

2022 IEEE 12th International Conference on Consumer Electronics (ICCE-Berlin 2022)

**Berlin, Germany
4-5 September 2022**



**IEEE Catalog Number: CFP22BIC-POD
ISBN: 978-1-6654-5677-7**

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IEEE Catalog Number:	CFP22BIC-POD
ISBN (Print-On-Demand):	978-1-6654-5677-7
ISBN (Online):	978-1-6654-5676-0
ISSN:	2166-6814

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Sunday, September 4

Sunday, September 4 10:00 - 11:30 (Europe/Berlin)

S1: IoT, SMARTPHONE AND MOBILE DEVICES TECHNOLOGY

Room: a5

Chairs: Lucio Ciabattoni (Polytechnic University of Marche, Italy), Alessandro Tonacci (Institute of Clinical Physiology (IFC) National Research Council of Italy (CNR), Italy)

10:00 Text Message Exchange in Nototemari Growth Management System using Private LoRa.....N/A

Mikiko Sode Sode Tanaka (International College of Technology, Japan)

"Nototemari" is a kind of mushroom that is a representative agricultural product, and is cultivated in the greenhouse of Noto's Satoyama. The greenhouses are far from the management office, and it is costly to visit the greenhouses to understand the growth situation. In addition, many producers are elderly. Therefore, we decided to build a private LoRa network and send image data of the growth situation to the management office on a regular basis to improve the efficiency of cultivation work. However, because the transmission speed of LoRa communication is slow, it took time to send the image data. Therefore, we built a mechanism that is by recognizing an important monitoring point by object detection based on deep learning, the image data is transmitted in a practical time. To improve the further work efficiency, we propose LoRa module that can be connected to a mobile phone. It is easy to carry, and support SMS function. In this paper, we present the Nototemari growth management system using it, and the communication protocol. Using the function, SMS function can be used even in Satoyama, where there is no mobile phone network, and it is possible to confirm safety and make simple but important communications.

10:20 Secure, Interoperable, End-to-End Industry 4.0 Service Platform for Lot-Size-One Manufacturing.....5

Soumya Kanti Datta (Digiotouch, Estonia)

The paper introduces a novel secure, interoperable, and end-to-end industry 4.0 service platform for lot-size-one manufacturing. The challenges faced by the European manufacturing industry that prevent it from embracing such a new paradigm are outlined. Then, the platform architecture and operational steps are summarised.

10:40 A LoRa Network Emulator Using Software Defined Radio.....8

Mahmoud Shawky (The German University in Cairo, Egypt); Ziad Ayman (German University in Cairo, Egypt); Kareem Mahmoud and Tallal Elshabrawy (The German University in Cairo, Egypt)

Nowadays, the internet of things and its application have rapid growth in the industry and research

committee. Many of those applications require long battery life. Such applications have motivated the recent developments in LoRa technology. LoRa has a simple modulation scheme that allows the transmission with low power consumption, low bit rates, and extensive coverage area through an IoT network. As a result, the capacity estimation of LoRa networks has paramount importance in the design phase. This paper aims to develop a LoRa network emulator that can represent the LoRa traffic received from thousands of IoT devices at a given LoRa gateway. The proposed emulator utilizes an SDR device and LoRa commercial transceiver to design a realistic network capacity estimation. The proposed network emulator incorporates different wireless channel conditions within the network under study. Furthermore, the transmitted signals from the SDR consider interference scenarios in terms of relative time over lap as well as SIR between interfering signals. The capacity of LoRa networks can be evaluated by the proposed emulator. The presented emulator for capacity evaluation has the advantage that it derives the cumulative distribution that could be supported from the cell edge towards the cell-center of an individual LoRa gateway. The experimental result shows that the emulator can generate a representative SIR/SNR profile by comparing target emulated traffic signal level cumulative distribution with that measured by a commercial LoRa transceiver. The emulator adopts a calibration process such that the confidence interval for estimated data extraction rate performance is within the scale of $\pm 2\%$.

11:00 *FastShare: push-based file sharing approach on wireless multi device environment.....14*

Seung Bum Lee (Samsung Electronics, Korea (South)); Lukasz Dudek and Piotr Wojdyna (Samsung Electronics, Poland)

This paper presents FastShare, a novel high performance push-based file sharing approach on wireless closes-range multiple device environment. In order to enhance previous approach, FileShare, FastShare includes TCP connection reduction, push-based approach and notification simplification. Compared with previous and existing approaches, FastShare shows excellent performance with multiple small files and even fair results with large sized files in terms of delivery.

