

2019 IEEE International Conference on Consumer Electronics (ICCE 2019)

**Las Vegas, Nevada, USA
11 – 13 January 2019**



**IEEE Catalog Number: CFP19CCE-POD
ISBN: 978-1-5386-7911-1**

**Copyright © 2019 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP19CCE-POD
ISBN (Print-On-Demand):	978-1-5386-7911-1
ISBN (Online):	978-1-5386-7910-4
ISSN:	2158-3994

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

Friday, January 11

Friday, January 11 8:30 - 8:50

Breakfast

Room: N260-N258

Friday, January 11 8:50 - 9:15

Opening Remarks from CE Society President, Mayor Goodman, Gary Shapiro, CTA, Intro from General Chair

Room: N260-N258

Friday, January 11 9:20 - 10:20

Session 1.1: Security and Privacy for CE 1

Room: N256

Chair: Himanshu Thapliyal (University of Kentucky, USA)

9:20 Detection of Abnormal Iris Authentication.....1

Jaehoon Lee (Hanyang University, Korea); Sang Hwa Lee (Seoul National University, Korea); Jong-Il Park (Hanyang University, Korea)

This paper deals with detecting abnormal situations in iris authentication, such as cosmetic contact lenses, printed iris images, and fake eyeballs. The proposed algorithms exploit liveness of iris images and texture features to discriminate the fake iris inputs. In the proposed process, the liveness of iris images is first evaluated by inspecting the variation of eyelid curvature, blinking, and pupil gaze. The liveness test filters the most of fake eyeball and printed iris images. Then, the features of true iris images are examined to detect cosmetic contact lenses and fake iris images which have passed the liveness test. According to the experiments with commercial mobile devices, the proposed algorithms detect abnormal iris inputs with 95% accuracy. The proposed system prevents fake and inappropriate iris inputs, thus it makes iris authentication systems to be more reliable.

9:35 Robust Online Signature Verification Using Long-term Recurrent Convolutional Network.....3

Chan-Yong Park and Han-Gyu Kim (KAIST, Korea); Ho-Jin Choi (Korea Advanced Institute of Science and Technology (KAIST), Korea)

The explosively increasing use of personal computing devices that contain a touchscreen as input interface and the inconvenience of manually pressing password on the devices lead to studies on alternative biometric authentication methods. Among these, handwritten signature has an advantage that using signature as a means of authentication is already familiar to people, but it also has disadvantage that forger can easily attempt to imitate the signature of others. In this context, the purpose of this paper is to boost the forgery verification performance using the machine learning approach. This paper proposes an online signature verification using long-term recurrent convolutional network (LRCN) that ensures extracting distinguishable features between genuine and forged signature. In the proposed method, CNN and time interval embedding are used for feature extraction of signature strokes and LSTM is used for modeling long-term temporal characteristics of stroke sequences. Besides, a forgery-sensitive loss is proposed for robust signature verification against forged signatures. With the loss function, the proposed network provides a feature vector of signature to support vector machine-based classifier for distinguishing a genuine signature from forgeries. The signature verification experiments on the SUSIG dataset show that our proposed work outperforms other state-of-the-art methods on forgery verification performance.

9:50 An Efficient Two-Server Password-only User Authentication for Consumer Electronic Devices.....9

Odelu Vanga (Birla Institute of Technology & Science (BITS), Pilani, Hyderabad Campus, India)

We propose an efficient and secure two-server password-only remote user authentication protocol for consumer electronic devices, such as smartphones and laptops. Our protocol works on-top of any existing trust model, like Secure Sockets Layer protocol (SSL). The proposed protocol is secure against dictionary and impersonation attacks.

Session 1.2: CE for Smart City

Room: N254

Chair: Qijun Gu (Texas State University, USA)

9:20 A Consumer UAV-based Air Quality Monitoring System for Smart Cities.....11

Qijun Gu (Texas State University, USA); Chunrong Jia (University of Memphis, USA)

Growing concerns on air pollution in large cities urge the development of new smart cities technologies to monitor and improve air quality of the cities. Unmanned aerial vehicle (UAV) is getting attentions in air monitoring applications due to its high maneuverability in both horizontal and vertical dimensions to obtain high-spatial-resolution and near-surface vertical profiling of atmosphere pollution. Low cost micro-sensors add additional advantages to UAVs to offer numerous advantages for capturing the spatial and temporal variability of air pollutants. Despite all these exciting prospects, challenges need to be studied and addressed to exploit UAV technologies for air quality monitoring. This work designs and develops a consumer UAV-based air quality monitoring system with off-the-shelf consumer components. The design enables a UAV to carry multiple sensors to accomplish real-time monitoring of multiple air pollutants. Our prototype and experiments verify the feasibility of the system and show that it features a stable and high precision spatial-temporal platform for air sample collection.

9:35 User Test Report of Personal Mobility Vehicle, RT-Mover PType WA.....17

Shuro Nakajima (Wakayama University, Japan)

The demands for continued development in personal mobility vehicles are increasing due to the need to improve users' lives. We have developed RT-Mover-type PMVs, which has two drive modes, in accordance with the terrain encountered in daily activities: wheel mode and leg motion mode. The latest version of RT-Mover-type PMVs is the RT-Mover PType WA. In this paper, one set of results of user tests of P-WA in a real environment is described. The scenario discussed in this paper is climbing up and down a sidewalk on a slope. Through these tests, P-WA shows its potential for use in our daily lives.

9:50 Simulation and Prediction of Public Transportation with Maps of Local Density Blobs.....19

Dancho Panovski (Telecom SudPairs & Institut Mines Telecom, France); Veronica Scurtu (Telecom SudPairs, France); Titus Zaharia (Institut TELECOM, France)

Public transportation in urban areas is a subject that receives today considerable attention from both academic and industrial research. The main objective of the proposed approaches is to improve the public transportation system (and more specifically buses) by making it more accurate, reliable and convenient. We show that a global prediction approach, under some global macro-parameters (total number of vehicles, pedestrians...) is not feasible. This observation leads us to the introduction of finer granularity approach, where the traffic conditions are represented in terms of maps of local density blobs. Under this new paradigm, the experimental results obtained with both linear and SVR regressors show promising prediction performances.

10:05 Design Pruning of DSP Kernel for Multi Objective IP Core Architecture.....23

Anirban Sengupta (Indian Institute of Technology Indore, India)

Owing to significant market pressure the design and development time for the intellectual property (IP) core needs to be rapid with concurrent minimization in the cost of development. For most of the modular systems the optimization and accurate selection of the system architecture is one of the prime stages of the development process. But the process of accurate selection of the architecture by early planning and efficient design space exploration is very lengthy and expensive. Furthermore the evaluation of the design space through exhaustive search technique is strictly forbidden. Any mistake in the development process during architecture selection leads to devastating effects in system output and expenditure. Redesigning the system requires extensive hours of work for the designer and incurs high cost. In this paper we provide a novel design space exploration strategy for the design of systems based on hard real time processing and multi parametric optimization requirements. Furthermore we provide an approach which helps in rapid re-selection of the architecture when the system requires reconfiguration in architecture such as relaxation in timing constraint or changes in other objective parameters (such as hardware area).

Session 1.4: RF, Wireless, and Network Technologies 1

Room: N262

Chair: Yuki Koizumi (NHK(Japan Broadcasting Corporation), Japan)

9:20 Evaluation of Prototype Transmitter and Receiver with 64APSK Coded Modulation in Non-Linear Channel.....28

Yuki Koizumi (NHK(Japan Broadcasting Corporation), Japan); Yoichi Suzuki (NHK Science & Technology Research Laboratories, Japan); Masaaki Kojima (NHK(Japan Broadcasting Corporation), Japan); Hisashi Sujikai (NHK Science and Technical Research Laboratories, Japan)

We are researching on a set-partitioning 64APSK coded modulation as a scheme of expanding transmission capacity for satellite broadcasting. We prototyped a transmitter and receiver with our 64APSK coded modulation and evaluated its transmission performance through the "satellite simulator" that has a non-linear channel with 12GHz-band satellite transponder characteristics, and compared the performance of the prototype with that of computer simulation. The results indicated that the performance of the prototype in the non-linear channel was qualitatively equal to the computer simulation.

9:35 UWB NLOS Identification with Feature Combination Selection Based on Genetic Algorithm.....30

Zhuoqi Zeng (Bosch (China) Investment Ltd., P.R. China); Steven Liu (University of Kaiserslautern, Germany); Lei Wang (Tongji University, Shanghai, P.R. China)

Non-line-of-sight (NLOS) identification is very important for accurate localization based on ultra-wide band (UWB) system. One of the most widely used approach for NLOS detection is based on machine learning algorithms with features extracted from the channel impulse response (CIR). Features, such as kurtosis, mean excess delay, root mean delay, energy and rise time are discussed in a lot of papers. Other features, like signal to noise ratio, form factor and crest factor etc. are barely discussed but they are also very useful parameters for NLOS detection. In this paper 18 useful features are discussed in total. The support vector machine (SVM) is used for the identification of the NLOS condition. Since the identification accuracy does not always improve with an increase in the number of used features, in this paper the best feature combination is selected based on genetic algorithm. By reducing the used features,

not only the accuracy improves, but also the computation complexity is reduced. The experimental results show that, the RMS delay, maximal amplitude, received signal energy, distance between MS and BS, peak to start of the received pulses time delay are the optimal combination leading to best accuracy.

9:50 Improvement of 4K/8K Multi-Channel IP Multicast Using DOCSIS over In-Building Coaxial Cable Network.....35

Tomoya Kusunoki (NHK, Japan)

In Japan, 4K/8K satellite broadcasting is scheduled to start in December 2018 and ultra high definition video service is expected to be spreading rapidly. In the future, 4K/8K multi-channel broadcasting by cable television operators is also expected. The challenge in introducing this service is that the transmission method in older apartment buildings is not FTTH. Therefore, we investigated 4K/8K multi-channel IP multicast distribution using DOCSIS, which utilizes in-building coaxial cable networks. We have proposed a transmission method which can distribute with a smaller number of QAM signals than conventional methods.

10:05 Impulsive Noise Mitigation Scheme by Selective Remapping of Signal Points.....40

Keisuke Ogura, Akira Nakamura and Makoto Itami (Tokyo University of Science, Japan)

In the OFDM modulation, one of the problems is the impulsive noise that is added in the channel. All sub-carriers of OFDM symbols are influenced by the impulsive noise. Therefore, it is necessary to remove the impulsive noise. Conventional schemes cannot improve the reception characteristics under the case that high order modulation is used. In this paper, the proposed scheme using selective remapping of signal points is proposed. As the result of computer simulations, the proposed scheme can improve the reception characteristics in higher order modulation.

Session 1.5: Entertainment, Gaming, and Virtual and Augmented Reality 1

Room: N253

Chair: Fabrizio Lamberti (Politecnico di Torino, Italy)

9:20 Design and Implementation on Real-time Monitoring Equipment for 8K UHD Services.....42

Minjae Seo, Min-Ju Cho, Yejin Sohn and Jong Ho Paik (Seoul Women's University, Korea)

In this paper, we propose a design method of monitoring equipment that verifies 8K UHD video service provided in various forms to enable stable transmission and reception. It is implemented to be able to receive 8K video of split type transmitted by heterogeneous network normally.

9:35 Designing Interactive Robotic Games based on Mixed Reality Technology.....44

Fabrizio Lamberti, Alberto Cannavò and Paolo Pirone (Politecnico di Torino, Italy)

This paper focuses on an emerging research area represented by robotic gaming and aims to explore the design space of interactive games that combine commercial-off-the-shelf robots and mixed reality. To this purpose, a software platform is developed which allows players to interact with both physical elements and virtual content projected on the ground. A game is then created to show designers how to maximize opportunities offered by such a technology and to build playful experiences.

9:50 The design and Implementation of a VR gun controller with haptic feedback.....48

Sasan Haghani (University of the District of Columbia, USA); Ali Rahimi, Hammad Ajmal and Het Patel (Rutgers University, USA)

Virtual reality is often interpreted as an experience where the user is immersed in a responsive virtual world. Gaming in a virtual world often utilizes peripherals in order to enhance user immersion. This paper provides the design and implementation of a VR gun controller with haptic feedback for the HTC Vibe. Compared to current gun controllers with recoil systems that cost between \$260 to \$1000, the proposed design costs \$150 while providing an immersive experience to the users.

Session 1.6: Security and Privacy for CE 3

Room: N264

Chair: Saraju P Mohanty (University of North Texas, USA)

9:20 Privacy-Preserving Data Collection Scheme on Smartwatch Platform.....50

Jong Wook Kim, Jong Hyun Lim, Su Mee Moon, Beakcheol Jang and Hoon Yoo (Sangmyung University, Korea)

In recent years, smartwatches, which are the most representative wearable device exploiting Internet of things technologies, have been developed and used. With growing use of smartwatches in the healthcare field, there have been considerable efforts to use diverse smartwatch sensor data such as heart rates and body temperatures with the aim of improving healthcare services. However, because the data collected from smartwatches usually contain sensitive user information, individual users are reluctant to provide their data to healthcare service providers because of privacy concerns. Thus, to support such healthcare service provider needs, a method capable of collecting individuals' sensitive data from smartwatches, while preserving privacy, is presented. Preliminary experimental results demonstrate that the proposed approach is well suited to the collection of smartwatch users' sensitive data for the purpose of inferring population statistics while preserving privacy.

9:35 Privacy & Usability of IPTV Recommender Systems.....54

Tolga Arul and Nikolaos Athanasios Anagnostopoulos (TU Darmstadt, Germany); Stefan Katzenbeisser (Technische Universität Darmstadt, Germany)

IPTV is capable of providing recommendations for upcoming TV programs based on consumer feedback. With the increasing popularity and performance of recommender systems, risks of user privacy breach emerge. Although several works about privacy-preserving designs of recommender systems exist in the literature, a detailed analysis of the current state-of-the-art regarding privacy as well as an investigation of the usability aspects of such systems, so far, have not received consideration. In this paper, we survey current approaches for recommender systems by studying their privacy and usability properties in the context of IPTV.

9:50 Anomaly Detection for Smart Home Based on User Behavior.....56

[Masaaki Yamauchi](#), Yuichi Ohsita and Masayuki Murata (Osaka University, Japan); Kensuke Ueda and Yoshiaki Kato (Mitsubishi Electric Corporation, Japan)

Many devices, such as air conditioners and refrigerators, are now being connected to the Internet and, as a consequence, have become targets of cyberattacks. Especially, the operations by attackers can cause serious problems, which may harm users. However, such attacks are difficult to detect because they use the same protocol as legitimate operations by users. In this paper, we propose a method to detect such attacks based on user behavior. We model user behavior as a sequence of events, which includes the operation of IoT devices and other behavior monitored by any sensors. Our method learns sequences of events for each one of a predefined set of conditions and detects attacks by comparing the sequences of the events including the current operation with the learned sequences. We evaluate our method by using data collected by monitoring the behavior of four users. Based on the results of this evaluation, we demonstrate the accuracy of our method and discuss the limitations of our method.

10:05 Biometric Template Protection Through Adversarial Learning.....62

Santosh Kumar Jami (TCS Innovation Labs, TATA Consultancy Services Limited, India); [Srinivasa Rao Chalamala](#) (TATA Consultancy Services Ltd & IIT Hyderabad, India); Arun Kumar Jindal (TATA Consultancy Services, India)

An ideal biometric template security method must secure the templates without compromising on matching performance. Many biometric template protection methods have been reported in recent years, but most of them have a trade-off between matching performance and template security. Some of these approaches also require re-enrollment in case the biometric templates are compromised. In this work, we propose a method for face template protection which improves the matching performance while providing high template security and also addresses the re-enrollment problem. Our approach relies on computing identity or class-specific perturbations to the input facial feature vectors as a function of gradients of mapping network as in targeted adversarial learning. Further, a cryptographic one-way hash function is applied on the target-specific class labels and the hashes are stored as templates in a database during enrollment. During verification, given an input face image of a user, the extracted facial features from Convolutional Neural Network(CNN) along with the pre-computed perturbations are used to predict the template and matched against the corresponding template of the user stored during enrollment. If any of the templates is compromised, it is revoked and a new set of perturbations for the corresponding user is computed with respect to the new target-specific class label assigned to the user. The efficacy of the approach is evaluated on three face datasets, namely, CMU-PIE, FEI, and Color-FERET. The proposed method achieves ~98% Genuine Accept Rate (GAR) at zero False Accept Rate (FAR). This approach outperforms the state of the art by ~7% in terms of matching performance, while solving the re-enrollment problem without compromising on the template security largely due to the way the perturbations are computed.

Friday, January 11 10:25 - 15:55

Committee Meetings

Room: N253

Committee Meetings

Room: N254

Committee Meetings

Room: N256

Committee Meetings

Room: N262

Committee Meetings

Room: N264

Friday, January 11 10:25 - 11:25

Expert Panel 1: Cyber-security

Room: N260-N258

Chair: Himanshu Thapliyal (University of Kentucky, USA)

Friday, January 11 11:25 - 12:25

Keynote 1: Jim Slevinsky, Director of Technology Innovation at TELUS

Room: N260-N258

Friday, January 11 12:25 - 12:40

IEEE Fellow Elevation Ceremony presented by CE Society President

Room: N260-N258

Friday, January 11 12:40 - 13:40

Keynote 2: Joe Cavallaro, IEEE Fellow, Professor, Rice University, Houston, USA; Lunch

Room: N260-N258

Friday, January 11 13:40 - 15:10

IEEE Future Directions

The New World of Mixed Reality, Robotics and Autonomous Systems

Tom Coughlin (Coughlin Associates, IEEE USA), Lee Stogner (Battery Initiative), Jesse Lowe (IEEE Brain Initiative), Yu Yuan (Senses Global Labs & Ventures), Soumya-Kanti Datta (Eurecom)

Room: N260-N258

Chairs: Thomas Coughlin (Coughlin Associates, USA), Kathy Grise (IEEE, USA)

The IEEE Future Directions Committee explores the technologies that will define the future of technology and human civilization. This session will explore what is being done in the various IEEE FDC initiatives, including 5G, Block Chain, VR/AR/ML, Symbiotic Autonomous Systems and direct brain to electronics interfaces. It includes experts on these initiatives from the IEEE Consumer Electronics Future Directions Committee.

Friday, January 11 15:15 - 15:50

Poster Session 1

Room: Hall Area

Chair: Konstantin Glasman (St. Petersburg State University of Film and Television, Russia)

Two-Stage YOLOv2 for Accurate License-Plate Detection in Complex Scenes.....68

Shohei Yonetsu, Yutaro Iwamoto and Yen-Wei Chen (Ritsumeikan University, Japan)

License-plate detection is an important preprocessing step in the vehicle license-plate recognition system, which is one of the key components of intelligent transport systems (ITSs). Two-stage YOLOv2 can detect license-plates even in complex scenes including nighttime scenes, blurry images, various sizes of cars, and various other objects. The first stage detects cars and then the second stage detects the license-plate in the detected car region. Our experimental results have demonstrated that our proposed method improves the detection accuracy over the original YOLOv2.

Security Applications and Challenges in Blockchain.....72

Austin Draper, Aryan Familrouhani and Devin Cao (California State University, Fullerton, USA); Tevisophea Heng (California State University, Fullerton); Wenlin Han (California State University, Fullerton, USA)

Blockchain technology is a highly popular yet highly misunderstood concept that is used today and in future applications. To enhance security and privacy, many applications adopt Blockchain. However, there are intrinsic drawbacks and emerging challenges. In this paper, we study popular security applications in Blockchain, present their major problems, as well as other challenges in Blockchain which allows future research to be conducted more efficiently.

Brain's Stress Observation System Using 2-Channels NIRS Based on Classroom Activity.....76

Kant Sunthad, Yoshihiro Niitsu, Masahiro Inoue and Taketoshi Yokemura (Shibaura Institute of Technology, Japan)

In classroom, teachers have a role to impart education and encourage learning to their students. More teachers are using various activities to make students keep focus on class but in the real situation teachers are facing a difficulty to make all student keep attention, because each student's mental activity and

personal problem are different [1]. To improve classroom management, we proposed a method to make teachers are able to keep monitoring and analyzing student's brain stress level by using 2-channels near-infrared spectroscopy (NIRS) sensor. This paper focuses on a method for observing brain behavior under stress based on classroom activity.

Internet of Things for Greenhouse Monitoring System Using Deep Learning and Bot Notification Services.....80

Nuttakarn Kitpo (Shibaura Institute of Technology, Japan); Yosuke Kugai (Shibaura Institute of Technology, Malaysia); Masahiro Inoue and Taketoshi Yokemura (Shibaura Institute of Technology, Japan); Shinichi Satomura (Valley Campus Japan, Japan)

Internet of things (IoT) plays a big important role in agriculture industry recently in order to provide a support to farmers such as growth monitoring system of temperature, humidity and water supply, and also early disease monitoring and detection system. To provide a smart farming solutions, this paper proposed an IoT system with a bot notification on tomato growing stages. The tomato dataset was obtained from Shinchi Agri-Green, the tomato greenhouse in Fukushima, Japan. We trained and tested the deep learning model to detect the fruit proposal region. Then, the detected regions were classified into 6 stages of fruit growth using the visible wavelength as a feature in SVM classification with the weight accuracy of 91.5%.

A Distributed MQTT Broker System for Location-based IoT Applications.....84

Ryo Kawaguchi and Masaki Bandai (Sophia University, Japan)

In this paper, we propose a distributed broker system for large-scale location-based IoT services. The proposed method introduces a topic structure suitable for handling location-dependent data. In addition, distributed brokers and gateways are introduced to reduce broker's load and to support heterogeneous brokers in a system. From the prototype implementation and theoretical evaluation, we show the effectiveness of the proposed system.

A Cluster Management Method for Heterogeneous Vehicular Networks.....88

Toshihide Inake and Masaki Bandai (Sophia University, Japan)

In this paper, we propose a cluster management method to shorten the data latency for heterogeneous vehicular networks (VANETs). The proposed method introduces secondary cluster head (CH) in addition to primary CH to shorten the hand-over time of CHs. When a primary CH moves out from a cluster, the secondary CH starts to work as CH seamlessly. Via computer simulations, we confirm that the proposed method is effective to shorten the data latency in cluster-based heterogeneous VANETs.

MaHG-RGBD: A Multi-angle View Hand Gesture RGB-D Dataset for Deep Learning Based Gesture Recognition and Baseline Evaluations.....90

Jiaqing Liu, Kotaro Furusawa and Tsujinaga Seiju (Ritsumeikan University, Japan); Tomoko Tateyama (Hiroshima Institute of Technology, Japan); Yutaro Iwamoto and Yen-Wei Chen (Ritsumeikan University, Japan)

Here, we present a new dataset, named MaHG-RGBD, including 25 hand gestures performed by 15 participants as viewed from multiple angles. This dataset is intended to train models for deep-learning-based hand-gesture recognition. Unlike existing datasets, MaHG-RGBD includes not only front views (tilt angle = 0) but also the tilted views (tilt angle = 45 degrees), which are often needed when there are space constraints. In addition, the dataset includes pairs of synchronized color and depth images of the hand region that are well segmented. Users can utilize just one of the image modalities or both depending on the application. This dataset includes a wide variety of different gestures classes: a total of 25 hand gestures. We evaluate the recognition accuracy of 25 different hand gestures using deep learning as a benchmark with this dataset. The MaHG-RGBD dataset is available at <http://www.iipl.is.ritsumei.ac.jp/MaHG-RGBD>

Design of Chaotic Block Cipher Operation Mode for Intelligent Transportation Systems.....94

Graham Thoms and Radu Muresan (University of Guelph, Canada); Arafat Al-Dweik (Khalifa University, United Arab Emirates)

A chaotic two dimensional block cipher operation mode used for encrypting images in intelligent transportation systems.

Aggregating CNN and HOG Features for Real-Time Distracted Driver Detection.....98

Md Rifat Arefin, Farkhod Makhmudkhujaev, Oksam Chae and Jaemyun Kim (Kyung Hee University, Korea)

Detecting distracted behaviors of drivers, and warning them in real-time can reduce the number of road accidents. Recently, Convolutional Neural Network (CNN) has been successfully applied for this task, however, a huge number of learn-able parameters makes it problematic for real-time systems. To alleviate this issue, we propose a robust method that consists of a modification of AlexNet architecture with the aggregation of HOG features. The number of parameters in our model compared to AlexNet reduces from 62.3M to 9.7M, where evaluation on publicly available dataset shows our model's comparative accuracy of 93.19% against 93.65% of the original AlexNet.

