Program

Program at a glance:

	14.9., Sofitel Munich					15.9., BMW Welt Munich						16.9., BMW Welt Munich					
	BR	BH 1	BH 2	Lehel 5	Lehel 6	BC	T1a	T1b	DC	T2a	T2b	BC	T1a	T1b	DC	T2a	T2b
09.00 - 09.30						Welcome						Welcome					
09.30 - 10.00						Keynotes						Keynotes					
10.00 - 10.30						Coffee Break						Coffee Break					
11.00 - 11.30						12	1	2	0	5	6	11	7	4	12		
11.30 - 12.00																WWRF	Alfred
12.00 - 12.30																	
12.30 - 13.00						Lunch						Lunch					
13.00 - 13.30																	
13.30 - 14.00						Keynote Dr. Weigel, Huawei						Keynote Prof. Buchanan, Napier Univ.					
14.00 - 14.30		1a	Spaimeh + ReHIS	SSH	SCH'16												
14.30 - 15.00						5GIII						10	8	4			
15.00 - 15.30																	
15.30 - 16.00	ETPHA	3	Spaimeh + ReHIS	SSH	H4.0 Global Village							Closing Ceremony					
16.00 - 16.30						9											
16.30 - 17.00			2a	5	6	13	1	2	5GIII	5	6						
17.00 - 17.30		iOR															
17.30 - 18.00																	
18.00 - ...	Welcome Reception					Banquet: Hofbräuhaus											

Venue 14.9.: Hotel Sofitel Munich (at main train station - Hauptbahnhof)
Venue 15.9. & 16.9.: BMW Welt Munich

Wednesday, September 14

Wednesday, September 14, 13:30 - 16:30

Workshop: SPAIMEH & ReHIS

Shared session between the 3rd International Workshop on Secure and Privacy-Aware Information Management in eHealth + the 3rd International Workshop Reliability of eHealth Information Systems
Room: Sofitel: Bogenhausen 2
Chairs: Haider Abbas (King Saud University, Saudi Arabia), Randike Gajanayake (SMS Management and Technology, Australia), Amjad Gawanmeh (Khalifa University, United Arab Emirates (UAE)), Daniel Grunwell (Queensland University of Technology, Australia), Youssef Iraqi (Khalifa University, United Arab Emirates (UAE)), Tony R Sahama (Queensland University of Technology & IEEE ACM IBS ACS SSAInc HISA, Australia), Kashif Saleem (King Saud University, Saudi Arabia)

SPAIMEH: Traditional access control measures for privacy preservation may not match the eHealth record system scenario, where the roles of all stakeholders are less defined. Questions regarding data ownership and information management obligations for major stakeholders (healthcare professionals, patients, administrators) arise. Healthcare professionals require ready access to as much information as possible to support informed decision making. However, patients may want to exercise control over the entities gaining access to their personal health information, with particular concerns for information privacy. Balancing these competing concerns is a major challenge in the implementation of successful e-Health systems. This is not just a technological challenge, but a multidisciplinary problem with technological, social, legal and health policy aspects.

ReHIS: The workshop provides an international forum for research community working on testing, verification, performance evaluation, and reliability of eHealth research areas.

Workshop: SSH

The 4th International Workshop on Service Science for e-Health (SSH 2016)
Room: Sofitel: Lehel 5
Chairs: Jolanta Mizera-Pietraszko (Opole University, Poland), Pawel Swiatek (Wroclaw University of Technology, Poland)

Technological developments in computing and networking have largely made the delivery of health services, including medical diagnosis and patient care, possible from a distance. Many funded projects have evaluated and are evaluating the use of communications technology in the implementation and performance of telemedicine activities, and examined the impact of telemedicine on medical care in terms of cost, quality, and access. Telemedicine has become a growing new interdisciplinary field, which will eventually contribute to improving the quality of health care for everyone. However, successful implementation of this vision depends not only on innovative telemedicine applications but also on networking and computing technical readiness. Furthermore, many ethical, social, and political problems arising in telemedicine need technical solutions.