Sunday, September 4 11:30 - 11:45 (Europe/Berlin)

C1: Coffee Break (Morning)

Room: a5

Sunday, September 4 11:45 - 13:15 (Europe/Berlin)

S2: MACHINE LEARNING, DEEP LEARNING & AI (Part 1)

Room: A5

11:45 *A Temporal Scores Network for Basketball Fouls Classification.....16*

Po-Yung Chou, Cheng-Hung Lin, Wen-Chung Kao, Yi-Fang Lee and Chen-Chien Hsu (National Taiwan Normal University, Taiwan)

Deep learning has developed rapidly in recent years, not only in image recognition, but now also in action recognition. The research on action recognition started with 3D-CNN, which has achieved good results

on many tasks. But most action recognition networks have room for improvement in fine-grained action recognition. The reason is that there is only a slight difference between categories in the fine-grained classification task. e.g. basketball fouls only occur in a few frames and a small region. This situation may lead to some errors with 3D-CNN methods because these models tend to merge all temporal features. To identify these fouls, it is necessary to strengthen the detection of small periods. In this paper, we propose a temporal score network suitable for existing networks, including 3D-Resnet50, 3D-wide-Resnet50, R(2+1) D-Resnet50, and I3D-50 to improve the accuracy of fine-grained action recognition. The experimental results show that the accuracy of various models is improved by 3.85% to 6% after adding the proposed network. Since there is no relevant public dataset, we collect the data ourselves to create a basketball foul dataset.

12:05 Incremental Two-Stage Logo Recognition with Knowledge Distillation.....18

Simone Bianco, Marco Buzzelli and Gianluca Giudice (University of Milano - Bicocca, Italy)

Logo recognition can be useful to monitor brand visibility on social media, protect intellectual property, and develop autonomous checkout systems in retail environment. Many new brands are constantly being created, thus making it necessary to develop systems that keep up with the creation of new logos. We define a two-stage logo recognition system composed of agnostic logo detection and incremental logo classification. We investigate the method sensitivity to regularization and memory availability, and we develop two alternative model compression techniques. Comparison with state of the art shows promising results.

12:25 Unsupervised Deep Learning-based clustering for Human Activity Recognition.....24

Hamza Amrani and Daniela Micucci (University of Milano-Bicocca, Italy); Paolo Napolitano (University of Milan Bicocca, Italy)

One of the main problems in applying deep learning techniques to recognize activities of daily living (ADLs) based on inertial sensors is the lack of appropriately large labeled datasets to train deep learning-based models. A large amount of data would be available due to the wide spread of mobile devices equipped with inertial sensors that can collect data to recognize human activities. Unfortunately, this data is not labeled. The paper proposes DISC (Deep Inertial Sensory Clustering), a DL-based clustering architecture that automatically labels multi-dimensional inertial signals. In particular, the architecture combines a recurrent AutoEncoder and a clustering criterion to predict unlabelled human activities-related signals. The proposed architecture is evaluated on three publicly available HAR datasets and compared with four well-known end-to-end deep clustering approaches. The experiments demonstrate the effectiveness of DISC on both clustering accuracy and normalized mutual information metrics.

12:45 A Self-Adaptive Wireless Network Service Embedding through SVM and MTA.....30

Sujitha Venkatapathy (Kunsan National University & Gunsan, Korea (South)); In-Ho Ra and Han-Gue Jo (Kunsan National University, Korea (South))

Network virtualization (NV) provides a feasible mechanism for operating numerous diverse virtual networks concurrently on a shared physical infrastructure network. The key issue in NV is virtual network embedding (VNE), which efficiently and effectively maps virtualized networks (VNs) with multiple resource needs for

nodes and links to the underlying physical network with limited resources. A multiple topological attributes (MTA) based embedding algorithm is proposed to address the issue of providing different virtual request services delivered in a wireless network environment, leading to an unstable utilization of physical network resources and a low access rate for subsequent requests. It is emphasized that machine learning (ML) should be integrated into the process of network slicing in order to properly classify the received wireless virtual request. In this work, virtual request services are categorized automatically using support vector machine (SVM), and resources are allocated accordingly. The proposed technique organizes nodes in the embedding process according to their priority based on multiple topological properties of virtual and physical networks. According to the findings of the simulations, the SVM-MTA algorithm enhances both the acceptance rate and the resource efficiency of the network.

Sunday, September 4 13:15 - 14:00 (Europe/Berlin)

L1: Lunch & Networking

Room: a5

Sunday, September 4 14:00 - 15:00 (Europe/Berlin)

W1: Welcoming Ceremony

Room: a5

Sunday, September 4 15:00 - 16:30 (Europe/Berlin)

S3: CONSUMER HEALTHCARE (Part 1)

Room: a5

15:00 A health telemonitoring platform based on data integration from different sources.....36

Gianluigi Ciocca (University of Milano-Bicocca, Italy); Paolo Napoletano (University of Milan Bicocca, Italy); Matteo Romanato (University of Milano-Bicocca, Italy);
Raimondo Schettini (University of Milano Bicocca, Italy)

The management of people with long-term or chronic illness is one of the biggest challenges for national health systems. In fact, these diseases are among the leading causes of hospitalization, especially for the elderly, and huge amount of resources required to monitor them leads to problems with sustainability of the healthcare systems. The increasing diffusion of portable devices and new connectivity technologies allows the implementation of telemonitoring system capable of providing support to health care providers and lighten the burden on hospitals and clinics. In this paper, we present the implementation of a telemonitoring platform for healthcare, designed to capture several types of physiological health parameters from different consumer mobile and custom devices. Consumer medical devices can be integrated into the platform via the Google Fit ecosystem that supports hundreds of devices, while custom devices can directly interact with the platform with standard communication protocols. The platform is designed to process the acquired data using machine learning algorithms, and to provide patients and physicians the physiological health parameters with a user-friendly, comprehensive, and easy to understand dashboard which monitors the parameters through time. Preliminary usability tests show a

good user satisfaction in terms of functionality and usefulness.