Handover Optimization and User Mobility Prediction in LTE Femtocells Network.....101

Mahmoud Mandour and Fayez Gebali (University of Victoria, Canada); Ashraf Elbayoumy (Military Technical College, Egypt); Gamal Abdel Hamid (Military Technical Collage, Egypt); Amr Abdelaziz (The Ohio State University & Military Technical College, USA)

Mobility prediction in cellular networks helps in reducing the number of unnecessary handovers (HO). The reduction of unnecessary handovers challenges is getting more considerable in case of a large number of femtocells in used. Femtocells achieve higher data rate and extend the coverage area in cellular networks. Deploying a huge number of femtocells results in more frequent initiation of an HO procedure. In this paper, a novel algorithm based on the Reference Signal Received Power (RSRP), Reference Signal Received Quality (RSRQ) and some User Equipment (UE) parameters like moving direction and the position inside the femtocell used as decision criteria. The goal of the proposed algorithm is to nominate the most proper target femtocell among many candidates and to eliminate the redundant HO in femtocell based cellular networks. Toward this goal, the results show the proposed algorithm will increase/decrease the HO success/failure probability, respectively.

Evaluation of Indoor Positioning System Based on Attachable Infrared Beacons in Metal Shelf Environment.....107

Taiga Arai, Takahiro Yoshizawa, Takuya Aoki, Keiichi Zempo and Yukihiko Okada (University of Tsukuba, Japan)

In this paper, we developed the indoor positioning system with infrared (IR) beacon, and we evaluated the utility of the proposed system through dynamic measurement experiment and static measurement experiment with multiple IR beacons. In these experiments, we verified positioning capability of the IR system and the Bluetooth Low Energy (BLE) system in the metal shelves environment imitating retail stores. As a result, estimated position of the IR system is more accurate than the BLE system in dynamic measurement. The average positioning error was 147 mm with multiple IR beacons, and estimated movement of pedestrian corresponds actual movement.

The Strengthening of Hash Function Implementation Through Collision Reduction via Dependent Set Hashing.....111

Mason Molesky (The George Washington University, USA)

The use of hash functions is imperative to the security of data today. Hash functions are primarily used for data integrity validation and essential for security. This paper proposes a methodology to increase the difficulty of discovering a collision through the restriction of possible inputs using dependent sets in the implementation of a hash function. This method is time and space efficient making it ideal for devices with limited resources, such as IoT devices, allowing the device to utilize weaker and less resource intense algorithms without compromising on security.

A Botnet Detection Method on SDN Using Deep Learning.....115

Shogo Maeda and Atsushi Kanai (Hosei University, Japan); Shigeaki Tanimoto (Chiba Institute of Technology, Japan);

Takashi Hatashima (NTT, Japan); Kazuhiko Ohkubo (NTT Secure Platform Laboratories, Japan)

we analyze the traffic data of malware collected from an existing network and classify benign connections and malicious traffic by using deep learning. This makes it possible to combat unknown malware that cannot be dealt with using rule-based anti-virus software. By manipulating the network through programming, we can flexibly deal with malware. We propose running deep learning on software defined network to prevent host detection after infection and secondary damage detection of an infected host. In our method, we implement a connection block to the external network and perform network isolation to prevent internal infection.

Random Sampling and Inductive Ability Evaluation of Word Embedding in Medical Literature.....121

Huaze Xie, Mohd Anuaruddin Bin Ahmadon and Shingo Yamaguchi (Yamaguchi University, Japan); Ichiro Toyoshima (Toshiba Energy Systems & Solutions Corp., Japan)

In the NLP applied to medical literature semantic analysis, we propose a method with random sampling and inductive ability evaluation to improve the efficiency of the previous algorithm models.

Study on Mistype Classification in Japanese Input Using Machine Learning.....126

Ryuki Komatsu and Yoshihisa Nakatoh (Kyushu Institute of Technology, Japan)

In this paper, we examine classification of mistypes for Japanese input using machine learning. First, we classified the category of mistypes in Japanese input into six types. Experimental results showed that there was a common trend such as many replacement errors in all subjects, and characteristic mistypes were found for each subject. Next, we made the neural network (RNN · LSTM) to learn the mistype data of all subjects and classified. As a result, the correct answer rate of RNN was 10%, and the correct answer rate of LSTM was 88%. We are planning to use LSTM for correcting mistype in the future.

Proof-of-Authentication for Scalable Blockchain in Resource-Constrained Distributed Systems.....128

Deepak Puthal (University of Technology Sydney, Australia); Saraju P. Mohanty (University of North Texas, USA); Priyadarsi Nanda (University of Technology Sydney, Australia); Elias Kougianos (University of North Texas, USA); Gautam Das (University of Texas Arlington, USA)

Modern world adopts technologies widely to make automatic decision making. These applications range from smart health to smart cities, where resource constraint distributed systems become backbone for data sensing and processing. Resource constraint distributed systems such as Internet of Thing (IoT), edge computing and fog computing etc. deployed for real-time monitoring and evaluations. There are wide variety of applications dealt with highly sensitive information processing and decision making, where securing the data and system is a key requirement. Current security solution has a biggest drawback with centralized controlling entity. Where, single point failure can lead to compromise of whole system. Blockchain efforts to make the security architecture decentralized with the implementation of proof-of-work. Proof-of-Work is an expensive process for IoT and edge computing environment due to the deployment of resource constraint devices. Proof-of-Authentication is proposed to replace Proof-of-Work and introduce authentication in such environment to make blockchain application specific. This paper implemented the Proof-of-Authentication to evaluate the sustainability and bring into reality for IoT and edge computing. The evaluation process is conducted in both simulation and real-time testbed to present the evaluated performance. Finally, we have discussed the process Proof-of-Authentication and its integration with blockchain in resource constraint distributed systems.

Securing Face Templates Using Deep Convolutional Neural Network and Random Projection.....133

Arun Kumar Jindal (TATA Consultancy Services, India); Srinivasa Rao Chalamala (TATA Consultancy Services Ltd & IIIT Hyderabad, India); Santosh Kumar Jami (TCS Innovation Labs, TATA Consultancy Services Limited, India)

Rapidly growing use of biometrics across enterprises, consumer electronics, and applications has made biometric template protection indispensable to any practical biometric system. To provide biometric template protection, several methods have been reported but most of them have a trade-off between matching performance and the template security. To address this problem, we improvise upon existing methods to provide a method for face template protection with improved matching performance and high template security. The proposed method uses deep Convolutional Neural Network (CNN) together with random projection to maximize the inter-user variations, reduce the dimensionality (thus eliminating redundancy) of the extracted feature vector of each face image and minimize the intra-user variations. The proposed method is robust enough to perform even with one-shot enrollment of users. Three publicly available face datasets, namely, CMU-PIE, FEI and Color-FERET are used for evaluation. The proposed method achieves ~99.5% Genuine Accept Rate (GAR) at zero False Accept Rate (FAR), improving the matching performance by ~10% over the comparable state-of-the-art methods, while

Friday, January 11 15:55 - 16:55

Session 1.3: Vehicular Security, Trust and Privacy

Room: N256

Chair: Himanshu Thapliyal (University of Kentucky, USA)

15:55 Anomaly Detection of Cyber Physical Network Data Using 2D Images.....139

Michael R. Moore and Jason M Vann (Oak Ridge National Laboratory, USA)

Vehicles are increasingly cyber-physical systems which depend on upwards of 100 or more networked control units. Consequently, vehicles - especially those produced after about 2010 - face challenges to ensure autonomy, security, and safety. The vehicles' electronic control units (ECUs) control most of the safety-critical systems. Protecting these networks is especially challenging because there is no publicly available translation of in-vehicle network data to vehicle functions. Thus, an intrusion detection system (IDS) based on mapping the controller area network (CAN) data to 2D images has been developed. While somewhat similar to other recent works that map network features to images, this novel approach utilizes the underlying physical model to automatically group features in a method that makes convolutional neural network (CNN) analysis more feasible. It addresses the most challenging attack in which a compromised ECU sends out incorrect values but sends them within the correct time window. This novel method is shown to detect these kinds of rogue ECU cyber-attacks with greater than a 90% accuracy using very limited training data

16:10 Vehicle Charging Infrastructure Security.....144

Thomas E. Carroll and Richard Pratt (Pacific Northwest National Laboratory, USA)

The electric vehicle charging infrastructure supports Plug-in Electric Vehicle (PEV) refueling through vehicle charging equipment (EVSE). Communication and control methods are being developed and tested to respond to growing PEV electrical load and enable this new grid load to expand renewable resource integration and grid services, without additional electrical distribution system capacity and investment. The new communication and control method increases the potential for cyberattacks or malware to pass through the electric vehicle charging infrastructure. The infrastructure---comprising EVs, EVSEs, building automation and energy management systems, and electric power grid---can be adversely impacted, negatively affecting safety, reliability and efficacy objectives. In this work, we describe principles of Vehicle Charging Infrastructure Security (VCIS) that addresses critical gaps in the present security paradigm, while retaining privacy and autonomy of stakeholders. The VCIS principles we enumerate are: isolate network communications, implement advanced, continuous monitoring by "trusted" entities, verify compatibility of physical measurements and cyber state, and incorporate processes to respond and recover to cyberattacks commensurate with the threat. We further foresee that information sharing and coordination between car manufacturers, EVSE vendors, facilities, and electric utilities is essential for VCIS success.

16:25 Towards Protection Mechanisms for Secure and Efficient CAN Operation.....149

Todd R Andel (University of South Alabama, USA); Jeffrey Todd McDonald (University of South Alabama & School of Computing, USA); Adam Brown, Tyler Trigg and Paul Carsten (University of South Alabama, USA)

Cyber attacks against automobiles have increased over the last decade due to the expansion in attack surfaces. This is the result of modern automobiles having connections such as Bluetooth, WiFi, and other broadband services. While there has been numerous proposed solutions in the literature, none have been widely adopted as maintaining real-time message deliverability in the Controller Area Networks (CAN) outweighs proposed security solutions. Through iterative research, we have developed a solution which mitigates an attacker's impact on the CAN bus by using CAN's inherent features of arbitration, error detection and signaling, and fault confinement mechanism. The solution relies on an access controller and message priority thresholds added to the CAN data-link layer. The results provide no time delay for non-malicious traffic and mitigates bus impact of a subverted node attempting to fabricate messages at an unauthorized priority level.

16:40 Safety, Security, and Reliability: The Automotive Robustness Problem and an Architectural Solution.....155

Sandip Ray (University of Florida, USA)

As we move towards increasingly autonomous vehicles, it is getting increasingly crucial to ensure that they behave safely, securely, and reliably. Automotive robustness refers to the study of synergies and trade-offs between these requirements. We discuss challenges and practice in two critical components of automotive robustness, functional safety and security. We also discuss the potential application of a flexible architecture for systematically implementing these requirements.

Session 1.7: Entertainment, Gaming, and Virtual and Augmented Reality2

Room: N254

Chair: Fabrizio Lamberti (Politecnico di Torino, Italy)

15:55 Environment Detection of 3D LiDAR by Using Neural Networks.....159

Yu-Cheng Fan and Po-Tai Wu (National Taipei University of Technology, Taiwan); Chun-Ju Huang and Yun-Hao Bai (NTUT, Taiwan)

Autonomous vehicles and robot are more and more popular, and it is important to sense the environment for autonomous vehicles and robot. LiDAR is a very powerful device, it can capture the distance and contour of object precisely and quickly. And the scanning range is very wide. we use 3D LiDAR and

neural network to detect the environment. We get the data packet from LiDAR, and decode the data packet to 3D point cloud coordinate. Then extract the drivable road by neural network and mark the obstacle.

16:10 Three-bit fast error corrector for BCH codes on GPUs.....161

Arul Subbiah (Santa Clara University & Broadcom Ltd, USA); Tokunbo Ogunfunmi (Santa Clara University, USA)

Recent developments with General Purpose Graphical Processing units (GPGPU) within gaming and mobile platform has attracted researchers to contribute efficient methods to correct errors for Bose-Chaudhuri-Hocquenghem (BCH) codes. Three-bit error correction is widely used in Single Level Cell (SLC) flash memory arrays, and Optical Transport Networks (OTN). In this paper, we propose an optimized method for correcting three-bit errors in such system. Precisely, we optimize the kernel routine for key-equation solver to have better performance. We have devised an engine, on a GPGPU, that decodes code size of $(n=1023, k=963, t=3)$ and compare it against the conventional inversion-less Berlekamp-Massey algorithm (iBMA). Then, we extend the same scheme to different code sizes, and the results have shown that there is a 20% increase in performance by reducing the latency incurred by the key equation solver routine.

16:25 Prototyping interactive Multimodal VR Epidural Administration.....165

Tatiana Ortegon, David Acosta, Sebastian Salgado, Wilhelm Mino, Oscar Caldas and Ricardo Rojas (Universidad Militar Nueva Granada, Colombia); Juan Abril (Universidad Militar Nueva Granada, Canada); Oswaldo Rivera (Universidad Militar Nueva Granada, Colombia); Joss Moo-Young, Danny Luk, Connor Smiley, Jacky Yang and Tom Tsiliopoulos (University of Ontario Institute of Technology, Canada); Alvaro Uribe Quevedo (University of Ontario Institute of Technology & Universidad Militar Nueva Granada, Canada); Bill Kapralos (University of Ontario Institute of Technology, Canada); Byron Perez-Gutierrez (Universidad Militar Nueva Granada, Colombia); Fahad Alam (Sunnybrooke Health Sciences Centre, Canada) Developing multimodal virtual reality simulations, serious games, or interactive media, requires interdisciplinary teams accounting for the technological, instructional, and content expert roles. In medical simulation, virtual reality presents engaging opportunities for developing complementary learning tools. In this paper, we present the design and prototyping of three prototype virtual reality tools employing immersive headsets with low and medium-grade haptic devices developed for epidural insertion training within the scope of a Colombia-Canada joint graduate course on virtual and augmented reality.

16:40 Indoor Localization with Smartphones: Magnetometer Calibration.....168

Alwin Poulouse, Dong Seog Han and Jihun Kim (Kyungpook National University, Korea)

Position can be effectively determined through the use of accelerometer, magnetometer and gyroscope sensors available in an inertial measurement unit (IMU). However, the data from the magnetometer plays a major role in estimating the position. The magnetometer is easily affected by external magnetic field during the experiment time. Hard and soft iron effects affect the magnetometer readings. It is necessary to compensate the magnetometer data before estimating the position. This paper proposes a magnetometer calibration algorithm for position estimation. The proposed calibration method has several advantages in terms of elimination of hard and soft iron effects from the magnetometer. The experimental results demonstrate the performance of the proposed calibration algorithm and it gives high position accuracy.

Session 1.8: Audio, Video and Cameras 1

Room: N264

Chair: Miguel Chavarrias (Universidad Politecnica de Madrid, Spain)

15:55 PlayNPort: A Portable Wireless Music Player and Text Reader System.....171

Lakhan Shiva Kamireddy and Dharmik Thakkar (University of Colorado Boulder, USA); Lakhan Saiteja Kamireddy (Indian Institute of Technology Kharagpur, India)

Portable Consumer Electronics has made a mark in the industry. With the ease of use at an accessible price range, they have experienced significant growth in the market. Our idea is to develop a portable wireless music player and text reader using a Cortex-M series microcontroller and bare-metal programming techniques. We chose to use an SD card as the storage device. The resulting electronic device is similar to a consumer-grade music player available in a car. We also present challenges involved in developing the system and solutions we used to overcome them.

16:10 Time Domain Reflectometer Measurements on MIPI D-PHY Protocol for Signal Integrity Analysis.....176

Aldo Morales (Penn State Harrisburg, USA); Sedig S Agili (Penn State University, USA); Bogdan Iepure and Patrick McKeone (Bosch LLC, USA)

As data rates continue to rise, data protocols allow engineers the bandwidth and speed necessary to utilize an ever increasing video resolution and quality. The Mobile Industry Processor Interface (MIPI) D-PHY CSI-2 protocol is one such solution. The MIPI standards utilizes High Speed (HS) and Low Power modes. These modes occupy the same data lines, making oscilloscope measurements difficult to obtain because the modes are constantly switching. In addition, the amount of data sent, during HS mode, changes with each packet. Real time oscilloscopes can recognize the HS mode data and wait for single triggered measurements to create a real time eye diagram. This process is time consuming and if the PCB is not designed for signal integrity testing, the measurements involve holding a differential probe steady on the DUT, introducing human error. In this paper, we propose to use Time Domain Reflection (TDR) measurements which can be easily made on any board as they do not require capturing live data. Using differential probes, TDR measurements also capture waveforms for each data lane and obtain an eye diagram. Results show a good correlation between real time scope and TDR eye diagrams. Also, TDR software allows S-parameters to be obtained.

16:25 On the Implementation of HEVC Decoders with High Parallelization Degree with OpenMP.....182

Daniel García and Sergio Atienza (Universidad Politécnica de Madrid, Spain); Miguel Chavarrias (Universidad Politecnica de

Madrid, Spain); Fernando Pescador (Universidad Politécnic de Madrid, Spain)

HEVC is nowadays the de facto video coding standard. In this work, the OpenHEVC open source software has been modified in order to enlarge its interoperability by using OpenMP instead of POSIX threads. This work presents a new proposal on how to handle the parallelization during the decoding process. This solution outperforms the POSIX-based one by at least a 10%, while a higher interoperability degree is provided.

16:40 Image Fusion Method Using Noise-Robust Contrast Discrimination Measure.....184

Ryuichi Akashi, Takashi Shibata, Masato Toda and Keiichi Chono (NEC Corporation, Japan)

This paper proposes an image fusion method using a noise-robust contrast discrimination measure for night vision applications with short-wave infrared (SWIR) and long-wave infrared (LWIR) cameras. At night, SWIR images typically contain heavy noise while LWIR images contain less noise. The conventional method, which adapts the fusion ratio on the basis of only local contrasts, does not work appropriately for such SWIR and LWIR images since local contrasts of noisy SWIR images are unreliable due to the heavy noise. The proposed method adapts the fusion ratio on the basis of local contrast and noise variance. The experimental results show that the proposed method can generate visually pleasant fused images even when the SWIR images are severely degraded by noise.

Session 1.9: Audio, Video and Cameras 2

Room: N262

Chair: Pei-Jun Lee (National Chi Nan University, Taiwan)

15:55 All Colors Motion Estimation for the Frame Sequential Video with Pastel Color.....186

Yoshikazu Honma and Kenji Sugiyama (Seikei University, Japan)

We have proposed the frame sequential system with pastel color. To address the conversion to RGB, motion estimation should be used, some problem of motion vector still remains. To correct motion vectors, the process of motion estimation should be enhanced. In this paper, all colors motion estimation is added as new motion estimation after the previous motion estimation. We use these processes as two stages motion estimation. Two stages motion estimation is compare to the previous only. From experimental results, the all colors motion estimation gives higher PSNR.

16:10 Improve the HEVC Algorithm Complexity Based on the Visual Perception.....190

Trong-An Bui and Pei-Jun Lee (National Chi Nan University, Taiwan)

The visual perception, we want to mention here is the three visual methods in image processing. It is Just Noticeable Difference (JND), Luminance Histogram Bin Variation and Edge Detection. Based on these three methods, we reduce CU (coding unit) splitting coding time. In addition, we use the previous edge detection data to reduce the candidate of PU mode. HEVC (high efficiency video coding), as the latest video coding standard, can achieve up to 50%-bit rate saving while maintain the same subjective quality compared to H.264/AVC. However, HEVC take very high computational complexity. In this research, we will combine two methods of CU splitting and PU mode deciding to improve this problem. Experimental results show that the proposed algorithm can achieve about 36.25% encoder time saving on average with 0.123dB PSNR loss while result in negligible BD-Bitrate loss compared with HM 16.0 (HEVC test model).

16:25 Single Image Dehazing Using Positive Correlation Under Gradient Constraint.....N/A

Yi Lai (Xi'an University of Posts and Telecommunications, P.R. China); Chaoyan Wu, Bingheng Li and Ying Liu (Xi'an University of Post and Telecommunications, P.R. China)

We propose an accurate and efficient dehazing method. First of all, we obtain the positive relationship between the minimum channel of a hazy image and the corresponding depth map. Based on this relationship and the gradient constraint, the depth map is estimated. And then, in a hazy image, according to the derivation that the atmosphere light relates to the brightest pixels, quad-tree subdivision algorithm is introduced to achieve the region with maximum intensity which can be further utilized to calculate the atmosphere light. Finally, the haze-free image is restored using the traditional atmospheric scattering model. Experimental results demonstrates that the proposed method can not only restore the high-grade image but also have a lower time consumption compared to the state-of-the-art methods.

16:40 Misalignment-Robust Pedestrian Detection Framework for Visible and Far-Infrared Image Pairs.....194

Takashi Shibata (NEC Corporation, Japan); Azusa Sawada (NEC, Japan)

Inspired by recent progresses of hardware technologies of consumer electronics, joint use of visible and far-infrared (FIR) images becomes more common for various applications such as pedestrian detection. In actual situation, there is misalignment between the visible and FIR images, because the axis of these two cameras are different. Although various existing pedestrian detection algorithms have been proposed, the existing methods are sensitive to the misalignment because these methods assume that the input visible and FIR image pair is strictly aligned. This paper presents a novel misalignment-robust pedestrian detection framework for the visible and FIR image pairs. The keys of the proposed framework are the following two points: 1) a set of perturbed FIR images is used to contain the aligned visible and FIR image pair, and 2) our proposed framework employs a merged criterion that combines a learning-based detection approach and a image-processing-based similarity measure. Experimental result on the real image dataset shows that the proposed framework outperforms existing methods in terms of log-average miss rate.

Session 1.10: Audio, Video and Cameras 3

Room: N253

Chair: Anil Fernando (Center for Communications Research, University of Surrey, United Kingdom (Great Britain))

15:55 Content Adaptive Fast CU Size Selection for HEVC Intra-Prediction.....197

Buddhiprabha Erabadda (University of Surrey, United Kingdom (Great Britain)); Thanuja Mallikarachchi (University of Surrey & University of Surrey, United Kingdom (Great Britain)); Gosala Kulupana (University of Surrey, United Kingdom (Great Britain)); Anil Fernando (Center for Communications Research, University of Surrey, United Kingdom (Great Britain))

This paper proposes a content adaptive fast CU size selection algorithm for HEVC intra-prediction using weighted support vector machines. The proposed algorithm demonstrates an average encoding time reduction of 52.38% with 1.19% average BDBR increase compared to HM16.1 reference encoder.

16:10 Single Image Dehazing Based on Weighted Dark Channel.....199

Hong-Kyu Shin, Joon-Yeon Kim, Han-Kyu Lee and Sung-Jea Ko (Korea University, Korea)

Most single image dehazing methods are based on the dark channel prior. However, since the use of the dark channel prior results in halo artifacts, these conventional dehazing methods employ computationally complex post-refinement processes to eliminate the halo artifacts. In this paper, we propose a single image dehazing method using a weighted dark channel that does not require any post-refinement process. Unlike the conventional dark channel obtained by selecting the minimum intensity value in the local patch, the weighted dark channel is generated by considering the color similarity and spatial distance in the local patch. Experimental results show that the proposed method does not only remove the haze effectively, but also prevent the halo artifacts.

16:25 Block-based Temporal Metric for Video Quality Assessment.....201

Kavitha Sampath (Multicoreware Inc, India); V. Pooja (Multicoreware Incorporated, India); Pradeep Ramachandran and Kalyan Goswami (Multicoreware Inc, India)

Video Multi-method Assessment Fusion (VMAF) uses motion along with other spatial features to predict perceptual video quality. It implements a basic co-located luminance difference method to determine motion which is inadequate to capture the temporal characteristic of the video. In this paper, we propose Temporal Motion Vector based VMAF (TMV-VMAF) that uses a block-based motion state classification method to approximate motion score. This temporal feature along with other spatial features is later trained using a Support Vector Regression framework. Our results show that the TMV-VMAF achieves better correlation to human opinion score when compared to the existing VMAF

16:40 Rounding Modulation for Transparent Data-Hiding Scheme in High-Quality Audio File.....205

Rizki Rivai Ginanjar, Sanjay Bhardwaj, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

In this paper, a novel digital data-hiding technique for the high-quality audio file is introduced. The data is embedded into the frequency domain of the host audio signal utilizing the Fast Fourier Transform (FFT). The data is embedded into the phase element of the selected samples using the concept of rounding of the traditional Phase Shift Keying (PSK) technique. The perceptual quality of the embedded audio file is changed as minimum as possible which means that there will be no noticeable difference between the original and the embedded audio file by the human ears.

Friday, January 11 17:00 - 18:00

Committee Meetings

Room: N262

Expert Panel 2: Fog/Edge Computing

Fog/Edge Computing and Networking - Challenges, Opportunities and Current Status

Tao Zhang (Huawei), Tom Coughlin (Coughlin Associates, IEEE USA), John Zao (NCTU, OpenFog Consortium, IEEE 1934), Alex Gelman (IEEE/ComSoc Standards Activities)

Room: N260-N258

Chairs: Thomas Coughlin (Coughlin Associates, USA), Douglas N. Zuckerman (Perspecta Labs, USA)

Interest in Fog computing and networking has continued to grow as an enabler of the "cloud-to-thing" continuum, filling the gap between Cloud and Edge. A future with "Fog" will be critical to achieving high-bandwidth, low-latency and secure consumer products and services, such as autonomous vehicles, smart cities, home networking, mixed reality, robotics and highly efficient automation environments. This panel will bring together renowned experts in this area to present and debate recent progress and their vision for the future, including standards such as IEEE P1934/1935 and early implementations.