e-Health/m-Health Services for Dermatology Outpatients Screening for Skin Cancer and Follow-up
Zviad Kirtava (Tbilisi State Medical University; Partners for Health NGO); Teona Shulaia (Marjani Clinic, Georgia); Natalya Kiladze and Nato Korsantia (Tbilisi State Medical University, Marjani Clinic, Georgia); Teimuraz Gogitidze (Batumi Maritime Hospital, Georgia); David Jorjoliani (Partners for Health NGO, Georgia)
Skin cancers and melanoma represent one of the most common cancer types, and their incidence is growing in last decades, especially, among Caucasians and in places with strong ultraviolet insolation. Early stage diagnosis significantly improves patients' survival rates. We aimed to evaluate the efficiency of m-Health and e-Health methodologies (e-registry, mobile teleconsultations and teledermoscopy) among dermatological outpatients with different pigmented lesions for skin cancer screening and follow-up. 584 outpatients from Tbilisi (301 pts) and seaside rural region - Adjara (283 pts) have been engaged in TeleDerm project. Total 2811 teledermoscopic investigations (5.1 per patient) have been carried out. In 92% benign and in 8% malignant pathologies were mostly correctly diagnosed by teledermoscopic investigation. As a result of teleconsultations of remote patients initial clinical diagnosis was confirmed by teledermoscopy in 82% and modified/corrected - in 18%. Problems of mobile - HSPA+ and/or CDMA/EV-DO - communication - delay/stacking of transferring large dermoscopic images were registered in 9% of the cases. Cost of teledermatology consultation was 3.1-8.2 times lower than in a traditional setting. According to Quality of Experience surveys 62.5%-86.5% patients ranked TeleDerm service as beneficial, cost- and time-efficient, and improving their confidence in qualified medical care provision. Teledermatology with teledermoscopy can be regarded as a method of choice for skin cancer screening, dermatology patients full-scale e-registry development and follow-up in case of onco-vigilance. m-Teledermoscopy represents feasible and cost-efficient methodology particularly for regional institutions. Combination of both clinical and dermoscopic image-repository in TeleDerm e-Registry for diagnostic and follow-up purposes, as well as joint appliance of m-Health and e-Health methodologies represent the best mix for yet-limited mobile broadband areas.

Easy Fall Risk Assessment by Estimating the Mini-BES Test Score
Giovanna Sannino (Institute of High Performance Computing and Networking National Research Council of Italy, Italy); Ivanoe De Falco (Institute of High Performance Computing and Networking, ICAR-CNR, Italy)
The aim of this study is to identify an explicit relationship between life-style and the risk of falling under the form of a mathematical model. Starting from some personal and behavioral information as, e.g., weight, height, age, data about physical activity habits, and concern about falling, the model would easily estimate the score of the Mini-Balance Evaluation Systems (Mini-BES) test. This would make fall risk assessment less invasive, because subjects would not need to undergo the classical Mini-BES test, rather they could estimate it at home by answering some questionnaires. The mathematical model obtained in this study has been tested over a subset of unseen subjects and the results show an average error of ±2.74.

An Algorithm for Estimating Baseline Wander Based on Nonlinear Signal Processing

Krzysztof Brzostowski (Wroclaw University of Technology, Poland)

In the paper, the new method to estimate Baseline Wander from ECG signal is proposed. Baseline Wander is a low-frequency noise having non-linear and non-stationary nature. The classical methods such as high-pass filtering cannot provide full separation of the signal from baseline wander. In this work an approach to estimate the low-frequency noise based on piecewise linear estimation and nonlinear smoothing is proposed. The general idea is to determine baseline wander locally and then, using non-linear signal processing; the estimated signal is smoothed. The proposed approach is experimentally compared with reference methods.