15:20 *Augmented Reality for the Visually Impaired: Navigation Aid and Scene Semantics for Indoor Use Cases.....42*

Kiavash Fathi, Alireza Darvishy and Hans Wernher van de Venn (Zurich University of Applied Sciences, Switzerland)

With the Augmented Reality (AR) technology available today, it is quite feasible to accommodate the needs of the visually impaired (VI) via AR. In this paper, a framework is introduced to help the VI navigate and explore unfamiliar indoor environments. In contrast to commonly used AR applications focused on visual augmentation, the proposed framework employs auditory three-dimensional feedback (A3DF) for guiding the VI. Concretely, the current framework reads the pose of the user and helps the VI reach a target location via A3DF. The A3DF is implemented with the Unity game engine to provide the optimal user experience. After acquiring the environment mesh, the optimal path from the user's location to the target location is calculated, while avoiding obstacles using Unity's navigation system. Moreover, the user is provided with semantic information about the unknown environment whilst exploring via auditory information. This framework is implemented on Microsoft HoloLens 2 and tested at an office environment with different locations of interest. Additionally, this framework potentially accelerates the learning curve since the user can be trained using Unity's simulation environment. Lastly, given different design parameters of the framework, the proposed method can be fine-tuned to fit the specific needs of the individual VI

15:40 *A low-cost telerehabilitation and telemonitoring system for people with Parkinson's disease: the architecture.....48*

Antonia Antoniello (Polytechnic University of Marche, Italy); Antonio Sabatelli (Revolt SRL, Italy); Simone Valenti (Università Politecnica delle Marche, Italy); Maria Di Tillo (Revolt SRL, Italy); Lucia Pepa (Università Politecnica Delle Marche, Italy); Luca Spalazzi and Elisa Andrenelli (Università Politecnica delle Marche, Italy); Marianna Capecci and Maria Gabriella Ceravolo (Università Politecnica Delle Marche, Italy)

This article presents the architecture of a telerehabilitation and telemonitoring system for people with Parkinson's disease. The main advantages of the system are the use of low-cost and widespread consumer technology devices. A pilot study on 5 patients allowed a first assessment of the technical reliability, usability, and acceptability of the system, helping the technical and clinical staff to better the system.

16:00 *Virtual Reality meets sensoriality: perspectives and challenges for "virtual olfaction".....N/A*

Alessandro Tonacci (Institute of Clinical Physiology (IFC) National Research Council of Italy (CNR), Italy); Raffaele Conte (National Research Council of Italy (CNR), Italy); Lucia Billeci and Francesco Sansone (Institute of Clinical Physiology (IFC) National Research Council of Italy (CNR), Italy)

Virtual Reality (VR) tools were increasing in number and quality in the last years, many of them including functionalities that, with different fortunes, attempt at mimicking sensory function. Although some sensory

channels, based on physical principles (including sight, hearing, touch) were successfully embedded within VR devices, other senses, mainly referring to chemical ones (i.e., olfaction and taste), encountered more problems, making their integration troublesome, due to their intrinsic nature. In the present paper, we present the state-of-the art in this regard, with the actual discoveries, open issues and perspectives concerning the integration of chemical senses, olfaction in particular, into VR tools and devices.

Sunday, September 4 16:30 - 16:45 (Europe/Berlin)

C2: Coffee Break (Afternoon)

Room: a5

Sunday, September 4 16:45 - 18:15 (Europe/Berlin)

S4: AUDIO, VIDEO SYSTEMS AND SIGNAL PROCESSING

Room: a5

16:45 *Truncated Edge-based Color Constancy*.....50

Simone Bianco (University of Milano-Bicocca, Italy); Marco Buzzelli (University of Milano - Bicocca, Italy)

In this paper we propose the truncated edge-based framework for color constancy. It is based on, and extends, the edge-based framework by introducing the use of truncated Gaussian filters. The truncation level can be controlled with the use of a dedicated parameter that is added to the other three parameters existing in the edge-based framework, namely the derivative order, the standard deviation of the Gaussian filter, and the Minkowski norm. Experimental results on two standard dataset for color constancy show that the truncated edge-based framework allows to achieve the same or higher illuminant estimation accuracy of the edge-based framework considerably reducing the number of operations.

17:05 *Cell-wise encoding and decoding for TLC flash memories*.....55

Daniel Nicolas Bailon (University of Applied Sciences, Konstanz, Germany); Sergo Shavgulidze (Georgian Technical University, Georgia); Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

Automotive computing applications like AI databases, ADAS, and advanced infotainment systems have a huge need for persistent memory. This trend requires NAND flash memories designed for extreme automotive environments. However, the error probability of NAND flash memories has increased in recent years due to higher memory density and production tolerances. Hence, strong error correction coding is needed to meet automotive storage requirements.

