysis***

De-Yan Lu and Jian-Jiun Ding (National Taiwan University, Taiwan)

Time-frequency analysis represents the signal in the time-frequency domain and is very important tool for signal analysis, including animal voice analysis. In the conventional time-frequency method, we use the short-time Fourier transform (STFT) to analyze signals. In recent years, the reassignment method becomes more popular, which can improve the time and the frequency resolution simultaneously. Afterwards, the sychrosqueezing transform (SST) and the high-order SST were developed. They both shift the energy-band along the frequency axis. Our proposed architecture combines the high-order SST with many modified methods, which can achieve best resolution of time and frequency and reduce the cross terms.

## ***Frequency Selective Filtering of Graph Signal in Directed Graph Fourier Transform Domain***

Chien-Cheng Tseng (National Kaohsiung University of Science and Technology, Taiwan); Su-Ling Lee (Chang-Jung Christian University, Taiwan)

In this paper, a frequency selective filtering of real-valued graph signal in the directed graph Fourier transform (DGFT) domain is presented. First, the spectral properties of the GDFT are investigated. Then, the eigenvalues of directed Laplacian are divided into real and complex valued sets to constrain the ideal spectral response of graph filter such that real-valued filtered signal can be preserved. Next, lowpass, bandpass and highpass filtering methods of graph signals are studied. Finally, the proposed filtering method is used to reduce the unwanted noise superimposed on temperature data for demonstrating the effectiveness of the proposed method.

## ***Development of a fake news checking crowdsourcing platform consisting of smart contracts combined with gamification***

Wei-Shuan Wang and Lai-Chung Lee (National Taipei University of Technology, Taiwan)

In recent years, fake news has begun spreading rapidly via social media platforms. Several companies and civil organizations have set up crowdsourcing platforms to combat the spread of fake news. However, these platforms usually encounter the problem of insufficient manpower. Research has proven that gamification is an effective way to increase public participation in crowdsourcing. Based on this, this study proposes a fake news checking platform named "One For All" comprising smart contracts combined with game crowdsourcing. We added the core drives of Octalysis in gamification during platform design and executed the platform rules using smart contracts to ensure transparency and fairness of the platform. This is expected to increase the public's intention to use the platform and their trust in it.

## ***Defect Detection on Wafer Map Using Efficient Convolutional Neural Network***

Chieng Yang Wang and Tsung-Han Tsai (National Central University, Taiwan)

In semiconductor manufacturing, defect patterns on wafer maps hide important information about production problems. Therefore, the detection and identification of wafer pattern defects are one of the important topics in semiconductor manufacturing. Since there are few datasets of wafer maps, this paper solves the problem of overfitting by classifying wafer map defects using the model base on MobileNet V2. Finally, the accuracy of the WM-811K dataset reaches 96.56%.

### ***Preliminary Analytics of Video Cache Improvement using Random Linear Network Coding***

Chao-Hsien Lee and Hsueh-Tse Li (National Taipei University of Technology, Taiwan)

The demand of video streaming has become part of our modern daily life, especially under the threat of COVID-19. In order to promote the video quality, several video streaming techniques design and configure video cache along the transmission path. This paper investigates and studies how to improve video cache based on Random Linear Network Coding (RLNC). According to our initial experimental results on Peer-to-Peer (P2P), the proposed strategies can provide more flexible video distribution.

### ***Image Quality Analysis Technique for Optical-Based Fingerprint on Display (FoD) Applications***

Xiu-Zhi Chen, Hung-Chi Lai and Yen-Lin Chen (National Taipei University of Technology, Taiwan)

Removing physical scanners on mobile devices has come to be one of the most recent trends, adopting in-display scanners becomes the solution of mobile device authorization applications. As the characteristics of the image captured from in-display scanners were quite different from physical scanners, the criteria of the image quality should be reconsidered to maintain the effectiveness. This paper proposes an image quality analysis technique for optical-based fingerprint on display (FoD) applications, we evaluated the method on our own dataset with 11520 images, and proof that it is truly useful to fingerprint images captured from optical-based in-display scanners.

### ***Depth Information based Image Restoration Method for Rotors***

Yi-Hao Chung, Chao-Wei Yu, Bo-Rui Wen and Yen-Lin Chen (National Taipei University of Technology, Taiwan)

This paper presents a new depth information based image restoration method (DIBIRM) for rotors. The restoration method applies 3D sensor to obtain amplitude and depth image for a rotor. The overexposed areas can be detected by using depth data, and the mean value of amplitude images can be used to repair overexposed pixels. Experimental results showed that our proposed method was superior in terms of efficiency, effectiveness, and robustness in online, real-time manufacturing automation system.

### ***High Voltage a-IGZO Thin Film Transistor for 3D IC Application***

Hsin-Hui Hu, Tsung-Han Lu and Ching-Fan Meng (National Taipei University of Technology, Taiwan)

An amorphous indium gallium zinc oxide (a-IGZO) thin-film transistors (TFTs) with gate-to-drain offset structure are presented. The breakdown voltage increase as the gate-to-drain offset length is increased. The high voltage a-IGZO TFT with gate-to-drain offset length  $L_{gd} = 260$  nm possesses a high breakdown voltage exceeding 70 V. This result indicates the great potential of a-IGZO TFT technology for future monolithic 3-D integration.

### ***Image Enhancement Based on Generative Adversarial Neural Network***

Yu-Cheng Fan (National Taipei University of Technology, Taiwan)

In this paper, we present an image enhancement scheme based on generative adversarial neural network. We use deep learning to decompose the image to obtain the shadow layer and the reflection layer image,

and then perform image enhancement for the shadow layer image. In addition to being faster than the traditional method, the method we proposed also achieves better results. In this way, the overexposed or dark parts of the picture can be repaired, and more complete picture information can be obtained. For the repair of the shadow layer, we use a neural network for algorithm simulation. The Generative Adversarial Neural Network makes the training and testing speed more accurate and faster by giving conditional restrictions.

### ***Implementation of a Novel Intelligent Drowsiness Detection Warning System***

Robert Chen-Hao Chang, Chia-Yu Wang and Yu-Ya Kao (National Chung Hsing University)

A new intelligent drowsiness detection warning system is proposed in this paper. Electrocardiogram (ECG) signals are input from sensors. Through Bluetooth connection, the raw data is received on the remote end. In order to obtain accurate R-R interval data, this study uses the R waveform of the ECG signal to be detected and uses the enhanced So and Chan method to obtain the waveform signal. Perform preprocessing and FFT based on the captured signal, and calculate power spectral density (PSD) data. Finally, the proposed novel drowsiness judgement and analysis are performed. The entire system is implemented on Zedboard. Graphical user interface is developed using the Linux operating system. It can immediately display the ECG waveform, PSD analysis of heart rate variability, sympathetic/parasympathetic nervous balance index, and smile levels, which can effectively indicate the diver's physiological state.

### ***Q-learning based Tracking Control and Slope Climbing Strategy Design of Autonomous Mobile Robot and Flatbed Vehicle***

Kuan-Yu Chou, Yu-Ting Chen, Jing-Kai Lin, Shi-Lin Ho and Yon-Ping Chen (National Yang Ming Chiao Tung University, Taiwan)

Thanks to advances in technology, the forth industrial revolution (Industry 4.0) is coming. All the manufacturers are undertaking large-scale technological innovations which include artificial intelligence and auto guided vehicle. These two research fields are also the major techniques in the proposed paper. In this paper, the tracking control and slope-climbing strategy between autonomous mobile robot and flatbed vehicle is proposed. The structure is integrated by three parts. First, the Q-learning algorithm is applied to controller design. Second, LIDAR sensor and camera are used to measure distance, forward direction and position of flatbed vehicle relative to autonomous mobile robot. Third, Robot Operation System (ROS) is adopt to be the data communication system among central processor unit, LIDAR sensor and camera of the autonomous mobile robot. In the simulation results, the flatbed vehicle follows three different trajectories, and the autonomous mobile robot computes tracking paths by machine vision and Q-learning algorithm. After reaching a certain distance, the autonomous mobile robot would carry out slope-climbing strategy to link with flatbed vehicle successfully.

### ***Vehicle Turning Intention Prediction Based on Data-Driven Method with Roadside Radar and Vision Sensor***

Jyun-Hong He, Yen-Lin Chen and Xiu-Zhi Chen (National Taipei University of Technology, Taiwan); Hsin-Han Chiang (National Taiwan Normal University, Taiwan)

The trajectory tracking and turning intention prediction of vehicles at intersections are a vital part of smart traffic safety. With the height limitation, traffic objects are often obscured by other vehicles that easily results in blind spots for the visual sensing system. This paper summarizes the author's practice of a roadside unit composed of monitors and radar sensors to track and predict behavioral intentions of traffic

objects, and develop a stable system based on the fusion of radar and image sensing information to reduce the danger caused by the steering of other vehicles that are not predicted by the driving sight and the blind angle of the on-board sensor. The roadside unit is installed at the intersection to collect vehicle data on the road, such as position, speed, and direction. An artificial neural network based on LSTM-GAN is used to process data and predict vehicle turning intention. The research case shows that the proposed model has about 91% prediction accuracy.

### ***Use subsequent neural network to analyze ICEMI***

Shu-Yao Hsuan and Shih-Yi Yuan (Feng Chia University, Taiwan)

Among the security issues of embedded systems, electromagnetic (EM) information leakage problem is difficult to detect and prevent. This problem has nothing to do with software vulnerabilities, but when the embedded system is operating, different commands will emit different EM signals. In the previous study, a neural network (NN) was used to analyze the EM signals through Integrated Circuit Electromagnetic Interference measurement, and the best accuracy was only 38%. In this paper, we propose a NN architecture based on the previous study, which can effectively improve the accuracy up to 66%.

### ***Meticulous Alignment for On-Display Fingerprint Sensor on Smartphone***

Yung-Zhe Wu, Huei-Ming Wu and Pei-Yung Hsiao (National University of Kaohsiung, Taiwan)

This paper presents a fingerprint alignment algorithm based on the latest on-display optical fingerprint image sensors used for the brand-new smartphone. In order to avoid finding very similar but wrong alignment results, fingerprint ridges are used for matching instead of minutia points. Besides, the Gabor filtering enhancement is added to the algorithm to improve the disordered ridge-line problem. We have also designed a set of graphical user interface for producing ground truths very efficiently to shorten the verification time required to produce correct alignment and matching results. Even if the quality of the fingerprint image from on-display fingerprint sensor is poor, the accuracy of fingerprint alignment can be improved through the proposed algorithm. The higher the accuracy, the more secure the data in the mobile application can be ensured.

## **E1: Intelligent Devices, Circuits, Systems, and Algorithms for Smart Lives**

Room: [conference hall](#)

Chairs: Chien-Cheng Tseng (National Kaohsiung University of Science and Technology, Taiwan), Ching-Hu Lu (National Taiwan University of Science and Technology, Taiwan)

### ***9:00 Accuracy Improvement of Deep Learning 3D Point Cloud Instance Segmentation***

Ru-Yi Pan and Cheng-Ming Huang (National Taipei University of Technology, Taiwan)

In the field of computer vision, the research on 3D point clouds is one of the important tasks of 3D scene understanding, such as target detection, semantic segmentation, etc., which have achieved rich research results. Combining the concepts of target detection and semantic segmentation, it is not only necessary to identify point clouds of different semantics, but also to distinguish instances of the same semantics. Therefore, the research on 3D point cloud instance segmentation will be more challenging. The results of



most instance segmentation methods have found that if the distances between different objects of the same semantic are too close, it is difficult to distinguish them from each other, resulting in poor accuracy of instance segmentation. In order to improve this problem, based on the method of a deep learning instance segmentation of the 3D point cloud scene, the 3D object point cloud with the same semantic meaning and the same color label is transferred in to the voxel space. The voxels of an object is then projected onto the 2D image from the top view. At last, the image segmentation for post-processing is utilized to further improve the accuracy of instance segmentation.

### **9:15 Development of a Leakage Energy Recovery Applied to Full-Bridge Converter**

Yong Dong Chang and Guo-Xiang Liu (National Penghu University of Science and Technology, Taiwan)

In the research, a full-bridge converter with the leakage inductance absorber is developed. The proposed converter can reduce the high voltage stress caused by leakage inductance, simultaneously achieve the functions of surge suppression. The absorber can be regarded as a passive snubber to reduce the ringing frequency. It includes four diodes and a single recovery capacitor, which has advantages of the simple structure and bipolar energy absorption. Finally, a prototype circuit of 250 W has actually implemented to verify the proposed converter feasibility. From the measured waveforms, the amplitude of the voltage spike across the active switches are significantly suppressed, and the ringing is also effectively alleviated. It proves that the proposed leakage inductance absorber can be applied to the full-bridge converter.

### **9:30 A 24-28 GHz Frequency Synthesizer for 5G Applications**

Kang-Chun Peng and Wei-Lung Wu (National Kaohsiung University of Science and Technology, Taiwan)

This work developed a 24-28 GHz frequency synthesizer. The synthesizer is based on a phase-locked loop (PLL). The loop filter is designed to optimize both the phase noise performance and settling time. Experimental results demonstrate that the 24-28 GHz frequency synthesizer achieved a very good performance. The phase noise is as low as -119.4 dBc/Hz at the 10 MHz offset frequency. The settling time is shorter than 233  $\mu$ s.

### **9:45 AIoT-based Audio Recognition System for Smart Home Applications**

Bo-Wei Chen, Yu-Syuan Jhang, Hao-Ting Pai, Szu-Hong Wang and Ming-Hwa Sheu (National Yunlin University of Science & Technology, Taiwan); Tzu-Hsiung Chen (Taipei Chengshih University of Science & Technology, Taiwan)

In this paper, we design an audio recognition system to detect events of lighters sound, which names Audio Recognition System (ARS). ARS is composed of AIoT device (i.e. Raspberry Pi), deep-learning-based analytics, and real-time alarming advisory (e.g. Line Notify). We conduct experiments with 8,000 observations. The result shows ARS achieves 97% accuracy in a quiet place and 94% accuracy in a noisy environment.

### **10:00 Graph Signal Denoising Method Using the K-Nearest Neighbors Found by Dijkstra's Algorithm**

Chien-Cheng Tseng (National Kaohsiung University of Science and Technology, Taiwan); Su-Ling Lee (Chang-Jung Christian University, Taiwan)

In this paper, graph signal denoising problem is investigated. First, conventional graph signal denoising

method using graph Laplacian matrix (GLM) is described to show that a big matrix inversion is needed in this method. To reduce computational load, a modified Dijkstra's algorithm is presented to find the K-nearest neighbors (K-NN) of a given vertex in the graph and a local graph Laplacian matrix (LGLM) of the sub-graph around this vertex is constructed by using the K-NN information and graph adjacency matrix. Then, based on the local smoothness property of graph signal and LGLM, the denoised signal at the given vertex can be computed by a Cramer's rule method. Finally, real temperature data is used to show the effectiveness of the proposed denoising method and performance comparison with conventional method is made.

### **10:15 A Matrix Inversion Free Method for Computing Katz Centrality of Taipei Metro System Using Neumann Series**

Chien-Cheng Tseng (National Kaohsiung University of Science and Technology, Taiwan); Su-Ling Lee (Chang-Jung Christian University, Taiwan)

In this paper, the Katz centrality and Neumann series are used to identify the station importance of Taipei metro system. First, node importance of complex network is computed by the Katz centrality whose solution needs to solve the matrix inversion (MI). To get a MI free computation method, the truncated Neumann series expansion is then employed to approximate the MI. Next, a polynomial graph filtering implementation structure is presented to realize the proposed computation method. Finally, the station importance of Taipei metro system is identified by the conventional MI method and the proposed method. The top-K important stations are demonstrated to show both methods obtain the same results, so the proposed approximation method performs well.

### **10:30 High-efficient Semantic Segmentation for Internet-of-Things-enabled Smart Cameras**

Kuan-Ting Lai (HiMax Corp., Taiwan); Jirayu Petchhan and Ching-Hu Lu (National Taiwan University of Science and Technology, Taiwan)

Even in the era of the Internet of Things (IoT), existing smart cameras still cannot efficiently run complex neural networks of image segmentation due to restricted storage and computing capacities. To address this issue, we proposed a high-efficient semantic segmentation for IoT-enabled smart cameras. The experiment results show that the accuracy of the proposed semantic segmentation model can improve the classwise accuracy by 4%, given that the model is reduced by 12.5% and even runs faster than prior studies.

