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Monday, November 9 15:15 - 15:25 (Europe/Berlin)

Networking Intro

Room: Berlin 1

Monday, November 9 15:25 - 16:25 (Europe/Berlin)

Security of CE systems

Room: Berlin 1

Chair: Vipul Mishra (Bennett University, India)

15:25 *Securing IP Cores in CE Systems using Key-driven Hash-chaining based Steganography...1*

Mahendra Rathor (IIT Indore, India); Pallabi Sarkar (VIT University, Bhopal, India); Vipul Mishra (Bennett University, India); Anirban Sengupta (Indian Institute of Technology Indore, India)

Digital signal processor (DSP) intellectual property (IP) cores are the underlying hardware responsible for high performance data intensive applications. However an unauthorized IP vendor may counterfeit the DSP IPs and infuse them into the design-chain. Thus fake IPs or integrated circuits (ICs) are unknowingly integrated into consumer electronics (CE) systems, leading to reliability and safety concerns for end consumers. The latent solution to this threat is hardware steganography wherein vendor's secret information is covertly embedded into the design to enable detection of counterfeiting. This paper presents a key-driven hash-chaining based hardware steganography to secure against counterfeiting threat. The proposed approach yielded a robust steganography achieving very high security in terms of stego-key size than similar previous work.

15:45 *Side Channel Attack Resistance of the Elliptic Curve Point Multiplication using Eisenstein Integers...5*

Johann-Philipp Thiers and Malek Safieh (University of Applied Sciences, Konstanz, Germany); Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

Asymmetric cryptography empowers secure key exchange and digital signatures for message authentication. Nevertheless, consumer electronics and embedded systems often rely on symmetric cryptosystems because asymmetric cryptosystems are computationally intensive. Besides, implementations of cryptosystems are prone to side-channel attacks (SCA). Consequently, the secure and efficient implementation of asymmetric cryptography on resource-constrained systems is demanding. In this work, elliptic curve cryptography is considered. A new concept for an SCA resistant calculation of the elliptic curve point multiplication over Eisenstein integers is presented and an efficient arithmetic over Eisenstein integers is proposed. Representing the key by Eisenstein integer expansions is beneficial to reduce the computational complexity and the memory requirements of an SCA protected implementation.

16:05 *Detecting DDoS Attacks Near The Edge with Router Canaries...11*

Winston Howard and Mike Borowczak (University of Wyoming, USA)

As consumers place more devices within their local networks the ability to detect and disrupt Distributed Denial of Service (DDoS) attacks must move closer to the edge in order to provide resilient and effective decentralized protection. To move detection from centralized entities towards the edge a distributed technique to detect DDoS attacks through the use of entropy-based canaries located near edge devices (e.g., switches, and routers) is proposed. The benefit of this approach is that a set of infrastructure devices could prevent attacks using hijacked devices from ever leaving local networks. In order to evaluate this approach an open-source Python software package was built on top of the Common Open Research Emulator (CORE) in order to simulate and assess these entropy-based canaries. This distributed entropy-based detection technique, based on prior centralized entropy-techniques, is able to achieve 100% detection rate even when attacker-node comprise only 25% of the total nodes. While these distributed entropy-based canaries can rapidly detect simulated DDoS attacks with high accuracy these preliminary results motivate future investigation using more diverse typologies and real-world data.

Consumer Technology for Smart City

Room: Berlin 2

Chairs: Shaibal Chakrabarty (AT&T Cybersecurity & Cardiotrack, USA), Lucio Ciabattoni (Universita' Politecnica delle Marche, Italy)

15:25 *Car parking detection in a typical village core street using public camera feeds...15*

Andre Coleiro (Malta College for Arts, Science and Technology, Malta); Daren Scerri (MCAST, Malta); Ivan Briffa (Malta

College for Arts, Science and Technology, Malta)

Malta is a small island with a highly dense car population. In many towns and villages parking is a serious problem leading to time waste and pollution. This study proposes a solution to accurately detect any available parking spaces in a typical village street. Solutions making use of IoT sensors beneath the top layer of asphalt in each parking space are expensive to scale and were only employed on the island in two pilot studies. Our solution proposes a two-phase approach to provide a dynamic low-cost solution by using public camera feeds. Phase 1 makes use of a Convolutional Neural Network (Mask R-CNN) to detect cars. Cars behavior over time is then exported and used to generate a heatmap which is then processed through a series of thresholding, morphological and contour detection operations to automatically annotate parking slots. In phase 2 the annotated street is fed into a second algorithm to determine parking space occupancy. We found that although our system automatically annotates parking spaces, results were very similar to other systems that require manually annotated parking boxes. Moreover, our system enables re-learning of annotations at desired intervals, thus creating a solution which adapts itself to street changes.

15:45 *Automating car park management with blockchain and computer vision...21*

Eman Sammut, Frankie Inguanez and Andrew Cortis (MCAST, Malta)

Most current semi-automated parking lots are not able to cater for fully autonomous vehicles since traditional systems assume a human is driving the vehicle and making a payment physically. This empirical research aims to determine whether a system combining computer vision with blockchain technology, can be used to document parking occupancy in a transparent and efficient manner whilst facilitating payment autonomously. There are three main components to the proposed solution, which are: Identifying and Authorisation of vehicles; Occupancy Detection; and Payment handling. This study investigates the accuracy, scaling, and efficiency of all three components. Two parking lots, indoor/outdoor, and 5 different vehicles were used to simulate interactions that may occur whilst making use of a parking lot. Whilst noting that the identification and authorisation of vehicles is possible with an accuracy around 96%, the detection of occupancy and vacating of a parking space is also possible with an accuracy around 94%, we do not that the use of blockchain suffers from a volatile price index and limited transaction speeds. Analysis of the results showed that making use of a permission based blockchain, resulted in faster and cheaper transactions whilst sacrificing on decentralisation. The main components of the proposed solution are executed at the source, meaning a low-cost computer attached at each camera point is sufficient, resulting in a system which can scale upwards by design.

16:05 *Consumer Frameworks for Smart Environments...27*

Shaibal Chakrabarty (AT&T Cybersecurity & Cardiotrack, USA); Daniel W Engels (HSBC); Luke Wood (Google, USA)

In this paper, we present a smart framework for Internet-of-Things (IoT) enabled environments that promotes consumer interaction with that smart environment and provides the control and management functionality necessary to manage the environment. Traditional smart frameworks focus solely upon the control and management functionality, allowing for consumer interaction via the centralized controller only (typically through a website or dedicated application). These frameworks can work in small, single manager environments, but are impractical in even medium sized, complex, or distributed always-on multi-manager environments such as smart homes, smart buildings, and smart cities. Our framework is built upon the Liberated Object Location System (LOLS) that provides a distributed, decentralized, secure, and consumer oriented system that merges a control management framework for data collection and analysis with the consumers and the smart elements in the environment. Digital twins, in the form of proxy services, are created for each device. LOLS provides a directory service for each device and its digital twin, allowing consumers to interact with the IoT and other smart devices in the environment either directly or through the digital twin. Digital twins may exist at multiple levels in the information hierarchy, allowing for localized, regional, or even global functional scope. All digital twins are integrated with the environment control and management functionality, allowing for scalable, distributed smart environments that provide a consumer accessible interface for each smart device.