Muscular Activation Intervals Detection Using Gaussian Mixture Model GMM Applied to sEMG Signals

Amal Naseem (University of Orleans, France); Meryem Jabloun, Philippe Ravier and Olivier Buttelli (Université d'Orléans, France)

We propose to apply the Gaussian Mixture Model (GMM) to surface electromyography (sEMG) signals in order to detect the muscular activation (MA) onset, timing off and intervals. First, classical time and frequency features are extracted from the sEMG signals, beside the Teager-Kaiser energy operator (TKEO) is evaluated and added as a new feature which enhances the detection performance. All the obtained features are then used as the input for the GMM to conduct the binary clustering. Finally, a decision theory is applied in order to declare sEMG activation timing of human skeletal muscles during movement. Accuracy and precision of the algorithm are assessed by using a set of synthetic simulated sEMG signals and real ones. A comparison with two previously published techniques is conducted: wavelet transform-based method [1] and double threshold-based method [2]. Our experimental results prove that the proposed GMM-based algorithm is able to accurately reveal the MA timing with performance beyond that of the state-ofthe- art methods. Moreover, this proposed algorithm is automatic and user-independent.

Current Health Records Practices in Afghanistan and Possible Future Development

Abdul Wahid Samadzai, Vladimir Tomberg and David Lamas (Tallinn University, Estonia)

In this paper, we have reviewed different types of medical records like the Paper Based Medical Record, Electronic Medical Records, Electronic Health Records, and Personal Health Records. Also, we have examined a process of medical records in Afghanistan private and public hospitals. On that base we have discussed the opportunities for developing of electronic health records system in Afghanistan.

Nurturing Wearable and mHealth Technologies for Self-Care: Mindset, Tool Set and Skill Set

Zilu Liang (National Institute of Advanced Industrial Science and Technology & The University of Tokyo, Japan); Yukiko Nagata and Mario Alberto Chapa Martell (The University of Tokyo, Japan); Takuichi Nishimura (National Institute of Advanced Industrial Science and Technology, Japan)

This study aimed to understand whether and how wearable technologies and mHealth services could be nurtured for self-care at the individual-level. We launched a self-care online survey in 2015, and a total of 188 participants (66% female; mean age = 30 years) completed the survey. Following the survey, we also conducted a qualitative study with 12 Fitbit users. In both studies, we focused on understanding three prerequisite elements for behavior change: mindset, tool set and skill set. The results showed that most people had the mindset that self-care was important for preventing chronic diseases, and their top health concerns were sleep quality, body weight, mood, skin conditions and chronic fatigue. As for tool set, users acknowledge the potentially positive impact and efficacy of the technologies in facilitating self-care. However, current technologies have several usability issues such as low accuracy, low technology transparency, and limited feedback. As for skill set, two major obstacles were identified: difficulty in sustaining the usage of the technologies, and lacking domain knowledge and data analysis skills to gain insights from personal data. Different from existing studies which mainly focused on understanding the tool set, i.e., the technologies and services per se, this study produced new insights on the current landscape of people's mindset and skill set on adopting the technologies for health behavior change. We also summarized the opportunities and challenges to guide researchers in designing new wearable technologies and mHealth services for self-care.

IoT Modelling and Runtime Suite for e-Health

Pawel Stelmach, Łukasz Falas, Grzegorz Kasiukiewicz, Paulina Kwaśnicka and Pawel Swiatek (Wroclaw University of Technology, Poland)

E-Health services are a topic of many Internet of Things (IoT) related research. In this paper a model-centric platform for In-ternet of Things and e-Health scenarios is presented. Multiple e-Health scenarios showcase the ability of the platform to model, support configuration and gathering data at runtime for multiple use cases at the same time, often with option to share sensors' and Things' models among those use cases. Tools for creating metamodels, ontologies and IoT and service repositories are pre-sented and their role in the proposed IoT platform discussed.