## **E2: Circuits and Systems for Intelligent Signal Processing Technology**

Room: 103

Chairs: Chih-Peng Fan (National Chung Hsing University, Taiwan), Kuan Hung Chen (Feng Chia University, Taiwan)

### **9:00 SAFER & SAFEST: Single-Aging-Factor Enhanced Rings and Shadow Trees for Data Annotation and Early Warning in Online Aging Monitors of Automotive SoCs**

Cho-Sheng Lin, Jing Huang, Po-Sheng Chang, Chun-Yen Tsai and Tsung-Chu Huang (National Changhua University of Education, Taiwan)

AI techniques have been widely applied in consumer electronics, especially automotive advanced driver

assistant systems. The reliability of the AI processors in the harsh environment is facing a critical challenge. In this paper we explore and exploit high correlation between single-aging-factor (SAF) enhanced oscillating rings (SAFERs) for online data annotation in early stage and SAF shadow trees (SAFESTs) for training and on-line aging monitoring later. Compared with previous work, 85% of accuracy for high correlation supervised classification will be more reliable than 99% of meaningless clustering.

### **9:15 Reconfigurable Deep Learning Accelerator Hardware Architecture Design for Sparse CNN**

Chung-Bin Wu, Chung-Hsuan Chen and Chen-Peng Kuan (NCHU, Taiwan)

The design architecture proposed in this paper uses the row-sparsity -map compression method. Proposed row-leap to solve the PE balance problem. Proposed the channel-leap to increase the PE usage. The design architecture proposed in this paper can achieve 95% PE usage under the Yolo-like network. And the bandwidth is reduced by 40%.

### **9:30 Sensing Error Compensation Algorithm for Ultra-Wideband Following Systems**

Kuang-Hao Lin and Da-Gang Ye (National Formosa University, Taiwan)

This study proposes a sensing error compensation algorithm to correct the distance estimated by ultra-wideband (UWB) following systems that estimate distance based on sensor data. The UWB following systems used for carts on farms and in shopping malls inevitably have errors to the magnitude of 0.25-0.4 m in distance estimation. The proposed algorithm reduces errors to less than 0.05 m, greatly increasing the sensitivity of the following systems and reducing the risk of collision.

### **9:45 Ultrasound Phased Array Radar Design for Ranging and Direction of Arrival Estimation**

Jia-Jhan Nian, Chu-Chen Wu and Yin-Tsung Hwang (National Chung Hsing University, Taiwan)

The design of an air-coupled ultrasound phased array radar is presented. The target application is for the estimations of object distance and direction in short range. The main technical contributions of this design include 1) mitigating the estimation alias problem introduced by a under-sampling phased array front end, and 2) developing a low computing complexity DoA estimation scheme and implemented in an FPGA device. The ultrasound transducer array front end is built from discrete air-coupled components. A skewed two-row array configuration consisting of one transmitter and 8 receivers in total is introduced to tackle the under-sampling problem due to excessive transducer component size. The FoV (field of view) alias free estimation is extended to  $\pm 50$  degrees. The proposed system adopts a pulse modulation scheme and performs ranging based on time-of-flight. A low complexity orthogonal matching pursuit (OMP) scheme is employed for DoA estimation. The maximum detection distance is 2 meters with a 3-cm resolution. In addition, a maximum of 4 objects of the same distance can be distinguished with an angular resolution of 5 degrees and a 78.1% accuracy rate. The hardwired design of the proposed algorithm is also developed and implemented in an FPGA device. It consists mainly of a 32-point FFT computing kernel, a QR decomposition module, a matching pursuit module. The design operates at 48MHz and support a new estimation every 14.5ms.

### **10:00 Effective Two-Stage Processing Based Lite Deep Learning Classifier for Gender Detection**

Hua-Luen Chen, Chi-Chun Lai and Jie-Min Lin (National Chung Hsing University,

Taiwan); Kuan Hung Chen (Feng Chia University, Taiwan); Yin-Tsung Hwang and Chih-Peng Fan (National Chung Hsing University, Taiwan)

For an intelligent autonomous mover, in addition to providing the functions of object detection and collision avoidance, gender classification has acquired more attentions recently due to its important role in user-friendly use in surrounding-crowds environments. In this study, we propose a two-stage processing based lite convolutional neural network (CNN) architecture for gender classification, where the pedestrians' boxes inferred by the first stage detection are used as the inputs of the gender classification by the second stage process. By the proposed second-stage lite CNN-based model, the recognition accuracy of gender classification can be up to 99% with the image datasets collected in supermarket. Compared with the previous methodologies, the proposed two-stage processing approach performs higher recognition accuracy for gender classification.

### **10:15 Behavior Detection in Supermarket Based on Image Caption with UNITY**

Li-Min Chen and Wei-Liang Lin (National Chung Hsing University, Taiwan)

This paper uses image caption to identify human behavior in supermarkets. In addition to observing the human posture to judge the current human behavior, we can reconstruct various human postures and scenes in Unity, and collect the human activity data set in the supermarket through the above methods.

### **10:30 Hardware Generator for Edge Artificial Intelligent Inference System**

Yeong-Kang Lai and Chuan-Wei Huang (National Chung Hsing University, Taiwan)

This paper designs an optimized hardware generator (IP Generator) based on convolutional neural networks. Users can use IP Generator to create any neural network model they want. With our user interface, output the combination of the model's parameters and model architecture, you can get the corresponding optimized Verilog code efficiently. The network is a network model that simplifies some network layers by Yolo-v1. Run 100MHz on Xilinx's ZCU102 board, which can reach a throughput of 28.8GOP/s.

## **E3: Advanced Machine Learning for Smart IoT Applications**

Room: 104

Chairs: Wen-Huang Cheng (National Yang Ming Chiao Tung University, Taiwan),  
Ching-Chun Huang (National Chiao Tung University, Taiwan)

### **9:00 Smart Augmented Reality of the Perspective-Taking Application of Exhibits**

Tzu-Jung Kung and Chi-Hao Lung (National Taipei University of Technology, Taiwan)

In this study, we present a new type of screen immersive experience wherein the augmented, virtual, and real spatial perceptions are combined by breaking through the limitation of single-view viewing using perspective tracking. The main goal is to combine the virtual space and real space to achieve the effect of spatial continuity. The technology integrates the real space through the virtual space of virtual reality, and puts the function of spatial experience into the virtual reality experience of augmented reality, allowing users to enjoy the virtual reality integration experience without wearing heavy virtual reality devices.

### **9:15 Un-rectifying ReLU Deep Neural Network in Compressed Sensing Recovery**

Shih-Shuo Tung and Wen-Liang Hwang (Institute of Information Science, Academia

Sinica, Taiwan)

The ReLU network in this study was un-rectified means that the activation functions could be replaced with data-dependent activation variables in the form of equations and constraints. We demonstrate that by introducing data-dependent slack variables as constraints, it is possible to optimize a network based on the augmented Lagrangian approach. In the experiments, our approach achieved state-of-the-art performance when applying the MNIST dataset and natural images to the compressed sensing recovery problem.

### **9:30 Online Learning for Network Traffic Data Classification**

Henry Horng-Shing Lu (National Yang Ming Chiao Tung University, Taiwan)

Based on an online-learning algorithm, we usually can create a dynamic prediction model and transform a linear model into a non-linear one using kernel functions. This study derives a new online-learning algorithm by combining the popular online-learning algorithm, Passive-Aggressive algorithm, with kernels and the concept of budget. The new algorithm creates a non-linear model and manages the resources used by the model. The proposed algorithm is tested on the network traffic data and shows its potentials for IoT applications.

### **9:45 ZYELL-NCTU NetTraffic-1.0: A Large-Scale Dataset for Real-World Network Anomaly Detection**

Lei Chen, Shao-En Weng, Chu-Jun Peng, Hong-Han Shuai and Wen-Huang Cheng  
(National Yang Ming Chiao Tung University, Taiwan)

Network security has been an active research topic for long. One critical issue is improving the anomaly detection capability of intrusion detection systems (IDSs), such as firewalls. However, existing network anomaly datasets are out of date (i.e., being collected many years ago) or IP-anonymized, making the data characteristics differ from today's network. Therefore, this work introduces a new, large-scale, and real-world dataset, ZYELL-NCTU NetTraffic-1.0, which is collected from the raw output of firewalls in a real network, with the objective to advance the development of network security researches.

### **10:00 Bio-medical Image Analysis for Diagnosis and Healthcare Detection System of Skin Cancer**

Chia-Jung Yu and Chiung-An Chen (Ming Chi University of Technology, Taiwan);  
Shih-Lun Chen (Chung Yuan Christian University, Taiwan)

Diagnosis of melanoma not only requires specialized equipment, but melanoma is also the deadliest. Because of a lack of medical resources, patients living in remote areas normally cannot use such facilities for skin detecting. To overcome these problems, this paper discusses opportunities in remote and melanoma detection system, a called telemedicine for the consumer electronics industry. In this research, the proposed melanoma detection system will use a variety of image processing methods, and present the discrimination results on the interface, and help doctors diagnose melanoma, and early detection of melanoma can increase the survival rate of the patients.

## **E4: Advanced Cryptography and Its Applications**

Room: 402-1

Chairs: Yuta Kodaera (Okayama University, Japan), Yasuyuki Nogami (Okayama University, Japan)

**9:00 A Study on Use of Machine Learning to Evaluate the Security of Common Key Cryptosystem**

A Inomata (Graduate School of Computer Science and System Engineering, Kyushu Institute of Technology, Japan); Shunsuke Araki and Ken'ichi Kakizaki (Kyushu Institute of Technology, Japan)

This paper investigates a machine learning based method to classify common keys of Advanced Encryption Standard (AES). Analysis to encryption procedures of AES identifies the key sub-procedures that provides the security feature against machine learning based attack.

**9:15 A Study on Control Parameter and Output Sequence of the Logistic Map over Integers for Pseudorandom Number Generation**

Gen Osono (Kyushu Institute of Technology Graduate School, Japan); Shunsuke Araki (Kyushu Institute of Technology, Japan); Takeru Miyazaki and Satoshi Uehara (The University of Kitakyushu, Japan); Ken'ichi Kakizaki (Kyushu Institute of Technology, Japan)

In this paper, we discuss the definition of control parameters that determine the input-output relationship in a logistic map over integers for the configuration of a pseudorandom number generation. Specifically, we show that there is a difference in the similarity of the output value series due to the difference in the domain of the control parameter.

**9:30 A Study on Digital Watermarks for Audio Signals Using Phase of Frequency Signals in Addition to the Other Methods**

Kako Takahashi and Takeru Miyazaki (The University of Kitakyushu, Japan); Shunsuke Araki (Kyushu Institute of Technology, Japan); Satoshi Uehara (The University of Kitakyushu, Japan); Yasuyuki Nogami (Okayama University, Japan)

In this paper, we focus on a digital watermarking method for voice signals recorded by a digital voice recorder especially in conferences. We will discuss some requirements for detecting falsifications in the voice signal, because the conference record has the probability that a conclusion is changed for only a falsification in a little time interval. Then, we will propose an enhanced watermarking scheme using phase of frequency signal in addition to our previous methods, and assess its soundness.

**9:45 A Study on Relationship Between Period and Number of Divisions in Piecewise Logistic Map over Integers**

Sota Eguchi (The University of Kitakyushu & Kitakyushu, Japan); Takeru Miyazaki and Satoshi Uehara (The University of Kitakyushu, Japan); Shunsuke Araki (Kyushu Institute of Technology, Japan); Yasuyuki Nogami (Okayama University, Japan)

The piecewise logistic map proposed by Wang, Liu and Lei provided a wider range of the control parameter than one by the logistic map. However, it is not clear enough to describe relations between the number of divisions and properties of the map. In this paper, we investigate how the period and link length change with respect to number of divisions. As a result, we confirmed period and link length increases or decreases periodically. Further, we confirmed randomness of long period sequence comparable to the randomness

of logistic map over integers with high available bits for 2 bits.

### **10:00 Consideration of Generating Suitable Parameters for Constructing type $(h, m)$ Gauss Period Normal Basis**

Keiji Yoshimoto, Yuta Kodera, Takuya Kusaka and Yasuyuki Nogami (Okayama University, Japan)

In this research, the authors consider and evaluate a method to find a prime number that satisfies the condition to construct type  $(h, m)$  Gauss period Normal Basis. More precisely, we use methods for prime factorization, elliptic curve method, to determine the suitability of a prime number for the construction. In addition, we consider the condition of parameters that easy to find such a prime.

### **10:15 An Optimal Curve Parameters for BLS12 Elliptic Curve Pairing and Its Efficiency Evaluation**

Daichi Hattori (Okyama University, Japan); Yuto Takahashi and Tomoya Tatara (Okayama University, Japan); Yuki Nanjo (OKAYAMA University, Japan); Takuya Kusaka and Yasuyuki Nogami (Okayama University, Japan)

Recently, pairing cryptography has attracted many security researchers because of its high functionality such as ID-based cryptography and homomorphic encryption. Homomorphic encryption is a cryptographic protocol that allows the server side to perform calculations with the encrypted data. The pairing cryptography requires a lot of complicated calculations, the large calculation cost of a pairing calculation becomes a problem for a practical implementation on some real devices. In order to overcome this, many efficient implementation techniques have been proposed and the authors have been updating ELiPS (Efficient Library for Pairing Systems) as one of efficient pairing calculation libraries. ELiPS of the latest version supports asymmetric pairing and symmetric pairing on the BN curve and BLS curve (BLS12) of embedding degree 12. In this study, in order to further speed up ELiPS, we focus on the calculation part of Miller's algorithm with the projected coordinate that is basically proposed by Costello et al.. According to Costello et al.'s work, since the computational cost of Miller's algorithm is closely related to the selection of the coefficients of the pairing elliptic curve, we have searched the parameters that enables Miller's algorithm the most efficient. Then, this paper shows its practical algorithm implementation.

## **E5: Best Paper Competition**

Room: 402-2

Chair: Robert Chen-Hao Chang (National Chung Hsing University, Taiwan)

### **9:00 A Posture Features Based Pedestrian Trajectory Prediction with LSTM**

I-Hsi Kao (University of California, Berkeley, USA); Xiao Zhou (Wuhan University of Technology, China); I-Ming Chen (University of California at Berkeley, USA); Pin Wang (University of California, Berkeley, USA); Ching-Yao Chan (California University, Berkeley, USA)

Accurately predicting the trajectory of pedestrians helps autonomous vehicles to drive safely. In this paper, a work of predicting the trajectory of pedestrians by considering their posture is described. Two seconds of historical data are used to predict the pedestrian's actions in the next second based on a long short-term

memory approach. The purpose of this experiment is to estimate whether pedestrians will cross the road in a mid-block setting without crosswalks and what paths they will take. The scene of this experiment is located on a street near the campus of the University of California at Berkeley.

### **9:15 *The Effect of Time Lag between Servers on QoE of Multi-View Video and Audio Transmission***

Toshiro Nunome and Takuro Ito (Nagoya Institute of Technology, Japan)

This paper considers multi-view video and audio transmission from multiple servers. When the servers have a time lag because of the failure of time synchronization, the lag can be an influencing factor of QoE. If two servers have different clocks, the skew causes forward and back when the viewpoint change occurs. We evaluate the effect of lag by a subjective experiment. We then investigate the acceptable time lag for the users.

### **9:30 *Degradation of Metal Corner Reflectors' Radar Cross-Section in a Radome with Imperfect Characteristics***

Hsi-Tseng Chou (National Taiwan University, Taiwan); Rong-Chung Liu (Yuan Ze University & WavePro, Taiwan); Yao-Chiang Kan (Yuan Ze University, Taiwan); Chih-Te Huang (National Chung-Shan Institute of Science and Technology, Taiwan); Hsien-Kwei Ho (WavePro Technology Inc., Taiwan)

This paper presents a study of electromagnetic (EM) backscattering from a metal corner reflector (MCR) in an imperfect radome scenario. The "defocus" behavior of scattering fields by the imperfect radome results in the degradation of radar cross-section (RCS) from the MCR. It causes incorrect justification of antenna behaviors in RCS estimation for the target under detection. In this study, three simplified radome models are simulated by EM full-wave analysis to verify the impact of defocusing behaviors on RCS estimations. The computed RCS curves show the explicit degradation of RCS performance, especially on the horizontal plane, the most often scanned plane to estimate RCSs.