Many errors can be corrected by soft decoding algorithms. However, soft decoding is very resource-intensive and should be avoided when possible. NAND flash memories are organized in pages, and the error correction codes are usually encoded page-wise to reduce the latency of random reads. This page-wise encoding does not reach the maximum achievable capacity. Reading soft information increases the

channel capacity but at the cost of higher latency and power consumption.

In this work, we consider cell-wise encoding, which also increases the capacity compared to page-wise encoding. We analyze the cell-wise processing of data in TLC NAND flash and show the performance gain when using LDPC codes. In addition, we investigate a coding approach with page-wise encoding and cell-wise reading. Such TLC NAND flash memories will be used in the automotive market.

17:25 *Analysing Foreground Segmentation in Deep Learning based Depth Estimation on Free-Viewpoint Video Systems.....61*

Javier Uson, Julián Cabrera, Daniel Corregidor and Narciso García (Universidad Politécnica de Madrid, Spain)

Volumetric video acquisition systems enable realistic virtual experiences such as Free-Viewpoint Video (FVV). Stereo matching is a well known way of obtaining this volumetric information as depth images, calculating the disparity between two stereo color images. On these applications, the background of the scene captured is static and does not change, so foreground information is much more valuable. We propose adding foreground segmentation to help learning based algorithms, such as deep learning models, improve results previously obtained. We utilized the framework Detectron2 to model foreground segmentation by detecting people. Additionally, we built a large stereo dataset focused on FVV systems. Finally, we modified a successful deep learning model from the state-of-the-art, CREStereo, to add foreground segmentation and performed supervised training on it to estimate disparity, obtaining promising results.

17:45 *A comparison of temporal aggregators for speaker verification.....66*

Flavio Piccoli (Istituto Nazionale di Fisica Nucleare (INFN) & University of Milano-Bicocca, Italy); Lorenzo Olearo and Simone Bianco (University of Milano-Bicocca, Italy)

Speaker verification is the task of examining a speech signal to authenticate the claimed identity of a speaker as true or false. In order to deal with utterances having different lengths, and to accumulate information along the time dimension, different temporal aggregators have been proposed inside speaker verification pipelines.

In this paper we investigate the behavior of five different temporal aggregators in the state of art, namely Temporal Average Pooling (TAP), Global Statistical Pooling (GSP), Self-Attentive Pooling (SAP), Attentive Statistical Pooling (ASP), and Vector of Locally Aggregated Descriptors (VLAD) at varying lengths of the two utterances.

Starting from a speaker verification method in the state of the art, the experimental results on the VoxCeleb2 dataset show that there is a sweet spot for utterance length where speaker verification performance is higher independently from the temporal aggregator used.

18:05 *Development of an appliances control system based on standardized architectures.....72*

Manuel Lopera Rodríguez (University of Córdoba, Spain); Jose-Maria Flores-Arias

(University of Cordoba, Spain); Francisco J. Bellido-Outeiriño, Francisco J. Quiles Latorre and Cristina Martinez-Ruedas (University of Córdoba, Spain)

The article presents the development, on a standardized architecture, of a system capable of intercommunicating devices for open loop control and data monitoring, developing an application that allows a user to control the evolution of the system information and allow request data on it or act on it in order to control elements such as appliances, which account for a high percentage of energy consumption in homes. Thus, the existence of an appliance control system, combined with the possibility of access to it by the user, in order to monitor and / or act on the elements that compose it, not only allows to regulate household consumption, but also provides a convenient tool to its users to take part in this optimization process. The development of hardware tools and control and communications software based on oneM2M has been carried out, for the integration of loads of residential environments of variable size in a system capable of monitoring and consequent action, in order to implement improvements in the efficiency of the integrated elements and allow the supervision of the system by an authorized user. The objective of the system will be the control of resources for the optimization of their consumption, maintaining or improving their functional characteristics. For this purpose, a cost efficient system has been developed and tested. The result is a load control and monitoring system, under the oneM2M standard, with interoperability with protocols not covered by it.

Sunday, September 4 18:30 - 21:00 (Europe/Berlin)

W2: Welcome Reception

Room: a5

Monday, September 5

Monday, September 5 10:00 - 11:30 (Europe/Berlin)

S5: CONSUMER HEALTHCARE (Part 2)

Room: a5

10:00 Parkinson's disease telemonitoring and telerehabilitation based on commercial wearable sensor data analysis: a pilot study.....75

Antonio Sabatelli (Revolt SRL, Italy); Simone Valenti (Università Politecnica delle Marche, Italy); Antonia Antoniello (Polytechnic University of Marche, Italy); Maria Di Tillo (Revolt SRL, Italy); Lucia Pepa (Università Politecnica Delle Marche, Italy); Luca Spalazzi and Elisa Andrenelli (Università Politecnica delle Marche, Italy); Marianna Capecci and Maria Gabriella Ceravolo (Università Politecnica Delle Marche, Italy)