Computer-Assisted Clinical Diagnosis in the Official European Union Languages

Jolanta Mizera-Pietraszko (Opole University, Poland)

eHealth services integrate Web Information Retrieval and Intelligent Medical Decision Support for health care professionals based on the range of possible symptoms which a patient reports. However, many symptoms like high temperature, fever, or headache, are ambiguous in terms of suggesting wide variety of possible patient's conditions to the GP, while other symptoms are mutually dependant, which again can be misleading to make an accurate diagnosis. On the other hand, doctor's up-to-date knowledge on the medicaments, drugs, active medical substances included, anticipated range of diseases relating to the symptoms reported, and the most reliable pharmaceutical manufacturers, are of the greatest importance to cure the illness successfully. This study proposes an approach to support so called standard medical procedure or clinical guidelines in treatment of each of the diseases by delivering such a knowledge to the physician and by individualizing the selection of drugs in respect to the patient's specific needs in order to avoid potential drug interaction. We evaluate efficiency of a medical multilingual decision support system Diagnosia on the grounds of accessibility to such a knowledge depending on the EU language and we use Bayesian inference for generating the optimal decision on reaching a particular diagnosis accuracy. Our methodology is examined on the real data taken from the American service Prescriber Check up and some other knowledge-based medical resources of nationally recognized rank. Our findings indicate that this approach outperforms not only traditional standard procedure of curing some commonly occurring illnesses, but also many commercial computer-assisted medical support diagnostic systems.

A Non Invasive and Intelligent Method for Cardiovascular Parameters Tele-Monitoring

Ridha Ben Salah (Prince Sattam Bin Abdulaziz University & College of Applied Medical Sciences, Saudi Arabia); Tareq Alhadidi (Prince Sattam bin Abdulazizi University & Biomedical Technology Dep., Saudi Arabia); Ihsen Ben Salah (National Engineering School of Carthage, Tunisia); Kaïs Ouni (ENICarthage, Tunis & National Engineering School of Carthage, Tunisia); Sofienne Mansouri (Biophysics Research unit (Medical school of Tunis), Tunisia); Souhir Chabchoub (High Institute of Medical Technology Tunis, Tunisia)

The innovation of our method is to design a new techniques with multiple capabilities, autonomy and automatic applications in the tele-monitoring and diagnosis of some cardiovascular parameters relative to a certain categories of patients (elderly, children, pregnant women) with cardiovascular diseases. Theoretical model of transthoracic impedance is performed in order to determine aortic pressure with a non invasive method: the bioimpedance method. The start idea is that aortic impedance variation depends on aortic section, which depends on systolic and diastolic pressure, during cardiac cycle. Theoretical relationships, between electrical bioimpedanc signal and aortic pressures are therefore established. The second parameters is the cardiaq output Q. The third parameters determined is the arterial compliance C. Results reflect those reached in bibliography, that Cp is significantly reduced in hypertensive patients (Cp=0.48 ± 0.09 E-10 m5.N; normal value of Cp is 1.76 ± 0.28 E-10 m5.N). All this parameters are monitored using telemedicine techniques.

Performance Evaluation of Mobile Medical Multimedia Transmission Over ITS GeoNetworking Protocol

Norbert Varga and Laszlo Bokor (Budapest University of Technology and Economics, Hungary)

Novel mobile healthcare (mHealth) services can actively benefit from the advantages of heterogeneous vehicular networks in Cooperative Intelligent Transport Systems (C-ITS) by transferring various medical data between drivers/passengers and the designated healthcare infrastructure or medical experts. Even real-time mobile medical multimedia transmission can be valid and relevant. Based on the actual scenario of an in-vehicle healthcare solution, different vehicular communication patterns, e.g., Vehicle to Infrastructure (V2I) or Vehicle-to-Vehicle (V2V) can be applied to extend electronic healthcare services of our future smart homes into the smart cities and highways through the smart vehicles we will use. In V2V schemes, a group of vehicles within a geographical area can be addressed using the ITS GeoNetworking (GN) protocol, which could allow to send medical data to a predefined geographical location and such fasten the best possible medical assistance in an emergency situation. In case of pervasive, real-time mHealth applications the efficient multimedia transmission with strict medical level Quality of Service (QoS) and Quality of Experience (QoE) provision is essential. In this paper we propose an in-vehicle healthcare use-case and an extended GN forwarding algorithm. A comprehensive evaluation of mobile medical multimedia transmission between vehicles over ITS GN protocol is also presented.