### **9:45 *FB-KEA: A Feature-Based Keyword Extraction Algorithm for Improving Hit Performance***

Ssu-Chi Kuai and Wen-Hwa Liao (National Taipei University of Business, Taiwan); Chih-Yung Chang (Tamkang University, Taiwan); Gwo-Jong Yu (Aletheia University, Taiwan)

In the age of Internet, people usually use search engines by giving keywords to find the information they need. For content providers, the reference performance of a given content is majorly determined by the set of keywords. In literature, there have been many studies proposed algorithms for finding keywords. However, most of them cannot reflect important properties, such as the expert's knowledge and trends. This work proposes a novel keyword extraction algorithm, called FB-KEA, which extracts the keywords based on the features including semantic, expert experience as well as trend of hot search. Experimental results show that the proposed FB-KEA has significant improvements in terms of hit ratio, as compared with traditional methods.



**10:00 *An Energy-efficient and Programmable RISC-V CNN Coprocessor for Real-time Epilepsy Detection and Identification on Wearable Devices***

Yi-Wen Hung, Yao-Tse Chang and Shuenn-Yuh Lee (National Cheng Kung University, Taiwan); Chou-Ching K. Lin (National Cheng Kung University Hospital, Taiwan); Gia-Shing Shieh (Ministry of Health and Welfare Tainan Hospital, Taiwan)

This paper has proposed an energy-efficient epilepsy detection framework for embedded systems. The epilepsy detection framework is implemented in 11 layers Convolutional Neural Network (CNN) with a 2-stage RISC-V core and a coprocessor to accelerate CNN inferences. The CNN algorithm provides 97.8% and 93.5% accuracy on floating-point and fixed-point operations respectively. The proposed CNN coprocessor is designed to offload CNN inference from RISC-V core to hardware with 51 nJ data transfer energy and 0.9  $\mu$ J inference energy for each 500 points input data frame. The coprocessor reduces the runtime of CNN inferences over  $10^6$ x to perform only 0.012 s latency for each classification. According to the energy-efficient coprocessor, an AI-based solution is practical for real-time epilepsy detection on wearable devices for consumer electronics.

**10:15 *Discussion on the recent development of OTT platforms in Taiwan***

Shyang-Yuh Wang (Chinese Culture University, Taiwan); Sheng-Tsung Tu (Ming Chuan University, Taiwan); Chian-Shin You (Chinese Culture University, Taiwan); Yue-Nuo Yan (Chinese Culture University, Taiwan); Chien-Hsing Chou (Tamkang University, Taiwan)

With the rapid development of networks and the popularization of mobile devices, the consumer behavior of viewers has changed. Online viewing of audio and video has become a major entertainment activity. The OTT industry was first developed in the United States, and when it matured, they transferred it to overseas markets to expand. It entered Taiwan in 2016, enabling the domestic online audio-visual streaming industry to develop rapidly. Beside the convenience of mobile audio and video, it also effects on traditional cable television. The number of subscribers fell from 5.26 million subscribers to 4.86 million. So far, the total number of subscribers is still on a downward trend. The shows that the usage habits of Taiwanese people have shifted from TV to OTT platforms. Therefore, this study will collect samples of the two platforms with a higher usage rate and combine the KEYPO big data to analyze the network volume, network popularity, and community activity to analyze the development of the industry.

## E6: Efficient Algorithm and Architecture Designs for Circuit and System

Room: 408-1

Chairs: Yu-Hsuan Lee (Multimedia Circuit and System Lab, Department of Electrical Engineering, Yuan-Ze University, Taiwan), Duo Sheng (Fu Jen Catholic University, Taiwan)

**9:00 *A Buffer Circuit for the Interface of RF and Baseband System***

Hung-Wen Lin (YuanZe University, Taiwan); Zhi-Sheng Zhang and Zhi-Yi Chen (Yuan Ze University, Taiwan)

This paper presents a wide-bandwidth buffer with adjustable common-mode levels and differential-mode

swing. By using an analog common-mode feedback control loop consisted of a rail-to-rail error amplifying OP and complementary current mirrors, the range of output common-mode levels are maximized. By digital tail current source controls, the differential swing was almost independent to the common-mode levels. In 0.18 $\mu$ m technology, the buffer test chip occupies an active area of 0.082mm<sup>2</sup>. Under single 1.8V of supply voltage, the buffer with a 0.3-to-1.5V of controlled common-mode level, a 6-to-21dB of variable gain and a 275MHz of -3dB bandwidth.

### **9:15 DLL-Based Transmit Beamforming IC for High-Frequency Ultrasound Medical Imaging System**

Duo Sheng, Chih-Hao Liu, Sih-Ying Chen, Bin-Yang Song, Ying-Chi Chiu and Ming-Han Cai (Fu Jen Catholic University, Taiwan)

A high delay resolution and all-digital transmit-beamforming integrated circuit for high frequency ultrasound imaging systems is presented. The proposed transmit-beamforming design employs two all-digital delay-locked loops to provide a specified digital control code for a counter-based beamforming delay line (CDDL) to generate stable and suitable delays to excite the array transducer elements without variations in process, voltage, and temperature. In addition, the proposed CDDL requires only a few delay cells, which significantly reduces hardware cost and power consumption, to maintain the duty cycle of long propagation signals. Simulation results show that proposed transmit-beamforming design can achieve a maximum time delay of 451.9 ns with a time resolution of 652 ps, and the maximum lateral resolution error at 6.8 mm is 0.04 mm.

### **9:30 AN-Coded Redundant Residue Number System for Reliable Neural Networks**

Hsiao-Wen Fu, Ting-Yu Chen, Cheng-Di Tsai, Meng-Wei Shen and Tsung-Chu Huang (National Changhua University of Education, Taiwan)

Residue Number Systems (RNS) can simultaneously improve computing acceleration, area reduction and power saving. For high-reliability applications like automotive electronics, partition-ability empowers the redundant RNS fault tolerance. However the parallel multiple modular redundancy will take a huge number of convertors. This is the first paper to incorporate AN codes to the RRNS applied in high-reliable neural networks. From experimental results, the k-modulus redundancy can be reduced from 2 paths to only one, and the residue-to-binary convertors can be saved from  $(k+2)(k+1)$  to only  $k+1$  for the external-coding structure, and even to only one for the internal-coding structure in the single residue arithmetic-weight error correcting. From BLER simulations, about 130 times of reliability can be achieved for a block of 16-bit 47N-coded MAC.

### **9:45 Hybrid BP-SC/SCF Decoding for Polar Codes**

Chih-Heng Cheng and Cheng-Hung Lin (Yuan Ze University, Taiwan)

There are two main algorithms, successive cancellation (SC) algorithm, and brief propagation (BP) algorithm, for decoding polar code. The SC algorithm has better error-correcting performance and the BP algorithm has low latency. The hybrid BP-SC decoding combines these two decoding algorithms and achieves improvements. Furthermore, the successive cancellation flip (SCF) algorithm improves the error-correcting performance for the SC algorithm, but it has higher computation complexity and latency. Based on the hybrid BP-SC decoding, we proposed a combination of BP, SC, and SCF decoding for polar codes in this paper to further improve the error-correcting performance. The result shows our approach outperforms to frame error rates (FER) of the SC decoding and BP decoding at least 0.5-dB and outperforms hybrid BP-SC decoding by 0.2-dB to 0.4-dB. Compared with the SCF decoding, the hybrid BP-

SC/SCF decoding has a small degradation of FER in a high-quality channel but it significantly reduces the average computation complexity.

### **10:00 *Lossless Image/Video Embedded Compression for Memory Bandwidth Saving of AI Applications***

Yu-Hsuan Lee (Multimedia Circuit and System Lab, Department of Electrical Engineering, Yuan-Ze University, Taiwan)

Artificial Intelligence (AI) has gradually become a part of our daily life. Nevertheless, it also causes considerable memory bandwidth and memory access power especially for image/video AI applications. In this paper, an efficient lossless embedded compression (EC) is proposed to save the memory bandwidth of an AI system. It consists of two core techniques: Hybrid Prediction and Partition-based Grouping. Hybrid Prediction can transform all pixels of an 8x8 block to efficient residuals. Partition-based Grouping can further classify them into smaller groups for better compression ratio. The experiment results show that this study presents better performance than the other sophisticated EC algorithms. This study achieves a better lossless compression ratio of 2.21, saving the memory bandwidth of an AI system by 54.8%. In addition, the visual quality of image/video can be fully preserved.

## **E7: QoS/QoE-Related Technologies for Future Communication Systems**

Room: 408-2

Chairs: Ryo Yamamoto (The University of Electro-Communications, Japan), Yoshiaki Nishikawa (NEC Corporation, Japan)

### **9:00 *Study of flower image classification using deep learning to support agricultural pollination***

Eisuke Fukuyama (Nippon Institute of Technology & Electronics, Information and Media Engineering Major, Japan); Tomotaka Kimura (Doshisha University, Japan); Nobuhiko Itoh and Takefumi Hiraguri (Nippon Institute of Technology, Japan)

In smart agriculture, research and development is advanced by robots performing agricultural works instead of humans. Agricultural works requires experience and the human sense of sight and touch. In our study, experience and the sense of sight are replaced by machine learning. We developed a deep learning classification method and implemented it for tomato flower pollination classification in the agricultural field.

### **9:15 *Vulnerability Assessment for Deep Learning Based Phishing Detection System***

Yuji Ogawa, Tomotaka Kimura and Jun Cheng (Doshisha University, Japan)

Recently, the threats of phishing attacks have increased. As a countermeasure against phishing attacks, phishing detection systems using deep learning techniques have been considered. However, deep learning techniques are vulnerable to adversarial examples (AEs) that intentionally cause misclassification. When AEs are applied to a deep-learning-based phishing detection system, they pose a significant security risk. Therefore, in this paper, we assess the vulnerability of a phishing detection system by inputting AEs generated based on a dataset that consists of phishing sites' URLs. Moreover, we consider countermeasures against AEs and clarify whether these defense methods can prevent misclassification.

### **9:30 Unit Traffic Classification by Two-stage Clustering on P2PTV Applications**

Rina Ooka, Takumi Miyoshi, Taku Yamazaki and Thomas Silverston (Shibaura Institute of Technology, Japan)

Peer-to-peer video delivery (P2PTV) is still one of popular applications to enjoy video streaming service. To grasp and understand P2PTV traffic characteristics, a two-stage unit traffic clustering method has been proposed. In this paper, we verify the efficiency and generality of the proposed method through classifying mixed traffic data sets generated by two P2PTV applications, PPStream and PPTV. From the obtained results, we successfully obtained six components of unit traffic that are independent of each other.

### **9:45 Mobile User Density Estimation Based on Graph Laplacian Regularized Recursive Least Squares**

Kaisei Neichi and Takahiro Matsuda (Tokyo Metropolitan University, Japan)

In mobile networks using Unmanned Aerial Vehicle (UAV) Base Stations (UAV-BSs), it is necessary to dynamically deploy UAV-BSs according to the user density in order to achieve effective traffic offloading. In this paper, we propose a two-step user estimation scheme for the user density distribution using Graph Laplacian Regularized Recursive Least Squares (RLS). In the first step of the proposed scheme, the user density distribution is roughly estimated with user densities measured at fixed BSs. In the second step, measurement UAVs are deployed in the area according to the estimated distribution in the first step, and a finer distribution is obtained with user densities measured by UAVs. We validate the proposed scheme with simulation experiments.

### **10:00 Sequential Least Squares-Based Traffic Estimation for Anomaly Detection in Cloud Computing Environments**

Kenta Yumoto and Takahiro Matsuda (Tokyo Metropolitan University, Japan); Takeshi Kodama (Fujitsu Laboratories Ltd, Japan); Junichi Higuchi and Hitoshi Ueno (Fujitsu Laboratories Ltd., Japan)

In IaaS (Infrastructure as a Service) cloud computing environments, where VMs (Virtual Machines) communicate with other VMs or external networks via physical NICs (Network Interface Cards), we consider traffic anomaly detection to detect VMs sending an excessively large amount of traffic compared to normal states of the VMs. In order to detect VMs with anomaly states, in this paper, we propose a traffic estimation scheme based on sequential least squares with constraints. We regard to VMs and physical NICs as nodes, and define a collection of packets between a pair of nodes as a flow. In the proposed scheme, the relationship between traffic volume of transmitted and received packets at nodes and traffic volume of flows is formulated as a system of linear equations, and the traffic volume of the flows is estimated from observed traffic volume of nodes. We evaluate the proposed scheme with simulation experiments.

### **10:15 A Study on effect of Advertisement Insertion to QoE in Video Streaming Services**

Yukiya Kunugi and Ryo Yamamoto (The University of Electro-Communications, Japan); Satoshi Ohzahata (The University of Electro-Communications & Graduate School of Information Systems, Japan); Toshihiko Kato (University of Electro-Communications, Japan)

Video streaming services such as Youtube and Netflix are one of the largest growing online services in the past few years. Currently, many video streaming service systems insert one or more advertisements in the middle of videos. However, such interruption of video viewing by the advertisement insertion forces users to view completely different videos which they are willing to and may be a cause of user's quality of experience (QoE) degradation. To address the aforementioned issue, this study has done the experiment to evaluate the impact of multiple advertisement insertion into a single video to QoE. The experimental results showed that the user's QoE increases when the advertisements are interesting to the user and there is no overlapped content in the multiple advertisements. We also discussed the maximum usage time to obtain sufficient utility from the perspective of service management based on two indicators: the profit obtained by an advertisement provider and the QoE of users.

### **10:30 *Delay-based Task Offloading for Fog Computing in IoT Networks***

Takamichi Yamamoto and Ryo Yamamoto (The University of Electro-Communications, Japan); Satoshi Ohzahata (The University of Electro-Communications & Graduate School of Information Systems, Japan); Toshihiko Kato (University of Electro-Communications, Japan)

The recent rapid growth and spread of IoT (Internet of Things) devices incur the increase of Cloud Computing (CC) utilization to process various kinds of data exchanged inside IoT networks. However, such a demand increase causes the processing load increase of CC, and propagation delay also increases depending on the distance between devices and CC. To address the issues, Fog Computing (FC), which employs processing resources closer to the device, has been proposed to improve response time and balances processing loads. In this paper, we propose an efficient task offloading method to improve the response time and to balance the processing load. The evaluation results show that the proposed method could effectively achieve the objective.

Thursday, September 16 10:30 - 10:50

Coffee Break

Thursday, September 16 10:50 - 11:50

Keynote Speech III: Donald Y. C. Lie (Conference Hall)

Chair: Ding-Bing Lin (National Taiwan University of Science and Technology, Taiwan)

Thursday, September 16 11:50 - 13:10

Lunch

Thursday, September 16 13:10 - 17:00

Tour

Thursday, September 16 17:30 - 21:00

Banquet (Four Points by Sheraton)

Friday, September 17

Friday, September 17 9:00 - 10:30

Poster D

Room: poster area

Chair: Ching-Chun Huang (National Chiao Tung University, Taiwan)

***Optimization and realization of Network Time Protocol on IIOT***

LinHung Liu and YiTing Chen (National Chung Cheng University, Taiwan); Yuan-Sun Chu and Ting-Chao Hou (National Chung Cheng University, Taiwan)

In the Industrial Internet of Things, the Network Time Protocol (NTP) can be used for time synchronization to allow machines to operate synchronously. This paper proposed an optimized NTP: adaptive offset adjustment and clock skew compensation, so that the NTP synchronization time can be controlled within 1ms in the wired network environment.

***Design and Implement a Smart Umbrella Stand System with Instant Message Application***

Yi-Shiun Lee, Yong-Yi Fanjiang, Chi-Huang Hung and Chiu-Yen Huang (Fu Jen Catholic University, Taiwan)

In the rainy season, people are easy to forget to take an umbrella when he goes out. In this study, it combined the traditional umbrella stand, coupled with blowing hot air to dry the umbrella that has been wet. Adding a sensing element to the umbrella stand can not only display the current temperature and humidity, but also use instant messaging software to remind the user to go out and bring an umbrella. When the system senses that, the user is going out and approaching the umbrella stand. It can also synchronize reminder messages to sport bracelets at the same time.

***Anti-multipath near-field localization in multi-path underwater acoustic channel***

Haiyan Song (Heilongjiang Institute of Technology, China); Chang-Yi Yang (National Penghu University of Science and Technology, Taiwan)

Focused beamforming is a useful method for solving near-field localization problem in underwater

acoustic. But we should consider the following conditions: (1) we should regard the radiated noise in the near-field as non-point sources. (2) Multi-path signal may severely interfere with the location results in the shallow sea. Due to the above two factors, the locating performance of focused beamforming is declined seriously. Hence, it is urgent to solve the non-point sources localization problem in shallow water. In this paper, a new anti-multipath near-field localization technique is introduced. Compared with other methods, because the new proposed method makes utilize of the spatial geometry, it can effectively obtain the channel impulse response and match the underwater channel in practice.