Saturday, January 12

Saturday, January 12 8:30 - 8:55

Breakfast

Room: N260-N258

Saturday, January 12 8:30 - 10:30

Committee Meetings

Room: N254

Committee Meetings

Room: N256

Committee Meetings

Room: N262

Committee Meetings

Room: N264

Saturday, January 12 9:00 - 10:00

Keynote 3: Anoop Nair, Sr. Director, Software Technology and Architecture in the CTO group at Flex

Room: N260-N258

Saturday, January 12 10:00 - 11:00

Keynote 4: Saraju P. Mohanty, Professor, University of North Texas, USA

Room: N260-N258

Saturday, January 12 11:05 - 12:05

Industrial Forum (IFT)

Room: N253

Chairs: Thomas Coughlin (Coughlin Associates, USA), Lee Stogner (Vincula group, USA)

Session 2.1: Smart Systems: Security-Power/Energy Tradeoff for Application Specific Processor Hardware

Room: N256

Chair: Anirban Sengupta (Indian Institute of Technology Indore, India)

11:05 2D Line Draw Hardware Accelerator for Tiny Embedded Processor in Consumer Electronics.....207

Ji kwang Kim (Seoul National University of Science And Technology, Korea); Jung Hwan Oh, Jun Hyeok Yang and Seung Eun Lee (Seoul National University of Science and Technology, Korea)

In this paper, we present a 2D line draw hardware accelerator for embedded devices. Embedded devices require the display to print out the image for consumers convenience. Therefore, the graphical computational overheads are required to embedded processor. By exploiting the 2D line draw accelerator in embedded devices, the device enhances the performance by decreasing the workload of the image processing. The line drawing accelerator is verified by using FPGA and demonstrated the system validation successfully.

11:20 Improved Delay Estimation Model for Loop Based DSP Cores.....209

Anirban Sengupta (Indian Institute of Technology Indore, India); Mahendra Rathor (IIT Indore, India)

Schedule delay or latency of a control data flow graph (CDFG) is determined during scheduling in design space exploration (DSE) process of high level synthesis (HLS). Estimated delay must be accurate enough otherwise it may mislead the DSE to reach non-optimal solution (violating user constraints). Typically latency of a loop based DSP core is calculated using an approximate delay model by unrolling the loop with different values of loop unrolling factor (UF). However there are limitations in existing delay model due to which latency determined is less accurate than commercial HLS tools such as Vivado HLS. This barrier between existing delay model used during DSE in HLS and Vivado HLS tool has been solved by proposing an improved (accurate) delay estimation model in this paper. This model can be used in conjunction with any commercial HLS tool in case of performing DSE of DSP cores. In this paper we achieve this by evaluating the latency of Vivado HLS tool after synthesizing high level description (C, C++ or system C) of same loop based design by imposing resource constraints and UF as optimization directives. Results indicate that the proposed delay model is able to calculate delay with same accuracy as a commercial HLS tool, which thus enables this model to be integrated seamlessly with any DSE approach during low cost architecture exploration of a loop based DSP core.

11:35 Low-Overhead Robust RTL Signature for DSP Core Protection: New Paradigm for Smart CE Design.....213

Anirban Sengupta and Dipanjan Roy (Indian Institute of Technology Indore, India); Saraju P Mohanty (University of North Texas, USA)

The design process of smart Consumer Electronics (CE) devices heavily relies on reusable Intellectual Property (IP) cores of Digital Signal Processor (DSP) and Multimedia Processor (MP). On the other hand, due to strict competition and rivalry between IP vendors, the problem of ownership conflict and IP piracy is surging. Therefore, to design a secured smart CE device, protection of DSP/MP IP core is essential. Embedding a robust IP owner's signature can protect an IP core from ownership abuse and forgery. This paper presents a covert signature embedding process for DSP/MP IP core at Register-transfer level (RTL). The secret marks of the signature are distributed over the entire design such that it provides higher robustness. For example for 8th order FIR filter, it incurs only between 6% and 3% area overhead for maximum and minimum size signature respectively compared to the non-signature FIR RTL design but with significantly enhanced security.

11:50 Smart System for Automatic AC Motor Starter based on GSM.....219

Udayan Patankar (TTU, Estonia); Vilas Nitnaware (, India); Ants Koel (Tallinn University of Technology, Estonia)

Geographically India is having very diverse geometric conditions which lead to many irrigational conditions and circumstances. As per the survey conducted by the Government of India, 75% of the population lives in the countryside where farming is the key source of earning. Present studies indicate that there is a drastic change in the weather condition due to globalization and scarcity of resources which have directly affect adversely on the farming. The major issues that raise the rate of reducing farming conditions can be considered as improper irrigation systems, Losses, Improper practices etc. In present irrigation system farming is very tedious and involves the physical presence of a farmer. Due to improper timings of electric supply for field irrigation system sometimes the conditions were so uncomfortable and dangerous too for watering the field thus looking into those problems faced by farmers we proposed a low cost easily maintainable watering solution for farmers. In this, we use preexisting Mobile GSM network and with the help of Automatic AC Motor Starters, we will control the action of Water irrigation systems. The complete design is based on a simple SEE - SAW Structure of Starter Automation. The main focus of this design is to keep design criticality as less as possible, which makes it easy to maintain and repair.

Session 2.2: Audio, Video and Cameras 4

Room: N254

Chairs: Maryam Azimi (University of British Columbia, Canada), Jiro Katto (Waseda University, Japan)

11:05 Improvement of H.265/HEVC Encoding for 8K UHD TV by GOP Size and Prediction Mode Selection.....223

Yusuke Sakamoto, Ryota Yokoyama and Masaru Takeuchi (Waseda University, Japan); Yasutaka Matsuo (Japan Broadcasting Corporation (NHK), Japan); Jiro Katto (Waseda University, Japan)

New video coding standards bring high coding efficiency at the cost of large computational complexity. Especially, in 8K sequence, computation cost becomes much larger due to its super high spatial resolution. In this paper, we propose a method to improve 8K UHD TV coding performance of H.265/HEVC. Our proposed method pre-analyzes spatial and motion complexity, and selects an optimal GOP size or intra/inter prediction mode. Experimental results suggest that the proposed method can improve coding efficiency and reduce computational cost.

11:20 A Noise Robust Hearable Device with an Adaptive Noise Canceller and Its DSP Implementation.....225

Akihiko K. Sugiyama (NEC Corporation, Japan); Ryoji Miyahara (NEC Platforms, Ltd.); Kouji Oosugi (NEC Corporation, Japan)

This paper presents a noise-robust hearable device with an adaptive noise canceller. The hearable device has an inner-ear and an outer-ear microphone to collect ear-canal speech signal and the outer-ear environmental signal, respectively. The environmental signal drives an adaptive filter to generate a noise replica which is subtracted from the inner-ear microphone signal to cancel the noise. Coefficients of the adaptive filter are updated by an NLMS algorithm with an SNR-controlled stepsize for small speech distortion. The adaptive noise canceller is realized on a DSP chip with 39 McPS for 64 taps. Evaluation results in speech recognition demonstrates that a word recognition rate of 89% is achieved when the noise level is 80 dBA with 38% improvement over the inner-ear signal without adaptive noise cancellation.

11:35 An Entropy-Based Inverse Tone Mapping Operator with Improved Color Accuracy for High Dynamic Range Applications.....227

Pedram Mohammadi and Maryam Azimi (University of British Columbia, Canada); Mahsa T Pourzad (TELUS Communications Company, Canada)

Conversion of existing image and video content to High Dynamic Range (HDR) using inverse Tone Mapping Operators (iTMOs) is expected to open new market opportunities for studios and content owners. One of the issues facing iTMOs arises from the fact that changing the input Standard Dynamic Range (SDR) luminance to HDR results in color shifts, regardless of the color space or gamut that the operation takes place, requiring the use of an efficient color restoration method. Therefore, maintaining the color accuracy between the input SDR and output HDR content is of high importance in designing iTMOs. In this paper, we propose an iTMO capable of maintaining the color accuracy between the original SDR and the resulting HDR output, while at the same time providing a good balance between the overall brightness and contrast in the HDR content. The results of our subjective evaluation demonstrate that the colors of the generated HDR content closely match those of the original SDR input, outperforming the existing state-of-the-art iTMOs and making the resulting HDR look natural and more appealing to the viewers.

11:50 An Adaptive Video Streaming Framework for Scalable HEVC (SHVC) Standard.....229

Sarat Rakngan (University of Surrey, United Kingdom (Great Britain)); Thanuja Mallikarachchi (University of Surrey & University of Surrey, United Kingdom (Great Britain)); [Anil Fernando](#) (Center for Communications Research, University of Surrey, United Kingdom (Great Britain))

This paper presents an implementation of a Media Aware Network Element (MANE) for dynamic video content adaptation in Scalable HEVC (SHVC) video streaming. The experimental results discuss the varying quality-to-playback time ratio and decoding power consumption with random access period in SHVC encoding under fluctuating and persistent network bandwidth conditions.

Session 2.3: Digital Experience in Consumer Electronics 1

Room: N264

Chair: Si Jung Kim (University of Nevada Las Vegas, USA)

11:05 New Electrical Modeling Method for Signal Integrity of Ultra-Small Electronic Device.....231

[Hungying Louis Lo](#) (Intel Corporation, USA)

The accuracy of electrical modeling depends on the modeling method, the geometry of simulated device, and simulation tool. Due to the complex geometry of ultra-small consumer electrical device and the small signal integrity margin on low power consumption design, the accuracy of electrical modeling method is critical factor for designing a cost-effective design with proper margin. In this paper, simulation data from traditional modeling methods are reviewed and compared with measured data. Based on the interconnecting technologies, different method is suitable for different technologies. For System in Package (SiP) with complex traces, sharp serpentine angles and, routing over voids, the full-wave modeling of one complete structure as a single section generates most accurate results through the correlation with measured data.

11:20 'Captain Carroll': Camera-Movement and Device Orientation Based Procedural Object Rendering Approach for Mobile VR Game.....236

[Markus Santoso](#) (University of Florida, USA)

Mobile devices are one of the most promising platforms to bring Virtual Reality (VR) to the mass market in the present day. However, mobile device has a limited computational power compare to the personal computer (PC) meanwhile VR consume a lot of powers during its operational. In this paper, authors developed a mobile VR game, titled Captain Carroll, that employed camera-movement based procedural object rendering approach to make sure that the audience would have a seamless VR gaming experience.

11:35 Single-Support Stance and VR Implementation as Visual Perturbation in Human Balance Assessment.....239

[Markus Santoso](#) (University of Florida, USA)

Human controls their balance through variety of sensors and one of it is visual input. Previous study found that the visual proprioceptive information is more potent than the nonvisual. In this research, authors conducted an experiment on the implementation virtual reality (VR) as visual perturbation combined with single-support stance to distort human's balance. This research focused on the single-support stance where subject stood on their dominant leg during the experiment with VR goggle.

11:50 Affordable Drilling Interface for Haptic Interaction in Virtual Environment.....243

[Dong-Soo Choi](#), SiHo Ryu and YeongSeok Do (Korea University of Technology and Education, Korea); Ki-Uk Kyung (KAIST, Korea); Kyeongbok Jin (Korea University of Technology and Education, Korea); Sang-Youn Kim (Korea University of Technology and Education, Korea)

This paper presents initial design and demonstration for an interactive drill-ing simulation. We have developed a new haptic feedback drill interface whose outer figure is identical to a conventional electric drill. The proposed system is designed for providing haptic responses to users such as contact re-sponse, thrust force, machinery vibration, torsional forces and the edge pene-tration force occurred during drilling task. In addition, interactive auditory and visual feedback are also provided together for more realistic multimodal interaction.

Session 2.4: Audio, Video and Cameras 5

Room: N262

Chair: Alvaro Uribe Quevedo (University of Ontario Institute of Technology & Universidad Militar Nueva Granada, Canada)

11:05 Gradient-Based Low-Light Image Enhancement.....245

Masayuki Tanaka (National Institute of Advanced Industrial Science and Technology, Japan); Takashi Shibata (NEC Corporation, Japan); Masatoshi Okutomi (Tokyo Institute of Technology, Japan)

A low-light image enhancement is a highly demanded image processing technique, especially for consumer digital cameras and cameras on mobile phones. In this paper, a gradient-based low-light image enhancement algorithm is proposed. The key is to enhance the gradients of dark region, because the gradients are more sensitive for human visual system than absolute values. In addition, we involve the intensity-range constraints for the image integration. By using the intensity-range constraints, we can integrate the output image with enhanced gradients preserving the given gradient information while enforcing the intensity range of the output image within a certain intensity range. Experiments demonstrate that the proposed gradient-based low-light image enhancement can effectively enhance the low-light images.

11:20 Emotional Speech Synthesis for Multi-Speaker Emotional Dataset Using WaveNet Vocoder.....247

Heejin Choi and Sangjun Park (Korea Advanced Institute of Science and Technology, Korea); Jinuk Park and Minsoo Hahn (Korea Advanced Institute of Science And Technology, Korea)

This paper studies the methods for emotional speech synthesis using a neural vocoder. For a neural vocoder, WaveNet is used, which generates waveforms from mel spectrograms. We propose two networks, i.e., deep convolutional neural network (CNN)-based text-to-speech (TTS) system and emotional converter, and deep CNN architecture is designed as to utilize long-term context information. The first network estimates neutral mel spectrograms using linguistic features, and the second network converts neutral mel spectrograms to emotional mel spectrograms. Experimental results on a TTS system and emotional TTS system, showed that the proposed systems are indeed a promising approach.

11:35 Fast Motion Estimation Based on Diamond Refinement Search for High Efficiency Video Coding.....249

Yeong-Kang Lai (National Chung Hsing University, Taiwan)

High-efficiency video coding (HEVC) is the latest video coding standard, and it has become more and more important due to its excellent coding performance. However, compared with the previous H.264 / AVC, the performance is significantly improved at the cost of higher coding complexity. The motion estimation (ME) is the most time-consuming part of removing the time redundancy effectively. In the reference software of HEVC, the search method of testing is adopted, and (TZ-Search) is used as the default fast ME method, but its computational complexity is still too high for real-time applications. In this paper proposes a fast motion estimation algorithm based on diamond refinement search and mode decision for efficient video coding standard. It will accelerate the calculation of SAD time for each modification of the search method. Then use the PU Mode usage rate to select the most commonly used PU Mode to reduce the PU Mode Decision option and increase the overall calculation time. In addition, the reduction of Inter Prediction Min Block Size has also been proposed to compensate for the reduction of PSNR loss after PU Mode Decision, thereby maintaining a certain image quality while saving overall computing time. Compared with TZ-Search, the total encoder complexity is reduced by 46.15% and the rate distortion degradation is negligible in the low-delay P configuration; therefore, the complexity is reduced and the savings are achieved.

Saturday, January 12 12:10 - 13:30

Keynote 5: Martin G. Kienzle, IBM Research; Networking Lunch; IBUKA Award Winner presented by CESoc President

Room: N260-N258

Saturday, January 12 13:35 - 18:00

BOG Meeting

Room: N253

Saturday, January 12 13:35 - 15:05

Session 2.5: Internet of Things 1

Room: N256

Chair: Lucio Ciabattoni (Universita' Politecnica delle Marche, Italy)

13:35 A Bio-Sensing System-on-Chip and Software for Smart Clothes.....251

Hsu-Kang Dow (National Sun Yat-sen University, Taiwan); Ing-Jer Huang (National Sun Yat-Sen University, Taiwan); Robert Rieger (Kiel University, Germany); Ko-Chi Kuo (National Sun Yat-sen University, Taiwan); Lan-Yuen Guo (Kaohsiung Medical University, Taiwan); Shih-Jung Pao (National Sun Yat-sen University, Taiwan)

In this paper, we present a bionic sensing system that monitor electromyography (EMG), electrocardiogram (ECG), vibration, and temperature for elderly care. The bionic sensor system contains analog front-end circuits (AFE) including sensor read-out circuit for bio-potential signal pickup, a piezo wave sensing circuit for vibration sensing, a low-power analog-to-digital (ADC) circuit with pulse-width modulation (PWM) digital signal output and a bandgap

circuit for temperature tracking. For digital signal processing, we integrated a digital signal controller for AFE control and calibration, an ARM-like microprocessor (SYS32TM) for compression and communication. Finally, a phase-lock loop (PLL) circuit for system clock generating and power on reset. The analog and digital part of the chip has been tape-out separately. Analog circuit is integrated and tested with Xilinx Zynq System-on-Module (SoM). This verification platform is versatile for development while maintaining small form factor for user to wear the system while recording the bio-signals. The sensor system is currently used in elderly care and precision sport study.

13:50 Lifestyle Analysis with IoT Data Acquired from Coffee Roaster for Service Development.....255

Masaaki Terano (Panasonic Corp., Japan); Ayaka Kimura (Panasonic Corporation, Japan); Jun Ozawa and Yuri Nishikawa (National Institute of Advanced Industrial Science and Technology (AIST), Japan); Takeshi Takenaka (AIST, Japan); Fuko Oura (Tokyo Metropolitan University, Japan)

This paper presents the lifestyle analyses of users via the appliance logs of our IoT coffee roasting service combined with a questionnaire survey on their lifestyles. We found that there is a difference in lifestyle trends between subscribed and non-subscribed users of the service. We also found that users showing a certain lifestyle have specific usage patterns of the roaster. In addition, we confirmed differences between the lifestyles of some users who quit the service and those who did not. Finally, we defined a service continuity index and discussed examples of measures to enhance service continuity by lifestyle analysis.

14:05 Early Detection System for Gas Leakage and Fire in Smart Home Using Machine Learning.....259

Lamine Salhi, Thomas Silverston, Taku Yamazaki and Takumi Miyoshi (Shibaura Institute of Technology, Japan)

Making houses more inclusive, safer, resilient and sustainable is an important requirement that must be achieved in every society. Gas leakage and fires in smart houses are serious issues that are causing people's death and properties losses. Currently, preventing and alerting systems are widely available. However, they are generally individual units having elementary functions without adequate capabilities of multi-sensing and interaction with the existing Machine-to-Machine (M2M) home network along with the outside networks such as Internet. Indeed, this communication paradigm will be clearly the most dominant in the near future for M2M home networks. In this paper, we are proposing an efficient system model to integrate the gas leakage and fire detection system into a centralized M2M home network using low cost devices. Then, through machine learning approach, we are involving a data mining method with the sensed information and detect the abnormal air state changes in hidden patterns for early prediction of the risk incidences. This work will help to enhance safety and protect property in smart houses.

14:20 TAOS-CI: Lightweight & Modular Continuous Integration System for Edge Computing.....265

Geunsik Lim, MyungJoo Ham, Jijoong Moon, Wook Song, Sangjung Woo and Sewon Oh (Samsung Electronics, Korea)

With the proliferation of IoT and edge devices, we are observing a lot of consumer electronics becoming yet another IoT and edge devices. Unlike traditional smart devices, such as smart phones, consumer electronics, in general, have significant diversities with fewer number of devices per product model. With such high diversities, the proliferation of edge devices requires frequent and seamless updates of consumer electronics, which makes the manufacturers prone to regressions because the manufacturers have less resource per an instance of software release; i.e., they need to repeat releases by the number of product models times the number of updates. Continuous Integration (CI) systems can help prevent regression bugs from actively developing software packages including the frequently updated device software platforms. The proposed CI system provides a portable and modular software platform automatically inspecting potential issues of incoming changes with the enabled modules: code format and style, performance regressions, static checks on the source code, build and packaging tests, and dynamic checks with the built binary before deploying a platform image on the IoT and edge devices. Besides, our proposed approach is lightweight enough to be hosted in normal desktop computers even for dozens of developers. As a result, it can be easily applied to a lot of various source code repositories. Evaluation results demonstrate that the proposed method drastically improves plug-ins execution time and memory consumption, compared with methods in previous studies.

14:35 An InterPlanetary File System (IPFS) Based IoT Framework.....270

Shapna Muralidharan (Korea Institute of Science And Technology (KIST), Korea); Heedong Ko (Korea Institute of Science and Technology, Korea)

The Internet of Things (IoT) promises to bring immense value to various sectors by increasing efficiency and creating better experiences for the user. Currently, IoT works in a centralized, client-server model where data generated is stored and managed in centralized cloud servers. A concept of decentralized, peer-to-peer computing can ensure reliability, privacy, and interoperability in data management among IoT applications. The InterPlanetary File System (IPFS) is a peer-to-peer versioncontrolled file system which can envision a decentralized IoT system. In this paper, we have tried to adopt the engineering principles of IPFS in an IoT environment to understand and evaluate the need for a decentralized infrastructure.

Session 2.6: Internet of Things 2

Room: N254

Chair: Lakhan Shiva Kamireddy (University of Colorado Boulder, USA)

13:35 A Hybrid Testing Environment Between Execution Test and Model Checking for IoT System.....272

Takeru Kuroiwa, Yusuke Aoyama and Noriyuki Kushiro (Kyushu Institute of Technology, Japan)

The Internet of Things (IoT) systems obliged us frequent validation. The validation includes a huge regression test to avoid recurrence of the past faults. We propose a hybrid testing environment between execution test and model checking to support huge number of regression tests in the IoT system. The environment is composed of emulators of every targeted software for the execution test and a test case execution unit with model checker. As the results of these solutions, the environment conducts the huge regression test automatically in all possible sequences for the targeted software on the emulator.

13:50 Evaluation of Human Behavior Estimation of Smart Tap Using Self-Diagnostics.....274

Yuki Takabayashi, Hiroki Fuse and Yusuke Nomoto (Kanagawa Institute of Technology, Japan); Masao Isshiki (Kanagawa Institute of Technology and Keio University, Japan); Keiichi Abe (Kanagawa Institute of Technology, Japan)

Solutions to social problems such as an unattended death of the elderly living alone has been demanded. Systems for monitoring the living condition of a person in a remote house using the power consumption data obtained via HEMS or the like have been studied and developed. There are two types of techniques for obtaining power consumption data for life monitoring systems: One method utilizes a smart meter installed in each home by an electric power company. The other method utilizes a smart tap installed by users as needed. In our past research, which was focused on a life monitoring system using a smart tap, we classified home electronics into four categories according to their operations based on the power consumption data obtained with the smart tap, and clarified what types of household electric appliances are suitable for life monitoring. We have aimed at providing a system which allows even individuals without expert knowledge to monitor their lives using smart taps. This time, we developed a self-diagnostic tool that helps to find optimum home appliances for life monitoring. When building a life monitoring system with a smart tap using this self-diagnosis tool, we validated and evaluated whether we can accurately estimate four human behaviors: getting up, going out, getting home, and going to bed. As a result, we confirmed that our proposed method can estimate human behaviors with higher accuracy than smart meters.

14:05 iWATT: Architecture and Design of Web-Based IoT Application Development Toolkit.....280

KwangHyuk Kim and Hunseop Jeong (Samsung Electronics, Korea); DoHyung Lim (Samsung Electronics Co., Korea); Hye Kyoung Hwang (Samsung, Korea); Tomasz Lukawski (Samsung R&D, Poland)

We present the architecture and design of IoT Web Application auThoring Toolkit (iWATT), a web-based solution for reducing the development effort of IoT applications. iWATT provides a What You See Is What You Get (WYSIWYG) design editor that consists of IoT widgets; thus developers can create an IoT application by combining widgets via drag and drop interaction. And developers can immediately check the application that they are writing. Each widget component in the design editor is implemented based on the Tizen Advanced UI (TAU) framework. To support convenient data binding, we also develop Sthings framework that facilitates data binding between widget and IoT device capability. We expect that IoT application developers will use iWATT to develop IoT application more conveniently.

14:20 Leader-Follower Based Smart Mobile Objects in Internet of Things.....283

Donghyun Lim, Yujin Kim and Chantae Jeon (Kangwon National University, Korea); Dongmahn Seo (Daegu Catholic University, Korea); Soobin Jeon and Inbum Jung (Kangwon National University, Korea)

In this paper, we propose SMO (Smart Mobile Objects) based on Internet of Things using a Leader-Follower approach in MinT (Middleware for Cooperative Interaction of Things). In the proposed system, the leader mobile object and the follower mobile object are implemented to avoid obstacles while real-time tracking specific objects by image processing.

14:35 Cooperation Between Heterogeneous IoT Devices Using iHAC Hub.....285

Kosuke Hayashi and Hidekazu Suzuki (Meijo University, Japan)

We have proposed an intuitive Home Appliance Control (iHAC) framework which can intuitively control smart home appliances without being conscious of the difference of communication protocol. This paper proposes a method to achieve cooperation between heterogeneous Internet of Things (IoT) devices by extending iHAC framework. The extended iHAC framework can acquire the environmental information observed by the IoT device in real time and automatically control the smart home appliances when the conditions are satisfied. We developed the iHAC Hub as a small home device with this framework implemented. As a result of performance comparison experiment with the existing device linkage service, we confirmed that the proposed method can control smart home appliances based on environmental information in a shorter time than existing service.