Monday, November 9 16:30 - 17:00 (Europe/Berlin)

Welcome & Opening Words

Room: Berlin 1

Monday, November 9 17:00 - 18:00 (Europe/Berlin)

Keynote: Humachine Intelligence (HI): The mind at the epicenter of smart cars, buildings, cities, and worlds

Steve Mann

Room: Berlin 1

Chair: Nahum Gershon (MITRE Corporation, USA)

Humanistic Intelligence (HI) defines Smart Cities, Internet of *, VR AR and XR, Automotive, Sensors and Actuators, Consumer Health Technology, Humachine Interaction, AI, and Consumer Technology for Pandemics, in a way that puts the human mind at the epicenter of it all. Please refer to the accompanying figure and note the fractal (self-similar) nature of Mind-Body interaction which mimics Human-Machine interaction. Whereas the human mind and body are interconnected

through efferent and afferent nerves, we're similarly connected to our technologies by their sensors and our senses. Most importantly, Today's consumer technologies are machines of surveillance that must be balanced with inverse surveillance ("sousveillance") to form a complete feedback loop (rightmost in the figure). We must think in not just a human-centered framework but a mind-centered framework. I will deliver the Keynote using the BlueberryX brain-and-world-sensing eyeglass, thus allowing you to see inside my mind while I present these important ideas.

Monday, November 9 18:00 - 19:00 (Europe/Berlin)

Keynote: PACT: Private Automated Contact Tracing

Marc Zissman

Room: Berlin 1

PACT is a collaboration led by the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT Internet Policy Research Initiative, Massachusetts General Hospital Center for Global Health and MIT Lincoln Laboratory. It includes close collaborators from many other public and private research and development centers and is a partnership among cryptographers, physicians, privacy experts, scientists and engineers. Our mission is to maximize the utility of exposure detection functions in personal digital communication devices such that they can enhance and augment existing contact tracing strategies while preserving privacy. In this talk, we will provide a brief background of the COVID-19 pandemic and how automated contact tracing might fit into the overall fight against its spread, we will discuss and assess technical approaches for using smartphone technology to detect contact exposure events while preserving privacy, and we will report on PACT's impact to date and the road ahead.

Tuesday, November 10

Tuesday, November 10 13:30 - 14:30 (Europe/Berlin)

Keynote Panel: Security by Design for Sustainable Cyber-Physical Systems

Saraju Mohanty & Himanshu Thapliyal

Room: Berlin 1

Tuesday, November 10 14:30 - 15:30 (Europe/Berlin)

AI/ML for CE Technology - 1

Room: Berlin 1

Chairs: Theodore A. Antonakopoulos (University of Patras, Greece), Frankie Inguanez (MCAST, Malta)

14:30 *Traffic Sign Detection Using YOLOv3...32*

David Mijić (Institute RT-RK Osijek LLC for Information Technology Osijek, Croatia); Matteo Brisinello (RT-RK Institute for Computer Based Systems, Croatia); Mario Vranjes (University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology, Croatia); Ratko Grbić (University of Osijek, Faculty of Electrical Enginneering, Croatia)
Advanced driving assistance systems (ADASs) are increasingly being installed in modern vehicles because they make driving safer and more comfortable. With the implementation of cameras in the vehicle, the range of possible ADASs increases. One of such systems is the one aimed for traffic sign recognition, which alerts the driver about different road conditions such as excess of the speed limit or traffic ban. In this paper, a solution for detecting a specific set of 11 traffic signs typical for most European countries is presented. The algorithm used for detecting traffic signs is YOLOv3, where the model parameters are trained on a train set acquired from the newly created dataset. The rest of the dataset images are used for creating a test set. The dataset is derived from the video signals that were capturing traffic with a front view camera mounted inside the vehicle, in the city of Osijek in different weather conditions (sunny, cloudy, rain, night). The dataset images are extracted from 28 different video sequences, which resulted in 5567 images with the total number of 6751 annotated traffic signs. The proposed solution for detecting a specific set of traffic signs achieves high performance when tested on the test set created from the proposed dataset.

14:50 *Multi-Tier accent classification for improved transcribing...38*

Damiano Nicastro and Frankie Inguanez (MCAST, Malta)
Corporate companies are becoming more aware of gathering public sentiment, which is facilitated with the presence and vast usage of social networks and media platforms. This is a big data problem, and thus automated machine learning systems are deployed. The

process requires the analysis of textual mentions, visual illustrations of the brand and/or respective location, as well as audio mentions of the corporate identity and respective products. When focusing on gathering sentiment analysis from the spoken language, the problem of accent recognition is evident across native and non-native English speakers. Thus, in this research, we investigate the key features of accent recognition, calibrate a proposed system based on previous research using the Wildcat Corpus, and apply on a recent dataset, the Common Voice. Finally applying to a custom dataset gathered from an online media platform. We propose a novel hierarchical classifier solution, trained on the Common Voice dataset and tested on the custom dataset. Our three-tier solution achieved 86\% and 89\% in the first two levels of accents, and 59\% at the final level. From this research, we highlight the issues around the considered datasets and propose a number of recommendations for future researchers. In this research we are not improving or comparing any existing works, but rather offer new insights on the Common Voice dataset. We are presenting a hierarchical classifier for the accent classification problem as proposed.

15:10 *Clustering of classroom computers for academic research...44*

Irisann Agius and Frankie Inguanez (MCAST, Malta)
Academic researchers who are performing computational-heavy research may be at a disadvantage if their available systems are not suitable enough or may take a lot of time to produce a result set. Some academic institutions might not have the necessary resources to address the research needs. In this research, we extend our initial concept of clustering Raspberry Pi systems to investigate the viability and requirements needed to utilise school computers to create a Platform as a Service that can serve the needs for undergraduate researchers. A computer cluster utilising twenty-five school mid-level computers was created with a novel quality of service offering and bench-marked for performance while also creating a platform for students to be able to submit multiple neural network models to train them concurrently by utilising Distributed TensorFlow. It was concluded that low-to-medium end computers could be used to create a computer cluster for research purposes, yet a number of factors need to be taken into consideration.