### ***Robust Source Localization in Shallow Sea Used SOCP***

Haiyan Song (Heilongjiang Institute of Technology, China); Chang-Yi Yang (National Penghu University of Science and Technology, Taiwan)

This paper introduces a robust source localization technique in shallow sea, which makes utilize of the SOCP (Second-Order Cone Program) concept. In our method, the uncertainty or variation in the underwater channel has been explicitly taken into account. Sources of this uncertainty or variation include imprecise knowledge of the sea depth, the boundary reflection coefficient and so on in the shallow sea. The source vector errors are explicitly modeled via a sphere set which contains all the possible values of the array manifold. If the sphere becomes a single point, the proposed method will turn into the classical MVDR (Minimum Variance Distortionless Response) method. Numerical example demonstrates that in the multipath underwater channel, our proposed robust source localization method can perform well.

### ***A 0.5V True-Single-Phase 16T Flip-Flop in 180-nm CMOS for IoT Applications***

Zhi-Zhong Wang (Chaoyang University of Technology, Taiwan); Yi-Hsuan Hung (National Yunlin University of Science and Technology, Taiwan); Jun-Ting Wu (Chaoyang University of Technology, Taiwan); Zheng-Jie Hong (National Chung Hsing University, Taiwan); Jin-Fa Lin (Chaoyang University of Technology, Taiwan)

A low voltage and low power true-single-phase flip-flop (FF) design with 16-transistor only is proposed. It is adapted from conventional master-slave based design and reduces circuit complexity by using hybrid logic scheme. Optimization measures have resulted in a new FF with better power and area performances. Based on post-layout simulation results using the TSMC CMOS 180nm, our design outperforms the conventional TGFF design by 67.3% in energy and 31% in layout area.

### ***A New Approach of RoF System Using Optoelectronic Oscillator and Discrete Mode Laser***

Jyun-Wei Li, Yu-Chien Yu, Zhi-Qi Yang, Yibeltal Chanie Manie and Peng-Chun Peng (National Taipei University of Technology, Taiwan)

In this paper, a new approach of radio-over-fiber (RoF) system using optoelectronic oscillator (OEO) and discrete mode laser (DML) is proposed and experimentally demonstrated. Ultra-pure and high-frequency radio-frequency (RF) signals are generated by utilizing simple, reliable, and low-phase noise OEO. OEO is one of the main considerations for next-generation photonic RoF system. Moreover, the DML is characterized by its narrow linewidth to optical feedback. The experimental results prove that when using DML as a light source, the narrow linewidth has lower phase noise and promising for photonic RoF system.

## ***Markov-chain Analysis Model based Active Period Adaptation Scheme for IEEE***

### ***802.15.4 Network***

Ryota Horiuchi and Nobuyoshi Komuro (Chiba University, Japan)

Energy efficiency is one of the critical issues for Wireless Sensor Networks (WSN). IEEE 802.15.4 beacon-enabled MAC protocol achieves low energy consumption by having periodical inactive portions, where nodes run in low power. However, IEEE 802.15.4 beacon-enabled protocol cannot respond to dynamic changes in the number of sensor nodes and data rates in WSN because its duty cycle is fixed and immutable. In this paper, we propose a dynamic superframe duration adaptation scheme based on the Markov chain-based analysis methods for IEEE 802.15.4 beacon-enabled protocol. The proposed methods can flexibly respond to changes in the number of sensor nodes and differences in data rates in a WSN while maintaining low latency, low energy consumption, and little deterioration on the packet delivery ratio.

## ***On the Simulation Analysis for a Wideband Common-mode Filter with Defected Corrugated Reference Plane Structure***

Ding-Bing Lin (National Taiwan University of Science and Technology, Taiwan);  
Chung-Ke Yu (National Taipei University of Technology, Taiwan); Chang-Keng Lin  
(National Taiwan University of Science and Technology, Taiwan); Hsin-Piao Lin  
(National Taipei University of Technology, Taiwan)

A new scheme of a wideband common-mode filter for defected corrugated reference plane structure (DCRP), which is embedded in a multilayer printed circuit board. It utilized the common-mode current return path principle, stepped-impedance characteristics, and defected ground structure (DGS), to generate a specific rejection band, many close transmission zeros generate in the common-mode (CM), the common-mode noise causes the stopband effect. The design analysis and simulation results by HFSS indicate that the common-mode noise suppressed over 10dB from 3.76 GHz to 16.09 GHz with 124 percent of fractional bandwidth, the insertion loss of differential-mode (DM) remained less than -2.2 dB from DC to 20 GHz. The DCRP filter is a low-cost design, which applicable wideband suppression of common-mode noise for differential pair signals up to 16 GHz frequency.

## ***Applying Neural Network Algorithm of MIMO Log-normal Channel for OFDM/OCDMA System***

Chih-Ta Yen (National Taiwan Ocean University, Taiwan); Hsin-Han Tsai (National Formosa University, Taiwan)

This study used wireless orthogonal frequency-division multiplexing (OFDM) combined with optical code division multiple access (OCDMA) technology and applied multi-input multi-output (MIMO) architecture with neural network algorithm in a free space optical (FSO) channel. Walsh-Hadamard coding technology was used in this system as each user's codeword, which used the characteristics of fixed cross-correlation between each group of Walsh-Hadamard codewords and effectively eliminated interference between base stations at the receiving end using a balance test. In the rainy climate, when the number of users is 25, the data transmission rate is 10G (bit/s), and the effective receiving power is of -22 dBm, the BERs without- and with- neural network algorithm are  $2.41 \times 10^{-4}$  and  $8.48 \times 10^{-10}$ , respectively.

## ***Combined ZnO nanorod humidity sensors and DSCs for IOTs application***

Sheng-Joue Young and Yu-Jhih Chu (National United University, Taiwan)



In this study, ZnO nanorod humidity sensors with dye-sensitized solar cells (DSCs) were prepared on indium tin oxide conductive glass. The integrated device exhibited similar stable and sensitive performance as the traditional ZnO humidity sensor. Experimental results revealed that DSCs can be integrated with ZnO nanorod humidity sensors to create a self-powered integrated device that has potential for Internet of Things applications.

### ***Performance Evaluations of Hand Number Gesture Recognition by Convolution-Based Deep Neural Networks***

Ing-Jr Ding, Meng-Chuan Hsieh, Xue-Lin Mo, Sheng-Qi Wang and Dai-Ru Wu  
(National Formosa University, Taiwan)

With rapid developments of artificial intelligence (AI) techniques, biometrical recognition will be further extended to the field of hand gesture recognition. It's expected that common hand gesture actions in the daily life will be able to be smartly recognized by an AI system to further promote communication between persons and persons (or machines). This paper presents a hand number gesture recognition system where the popular deep learning model technique, the convolution neural network (CNN), is employed for classifications of hand number gesture images. In this work, recognition performance evaluations are done by different system settings including mainly CNN input images, CNN structures and fully connected layer (FC) parameters of CNN. In hand number gesture experiments with various system settings, the setting that the input hand number gesture image with segmentations of region of interest (ROI) combined with the specific CNN model containing two FC layers can have the most satisfactory performance, achieving the validation accuracy of 92.3% and the test accuracy of 81.3%.

### ***Eye Movement Analysis for Consumer Devices***

Marvin Yen, Hao-Wei Li, Chun-Wei Shen, Ren-Xiang Ying and Wen-Chung Kao  
(National Taiwan Normal University, Taiwan)

The eye tracker enables the new applications for consumer electronics. By estimating the human gaze direction in real-time as a human-machine interface (HMI), various novel computer games or remote learning systems for education purpose could be developed. In this paper, a new HMI system, which integrates a visible-spectrum gaze tracker, a fixation/saccade analyzer, an object tracking, and a score evaluation module, has been proposed. This system aims at guiding the design the computer game as well as the examination of human visual reaction for various consumer electronics.

### ***Binary- and Multi-class Network Intrusion Detection with Adaptive Synthetic Sampling and Deep Learning***

Jehn-Ruey Jiang and Chia-Lin Li (National Central University, Taiwan)

Intrusion detection system (IDS) is becoming more and more important for detecting network intrusions, anomalies or attacks. This paper proposes a method that first uses adaptive synthetic (ADASYN) sampling to oversample data in small-size class, then uses deep learning models, such as the variational autoencoder (VAE), long short-term memory (LSTM) network, and deep neural network (DNN), for network intrusion detection. The well-known NSL KDD dataset is applied to evaluate the effectiveness and superiority of the proposed method.

### ***Identifying IoT Devices with SMTP***

Jyun-Shao Wu, Fu-hau Hsu and Chia-Hao Lee (National Central University, Taiwan)

In this paper, a novel method is proposed from the perspective of spam to detect whether a sender of the mail is an IoT device. How to prevent cyber-attacks has always been an important research topic in this field. Malicious attackers will hide their identifications when they launch attacks so that defenders cannot catch them. Thus from our method, using this information effectively in security research field is useful for preventing malicious behaviors in the future. The security problems of the increment of the Internet of Things (IoT) will come to the forefront. We utilize this method to identify IoT devices effectively.

## F1: Consumer IC Researches and Applications

Room: conference hall

Chair: Shao Chang Huang (Vanguard International Semiconductor Corporation, Taiwan)

### **9:00 Signal Control Switching Applied on Large Array Devices' Layouts**

Shao Chang Huang (Vanguard International Semiconductor Corporation, Taiwan); Yu-Yung Kao (NCTU, Taiwan); Ching-Ho Li (VIS, Taiwan); Li-Fan Chen (Chen, Taiwan); Chun-Chih Chen, Kai-Chieh Hsu, Gong-Kai Lin and Jian-Hsing Lee (VIS, Taiwan); Ke-Horng Chen (NCTU, Taiwan)

Large Array Device (LAD)'s electrical performance is very sensitive to its layout. Signal control switching (SCS) can add LAD's performances, but the layout impacting is not depicted. In this study, the layout with different poly finger amount in one guard ring is discussed for device improvement.

### **9:15 Optimizing Power IC Layouts by Simulation Tools**

Shao Chang Huang (Vanguard International Semiconductor Corporation, Taiwan); Ching-Ho Li (VIS, Taiwan); Li-Fan Chen (Chen, Taiwan); Chun-Chih Chen, Kai-Chieh Hsu, Gong-Kai Lin and Jian-Hsing Lee (VIS, Taiwan)

Power Integrated Circuit (IC) needs to consume huge currents so it often includes a large size device. In order to approach IC driving capabilities, 1.5 times to the simulation size can be used. In this study, 40 % reduction in IC layout can be reached after the correct simulation tool flow is adopted.

### **9:30 Low Latency Design of Polar Decoder for Flash Memory**

Yi-Fu Tseng, Ming-Der Shieh and Chih-Hung Kuo (National Cheng Kung University, Taiwan)

We propose a multiple error correction coding scheme with systematic polar code to enhance the data reliability and to prolong the endurance for flash memory. A line-based 2-bit simplified successive cancellation (SSC) decoder is integrated with a bit-permutation construction to lower the latency. The pattern of information bits and frozen bits are rearranged. The experimental results show that the hardware implementation of the SSC decoder with the codeword permutation speed up 8.1% compared to the prior design.

### **9:45 Creating Output Buffer Circuits by Karnaugh Maps**

Shao Chang Huang (Vanguard International Semiconductor Corporation, Taiwan); Yu-Yung Kao (NCTU, Taiwan); Ching-Ho Li (VIS, Taiwan); Ching-Hua Liu (NTUST,

Taiwan); Ke-Horng Chen (NCTU, Taiwan)

Output buffer circuits are often adopted for driving next stage Integrated Circuit (IC). Most Input/ Output (I/O) circuit designers use the output buffer circuits, but cannot majorly modify the circuits. In this study, output buffer circuits are derived from Karnaugh maps so I/O designers can use only one pen and one paper to draw output buffer circuits. They don't need to look at any existed circuits, but just realize output design principals. Then, they can easily create output buffer circuits.

### **10:00 Holding-voltage Improvement of UHV Circular nLDMOS Transistors by the Drain-side SCR Engineering**

Tien-Yu Lan, Shen-Li Chen, Yu-Jie Zhou, Shi-Zhe Hong, Jhong-Yi Lai and Zhi-Wei Liu (National United University, Taiwan)

Due to the low  $R_{dson}$ , an LDMOS parasitic SCR will cause the problem of low component holding-voltage. In this paper, the modulations are divided into two categories. The first modulation embedded parasitic SCRs in the drain side and used the discrete method to evaluate the influence of different concentration of the P + which formed the parasitic SCR in drain side. The second modulation embedded the Schottky diode in the drain side and with the parasitic SCR path by the P-body layer under the drain end. According to the test results, these two modulations not only can improve the low holding-voltage problem, but also can enhance the ESD immunity. The modulation of SCR discrete P + can increase  $I_{t2}$  upmost 88.61% and the modulation of Schottky diode connected in series with the parasitic SCR path can increase  $I_{t2}$  by up to 123.93%.

### **10:15 ESD-Immunity Impact of HV pLDMOS with Drain-side Embedded Horizontal P-type Schottky Modulations**

Shi-Zhe Hong, Shen-Li Chen, Tien-Yu Lan, Yu-Jie Zhou, Zhi-Wei Liu and Jhong-Yi Lai (National United University, Taiwan)

The ESD-ability effect of parasitic p-type Schottky diodes on the high-voltage pLDMOS is evaluated in this paper. By using the TLP testing machine, it can be used to analyze the component of snapback I-V measurement values such as component trigger voltage ( $V_{t1}$ ), holding voltage ( $V_h$ ), and secondary breakdown current ( $I_{t2}$ ) data. Finally, it can be found that this parasitic Schottky device structure can be regarded as adding a reverse Schottky diode in series at the drain-end of the reference device. In this way, the on-resistance of the component increases, and the trigger voltage ( $V_{t1}$ ) tends to be increased too. It is also found that as the area ratio (>85%) of the reverse Schottky diode of the drain-end increases, the current density at the drain terminal becomes more dispersed. Then, the immunity of components to ESD is also significantly improved.

### **10:30 Improved UHV IGBT-Cell for ESD Protection with High Holding Voltage via a 0.5 $\mu$ m BCD Process**

Yu-Jie Zhou, Shen-Li Chen, Tien-Yu Lan, Shi-Zhe Hong, Zhi-Wei Liu and Jhong-Yi Lai (National United University, Taiwan)

CMOS technology can be applied to POWER MOSFET integrated Circuits(ICs) for vehicle power management system. However, the Electronic Discharged (ESD) reliability of the device is essential issue for Power MOSFETs. Because ESD failure is one of the most serious problem in the reliability of ICs and other electronic systems. In order to enhance the ESD capability of ultra-high voltage (UHV) lateral diffused MOS (LDMOS) devices, we designed an IGBT-like cell for a 0.5 $\mu$ m 300V BCD process. This paper proposed

to improve the problem of low holding-voltage caused by IGBT-like cells. First, the drain side radius is decreased from 32.5 $\mu\text{m}$  to 19.5 $\mu\text{m}$ . Meanwhile, the drain side is divided into three partitions of circles. Then, the device drain side p+ outer circle was floating. Finally, the holding voltage( $V_h$ ) of the reference device is improved 41% from 66.88V to 94.85V. Compared with the Reference UHV LDMOS, the second breakdown current( $I_{t2}$ ) of the IGBT\_PPN4 is increased from 1.72A to 4.17A.

## F2: Human-Machine Interaction and User Experience I

Room: 103

Chair: Wen-Liang Hwang (Institute of Information Science, Academia Sinica, Taiwan)

### **9:00 *A Mobile App for Travel: Knowing the Foreign Food from the Tastes of Food in Our Memory***

Chih-Yi Yeh and Nan-Ching Tai (National Taipei University of Technology, Taiwan)

It is often difficult to infer the taste of food from its name, and even more challenging when the name is translated into foreign languages. As a result, we often have difficulty in imagining the foreign food on the menu or on the plate when traveling to a place with an unfamiliar culture. This study proposes an innovative method for describing the taste of the food based on the combination of foods we have tasted before. A prototype of a mobile app that allows one to retrieve the prior taste experience of different foods to assemble into an imagination of the unfamiliar foreign food is proposed as a possible traveling aid.