Session 2.7: Internet of Things 3

Room: N264

Chair: Felipe Nunez (Pontificia Universidad Catolica de Chile, Chile)

13:35 Internet of Things: An Analysis and Proposal of White Worm Technology.....287

Mason Molesky (The George Washington University, USA); Elizabeth A. Cameron (Alma College, USA)

The quantity of Internet of Things (IoT) devices in the marketplace and lack of security is staggering. The interconnectedness of IoT devices has increased the attack surface for hackers. "White Worm" technology has the potential to combat infiltrating malware. Before white worm technology becomes viable its capabilities must be constrained to specific devices and limited to non-harmful actions. This paper addresses the current problem, international research, and the conflicting interest of individuals, businesses, and governments regarding white worm technology. Proposed is a new perspective on utilizing white worm technology, while overcoming its challenges, to protect the vulnerability of IoT devices.

13:50 Hajime Worm with Lifespan and Its Mitigation Evaluation Against Mirai Malware Based on Agent-Oriented Petri Net PN2.....291

Shingo Yamaguchi (Yamaguchi University, Japan); Pattara Leelaprute (Kasetsart University, Thailand)

This paper proposed to introduce lifespan to IoT worm called Hajime. Hajime worm is regarded as a method to mitigate IoT malware like Mirai malware, but it is said to be in a gray area because it keeps a remote control mechanism. A Hajime worm with a lifespan destructs itself when exhausting the lifespan. Using agent-oriented Petri net PN2, we analyzed the influence of the Hajime worm's lifespan in the mitigation against IoT malware. From the result, we can say that Hajime worm with lifespan becomes a safer mitigation method.

14:05 Scalability and Integration of a Thread Implementation in a Home Area Network.....295

Felipe Nunez and [Tomas Herrera](#) (Pontificia Universidad Catolica de Chile, Chile)

The Internet of Things is rapidly becoming reality. Currently, a variety of technologies co-exist in large-scale deployments yet pervasive connectivity between things is still an open issue. Several IP capable protocol stacks are emerging to address these issues; however, no systematic evaluations regarding integration and scalability exists in the literature. This work looks to analyze the performance of one of the latest protocol stacks focusing on home area networks: the Thread stack.

14:20 Accuracy Evaluations of Contact-Free Heart Rate Measurement Methods Using 4K Facial Images.....300

[Masaki Yasumaru](#), Zhengxue Cheng, Ryota Yokoyama, Kenji Kanai and Jiro Katto (Waseda University, Japan)

Recently, with the spread of Internet of Things (IoT), video surveillance system is widely used to detect abnormal activity using cameras and sensors. In such video surveillance system, contact-free heart rate measurement is a highly required technology to predict the occurrence of abnormal activities and suspicious humans. In this paper, our main contributions can be summarized by two aspects. First, we compare the accuracy performance of heart rate measurement using six heart beat waveform acquisition methods and two heart rate calculation methods. Second, we discuss the influence of image resolutions of RGB cameras on accurate performance, to investigate the requirement of surveillance cameras in actual scenarios.

14:35 A Multi-Radio Gateway Architecture and Implementation for Consumer Electronics.....305

[Tiago Barros](#) (CESAR Recife Center for Advanced Studies and Systems & CESAR School, Brazil); Claudio Takahasi, Vitor Aquino, Paulo Serra Filho, Ramon Ribeiro and Joao Alexandre Neto (CESAR Recife Center for Advanced Studies and Systems, Brazil); Cesar Perdigao, Pedro Victor Caldas, Everton Cavalcante and Thais Batista (Federal University of Rio Grande do Norte, Brazil)

The main purpose of Internet of Things (IoT) is to embed connectivity into everyday devices, making them smarter and adding more value. Due to constraints such as cost, bandwidth, power consumption, and communication range, not all IoT devices have direct connection to the Internet. This requires a gateway to deal with the communication protocol used by each device and connect it with the Internet towards providing external access for users. In this paper, we introduce an open-source multi-radio gateway to consumer electronics applications.

14:50 Securing IoT Platforms.....311

[Soumya Kanti Datta](#) (EURECOM, France); Christian Bonnet (Institut Eurecom, France)

Ensuring adequate security features for the Internet of Things (IoT) Platforms is often challenging. This paper focuses mechanisms to engineer authentication, authorization, and trust among the IoT Platform elements. JSON Web Token (JWT) based authentication and authorization are described. Trust is established by mutual certificate based authentication. We have shown how these security features have been incorporated in the EURECOM IoT Platform.

Session 2.8: HCI Technologies

Room: N262

Chair: Alvaro Uribe Quevedo (University of Ontario Institute of Technology & Universidad Militar Nueva Granada, Canada)

13:35 Effective Marker and IMU Based Calibration for Head Movement Compensation of Wearable Gaze Tracking.....313

Chih-Hsuan Fang and [Chih-Peng Fan](#) (National Chung Hsing University, Taiwan)

In this paper, the effective marker and inertial measurement unit (IMU) based calibration technique is developed for head movement compensation of wearable gaze tracker. Firstly, the location of the pupil center is estimated, and the initial calibration process is done by the affine transform based gaze mapping. When the head of user is moved after the initial calibration is finished, the wearable gaze tracker reduces gaze tracking errors effectively by the proposed marker and IMU based head movement compensation. When the user's head changes from the initial calibration position (i.e. 40cm) to the 60cm position, the proposed design reduces from 33% to 64% gaze tracking errors at the gaze tracking mode than the design by only the initial calibration without any head compensation scheme. The proposed technique can be applied to the wearable consumer devices, which include the user-friendly gaze tracking function.

13:50 Hand Gesture-based Wearable Human-Drone Interface for Intuitive Movement Control.....315

[Sangyun Shin](#) and Yongwon Kang (Sejong University & HCI Lab, Korea); [Yong-Guk Kim](#) (Sejong University, Korea)

Although Radio Control (RC) has been a dominant device for controlling a drone, it is known that a fair amount of training period is required to master it. One way to sidestep such an RC-based control scheme would be utilizing either Kinect or Leap Motion sensor by which the user interacts with a drone more naturally. In such cases, however, the pilot has to hang around the sensor since the operating distance of such sensors is rather short. In this study, we propose a new wearable human-drone interface embedded on a Raspberry Zero, by which even a novice can let the drone not only take-off, land and fly to the intended directions according his hand-pose gestures but also make diverse flying trajectories such as circle, square and spiral using a sequence of hand gestures. Results from Gazebo simulator and several field experiments combined with a personalized calibration program demonstrate the feasibility of its commercial applications.

14:05 EMC Design Support Tool for Consumer Product.....321

[Noriyuki Kushiro](#) and Taishiro Tanaka (Kyushu Institute of Technology, Japan); Yoshitaka Watanabe (Persol AVC Technology Co., Ltd., Japan)

Design method for EMC in consumer products still remains in trial and error approaches. Most EMC engineers try to reduce noise emission from the

product indirectly and heuristically just on the noise emission data measured in an anechoic chamber. In this study, an EMC design support tool, which visualized noise distribution directly on the product, and realized the subtraction method of simulating and estimating on the tool, was developed. The tool was applied to EMC design for television sets. As the results of the application, we confirmed that the tool provided intuitive understanding of noise distribution, and helped the EMC engineers create solutions and implement them effectively in their usual way on the tool.

14:20 An Adaptive System to Manage Playlists and Lighting Scenarios Based on the User's Emotions.....323

Alex Altieri and Silvia Ceccacci (Università Politecnica delle Marche, Italy); Lucio Ciabattini (Università Politecnica delle Marche, Italy); [Andrea Generosi](#) and Abudukaiyoumu Talipu (Università Politecnica delle Marche, Italy); Giacomo Turri (Università Politecnica delle Marche, Italy); Maura Mengoni (Università Politecnica delle Marche, Italy)

This paper introduces a new system capable of adaptively proposing multimedia contents (e.g. music, video clips, etc.) and lighting scenarios based on the detected user's emotional state. The system captures the emotion from the user's face mapping it into a 2D valence-arousal space where the multimedia content lies. A preliminary test has been conducted in the context of a proper use case scenario. Experimental results suggest that the proposed system is able to detect the effective user's emotional state and manage proper music and light colors in an effective way

14:35 Home Automation Platform Using Interaction-Based Sensing.....325

[Kenichiro Ito](#) (The University of Tokyo, Japan); Takahiro Miura (The University of Tokyo & National Institute of Advanced Industrial Science and Technology (AIST), Japan); Ken-ichiro Yabu, Taketoshi Mori, Tohru Ifukube and Junichiro Okata (The University of Tokyo, Japan); Atsushi Maki, Masahiko Ando and Nobuhiro Fukuda (Hitachi Ltd., Japan); Atsushi Hiroike (Hitachi, Ltd., Japan); Masanao Kotani, Yasuhiro Asa and Yuto Komatsu (Hitachi Ltd., Japan)

In Japan, care giving for elderly has received the support of families, relatives, and traditional communities. Recently, care giving service has started to be socialized by some nursing care insurance. However, quality is insufficient due to cost problems and understaffed issues. Therefore, understanding the supportive living environment utilized by cyber infrastructure which lightens the burden of family care and social care is important. This paper proposes a home automation platform using interaction based sensing technology for supportive living environment. In particular, an experimental home was developed with home automation platform integrated with a prototype system based on interaction based sensing.

Saturday, January 12 15:10 - 15:50

Poster Session 2

Room: Hall Area

Chair: Konstantin Glasman (St. Petersburg State University of Film and Television, Russia)

Multi-Service Charging Platform Based on Smart Plug for Electric Vehicle in Residential Complexes and Buildings.....327

[Sanghoon Lee](#) and Myeong-in Choi (Chung-Ang University, Korea); Sang Hyeon Lee (Chung-ang University, Korea); Keonhee Cho and Sehyun Park (Chung-Ang University, Korea)

In order to continuously increase the growth rate of rechargeable electric vehicles, it is necessary to construct an electric vehicle charging infrastructure all over the region. To do this, it is necessary to develop a charging platform that can be installed in residential complexes and buildings that having general power supply facilities. Due to these necessities, this paper proposes a platform that enables real-time payment and slow charging, utilizing smart plugs and clouds network that can be easily installed. In addition, this paper proposes a business models for multi-service that can be used through the proposed platform.

Design of Intelligent Energy Management System Based on User Schedule.....329

[SeungHwan Kim](#) (Chung-ang University, Korea); Tacklim Lee, Seung Min Kim, Sanghoon Lee and Sehyun Park (Chung-Ang University, Korea)

As energy management becomes more important, many energy management systems are emerging. This paper proposes a system to manage the energy inside the office by calculating energy saving level on user schedule.

Virtual Simulation Mechanism for Distributed Energy Resources Based on Home Energy System Facilities.....332

[Tai Yeon Ku](#) (ETRI, Korea)

Renewable energy development is expanding to reduce carbon emissions from global warming problems. Renewable energy is unreliable due to the inherent instability of power production. While the supply of low-cost energy storage systems (ESS) is increasing in each household to ensure the safety of power systems due to renewable energy, it is necessary to connect renewable energy with economically stable energy. In addition to improving the efficiency of the ESS, competitive technologies such as harmonization / interoperability with other systems and improvement of deployment structure / operation technology are required. In this paper, we propose a Virtual Simulation Mechanism for Distributed Energy to derive the optimum capacity calculation, layout and operation plan of the energy storage system suitable for the home energy system (HES) facility.

Weight-Based Page Cache Management Scheme for Enhancing I/O Proportionality of Cgroups.....334

[Kwonje Oh](#), Jonggyu Park and Young Ik Eom (Sungkyunkwan University, Korea)

Recently, many cloud systems, including home cloud servers, adopt Docker as their virtualization framework due to its lightweight architecture. Docker utilizes Cgroups to control the system resources. However, I/O weight of Cgroups does not consider the page cache layer, and thus, performance proportionality is degraded. In this paper, we propose a weight-based page cache management scheme that reflects I/O weight of Cgroups on the page

reclamation process to improve I/O proportionality. Experimental results show that our scheme provides better proportionality than the conventional one with negligible overhead.

Smart Ambulance Approach Alarm System Using Smartphone.....337

Toru Kobayashi (Nagasaki University, Japan); Fukuyoshi Kimura (Nagasaki University & System Five Co., Ltd, Japan); Kenichi Arai (Nagasaki University, Japan)

In order to inform the approach of the ambulance to other vehicles, we developed a smart ambulance approach alarm system by making the position information of the ambulance open. The position information of the ambulance has not made open until now due to the development cost or privacy issue. Our proposed system is to make an ambulance IoT just to put a smartphone installed special application on a dashboard. Our cloud side application also controls the position information of the ambulance distribution in consideration for the situation of other vehicles and the privacy of ambulance users.

Antenna Pattern Reconstruction from Measurements in a Reverberant Chamber Using 3D Impulse Response.....339

Jinhwan Koh (Gyeongsang National University, Korea); Cesar Segura and Won-il Cho (GyeongSang National University, Korea)

Impulse Response with 3D is a novel free-space pattern reconstruction technique which features deconvolution in azimuth and elevation domain to enhance quality of free-space pattern reconstruction compared with the previous technique, Impulse Response with 2D. Antenna configuration is designed to operate at 9 GHz (X band) in a reverberation chamber and after simulated, its results are computed through Impulse Response with 2D and 3D to calculate free-space radiation pattern. The objective of this communication is to show the feasibility to use Impulse Response with 3D instead of Impulse response with 2D as a tool to reconstruct free-space antenna pattern based on the comparison of accuracy and error of both methods.

Smart Telemetry Monitoring Technique for TV Transmitter Using RF Watermark Signal.....344

Jaekwon Lee (KBS, Korea); Dong Ku Kim (Yonsei University, Korea)

In this paper, RF watermark signal based RF telemetry monitoring technique is proposed to observe the operating status and signal quality of unmanned TV transmitter. The simulation results demonstrate that the proposed technique can achieve an additional data transmission capability with backward compatibility to legacy TV receiver and provide remote monitoring and measurements of transmitter status without requiring other telecommunication link channels.

Design and Implementation of ATSC 3.0 Home Media Gateway for UHD TV and Companion Devices.....346

Byungjun Bae (Electronics and Telecommunications Research Institute, Korea); Nayeon Kim (University of Science and Technology, Korea); Sang-Jung Ra (Electronics and Telecommunications Research Institute, Korea); Yang KyuTae (Electronics and Telecommunications Research Institute, Korea); Youngsuk Kim (LowaSIS, Inc., Korea)

ATSC 3.0 is a next-generation terrestrial-broadcasting standard for television (TV) systems. As the early versions of 4K ultrahigh definition TVs do not use an ATSC 3.0 receiver, consumers have had to use a separate converter device. Herein, we introduce a concept and system structure for a home media gateway that can transfer various ATSC 3.0 broadcast channels to any device equipped with network function. We evaluated a home media gateway and verified its performance to build a test case.

A Study on LDM-BST-OFDM Using Extended Parity in Enhanced Layer of LDM for Fixed Reception.....349

Hiroto Yamamoto, Akira Nakamura and Makoto Itami (Tokyo University of Science, Japan)

In Japan, the scheme that combines LDM(Layered Division Multiplexing) to the BST-OFDM(Band Segmented Transmission - Orthogonal Frequency Division Multiplexing) is proposed. In the proposed scheme for fixed reception, the parity-check matrix of the conventional LDPC code whose length is 69120 is extended. After that, the extended parity bits are generated by the parity-check matrix and modulated. These modulated symbols are multiplexed by LDM to symbols for mobile reception. The performances of the proposed scheme are evaluated by computer simulations under Gaussian channel, and the required CNR(Carrier to Noise Ratio) of fixed reception can be improved by the proposed scheme.

A Real-time Object Recognition Algorithm for Air Target Based on Level Set Method.....351

Jijun Ren (Xi'an University of Post & Telecommunications, P.R. China); Yibo Huai (Xi'an University of Posts and Telecommunications, P.R. China)

In this paper, we proposed a real-time object recognition algorithm based on level set for air target video. Firstly, the correlation that level set curve lies on boundary is calculated by pattern geometry classification model. Secondly, the term of region strategy, which is correlated with the correlation, is appended to the level set function. Finally, by using the image regional information, we improve image segmentation quality of level set method. The experimental results suggest that the algorithm is effective.

Study on Door-to-door Sales Detection Method in Watching System for Seniors Living Alone.....355

Rin Hirakawa and Yoshihisa Nakatoh (Kyushu Institute of Technology, Japan)

In recent years, the number of seniors living alone has increased, so the demand for the watching system has increased. In this paper, we propose a method to detect door-to-door sales from voice information with the aim of constructing a watching system to prevent consumer troubles of seniors living alone. In the proposed method, speech recognition is performed on conversation voice acquired from a microphone, and converted into text data. Subsequently, text data is input to the Doc2Vec model that has learned the conversation data on door-to-door sales and the cosine similarity is calculated. In this system, when the similarity exceeds a certain threshold value, it is determined that door-to-door sales is being conducted and a warning is issued to relatives. In order to evaluate the effectiveness of the proposed method, binary classification experiments of conversational text data were conducted. As a result, the area under the ROC curve drawn based on the cosine similarity was 0.94, suggesting that a valid decision was made.

Slope Information Collection System Using Sensor Information from General-Purpose Wheelchair Users.....357

Kenichi Arai, Chisato Miura and Toru Kobayashi (Nagasaki University, Japan)

In this study, we propose a system that collects slope information from various types of sensors attached to general-purpose wheelchairs and feeds this slope information back to wheelchair users. General-purpose smartphones are attached to the wheelchairs in this system, and by collecting information from the various sensors embedded within the smartphone, slope information can be collected in a short period of time and with low cost. In this paper, we show the results of an evaluation experiment using this system.

Describing Services Geolocation in IoT Context.....359

Pablo César Calcina Ccori (University of Sao Paulo, Brazil); Laisa C. P. Costa (University of Sao Paulo & LSI-TEC, Brazil); Carlos Eduardo de Oliveira (University of São Paulo, Brazil); Geovane Fedrechski and Flavio S Correa da Silva (University of Sao Paulo, Brazil); Marcelo Knörich Zuffo (Universidade de São Paulo, Brazil)

In the Internet Of Things (IoT), especially considering the Swarm approach, "things" will be connected to each other sharing their resources. In this context, there will be large amounts of services to be discovered and an essential aspect to be considered is their position. This work proposes a geolocation description method for services in IoT. An ontology was designed and a section for a semantic service description was proposed. A software prototype was implemented and tested using absolute and relative position queries for a testbed of six samples of services, obtaining satisfactory results.

Swarm Assistant: An Intelligent Personal Assistant for the Swarm.....361

Laisa C. P. Costa (University of Sao Paulo & LSI-TEC, Brazil); Pablo César Calcina Ccori (University of Sao Paulo, Brazil); Guilherme Corazza and Matheus Guinezi (University of São Paulo, Brazil); Geovane Fedrechski (University of Sao Paulo, Brazil); Marcelo Knörich Zuffo (Universidade de São Paulo, Brazil)

Billions of devices belonging to different manufacturers and domains are connected to the Internet of Things. The amount of consumer equipment that a single person can manage, however, is limited. Additionally, personal information is spread across several sources, which prevents a seamless integration. Intelligent personal assistants are a solution to facilitate the integration of online services and data sources. However, the management of IoT equipment is still challenging due to difficulty of interaction, security information integration, among other problems. This paper proposes the architecture and implementation of an intelligent personal assistant based on the Swarm, a decentralized IoT platform for heterogeneous smart devices. Our proposal focus on ease of interaction and semantic data integration.

A Digital Twin Architecture Based on the Industrial Internet of Things Technologies.....363

Vinicius da Silva Souza, Robson Cruz, Walmir Silva, Sidney Lins and Vicente F. Lucena, Jr. (Federal University of Amazonas, Brazil)

Computation and communication evolved to enable digital representations of physical systems. Decision-making support via data analysis, virtualization of machinery control, information flowing over the Internet are all trending on industrial systems. This allowed emerging one of the main concepts applied in manufacturing processes, the Digital Twins. A digital counterpart of a physical process allows management, remote control and simulations over the process in a safe environment. This work proposes guidelines to design a Digital Twin architecture using Industrial Internet of Things and the integration of current technologies, applying these aspects in an experimental application.

Improved Visibility of High Dynamic Range Image During Trick-Play.....365

Masaaki Shimada and Kosuke Yagi (Advanced Technology R&D Center & Mitsubishi Electric Corporation, Japan); Nobuo Takeshita (Mitsubishi Electric Corporation, Japan)

This paper introduces a method that improves the visibility of images having a wide dynamic range of luminance in the trick-play mode by controlling the peak output luminance levels of the images. Our study found that this technology not only improves the visibility of images but also reduces eye strain.

Saturday, January 12 16:00 - 17:30

Session 2.11 Security and Optimization in CPS and IoT

Room: N264

Chair: Tauhidur Rahman (University of Alabama in Huntsville, USA)

16:00 Exploiting DRAM Latency Variations for Generating True Random Numbers.....367

Bashir Mohammad Sabquat Bahar Talukder and Joseph Kerns (University of Alabama in Huntsville, USA); Biswajit Ray (University of Alabama in Huntsville & 301 Sparkman Drive, USA); Tommy Morris (University of Alabama at Huntsville, USA); Md Tauhidur Rahman (University of Alabama in Huntsville, USA)

True random number generator (TRNG) plays a vital role in cryptography to ensure confidentiality, integrity, and safety in modern electronic systems because their failure can endanger privacy and undermine the viability of cyber-physical systems. However, the security of such systems depends on the quality of the TRNG. Unfortunately, existing Dynamic Random Memory (DRAM)-based TRNGs produce random numbers with either limited entropy or poor throughput. In this paper, we propose a DRAM-latency based TRNG that generates high-quality random numbers. The silicon results show that our proposed DRAM-latency based TRNG is robust against hostile environments and acceptably fast.

16:15 Runtime Integrity Verification in Cyber-physical Systems Using Side-Channel Fingerprint.....373

Shuo Yang, [Abdulrahman Alaqi](#) and Tamzidul Hoque (University of Florida, USA); Swarup Bhunia (UFL, USA)

The world is moving towards a connected ecosystem of cyber-physical components, which are increasingly deployed in diverse fields, from automobiles, to power grids, city infrastructure, manufacturing, and biomedical systems. Majority of these applications call for physical proximity of users to the system due to the nature of the service (e.g., health care). Both remote (through a network) and physical access to these systems have significantly broadened the attack surface of Cyber-Physical Systems (CPS) by providing increased flexibility to observe and alter the system maliciously. Many such systems are deployed in critical applications requiring a high level of operational integrity. Existing solutions for attack detection and prevention are often not adequate, specifically with respect to emerging vulnerabilities. In this paper, we focus on run-time monitoring of CPS with respect to attacks on hardware and software. In particular, we present the motivation for run-time monitoring and then propose methods for detection of physical attacks on hardware and activation of malicious programs in system software, both of which are severe threats to traditional and emerging applications of CPS. We propose a power-up and runtime hardware-software integrity monitoring of sensing and computing equipment in CPS through continuous observation of various side-channel parameters using a plug-and-play hardware module. We present a systematic framework that includes signature generation and comparison technique through device calibration, noise reduction, and workload analysis. Finally, we present a framework for monitoring two side-channel parameters (namely, power and electromagnetic radiation) to detect component replacement and malicious code execution.

16:30 AR-PUFs: Advanced Security Primitives for the Internet of Things and Cyber-Physical Systems.....379

Nikolaos Athanasios Anagnostopoulos, Tolga Arul, [Yufan Fan](#) and Manish Kumar (TU Darmstadt, Germany); Stefan Katzenbeisser (Technische Universität Darmstadt, Germany)

In this work, we examine very briefly a number of Advanced Reconfigurable Physical Unclonable Functions (AR-PUFs) that can be used to enhance the security of devices used for the realisation of the Internet of Things (IoT) and Cyber-Physical Systems (CPS). To this end, we also present two practical lightweight protocols that can be implemented using such AR-PUFs on IoT and CPS devices, in order to significantly enhance their security, even allowing the security of such devices to be restored after they have been compromised.