Hardware Systems for CE Technology

Room: Berlin 2

Chairs: Theodore A. Antonakopoulos (University of Patras, Greece), Martin Margala (University of Massachusetts Lowell, USA)

14:30 *A Motion Estimation Search Algorithm and its Hardware Implementation for HEVC/H.265...50*

Sushanta Gogoi and Rangababu Peesapati (National Institute of Technology Meghalaya, India)

In this paper, a new alternating Motion Estimation (ME) search pattern algorithm and its hardware architecture have been proposed. The number of search points in the algorithm is reduced to (24 and 26) compared to Test Zonal Search(TZS)(77 for diamond search pattern and 81 for square search pattern). The proposed algorithm takes 7.89% and 8.47% less encoding time with a small increase in Bjøntegaard delta bitrate (BD-BR) 1.18% and 2.38% compared to the TZS algorithm. The proposed architecture was implemented in the FPGA platform and operates at 162 MHz. It can process 8K UHD (8192×4320)@78 fps.

14:50 *Automated Hardware and Neural Network Architecture co-design of FPGA accelerators using multi-objective Neural Architecture Search...56*

Philip J Colangelo (Intel Corporation, USA); Oren Segal and Alexander Speicher (Hofstra University, USA); Martin Margala (University of Massachusetts Lowell, USA)
State-of-the-art Neural Network Architectures (NNAs) are challenging to design and implement efficiently in hardware. In the past couple of years, this has led to an explosion in research and development of automatic Neural Architecture Search (NAS) tools. AutoML tools are now used to achieve state of the art NNA designs and attempt to optimize for hardware usage and design. Much of the recent research in the auto-design of NNAs has focused on convolution networks and image recognition, ignoring the fact that a significant part of the workload in data centers is general-purpose deep neural networks. In this work, we develop and test a general multilayer perceptron (MLP) flow that can take arbitrary datasets as input and automatically produce optimized NNAs and hardware designs. We test the flow on six benchmarks. Our results show we exceed the performance of currently published MLP accuracy results and are competitive with non-MLP based results. We compare general and common GPU architectures with our scalable FPGA design and show we can achieve higher efficiency and higher throughput (outputs per second) for the majority of datasets. Further insights into the design space for both accurate networks and high performing hardware shows the power of co-design by correlating accuracy versus throughput, network size versus accuracy, and scaling to high-performance devices.

Tuesday, November 10 15:30 - 16:30 (Europe/Berlin)

AI/ML for CE Technology - 2

Room: Berlin 1

Chairs: Theodore A. Antonakopoulos (University of Patras, Greece), Ravi Kumar Arya (National Institute of Technology Delhi, India)

15:30 *The Use of Artificial Neural Networks for Predicting Response of Frequency Selective Surfaces...62*

Ravi Kumar Arya (National Institute of Technology Delhi, India); Abhinav Gola and Animesh Animesh (NIT Delhi, India); Hulusi Acikgoz (KTO Karatay University, Turkey); Rahul Sawlani (National Institute of Technology Delhi, India); Konark Sharma (National Institute of Technology, Kurukshetra, India); Malay Ranjan Tripathy (Room No. 214 (A) E-1 Block, India & Amity University Uttar Pradesh, unknown)

In the real world problems, mostly there is difference between dimensions of simulated and corresponding fabricated structures. In case of Frequency Selective Surface (FSS), this variation can be even larger as the frequency gets into terahertz range. One of the approach to study such variations is metamodeling. In this work, we address the problem of modeling such structures with statistical variations in their geometries by using artificial neural network (ANN). We train and test this metamodel and finally show its performance statistics.

15:50 *Deep Learning Methods for Indian Sign Language Recognition...66*

Pratik Likhar and Neel Kamal Bhagat (Indian Institute of Science Bangalore, India); Rathna G N (Indian Institute of Science, Bangalore, India)

The language used by speech and hearing impaired people is known as Sign Language. Indian Sign Language is the language used by specially abled people in India. Unfortunately the general population has no understanding of the sign language which hampers the communication between the specially abled and the general population. We are proposing a methodology to bridge this gap and help specially abled people communicate with the general population seamlessly. We have used two approaches to solve this problem. First using the depth+RGB data captured using a Microsoft Kinect and predicting the gestures in real time. For segmenting the hand region from the data obtained by the RGB-D camera we used 3D reconstruction and affine transformation to map the depth and RGB information. Convolutional neural networks were used and segmented hand images/videos were used as an input to them. 36 static hand gestures from Indian Sign Language were trained. This model also showed a good performance when we transfer learned the American Sign Language. LSTM with a convolutional kernel was used for training 10 dynamic gestures. But as soon as we implemented this system, we figured out there is an inherent problem with this methodology. It is practically unreasonable to carry the bulky Microsoft Kinect around along with a system capable of performing the computation to communicate with people. We attempted to solve this problem using semantic segmentation of the hands. We used U-Net with ResNet 101 as the backbone for the same. Semantic segmentation utilises the input from a normal RGB camera which completely removes the necessity of using a RGB-D Kinect camera.

16:10 *ABCD: A Compact Object Detector Based on Channel Quantization and Tensor Decomposition...72*

Bingyi Zhang and Peining Zhen (Shanghai Jiao Tong University, China); Junyan Yang and Saisai Niu (Shanghai Aerospace Control Technology Institute, China); Hang Yi (Beijing Institute of Astronautical Systems Engineering, China); Haibao Chen (Shanghai Jiao Tong University, China)

Object detection and tracking are critical computer vision tasks because of the broad needs in society; however, deep neural network-based methods cost many computational resources that hinder them from real scene applications. Quantization is a widely adopted technique to reduce the storage space and memory footprint which makes deep learning models more energy-efficient and resource-friendly. Traditional network quantization methods directly quantize neural networks layer-wise, which means the parameters in different channels take the same quantization range. In this paper, we propose a low-bit learning method for convolutional neural network object detector quantization. Different from previous methods, we quantize the detector channel-wisely to avoid accuracy loss in the low-bit framework. We use progressive quantization, progressive batch normalization fusion, and cut the unnecessary long-tail weights and activations to reduce quantization loss. Moreover, based on the object detector and long short-term memory network (LSTM), we develop a high-performance tracking system. We leverage the tensor decomposition to compress weights in LSTM for getting a higher compression ratio. Experiments are conducted on public datasets and our infrared aerial dataset for object detection and tracking. The experimental results show that our approach obtains better performance compared with the state-of-the-art methods in terms of accuracy and compression ratio.