### **9:15 *Innovative CAPTCHA to Both Exclude Robots and Detect Humans with Color Blindness***

Jia-Ling Wu and Nan-Ching Tai (National Taipei University of Technology, Taiwan)

This paper presents a design concept of an innovative CAPTCHA that can filter the color-vision-recognition states of different users. It can simultaneously verify the real-human-user identity, differentiate between the color-vision needs, and decide the content to be presented automatically.

### **9:30 *Development of human-friendly plant cultivation pot using IoT***

Kotoko Tanaka (University of Fukui, Japan); Sakiko Ogoshi (National Institute of Technology, Fukui College, Japan); Chika Mori (National Institute of Technology, Fukui College, Japan); Yasuhiro Ogoshi (University of Fukui, Japan)

In the agricultural field, attempts have been made to collect environmental information such as soil water content, temperature, and illumination with sensors using Internet of Things (IoT) technology for plant cultivation. Using IoT Technology, we have made a prototype of a human-friendly plant pot system. Based on the acquired data of environmental condition, voice and image information by the system proposes suitable and comfortable environment for both the plant and people, who take care the plant. It is like a communication between the plant and people. In the future we will investigate the impact on the people after the communication.

### **9:45 *Evaluating features of Moto Park using The Kano Model***

Lai-Chung Lee and Monika Panchal (National Taipei University of Technology, Taiwan)

Transportation takes us to anywhere we want to go and makes our life easier. Whether to take a car or motorbike depends on the distance, people prefer cars for the long-distance and motorbike for the short distance journey. A small country like Taiwan has 23 million population with 94% of them owning a personal motorbike. Traveling on a bike is convenient and fast, but the main issue is finding safe and secure parking. As the motorbike population is increasing, the space for parking is decreasing. In this paper, we will discuss the problem related to motorbike parking and provide a solution through a mobile application called MOTO PARK with all the features of pre-booking, paid parking, free parking, google map, rewards, and parking space sharing. All the features will be analyzed using the Kano model to understand the value and prediction of each features. Analysis has been done on two categories of the participants- first, the foreigner working in Taiwan and second, the young college students.

### **10:00 *Effects of Olfactory Memory on Augmented Gustation***

Ying-Li Lin and Lai-Chung Lee (National Taipei University of Technology, Taiwan);  
Chien-Hsing Chou (Tamkang University, Taiwan)

This paper presents an improved concept fork with olfactory feedback and microcurrent and an augmented gustatory feature. It is used to detect the difference between electrical gustation and retronasal olfaction. The fork augments gustation by adding a non-invasive flavor. Olfactory memory is then deployed to compare smell (olfaction) with taste (gustation). In this paper, we present TransFork+ to assure tentative consumers of food's gastronomic quality; essentially, we hope to convince these consumers that what they smell is what they (will) taste.

## F3: Machine Learning, Deep Learning and AI in CE I

Room: 104

Chairs: Shen-Fu Hsiao (National Sun Yat-sen University, Taiwan), Shingchern D You  
(National Taipei University of Technology, Taiwan)

### **9:00 *Velocity Prediction for MIDI Notes with Deep Learning***

Chien-Sheng Kuo, Woei-Kae Chen, Chien-Hung Liu and Shingchern D You (National Taipei University of Technology, Taiwan)

This papers studies the use of a deep autoencoder to automatically generate dynamics for MIDI (Musical Instrument Digital Interface) files without velocity information. The experimental results show that the proposed approach outperforms existing methods. The subjective tests also show that a MIDI file with velocity values generated by the proposed model sounds more pleasant.

### **9:15 *Self-supervised Learning Aided Blind Stitched Panoramic Image Quality Assessment***

Jui-Hsiu Chiang and Chih-Wei Tang (National Central University, Taiwan)

For deep learning based stitched panoramic image quality assessment, it is costly to train a network model using a large-scale dataset with human annotation. Moreover, it is practical to evaluate image quality without reference images (i.e., Blind Stitched Image Quality Assessment, BSIQA). Self-supervised learning (SSL) avoids the use of annotated large-scale training dataset while few BSIQA schemes of panoramic stitched images using SSL have been proposed. Thus this paper proposes a SSL aided BSIQA scheme for panoramas. The first training phase learns from a large-scale dataset, where SSL based image colorization

is incorporated into supervised learning based classification for learning generalized visual representations. With transferred knowledge from the first phase, the second training phase learns from a small dataset with subjective scores for the task of BSIQA. Test results show that SSL indeed improves prediction accuracy of BSIQA of panoramas on ISIQ dataset.

### **9:30 Cross-view Self-supervised Learning via Momentum Statistics in Batch Normalization**

Guang Li, Ren Togo, Takahiro Ogawa and Miki Haseyama (Hokkaido University, Japan)

A novel cross-view self-supervised learning (CVSSL) method via momentum statistics in batch normalization is presented in this paper. The problem of accuracy degradation in small-batch cases is currently common in self-supervised learning. Our method introduces the cross-view loss and the momentum statistics in batch normalization to solve the accuracy degradation problem in small-batch cases. Experimental results show that our method can drastically outperform the state-of-the-art self-supervised learning method in small-batch cases on the STL-10 dataset.

### **9:45 Efficient Computation of Depthwise Separable Convolution in MobileNet Deep Neural Network Models**

Shen-Fu Hsiao (National Sun Yat-sen University, Taiwan); Bo-Ching Tsai (National Sun Yat-Sen University, Taiwan)

MobileNets are light-weight deep neural network (DNN) models with fewer parameters and less computation compared with some popular models such as AlexNet and VGG. MobileNets adopt depthwise separable convolution (DSC) composed of 1x1 pointwise convolution (PWC) and depthwise convolution (DWC) to reduce model complexity. In this paper, we present a DNN accelerator design which can perform the DSC more efficiently by combining the PWC and DWC with fewer external memory accesses. Experimental results show that the proposed design can reduce more than 50% DRAM accesses with increased speed.

### **10:00 Multi-threaded System Design of A Multi-Precision Deep Learning Accelerator on FPGA with Optimized Memory Usage**

Shen-Fu Hsiao (National Sun Yat-sen University, Taiwan); Jyun-Liang Chen, Yi Hsu and Xiang-Ting Huang (National Sun Yat-Sen University, Taiwan)

A complete deep learning acceleration system usually consists of bus-connected micro-controllers, hardware accelerators, and external memory in order to support all the operations in various deep neural network (DNN) applications. In this paper, we present a hardware/software integration flow that facilitates the FPGA deployment of a DNN hardware accelerator which supports different bitwidths of activation data and weights. The complete DNN acceleration system mapped on a Linux-based System-on-Chip (SoC) FPGA with customized DNN instruction set includes multi-threading for streaming processing, optimized DRAM allocation for small external memory footprint, a reshape unit for efficient tile-based execution. Implementation results for tiny YOLOv3 object detection show that the proposed DNN system achieves peak performance of 120 GOP/s on Xilinx Zynq UltraScale + XCZU9EG.

### **10:15 Quantization of Deep Neural Network Models Considering Per-Layer Computation Complexity for Efficient Execution in Multi-Precision Accelerators**

Shen-Fu Hsiao (National Sun Yat-sen University, Taiwan); Yu-Che Yen (National Sun Yat-Sen University, Taiwan)

Quantization of parameters and activation data in deep neural network (DNN) models plays an important role in multi-precision DNN hardware accelerators where the per-layer bit-widths are dynamically adjusted to speed up the computation. In this paper, we present an efficient quantization algorithm which considers the supported types of bit-width in the multi-precision DNN hardware when quantizing activations and parameters from the pre-trained models. Furthermore, we consider various computation complexity in different DNN layers in order to minimize the execution time in the DNN hardware. Experimental results show that the proposed algorithm has better quantization results for more efficient computation in multi-precision DNN hardware accelerators.

### **10:30 Model-based Local Distortion Flow Estimation for Wide-angle Image Rectification**

Ching-Chun Huang (National Chiao Tung University, Taiwan); Zhi-Xiang Liao (National Chung Cheng University, Taiwan); Ching-chun Hsiao (National Yang Ming Chiao Tung University, Taiwan); Jui-Chiu Chiang (National Chung Cheng University, Taiwan)

Wide-angle cameras are important for large-scale surveillance because of the larger field of view. However, due to lens design limitations, it distorts the captured image to enlarge the camera view. The degree of distortion is usually varied according to the position of the object. Nevertheless, a regular and perspective image view is preferred for viewers; thus, image rectification becomes essential. This paper proposed a learning network to estimate the distortion flows coupled with locally-adaptive model fitting to correct the distortion of wide-angle lens images. Unlike some data-driven methods that directly learn the mapping between an input image and its image distortion parameters, we firstly estimated the motion flow between the distorted and rectified images. Next, by fitting a model to locally infer the model parameters, we generated a model-regularized flow map for rectification. Our experimental results show the barrel distortion can be robustly corrected.

## **F4: Biomedical Circuits and System Technology and Bioinformation Procession & Non-Invasive Biomedical Technology and Digital Health Care**

Room: 402-1

Chairs: Pao-Cheng Huang (Fujian Agriculture and Forestry University, China), Liang-Hung Wang (Fuzhou University, China)

### **9:00 Method of ECG Lead Recovery from 3-Lead to 12-Lead**

Liang-Hung Wang (Fuzhou University, China)

Wearable ECG collection system for home detection has attracted increasing attention. Such devices are designed to be portable with fewer leads. Reconstruction from three-lead ECG to 12-lead ECG can provide

useful auxiliary information for telemedicine dynamic ECG detection. In this study, two reconstruction algorithms are discussed, and the correlation coefficients of the reconstruction results are analyzed. The average correlation coefficient in the randomized experiment reaches 0.901.

### **9:15 *Noninvasive Blood Pressure Classification based on ECG with ResNet Algorithm***

Liang-Hung Wang (Fuzhou University, China)

This study proposes a noninvasive end-to-end blood pressure (BP) classification model based on electrocardiography (ECG), dividing BP into three categories, namely, normotension (N), prehypertension (Pre), and hypertension (H). This study includes three parts: (1) preprocessing ECG signals, including cutting signals into fixed-length segments and denoising; (2) building a proper ResNet model with a 1D convolutional neural network (1D-CNN) to train data; and (3) evaluating the performance of the classification model. The classification algorithm can identify three types of BP, and the accuracy rate of the classification algorithm over the test set is 87.89%.

### **9:30 *Design, Integration, and Verification of a Low-Cost Nailfold Capillaroscopy***

Hung-Hsiang Wang and Chih-Ping Chen (National Taipei University of Technology, Taiwan)

Machine learning can accurately classify the clarity of nailfold capillaroscopy (NC) images and be applied as a verification tool during the preliminary design stage of medical devices. The method can be beneficial for systems that require a myriad of image datasets. This study has focused on the design, integration, and verification of the NC. The study utilized the low-cost NC prototype to record two videos and extract 600 photos, including both blurry and sharp images. Then we used the Laplace operator method for blur detection among the pictures. Statistics has shown the Laplace score of each photo and lead to the distribution of clear photos in NC. Finally, t-SNE, an unsupervised nonlinear machine learning technique, was applied as a data visualization tool to determine clear images. The results showed similar cluster distribution of clear images in NC with the t-SNE method and the Laplace operator method.

### **9:45 *A Multi-lead ECG Acquisition Device Base on Bluetooth Microcontroller***

Pao-Cheng Huang (Fujian Agriculture and Forestry University, China); Wen-Ping Tsai (Fuzhou University, China); Riqing Chen (Fujian Agriculture and Forestry University, China); Liang-Hung Wang (Fuzhou University, China)

This study proposed the design of a multi-lead ECG wearable device based on Bluetooth microcontroller. The main parts include the ECG sensing electrodes and the ECG acquisition hardware circuit. ECG signals from three leads of I, II, and V1 can be recorded by the sensing electrodes completely and steadily. The hardware circuit is designed to implement signal conversion and data transmission. Two sampling rates in software program: 100Hz and 400Hz, are available for this device. This device satisfies the real requirement of small size, hand-held and real-time acquisition. The experimental results show, the device can provide good-quality ECG signals.

### **10:00 *Heart Beat Classification Method based on Random Forest Algorithm***

Pao-Cheng Huang (Fujian Agriculture and Forestry University, China); Liang-Hung Wang, Shuo Liu and Ming-Hui Fan (Fuzhou University, China)

An interpatient classification method using the second lead for the AAMI standard is introduced. This study includes three parts. In the first part, the fuzzy matching algorithm is used to locate the key waveform



points of ECG data. In the second part, the feature engineering algorithm is used to filter the extracted data sets. In the third part, the random forest model is carried out to realize the five classifications of heart disease by the selected features. The final precision, recall, and F1-score are 91%, 89%, and 90%, respectively.

### **10:15 *Selective Microwave Ablation Using Low Power Monolithic Microwave Heater***

Shao-Jyun Lin, Hue-Sin Tian, Hsiao-Chin Chen and Tzu-Yu Tseng (National Taiwan University of Science and Technology, Taiwan); Hung-Wei Chiu (Taipei Tech, Taiwan)  
This paper presents microwave heating effects among different phantoms and the possibility of microwave ablation with a monolithic microwave heater. Microwave heating is performed on agar phantoms that mimic different cell tissues including muscle, blood, fat, skin and tumor. The experimental results show that the tumor-mimicking phantoms exhibit the highest heating rate among all the phantoms.

## F5: Energy Efficient Objects Detection for Smart Devices

Room: 402-2

Chair: Shanq-Jang Ruan (National Taiwan University of Science and Technology, Taiwan)

### **9:00 *A Novel Bird Detection and Identification based on DPU processor on PYNQ FPGA***

Guan-Zhou Lin (National Yunlin University Science and Technology, Taiwan); Hoang Minh Nguyen and Chi-Chia Sun (National Formosa University, Taiwan); Po-Yu Kuo and Ming-Hwa Sheu (National Yunlin University of Science & Technology, Taiwan)  
In this paper, deep learning bird identification is proposed and implemented on PYNQ FPGA with SoC architecture. The new detection method can be divided into moving object detection, and neural network processor architecture. The moving object detection is based on the principle of frame difference to obtain the image label. The recorded frames after being processed through morphology, fuzzy and binarization result in the moving object detected with its size and position within the image. The confirmed moving object is pushed through a deep-learning processor unit (DPU) for classification, resulting in the type of the bird. The results of the experiment show that the proposed method can reach 84.3% accuracy with 126.8 GOP/s/W power efficiency, which is very suitable for low power surveillance experiments in forests or outdoor environments.

### **9:15 *Multi-language Text Detection and Recognition Based on Deep Learning***

Hao-Hsiang Chaung and Di-Wen Chen (NTUST, Taiwan); Chang Hong Lin (National Taiwan University of Science and Technology, Taiwan)  
In order to improve the accuracy of rotated text detection effectively, we combine the network architectures with different functions to make up for the shortcomings of each network. First, rotate proposal regions to achieve scene text detection in any direction. We also enhance the features of important channels and weaken the features of non-important channels to effectively improve the accuracy of the overall network. In order to achieve multi-scale target detection in the scene, the chips of the same size are intercepted on different scales. Therefore, it can zoom in on smaller targets, and zoom out on larger targets. The experiments show that this method is competitive in accuracy with traditional architecture.

### **9:30 31-33 GHz CMOS PA For Ka-Band Radar System**

Chih-yu Chang, Hsiao-Chin Chen, Chen-Ang Wu, Kun-Yu Lee, Yu-Jie Chou and Li-Tung Chiu (National Taiwan University of Science and Technology, Taiwan)

A 31-33 GHz CMOS PA is designed and implemented using 90-nm CMOS technology for radar applications in this work. Based on the two stage differential class-AB power amplifier architecture, the PA is realized by using transformers as matching elements to save chip area. Moreover, a neutralization technique is applied to ensure the stability. Consuming the power of 109.8 mW, the PA achieves the output power of 9.93 dBm and the PAE of 6.9 % at 32 GHz for the input power of -7 dBm.

### **9:45 Efficient Hand Gesture Recognition System based on Computer Vision: An Overview**

Chong-Hao Xu and Shanq-Jang Ruan (National Taiwan University of Science and Technology, Taiwan)

Gesture recognition has been applied in many fields such as human-machine interface (HCI), home automation, robot control, etc. Hand gestures can be considered as a form of nonverbal communication. Various techniques including software and hardware are used to improve hand gesture recognition. Unlike the use of sensors for gesture detection, the recognition algorithm can be as simple as conventional image processing methodology based on rule-based classification algorithms, or complicated as deep learning identification that uses large datasets and computational resources to achieve dynamic gesture recognition. This paper provides a brief review of the approaches for gesture recognition and applications in various fields on computer vision.