16:45 Memristor Crossbar PUF Based Lightweight Hardware Security for IoT.....384

[Mesbah Uddin](#) (The University of Tennessee, USA); Aysha Shanta (The University of Tennessee, Knoxville, USA); Md. Badruddoja Majumder (Graduate Research Assistant, USA); Md Sakib Hasan (University of Tennessee Knoxville, USA); Garrett Rose (University of Tennessee, USA)

Billions of IoT (Internet of Things) devices are being introduced to our everyday life each year. Most of them have little to no security features embedded in them although these devices connect to internet and communicate with other devices all the time which pose a great security and privacy risk. Due to the resource constraint nature of these devices, initially security was not being considered as an essential feature. Therefore, any security features to be included in these devices should be minimal in area, energy consumption and added delay. Physical unclonable function (PUF) has emerged as low-overhead solutions for a variety of security concerns in recent years. In this paper, we have presented a simple security method for these small IoT devices based on PUFs. The idea is to secure the backed up data during sleep mode of the embedded processor or when power is unavailable for a batteryless system. With the emergence of nano-technology, memristors are being widely explored due to their non-volatility, low footprint among other advantages. Our proposed security system utilizes a memristor based PUF along with memristors as a non-volatile backup memory. The proposed system is very lightweight as this domain demands and provide reasonable security.

17:00 Hybrid Weight Link Scheduling Method for IEEE 802.15.3c-Based Millimeter-Wave Wireless Networks.....388

[Yonggang Kim](#) (Gwangju Institute of Science and Technology (GIST), Korea); Ryangsoo Kim (ETRI, Korea); Hyuk Lim (Gwangju Institute of Science and Technology, Korea)

In a wireless personal area network (WPAN) consisting of a coordinator and multiple nodes, the coordinator determines which communication link between nodes to be activated, because multiple links cannot be activated simultaneously owing to an interference from each other. However, if nodes in a WPAN use a millimeterwave (mmWave) and the beamforming technique which forms the beam in the desired direction, the coordinator can select multiple links to be activated. This is because mmWave signal with beamforming technique shows narrow beam width and high directionality, and thus, interference to the undesired direction is considerably low. To improve the network performance by activating multiple links simultaneously, the methodology for scheduling multiple links has been an important issue in a mmWave wireless network. In this paper, we study the mmWave link scheduling problem for a mmWave WPAN following an IEEE 802.15.3c standard. The proposed method adjusts weight for selection of each link based on the queue length information, and schedules links by using the adjusted weights and transmission rates. The weight is adjusted by employing a hybrid approach of linear and equal weight determinations. Through extensive simulation results, we verify the network throughput and stability performance of the proposed link scheduling method.

17:15 An Architecture for Multimedia Transmission Through Infrared Light Communications in Consumer Electronics Environments: First Results.....394

Allan Amorim, Agemilson Pimentel, Petrina Kimura and XianPan Chen (TPV Technology, Brazil); Eddie B de Lima Filho (TPV & Universidade Federal do Amazonas - UFAM, Brazil)

Interconnection among consumer electronics products is of paramount importance and wide bandwidth is necessary for video. Therefore, light links are advantageous, because their spectrum is unregulated. The present article proposes an infrared-light-based architecture for transmission of multimedia content, whose initial results showed its effectiveness, with a transmission distances exceeding 55m.

Session 2.12: AR & VR Display and Human Interface Technologies 1

Room: N262

Chairs: Fumio Isshiki (Finekit Inc., Japan), Haruhiko Okumura (Toshiba Corp. R & D Center, Japan)

16:00 Holographic Displays for AR Applications.....398

Yan Li and Pengcheng Zhou (Shanghai Jiao Tong University, P.R. China); Yikai Su (Shanghai jiao tong university, P.R. China)
We report two compact designs for holographic AR displays using holographic optical elements (HOEs). The HOEs are thin Bragg holograms that can realize the functions of an optical combiner, a see-through eye piece or a beam expander. With small form factors, our holographic displays are promising for mobile augmented reality (AR) applications.

16:15 Head-up Display (HUD) Requirements Posed by Aspects of Human Visual System.....400

Sakuichi Ohtsuka (Kagoshima University, Japan)
HUD is a key cutting edge technology for automobile display systems. Before starting mass-production, we should carefully consider (1) effects of user diversity (e.g., skill, age, and color vision deficiency, etc.) and (2) effects of HUD on the human visual system. In this paper, we first describe (1) a primitive analysis of the effects of HUD on the human visual system from the aspects of background illumination and color vision deficiency and (2) a summary of our previous work. Our key finding is the necessity of a diffuser and an attenuation filter for separating real background information from artificial information.

16:30 Reducing Driver Distraction by Utilizing Augmented Reality Head-Up Display System for Rear Passengers.....404

Shu Wang, Vassilis Charissis, Ramesh Lagoo, Julie Campbell and David Harrison (Glasgow Caledonian University, United Kingdom (Great Britain))
Long distance travelling and commuting can be particularly tiring for the driver and the rear passengers. The level of driver distraction could be further increased if younger passengers onboard are idle for long time during the drive. This paper presents a novel Augmented Reality (AR) Head-Up Display (HUD) interface that aims to attract rear passengers' attention through assortment of infotainment application superimposed on the side car-windows. The system additionally offers a bespoke provision of educational value, which provides superimposed data and games available for the different landmarks. The simplified interface enables the use from younger passengers and seniors alike. The proposed system has undergone two main evaluations involving 50 users and 10 families aiming to identify the system usability. The evaluation took place in a full-scale Virtual Reality driving simulator, which tested the drivers/parents ability to avoid collisions. The evaluation outcome offered an informative appraisal of the systems efficiency and overall positive feedback from the users.

16:45 Multi-Mirror Array Optics for Augmented Reality Devices and Optical Distortion Correction.....410

Tomoya Tsuruyama (Toshiba Corp., Japan); Haruhiko Okumura (Toshiba Corp. R & D Center, Japan); Aira Hotta and Takashi Sasaki (Toshiba Corp., Japan); Nao Mishima (Toshiba Corporation, Japan)
Multi-Mirror Array can minimize the optics of Augmented Reality devices. We made a glass-type display device with Multi-Mirror Array, and Wide field of view combiners for head-up displays with Fresnel reflector that has optical power to magnify the projected image. We also developed Optical Distortion Correction for projecting the images on Multi-Mirror Array. Finally, we show an application of Optical Distortion Correction.

17:00 Augmented Reality Using High Resolution Adaptive Headlights.....416

Christiane Jasmin Reinert-Weiss (University of Stuttgart, Germany); David Duhme (HELLA KGaA Hueck & Co., Germany); Norbert Fruehauf (University of Stuttgart, Germany)
Implementing augmented reality in a vehicle is able to increase safety and comfort of the driver. Integrating an active matrix liquid crystal display in an adaptive headlight enables an intuitive use of augmented reality and provides additional communication with other road users.

Session 2.9 Machine Learning, Deep learning and AI in Consumer Electronics 1

Room: N256

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

16:00 Using Neural Networks to Enhance the Quality of ROIs for Video Based Remote Heart- Rate Measurement from Human Faces.....418

Thomas Pursche, Bernd Tibken, Roland Clauß and Moeller (University of Wuppertal, Germany)
Classical approaches for measurement of a patients heart rate (HR) inherent several disadvantages like discomfort or irritation of the skin. Therefore, non-invasive and non-obtrusive methods, like video based ones become more and more popular. A majority of the methods described in the past, use video data of human faces. These methods recon minimal changes, invisible for the human eye, in the color spectrum of a persons face to measure the heart activity. It is obvious, that measuring the HR from a persons video data is not a trivial -- though a very challenging -- task, as seen in the last years. Quality of the results can be improved in multiple ways. Most of the presented approaches using filter methods like independent component analysis (ICA), Blind source separation (BSS) or many others to improve the given data. Because all of these techniques intervene at a relative late point in the algorithm, in this paper another approach is described. By detecting and enhancing the region of interest (ROI) from video data made before, it is possible to improve quality of the given data for the later use in any algorithm. A huge acceleration in processing time is realized. To achieve this the here proposed method using neural networks to detect and improve the ROI from given video data is used. By the later use of ICA the here proposed algorithm is able to measure HR with a very high accuracy. The combination of this two techniques, is able to deal with various situations in different lighting conditions and patients activation level, therefore a better accuracy and an improvement in runtime towards more realistic applications was realized.

16:15 Orientation and Occlusion Aware Multi-Person Pose Estimation Using Multi-Task Deep Learning Network.....423

Huiyang Zhang, Yanlei Gu and Shunsuke Kamijo (The University of Tokyo, Japan)
In this paper, we present a multi-task pose estimation approach to deal with human behavior understanding. Our deep learning model is based on Mask-

RCNN, of which the output contains 4 tasks: human keypoint prediction, body segmentation, orientation prediction and mutual occlusion detection. Our model is trained on the public dataset COCO, which is further augmented by ground truths of orientation mask and occlusion mask. Experiments show the learning accuracy of the proposed method. Comparisons further illustrate the performance improvement after combining more features by multi-task strategy.

16:30 Indoor Positioning in Large Shopping Mall with Context Based Map Matching.....428

Yoshihiko Kamiya (University of Tokyo, Japan); Yanlei Gu and Shunsuke Kamijo (The University of Tokyo, Japan)

This paper focus on large indoor environment and proposes an accurate indoor positioning system with context based map matching. Our system adopts smartphone as the positioning platform, and uses the motion sensors in a smartphone to recognize various human activities which are meaningful for the localization. We divide the activities into vertical direction activity between floors and horizontal direction activity on the floor. We recognize the activities using the Long Short-Term Memory (LSTM) Network and aware of the context about the position information. These positions information are integrated in a Hidden Markov Model (HMM) to conduct an accurate indoor positioning.

16:45 Convolutional Neural Network Based Inverse Tone Mapping for High Dynamic Range Display Using LUCORE...434

Katsuhiko Hirao, Zhengxue Cheng, Masaru Takeuchi and Jiro Katto (Waseda University, Japan)

The popularity of high dynamic range (HDR) makes the inverse tone mapping become an important technique for HDR display. In this paper, we propose a convolutional neural network (CNN)-based inverse tone mapping method to generate a high-quality HDR image from one single standard dynamic range (SDR) image. First, we present a CNN design with a three-channel input, which considers both luminance and chrominance. Second, we propose to use overlapped inputs to remove the boundary artifacts, caused by zero paddings in CNN. Experimental results demonstrate the high quality of our generated HDR images compared to the ground truth.

17:00 Highly Pipelined Accelerator for Convolutional Neural Network.....436

Junkyung Kim, HwangSik Bae, Kyeong Yuk Min and Jong-Wha Chong (Hanyang University, Korea)

We propose a highly pipelined accelerator (HIPA) for the convolutional neural network (CNN). The CNN achieves remarkable performance in computer vision application with high computational power and low energy efficiency than conventional algorithms. Recent CNN accelerators with energy efficiency perform pre-loading in the internal memory by reducing data transmission from off-chip. We focus on the input data loading time to the processing unit for higher throughput. HIPA reduces loading time with optimized internal memory structure. For throughput, we propose a continuous snake-scan order to maximize data re-use. HIPA shows the input data loading time reduction by over 37% from VGGNet-D, and speed up to 530GOp/s.

17:15 Single Image Dehazing Based on Convolutional Neural Network Using Boundary Constraint.....438

Yi Lai (Xi'an University of Posts and Telecommunications, P.R. China); Xinyu Wu (Xi'an University of Posts and Telecommunications, P.R. China); Gang Zhou (Xinjiang University, P.R. China); Tingge Zhu (Xi'an University of Posts and Telecommunication, P.R. China); Hanlu Zhang (Xi'an University of Posts and Telecommunications, P.R. China)

Images captured in haze weather conditions are often degraded. This paper presents a trainable and efficient method to restore a haze-free image. The proposed method employs the boundary constraint to improve the transmission, and estimate the atmosphere light based on quad-tree subdivision to raise the brightness of the haze-free image. Experiments results on synthetic and real-world images show the effectiveness of the proposed method.

Session 2.10: Automotive CE Applications 1

Room: N254

Chair: Martin Pöllot (FAU Erlangen-Nuremberg, Germany)

16:00 Irregular Motion Detection in Automotive Navigation Systems with Soft Map Rotation.....443

Martin Pöllot (FAU Erlangen-Nuremberg, Germany); Dominic Springer, Ralph Schleifer and Monika Nitsch (Audi AG Ingolstadt, Germany); Andre Kaup (University of Erlangen-Nuremberg, Germany)

Visually unpleasant and erroneous positioning in navigation scenes is an issue for, but not limited to, premium vehicle manufacturers. In order to assure consumers high quality products, intelligent automated display testing is required. This paper presents an enhanced version of an error detection algorithm for navigation sequences based on novelty detection. Experimental results demonstrate the improvement over the state of the art, being able to overcome hiding and concealing present positioning errors. Evaluating the performance of the proposed algorithm, a precision of 76.2% could be reached while not decreasing the recall at all.

16:15 Inertial-based Gesture Recognition for Artificial Intelligent Cockpit Control Using Hidden Markov Models.....449

Markus Haid (CCASS - Competence Center of Sensor Systems & Hochschule Darmstadt, Germany); Bernhard Budaker, Markus Geiger and Daniel Husfeldt (CSI GmbH, Germany); Marie Hartmann and Nick Berezowski (CCASS - Competence Center of Sensor Systems, Germany)

Driving a car is no longer just a means to get around quickly. Currently, driving itself has become an entertainment factor with steadily increasing occupant safety. This is ensured by a multitude of safety and comfort features, such as various driver assistance systems and innovative control options within the cockpit. This paper introduces a new way to cockpit operation where gesture recognition of the occupant is done using low-cost inertial sensors on a bracelet. The implementation of Hidden Markov models for the stochastic modelling of human motion is utilized for the establishment of an artificially intelligent data analysis system.

16:30 Real-Time Multi-Gesture Recognition Using 77 GHz FMCW MIMO Single Chip Radar.....453

Piyali Goswami (Texas Instruments India Pvt. Ltd., India); Sandeep Rao and Sachin Bharadwaj (Texas Instruments, India); [Amanda Nguyen](#) (Texas Instruments, USA)

Innovations in CMOS radar has paved way for new functions like gesture-based human-machine interaction using radar for consumer and automotive electronics. Single chip radars which integrate the RF front-end and digital processing logic are fit for such applications due to their cost and form factor but are constrained in angular resolution, memory, and processing power. In this paper, we propose low complexity radar-based multi-gesture classification solution which overcomes these constraints to achieve 96% accuracy for 6 gestures generalized across 8 users. The algorithm developed was found to consume only 8.4% DSP cycles and 256KiB memory on Texas Instrument's AWR1642.

16:45 Real Time Image Processing System for Detecting Infrastructure Damage: Crack.....457

Sung-Mo Kang, Chan-Jun Chun and Seung-Bo Shim (Korea Institute of Civil Engineering and Building Technology(KICT), Korea); [Seungki Ryu](#) (Korea Institute of Civil Engineering and Building Technology, Korea); Jong-Dae Baek (Korea Institute of Civil Engineering and Building Technology(KICT), Korea)

Infrastructure management is very important and costly task. The crack is one of the significant factors in infrastructure management. The big crack in road causes serious damage to the vehicle and shorten the life of the infrastructure and vehicle. This paper proposes image processing algorithm and portable system for detecting the crack in road. There are several ways to detect crack, and the camera-based method is used in this paper. The crack detection system using the camera-based method has some advantages such as simple, inexpensive and powerful. The proposed crack detection system consists of camera and small embedded board. Therefore, it can be easily installed on any vehicle. This paper implements the system and analyzes the results in the actual conditions of the road.

17:00 An FPGA-based Electronic Control Unit for Automotive Systems.....460

Jung Hwan Oh and [Young Hyun Yoon](#) (Seoul National University of Science and Technology, Korea); Ji kwang Kim (Seoul National University of Science And Technology, Korea); Hyung Bin Ihm and Shin Hye Jeon (Hyundai Motors Company, Korea); Tae Heon Kim (Hyundai NGV, Korea); Seung Eun Lee (Seoul National University of Science and Technology, Korea)

In this paper, we propose an Field Programmable Gate Array (FPGA)-based Electronic Control Unit (ECU) for automotive systems. By deploying the FPGA-based ECU in automobile, it improves the flexibility of entire system. The FPGA can communicate with an automotive MCU by deploying the Zipwire communication unit through high-speed and reliable protocol. The Zipwire communication unit is realized on FPGA and successfully demonstrates the Zipwire communication between the MCU and FPGA.

17:15 Study of LED Spot Beam Lighting for Headlights.....462

[Ritsuya Oshima](#) and Masashige Suwa (Mitsubishi Electric Corporation, Japan)

In order to improve the visibility of a driver and to secure the safety of pedestrians during night driving, it is required to upgrade the performance and function of headlights. In recent years, the variable light distribution type headlights that change the light distribution according to the surrounding environment and situation have been incorporated, such as the ADB (Adaptive Driving Beam) function that turns off the light only in the area of an oncoming car with the headlights always high-beam light and the spot beam function that emits narrow-angle light toward pedestrians and obstacles. Here we propose, as a method for realizing the spot beam function, a new variable light distribution method that changes the light projecting direction by driving only the optical components.

Saturday, January 12 17:30 - 18:00

Session 2.13: Energy Management for CE 1

Room: N256

Chair: Bibek Paudel (FOSS Nepal, Nepal)

17:30 Energy Management System Based on Augmented Reality for Human-Computer Interaction in a Smart City.....464

[Keonhee Cho](#) and Hyeonwoo Jang (Chung-Ang University, Korea); Lee Won Park (ChungAng University, Korea); SeungHwan Kim (Chung-ang University, Korea); Sehyun Park (Chung-Ang University, Korea)

As the importance of energy demand management grows, Energy Management System (EMS) is becoming increasingly popular. The existing EMS monitors the energy status based on the graph or numerical value through the monitor screen. Consumers have difficulties in understanding and using energy status through EMS. Therefore, this paper proposes a new interface EMS that can be easily accessed and utilized by consumers. It provides a new life value to consumers through a new interface called Augmented Reality and a diorama that can visualize it intuitively. Ultimately, the proposed system can be utilized for urban energy management and integrated energy management in future smart cities.

17:45 A Context-aware Architecture for Energy Saving in Smart Classroom Environments.....467

[Prabesh Paudel](#), Kyoungho Choi, Soonyoung Park and Sangkyoon Kim (Mokpo National University, Korea)

In this paper, we present a novel context-aware architecture for a classroom environment, recognizing student activities and saving energy. In contrast to previous models which are mainly focused on either video or image, various sensor data such as temperature, humidity, and luminance are combined with a video sequence in the proposed context-aware architecture. More specifically, student activities are classified using the convolutional 3D network (C3D) model and classroom temperature and humidity are predicted using a long short term memory (LSTM) network. Then, the outputs of the C3D model and

LSTM network are combined and fed into fully connected layers to produce control parameters such as turn on/off air conditioners/heaters/dehumidifiers. Experimental results show that the proposed context-aware framework can be used for energy saving in classroom environments.

Session 2.14: Energy Management for CE 2

Room: N254

Chair: Yuki Ogawa (Ritsumeikan University, Japan)

17:30 Energy Management Through EcoCute to Increase Self-Consumption of Solar Power.....469

Yuki Ogawa, Yuta Morizane, Akihiro Toda and Satoko Sakajo (Mitsubishi Electric Corporation, Japan)

EcoCute is expected as a self-consumption device for zero-energy house. Although some EcoCute, which can boil hot water by surplus power, have already been launched, it could store too less energy for tank as contribute for grid stability. We have constructed the system that predicted the generated power of the next day from the weather outlook and the past generation data, and shifts time schedule of boil from night to daytime to increase the amount of boiling water. We discuss about self-consumption system through EcoCute and the result of demonstration in this paper.

17:45 Efficient Ising Model Mapping to Solving Slot Placement Problem.....471

Sho Kanamaru, Daisuke Oku and Masashi Tawada (Waseda University, Japan); Shu Tanaka (Waseda University, Japan Science and Technology Agency, Japan); Masato Hayashi (Hitachi, Ltd., Japan); Masanao Yamaoka (Hitachi Ltd., Japan); Masao Yanagisawa and Nozomu Togawa (Waseda University, Japan)

Ising model-based computation has attracted attention as it can obtain better solutions of various combinatorial optimization problems at high speed. A slot placement problem is one of the combinatorial optimization problems which plays an important role in the optimal logic-block placement but it is known as an NP-hard problem. In this paper, we propose an efficient Ising model mapping to solve it and an interpretation method for the obtained Ising solutions to satisfy the constraints. On a fully-connected annealing machine, we could obtain feasible solutions with almost the same accuracy as the simulated annealing with two orders of magnitude faster.

Session 2.15: Energy Management for CE 3

Room: N264

Chair: Dipankar Pal (BITS-Pilani, K. K. Birla Goa-Campus, INDIA & Senior Member IEEE, India)

17:30 RF Harvesting System for Low-Power Applications Using FinFETs.....477

Dipankar Pal (BITS-Pilani, K. K. Birla Goa-Campus, INDIA & Senior Member IEEE, India); Nagateja T (National Chiao Tung University, Taiwan); Srinivasulu Avireni (JECRC University, India)

Two high efficiency FinFET-based negative voltage rectifiers for radio frequency (RF) applications have been proposed. These circuits have very good power conversion efficiency (PCE) especially in small RF input conditions. The designs are simple, yet the novelty lies in realisation utilising normal threshold voltage Si FinFET (NVT), low threshold voltage Si FinFET (LVT), high threshold voltage Si FinFET (HVT) which offers power efficient solutions for RF-harvesting applications. Simulations are carried out on 20 nm FinFET model files employing Cadence software. Performance-comparisons of these three models have been done to validate the two-designs and to benchmark them. We have investigated how to improve parameters such as the output DC voltage, output DC power and PCE of rectifier. With LVT FinFET the second rectifier proposed offers 92% of PCE, -342 mV of DC output voltage at RF input

17:45 Energy Consumption Minimization Control for Augmented Reality Applications Based on Multi-core Smart Devices...483

Sooeun Song, Junsung Kim and Jong-Moon Chung (Yonsei University, Korea)

In this paper, the power consumption model of AR application workloads is mathematically modeled, based on the dynamic voltage and frequency scaling (DVFS) and the parallel execution of multi-core CPUs. Based on the proposed model, the optimal core operation frequency and minimized power consumption are derived.

Session 2.16: Deep Learning & Perception on Conventional and Emerging Platforms

Room: N262

Chair: Laxmi Gewali (University of Nevada Las Vegas, USA)

17:30 Topological Map Generation for Intrinsic Visual Navigation of an Intelligent Service Robot.....487

Ren C. Luo and Wei Shih (National Taiwan University, Taiwan)

Navigation methods nowadays are mainly based on metric maps, and a set of explicit geometric coordinates must be provided. However, a service robot may struggle in reaching this precise coordinate. If there is an obstacle preventing the robot from reaching the goal coordinate, the robot will judge that it has not reached the goal even if it has already reached the area such as the "kitchen". Topological maps are a good way to record semantic meanings of the environments, such as images. We integrate metric maps and topological maps together for a mobile robot to perform navigation. We propose an image-based particle filter which can generate a more flexible estimated robot pose. We test our proposed method in an 1000 m² indoor environment. The experimental result shows that our proposed method can reduce total navigation time and reach higher success rate in navigation stage. We show that our proposed method is suitable for intelligent service robots, and can be used in any indoor area with ease.

17:45 Deep Learning Based Shopping Assistant for the Visually Impaired.....493

Justin Zhan (University of Nevada, Las Vegas, USA); Daniel Pintado (University of Nevada Las Vegas/AEOP, USA); Vanessa Sanchez (University of Nevada, Las Vegas, USA); Erin Adarve and Mark Mata (University of Nevada Las Vegas/AEOP, USA); Zekeriya Gogebakan and Bunyamin Cabuk (University of Nevada Las Vegas/RET, USA); Carter Chiu (University of Nevada, Las Vegas, USA); Laxmi Gewali (University of Nevada Las Vegas, USA); Paul Oh (University of Nevada, Las Vegas, USA)

Contemporary developments in computer vision and artificial intelligence show promise to greatly improve the lives of those with disabilities. In this paper, we propose one such development: a wearable object recognition device in the form of eyewear. Our device is specialized to recognize items from the produce section of a grocery store, but serves as a proof of concept for any similar object recognition wearable. It is user friendly, featuring buttons that are pressed to capture images with the built-in camera. A convolutional neural network (CNN) is used to train the object recognition system. After the object is recognized, a text-to-speech system is utilized to inform the user which object they are holding in addition to the price of the product. With accuracy rates of 99.35%, our product has proven to successfully identify objects with greater correctness than existing models.

Sunday, January 13

Sunday, January 13 8:55 - 9:55

Keynote 6: Gordana Velikic, RT-RK, Novi Sad, Serbia

Room: N260-N258

Sunday, January 13 10:00 - 10:30

Poster Session 3

Room: Hall Area

Chair: Konstantin Glasman (St. Petersburg State University of Film and Television, Russia)

Factory Environment Monitoring: A Japanese Tea Manufacturer's Case.....499

Yui Uehara (Graduate School of Engineering, Oita University, Japan); Satoshi Ohtake (Oita University, Japan)

This paper proposes a temperature and humidity monitoring system. The system was designed for monitoring and investigating the manufacturing environment in a tea factory based on the request of the factory's owner. The system had been installed in the factory and the monitoring has already been done. We show distribution of temperatures and humidities in the factory collected by the system.