CE Technology for Automotive Systems

Room: Berlin 2

Chairs: Nikola Sakic (Faculty of Technical Sciences, University of Novi Sad & RT-RK, Serbia), Mario Vranjes (University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology, Croatia)

15:30 *Camera-LIDAR Object Detection and Distance Estimation with Application in Collision Avoidance System...78*

Nikola Sakic (Faculty of Technical Sciences, University of Novi Sad & RT-RK, Serbia); Momcilo Krunic (RT-RK Institute for Computer Based Systems, Serbia); Stevan Stevic (University of Technical Sciences & RT-RK, Serbia); Marko Dragojevic (Faculty of Tehnical Sciences & RTRK, Serbia)

Nowadays we are aware of accelerated development of automotive software. Numerous of ADAS (Advanced Driver Assistance Systems) systems are being developed these days. One such system is the forward CAS (Collision Avoidance System). In order to implement such a system, this paper presents one solution for detecting an object located directly in front of the vehicle and estimating its distance. The solution is based on the use of camera and LIDAR (Light Detection and Ranging) sensor fusion. The camera was used for object detection and classification, while 3D data obtained from LIDAR sensor were used for distance estimation. In order to map the 3D data from the LIDAR to the 2D image space, a spatial calibration was used. The solution was developed as a prototype using the ROS

(Robot Operating System) based Autoware open source platform. This platform is essentially a framework intended for the development and testing of automotive software. ROS as the framework on which the Autoware platform is based, provides a library for the Python and C++ programming languages, intended for creating new applications. For the reason that this is a prototype project, and it is popular for application in machine learning, we decided to use the Python programming language. The solution was tested inside the CARLA simulator, where the estimation of the obstacle distance obtained at the output of our algorithm was compared with the ground truth values obtained from the simulator itself. Measurements were performed under different weather conditions, where this algorithm showed satisfactory results, with real-time processing.

15:50 *UrTra2D - Urban Traffic 2D Object Detection Dataset...84*

<u>Borna Jelić</u> (Institute RT-RK Osijek LLC for Information Technology Osijek, Croatia); Ratko Grbić (University of Osijek, Faculty of Electrical Enginneering, Croatia); Mario Vranjes (University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology, Croatia); Milan Z. Bjelica (University of Novi Sad, Serbia)

With progress being made in the field of artificial intelligence and especially machine learning, tech and vehicle companies acquired a powerful tool and made a large step towards realisation of a fully autonomous vehicle. Along with the exploding development of more and more powerful hardware, deep learning has become one of the most dominant fields of research in the automotive domain, succeeding the classical computer vision methods. However, to be able to apply deep learning methods to solve a problem, large and appropriate datasets are required in developing a solution, as there is never enough data for deep learning. In this paper, Urban Traffic 2D Object Detection (UrTra2D) dataset is presented, which is intended for training 2D detectors of specific objects common for urban traffic scenes. The data was recorded with an affordable camera mounted inside the vehicle. The dataset contains video sequences and labelled frames of the traffic in the city of Osijek in different weather conditions during both day and night. There are 5 770 labelled frames, totalling in 22 764 labelled objects throughout 11 categories. The UrTra2D dataset is freely available to the research community upon request.

16:10 *One solution of camera service in AUTOSAR Adaptive environment...90*

Mila Kotur (Faculty of Technical Sciences, Serbia); Nemanja Lukic (University of Novi Sad, Serbia); Momcilo Krunic (RT-RK Institute for Computer Based Systems, Serbia); Gordana Velikić (Universtity of Rochester, Serbia)

The rapid evolution of the automotive industry sets new requirements and challenges in the development of autonomous driving software. As an answer to these industry requests, for the development of such complex systems, a user-defined standards and software development process are required, which will minimize the risk to an acceptable minimum. These demands have become a foundation for AUTOSAR - an open, standardized software architecture, which introduced a new standard - Adaptive platform. Since the camera sensor is one of the most important, but also the most critical sensors in the cars, the implementation of the camera service component is presented, which relies on the usage of AUTOSAR Adaptive platform, C++ programming language and ARXML scheme, as parts of Adaptive standard. The solution was tested by measuring the performance of the camera services, more precisely the time required to deliver the frame from the camera to the client application. This way of developing software components, enables system resource planning at the design time, thus contributing to security and avoiding unwanted errors.

16:30 *Utilization of design patterns in AUTOSAR Adaptive standard...95*

Mila Kotur (Faculty of Technical Sciences, Serbia); Nemanja Lukic (University of Novi Sad, Serbia); Momcilo Krunic (RT-RK Institute for Computer Based Systems, Serbia); Gordana Velikić (Universtity of Rochester, Serbia)

Modern civilization faces a significant challenge in embracing emerging technologies, like autonomous driving. In this article authors present that autonomous driving lies in software safety standards which are in ongoing revisions and improvements under the eyes of interested parties and public in whole. The article explains the key concepts for software development in the modern automotive industry such as ISO, V model, ASIL, SOME / IP and programming languages used in the implementation of the solution, such as C ++. Article also addressed AUTOSAR as the global standardization consortium for automotive software architectures that aims to adapt to current trends, and to provide a consistent standard for these aspects. Design patterns in AUTOSAR Adaptive standard have been validated as a useful aspect in communication between different software components. So, there is a need to create and permanently upgrade a catalog of design patterns which helps designers to build reliable critical software architecture adequate for intense communication within the car.

Tuesday, November 10 16:30 - 17:00 (Europe/Berlin)

Networking Intermezzo - Bring the Coffee

Room: Berlin 1

Tuesday, November 10 17:00 - 18:00 (Europe/Berlin)

Keynote: The Journey to the Converged Edge

Tom Bradicich

Room: Berlin 1

The complex infrastructures emerging at the edge can be portioned into two main categories: IT compute, storage, and networking, and, OT (Operational Technologies) that include control systems, data acquisition systems and industrial networks. Great efficiencies are gained by the convergence of IT and OT. Dr. Tom Bradicich will discuss his journey in pioneering OT and IT integration at the edge and IoT, and review key real world deployments and their business benefits. Dr. Tom will close with a discussion on the future of IoT and the converged edge, he calls Converged Edge as-a-Service.

Tuesday, November 10 18:00 - 19:00 (Europe/Berlin)

Keynote: Delivering Continuous Intelligence from Streaming Data (Including Consumer Technology)

Simon Crosby

Room: Berlin 1

Scarcely a decade ago, cloud creators, confident that tech used in the largest clouds could also harvest insights from mountains of enterprise data. But yesterday's big-data has become today's boundless data, and it's time to face an uncomfortable truth: Tech from the "store-then-analyze" era can't keep up. Applications need to respond in real-time, but streams are boundless and data value is short-lived. This talk will provide an introduction into a class of software capabilities that can deliver continuous intelligence from streaming data (e.g., consumer technology data), analyzing, learning and predicting on-the-fly to deliver responses in real-time. Continuous intelligence adopts an "analyze, react, and then store" model in which computation is driven by the arrival of streaming data. It complements the stateless REST + database approach of today's cloud-native stacks with stateful, in-memory computation in which data is used to build and scale a live graph of concurrent actors that analyze data on the fly. Continuous intelligence applications are a million times faster and use 10% of the infrastructure of big-data applications.