### **10:00 Unveiling of How Image Restoration Contributes to Underwater Object Detection**

Peng Wen-Yi (National Chengchi University, Taiwan); Peng Yan-Tsung (National Chengchi University Computer Science, Taiwan); Lien Wei-Cheng (Hyson Technology Inc., Taiwan); Chen Chu-Song (National Taiwan University, Taiwan)

Most underwater image restoration works indicate that restoring images can improve their visual quality and performance of computer vision tasks that use the restored data. This paper aims to investigate how image restoration contributes to underwater object detection. We found that utilizing image restoration through data augmentation rather than using it as a pre-processing step can boost underwater object detection accuracy (up to a 1.9% gain in mAP) on URPC2019 dataset.

## **F6: Artificial Intelligence of Things for the Consumer Technology**

Room: 408-1

Chairs: Ming-Fong Tsai (National United University, Taiwan), Sheng-Joue Young (National United University, Taiwan)

### **9:00 Attendance Monitoring System based on Artificial Intelligence Facial Recognition Technology**

Ming-Fong Tsai and Min-Hao Li (National United University, Taiwan)

Attendance monitoring is a basic system that is required for the operation of a company. However, traditional paper-based clock-in devices and radio frequency identification methods cannot avoid consigning others to the punch card problem. This paper therefore presents an attendance monitoring system based on Artificial Intelligence (AI) facial recognition technology. The proposed system uses a deep learning Tensorflow framework to build a face recognition model that can detect images in real time and upload this information to a cloud server. Our face recognition system can be used to store 'punch card' records as part of an attendance monitoring system.

### **9:15 AIoT module development for automated production**

En-Shuo Cheng, Jun-Yi Yang, Jeng-Dao Lee, Kuo-Yi Chen, Nian-Ze Hu and Lin-Yin Chen (National Formosa University, Taiwan)

Nowadays, industrial developments in various countries around the world are all pursuing Industry 4.0. The primary goals are to digitalize machining data in the manufacturing process, and import intelligence techniques. Most of the small and medium enterprises (SMEs) in traditional industries are facing the problem of generational transition. The key operation and maintenance skills are often handled by senior employees and are difficult to pass on. Therefore, many companies now are more active to try the transformation of digitalization and automation. This study will develop an AIoT module by using AI algorithms to identify objects and calculate locations for items in automated production, to instantly send the information to the controller to ensure the overall automation process.

### **9:30 The Body Sensor Suit with Mixed Reality Interactive Games**

Kuo-Yi Chen, Jeng-Dao Lee and Ting-Jia Zhang (National Formosa University, Taiwan)

With the progress of the technology, the Virtual Reality (VR) that only provides viewing becomes more difficultly to provide users the better VR experience. In order to enhance VR interaction, there are various technologies to improve better VR experiences, such as users could control and move by their hand and feet. However, the most of the VR equipment only operate by controller's direction and the triggers on the controller button, it leads that users cannot use their own body to have an intuitive control. In order to improve this issue, this study focuses on maximizing the interactivity of VR of long-range moving, thus smartphone is chosen as our development platform. Based on Google ARCore library, the values of accelerometer, magnetism sensor and gyroscope from 9-axis sensor can be got. Furthermore, the Inertial Measurement Unit (IMU) is used to calculate information and motion tracking of body. Therefore, the smartphone could detect the body node on the user's three-dimensional movement accurately, and feedback the control information into mixed reality interactive games.

### **9:45 Sales Forecasting Using ANNs or RNNs - A Case Study of Freeway Service Station in Taiwan**

Yi-Fu Lin, Chia-Sheng Cheng and Yi-Chung Chen (National Yunlin University of Science and Technology, Taiwan)

Following recent progress in neural networks, an increasing number of researchers have applied this technique to sales forecasting. The accurate prediction of sales enables businesses to reduce stockpiles and scrap costs. However, it has been heavily debated whether artificial neural networks (ANNs) or recurrent neural networks (RNNs) are the most appropriate for sales forecasting. A number of factors influence sales, and it is difficult to determine whether daily business conditions are independent of each other. To fill this gap in the literature, we first employed conventional data analysis to identify suitable input fields for

ANN and RNN. We then input these fields into both types of neural network. To verify the validity of our discussion, we conducted an analysis using a real-world sales dataset from a service station on a freeway in Taiwan.

### **10:00 *Optimized Manpower and Location Scheduling Query for Shop Promotion Based on Records of Bicycle Sharing System***

Hao-Chun Yang, Chung-Yu Yeh, Yu-Rong Lin, Hsin-Yu Chen, Yu-Hsiang Wang and Yi-Chung Chen (National Yunlin University of Science and Technology, Taiwan)

With the increasing development of big data analytics, more and more researchers have started to apply related technologies to various business projects. However, so far most of these projects have only considered the data of the shop, such as daily visitor estimation or daily sales estimation. The substantial promotion of the shop and the scheduling of promotion manpower, however, remain topics that have rarely been discussed. Therefore, this study proposes a new query to discuss these two issues simultaneously. In this new query, we conduct the following steps: (1) Using the borrowed records of the bicycle sharing system for the location of the query shop, we find out what other locations are most frequently visited by people in the vicinity of the query shop, and consider these locations as key sources of customers; (2) Using NNs to predict the traffic at these key sources; (3) Using GA to find out how to schedule the staff to distribute flyers at these key sources if the shop needs to have such arrangement. The final experimental simulation verifies the effectiveness of the proposed method.

## F7: Internet of Things, Internet of Everywhere, and Edge Computing

Room: 408-2

Chair: Liang-Bi Chen (National Penghu University of Science and Technology, Taiwan)

### **9:00 *Smart Garden Monitoring and Irrigation System in Multiplatform Application Using IoT***

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Andrew M Santos and Daniel Frazao Luiz (Federal University of Amazonas, Brazil); Adriano Eustaquio Santos (Federal University of Amazonas - UFAM & SIDIA, Brazil)

This article presents the development of a low cost system, based on the IoT paradigm, to monitor and control the irrigation of plants and vegetables in domestic gardens. The system consists of a set of electronic components able to extract data from the garden and an Application Programming Interface (API), that uses the Message Queuing Telemetry Transport (MQTT) protocol, to control the communication with sensors and actuator. The sensed information can be further visualized on our own Web and Mobile Applications (for Android and iOS). Our system capabilities include obtaining weekly data plots (from hygrometer and humidity sensors) and automatizing the irrigation system, making the user able to schedule irrigation or even activate it remotely.

### **9:15 *A IoT System for Vehicle Tracking using Long Range Wide Area Network***

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva (Universidade Federal do Amazonas, Brazil); Abdel Fadyl Chabi and Daniel Frazao Luiz (Federal

University of Amazonas, Brazil); Adriano Eustaquio Santos (Federal University of Amazonas - UFAM & SIDIA, Brazil)

The main needs of a vehicle trackers are security and logistical planning. The GPS (Global Positioning System) realtime location provides more security and can be useful for fleet management. Vehicle trackers become more and more useful not only for car fleet companies but also for personal use, improving safety by theft recovery. The development of this work proposes a low cost Internet of Things (IoT) system based on the ESP32 controller as electronic hardware, ProIoT company as IoT platform and long range wide area network as communication protocol.

### **9:30 Smart Plug Prototype for Residential Electrical Energy Monitoring**

Celso Carvalho (Federal University of Amazonas, Brazil); Waldir Silva and Ângela Kimie Matsuo (Universidade Federal do Amazonas, Brazil); Daniel Frazao Luiz (Federal University of Amazonas, Brazil); Adriano Eustaquio Santos (Federal University of Amazonas - UFAM & SIDIA, Brazil)

Electricity has been one of the main needs of human beings. Moreover, it is worth noting that its uncontrolled or inefficient use generates high costs and in some cases reduces devices' lifespans. However, it is not possible to visually identify abnormalities in energy consumption. This paper describes the design of a low-cost system for residential electrical energy monitoring, similar to a smart plug, based on IoT (Internet of Things) concepts. Specifically, it is proposed the use of an Arduino Uno microcontroller together with an ESP-8266 Wi-Fi module and the voltage (ZMPT101B) and current (SCT-013-020) sensors. The IoT ThingSpeak platform is used for data storage and processing in the cloud. As a result, there is a system to which the measured device is connected and an Android application that, according to user registration, allows the management of energy consumption measurement points, with detailed consumption data and illustrative graphics.

### **9:45 AI-based Emotion Recognition System with Tensor Decomposition Optimized Pre-processing**

Chia-Yu Liao, Chia-Yu Li and Wai-Chi Fang (National Yang Ming Chiao Tung University, Taiwan)

In this paper, we proposed to optimize a CNN-based emotion recognition system using EEG signal input by integrating a tensor decomposition pre-processing engine. Although CNNs have been proven to be a strong method to solve the classification of emotion accurately, the amount of required computation and memory remains a challenge for edge AI implementation. The tensor decomposition pre-processing engine proposed in this work efficiently identified the key hidden core tensors containing the most contributing features to the classification of emotion while removing the unnecessary redundant data affecting the amount of required computation and memory usage. This pre-processing engine effectively speeds up the AI acceleration by a factor of 3 and reduced the memory usage by 35% while keeping comparable classification performances with an average accuracy slightly higher by 4%.

### **10:00 Using SRAM-based CIM Architecture as the Event Detector for AIoT Applications**

Chih-Cheng Lu (ITRI, Taiwan); Muhammad Bintang Gemintang Sulaiman, Chin-Yu Lin, Jian-Bai Li, Cheng-Ming Shih, Wei-Shu Rih and Kai-Cheung Juang (Industrial Technology Research Institute, Taiwan)

Convolutional neural networks (CNNs) play a key role in deep learning applications. Computing-in-memory (CIM) architecture has demonstrated great potential to effectively compute large-scale matrix-vector multiplication. For implementation a CIM-based accelerator, a software and hardware co-design approach have to consider the hardware limitations of the CIM macro to map the weight into the AI edge-devices. In this paper, we proposed a hierarchical AI architecture to optimized the end-to-end system power in the IoT application. CIM-based architecture for event detection is designed to trigger the next stage precision inference. In the experiment, CIM-aware algorithm with 4-bit activation and 4-bit weight on Hand gesture [2] and Yale face [3] datasets are examined to have >95% accuracy. Profiling tool to analyzed the entry-level CIM architecture are also developed.

### **10:15 A Smart Mini Marine Fish Tank System Based on AIoT Technology**

Yi-Hsuan Liu, Wen-Hui Wu, Xiang-Rui Huang, Wei-Han Chen and Liang-Bi Chen

(National Penghu University of Science and Technology, Taiwan)

This paper proposes an AIoT based smart mini marine fish tank system, which provides consumers feeding a more convenient way to enhance the comfort of seawater aquatic life and chances of survival. The proposed system can automatically adjust many related parameters such as marine water quality, water temperature, oxygen content in water, feeding, changing the water, and real-time water monitoring. Moreover, real-time monitoring of water status can identify abnormal biological illness, resolved in favor, and take care of the difficult marine fish pets care problems.

### **10:30 Smart Multi-mode Networking Architecture for Internet of Everywhere Using NB-IoT and LoRa**

Shang-Liang Chen, Zih-Yun Hong and Hsiang-Yu Chuang (National Cheng Kung University, Taiwan)

To solve signal instability or interruption that often occurs when using single-mode communication transmission, the smart multi-mode networking architecture through NB-IoT and LoRa with bi-direction communication function is suggested in this study.

Friday, September 17 10:30 - 10:50

Coffee Break

Friday, September 17 10:50 - 11:50

Keynote Speech IV: Rong-Chung Liu (Conference Hall)

Chair: Ming-Tien Wu (National Penghu University of Science and Technology, Taiwan)

Friday, September 17 11:50 - 13:10

Lunch

Friday, September 17 13:10 - 14:40

Poster E

Room: poster area

## ***Design of e-Health System for Heart Rate and Lung Sound Monitoring with AI-based Analysis***

Kuei-Chung Chang, Jun-Wei Huang and Yi-Fong Wu (Feng Chia University, Taiwan)

Traditionally, doctors have used stethoscopes for chest auscultation to diagnose respiratory and heart diseases. Auscultation can be used to initially diagnose the status of the patient, but this depends on the doctor's experience and waste time. Recently, electronic auscultation is proposed to diagnose the condition more carefully by sampling and processing sound signals. This paper designs a simple self-made stethoscope to digitize medical sound data. The sounds are then analyzed to give preliminary diagnosis to track health condition. The wave of monitored sounds and analyzed results can be displayed on mobile phones, so that patients can know health status immediately. In addition, an e-health home gateway and cloud-based AI system are also proposed for home-care patients to monitor health condition of chronic patients anytime at home or long-care center.

## ***Automated Detection System for Acoustic Signal of Breath***

Hsiu-Ting Hsu, Kai-Lin Chen, Po-Yen Huang and Yuan-Sun Chu (National Chung Cheng University, Taiwan)

The breathing signal itself contains rich information. By observing breathing signals, we can analyze many physical functions. However, most of the old breathing measurement methods such as straps and stethoscopes require the assistance of others and are easy to restrain the patient, so that it is difficult to get close to real life situations. In this study, We first use the microphone of the personal mobile phone to record the breathing signal, and use Mel-Frequency Cepstral Coefficient to obtain the characteristics. Then, with DNN, it can successfully achieve automatic classification of exhale, inhale and silence phases in human breathing behavior. The accuracy rate is as high as 94.66% when there are 90 subjects. In addition, DNN is also used to do recognition of respiratory symptoms. Combined with the analysis of the breathing rate, we complete an integrated system for judging symptoms and fatigue detection based on the respiratory signal.

## ***A Mirror-based Personal Health Monitoring System Integrating Wearable Devices and Non-contact Measurements***

Li-Wei Chang, Hong-Lin Liu, Cheng-You Ying, Wei-You Tsai and Yuan-Yu Tsai (Asia University, Taiwan)

This study integrates wearable devices and non-contact measurements to develop a mirror-based personal health monitoring system. Under user permission, we use Google Fit REST API to retrieve his/her activity history, including steps taken, calories burned, heart rate, and sleep data. All the physiological data are then visualized on the monitor with a bar chart, making user easily and quickly understand the historical behavior. We also integrate non-contact heart rate and respiratory rate real-time measurement and then evaluate the heart rate measurement accuracy through continuously comparing with the retrieved data from smart bracelets. Hope this device can be used for home health data collection and monitoring to assist the doctor to provide the appropriate diagnosis and treatment.

## ***Optical Comb Generator-based Microwave Photonic Filter Performance Improvement Using Multilayer Perceptron (MLP) Neural Network***

Jyun-Wei Li, Yibeltal Chanie Manie, Po-Han Chiu, Amare Mulatie Dehnaw and Peng-Chun Peng (National Taipei University of Technology, Taiwan)

In this paper, we proposed multilayer perceptron (MLP) neural network for improving the performance of a microwave photonic filter (MPF). Moreover, we proposed an optical comb generator to attain a central reconfigurable MPF. The frequency response of MPF varies due to some factors such as fiber length, optical carrier, and wavelength spacing. Thus, we can accurately adjust the center frequency of the MPF and its bandwidth by varying these factors, which enhances the network flexibility and very important for future optical networks. However, very difficult to determine these factors if we assign the MPF's transmission window randomly. Thus, we apply MLP technique to learn and understand the inverse mapping between the frequency response and the MPF parameters such as length of the fiber and wavelength spacing for precise prediction of the given arbitrary frequency response. Therefore, the experimental result proves that the proposed MLP model accurately predicts the parameters of MPF such as length of the fiber and wavelength spacing.

### ***A Deep Metric Learning Method with Combined Loss of Triplet Network and Autoencoder***

Po-Hsuan Yen and Chien-Cheng Tseng (National Kaohsiung University of Science and Technology, Taiwan); Su-Ling Lee (Chang-Jung Christian University, Taiwan)

In this paper, a deep metric learning method with combined loss of the triplet network and autoencoder is presented. Autoencoder is regarded as the regulation network to enable the embedding vector to have some latent features of the input image, and improve its performance. Compared with the pure triplet network, although it increases some complexity during training due to the addition of the decoder, but during testing, their complexities are exactly the same, because the decoder can be completely removed after training. The experiments of the proposed method, triplet network, and one-hot encoded network are performed on various character datasets to show that the proposed method not only achieve better classification performance, but also inherit the benefits of deep metric learning.