360 Degree Panorama Generation Using Drone Mounted Fisheye Cameras.....502

Osama Zia (Sejong University, Korea); Junho Kim (Dongseoul University, Korea); Kyungjin Han and Jong Weon Lee (Sejong University, Korea)

We propose a system that produces a high quality 360° panorama from images captured by fisheye cameras mounted on a drone. The hardware of the system is designed in such that no user input is required to stitch the individual images. The auxiliary equipment such as drone wings and legs are not a part of the automatically stitched panorama. Hence, no additional post processing is required to remove unwanted artifacts. Automatic stitching is performed using Nvidia VRWorks 360 SDK. The stitched panorama has no visible seams in it. Furthermore, the panorama is automatically straightened with respect to the horizon.

360-Degree Video Streaming Using Stitching Information.....505

Bong-Seok Seo (Seoul National University of Science and Technology, Korea); Dong Ho Kim, Eunyoung Jeong and ChangJong Hyun (Seoul National University of Science and Technology, Korea); Dongho You (Technische Universität Dresden & The Deutsche Telekom Chair of Communication Networks, Germany)

Recently, as 360 contents are explosively increased, studies on how to create, store, and transmit 360 contents are being actively carried out. However, the 360 content is very significant at a large resolution with very little viewing area for the user at a time. Also, the shooting process is limited in shooting and production, and since a very large resolution image editing process requires a high-end computer in the editing process, there is a problem that various people are not easily accessible. In addition, as mentioned above, in the transmission, the area actually viewed by the user is very small compared to the image to be transmitted. Therefore, the band efficiency problem is also pointed out as a serious problem to be solved. In order to solve these problems, researches are being actively carried out to realize user view-port adaptive transmission by dividing / storing images in various forms. In this paper, we will discuss how to simplify the production process and storage method and implement view-port adaptive transmission through Stitching Information to solve the above-mentioned problems at the same time.

WSNs-based Long-Range Selfie Camera System.....509

Thanh Trung Ngo, Jae Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

This paper proposes a WSN-based long-range selfie system, which is capable of taking selfies and landscape photos from long distances. In the proposed

system, a low-power wireless sensor network is used to provide long-range communication between a camera and a sensor node. The operating range of the proposed system can be extended easily by adding more relay nodes to the network. Experimental results show that the proposed system performs efficiently in terms of network range, end-to-end network delay, and processing time.

Non-linear Acoustic Echo Cancellation Based on Mel-Frequency Domain Volterra Filtering.....512

Geon Woo Lee and Jung Hyuk Lee (Gwangju Institute of Science and Technology (GIST), Korea); Jung Min Moon (Gwangju Institute of Science and Technology, Korea); Hong Kook Kim (Gwangju Institute of Science and Technology (GIST), Korea)

This paper proposes an acoustic echo cancellation (AEC) algorithm based on mel-frequency domain Volterra filtering in order to reduce complexity of a conventional Volterra filter. By doing this, the proposed AEC implemented in the mel-frequency domain can work around 50 times faster than the conventional one using linear-frequency domain Volterra filtering. Meanwhile, the echo return loss enhancement (ERLE) of the proposed ACE is 9dB lower than the conventional one under a single talk condition.

Self-Adjustable Speech Enhancement and Recognition System.....514

Tomoko Kawase (NTT Corporation, Japan); Okamoto Manabu (NTT Media Intelligence Laboratories & Nippon Telegraph and Telephone Corporation, Japan); Takaaki Fukutomi, Yamato Takahashi, Ryota Masuda and Takayuki Ootake (NTT Corporation, Japan)

We have developed a self-adjustable speech enhancement and recognition (SSER) system to make automatic speech recognition (ASR) robust to variation of acoustic conditions. The SSER system enhances speech components in observed signals, switching parameter values in accordance with the acoustic conditions. Candidates for the parameter value are automatically generated using a real-coded genetic algorithm (GA) in advance. The experimental results show that the performance of the parameter-set values is improved by the proposed method.

Fast Video Shot Boundary Detection Based on Visual Perception.....516

Yin Gao and Yi Lai (Xi'an University of Posts and Telecommunications, P.R. China)

Dividing video sequences into shots for video content analysis and video retrieval is very important, so shots are the beginning of these advanced analyses. In this paper, we proposed a new model based on visual perception, which can be expressed as "whole to local", following the concept of human vision. We first browse the video to remove the redundant frames of the video, which can reduce the computational cost. Then, the visual consistency feature of the video is used to construct the consistency function between frames to create pending shots. Finally, the shot boundary detection results are further optimized in conjunction with the motion feature. The new model which contains the inter-frame coherence and optical flow feature for shot boundary detection can shorten the calculation time and detect the shots boundary fast and accurately, without sacrificing detection performance. In terms of evaluation, the precision, recall and F1 value of the model shows good results.

Single Image Super-resolution with Self-similarity.....520

Yoojun Nam, Junwon Mun, Yunseok Jang and Jaeseok Kim (Yonsei University, Korea)

Degraded low-resolution (LR) images are often obtained from cameras. Resolution enhancement and image restoration are very practical in many fields such as medical imaging, surveillance system and remote sensing. Single image super-resolution is a technique which reconstruct a restored high-resolution (HR) image from a degraded LR image. In this paper, we propose single image super-resolution based on sparse coding using self-similarity prior. A sparsity constraint is used to jointly train coupled dictionaries which can generate high frequency details. Reconstructed HR output is enhanced with non-local means based on self-similarity prior. Experimental results demonstrate that our method shows higher performance than other existing algorithms.

Scene Exchange: An Audio Processor to Replace the Background Signal for a Different Scene.....522

Akihiko K. Sugiyama (NEC Corporation, Japan); Ryoji Miyahara (NEC Platforms, Ltd.)

This paper proposes an audio processor, Scene Exchange, to replace the background signal for a different scene. A foreground signal is carefully extracted from an input signal by a noise suppression technique and reshaped by linear prediction. A new background signal, which is stored in a database in advance and describes a different scene, is added to the extracted foreground signal with a specified ratio. Evaluation results in spectrogram demonstrate successful replacement of the background signal components. Scene Exchange is a powerful tool for consumer applications such as AR/VR data authoring, alibi phone, and personal authentication.

IoT Based Interactive Dual Mode Smart Home Automation.....524

Abdul-Rahman Al-Ali, Omar Hamdan, Tamer Shanableh, Hassan Shanableh and Inas Zaki (American University of Sharjah, United Arab Emirates)

Smart home appliances nowadays can be networked utilizing the IoT communication protocols. Appliances can be monitored and controlled using local switches and remote access via mobile phones. Many systems are reported in the literature based on single monitoring and controlling mode utilizing text, voice or gesture commands. This paper presents an IoT-based Dual-mode system to monitor and control home appliances. In the proposed system, home appliances are interfaced with a general purpose digital and analog inputs and outputs of a single chip microcontroller. The microcontroller has a built-in wireless access point that enables the system to communicate with a home server. The system has two different operation modes. The first mode makes use of a mobile app interface with virtual switches and sliders to monitor and control appliances. The second mode is chat based that uses text or audio commands fitted with Natural Language Processing to monitor and control the home appliances. The proposed system is scalable in that it is able to add and remove rooms on demand. For validation and testing purpose, a prototype is built that includes home appliances, room controllers, home server and a mobile app.

MoBeTrack: A Toolkit to Analyze User Experience of Mobile Apps in the Wild.....526

Andrea Generosi, Silvia Ceccacci and Alex Altieri (Università Politecnica delle Marche, Italy); Gabriele Foresi (Università Politecnica delle Marche, Italy); Abudukaiyoumu Talipu (Università Politecnica delle Marche, Italy); Giacomo Turri

(Universita' Politecnica delle Marche, Italy); Maura Mengoni (Università Politecnica delle Marche, Italy); Luca Giraldi (Polytechnic of Marche, Italy)

MoBeTrack is a toolkit for automated data collection to support User Experience assessment of mobile applications: it is able to collect user demographic information, trace user interactions and recognize user's emotions during the use of an application. An SDK allows to easily add the toolkit to every mobile application, in a flexible and scalable way

Castanets: Distributed Web Engine Model for Multi-Device Experiences.....528

Hyowon Kim, [Sunwoo Nam](#), Joonghun Park, Suyambulingam Rathinasamy Muthupandi and Daehyun Ko (Samsung Electronics, Korea)

As IT devices have increased and diversified, Multi-Device Experiences (MDE) has been brought to public attention. However, there has been little study that tried to reconfigure web engine architecture for MDE scenario. This paper will present a novel architecture of web engine for distributed environment. Its effectiveness will be demonstrated with our experimental results using a variety of test scenarios.

A Real-Time Smartphone App for Unsupervised Noise Classification in Realistic Audio Environments.....531

[Nasim Alamdari](#) and Nasser Kehtarnavaz (University of Texas at Dallas, USA)

This paper presents a real-time unsupervised noise classifier smartphone app which is designed to operate in realistic audio environments. This app addresses the two limitations of a previously developed smartphone app for unsupervised noise classification. A voice activity detection is added to separate the presence of speech frames from noise frames and thus to lower misclassifications when operating in realistic audio environments. In addition, buffers are added to allow a stable operation of the noise classifier in the field. The unsupervised noise classification is achieved by fusing the decisions of two adaptive resonance theory unsupervised classifiers running in parallel. One classifier operates on subband features and the other operates on mel-frequency spectral coefficients. The results of field testing indicate the effectiveness of this unsupervised noise classifier app when used in realistic audio environments.

Enhanced Flash Swap: Using NAND Flash as a Swap Device with Lifetime Control.....536

[Taejoon Song](#), Gunho Lee and Youngjin Kim (LG Electronics, Korea)

Modern mobile consumer electronics require more memory than ever, as more complicated and memory-heavy features are becoming more common. One of the ways to improve memory space is to have NAND flash as a swap device. However, naively adopting such approach has reliability issues, due to the limited lifetime of NAND flash devices. In this paper, we propose a new solution, Enhanced Flash Swap (EFS). EFS uses NAND flash as a swap device with a careful control of its lifetime. This paper introduces several techniques to address the issue of lifetime on flash-based swap, including deduplication, compression, buffering and physical block management. We also present how to optimize write I/O patterns for a longer lifetime through an intensive experiment of WAF estimation on real devices. Experimental results show that EFS has greater lifetime by 3.6x - 138x than traditional swap system.

Least Object Transfer Latency in the IoT with Small Congestion Window.....541

[Yong-Jin Lee](#) (Korea National University of Education, Korea)

Object transfer latency is a main factor composing the end-to-end latency in the Internet. The object transfer latency is affected by object size and transmission time by TCP congestion control mechanism. This paper aims to deal with the narrowband IoT (Internet of Things) environment which does not allow fast data retransmission due to the very small size of window. Our analytical model estimates the least latency when all the packet losses occur in the last congestion window during slow start. Our model can compute the object transfer latency when the packet loss rate, the initial congestion window size, the link bandwidth, and round trip time are given.

Boundary Recovery of Depth Map for Synthesis View Optimization in 3D Video.....543

[Meng Yang](#), Yu Cheng, Yujie Guang, Jianji Wang and Nanning Zheng (Xi'an Jiaotong University, P.R. China)

Depth map generally includes structural errors and blurs near boundaries. These distortions severely degrade the quality of synthesis views in 3D video systems. We propose a method to accurately recover the boundaries of the depth map with the guidance of its associated texture image. Experiments are conducted on a set of depth maps and compared to four state-of-the-art methods. The results show that the boundaries of the depth maps with the proposed method are more accurate and clear than that of the other methods. Consequently, it well improves the subjective quality of the generated synthesis views.

Channel Selective Independent Vector Analysis Based Speech Enhancement for Keyword Recognition in Home Robot Cleaner.....547

[Jaepil Seo](#) (Artificial Intelligence Lab., LG Electronics, South Korea); Keunsang Lee and Jaewoong Jeong (Artificial Intelligence Lab., LG Electronics, South Korea, Korea)

In this paper, we proposed a speech enhancement based on channel selective independent vector analysis (CS-IVA) for improving the keyword recognition rate in home robot cleaner. At first, the proposed method eliminates the noises generated by home robot cleaner. Then the CS-IVA separates sources and estimated target speech is selected. Finally, residual noise contained in CS-IVA output is reduced. Simulation results show performance of keyword recognition is improved.

Deep Neural Network-based Speech Separation Combining with MVDR Beamformer for Automatic Speech Recognition System.....550

[Bong-Ki Lee](#) (LG Electronics, Korea); Jaewoong Jeong (Artificial Intelligence Lab., LG Electronics, South Korea, Korea)

This paper presents a speech enhancement system based on deep neural network (DNN) combined with a minimum variance distortionless response (MVDR) beamformer for a noise robust automatic speech recognizer (ASR). Although adaptive beamforming algorithms have been proposed to improve speech recognition performance, they still have problem with performance degradation in low signal-to-noise ratio (SNR) and speech-like noisy environments such as babble, music, and TV noises. Therefore, in this study, we propose a speech enhancement algorithm that combines DNN-based

speech separation and MVDR beamforming algorithms to improve the ASR performance. First, DNN-based speech separation algorithm using an ideal ratio mask (IRM) is performed on the signals captured from each microphone. For this, the IRM estimated by the DNN is applied independently for each microphone channel using a mean value of the estimated masks. After that, the output signals of the DNN-based speech separation are processed by an ideal binary mask (IBM)-based MVDR beamformer to reduce the residual noise and reverberation where the IBM is estimated using the DNN. Experiments show that the proposed algorithm, which combines the DNN-based speech separation and MVDR beamforming algorithms, is better than DNN or MVDR alone in the QVoice, LG's ASR system in G7 smartphone.

App for session monitoring and subjective quality assessment of 2D and 360VR video in real time.....554

Javier Escobar, César Díaz and Fernando Jaureguizar (Universidad Politécnica de Madrid, Spain); Pablo Pérez (Nokia Bell Labs, Spain); [Narciso García](#) (Universidad Politécnica de Madrid, Spain)

We present an app to both monitor the session activity and conduct subjective quality tests of both 2D and 360VR content transmitted through adaptive bitrate streaming techniques in real time in an unsupervised, highly-configurable, minimum-intrusive, integrated fashion. Users carry out the tests within the app environment, thus fostering immersiveness and engagement. Furthermore, monitoring and test results are collected and stored in a cloud database for subsequent analysis.

Data Communication Security Based on Novel Reversible Mean Shift Steganography Algorithm.....556

Tao Wang, Zongmin Zhao, Pei Du, Weike Wang, Yuntong Tian, Qiang Hao, Zhun Zhang and [Xiang Wang](#) (Beihang University, P.R. China)

With the popularity of node data to the sink-node in wireless sensor networks (WSNs), it is vital to protect the privacy of data and enable the sink-node to easily manage the data at the same time. Under such demands, reversible data steganography in encrypted images attracts more and more researchers' attention. In this paper, we propose a novel reversible mean shift steganography algorithm for improving the security of data communication in WSNs. The algorithm first calculates the l , α , and β sub-components after removing the l component of the original image. At the same time, we use mean shift clustering algorithm to calculate the 3-dimensional regional maximum points based on l , α , and β components and mark them. Finally, the secret information is encoded and hidden in the corresponding extreme points of the Bit plane 0 of the sub-components, and then scrambled with the key. The extensive experimental results show that the proposed algorithm has little influence on the original image, and the histogram is almost the same, and the average error bit ratio (EBR) is only 0.164%.

A Novel Channel Emulation Method in Multi-Probe Anechoic Chamber Setups.....561

[Ruru Wang](#) (Beijing University of Posts and Telecommunications, P.R. China); Yifu Ding (China Automotive Technology and Research Center Co. Ltd, P.R. China); Weimin Wang (Beijing University of Posts and Telecommunications, P.R. China); Lei Chen (China Automotive Technology and Research Center Co. Ltd, P.R. China); Yongle Wu (Beijing University of Posts and Telecommunications, P.R. China); Yuanan Liu (Beijing University of Posts and Telecom, P.R. China)

This paper proposes a novel channel emulation method in multi-probe anechoic chamber setups to reproduce the desired channel model within the test area. The core of the channel emulation method is how to map the desired channel model onto the limited number of probes. For the proposed method, each probe transmits the signal with parts of channel characteristics instead of rayleigh fading signal embedding all channel characteristics in the Prefaded Signals Synthesis (PFS) method. The signal transmitted from the probe depends on the channel model and the angular location of the probe. Simulation results indicate that the field distribution and temporal correlation derived with the proposed method provide better performance. Furthermore, the accuracy of the emulated spatial correlation is the same as that with PFS if identical power weights are utilized.

A Review of Driver Fatigue Detection: Progress and Prospect.....566

[Fan Liu](#), Xueyi Li, Tanyue Lv and Feng Xu (Hohai University, P.R. China)

Fatigue driving has become one of the main causes of road traffic accidents which threatens people's life and property safety seriously. This paper mainly reviews the research status and development trends of driver fatigue detection technology where the fatigue detection based on driver's physiological signals and behavior characteristics, vehicle's running status and information fusion are respectively studied and compared. In addition, we also study two new trends in this field in recent years: fatigue detection based on RGB-D camera and deep learning. Then, the idea of using both RGB-D camera and deep learning for driver fatigue detection is also discussed.

Sunday, January 13 10:30 - 12:00

Session 3.1: Mobile Device Technologies

Room: N256

Chair: Hungying Louis Lo (Intel Corporation, USA)

10:30 Temporal and Geometric Calibration Between Camera and IMU Systems for Motion Estimation.....572

[Jaejoon Choi](#) (Hanyang University, Korea); Sang Hwa Lee (Seoul National University, Korea); Jong-Il Park (Hanyang University, Korea)

Cameras and IMU (Inertial Measurement Unit) systems help driving AR (Augmented Reality) and MR (Mixed Reality) applications more effectively. However, the temporal and geometric offsets between the two systems cause problems of asynchronization when the mobile devices move. This paper proposes the method to minimize the geometric distortion of IMU and the temporal offset between camera and IMU. This approach does not require any additional calibration devices, and estimates the relationship of two systems from the consumer's daily use.

10:45 The Hybrid Coplanar Transmission Line Design and Simulation for an Ultra Small Solid State Drive with Massive Storage Capacity Used in Mobile Device.....576

Hungying Louis Lo (Intel Corporation, USA); Hany Eskandar (Intel Corp, USA)

This paper analyzes the electrical design alternative for the challenges of the system in package (SiP). Due to the physical limitation of the size to meet the industrial requirements, the substrate of SiP is limited with layer count and limited space between signal traces. In order to control the trace impedance with limited ground layers, the transmission need to use the unconnected power nets as its reference planes and make it function as ground planes for transmission line signal integrity. This idea is realized by using electrical power nets being coupled to ground filling between traces in the routing layer and having connections between ground fillings along the transmission line as a closed ground return path. Since these connected ground fillings along the traces looks like coplanar transmission line, we call these type of connections as hybrid coplanar transmission line. The signal propagation on the hybrid coplanar transmission line is simulated and correlated with electrical measurements in the lab. By using the hybrid coplanar transmission line, we can reduce the layer count to reduce the substrate thickness and maintain the signal integrity performance for the high-speed signal performance in high-density Solid State Drive (SSD) manufactured by Intel.

11:00 Performance Analyses on Logging Policies of Log-structured File System.....580

Sungwoo Lee, Jonggyu Park and Young Ik Eom (Sungkyunkwan University, Korea)

Log-structured filesystems have suffered from garbage collection overheads when they have lack of free space. To address the problem, previous research suggested threaded logging that reuses invalidated blocks without a cleaning process. However, threaded logging incurs random writes that can degrade the performance of upcoming read operations, since the invalid blocks can be discontinuous. In this paper, we show the performance of the two logging policies and analyze their performance characteristics.

11:15 Proposal of Flat-coaxial Cable Structure and Its Design Methodology Based on FPCB Process for 5G Application...582

Bumhee Bae (Samsung Electronics, Korea)

For 5G application, cable is essentially required for a low signal loss characteristic and immunity to the external noise inside a mobile product. A conventional coaxial cable can carry out such functions but there are critical disadvantages with using a cable. One is that interconnection of multiple signals in one cable structure is impossible, and the other is that automated assembly of a cable and a PCB is difficult. Consequently, these disadvantages restrict design flexibility of a product. Therefore, development of a new cable structure which overcomes these problems is necessary. In this paper, we propose a novel coaxial cable structure which uses a Flexible PCB (FPCB) process for foldable mobile device. This is the first cable structure with attributes including both a coaxial and a multiple channel. Since the proposed cable structure is flat and has a fixed form, automated assembly of a cable and a PCB could be made possible using a suction machine. We also propose a three-step cable design methodology for performance improvement. The first step involves design, fabrication, and measurement of the proto-type cable structure. The second step involves extraction of effective material characteristics of the proto-type structure. The third step involves signal integrity design and optimization with the proposed model. With the proposed methodology, estimated performance before fabrication is well correlated with the measurement at frequencies up to 20 GHz which includes the intermediate frequency (IF) of 5G application.

11:30 A Scalable Automated System to Measure User Experience on Smart Devices.....587

Zongyi Liu (Amazon.com, USA)

In this paper, we present an automated scalable system that measures user experience on smart devices such as TVs, tablets and smart phones. The system consists of three parts: (i) a robot with a mobile arm to perform touches and clicks on a tested device such as a tablet or a phone, and sensors to capture the video signals, (ii) a signal capturing process records the input video in real time, controlled by algorithms that use a deep detection model and a text matching model to estimate app state, and a deep classification model to navigate, and (iii) a quality metrics computation process that uses spatial and temporal computer vision algorithms. We show that this system can continuously evaluate the major streaming apps such as the Prime Video app, the popular shopping apps such as Amazon retail app, and other mobile apps. We also do manual validation for a subset of the metrics to evaluate the reliability of our system.

Session 3.2: Machine learning, Deep learning and AI in Consumer Electronics 2

Room: N254

Chair: Fabrizio Lamberti (Politecnico di Torino, Italy)

10:30 A Novel Multi-scale 3D CNN with Deep Neural Network for Epileptic Seizure Detection.....592

Gwangho Choi, Chulkyun Park, Junkyung Kim and Kyoungin Cho (Hanyang University, Korea); Tae-Joon Kim (Seoul National University Hospital, Korea); HwangSik Bae and Kyeong Yuk Min (Hanyang University, Korea); Ki-Young Jung (Seoul National University Hospital, Korea); Jong-Wha Chong (Hanyang University, Korea)

Accurate and timely detection of seizure activity during continuous EEG monitoring either in epilepsy monitoring unit or in neuro-intensive care unit is crucial for both physician and paramedical personnel. However, it is laborious work and required special training for epilepsy and EEG interpretation. In order to detect automatically seizure, we propose a Multi-scale 3D-CNN with Deep Neural Network (DNN) model for non-patient-specific seizure detection. We considered spectral, spatial and temporal features. The EEG signals are transformed to frequency domain using Short Time Fourier Transform (STFT) to extract spectral features. The spectral features are mapped to 2D images to preserve the position of the electrodes. The proposed model is composed of 3D-CNN and bidirectional Gated Recurrent Unit (GRU) to extract spatial and temporal features from the 2D mapped images. We evaluated the proposed model using CHB-MIT and Seoul National University Hospital (SNUH) Scalp EEG database. Our proposed model achieves the sensitivity of 89.4% and 97% and a false positive rate of 0.5/hours and 0.6/hours on the CHB-MIT database, and the SNUH database, respectively.

10:45 Design of a CNN Face Recognition System Dedicated to Blinds.....594

Bogdan Mocanu (Institut TELECOM, France); [Ruxandra Tapu](#) (Institut Telecom / Telecom SudParis, France); Titus Zaharia (Institut TELECOM, France)

Identifying other persons is a major challenge for blinds and visually impaired people that can hinder interaction in social activities. This paper introduces a novel CNN based face detection, tracking and recognition system designed to improve users' interaction and communication in social encounters. The major contribution consists in a novel weight adaptation scheme able to determine the relevance of face instances and to create a global, fixed-size representation from all face instances tracked during the video stream, while remaining independent of the track length. The experimental evaluation performed on a large set of video streams validates the approach that returns accuracy and recognition rates superior to 90%.

11:00 Multi-View Image-based Vehicle Brand Recognition System with Cascaded Convolutional Neural Network.....596

[Namhyun Ahn](#) (Sogang University, Seoul, Republic of Korea, Korea); Suk-Ju Kang (Sogang University, Korea)

In this work, we propose a novel vehicle brand classification system using the cascaded convolutional neural network (CNN). While conventional methods use only the front image of a vehicle, we can use input images in all directions and recognize the characteristics. In the simulation results, we achieve high performance of 91% accuracy using the cascaded CNN. We also demonstrate the distinction of our system compared to conventional network using classification activation map for visualizing the region that the network focuses on.