Wednesday, September 14, 13:30 - 15:00

Workshop: SCH'16

SOCIALHEALTH 2016 - International Workshop on Social Computing in Digital Health

Room: Sofitel: Lehel 6

Chairs: Jim Black (The University of Melbourne, Australia), Fernando Koch (Samsung Research Institute, Brazil), Kashif Saleem (King Saud University, Saudi Arabia)

"Social Computing in Digital Health" aims to discuss the application of social computing to eHealth, mHealth, and public health services. This field of research aims to bring together interactive social intelligence to eHealth systems by combining information from multiple users and groups, along with context information and social interaction to promote innovative methods of health system and monitoring.

GP01-a: Ambient Assisted Living

Room: Sofitel: Bogenhausen 1

Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

NSense: A People-centric, Non-intrusive Opportunistic Sensing Tool for Contextualizing Nearness

Rute C. Sofia (COPELABS, University Lusofona, Portugal); Firdose Saeik (COPELABS, University of Lusofona, Portugal); Luis Amaral Lopes (COPELABS/ University Lusofona, Portugal); Waldir Moreira (COPELABS, University Lusofona, Portugal); Paulo Mendes (COPELABS / University Lusofona, Portugal)

In the context of social well-being and context awareness several eHealth applications have been focused on tracking activities, such as sleep or specific fitness habits, with the purpose of promoting physical well-being with increasing success. Sensing technology can, however, be applied to improve social well-being, in addition to physical well-being. This paper addresses NSense, a tool that has been developed to capture and to infer social interaction patterns aiming to assist in the promotion of social well-being. Experiments carried out under realistic settings validate the NSense performance in terms of its capability to infer social interaction context based on our proposed computational utility functions. Traces obtained during the experiments are available via the CRAWDAD international trace repository.

Activity Recognition Based on Micro-Doppler Signature with In-Home Wi-Fi

Qingchao Chen (University College London); Bo Tan and Kevin Chetty (University College London, United Kingdom); Karl Woodbridge (University College London (UCL), United Kingdom)

Device free activity recognition and monitoring has become a promising research area with increasing public interest in pattern of life monitoring and chronic health condition. This paper proposes a novel framework for in-home Wi-Fi signals based activity recognition in e-healthcare applications using passive micro-Doppler (m-D) signature classification. The framework includes signal modeling, Doppler extraction and m-D classification. A data collection campaign is designed to verify the framework where six m-D signatures corresponding to typical daily activities are successfully detected and classified using our software defined radio (SDR) demo system. Analysis of the campaign data focusses on potential discriminative characteristics, such as maximum Doppler frequency, time duration of activity etc. Finally, a sparsity induced classifier is applied for adapting the method in healthcare application scenarios and the results are compared with the popular Support Vector Machine (SVM) method.

Opportunistic Physical Activity Monitoring Via Passive WiFi Radar

Wenda Li (University of Bristol, United Kingdom); Bo Tan (University College London, United Kingdom); Robert J Piechocki and Ian Craddock (University of Bristol, United Kingdom)

Physical activity envelope provides invaluable information in numerous pervasive health applications. Physical activity is traditionally gleaned using a range of wearable inertial sensors and/or video technology. This paper introduces a novel opportunistic and non-intrusive monitoring system which can quantify activity levels based on analysis of ambient WiFi signal scatter. A real-time signal processing framework is developed, and the proposed system is implemented in software defined radio platform. Experimental results corroborate the efficacy of the proposed system in long term ADL monitoring in residential healthcare applications.