Wednesday, November 11

Wednesday, November 11 12:00 - 13:00 (Europe/Berlin)

Tutorial: Let's make a computer

Milan Vidakovic

Room: Berlin 1

Couple of years ago I decided to make a computer right from scratch. That task meant that I needed to devise an instruction set, internal architecture, and to make a choice of peripherals. For starters, I used a FPGA development board to implement the core of the system. Later, I added UART, keyboard, VGA graphics, SD card and Ethernet connectivity. In parallel, I needed to invent my own assembler, to modify GCC to work with my architecture and to reuse all sorts off open-source drivers for my peripherals. This is my journey into the world of low-level hardware and software development.

Wednesday, November 11 13:00 - 14:00 (Europe/Berlin)

IoT and CODEC

Room: Berlin 1

Chairs: Francisco J. Bellido-Outeiriño (University of Córdoba, Spain), Thomas Coughlin (Coughlin Associates, USA)

13:00 *On Flashing Over The Air "FOTA" for IoT Appliances - An ATMEL Prototype...101*

Wael Badawy (Badr University at Cairo, Egypt); Ahmed I. Ahmed and Samy H. Sharf (Nile University, Egypt); Rafaat Abd Elhamied, Mostafa Mekky and Mohamed Abd Elhamied (Fares PCB for Electronic Solutions, Egypt)

Wireless flashing over the air is a challenging task. Appliances are required to update its flash or EEPROM via a remote system update. However, direct connectivity via a wire is not available. Within the application of consumer electronics, such as utility meters or other appliances, there is always a room to update the appliance remotely for optimal operation. In this paper, we present a new system for remotely flashing all models of ATMEL AVR microcontrollers via Wi-Fi and LoRa technologies. Also, we will demonstrate an experimental work to prove our new methodology as well as applying it in industrial scenarios.

13:20 *On Scalable Video Codec for 4K and High Definition Video Streaming - the Hierarchical Adaptive Structure Mesh Approach "HASM-4k"...106*

Wael Badawy (Badr University at Cairo, Egypt)

This paper presents an efficient scalable Video Codecs using hierarchical representation for video dynamics that is tailored to 4K (3840 x 2160) and ultra-large resolution. The proposed coding is based on the Hierarchical Adaptive Structure Mesh and has been applied to 4k video resolution. It is called HASM-4k and it is used for intra-frame compression. The proposed technique has a limit of computational requirement while it has a significantly better visual fidelity.

13:40 *IoT Hardware-Defined Routing Protocol for Dynamic Self-organizing Wireless Mesh Networks...111*

Zhanserik NURLAN (Eurasian National University L. N. Gumilyev, Astana, Kazakhstan); Tamara Zhukabayeva (Eurasian National University, Kazakhstan); Mohamed Othman (Universiti Putra Malaysia, Malaysia)

In today's world, wireless devices have reached a modern level and this allows the use of wireless interfaces in the entire field of electronics replacing previously used wired solutions. These devices are used to monitor and manage objects. Nevertheless, these devices have the property not to work over long distances or even cease to accept requests. It is often associated with overlapping device frequencies in open ranges. In the proposed work, the subject of study was wireless mesh networks with the AODV routing protocol and with association of previously developed method based on painless mesh in the environment of SDN (software-defined networks). The objectives of study were previously identified Internet of Things (IoT) devices used at large facilities. A packet loss and delay in packet transmission are the study cases done by using both protocols under research.

Emerging CE Technologies

Room: Berlin 2

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

13:00 *The use of Spindle Feature Vectors in Wearable Devices for Sleep Monitoring and Analysis...115*

Ioannis Krilis and Theodore A. Antonakopoulos (University of Patras, Greece)

The influence of sleep quality on humans health is considered as one of the most important aspects for preventative care. During the last decade, several wearable sensors have been developed for monitoring bio-signals. In this work, we present the applicability of an automatic software tool, called Spindle Detection and Feature Extraction (SpiDeFex), developed for the analysis of multi-channel signals of professional EEG systems, in the consumer area. Using commercial devices based on lightweight, rechargeable pods that can sense, collect and transmit an EEG signal in real-time, we can extract information for sleep quality for commercial applications. This work presents the architecture and functionality of SpiDeFex, and based on experimental results, we demonstrate how it can be used for sleep quality monitoring and analysis in a consumer wearable device.

13:20 *Towards Higher Customer Conversion Rate: An Interactive Chatbot Using the BEET Model...121*

Wael Badawy (Badr University at Cairo, Egypt); Anan El-Helw (Arab Academy for Science and Technologies and Maritime Transport, Egypt); Aliaa Youssif (Arab Academy for Science and Technology, Egypt)

This paper presents an interactive Chatbot that increases the rate of customer conversion by observing the behavior emotion status. The trigger customer action accordingly using a customer behavior analysis model named "Behavioral Emotion Engagement Trigger" BEET model. BEET extends the operation of the Chatbot beyond conversational AI, sentiment analysis to evaluate the emotional status of the customer then it aligns the response using BEET to engage customer along with their own priorities. The performance of the chatbot is measured according to its ability to understand and classify both people and sentiments then it measure their conversion rate.

Wednesday, November 11 14:15 - 15:10 (Europe/Berlin)

Keynote: Wearable Healthcare Systems

Nima Taheri Nejad

Room: Berlin 1

Designing healthcare devices has always been very challenging, which -partly- stems from their interdisciplinary nature, bringing engineers and physicians together for a close -or an entangled- collaboration. Good communication between the two groups could largely reduce the difficulty: Engineers would understand the problem better and do their best to solve it; physicians would understand better what a device is capable of doing and what the limits (requiring complementary actions) are. Physicians would have an extensive knowledge about the physiology and nature of the problem that they could communicate to engineers. Engineers, on the other hand, would know in advance the (expected) operational and environmental conditions of the device and could take them into account at design time. However, the emergence of wearable devices has been a game changer in many aspects.