11:15 Automatic Gaze Correction Based on Deep Learning and Image Warping.....598

[Masataka Seo](#) and Yen-Wei Chen (Ritsumeikan University, Japan); Toshihiro Kitajima (Samsung, Japan); Takahiko Yamamoto (Ritsumeikan University, Japan)

When people take a selfie photo or talk to a distant person through a video chat system, people tend to look at the screen. Since the camera position is usually different from the screen, the gaze in the photograph or on the other side of the screen is directed to another direction. In this paper, in order to solve this problem, we proposed a method to correct the gaze by synthesizing the image texture. The image synthesis uses feature points around the eyes as landmarks. We use a common convolutional neural network and a long-term recurrent convolution network to extract or detect these feature points in a still image and a video image, respectively. The deep learning-based feature point detections are very accurate as compared with conventional methods based on active appearance model etc. These feature points are used as landmarks and the internal texture of these feature points are synthesized with the prepared template image in advance. Through these procedures, an automatic and natural gaze correction is realized. Even in a video image, our method still realized a natural gaze correction with less blur.

11:30 Generation of Correct Word Sequences from Multiple Outputs of a Conventional Automatic Speech Recognizer for Voice-Activated Information Appliances.....602

[Geonwoo Park](#) and Harksoo Kim (Kangwon National University, Korea)

In information appliances based on speech recognition, users' spoken queries are converted into text queries using automatic speech recognition (ASR) engines. If the top-1 results of the ASR engines are incorrect, these errors are propagated to the following natural language processing steps. To alleviate this error propagation problem, we propose a post-processing model for revising ASR errors. The proposed model does not require any external resources or feature engineering effort, because it uses only syllables as input features. In our experiments with a Korean spoken chatting and FAQ corpus, the proposed model outperformed the previous models.

Session 3.3: Automotive CE Applications 2

Room: N264

Chair: Jose-Maria Flores-Arias (University of Cordoba, Spain)

10:30 Development of an Electronic Shift Lever Control System Using Hand Pose Recognition.....606

[Hyunduk Kim](#), Sang-Heon Lee, Myoung-Kyu Sohn and Wonju Bae (Daegu Gyeongbuk Institute of Science & Technology, Korea)

In this paper, we introduce an electronic shift lever control system based on hand pose recognition technology to provide a convenient and simple interface to drivers. The hand pose recognition algorithm consists of three processes. The first is hand localization using a simple approach based on deep learning. The second step is the prediction of the 3D hand joint location, and the final step is hand pose recognition. During this process, we define six hand poses and extract feature vectors obtained using the 3D offset from the center of the hand location to the hand joint location. The hand pose is then recognized using a simple KNN classifier.

10:45 Implementation of a Binary Translation for Improving ECU Performance.....608

[Jong-taek Chong](#) (Carnavicom co., Ltd., Korea); Minwoo Jung (Carnavicom Co., Ltd, Korea); Jae-Jun Yun and Jung-Hwan Moon (Carnavicom co., Ltd., Korea)

An energy-area efficient IVN-connected software execution architecture in ECU processor is proposed. As the result of this paper, we show that the proposed technique reduces the energy consumption and packet delay of a ECU for executing the embedded software, as well as the reduced chip area by realizing a storage-less ECU architecture.

11:00 A Study of Entering to T-Junction with Safety Driving.....611

[Hirotu Furukawa](#) (Graduate School of Kanagawa Institute of Technology, Japan); Ryoza Kiyohara (Kanagawa Institute of Technology, Japan)

It is necessary to concern about safety driving to introduce the autonomous vehicle (AV) to current environment human-operated vehicles (HOV) are exist. We think it is difficult to introduce AV without method to eliminate the difference between AV and HOV. We propose the method to reducing dangerous behavior with reducing traffic jam.

11:15 Sensorized Camera System and Display to Increase Motorcycle Rider Safety.....613

Jose-Maria Flores-Arias (University of Cordoba, Spain); Manuel Núñez (Universidad de Córdoba, Spain); Carlos Diego Moreno Moreno (University of Cordoba & Escuela Politécnica Superior, Spain); Francisco J. Bellido-Outeiriño and Francisco J. Quiles Latorre (University of Córdoba, Spain)

The use of auxiliary cameras in motor vehicles is a trend that is being imposed both by increasing the safety of the driver caused by the control of the environment and by the legal regulations that are being issued. Having rear-view systems on motorcycles is conditioned to combine functionality, robustness and simplicity of use for the rider. Here it is proposed a prototype that tries to combine these characteristics at a low consumption and cost.

11:30 Robust Stereo Matching Based on Cost Volume Fusion for Optimal Disparity Estimation.....615

Nakeun Choi, Jinbeum Jang and Joonki Paik (Chung-Ang University, Korea)

This paper propose a local stereo matching method based on cost volume fusion. This method can be applied to various imaging applications, such as robot vision and autonomous vehicular systems.

Session 3.4: Automotive CE Applications 3

Room: N262

Chairs: Ismail Butun (Mid Sweden University, Sweden), Dongmahn Seo (Daegu Catholic University, Korea)

10:30 Web Scraping Crawling-based Automatic Data Augmentation for Deep Neural Networks-based Vehicle Classifications.....617

Yunsoo Lee and Suk-Ju Kang (Sogang University, Korea)

In this paper, we propose a novel data augmentation using the web scraping crawling for deep neural networks(DNNs). First, we collect training data through the proposed web scraping crawler and automatically increase given data by the image processing techniques optimized for the data augmentation. In addition, for the evaluation, we compare the effect of each image processing technique through the cross validation. In the simulation results, the validation accuracy of the DNN classifier using the augmented data through the optimal augmentation method was about 23.58% higher than that of the DNN classifier using original data.

10:45 Automatic Failure Detection and Correction for Real-Time Object Tracking with Kernelized Correlation Filter.....619

JungSup Shin, Heegwang Kim, Dasol Jeong and Joonki Paik (Chung-Ang University, Korea)

This paper proposes an algorithm that estimates tracking failure and track the target object again. The proposed algorithm consists of three steps: 1) Tracking target object with KCF tracker. 2) Estimating tracking failure by analysing correlation values. 3) Re-capturing the target object using multiple search windows and re-tracking. Experimental results shows that the proposed algorithm effectively corrects tracking failure situations.

11:00 Context Aware Vehicle Detection Using Correlation Filter.....622

Changeui Son, Seokmok Park, JaeMin Lee and Joonki Paik (Chung-Ang University, Korea)

As interest in autonomous driving system has increased recently, variety of ADAS technologies that are responsible for safety of passengers are receiving attention. Real-time analysis and robust vehicle detection are essential for ADAS technology to cope with rapidly changing road conditions. In this paper, we propose a real-time vehicle detection system based on correlation filter.

11:15 DNS Based Neighbor Discovery in ITS.....624

Zhiwei Yan and Hongtao Li (CNNIC, P.R. China); Hidenori Nakazato (Waseda University, Japan); Yong Jin Park (University Malaysia Sabah, Malaysia); Jong-Hyok Lee (Sangmyung University, Korea)

Vehicular information network and Internet of Things (IoT) technologies have been receiving a lot of attention in recent years as Intelligent Transportation Systems (ITS). As one of the most important and promising IoT area, ITS aims to implement a myriad of applications related to vehicles, traffic information, drivers, passengers and pedestrians. For Cooperative Adaptive Cruise Control (C-ACC), platooning and other typical use cases in ITS, a direct IP communication between neighbor vehicles is required which poses the following two issues: 1) how to discover the neighbor vehicle and the required service; and 2) how to discover the link-layer address of the neighbor vehicle and server. This paper presents a solution to these problems based on Multicast Domain Name Service (mDNS).

11:30 Experiment of Image Processing Algorithm for Efficient Pothole Detection.....626

SungWon Lee (Catholic University of Daegu, Korea); SeokJin Kim and Jeong Han (Daegu Catholic University, Korea); KwangEun An (Catholic University of Daegu, Korea); Seungki Ryu (Korea Institute of Civil Engineering and Building Technology, Korea); Dongmahn Seo (Daegu Catholic University, Korea)

The pothole is an important thing for pedestrian and drivers. The pothole can cause the critical accident. To find and repair the pothole is important. But it is hard to find the pothole. So, we developed the automatic system with image processing. To get higher accuracy and lower false rate, we compare the six image processing algorithms, such as background subtractor, convex hull, wavelet energy field, saliency map, differential, otsu binary for finding the optimized combination.

Sunday, January 13 10:30 - 11:10

IEEE Young Professionals

Room: N253

Chair: Shingo Yamaguchi (Yamaguchi University, Japan)

Sunday, January 13 11:10 - 12:00

Session 3.5 Digital Experience in Consumer Electronics 2

Room: N253

Chair: Si Jung Kim (University of Nevada Las Vegas, USA)

11:10 QoE Modelling of High Dynamic Range Video.....628

Carl Udora (University of Surrey, United Kingdom (Great Britain)); Junaid Mir (University of Engineering and Technology Taxila, Pakistan); Chatura Galkandage (University of Surrey, United Kingdom (Great Britain)); [Anil Fernando](#) (Center for Communications Research, University of Surrey, United Kingdom (Great Britain))

The level of user satisfaction has no standard way of measuring for HDR video content due to the proven difficulty of building HDR quality assessment metrics. To overcome this limitation, Quality of Experience (QoE) modelling of HDR video has been proposed to find a robust and accurate HDR video QoE metric. The proposed model is the first attempt towards assessing and devising a non-reference quality metric for HDR video. It is based on finding the correlation between the HDR video features and the subjective test results. The proposed model achieves a significant correlation score of 0.724 with the subjective results.

11:25 Construction of Linked Data Platform Implementing Feedback Data Model of Usage Records.....630

[Makoto Urakawa](#) (Nagasaki University, Japan); Toru Kobayashi and Kenichi Arai (Nagasaki University, Japan)

Data producers in LOD cannot comprehend How many times their generating data has been used by which applications. This paper proposes the data model in order to feedback usage records to them. This paper also shows the feasibility of the data model through a data entry workshop with citizens.

11:40 An Architecture for Content Multiplexing and Enhanced Connectivity in Digital TV Receivers.....635

[Jeferson Bentes da Costa](#), Nicoli Araujo, Aguinaldo Silva and Rômulo Fabrício, Jr. (TPV Technology, Brazil); Eddie B de Lima Filho (TPV & Universidade Federal do Amazonas - UFAM, Brazil)

Digital TV (DTV) receivers provide information and entertainment for Brazilian families; however, only one DTV program can be shown. This article proposes an architecture capable of presenting two programs, either using the same display or auxiliary devices. A prototype showed the effectiveness and feasibility of the proposed approach.

Sunday, January 13 12:05 - 13:30

Keynote 7: Peter Mui, Founder, Fixit Clinic, USA; Awards Lunch

Room: N260-N258

Sunday, January 13 13:35 - 17:30

BOG Meeting

Room: N253

Sunday, January 13 13:35 - 15:05

Session 3.6: Security and Privacy for CE 2

Room: N256

Chair: Anirban Sengupta (Indian Institute of Technology Indore, India)

13:35 Real-time Mandatory Access Control on SELinux for Internet of Things.....639

[Jae-Yong Ko](#), Sang-Gil Lee and Cheol-Hoon Lee (Chungnam National University, Korea)

IoT devices such as an IoT smart home Server require the real-time processing and SELinux to ensure periodicity through fast response and protect private

information using fine-grained access control. However, these two technologies have a conflict of interest regarding time management. SELinux has a latency due to the fine-grained access control, and the real-time process must reduce latency to ensure a periodicity. The alternative is real-time mandatory access control. Proposed Real-time Mandatory Access Control in this paper reduces the overhead of SELinux and secure the periodicity of the real-time process.

13:50 A Novel Security Hardware Design for Avoid Attacks in Embedded System.....N/A

Bin Xu (School of Electronic and Information Engineering of Beihang University, P.R. China)

At present, embedded systems face many kinds of software and hardware attacks, especially buffer overflow attacks. This paper presents a novel architectural-enhanced security hardware design to avoid attacks, including tracing crucial process of execution behavior, cryptographic algorithm and integrity schemes for memory authentication and secure tag validation. The automated compiler extracts the intrusion model for intrusion detection and secure tag of each main memory segment at the compile time automatically. At run-time, the designed hardware observes its dynamic execution trace and checks whether the trace conforms to the permissible behavior and trigger appropriate response mechanisms. Experimental results shows that the proposed design can avoid a wide range of software and hardware attacks with low performance penalties and minimal overheads.

14:05 Intelligent Threat Hunting in Software-Defined Networking.....645

Farah Kandah, Steven Schmitt and Dylan Brownell (University of Tennessee at Chattanooga, USA)

The emergence of Software-Defined Networking (SDN) has brought along a wave of new technologies and developments in the field of networking with hopes of dealing with network resources more efficiently and providing a foundation of programmability. SDN allows for both flexibility and adaptability by separating the control and data planes in a network environment by virtualizing network hardware. We, in this work, present an advanced threat hunting model by combining the SDN infrastructure with threat hunting techniques and machine learning models aiming to intelligently handle network threats such as denial of Service, repeat, and main in the middle attacks. This advancement enables the handling of dynamic network traffic in areas such as smart cities and autonomous vehicles more efficiently by rapidly mitigating network threats.

14:20 Threat Models and Security of Phase-Change Memory.....650

Gang Wang (University of Connecticut, USA)

Emerging non-volatile memories (NVMs) have been considered as the promising alternatives of DRAM for future main memory design. Among the NVMs, Phase-Change Memory (PCM) can be served as a promising alternative due to low standby power, high density, and good scalability. However, PCM also induces the security design challenges due to non-volatility. Threat model can help to identify security vulnerabilities in design processes. It is all about finding the security problems, and therefore it should be done early in the design and adoption of manufacture. This paper is first thoroughly to discuss the threat models for PCM memory, which can provide a good reference for designing the new generation of PCM. Meanwhile, this paper gives security advice and potential security solutions to design the secure PCM to protect these threats.

14:35 Security Implications of Fog Computing on the Internet of Things.....656

Ismail Butun (Mid Sweden University, Sweden); Alparslan Sari (University of Delaware, USA); Patrik Osterberg (Mid Sweden University, Sweden)

Recently, the use of IoT devices and sensors has been rapidly increased which also caused data generation (information and logs), bandwidth usage, and related phenomena to be increased. To our best knowledge, a standard definition for the integration of fog computing with IoT is emerging now. This integration will bring many opportunities for the researchers, especially while building cyber-security related solutions. In this study, we surveyed about the integration of fog computing with IoT and its implications. Our goal was to find out and emphasize problems, specifically security related problems that arise with the employment of fog computing by IoT. According to our findings, although this integration seems to be non-trivial and complicated, it has more benefits than the implications.

Session 3.7: AR & VR Display and Human Interface Technologies 2

Room: N254

Chairs: Fumio Isshiki (Finekit Inc., Japan), Haruhiko Okumura (Toshiba Corp. R & D Center, Japan)

13:35 Human-Man Interface Concept for Autonomous Car.....662

Herve Drezet (Automotive Engineering & Renault, France)

Autonomous car is the next major step for automotive market to increase safety, comfort, fun to travel. Renault, the hundred twenty years old automotive company, has its own vision about autonomous car: the autonomous SYMBIOZ demo car illustrates Renault Human-Man Interface (HMI) concept.

13:50 Interaction of Visual and Haptic Impressions in Visuo-haptic Texture Cognition.....667

Taishi Fujiwara, Yusuke Tani, Atsushi Takemoto, Kensuke Tobitani and Noriko Nagata (Kwansei Gakuin University, Japan)

The interaction among modalities is useful in the field of virtual reality and augmented reality. However, the effects of sensory interaction have yet to be fully elucidated. In this research study, we investigated the interaction between visual and haptic impressions in visuo-haptic texture recognition. We discovered that the influence of the interaction between visual and haptic impression varies depending on whether the impression have differences with regard to stimulus in the haptic modality.

Session 3.8 Blockchain Technology for Consumer Electronics Devices

Room: N264

Chair: Jong Lee (Kunsan National University, Korea)

13:35 Proof of Phone: A Low-cost Blockchain Platform.....669

Jae Min Kim, Jae Won Lee and Kyungsoo Lee (Samsung Electronics, Korea); Jun-Ho Huh (Samsung Electronics Co., Korea)
Blockchain which enables decentralization of data based on various consensus mechanisms is considered the leading technology of the next generation. Numerous applications are being proposed to benefit from its immunity against modification and manipulation. However, not many appears as a successful business up to now, except for crypto currencies. High operation cost which is essential for the conventional consensus, is acting as an obstacle to the wide adoption of blockchain applications. In this paper, we introduce a novel blockchain platform based on PoP (Proof of Phone), which lowers the operating cost by imposing high entry cost. We conduct theoretical analysis to show that our proposed platform reduces total cost by up to 96.2% compared to that of conventional blockchain. Our new platform will turn various blockchain applications from theory to practice.

13:50 Blockchain-based Notarization for Social Media.....673

Gyuwon Song (Korea Institute of Science and Technology, Korea); Suhyun Kim (KIST, Korea); Haejin Hwang (KIST, Korea); Kwanhoon Lee (KIST, Korea)

This paper presents a blockchain-based notarization service for social media. With the advent of smartphones, social media platforms have become an undeniably popular way to communicate with people across the world. However, fake news and maliciously fabricated screenshots are continuously produced and distributed in social media. To solve this problem, a novel approach using blockchain technology is proposed. Since the blockchain technology can store data in a secure and tamper-proof way, it is the most suitable platform for notarizing digital evidence. Based on the proposed method, an instant messaging system is presented as a proof-of-concept.

14:05 SCC: Storage Compression Consensus for Blockchain in Lightweight IoT Network.....675

Teasung Kim, Jaewon Noh and Sunghyun Cho (Hanyang University, Korea)

A centralized IoT network has a problem of data centralization because data is stored in a center. A blockchain is emerging as a solution to solve the problem in the IoT network by storing blocks to each device. However, lightweight IoT devices cannot store all of the blockchain due to their low storage capacity. We propose storage compression consensus (SCC) algorithm which compresses a blockchain in each device to ensure the storage capacity. When a lightweight device does not have enough storage space, the device processes the SCC to compress the blockchain.

14:20 A Blockchain-based Water Control System for the Automatic Management of Irrigation Communities.....679

Borja Bordel Sanchez (Universidad Politécnica de Madrid, Spain); Diego Martín de Andres and Ramon Alcarria (Universidad Politecnica de Madrid, Spain); Tomás Robles (Technical University of Madrid, Spain)

Irrigation communities, especially in rural areas whose economy depends on agriculture, face a critical problem with the increasing water crisis. In this paper it is proposed a water control system to efficiently manage and coordinate the use of water in these communities. Blockchain technologies are employed to support trust among community members and commercial resource constrained devices communicating with the Blockchain network compose the hardware platform. A first implementation of this system and an evaluation of the system's performance are also presented.

Session 3.9: Architectures for Next Generation IoT/Edge Computing

Room: N262

Chairs: Xianwei Cheng (UNT, USA), Saraju P Mohanty (University of North Texas, USA)

13:35 Engineering Platform for Sensor and Actuator Concepts During Cockpit Development.....681

Bernhard Budaker, Markus Geiger, Albert Seel, Keane Fernandes, Daniel Husfeldt and Simeon Schüller (CSI GmbH, Germany)

Digitalization and interconnected systems are currently revolutionizing the future of the entire car industry. Cars will be comprised of various complex mechatronic subsystems, which will be integrated into a mobility system consisting of different vehicle types, infrastructures and services. In order to design and implement newer, more advanced electronic systems, it is mandatory that future vehicle developments conform to certain standards when being integrated into preexisting digital platforms. This paper describes the development of a cockpit platform, into which sensors and actuators can easily be integrated. Furthermore, the implementation of an Automotive Ethernet interface as a communication backbone is discussed.

13:50 Exploration of System Configuration in Effective Training of CNNs on GPGPUs.....687

Li Zhang (University of North Texas, USA); Xianwei Cheng (UNT, USA); Hui Zhao and Saraju P Mohanty (University of North Texas, USA); Juan Fang (Beijing University of Technology, P.R. China)

Convolutional Neural Networks (CNNs) have shown a great potential in different application domains including object detection, image classification, nature language processing, and speech recognition. Since the depth of the neural network architectures keep growing and the requirement of the large-scale dataset, to design a high-performance computing hardware for training CNNs is very necessary. In this paper, we measure the performance of different configuration on GPU platform and learning the patterns through training two CNNs architectures, LeNet and MiniNet, both perform the image classification. Observe the results of measurements, we indicate the correlation between L1D Cache and the performance of GPUs during the training process. Also, we demonstrate that L2D Cache slightly influences the performance. The network traffic intensity with both CNN models shows that each layer has distinct patterns of traffic intensity.

14:05 Improving GPU NoC Power Efficiency Through Dynamic Bandwidth Allocation.....691

Xianwei Cheng (UNT, USA); Hui Zhao and Saraju P Mohanty (University of North Texas, USA); Juan Fang (Beijing University of Technology, P.R. China)

GPU accelerated systems demand high throughput in data communication to fully exploit thread level parallelism. Simply adopting NoC architectures from CPU-based Multi Processors to GPUs does not result in optimal performance cost tradeoff because their traffic pattern is very different. In addition, GPU NoCs usually are implemented using two physical networks to avoid deadlock between requests and reply messages. The workload imbalance between request and reply network, request network carry 70% of messages, which will cause the request network to be congested, while reply network is idle. According to this character, we proposed the technic calls Stop Request Network (SRN), which will stop the request network to save power. We evaluate the technic and the result shows that it can save 10% of energy in request network.

14:20 Stress-Log: An IoT Based Smart System to Monitor Stress-Eating.....695

Laavanya Rachakonda, Arham Kothari and Saraju P Mohanty (University of North Texas, USA); Elias Kougiianos (Universtiy of North Texas, USA); Madhavi Ganapathiraju (University of Pittsburgh, USA)

Stress eating, i.e., overeating due to stress, is one of the reasons for obesity. Chronic stress releases the hormone cortisol which increases the appetite levels of a person. Initial onset of stress causes a temporary loss of appetite but chronic stress leads to the development of addiction and/or cravings for 'comfort foods' that are calorific values. Chronic stress, uncontrolled or unmonitored food consumption, and obesity are intricately connected, even involving certain neurological adaptations. We propose a system which helps in identifying stress eating compared to normal eating. It allows the users to make a choice between two proposed methods for monitoring food intake: wearable and non-wearable. These methods take the log of food consumed by the user, calculate the calorie counts and notify the user about the eating behavior with an accuracy of 97%.

14:35 An IoT-based Drug Delivery System for Refractory Epilepsy.....701

Md Abu Sayeed and Saraju P Mohanty (University of North Texas, USA); Elias Kougiianos (Universtiy of North Texas, USA); Hitten Zaveri (Yale Univerity, USA)

Epilepsy affects around 1% of the world population, necessitating a unified system which can detect seizure as well as inject drugs simultaneously to suppress seizure progression. In this paper, a unified drug delivery system is proposed in the IoT framework, which provides drug injection upon seizure detection. An electromagnetically actuated valveless micropump has been utilized for drug delivery. The diaphragm of the micropump is composed of Polydimethylsiloxane (PDMS). The prototype of the system was implemented using Simulink and ThingSpeak. The simulation results show that the proposed system reduces power consumption considerably (10-30%) while maintaining high accuracy.

14:50 Verification of IMU-Based Inclination Estimates Using Video Motion Capture.....705

Henry Griffith, Subir Biswas and Yan Shi (Michigan State University, USA)

Refillable smart bottles providing automated tracking of water consumption are a valuable tool for promoting fulfillment of hydration goals. We have previously proposed an attachable accelerometer sensor capable of providing retrofittable consumption tracking functionality to any bottle. This paper expands upon our prior work by demonstrating inclination tracking using a six degree-of-freedom inertial measurement unit sensor. A simplified approach for fusing information from the accelerometer and gyroscope sensors is proposed herein. Estimates are verified using video-based motion capture performed in Blender. A performance improvement of over 25% is achieved through utilization of the proposed fusion approach versus estimates formulated using the accelerometer only.

Sunday, January 13 15:10 - 16:10

Session 3.11 Digital Experience in Consumer Electronics 3

Room: N254

Chair: Si Jung Kim (University of Nevada Las Vegas, USA)

15:10 A Methodology for Convergence Between Ginga and HbbTV.....709

Bruno Farias, Nicoli Araujo, Rômulo Fabrício, Jr. and Jeferson Bentes da Costa (TPV Technology, Brazil); Eddie B de Lima Filho (TPV & Universidade Federal do Amazonas - UFAM, Brazil)

The integrated broadcast-broadband generated new standards, but no global one. This article proposes a convergence methodology for Ginga and Hybrid Broadcast Broadband TV (HbbTV). Experiments regarding online and local HbbTV applications led to the development of a support tool able to make HbbTV applications executable by Ginga-NCL.