Wednesday, September 14, 15:00 - 16:30

Workshop: ETPHA

The 1st International Workshop on Emerging Technologies for Pervasive Healthcare and Applications (ETPHA 2016)
Room: Sofitel: Boardroom
Chairs: Thaier Hayajneh (New York Institute of Technology, USA), Muhammad Imran (KSU, Saudi Arabia)

The objective of this workshop is to offer an international platform for the presentation of research papers that would address the impact of Emerging Technologies on Healthcare applications and services. Recent advances in sensing, computing, communication and networking technologies have paved the way to dangle unprecedented pervasive healthcare applications and services. For example, body sensor networks (BSNs) employ numerous miniaturized, portable, and autonomous sensing devices in, on, or around the body for pervasive health monitoring such as predicting contingency abnormal condition and treatment of chronic diseases including diabetes and hypertension. Moreover, BSNs can help in determining context-aware psychological classification (e.g., personality type, mood, psychological condition) in real-time based on physiological parameters (e.g. body temperature, heart rate, blood pressure, perspiration, and brain impulses), which can revolutionize human-interactions. Other potential applications may include activity scheduling based on circadian rhythms, social network computing, interactive gaming, driver drowsiness detection, and entertainment. Nonetheless, enormous amount of critical data (Big Data) collected through various BSN nodes require fast, reliable, on-demand, scalable, secure, and powerful communication (e.g., 5G) and computing infrastructure (e.g., cloud computing). However, integration of these technologies introduces new social, legal, technical and security challenges. Emerging technologies have played a vital role to elevate the health services in rural and urban areas of entire world. New horizons are opened in Telemedicine, remote patient monitoring, remote ICU monitoring (e-ICU), wearable technology, patient data analytics and healthcare cyber-security. The aim of this workshop is to foster high quality original, unpublished research papers that articulate recent advancements on the domain.

Workshop: Health 4.0 Global Village

Room: Sofitel: Lehel 6
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Wednesday, September 14, 15:00 - 17:00

GP03: Telemedicine & Telematics

Room: Sofitel: Bogenhausen 1
Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

Architecture Design Ubiquitous Telemedicine Based on Arduino Mhealth LTE
Yair Rivera (Universidad Simon Bolivar, Colombia)
The paper focus on the design of open telematics architecture for telemedicine linked to a device mobile and ubiquitous, a standalone device with direct connection to the cellular data network LTE (Long Term Evolution). The device developed allows a multiplexing of biometric readings through the adaptation of specialized Sensors and distributed in different parts of the body, which allow mapping the vitals signal: level of glycemia,Body Temperature Sensor,Blood Pressure Sensor, Pulse and Oxygen in Blood Sensor (SPO2),Airflow Sensor (Breathing),Galvanic Skin Response Sensor (GSR - Sweating),Electrocardiogram Sensor (ECG),Electromyography Sensor (EMG). The moden of system(TELIT Le910) allows obtain geo positioning signal of each patient in real time through GPS positioning GLONASS system, this set of data are sending and stored to a geographic health information system, where there is a specialized middleware for a geo-referencing related in real time with those specialized health services and their physical infrastructures. Whole a technological system that allows take advantage of the services 4g and the geographic information systems of health monitoring for care of patients with chronic diseases in Colombia, where there are some remote areas and difficult access.

Potential Redundant Link Fail-over Strategies for Uptime-sensitive Medical Telemetry Applications
Isaac J True (Viaboxx GmbH, Germany & Swinburne University of Technology, Australia); Grenville Armitage (Swinburne University of Technology, Australia)
For some devices and services, a consistently reliable connection to the internet is crucial; a failure to report to an internet service could result in significant financial or property damage or loss of life. We propose a solution through the development and testing of a "High-availability Internet Gateway" (HaIG) which can be installed into a network and utilise multiple redundant internet connections in order to guarantee uptime for a secure tunnel for medical devices. Three potential solutions are evaluated: Layer 2 Bonding (L2B), Multipath TCP (MPTCP) and Stream Control Transport Protocol (SCTP). MPTCP and L2B were found to be less suitable than SCTP at providing a reliable, high-availability fail-over solution. We incorporated the SCTP-based solution into a consumer networking device running OpenWRT, and used controlled testbed trials to demonstrate the use of redundant internet connections for providing a high-availability connection for applications such as remote cardiac monitoring.