Wednesday, November 11 15:15 - 16:25 (Europe/Berlin)

IoT and Edge Computing

Room: Berlin 1

Chair: Leo Popokh (Hewlett Packard Enterprise (HPE) & Southern Methodist University (SMU), USA)

15:15 *Artificial Intelligence Service Architecture for Edge Device...126*

Seung Woo Kum (Korea Elecronics Technology Institute, Korea (South)); Youngkee Kim (Korea Electronics Technology Institute, Korea (South)); Domenico Siracusa (Fondazione Bruno Kessler, Italy); Jaewon Moon (Korea Electronics Technology Institute, Korea (South))

Edge computing is getting more focused recently due to high demand of Artificial Intelligence application, for example, detection of wearing masks from a video stream. In edge computing, the AI applications are placed near data source to improve quality of service, and there are several researches to bring AI service onto edge device such as TensorFlow Serving. However, existing researches focus on providing accessibility of the trained model itself and require additional preprocessing and postprocessing of data to build an end-to-end service. In this paper, an AI Service Architecture for an Edge Device is proposed to provide accessibility to the AI service itself. The proposed architecture provides AI as a service, which means it includes pre-processing and postprocessing, as well as the model itself. Since it includes all the methods which consists an AI service, the proposed architecture provides more intuitive ways to bring an AI method to edge device. Moreover, it defines interfaces to configure and access the AI service, which makes it suitable apply microservice architecture.

15:35 *Physical and Virtual Resources Inventory Modeling for Efficient VNF Placement...129*

Leo Popokh (Hewlett Packard Enterprise (HPE) & Southern Methodist University (SMU), USA); Suku Nair (Southern Methodist University, USA); Pablo Olive, Ignacio Aldama and Yaseen Al Doori (HPE, USA)

5G slice management supported by Network Function Virtualization (NFV) and cloud-native deployment is paramount for the rapid introduction of new 5G features like Enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (MMTC), and Ultra-reliable Low Latency Communications (URLLC). The 5G and NFV transformation allow mobile operators to address further the needs of Internet of Things (IoT) and Edge Computing in a highly efficient manner. In this transformation, the efficient deployment and optimal placement of Virtual Network Functions (VNFs) is another critical enabler. It is crucial to efficiently perform physical and virtual resource allocation to keep End-to-End (E2E) delays and latencies minimal. In our research, while we aim to solve VNF efficient placement in a timely way, we must first address the information model and mapping of Network Function Virtualization Infrastructure (NFVI) physical and Virtualized Infrastructure Management (VIM) virtual resources. Based on the information model, derive the VNFs' optimal placement to minimize the maximum distances across physical and virtual resources that are part of the VNF building blocks. In this paper we provide a methodology for real-time mapping of physical resources to the virtual components to create a uniform information catalogue that enables efficient placement of VNF components satisfying various service requirements.

Processors and Memory in CE Systems

Room: Berlin 2

Chair: Vipul Mishra (Bennett University, India)

15:15 *A Novel Approximate Constant Multiplier and HEVC Discrete Cosine Transform Case Study...135*

Hasan Azgin (Sabanci University, Turkey); Ercan Kalali (TU Delft, The Netherlands); Ilker Hamzaoglu (Sabanci University, Turkey)

Approximate computing is used for error tolerant applications to design faster, smaller area and lower power consuming hardware than exact optimized hardware designs by trading off speed, area and power consumption with quality. Constant multiplication is used in error tolerant applications with high computational complexity such as video processing, video compression and machine learning. Therefore, in this paper, a novel approximate constant multiplication technique is proposed. Approximate constant multiplier hardware implementing the proposed approximation technique reduces constant multiplication to multiplication with a smaller constant. The proposed approximate constant multiplier causes negligible quality loss when it is used to implement the constant multiplications in High Efficiency Video Coding (HEVC) discrete cosine transform (DCT). It reduces area, reduces power consumption and increases performance of HEVC DCT hardware.

15:35 *Bit-Labeling and Page Capacities of TLC Non-Volatile Flash Memories...141*

Johann-Philipp Thiers and Daniel Nicolas Bailon (University of Applied Sciences, Konstanz, Germany); Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

The reliability of flash memories suffers from various error causes. Program/erase cycles, read disturb, and cell to cell interference impact the threshold voltages and cause bit errors during the read process. Hence, error correction is required to ensure reliable data storage. In this work, we investigate the bit-labeling of triple level cell (TLC) memories. This labeling determines the page capacities and the latency of the read process. The page capacity defines the redundancy that is required for error correction coding. Typically, Gray codes are used

to encode the cell state such that the codes of adjacent states differ in a single digit. These Gray codes minimize the latency for random access reads but cannot balance the page capacities. Based on measured voltage distributions, we investigate the page capacities and propose a labeling that provides a better rate balancing than Gray labeling.

15:55 *An FPGA-Implemented Parallel System of Face Recognition, for Digital Forensics Applications...147*
M. Pantopoulou and Nicolas Sklavos (University of Patras, Greece)
With the number of crime cases increasing daily, the Digital Forensics sector is growing rapidly. More and more researchers search for efficient face recognition systems, which will provide fast and accurate results in order to uncover crime suspects. Although many software implemented systems exist, they seem to have speed problems. This is the reason why hardware implemented systems are preferred. In this paper, an FPGA hardware implementation is proposed, which processes four images in parallel in order to reduce the total execution time and the on-line training process is applied. The system operates in a frequency of 66.23 MHz and the total execution time is almost 128 ms due to the on-line training. The Yale face database is used and the accuracy of the implemented system is 80% for 30 consecutive trials. The design is performed for an Artix-7 FPGA.

Wednesday, November 11 16:25 - 17:00 (Europe/Berlin)

Young Minds: Robots for the Masses

Michael Wimmer

Room: Berlin 1

Learn the future of human-robot interaction from the perspective of a 12-year- old. Looking ahead, how can we ensure that consumers are educated and excited to accept the roles robots will play in their lives?

Wednesday, November 11 17:00 - 18:00 (Europe/Berlin)

Keynote Panel: Technology Predictions for Times of Pandemics

Dejan Milojicic & Tom Coughlin

Room: Berlin 1

Predicting the future is never easy, it always entails a degree of uncertainty, if not luck. Predicting technology trends is even harder as it requires both technical and business acumen, e.g., whether the technology will be developed, productized, and ultimately adopted on the market. It is almost an art to distill between a fashion and a true scientific trend. At the same time, the public likes to read predictions and many individuals and organizations regularly write technology predictions, such as Gartner, MIT, Forbes, and many others. Predicting technology in times of pandemics carries even more weight as it deals with human lives and economies of many nations, and the humanity as a whole. IEEE Computer Society started its technology predictions informally in early 2010 and formally via annual press releases in 2014. In 2016 we introduced scorecards for previous year. Our predictions reached substantial audience, e.g., in 2018, it was picked up by 300 media outlets (84.6M audience), entirely different from classical publishing. We consider predictions a new type of publication, a lightweight, short, approximately a paragraph per prediction. The predictions triggered other media outreach, such as blogs, interviews, panel sessions, and special issue of IEEE Computer magazine. In this panel talk, I will present history of predictions, followed by 10 technologies that may make a difference in addressing pandemics.