### ***Modeling of Convolutional Neural Network Circuits for Human Activity Recognition***

Chia-Yu Kuo, Yu-Hao Huang, Bing-Jun Hou and Syang-Ywan Jeng (Chung Yuan Christian University, Taiwan); Shang-Wei Chou (Silicon Jazz Ltd., Taiwan); Hao-Wei Weng (Chung Yuan Christian University, Taiwan)

Neural computing capabilities has been studied by neuromorphic neural network circuit modeling in this work. A non-overlapped implanted (NOI) non-volatile memory device is used. The NOI array is designed to form the synapses of a convolutional neural network. To verify the network, recognition rates on six kinds of human activity are investigated. There are 12,000 data in training set and 3,000 data in test set. Convolution neural network is first trained in software. The recognition rates are 100% in training set and 98% in test set. The hardware simulation result using circuit/device models on the same database is 89% in test set.

### ***Circuit Implementation of Convolutional Neural Network for Human Activity Recognition***

Shang-Wei Chou (Silicon Jazz Ltd., Taiwan); Chia-Yu Kuo, Yu-Hao Huang, Bing-Jun Hou, Syang-Ywan Jeng and Yueh-Lin Chiang (Chung Yuan Christian University, Taiwan)

Neural computing capabilities in a neuromorphic neural network circuit is studied in this work. A non-overlapped implanted (NOI) non-volatile memory device is used as a synaptic unit. The NOI array is



designed to form a convolutional neural network. To verify the network circuit, recognition rates on six kinds of human activity are investigated. There are 12,000 data in the training set and 3,000 data in the test set. Convolution neural network circuit is first initiated by transfer-learning from simulated weights. The simulated recognition rates are 100% in training set and 98% in test set. The circuit implementation result with transfer learning on the same database is 68% in test set.

### ***Development of AI-based Recycling Bins Using MobileNet-SSD Networks***

Wei-Chen Zheng and Jin-Shyan Lee (National Taipei University of Technology, Taiwan); Yuan-Heng Sun (Industrial Technology Research Institute, Taiwan)

With the rapid development of industrial technologies, a lot of wastes have been produced in modern life. In order to efficiently recycle the wastes, this paper has designed and implemented an intelligent recycling bin using the MobileNet-SSD (Single-Shot Detector) networks. Experimental results indicate the feasibility and practicality of the implemented system, in which the accuracy reaches above 90% for the plastic bottles and metal cans.

### ***Robust Remote Sensing FBG Sensor System Using Bidirectional-EDFA Techniques***

Jyun-Wei Li, Meng-Hsien Chan, Zhi-Qi Yang, Yibeltal Chanie Manie and Peng-Chun Peng (National Taipei University of Technology, Taiwan)

In this paper, we proposed and experimentally demonstrated a small integrator to replace optical spectrum analyzer (OSA) applications for robust remote sensing systems. Moreover, we demonstrated bidirectional Erbium-Doped Fiber Amplifiers (BiDi-EDFA) to improve sensing FBG sensor performance and provide gain for signals by increasing the optical signal-to-noise ratio (OSNR). The result of the experiment indicates that the BiDi-EDFA has a high power, which increases the gain of the transmitted signals. Furthermore, even the FBG sensors are placed after 50 km SMF, the sensing signal of FBGs achieves high OSNR using the proposed FBG integrator method.

### ***A Study of Development an English Vocabulary Learning Companion Robot Based on Progressive Prompting***

Ah-Fur Lai and YU-Chia Lin (University of Taipei, Taiwan); Horng-Yih Lai (National Taiwan University, Taiwan)

The purpose of this study was to develop a learning companion robot and system for helping the students to learn English vocabulary based on dynamic assessment theory. This study adopted multiple IOT components for front end interface of robot, and employed WoT, web technology and cloud service for learning management system in server side. The learners can interact with robot, and drill and practice English vocabulary in listening and speaking. After finished this learning companion robot, this study conducted a system evaluation by e learning experts and experienced teachers. Its result revealed that the evaluators show high appraisal toward this robot and system.

### ***Automatic Deployment Mechanism for Smart Communication Service Based on Container Technology***

Shang-Liang Chen and Hsiang-Yu Chuang (National Cheng Kung University, Taiwan)

In this research, we proposed a long-distance information transmission system architecture based on Container and Microservice technology, divide LPWAN multimode network communication module into several services depending on different functions. Through containerization technology, a mechanism is

designed to automate the entire communication service establishment process, and then the automated deployment of communication services is realized through containerized management tools. We test our architecture on mobile pumps maintain, and the results show that the developed mechanism can successfully achieve automate remote deploy or system service upgrade.

### ***Application of Whale Optimization Algorithm in the Optimization of Lithium Battery Parameters***

En-Jui Liu (National Tsing Hua University, Taiwan)

In this study, the Whale Optimization Algorithm (WOA) is used to identify the parameters of ternary lithium batteries. The main objective of the research is to calculate the theoretical internal parameters of the lithium battery by leveraging on the algorithm's global search capability. By using such a method, one will be able to obtain a highly accurate reading of the battery's chemical parameters without the need to disassemble it or conduct any form of special analysis on its internal components.

### ***Is Wearable Input Devices Better for 3D Modeling on Tablet? A Case study***

Hung-Hsiang Wang and Chih-Ping Chen (National Taipei University of Technology, Taiwan)

Tablet computers have become ubiquitous and important for product designers in daily use. Among various computer input devices, it might seem likely that the wearable input devices on a tablet would elicit higher time efficiency than the traditional mouse in a 3D model building environment. This paper presents five experiments that examine the speed of using different cursor control devices (mouse, pen mouse, ring mouse, stylus, and E-touch screen) to complete a 3D model task. Six participants were recruited in the investigation. The result shows that it took the least time to complete a 3D model by using the stylus, consecutively followed by the touch screen, the mouse, the pen mouse, and the ring mouse. The data indicated that the stylus is a useful and convenient tool when creating a 3D model on a tablet, while other innovative wearable input devices were more time-consuming than the traditional mouse.

### ***Influencing Factor Considerations for Designing a High-Performance Compact Antenna Test Range (CATR)***

Rong-Chung Liu (Yuan Ze University & WavePro, Taiwan); Teh-Hong Lee (Ohio State University, USA); Hsi-Tseng Chou (National Taiwan University, Taiwan); Yao-Chiang Kan (Yuan Ze University, Taiwan)

Compact antenna test range (CATR) is popularly used to produce a plane-wave like field-distribution in a small designated quiet zone to resemble the actual far-field scenario in electromagnetic (EM) related measurement. The quiet zone's performance relies on many factors that should be compromised for a trade-off between performance and system complexity. This paper presents major design concerns from the realizable industrial aspects and discusses their solutions when designing a high-performance CATR.

### ***RF Hardware Design for 5G mm-Wave and 6G Revolutions: Challenges and Opportunities***

Donald Lie (2500 Broadway & Texas Tech U, USA); Jill Mayeda (Texas Tech University, USA); Jerry Lopez (Texas Tech University & NoiseFigure Research Inc., USA)

The millimeter-wave (mm-Wave) 5G hardware design requirements are considerably tougher to meet compared to their sub-6 GHz 5G counterparts, especially on the stringent power efficiency, linearity,

bandwidth and cost. For the next generation 6G that utilizes Terahertz (THz) communication, its hardware design specs are expected to be even more challenging, putting a tremendous amount of pressure on the RF hardware design communities. In this paper, we will highlight some key challenges and opportunities on mm-Wave 5G and 6G hardware design for the upcoming 5G/6G revolutions.

## G1: Automotive CE Applications & Application-Specific CE for Smart Cities

Room: conference hall

Chairs: Tsung-Chu Huang (National Changhua University of Education, Taiwan), Jui-Feng Yeh (National Chiayi University., Chiayi City, Taiwan)

### **13:10 *Knee Lift Detection using Convolutional Neural Network Method with FPGA Hardware Design***

Tzu-Chieh Chen, Yi-Jhen Luo, Wei-Chung Wan and Tsung-Han Tsai (National Central University, Taiwan)

In this paper we propose a convolutional neural network (CNN) model to detect whether the action of knee lift is standard or not. We use HRNet as the previous part of system which can localize human anatomical keypoints to generate 2D keypoints as the input of our model. We can more easily distinguish whether the knee lift action has reached the required position or not. The simulation is based on the 2D skeleton points as the keypoints. Besides, we also implement this CNN model in FPGA hardware to reduce inference time.

### **13:25 *Pedestrian behavior and agent-based simulation modeling in public space***

Yu-Chen Wang (National Taipei University of Technology, Taipei Tech, Taiwan);  
Sheng-Ming Wang (National Taipei University of Technology, Taiwan)

Owing to the COVID-19 pandemic, people must practice social distancing (1.5 m) in public spaces. This restricts activities in such spaces, and traditional festivals are canceled. This study mainly focused on the COVID-19 outbreak and pedestrian gathering in public spaces and build up a simulation framework. Additionally, it examined pedestrian trajectory data to know the human behavior and seated the characteristic of the pedestrian. Agent-based modeling can make the agent in several behaviors know how they move in the space. The analysis and evaluation show that it's difficult in maintaining social distancing without protection stuff in public spaces. Subsequent studies are planned for different types of areas to generate and evaluate a variety of high-fidelity simulation patterns across several fields.

### **13:40 *Automotive Radar Precision Calibration with Compact Antenna Test Range***

Rong-Chung Liu (Yuan Ze University & WavePro, Taiwan); Chung-Huan Li (WavePro Inc., Taiwan); Teh-Hong Lee (Ohio State University, USA); Yao-Chiang Kan (Yuan Ze University, Taiwan)

A full measurement system for automotive radar at 77GHz is presented in this study. Radar applications require particularly outstanding quiet-zone performance for its measurement uncertainty and calibration, especially at millimeter wave (mmWave) frequency range. Therefore, this system employs compact antenna test range (CATR) to generate its quiet zone. In addition, a Radar Test Simulator (RTS) is used to test DUT with broad ranges of distance and speed range. Software is also developed to coordinate with the

hardware so the system is ready for commercial automotive radar test and calibration. An example design is also proposed in this paper to explain the whole system configuration and performance of a practical automotive radar test system.

### **13:55 *Intelligent Mango Fruit Glade Classification Using AlexNet with GrabCut Algorithm***

Jui-Feng Yeh (National Chiayi University., Chiayi City, Taiwan); Kuei-Mei Lin, Chen-Yu Lin and Jen-Chun Kang (National Chiayi University, Taiwan)

This paper invested an intelligent Mango glade classification based on AlexNet with GrabCut algorithm. The proposed system integrated four modules: user interface, pre-process of image, object detection and grade classification. A webcam integrated in user interface is for capturing the video and image of the target here. Image pre-process includes object mask and foreground segmentation using GrabCut. For glade classification, an AlexNet was adopted here to provide the output, mango grade. From the observation about experiment results, we can find the proposed approach with good performance and efficient. After implementation, the proposed system was applied in practical scenario and achieved he performance to fit the users' requirement.

### **14:10 *Error Correctable Range-Addressable Lookup for Activation and Quantization in AI Automotive Electronics***

Ting-Yu Chen, Cheng-Di Tsai, Hsiao-Wen Fu, Yung-Chun Yang and Tsung-Chu Huang (National Changhua University of Education, Taiwan)

In this paper, we generalize the lightweight-slope piecewise-line range-addressable lookup table for efficient approximate computing in any activation/quantization function, and propose an error-correcting algorithm and circuitry using the AN codes for enhancing reliability. A BLER/SNR simulation proves the SEC/DEC capability of the firstly-presented AN-coded neuron. Comparisons with similar state-of-the-art works show that the proposed technique is the most efficient and error-correctable lookup table for any function in a medium resolution within 8-12 bits.

### **14:25 *Thermal Pad Design Flow for Automotive Electronics***

Guan-Jia Chen, Hong-Wen Chiou, Yu-Teng Chang and Yu-Min Lee (National Yang Ming Chiao Tung University, Taiwan)

This work proposes an effective thermal pad (TP) design flow for automotive electronics. It contains modeling and design stages. In the modeling stage, thermal and cost functions are developed to evaluate thermal behavior and cost of TP. With these functions, an objective function is created. By solving the objective function, the suitable size and thermal conductivity of TP can be obtained. From measured results, the temperature of automotive electronics can satisfy the threshold temperature and the cost can be minimized by the proposed flow.

## **G2: Human-Machine Interaction and User Experience II & Sensors and Actuators**

Room: 103

Chair: Meng-Lieh Sheu (National Chi Nan University, Taiwan)

### **13:10 *The effect of children's belongingness on online knowledge-sharing behaviors in a library virtual book club***

Yun-Hui Chou and Chun-Ching Chen (National Taipei University of Technology, Taiwan)

People join online learning communities because of their interest. A successful online learning platform should enhance emotional connections and knowledge sharing. The purpose of this study is to explore the online knowledge-sharing model to understand the effect of children's sense of belonging by developing a virtual book club in the library. The results show that belongingness will affect the motivation of children's online knowledge-sharing behaviors, and good friends are important for children in the virtual community.

### **13:25 *Investigating the Design of the Emotion Function of an APP for Children's Libraries***

Yu-Wen Hsu and Chun-Ching Chen (National Taipei University of Technology, Taiwan)

Public library services are essential for children's physical and mental development. Children's libraries generally function to improve children's knowledge mostly through books. However, emotional awareness is also necessary for the overall growth of children. As part of a study on the development of an APP for children's libraries, an emotion function has been added to investigate the significance of such functions for children and propose directions for future development. The study suggests that the main factor of emotion feedback from children is the book content. The emotion function design can facilitate children's awareness of their empathy for the narratives and characters in books and evoke corresponding emotions, which is helpful in educating them about their emotions and cultivating their empathy.

### **13:40 *Design and Evaluation of Children Library App Interface***

Yu-Wen Hsu and Chun-Ching Chen (National Taipei University of Technology, Taiwan)

Public libraries provide important services for children. As traditional libraries gradually transition to Library 2.0, they are able to offer more digital services. Operating digital devices come naturally to children today, and there is a growing research interest in the field of human-machine interaction focusing on children as users. Consequently, this study developed a prototype app for children - "Book Search-Monster Island" - to conduct usability tests on the primary functions, explore issues that arise during usage, and further revise the app interface. The study results show that inappropriate use of graphics and insufficiently intuitive design may cause children to make cognitive errors. When designing future app interfaces, it should therefore be noted that adding text will help children identify the purpose of graphics, and using appropriate graphics along with intuitive visuals will prevent cognitive errors.

### **13:55 *The individual support system for people with sleeping trouble -a case study of banlangen tea-***

Chika Mori (National Institute of Technology, Fukui Collage, Japan); Sakiko Ogoshi (National Institute of Technology, Fukui College, Japan); Yasuhiro Ogoshi (University of Fukui, Japan)

The individual ICT support systems, which we originally developed for people with developmental disabilities, were adapted for people with sleeping problems. Japanese people have the shortest average

sleeping time in the world, and some have severe sleeping problems. To eventually develop a support system and a database for such people, we are developing a database for food and activities after consuming it. In our previous studies, banlangen (*Isatis tinctoria*), used in China for its antiviral activity, showed effects on sleeping, especially for people tended to have short sleeping. In this study, two people recorded their feelings, with or without taking banlangen tea, over a period of a month, using the adapted individual support system. Analysis of the records showed a mild correlation between taking this tea and their quality of sleep. This result suggested that there may be other factors influencing sleep.

#### **14:10 CMOS Capacitive Fingerprint Sensing Scheme with Transition Band of Low Pass Filter**

Meng-Lieh Sheu (National Chi Nan University, Taiwan)

A CMOS capacitive fingerprint sensing scheme is proposed in this paper. The proposed scheme uses the parasitic of interconnection to construct a low pass filter, and then use the transition band characteristic of low pass filter to discriminate the change of fingerprint capacitance. A proof-of-concept chip with 8x8 fingerprint sensor array is demonstrated with TSMC 0.18 $\mu$ m 1P6M CMOS process. The chip area is 852 $\mu$ m  $\times$  651 $\mu$ m and works at 1.8V power supply. The output voltage range is 0.4V~1.25V for the sensing capacitance range of 0fF~60fF.

#### **14:25 Development of Skin Sensing Module for Safety Control in Human-Robot Collaboration**

Hsiang-Yu Hsieh (National Taipei University of Technology, Taiwan); Zong-Yue Deng (Fu Jen Catholic University, Taiwan); Hsin-Han Chiang (National Taiwan Normal University, Taiwan); Hsiao-Chi Li (Fu Jen Catholic University, Taiwan)

In this study, a skin sensing module is designed for the robotic arm. Based on this module, the robotic arm can perceive physical contacts or collisions, and trigger its predefined safety mechanism. A solution is provided to deal with the hidden work safety issue arisen with the advancement of human-robot collaboration. The purpose of this work is to protect the machine operators and improve their working environment by providing the modularization of the signal transmission. According to the proposed architecture through sensitive pressure sensing technique and wireless transmission, the robotic arm in execution can respond in a timely manner for protection, and ensure the task execution and safety control of the robot arm.