Telemonitoring and telerehabilitation are important solutions to improve the clinical outcome in people with Parkinson's disease (PD). This work presents a method for remote monitoring of people with PD while they perform telerehabilitation sessions at their home. The method is based on data collected by a commercial smartwatch and is aimed at quantitatively assessing the effects of rehabilitation therapy

on patients' habits and clinical status. Data analysis adopts statistical analysis (One-way ANOVA) to find significant changes in physiological variables. It was tested on a pilot study involving 5 people with PD. Obtained results show that the proposed method may be useful to help understand the evolution of physiological variables throughout the rehabilitation therapy. However, the small amount of data and enrolled participants do not allow to individuate a cause-effect relationship between telerehabilitation and health status nor to draw general conclusions. Further research is warranted.

10:20 Design and Optimization of REST Services for Performance and Scalability in Provision of Big Environmental Data to Exploratory Analytics of their Effects on Progression of ALS and MS.....81

Arianna Dagliati (University of Pavia, Italy, Italy); Vladimir D. Urošević (Belit Ltd. Belgrade); Manuel Ottaviano (Universidad Politecnica de Madrid, Spain); Nikola Vojičić (Belit Ltd. Belgrade, Serbia); Cristiana Larizza (Università degli Studi di Pavia, Italy); Daniele Pala (University of Pavia, Italy)

We present the rationale and implementation examples of an architecture and design of the REST service tier APIs in a Java web-based stack, optimized in design towards performance in fetching and manipulating hundreds of thousands of collected ambient and patient activity sensed IoT data (mostly on air quality/pollution) in rich web UI interactive dashboarding exploratory analytics, to study of the possible effects and influences of environmental and daily living ambient and activity factors on the aetiology and progression of dire chronic neurodegenerative diseases of Amyotrophic lateral sclerosis (ALS) and multiple sclerosis (MS).

10:40 Age Group Classifier of Adults and Children with YOLO-based Deep Learning Pre-Processing Scheme for Embedded Platforms.....87

Jie-Min Lin, Wei-Liang Lin and Chih-Peng Fan (National Chung Hsing University, Taiwan)

Based on the information of body proportion, in this study, a simple and effective processing scheme is developed for two age groups classification, i.e. children and adults for the applications of smart autonomous movers. By the YOLO-based CNN model for head and body objects detections, the recognition accuracies of age group classification for children and adults are 95% and 92.5% respectively with the image datasets collected in publics. Compared with the existed design, the proposed methodology performs simpler and more effective recognition capability for age group classification of adults and children. The proposed design is implemented on GPU-based embedded platform for real-time applications.

11:00 An ICT-based module for genotype-phenotype association in neuromuscular diseases: the phenotype perspective.....N/A

Francesco Sansone, Maria Scudellari, Gianluca Diodato and Alessandro Tonacci (Institute of Clinical Physiology (IFC) National Research Council of Italy (CNR), Italy); Anna Rubegni (IRCCS Stella Maris Foundation, Italy); Giulia Ricci and Francesca Torri (Pisa University Hospital, Italy); Diego Lopercolo (Siena University Hospital, Italy);

Raffaele Conte (National Research Council of Italy (CNR), Italy)

The clinical profiling of individuals with rare neuromuscular diseases (NMD) is particularly tricky even for expert eyes, due to the low generalizability of findings given the small number of individuals affected by a specific disease (or subtype). In this scenario, the availability of ICT-based tools collecting data from various sources (clinical, instrumental, etc.), with the ultimate aim to implement and train Artificial Intelligence (AI) - based algorithms helping the clinicians with a better characterization of patients is of utmost importance. In this regard, an accurate definition of the individual phenotypes, perfectly characterizing the patient's clinical condition becomes pivotal for both the clinician and the data scientist. Here, the development of a module specifically dedicated to the phenotype within a comprehensive, cloud-based suite is briefly described, together with the integration with other modules composing the overall Health360 platform. Taken together with the other modules, this part could effectively support the medical doctor in a better clinical characterization of an individual with NMD, at the same time providing the data scientist with a precious, usable tool for genotype-phenotype correlation in such diseases.

Monday, September 5 11:30 - 11:45 (Europe/Berlin)

C3: Coffee Break (Morning)

Room: a5

Monday, September 5 11:45 - 13:15 (Europe/Berlin)

S6: SECURITY AND PRIVACY IN CONSUMER TECHNOLOGIES

Room: a5

11:45 *Testing Physical Unclonable Functions Implemented on Commercial Off-the-Shelf NAND Flash Memories Using Programming Disturbances.....N/A*

Nikolaos Athanasios Anagnostopoulos (TU Darmstadt & Universität Passau, Germany); Yufan Fan and Muhammad Umair Saleem (TU Darmstadt, Germany); Nico Mexis, Emiliia Gelóczy, Felix Klement and Florian Frank (University of Passau, Germany); André Schaller (EUMETSAT, Germany); Tolga Arul and Stefan Katzenbeisser (University of Passau, Germany)