15:25 Integration of OneM2M-based IoT Service Platform and Mixed Reality Device.....713

Seungwoon Lee, Gyu-min Lee, Geunkyung Choi and Byeong-hee Roh (Ajou University, Korea); Jinsuk Kang (Frontis, Korea)

To provide a more intuitive user experience, there have been studies to apply mixed reality to the Internet of Things. They have used a Mixed Reality device as a tailored application only or proposed an early stage of the architecture without any considering the IoT platform standard. In this paper, we introduce the architecture to integrate MR to OneM2M, the most widely known IoT platform standard. For integration, we consider the use cases of a MR device in IoT service. Also, the demonstration shows the feasibility of the proposed idea with integrating Mobius, open-sourced oneM2M platform, and HoloLens by Microsoft.

15:40 Augmentation of Visual Experiences Using Deep Learning for Peripheral Vision Based Extended Display Application.....717

Muhammad Ayaz Shirazi (KAIST & ARRC, KAIST, Korea); Hochul Cho and Woontack Woo (KAIST, Korea)

We propose the system that provides an immersive experience by automatically extending the video content of the TV to the wall. Though it is possible to

manually create the appropriate content that works on the existing TV screen, the cost is too expensive to create. The proposed deep neural network uses the center of the video as input and the outside area as output. The trained network automatically generates the extrapolated video according to the input video and a projector projects the resulting content on the living room wall around the TV thereby improving the immersive feeling. The proposed system is expected to pave a new road to the home appliance industry by transforming the living room into the new immersive experience platform.

15:55 MIP-VR: An Omnidirectional Navigation and Jumping Method for VR Shooting Game Using IMU.....719

Juyoung Lee (Korea University & Korea Institute of Science and Technology, Korea); Gerard J. Kim (Korea University, Korea); Sang Chul Ahn (Korea Institute of Science and Technology, Korea); Jae-In Hwang (KIST, Korea)

We suggest an omnidirectional navigation and jumping method using walking-in-place (WIP) interface. This method supports forward, backward, sideways walking and jumping include vertical jump. The shooting game is one of the contents that can best take advantage of VR. Since the WIP interface is a hands-free navigation method, it works well with VR shooting game. However, we need to extend WIP because this interface is not possible for sideways walking and jumping that is possible with existing keyboards or joysticks. We propose a forward and sideways walking method suitable for VR shooting game. Our method is inspired by human behavior and using a state diagram to support backward walking, running and vertical jump. We call it motion-in-place (MIP). Our method uses inertial measurement unit (IMU) only. A pilot test of 10 subjects showed that our method is less tiring and useful than a forward-only WIP interface. Our method can be used for most HMDs with built-in IMU and can be suitable for VR shooting game.

Session 3.12 Machine Learning, Deep learning and AI in Consumer Electronics 3

Room: N264

Chairs: Carter Chiu (University of Nevada, Las Vegas, USA), Atsushi Takemoto (University of Electro-communications, Japan)

15:10 T-RECSYS: A Novel Music Recommendation System Using Deep Learning.....722

Justin Zhan (University of Nevada, Las Vegas, USA); Ferdos Fessahaye, Luis Perez, Tiffany Zhan and Raymond Zhang (University of Nevada Las Vegas/AEOP, USA); Calais Fossier and Robyn Markarian (University of Nevada Las Vegas/RET, USA); Carter Chiu (University of Nevada, Las Vegas, USA); Laxmi Gewali (University of Nevada Las Vegas, USA); Paul Oh (University of Nevada, Las Vegas, USA)

A recommendation system is a program that utilizes techniques to suggest to a user items that they would likely prefer. This paper focuses on an approach to improving music recommendation systems, although the proposed solution could be applied to many different platforms and domains, including Youtube (videos), Netflix (movies), Amazon (shopping), etc. Current systems lack adequate efficiency once more variables are introduced. Our algorithm, Tunes Recommendation System (T-RECSYS), uses a hybrid of content-based and collaborative filtering as input to a deep learning classification model to produce an accurate recommendation system with real-time prediction. We apply our approach to data obtained from the Spotify Recsys Challenge, attaining precision scores as high as 88% at a balanced discrimination threshold.

15:25 Texture Synthesis with Desired Visual Impressions Using Deep Correlation Feature.....728

Atsushi Takemoto, Kensuke Tobitani, Yusuke Tani, Taishi Fujiwara, Yoichi Yamazaki and Noriko Nagata (Kwansei Gakuin University, Japan)

We propose a texture synthesis method with desired visual impressions, to realize product designs suitable for individual needs. First, we conducted an evaluation experiment and quantified visual impressions of texture images. After that, we modeled the relationship between the quantified visual impression and the image feature extracted by the convolution neural network. Based on the obtained model, we updated the features to have the desired visual impressions and generated texture image. Finally, we confirmed the effectiveness of our method by conducting a verification experiment.

Session 3.13: CE Sensors and MEMS

Room: N262

Chair: Mehdi Azadmehr (University of South-Eastern Norway, Norway)

15:10 Highly Stretchable Polymer-based Optical Strain Sensor for Integration with Soft Actuator.....730

Jaeyeon Jeong and Ki-Uk Kyung (KAIST, Korea)

For measuring strain of 100%, we have designed the stretchable sensor by embedding a waved optical fiber into polymer substrate. Inducing loss of light passes through the optical fiber by variation of bending curvature, the sensor can estimate its strain from the magnitude of output light intensity.

15:25 Q-Loading of Colpitts-Based Mass-Sensing Oscillators in Resonator-based MEMS Airborne Particulate Matter (PM) Sensors.....733

Mehdi Azadmehr (University of South-Eastern Norway, Norway); Igor Paprotny (University of Illinois at Chicago, USA); Yngvar Berg (University of South-Eastern Norway, Norway)

Air pollution is a major world-wide health concern, in particular the adverse effects resulting of exposure to fine airborne particulate matter (PM_{2.5}). Oscillator topologies have thus far been an overlooked aspect of MEMS based gravimetric PM-sensors. In this work, we analyze the effect of mass loading on selected Colpitts oscillator topologies. Five different Colpitts oscillators are considered in this paper, single ended and differential versions of common gate and common drain and an inverter-based Colpitts oscillator. Our results show that the Complementary common gate topology is the most stable regarding change in frequency and amplitude. The frequency of the complementary common gate increases by 2.5% to 114MHz when the loading is increased to 3K Ω and 11% with a loading of 6K Ω .

Session 3.10 IEEE-Sensors: Wearable Sensors for Health and the Environment and IEEE CE Society Future Directions

Room: N256

Chair: Tsukasa Noma (Kyushu Institute of Technology, Japan)

15:10 A Rapport and Gait Monitoring System Using a Single Head-Worn IMU During Walk and Talk.....737

Tong-Hun Hwang (Leibniz University Hannover & Institute of Sports Science, Germany); Alfred Effenberg (Leibniz Universität Hannover, Germany); Holger Blume (Leibniz Universität Hannover, Germany)

Public health is promoted when physical activity and social interaction increase. One's physical activity can be measured by wearable pedometers based on step counting, which contributes to physical health. However, thus far, no wearable device supports monitoring social interactions. In this paper, a single head-worn inertial measurement unit (H-IMU) is proposed to evaluate interpersonal activities, which can measure three objective components of rapport: positivity, mutual attentiveness, and coordination. Using angular kinematics, the number of head nods is counted for positivity (recognition rate: 94.34%). In terms of mutual attentiveness, we computed angle differences between two interactants' head orientations. The H-IMU can also measure coordination of two interactants' gait patterns based on individual gait events. These results can be a reference to estimate the level of rapport during walk and talk. The H-IMU is applicable to head-worn devices, such as smart earphones and head mounted displays (HMD).

15:25 An Implementation of an Intelligent Assistance System for Visually Impaired/Blind People.....742

Liang-Bi Chen, Jian-Ping Su, Ming-Che Chen, Wan-Jung Chang, Ching-Hsiang Yang and Cheng-You Sie (Southern Taiwan University of Science and Technology, Taiwan)

In this paper, we propose an intelligent assistance system for visually impaired/blind people, which is composed of wearable smart glasses, an intelligent walking stick, mobile devices application, and on-line information platform. When visually impaired/blind people wear the proposed smart glasses and holding the proposed intelligent walking stick, thus the obstacles can be detected. If a visually impaired/blind person is fall down, then the related information (GPS, fall down, etc.) will be recorded and uploaded to the on-line information platform. Related information can also be viewed by the proposed mobile devices application.

15:40 Implementation of Hand Gesture Recognition Based on Flexible Sensor Array for Mobile Devices.....744

Seok-pil Lee and Sung-Woo Byun (Sangmyung University, Korea)

As the digital devices have been developed, hand gesture recognition plays an important role in Human-Computer interface (HCI) for direct interaction without contact. Among them, the non-contact methods do not require attaching sensors to human's body and mostly use visual technologies such as Kinect or camera sensors. Various wearable devices have been developed using contact sensors such as inertial sensor, magnetic sensor, gyro sensor, electromyography (EMG), FSRs, and others to identify gestures. However, various drawbacks remain for these sensor in detecting gestures. In this paper, we propose a new method using strain gauges-based Flexible Epidermal Tactile Sensor Array to overcome the drawbacks of the existing sensors. It acquires electric signals generated according to the movements of the wrist based on strain gauge estimating the degree of deformation such as tension, compression, and twist. The proposed sensor array shows robustness, stability, and repeatability through various experiments for testing the sensor array. Furthermore, the proposed method is verified by confirming gesture recognition accuracy with multiple subjects and has a greater performance than the existing gesture recognition devices in accuracy tests.

15:55 Chain of Equipments: A Scheme for Life-Time Personal Photo Storage.....748

Tsukasa Noma and Kunio Yamamoto (Kyushu Institute of Technology, Japan)

Photographs in digital form is much more difficult to preserve than in films and prints. While long-term digital preservation has long been studied, the methods are for organizations, and are far from realistic for personal use. This paper proposes a new scheme for life-time personal photo preservation. In the scheme called a chain of equipments, a long-term photo preservation policy is determined first, and then manufacturers supply tailored storage devices, called ring equipments, under the policy. Complicated tasks for migration is encapsulated in the ring equipments, and a chain of ring equipments preserves photo data for a long time. The specifications of ring equipments are constrained only by the policy, and then the manufacturers can avoid technology obsolescence.

Sunday, January 13 16:15 - 17:30

Session 3.14: RF, Wireless, and Network Technologies 2

Room: N256

Chair: Jungsun Um (ETRI, Korea)

16:15 An Implementation of Wireless Power Transfer System for Multiple Receivers.....753

Soichiro Ito, Yoshiki Tsuchida and Masahiro Fukui (Ritsumeikan University, Japan)

This study proposes a new magnetic resonant wireless power transfer (WPT) system that transfers power to multiple receivers. In general, the received power at each receiver differs depending on the distance between the transfer and receiver coils. Therefore, we construct and evaluate a system that is robust to position gap and enables selective power supply for receivers by examining the shape of the transfer coil.

16:30 A Novel Antenna Pattern Design Using Generative Adversarial Network.....757

Seo Weon Heo and Kwi Seob Um (Hongik University, Korea)

In this paper, we propose a novel method of commercial product antenna pattern design using the deep neural network. Our design method is based on the hybrid scheme of both the generative and discriminative model. The advantage of the proposed method is that we can easily create an antenna of a commercial product without in-depth knowledge of the RF theory or antenna design methodology. The designer needs to provide only the designed radiation pattern and radiation coefficients. The neural network used is trained based on the unsupervised learning, which outputs the antenna pattern with the desired radiation characteristics. With the generative model, we generate the pattern and the discriminative network evaluates and outputs the desired antenna pattern. We use the same 8-layer LSTM (long short-term memory) for generator and discriminator to construct a neural network. We use numerical methods to better validate the discriminator's work by high frequency structure simulator (HFSS).

16:45 Implementation of Secure End-to-End Remote Control System for Smart Home Appliances on Android.....759

Hisayoshi Tanaka and Hidekazu Suzuki (Meijo University, Japan); Katsuhiko Naito (Aichi Institute of Technology, Japan); Akira Watanabe (Meijo University, Japan)

In most existing remote-control services for smart home appliances, a controller outside the home network can be used to control these appliances in the home network using a remote-control support server installed on the Internet. However, if the service provider ends the service, a user cannot control these appliances from outside the home. In this paper, we propose a secure end-to-end remote-control system based on NTMobile which is a technology to achieve NAT traversal and end-to-end encrypted communication. With the proposed system, the operating android device can remotely control the smart appliances existing in the house from outside the house safely and securely without requiring a manufacturer's remote-control server in the existing service. As a result of the operation verification and performance evaluation of the proposed system in the mobile Internet environment, we confirmed that the devices compatible with ECHONET Lite, which is a communication standard for controlling smart home appliances and residential equipments from inside the house, installed under the NAT router can be directly controlled from outside the house within the timeout time specified by the ECHONET Lite specification.

17:00 Implementation of Platform for Measurement and Analysis of LTE Traffic and Radio Resource Utilization.....765

Jungsun Um and Igor Kim (ETRI, Korea); Seung Keun Park (Electronics and Telecommunications Research Institute, Korea)

This paper introduces a platform that can gather and analyze the scheduling information of LTE network by decoding downlink control channel. Without connection to commercial mobile network, it can identify the amount of mobile traffic and the utilization rate of frequency resources on a single LTE cell continuously while without any LTE subframe loss. In addition, it can be applicable for observing cell operating conditions and providing measurement dataset for network research. In this paper, we focus on describing configuration and operating procedure of platform, and introduce examples of measurement results.

Session 3.15: Consumer Healthcare Systems 1

Room: N254

Chair: Francisco J. Bellido-Outeiriño (University of Córdoba, Spain)

16:15 Monitoring System for a Single Aged Person on the Basis of Electricity Use - By Using Smart Meter with B Route -...767

Yukio Nakano (Kanto Gakuin University, Japan); Fumitoshi Keino (NextDrive KK, Japan)

In order to develop monitoring systems for single aged persons by grasping their usage of electricity, we hatched out several algorithms to infer whether residents are living ordinary lives or not. And we also developed small devices to utilize smart meters. The smart meters have become widespread in Japan recently and it has become easy to extract instantaneous total watt of a household from a smart meter via a small device including ours and internet. Under these backgrounds, we made a proto-type monitoring system with our algorithms and devices. And we installed the systems at actual single aged households and began a demonstration test.

16:30 Daily Stress and Mood Recognition System Using Deep Learning and Fuzzy Clustering for Promoting Better Well-Being.....772

Worawat Lawanont, Masahiro Inoue and Taketoshi Yokemura (Shibaura Institute of Technology, Japan); Pornchai Mongkolnam (King Mongkut's University of Technology Thonburi, Thailand); Chakarida Nukoolkit (KMUTT, Thailand)

Nowadays, the overall well-being is considered to be one of the important issue. The company has been taking more and more consideration in improving their employees' well-being. The employees also have been taking several approaches to improve their current well-being status. However, the well-being is usually related to the daily activity and behavior, especially in the workplace where it directly affects stress and mood level of a person. In this study, we proposed a well-being recognition system where we adopted a deep learning technique to provide a non-invasive monitoring system. We classified the well-being level using three features from two surveys, which covered both stress and mood. For this preliminary study, we trained the model for both generic classification and personalized classification. The personalized approach was taken as a step to provide a personalized health decision support system, which will help raise awareness in users and encourage them to improve their behavior. We achieved the accuracy of 83% on generic model and 91% on a personalized model.

16:45 Infectious Disease Infection Index Information System.....778

Beakcheol Jang, Miran Lee, Myeong hwi Kim, Hyun jung Kim, Hoon Yoo and Jong Wook Kim (Sangmyung University, Korea)

Various infectious disease information systems have been developed to provide infectious disease outbreak information through personal devices. However, the existing systems deliver information in the form of e-mail or text file, so it is difficult to understand at a glance. Additionally, users are unable

to confirm the risk level because they are only provided with the number of outbreaks. In this paper, we propose a system that provides not only infectious disease outbreak but also relevant infection index information. We believe that our system provides effective infectious disease outbreak information by showing the user the risk level at a glance.

17:00 Electric Powered Wheelchair Command by Information Fusion from Eye Tracking and BCI.....782

Robson Cruz and [Vinicius da Silva Souza](#) (Federal University of Amazonas, Brazil); Teodiano Freire Bastos (Federal University of Espirito Santo, Brazil); [Vicente F. Lucena, Jr.](#) (Federal University of Amazonas, Brazil)

Since the first electric version, a lot of arrangements have been done in Motorized Wheelchairs to attend increasing user needs. Many applications have evolved from single input interface into multimodal, allowing one wheelchair to support various types of disability. In cases of severe impairments, Brain-Computer Interface and Eye Tracking are commonly applied. This proposal allows the user to command an Electric Power Wheelchair by information fusion from commercial Brain-Computer Interface and Eye Tracker devices, surpassing challenges of non-intentional commands and high user workload. Thereby, it is expected this user-wheelchair interface to be simple, safe and afford a better user experience.

17:15 Advanced Monitoring System for Daily Activity in Elderly People.....784

David Zambrano-Montenegro (Universidad Técnica de Manabí, Ecuador); [Francisco J. Bellido-Outeiriño](#) (University of Córdoba, Spain); Rodolfo Garcia-Bermudez (Universidad Técnica de Manabí, Ecuador); Jose-Maria Flores-Arias (University of Cordoba, Spain); Alexander Huhn (Berliner Verkehrsbetriebe (BVG), Germany)

The purpose of this paper is to evaluate the use of accelerometers in the detection of daily motion activities as well as falls, applied to an intelligent home system for dependent adults, thus determining the effectiveness of the use of these technological components for Ambient Assisted Living (AAL) environments. The proposed system aims to get the pattern of daily motion activities such as walking, getting up from a chair or suffering a fall in different ways by means of an accelerometer plus a gyroscope in a low energy and low weight device, minimally invasive. The experimental results obtained demonstrate the correct functionality of the system developed and the suitability of this type of system for monitoring the daily activity of elderly or dependent persons.

Session 3.16: Consumer Healthcare Systems 2

Room: N264

Chair: Lucio Ciabattoni (Universita' Politecnica delle Marche, Italy)

16:15 Sasthyakathan - A Health Based Social Robot.....786

[Tanhim Islam](#) (Brac University, Bangladesh); Tanjir Chisty, Israt Raza, Prova Roy, Abdulla Hil Kafi and Raihana Shams Islam Antara (BRAC University, Bangladesh)

Bangladesh has the highest rate of malnutrition around the world. More than 9.5 million children suffer from malnutrition and around 50 percent women of Bangladesh has BMI<18.5 kg/m². Malnutrition in children, adolescents and women is a major concern. Furthermore, health expert human shows disinterest to provide healthcare solution in a remote location or in rural areas. To solve this problem, we build an autonomous robot that interacts and communicates with humans which can questions and answers regarding healthcare queries intelligently, can recognize food and shows essential food nutrients separately and provide nutrition plan, health report individually.

16:30 An Integrated PPG and ECG Signal Processing Hardware Architecture Design of EEMD Processor.....790

[Wai-Chi Fang](#) and I-Wei Chen (National Chiao Tung University, Taiwan)

This study proposed an integrated Photoplethysmogram (PPG) and Electrocardiography (ECG) signal processing hardware architecture design based on Ensemble Empirical Mode Decomposition (EEMD) The proposed integrated dual signals EEMD processor is implemented in an on-board FPGA for on-line signal processing of the non-linear and non-stationary signal. The EEMD method is appropriate to analyze the non-linear PPG and ECG signals with assisting white noise and decompose the signal into 8 sets of Intrinsic Mode Functions (IMFs). The experimental results show that the hardware architecture proposed in this study can be applied to PPG and ECG signals, and can clearly analyze and separate high-frequency and low-frequency noise, and keep clear signals without any noise.

16:45 Design and Implementation of a Real-Time Upper Limbs Dyskinesia Detection System.....794

Giulia Belgiovine (Revolt SRL, Italy); Marianna Capecci (Università Politecnica delle Marche, Italy); Lucio Ciabattoni (Universita' Politecnica delle Marche, Italy); Maria Chiara Fiorentino (Università Politecnica delle Marche, Italy); [Gabriele Foresi](#) (Universita' Politecnica delle Marche, Italy); Andrea Monteriù and Lucia Pepa (Università Politecnica delle Marche, Italy)

In this paper a Real-Time L-dopa-Induced Dyskinesia (LID) Detection System based on Machine Learning Algorithms (MLAs) and simple devices such as smartphone and smartwatch is presented. The implementation of this system was performed in three steps. Firstly, the data collection is carried out, where each patient wears the smartwatch and completes some tasks, while a smartphone application captures data. Secondly, features in time and frequency domain were extracted from smartwatch data and used as input for the training of different off-line MLAs. Lastly, the best algorithm found has been integrated into a mobile App in order to real-time monitor the smartwatch data and detect LID.

Session 3.17: Automotive CE Applications 4

Room: N262

Chair: Srinivasa Rao (JNTU, India)

16:15 Remote In-System Reconfiguration for Automotive Device.....796

Young Hyun Yoon and Jung Hwan Oh (Seoul National University of Science and Technology, Korea); Ji kwang Kim (Seoul National University of Science And Technology, Korea); Hyung Bin Ihm and Shin Hye Jeon (Hyundai Motors Company, Korea); Tae Heon Kim (Hyundai NGV, Korea); Seung Eun Lee (Seoul National University of Science and Technology, Korea)

In this paper, we propose a remote In-System Reconfiguration (ISR) for automotive devices. An Field Programmable Gate Array (FPGA) based remote ISR reconfigures the automotive system when it requires to be fixed or updated. The remote ISR improves the system flexibility and enables the system to control various functions with restricted resources in the automobiles. In addition, the remote ISR enables to redesign the circuits without replacing any hardware components for driver convenience. The ISR is implemented on an FPGA with a microcontroller unit and we successfully demonstrated the feasibility of our proposal.

16:30 Traffic Sign Detection and Recognition Using a CNN Ensemble.....798

Aashrith Vennelakanti (IIT Madras, India); Smriti Shreya, Deepak Muddegowda, Resmi Rajendran, Debasis Sarkar and Phanish Hanagal Srinivasa Rao (Qualcomm, India)

In today's world, almost everything we do has been simplified by automated tasks. In this paper, we propose a method for Traffic Sign Detection and Recognition for an Advanced Driver Assistance System (ADAS) using image processing for the detection of the sign and an Ensemble of Convolutional Neural Networks (CNN) for the recognition of the sign. Image processing is used to discover the signs from the environment and enhance the image before it is sent through the CNN Ensemble for recognition. CNNs have a high recognition rate thus making it desirable to use for implementing various computer vision tasks. With the help of a CNN Ensemble we were able to observe very high accuracy rates for recognition. TensorFlow was used for the implementation of the CNN.

16:45 A Broken Line Detection Circuit for Multi-cell Li-ion Battery Module.....802

Chua-Chin Wang, Pang-Yen Lou and Chien-Hua Chu (National Sun Yat-Sen University, Taiwan)

This paper presents a novel broken line detection circuit for multi-cell Li-ion Battery modules. The broken line detection technique detects test lines between the battery pack and any following circuit, e.g., BMS (battery management system). The core of the broken line detection circuit consists of an RC filter, a Brokenline Detection Block, and a bias voltage source. A system-level experiment verifies that the proposed circuit can reliably detect any disconnection of Li-ion battery pack and the following circuit to ensure the safety of the system.

17:00 Locally Adaptive Contrast Enhancement Using a Modified 2D Smooth Histogram.....804

Yeong-Kang Lai and Shu-Ming Lee (National Chung Hsing University, Taiwan)

In this paper, we propose an locally adaptive contrast enhancement using a modified 2D smooth histogram method that allows an input image to expand the dynamic range and improve contrast and image detail information for Advanced Driver Assistance System (ADAS). We uses the relationship between each pixel's grayscale and its adjacent grayscale to construct a two-dimensional probability density of the input image grayscale distribute and masking operations are used to build the coefficient of determination. This coefficient is used to calculate the appropriate area window size for each pixel's neighborhood to reduce calculation time. A method for weighting the neighborhoods information and smooth two-dimensional histogram method are proposed. Experimental results show that the proposed method has well result and lower computational complexity.

17:15 Development of Autonomous Driving System Using State Estimator with Multi-rate Sampled-data.....806

Yongsik Jin, Seungyong Han, Eungchang Mason Lee and Sangmoon Lee (Kyungpook National University, Korea); Crino Shin and Jongpil Yun (KITECH, Korea)

This paper presents a state estimator design method using multi-rate sampled-data for autonomous vehicle driving system. The proposed state estimator is designed by using an affine matched T-S fuzzy model with the sampling information of each sensors. For the tracking control of autonomous driving system with fusion sensors, overall control structure is designed by using the error dynamic model based state estimator. The proposed method is verified by the experimental results on the skid-steering mobile robot equipped with lidar, camera and encoder.