#### **14:40 Gender perception of robots with different anthropomorphism**

Tung-Yi Cheng (National Taipei University of Technology, Taiwan)

This study ascertains the emotion perception of different gender consumers towards service robots with different degrees of anthropomorphic appearance in spaces for consumption. Differences between male and female consumers with regard to pleasure are examined through an experiment using robots with different degrees of anthropomorphic appearance in spaces for consumption. Results will provide a basis for the design of service robots. The 161 subjects between the ages of 20 and 50 first read a short passage on consumption behavior, and then they view pictures of robots with different degrees of anthropomorphic appearance. They then fill out a questionnaire on their perception of the role played by the robot in the scenario. Research results indicate that robots with higher degree of anthropomorphic appearance generated more pleasure among male subjects than female subjects, i.e. men prefer more human-like robots compared with women in spaces for consumption. Based on the results of this study, in spaces mainly for male consumers, robots should be designed with higher degree of anthropomorphic

appearance; in spaces mainly for female consumers, robots can be designed with either high or low degree of anthropomorphic appearance.

## G3: Wearable Technology on the Health and Medical Electronics

Room: 104

Chair: Jian-Chiun Liou (Taipei Medical University, Taiwan)

### **13:10 *Integrated infrared image system within accurate detection***

Jian-Chiun Liou and Zhen-Yu Yang (Taipei Medical University, Taiwan)

This study uses light in the near-infrared spectrum to absorb melanin and scatter tissue. It is relatively elastic, so it can penetrate the skin up to 4 mm. The system with the absorption wavelength (450 ~ 1200nm) is demonstration.

### **13:25 *An ultrasound system for the detection of dental caries prevention***

Jian-Chiun Liou and Zhen-Yu Yang (Taipei Medical University, Taiwan)

The development and research of an anti-noise ultrasonic imaging device uses a control module to divide a plurality of scanning units arranged in a two-dimensional array in an ultrasonic probe into a plurality of groups. Ultrasound has broad prospects as a diagnostic imaging tool for dental caries prevention.

### **13:40 *Development of an Electronic Stethoscope Using Raspberry***

Yu-Chi Wu and Fu-Lin Chang (National United University, Taiwan)

In this study, Raspberry Pi 3B was used to develop an electronic stethoscope by embedding a condenser microphone in the traditional stethoscope head to collect heart and lung sounds. The collected signals pass through amplification and filter circuits, and then the processed signals are transmitted to the Raspberry Pi through audio cables. In addition, a recording system for heart and lung sounds was developed in the graphic user interface on the Raspberry Pi. After recording, the audio file can be directly stored in Raspberry Pi, played on headphones or a small speaker connected to the Raspberry Pi, or transmitted via Bluetooth or Filezilla to a computer for further analyses. The functions of recording audio sounds and playing recorded sounds can help doctors to relieve the pain caused by the long-term use of the traditional stethoscope in the ear. They also improve the inability of recording the heart and lung sounds when using the traditional stethoscope. In this study, we also explored the use of dual microphones for noise reduction. Five kinds of stethoscope heads were developed, and the corresponding audio signals were observed using Fast Fourier Transform (FFT) to analyze their effects on noise reduction. The designed circuit has two modes for collecting sounds depending on the audio source: the heart sound mode or the lung sound mode, and it also has anti-noise mode. After testing, the effect on active noise cancelling proposed in this study is not as good as expected. The frequency of the noise sound changes after passing through the material that the stethoscope surface touches. Various materials cause different variations on frequency received by the microphone, causing incomplete frequency cancellation on noise sound. Based on the testing for passive noise cancelling, the best one, among all the stethoscope heads including one commercial electronic stethoscope, is that the microphone is placed in the stethoscope head and the periphery of the stethoscope head is covered by cork.

### **13:55 *Investigation PPG sensor and reflected intensity of the LED irradiated light***

Jian-Chiun Liou and Jie-Yu Chen (Taipei Medical University, Taiwan)

The hemodialysis tube is often regarded as the lifeline of dialysis patients. If the tube is blocked, it will not only cause panic in the patient, but also delay the course of treatment, and may even cause complications such as arterial embolism. This study uses the principle of PPG photoplethysmography. That is, by measuring the reflected intensity of the LED irradiated light, the blood vessel volume change caused by the pulsation is measured.

#### **14:10 Ultrasonic blood flow rate monitoring**

Jian-Chiun Liou and Zhen-Yu Yang (Taipei Medical University, Taiwan)

This study investigates the doppler effect of ultrasound in human blood vessels on hemodialysis to detect the flow rate of blood. The doppler effect waves have changes in frequency and wavelength. Integrated ultrasonic blood flow signal monitoring to complete the observation of the health status of hemodialysis patients.

## G4: Consumer Electronics and Services for AIoT Technology and Applications

Room: 402-1

Chairs: Chiu-Chin Chen (Zhao Qing University, China), Chia-Chun Liao (Zhao Qing University, China)

#### **13:10 Study the development of 5G applications in Mixed Reality**

Chia-Chun Liao and Chiu-Chin Chen (Zhao Qing University, China)

With the further development of virtual reality (VR) technology, mixed reality (MR) technology has also received more and more attention, and MR technology will surely form a revolutionary change in display technology. At present, the application services targeted by the 5th Generation Mobile Networks (5G) include smart medical care, smart education, and gaming services, all of which require the construction of infrastructure and social welfare. It means that 5G technology is the core of future social development and industrial competition in advanced countries. This study uses mixed reality combined with the development of 5G technology as the object, through consulting related literature. First, explore the current developments of mixed reality and 5G technologies, and analyze their advantages and disadvantages. Second, study the current application of the combination of the two to find out the existing problems. Explore the future trend of combining 5G and MR again. Finally, research and explore possible technical and security issues, and propose reasonable and effective solutions.

#### **13:25 Research on the use of AIoT and 5G in Mobile Commerce**

Chia-Chun Liao and Chiu-Chin Chen (Zhao Qing University, China)

With the continuous development of mobile communication technology, wireless Internet technology and the rapid growth of mobile phone users, mobile e-commerce has also been further developed. It can make people get the needed information at any time, pay all kinds of fees at any time, order goods at any time. At the same time, it is also people's "ID card", which is becoming an indispensable part of people's life. If the premise of interconnection of all things is mature 5G technology, then the catalyst of interconnection of all things is artificial intelligence. The combination of the two will change the whole mode of social production and improve social productivity. With the arrival of 5G network with characteristics of large bandwidth and low delay, more and more industries have the conditions to apply AI technology, so that



all things can be realized and application scenarios can be enriched. The future of mobile e-commerce is bright, but the road is tortuous. The key is to see the development direction of mobile e-commerce. If the development direction is right, then mobile e-commerce will develop at an amazing speed. This paper takes mobile business under the background of AIoT combined with 5G technology as the object. Firstly, take a large number of literature search and collation, then it introduces the overall environment of China's mobile commerce through questionnaire survey and case study, states in detail the changes of mobile commerce under the influence of 5G and AIoT technology from the three perspectives of pre transaction, mid transaction and post transaction of mobile commerce, further analyzes the current situation and existing problems of China's mobile commerce development, and combines the research results obtained from the research methods to become mobile commerce. The development of mobile commerce gives reasonable suggestions, which provides a reference for the ultimate trend of mobile commerce.

### **13:40 Research on the development of Fintech combined with AIoT**

Chiu-Chin Chen and Chia-Chun Liao (Zhao Qing University, China)

Fintech is an industry that uses a series of technological innovations such as cloud computing and big data to allow technology to serve finance and greatly improve financial efficiency. However, the Internet of Things technology connects all things to machines to realize information exchange. The effective integration of Fintech and AIoT will not only help improve finance and improve the efficiency of the financial industry, but also enable finance to better serve the real economy. This article aims to discuss the development status, prospects and development strategies of financial technology combined with Internet of Things technology. First, take "Industrial Bank, iFLYTEK and JD Finance jointly constructing AIoT finance" as an example to explore how financial technology companies use AIoT technologies to promote financial efficiency and service. Including the development status and development direction of two aspects of intelligent marketing and intelligent monitoring. Secondly, through situation analysis and political, economic, social, and technical analysis, explore the beneficial changes and difficulties faced by fintech companies after combining AIoT technology.

### **13:55 A Property Management System Using Image Recognition by YOLO**

Taiki Miyamoto, Ryo Fukushima, Keiji Yoshimoto, Yuta Kodera, Takuya Kusaka, Yasuyuki Nogami and Kazuaki Harada (Okayama University, Japan)

Property management is one of important operation in companies. In this research, we propose a property management system using markers, YOLO (image recognition), and OCR. The performance of the system is evaluated on a PC without GPU by processing time.

### **14:10 Development and Evaluation of Innovative Service Design Based on RFID Tag in medicine's Safety Applications and Recycling**

Luoyu Lu (National Taipei University of Technology, Taiwan); Yilei Jin (National Chengchi University, Taiwan); Lai-Chung Lee (National Taipei University of Technology, Taiwan)

The aging population in Taiwan increases over the years. Medicine has become an indispensable item within the elderly and their family. However, they may not notice the use period and remember the placement of those medicines. Furthermore, improper handling of Pharmaceutical waste also caused pollution problems. Hence, our team designed a service based on the concept above, which contains an RFID reader combined with medicines ID, and a background cloud database system. The App provides several functions such as reminding the medicine expiration date, prevent ingestion, provide medicines'

location, remind them to take medicine regularly, and medicine recycling functions. Moreover, through the Kano model questionnaire, we understand customer satisfaction and needs.

## G5: Machine Learning, Deep Learning and AI in CE II

Room: 402-2

Chair: Shu Min Tsai (National Penghu University of Science and Technology, Taiwan)

### **13:10 A Hybrid Model of CNN-SVM for Speakers' Gender and Accent Recognition using English Keywords**

Yeshanew Wubet and Kuang-Yow Lian (National Taipei University of Technology, Taiwan)

Nowadays, the speakers' accent recognition, speech to text conversion, and their applications are becoming popular research areas all over the world. This paper proposes a hybrid model composed of Convolutional Neural Network (CNN) and Support Vector Machine (SVM) for gender, accent, and keyword classification. The result of the hybrid model is better than just using CNN or SVM. It is well known that the training of the hybrid model will be more complicated than the training of pure CNN or SVM. The CNN extracts features from a spectrogram image representation of speech and SVM is applied to extracted features as a classifier. The fusion model of CNN-SVM converges fast and reduces the overfitting problem unlike to CNN model alone. The result shows that the proposed system carried out multiple tasks at the same time and achieved high recognition accuracy.

### **13:25 Testing Machine Learning Models for Individual Emotion Estimation from Indoor Environment Data**

Isao Kurebayashi, Nobuyoshi Komuro and Keita Hirai (Chiba University, Japan)

This study investigates various machine learning models for estimating individual emotions based on collected indoor environment data for human participants. Our previous study developed an individual emotion prediction system using environmental data regarding human perception. Emotions were estimated from indoor environmental data by various machine learning methods. This study investigates which machine learning method is effective for estimating individual emotions. The experimental results show that our system achieves about 80% or more estimation correspondence by using multiple types of sensors. We also found that Random Forest and Gradient Boosting Decision Tree are suitable for our system in terms of both estimation accuracy and computational speed.

### **13:40 An Improved EEG-Based LRCN Emotion Recognition System Using Fuzzy Processing on ECG and PPG Features**

Meng-Ting Wan, Yi-Kai Chen and Wai-Chi Fang (National Yang Ming Chiao Tung University, Taiwan)

In this paper, we proposed an improved emotion classification system based on a LRCN model using EEG signals and reinforced with a fuzzification process on extracted ECG and PPG features. In the EEG-based emotion recognition system, we used the LRCN model to classify the subject emotion into 3 classes. Although a good average accuracy can be achieved at 75%, the accuracy for some specific subjects remained very poor, mostly caused by a low correlation between EEG signal and emotion in a particular subject, or by a low-quality EEG signal recording. The fuzzification process on extra physiological signals

was added for EEG-based LRCN to improve the total average accuracy by 8% and correct some low correlated EEG signals and emotions for certain subjects.

### **13:55 A Real-time Posture Recognition System using YOLACT++ and ResNet18**

Jia-Cheng Lin and Chen-Chiung Hsieh (Tatung University, Taiwan)

This paper presents a deep learning based real-time two-stage gesture recognition system. In the first stage, the system deploys the YOLACT++ model to detect the human body mask. Then four ResNet18 models are used separately to predict the correctness of push-up, the number of push-ups, correctness of sitting posture, and the flexibility of the standing forward bend. The accuracy rates of these four ResNet18 models reached 97.9%, 97.5%, 95.1%, and 95.4%, respectively, using the test dataset collected from ten individuals.

## G6: Security and Privacy of CE Hardware and Software Systems & Smartphone and Mobile Device Technologies

Room: 408-1

Chair: Yi-Chong Zeng (Institute for Information Industry, Taiwan)

### **13:10 A Proposal for Testing Physical Random Numbers Using Stochastic Process**

Ryoichi Sato (Okayama University & None, Japan); Yuta Kodera, Takuya Kusaka and Yasuyuki Nogami (Okayama University, Japan)

In this research, we propose a method for verifying a random sequence of a physical random numbers using a Markov process.

### **13:25 Block Scrambling Image Encryption Used in Combination with Data Augmentation for Privacy-Preserving DNNs**

Tatsuya Chuman and Hitoshi Kiya (Tokyo Metropolitan University, Japan)

In this paper, we propose a novel learnable image encryption method for privacy-preserving deep neural networks (DNNs). The proposed method is carried out on the basis of block scrambling used in combination with data augmentation techniques such as random cropping, horizontal flip and grid mask. The use of block scrambling enhances robustness against various attacks, and in contrast, the combination with data augmentation enables us to maintain a high classification accuracy even when using encrypted images. In an image classification experiment, the proposed method is demonstrated to be effective in privacy-preserving DNNs.

### **13:40 Generation of Gradient-Preserving Images allowing HOG Feature Extraction**

Masaki Kitayama and Hitoshi Kiya (Tokyo Metropolitan University, Japan)

In this paper, we propose a method for generating visually protected images, referred to as gradient-preserving images. The protected images allow us to directly extract Histogram-of-Oriented-Gradients (HOG) features for privacy-preserving machine learning. In an experiment, HOG features extracted from gradient-preserving images are applied to a face recognition algorithm to demonstrate the effectiveness of the proposed method.

### ***13:55 Secure Comparison Protocol for Promoting Business to Business Collaboration on the Blockchain***

Hiroaki Nasu, Yuta Kodera and Yasuyuki Nogami (Okayama University, Japan)

To promote Industry 4.0 and Society 5.0 and so on, it is important to connect and share data so that every member can trust it. Blockchain technology is currently attracting attention as the most advanced tool and has been used in the financial field and so on. In this paper, we focus on the industrial field, using homomorphic encryption and blockchain technique. Each company on the supply chain can exchange confidential information on encrypted data and utilize the data for their own business.

### ***14:10 Performance Evaluation of a Deep Learning Model for Time Series Prediction on Android Devices***

Rika Sato (Ochanomizu University, Japan); Saneyasu Yamaguchi (Kogakuin University, Japan); Takeshi Kamiyama (Nagasaki University, Japan); Masato Oguchi (Ochanomizu University, Japan)

In this paper, to verify the feasibility of an application implementation that predicts and controls traffic congestion on Android devices, we embed a deep learning model previously trained on the server side into a verification application using TensorFlow Lite and evaluate its performance by comparing it with the prediction accuracy and processing speed on the server.

### ***14:25 Optimization of the Stack Structure of Electronic Paper Display Modules by Using the Taguchi Method***

Ning Luo, Huei Chuan Lee and Ching-I Chen (Chung Hua University, Taiwan); Hong Xing Qiu (3DFAMILY Technology Co. LTD., Taiwan)

The Taguchi method was used to optimize the stack structure of electronic paper displays. The falling ball experiment was performed to analyze the effect of various combinations of cover lenses, optically clear adhesives, and substrates on the impact strength of the module surfaces. The results revealed that the stack structure considerably improved the surface impact resistance. The combination of a glass substrate electronic paper display and a plastic cover lens achieved the highest surface impact resistance.