Thursday, November 12

Thursday, November 12 11:45 - 12:30 (Europe/Berlin)

Keynote Panel: The Frontier Between Medicine and Wellness

Dusan Maric & Dzihan Abazovic

Room: Berlin 1

In this interesting panel topic, during Keynote introductions you will learn how exoskeletons are used, why they are not recommended for consumer applications yet, and when we will have a device to create own stem cell facial cream.

Thursday, November 12 12:30 - 13:45 (Europe/Berlin)

RF, Wireless and Network Technology

Room: Berlin 1

Chair: Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

12:30 *Generalized Multistream Spatial Modulation Based on One Mannheim Error Correcting Codes and their Low-Complexity Detection...153*

Daniel Rohweder and Patrick Oleschak (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)

This paper proposes a novel transmission scheme for generalized multistream spatial modulation. This new approach uses one Mannheim error correcting codes over Gaussian or Eisenstein integers as multidimensional signal constellations. These codes enable a suboptimal decoding strategy with near maximum likelihood performance for transmission over the additive white Gaussian noise channel. In this contribution, this decoding algorithm is generalized to the detection for generalized multistream spatial modulation. The proposed method can outperform conventional generalized multistream spatial modulation with respect to decoding performance, detection complexity, and spectral efficiency.

12:50 *Soft-input decoding of concatenated codes based on the Plotkin construction and BCH component codes...159*

Daniel Nicolas Bailon and Johann-Philipp Thiers (University of Applied Sciences, Konstanz, Germany); Juergen Freudenberger (University of Applied Sciences, Konstanz & Institute for System Dynamics (ISD), Germany)

Low latency communication requires soft-input decoding of binary block codes with small to medium block lengths. In this work, we consider generalized multiple concatenated (GMC) codes based on the Plotkin construction. These codes are similar to Reed-Muller (RM) codes. In contrast to RM codes, BCH codes are employed as component codes. This leads to improved code parameters. Moreover, a decoding algorithm is proposed that exploits the recursive structure of the concatenation. This algorithm enables efficient soft-input decoding of binary block codes with small to medium lengths. The proposed codes and their decoding achieve significant performance gains compared with RM codes and recursive GMC decoding.

13:10 *Received Signal Strength Indicator Analysis for Item Tracking using Chipless RFID...164*

Vijay Sharma (IIIT-Delhi, India); Mohammad Hashmi (Nazarbayev University, Kazakhstan & IIIT Delhi, India)

The impact of RFID on a global scale can optimize the supply chain, monitor process behavior, and remotely track objects. RFID can also contribute to managing material handling, e.g., automatic material sorting, minimize manual work, improve speed, and record the necessary parameters. This paper aims to identify the chipless RFID properties concerning operational factors, tracking, and localization. The readers' antenna transmitting power is adjusted based upon the Received Signal Strength Indicator (RSSI) value. Hence, objects connected to the tag from the reader's coverage area can be tracked and traced efficiently. The outcome of this feasibility study can find usefulness in the classification and provide solutions as chipless RFID on different applications.

13:30 *A novel wide bandwidth antenna array using slotted spiral SIW for satellite communications...167*

Alla Eid (Faculty of Engineering, Egypt); Amgad Salama and Hassan El Kamchouchi (Alexandria University, Egypt)

In this paper, we demonstrate a novel slotted substrate integrated waveguide (SIW) antennas with two arms archimedean antenna configuration. Additionally, its near, as well as far-field characteristics, have been investigated. Furthermore, [1X2] slotted SIW traveling wave antenna array has been designed, fabricated, and measured. The proposed array based on the two arms archimedean spiral antenna which, has a superior characteristic of 18% RLBW, 12% boresight ARBW, and 7dBi directivity. We evaluate the performance of the proposed antenna array versus the last reported antenna and the proposed antenna array performance is superior to that of the others. Moreover, the measurements of the proposed array have a good agreement with the simulation results where, 28%, 9% RLBW, and ARBW, respectively, have been achieved. More, the directivity of the proposed antenna array is 9 dBi.

Security/Privacy and Optimization of CE systems

Room: Berlin 2

Chair: Ruslan Dautov (Rochester Institute of Technology, USA)

12:30 *On the Trade-off between Output SNR and Secret Key Generation Rate in Switch-and-Stay Combining...172*

Ruslan Dautov and Gill R Tsouri (Rochester Institute of Technology, USA)

Switch-and-Stay Combining (SSC) is a widely used switched diversity technique that reduces receiver complexity and provides improvement in fading conditions. Until now, the main objective of SSC, was to provide favorable decoding performance. Current work proposes to augment this objective with the main goal of Wireless Physical Layer Security (WPLS) - fast and secure key generation. In a typical practical scenario for consumer electronics, where only one of the two participants employs switched diversity in the form of SSC, we consider a communication protocol where one correspondent always sends a request, while another responds. We show that under

this assumption manipulating a switching threshold has a tremendous effect on the upper bound of Key Generation Rate (KGR). Thus, KGR improvement can reach up to 12%. More importantly, we show that maximizing the output SNR does not lead to the highest KGR, meaning that optimizing for both requires resolving a trade-off. If KGR is of priority, the loss in output SNR is approximately 0.4 dB.

12:50 *Automating the BGE Attack on White-Box Implementations of AES with External Encodings...176*

Alessandro Amadori (Eindhoven University of Technology, The Netherlands); Wil Michiels (NXP Semiconductors, The Netherlands); Peter Roelse (Irdeto BV, The Netherlands)

Cloud-based payments, virtual car keys, and digital rights management are examples of consumer electronics applications that use secure software. White-box implementations of the Advanced Encryption Standard (AES) are important building blocks of secure software systems, and the attack of Billet, Gilbert, and Ech-Chatbi (BGE) is a well-known attack on such implementations. A drawback from the adversary's or security tester's perspective is that manual reverse engineering of the implementation is required before the BGE attack can be applied. This paper presents a method to automate the BGE attack on a class of white-box AES implementations with a specific type of external encoding. The new method was implemented and applied successfully to a CHES 2016 capture the flag challenge.

13:10 *The Consumer and The Grid: A story about Balance...182*

Nebojsa Pjevalica (University of Novi Sad, Serbia); Velibor Pjevalica (JP Srbijagas, Serbia); Nenad Petrovic (School of Electrical Engineering, Serbia)

Since the early days of electrification, the relation between the consumer and the grid carries its permanently evolving challenges. Balancing issue is exposed through aspects of demand and supply, measurement and charge, quality of voltage vs. quality of current and distributed generation vs. loads. Balancing the daily load peak is focused in more detail, offering a novel approach targeting the level of the Distributive Transformer as a proposed basic hub for Demand Side Management. The simulation model is proposed offering modeling consumer appliances, its power profiles, statistical parameters, and scheduling mechanism for the shiftable loads. The main statistical parameters of the average European household is taken from the European Commission Energy Efficiency status report and used during the referent model development. Modeled Distributive Transformer peak demand exposed significant decrease potential if the scheduling of the shiftable loads has emerged. Consumption peak relative decrease of 25% is reached through the scheduling of the 70% of the available shiftable loads. As the IoT and Cloud technologies already offer reliable implementation framework, system prototyping at the level of single Distributive Transformer presents the next challenging research direction.