In this work, we present a Physical Unclonable Function (PUF) implemented on a Commercial Off-The-Shelf (COTS) NAND Flash memory module using programming disturbances, and examine the robustness of its responses to environmental variations. In particular, we test a removable Flash memory module serving as a PUF, under nominal conditions, as well as under temperature and voltage variations. To determine its resilience to environmental variations, we utilise well-known PUF metrics, such as the Hamming weight and the intra-device Hamming distance. Our results prove that, in general, the tested Samsung K9F1G08U0E NAND Flash memory can be used to realise a lightweight, scalable, and flexible hardware security primitive, namely a PUF, that can be utilised in the context of smart homes, smart vehicles, and other smart applications, as well as to protect commercial devices and networks in general. However, voltage variations seem to pose a substantial threat to the practical adoption of this PUF. This threat may be addressed by small-scale design improvements that should be implemented and tested in practice as part of future works.

12:05 DroParcel: Smart System for Secure Parcel Delivery.....90

Maryam Alghfeli, Meera Alnuaimi, Nouf Asebaiha, Shamsah Alnuaimi, Bivin Pradeep and Parag Kulkarni (UAE University, United Arab Emirates)

The online shopping industry continues to experience a phenomenal growth. Whilst online shopping is convenient, it comes with its own set of challenges, in particular, a rise in parcel theft when customers cannot be present to receive delivery and request it to be left at the doorstep. This paper presents 'DroParcel' a smart system for secure parcel delivery which has been devised to address the above challenge. DroParcel comprises a smart personal delivery box and a mobile application. Access to the smart box is facilitated by scanning the QR-Code / bar code that holds the tracking number printed on the shipping label of the parcel. This system not only facilitates parcel delivery by eliminating the need for the customer to be physically present during delivery but can also be used to facilitate access to multiple people on-demand through the use of a shared QR-code. This paper elaborates on the design and implementation of the complete system and highlights findings from a qualitative evaluation conducted by surveying different participants. As evident from these findings, the proposed system is easy to use and provides a robust means of secure parcel delivery.

12:25 Cloning Object Detectors.....96

Arne Aarts and Wil Michiels (Eindhoven University of Technology, The Netherlands); Peter Roelse (Irdeto BV, The Netherlands)

Object detectors based on neural networks are deployed in various consumer electronics products to predict different types of object and their location in images. This paper presents a cloning attack on object detectors, using problem domain samples and oracle access to a trained object detector. As in known cloning attacks on image classifiers, the presented attack uses the oracle access to label the samples. The resulting set of labeled samples, referred to as the surrogate dataset, is then used to train the clone detector. Compared to image classifiers, the surrogate dataset created by an object detector can contain more types of error. The paper describes a way to assess the quality of the surrogate dataset. The cloning attack was implemented, and experiments were conducted with a CenterNet and a RetinaNet object detector, and the Oxford-IIIIT Pet, Tsinghua-Tencent 100K, and WIDER FACE datasets. The results show that object detectors can be cloned successfully, even if the quality of the surrogate dataset is relatively low. However, in case of a low-quality surrogate dataset, the quality of the clone detector was only high if it used the same architecture as the target detector.

12:45 Hardware-Trojan Detection at Gate-level Netlists using Gradient Boosting Decision Tree Models.....102

Ryotaro Negishi, Tatsuki Kurihara and Nozomu Togawa (Waseda University, Japan)

Technological devices including consumer devices have become deeply embedded in people's lives, and their demand is growing every year. It has been indicated that outsourcing the design and manufacturing of ICs, which are essential for technological devices, may lead to the insertion of hardware Trojans. This paper proposes a hardware-Trojan detection method at gate-level netlists based on the gradient boosting decision tree models. We firstly propose the optimal set of Trojan features among many feature candidates at a netlist level through thorough evaluations. Then, we evaluate various gradient boosting decision tree models and determine XGBoost is the best for hardware-Trojan detection. Finally, we construct

an XGBoost-based hardware-Trojan detection method with its optimized hyperparameters. Evaluation experiments were conducted on the netlists from Trust-HUB benchmarks and showed the average F-measure of 0.842 using the proposed method. This value is 0.175 points higher than that of the existing best method.

Monday, September 5 13:15 - 14:00 (Europe/Berlin)

L2: Lunch & Networking

Room: a5

Monday, September 5 14:00 - 15:00 (Europe/Berlin)

P1: Panel - Consumer Technology Trends 2022 - Transforming the New

Room: a5

Monday, September 5 15:00 - 16:30 (Europe/Berlin)

S7: AUTOMOTIVE AND POSSIBLE APPLICATIONS IN CONSUMER TECHNOLOGIES

Room: a5

Chair: Nikolaos Athanasios Anagnostopoulos (TU Darmstadt & Universität Passau, Germany)

15:00 *In-Vehicle Monitoring for Passengers' Safety.....108*

Loujaina Hatim Backar and Meriam Khalifa (German University in Cairo, Egypt);
Mohammed A.-Megeed Salem (German University in Cairo & Ain Shams University, Egypt)