A Flexible Architecture for Mobile Health Monitoring
Mathieu Bagot (Université Bretagne Sud, France); Pascale Launay (IRISA, Université de Bretagne-Sud, France); Frédéric Guidec (Université de Bretagne-Sud (UBS) & IRISA Laboratory, France)
There is a growing need for systems that allow to monitor continuously the health condition of patients with chronic diseases, while allowing these patients to live their daily life as usual, at home as well as out of home. Developing such systems is now feasible based on currently available wireless transmission technologies and off-the-shelf wearable sensors, but most of the applications developed so far fall into the quantified-self movement, and can hardly be used for medical monitoring.

Multi-Layer Architectures for Remote Health Monitoring
Rahul Krishnan (Amrita Vishwa Vidyapeetham, India); Maneesha Vinodini Ramesh (Amrita Vishwa Vidyapeetham, Amrita University, India); Ekanath Rangan (Amrita University, India)
Remote health monitoring and delivery through mobile devices and wireless networks offers unique challenges related to performance, reliability, data size, power management, and analytical complexity. We present a multi-layered architecture that matches communication performance to medical importance of data being monitored. The priority of vital data and the context of sensing are used to select the communication medium and the power management policies. Further smartness is introduced into data summarization by employing a severity level quantizer, followed by a consensus abnormality motif discovery and an alert mechanism that prioritizes doctors' consultative time. We also present our successful implementation of the above multi-layered architecture in a system developed to remotely monitor cardiac patients.

An Innovative WebRTC Solution for e-Health Services
Paola Pierleoni, Luca Pernini, Lorenzo Palma, Alberto Belli, Simone Valenti, Lorenzo Maurizi and Loris Sabbatini (Università Politecnica delle Marche, Italy); Alessandro Marroni (DAN Europe, Malta)
Solutions and services for e-Health and telemedicine are constantly spreading and becoming increasingly important in the health area thanks to last innovations in electronics, informatics and telecommunications. This work proposes an innovative service for the e-Health oriented to the maximum ease of use and to the sharing of vital signs. The proposal consists in a tele-counseling service based on the WebRTC technology that allows any person residing remotely from medical staff or hospital to directly interact with them. Our solution provides all the common functions of the WebRTC, such as real-time video and audio streams, instant messaging, and file sharing with the only requirement of a traditional web browser. Beyond that, we implemented the real-time transmission and visualization of vital signs and parameters acquired by biomedical sensors connected to the patient's personal device through the RTCDataChannel. Currently our solution involves the installation of a browser extension, but this operation is very simple and may be avoided when WebRTC APIs and browsers will support media streams coming from sensors at the same way as audio and video streams. Our solution demonstrates how web technologies can be applied in the health sector providing very effective services to patients and users which for various reasons have difficulties to travel to hospitals in order to have medical support.

Time-Frequency Based Contactless Estimation of Vital Signs of Human While Walking Using PMCW Radar
Isar Nejadgholi (University of Ottawa, Canada); Sreeraman Rajan (Carleton University, Canada); Miodrag Bolic (University of Ottawa, Canada)
This paper presents a novel algorithm for radar-based estimation of vital signs in a noncontact, privacy friendly manner while subjects are in motion. Unlike the traditional methods that merely use the Fourier spectrum of the output of the radar receiver to obtain estimates of breathing and heart rates, the proposed algorithm uses time-frequency approach. From the Time-Frequency Representation (TFR) of the output of a pseudo-random binary Phase Modulated Continuous Wave (PMCW) radar, frequency of the maximum amplitude at every time instant is estimated and a timeseries of dominant frequencies is formed. MUSIC algorithm is then applied to estimate the vital signs from this series. The proposed algorithm is demonstrated using simulated and real data. Simulated data is obtained through modeling the output of a PMCW radar. Real data is obtained by monitoring a walking subject for 10 minutes in a realistic setting with a 24.125 GHz PMCW radar. The vital sign estimates obtained using the proposed method are found to match closely the estimates from wearable devices that were applied to provide the ground truth for breathing and heart rates.