Thursday, November 12 13:45 - 14:55 (Europe/Berlin)

Consumer Technology for Healthcare/Well-being

Room: Berlin 1

Chairs: Theodore A. Antonakopoulos (University of Patras, Greece), Reinhard Moeller (University of Wuppertal, Germany)

13:45 *Extensible Augmented Reality Assisted Contact-Free Patient Surveillance in Emergency Context...196*

Robert Roth, Thomas Pursche, Dena Farooghi and Reinhard Moeller (University of Wuppertal, Germany)

We present a concept for a supplementary patient monitoring and emergency alerting system. It renders hot pluggability of sensors possible by taking a modular design as a basis. Specialized sensor modules detect the occurrence of particular emergencies such as excessive increasing or decreasing heart rate. The observers operating the system can receive and easily react to these emergencies using augmented reality headsets without having to interrupt their routine. Means to monitor multiple patients per sensor are discussed in this paper as well.

14:05 *Slot-Dependent Wireless Power Transfer System for MBAN Applications...201*

Zhanel Kudaibergenova, Kassen Dautov, Galymzhan Nauryzbayev and Mohammad Hashmi (Nazarbayev University, Kazakhstan); Muhammad Akmal Chaudhary (Ajman University, Ajman, United Arab Emirates)

This paper presents for the first time the wireless power transfer (WPT) system that is fully dependent on the etched slot on the ground plane. At first, the defected ground structure-based resonator with the circuit area of 20-by-20 sq. mm and a rectangular defect was proposed. Then, it was changed to three rectangular slots to achieve resonance at the desired frequency. Subsequently, the resonators with optimized parameters were aptly utilized to design the WPT system that works at 2.4 GHz. The operating frequency complies with the practical medical body area network band and, therefore, can be employed to the biomedical implants. It has been demonstrated that the perfect coupling can be observed at a distance of 10 mm. As a consequence, at this distance the obtained simulation results of WPT show 67% efficiency and the figure of merit of 0.335.

Other CE Technologies

Room: Berlin 2

Chair: Carl James Debono (University of Malta, Malta)

13:45 *Monitoring Indoor Living Spaces using Depth Information...205*

Carl J. Debono, Matthew Sacco and Joshua Ellul (University of Malta, Malta)

Longer life expectancy is resulting in a steady increase in population that needs specific services to support their everyday routines. Public and private structures that provide services to these communities exist, however the increasing demands for service place these structures under stress and increased expenses. Assistive living systems can help reduce the demand and cost for these services by supporting the elderly at their homes, improving their quality of life in the process. In this paper we propose a solution that solely uses the depth information from RGB-D cameras to monitor the elderly within indoor living spaces. Deep learning on depth video data is used to detect the elderly and report the position to an application. This position information creates paths over time that can be monitored remotely by family members and caregivers to understand the behavior of the elderly and take appropriate action when needed. Experimental results show that the system manages to detect the person with an accuracy of 66.5% and a tracking accuracy of 59.1%.

14:05 *Defensive Strategies for Autonomous Decentralized Lightweight Swarms...210*

Shaya Wolf and Mike Borowczak (University of Wyoming, USA)

The SHARKS protocol enables agents to circle a two-dimensional target or ensphere a three-dimensional target through two simple distributed algorithms that ensure that the drones are equally dispersed from each other and maintain a specified distance from a target. An attack vector was identified in previous work that corrals agents and inhibits the swarms ability to create a perimeter. This research focuses on overcoming this attack without adding extensive overhead to the drones. Three basic techniques are proposed where the legitimate agents eject from their ideal circle around the target. By breaking out of this formation and quickly returning, the agents are able to bypass the adversarial nodes. The results were measured using a security metric based on the total disruption of the adversaries. These experiments showed that the total disruption across the swarm could be less than five percent using ejection strategies that set the ejection distance or the likelihood of ejecting based on the distance between the agents.

14:25 *Smart Home Energy Management System and how to make it cost affordable...216*

Javier-Alberto Gutierrez-Peña (Universidad de Córdoba, Spain); Jose-Maria Flores-Arias (University of Cordoba, Spain); Francisco J. Bellido-Outeiriño, Manuel A. Ortiz López and Francisco J. Quiles Latorre (University of Córdoba, Spain)

In this paper the importance of Smart Home Energy Management Systems (SHEMS) within Distributed Renewable Energy is analyzed, the state of art of low cost domotic technologies is showed and an overview about how to develop a SHEMS based on described technologies are provided. Finally, an example of how to develop a basic typical function of a SHEMS, based on low cost domotics is described.

Thursday, November 12 15:00 - 15:45 (Europe/Berlin)

Keynote: An Eye on the Future - Consumer Technology Trends Heading into 2021

Brian Markwalter

Room: Berlin 1

It has been an unprecedented year of disruption as the pandemic brought normal commerce and our personal lives to a standstill. Through it all, we relied on technology for work, education and entertainment. Despite the uneven recovery in different regions around the world, technology has remained a centerpiece and some applications, like digital health, accelerated rapidly this year. Learn how demand for consumer technology has shifted and which trends will continue as we head into 2021

Thursday, November 12 15:50 - 17:00 (Europe/Berlin)

Keynote Panel: Opportunities for consumer technology in the age of covid for affordable medical devices

Ram Dhurjaty

Room: Berlin 1

This pandemic has revealed the shortage of medical devices, such as ventilators as well as monitoring devices for testing the virus, Pulse Oximetry and remote temperature monitoring. Low and Middle Income countries are hit hardest due to affordability of devices such as ventilators that can cost several hundred dollars. Furthermore availability of affordable home monitoring of the virus can obviate the need to visit a testing center, regularly to monitor infection. The panelists will discuss the role of Consumer Technology, such as inexpensive processors, 3-D printing to enable affordable devices for treatment and monitoring. The first segment will discuss ventilators. The second segment will be a discussion on optical devices to monitor temperature and oxygen saturation. The final segment will relate to advances in home-testing of the virus. Each of these segments will illustrate the role of Consumer Technology in enabling such devices.

Thursday, November 12 17:00 - 17:30 (Europe/Berlin)

Award and Farewell

Room: Berlin 1