Driving drowsiness detection through videos/images is one of the most important issues for driver safety in today's world. Because of the great advancements in technology in the last few decades, deep learning techniques applied to computer vision applications such as sleep detection have shown promising results. Drowsiness is characterised by closed eyes, yawning, and micro-sleeps. Moreover, one of the biggest tragedies in the news lately, is toddlers or pets dying from heat built up in cars. In this work, a real-time deep learning algorithm is designed to monitor driver drowsiness, driver distraction, as well as an alert system for forgetting children and pets, and a seat belt usage system. The approach taken was to recognise and localise the face, eyes, and mouth, using the Dlib library, Histogram of Oriented Gradients, and a facial landmark predictor. The eye aspect ratio and the mouth aspect ratio are then calculated and evaluated for yawning detection and micro-sleep detection. The information on the driver's state was saved using a Firebase real-time database. This information is used by the children and pets detection algorithm, which sends an automatic email to the driver if a child or pet is discovered in the backseat when the driver is not in the car. When a driver uses a cell phone, eats, or drinks while driving, this is considered as a distraction. Canny edge detection is used to monitor the seat belt. Furthermore, the proposed method was subjected to several rounds of testing, that proved its viability and reliability.

15:20 Neural network aided reference voltage adaptation for NAND flash memory.....114

Daniel Nicolas Bailon (University of Applied Sciences, Konstanz, Germany); Guillaume Taburet (ENSICAEN, France); Sergo Shavgulidze (Georgian Technical University, Georgia); Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

Large persistent memory is crucial for many applications in embedded systems and automotive computing like AI databases, ADAS, and cutting-edge infotainment systems. Such applications require reliable NAND flash memories made for harsh automotive conditions. However, due to high memory densities and production tolerances, the error probability of NAND flash memories has risen.

As the number of program/erase cycles and the data retention times increase, non-volatile NAND flash memories' performance and dependability suffer. The read reference voltages of the flash cells vary due to these aging processes. In this work, we consider the issue of reference voltage adaption. The considered estimation procedure uses shallow neural networks to estimate the read reference voltages for different life-cycle conditions with the help of histogram measurements. We demonstrate that the training data for the neural networks can be enhanced by using shifted histograms, i.e., a training of the neural networks is possible based on a few measurements of some extreme points used as training data. The trained neural networks generalize well for other life-cycle conditions.

15:40 Deep learning-based diagnosis of Alcohol use disorder (AUD) using EEG.....119

Soyiba Jawed and Aamir S Malik (Brno University of Technology, Czech Republic); Rusdi Bin Abd Rashid (University of Malaya (UM), Malaysia); Mohamad Naufal Mohamad Saad (Universiti Teknologi PETRONAS, Malaysia)

Alcohol use disorder (AUD) involves people who have difficulty controlling their drinking habits. This results in significant distress and also affects functioning normally in their daily life. The challenge is to screen AUD patients successfully using subjective measures as they are dependent on self-assessment, which is not reliable in the case of alcoholics as they may lie or they may not correctly remember facts because access to alcohol use can affect memory. The solution is to use neuroimaging modalities such as electroencephalography (EEG), which looks into the brain patterns and does not involve self-rating. This study proposes a deep learning (DL) method to classify alcoholics and healthy controls. The proposed deep learning method applies EEG feature extraction automatically and classifies the participants into relevant groups. The participants, such as 30 AUD patients (mean age 56.70 ± 15.33 years) and 15 healthy controls (mean 42.67 ± 15.90 years), were recruited to acquire EEG data. The data were recorded during 10 minutes of eyes closed (EC) and eyes open (EO) conditions. Furthermore, 1D CNN was utilized to fit and evaluate the classification model. The EEG data were used to extract and classify EEG features using a convolutional neural network (CNN). As a result, the CNN has achieved the performance rendering a classification accuracy of (93%), specificity (89%), and sensitivity (89%) with an f1 score 0.94 for the AUD group. In addition, for the healthy control group, the specificity of (100%), the sensitivity of (100%), and the f1 score of 0.91 are achieved. In conclusion, the results implicated significant neurophysiological differences between alcoholics and control.

16:00 Continuous Supervision and Diagnostics System for Legacy Vehicles Integrated to Ambient Intelligence.....124

Walmir Acioli E Silva (Federal University of Amazonas (UFAM) & Sidia Institute of Science and Technology, Brazil); Marcos Negreiros Rylo (Federal University of Amazonas, Brazil & SIDIA, Brazil); Guido Machado (Federal University of Amazonas, Brazil); Renan Landau Paiva de Medeiros (Federal University of Amazonas - UFAM & Federal University of Amazonas, Brazil); Vicente F. Lucena, Jr. (Federal University of Amazonas, Brazil)

Maintenance aims to keep the vehicle in good working order and avoid unpleasant surprises, such as mechanical breakdown and component breakage due to damaged parts, increasing losses. Currently, to detect these problems, the On-Board Diagnostic II (OBDII) is used to diagnose issues in the Electronic Control Unit (ECU). Data are obtained from it by employing adapters, and such data are used in various applications. Ambient intelligence (AmI) is an environment with several devices connected in a wired or wireless network to obtain data from users without knowing it to aid and automate routine tasks. Through these devices, you can access the information that the house can offer. In this context, would it be possible to connect the car to the AmI to provide information that will help us avoid significant vehicle problems? This paper presents a system capable of sending vehicle information to the user's smartphone via the messaging app alerting that the vehicle is above normal temperature.

Monday, September 5 16:30 - 16:45 (Europe/Berlin)

C4: Coffee Break (Afternoon)

Room: a5

Monday, September 5 16:45 - 18:15 (Europe/Berlin)

S8: MACHINE LEARNING, DEEP LEARNING & AI (Part 2)

Room: a5

16:45 Gesture recognition of wrist motion using low-frequency PPG.....128

Marcos Negreiros Rylo (Federal University of Amazonas, Brazil & SIDIA, Brazil); Walmir Acioli E Silva (Federal University of Amazonas (UFAM) & Sidia Institute of Science and Technology, Brazil); Renan Landau Paiva de Medeiros (Federal University of Amazonas - UFAM & Federal University of Amazonas, Brazil); Vicente F. Lucena, Jr. (Federal University of Amazonas, Brazil)

This paper evaluated two machine learning techniques using low-frequency photoplethysmography and motion sensor data from wearable devices in gesture segmentation and classification. SVM and random forests were the classifiers selected for testing. Preliminary evaluations show that frequencies of 25 Hz are suitable for the recognition process, achieving an F1-score of 0.819 for seven gesture sets

17:05 Learning and detecting abnormalities in respiratory sounds on a tiny micro-controller.....N/A

Danilo Pietro Pau (STMicroelectronics, Italy); Abderrahim Khiari (Universita di Padova, Italy); Davide Denaro (STMicroelectronics, Italy)

According to the World Health Organization (WHO), 235 million people suffer from chronic respiratory diseases. More-over, 3 millions die yearly because of these diseases. Experts can hear, detect anomalous noises such as Crackles or Wheezes, and diagnose respiratory-related disorders during a lung auscultation, which is an important part of the medical assessment. In this study, an edge solution that monitors an individual respiratory sound and detects anomalies leading to early diagnosis of a disease was developed. A customized Echo State Network topology was designed to detect anomalies in the respiratory sounds achieving high performance with low complexity. It was also capable of on device learning for continuous adaptation to achieve individual personalization. The solution was tested on the respiratory audio database, ICBHI 17 challenge, achieving 0.87 sensitivity, 0.89 specificity and 0.9 f1 score. For inference the memory footprint on STM32H743ZI2 micro controller was as low as 43.6 KiB and each run required 1.27ms. For the learning stage, the memory footprint was 372 KiB and the computational time was 3981 ms at 400MHz using floating point calculations.

17:25 Architecture standardization for AI deployment on tiny micro-controllers.....N/A

Andrea Basso (Synesthesia, Italy); Daniele Bortoluzzi and Gianluca Torta (Università di Torino, Italy); Danilo Pietro Pau (STMicroelectronics, Italy); Leonardo Chiariglione (MPAI, Switzerland); Ferruccio Damiani (Università di Torino, Italy)

Artificial Intelligence (AI) systems have traditionally been associated with high-performance CPUs, GPUs, and FPGAs. This notion is rapidly changing as AI moves from the cloud to the edge, where recent highly optimized compute engines enable MCUs to be able to carry out complex machine learning tasks. This, in turn, allows these embedded systems to offer increased real-time responsiveness and device security against cyberattacks to adversarial events, as well as reduced bandwidth requirements, lower energy consumption and latency, cheaper prices, and scalability. Unfortunately, the AI world is still looking to standardize software architectures, which brings two issues: 1) Lack of compatibility, i.e., the ability of two or more systems or components to perform their required functions while acting in the same environment; and 2) Lack of interoperability, i.e., the ability of two or more systems to mutually exchange and subsequently use information. MPAI - Moving Picture, Audio, and Data Coding by Artificial Intelligence - is the first community to create data coding standards based on AI. MPAI targets widely accessible standards for AI-based data coding with the aim to achieve the same impact that digital media standards had since the late 80s. In this paper authors will introduce MPAI and will discuss the first implementation of the standard in the context of MCUs as well as discussing the pros and the cons.

17:45 Image Captioning using Pretrained Language Models and Image Segmentation.....132

Simone Bianco and Gabriele Ferrario (University of Milano-Bicocca, Italy); Paolo Napoletano (University of Milan Bicocca, Italy)

Large-scale pre-trained language models, which have learned cross-modal representations on image-text pairs, are becoming popular for vision-language tasks because the fine-tuning to a specific task enables state-of-the-art results. Existing methods require features of image regions as input, but these regions are

extracted with an object detection model that does not handle overlapping, noisy and ambiguous regions; this inevitably results in less meaningful features. In this paper we propose a new way to extract region features based on image segmentation, with the goal of reducing overlapping and noise. Our method is motivated by the observation that image segmentation can remove useless pixels using the binary mask to extract only the object of interest.