Wednesday, September 14, 16:30 - 18:00

GP02-a: Feature Recognition

Room: Sofitel: Bogenhausen 2
Chair: Norbert Noury (University of Lyon & Team Biomedical Sensors, France)

Intelligent Depression Detection and Support System: Statistical Analysis, Psychological Review and Design Implication
Mashrura Tasnim (Bangladesh University of Engineering and Technology); Rifat Shahriyar (Bangladesh University of Engineering and Technology, Bangladesh); Nowshin Nahar (Eastern University, Bangladesh); Hossain Mahmud (Technische Universität München, Germany)
Depression is a familiar psychological disorder caused by a combination of genetic, biological, environmental, and psychological factors. Untreated depression carries a high cost in terms of relationship problems, family suffering and lost work productivity. But diagnosis and treatment of depression is difficult due to varied severity, frequency, and duration of symptoms in depressed individuals. In this study, correlation between depression level and behavioral trends of individuals has been established through a survey involving around 120 undergraduate students. The survey outcome is analyzed in psychological viewpoint and finally some design implications on an automated system of depression detection and support system has been proposed.

EEG-based Automatic Emotion Recognition: Feature Extraction, Selection and Classification Methods
Pascal Ackermann, Christian Kohlschein, Jó Ágila Bitsch and Klaus Wehrle (RWTH Aachen University, Germany); Sabina Jeschke (RWTH Aachen University & Institute Cluster IMA/ZLW & IfU, Germany)
Automatic emotion recognition is an interdisciplinary research field which deals with the algorithmic detection of human affect, e.g. anger or sadness, from a variety of sources, e.g. speech or facial gestures. Apart from the obvious usage for industry applications in human-robot interaction, acquiring the emotional state of a person automatically also is of great potential for the health domain, especially in psychology and psychiatry. Here, evaluation of human emotion is often done using oral feedback or questionnaires during doctor-patient sessions. However, this can be perceived as intrusive by the patient. Furthermore, the evaluation can only be done in a noncontinuous manner, e.g. once a week during therapy sessions. In contrast, using automatic emotion detection, the affect state of a person can be evaluated in a continuous nonintrusive manner, e.g. for detecting early on-sets of depression. An additional benefit of automatic emotion recognition is the objectivity of such an approach, which is not influenced by the perception of the patient and the doctor. To reach the goal of objectivity, it is important, that the source of the emotion is not easily manipulable, e.g. as in the speech modality. To circumvent this caveat, novel approaches in emotion detection research the potential of using physiological measures, e.g. galvanic skin sensors or pulse meters. In this paper we outline a way of detecting them from brain waves, i.e., EEG data. While they allow for a continuous, realtime automatic emotion recognition, they furthermore have the charm of measuring the affect close to the point of emergence: the brain. Using EEG data for emotion detection is nevertheless a challenging task: Which features, EEG channel locations and frequency bands are best suited for is an issue of ongoing research. In this paper we evaluate the use of state of the art feature extraction, feature selection and classification algorithms for EEG emotion classification using data from the de facto standard dataset, DEAP. Furthermore, we present results that help choose methods to enhance classification performance while simultaneously reducing computational complexity.

Breast Mass Detection From Mammography Using Iteration of Gray-level Co-occurrence Matrix

Somchanok Tivatansakul and Keiichi Uchimura (Kumamoto University, Japan)

Worldwide Health Organization (WHO) has reported that cancer is a major cause of death around the world. The most common cancer in female is breast cancer. Radiologists typically diagnose breast abnormalities and indicate their regions from mammography. However, they might sometimes fail to detect the abnormalities or miss to correctly indicate their regions. To assist them and address the issues, a computer-aided diagnosis (CAD) is generally adopted to confirm the diagnosis results and increase the diagnosis accuracy. This study focused on precise detection of mass boundary from mammography. We adapted and applied a gray-level co-occurrence matrix (GLCM) with statistical features and edge detection which were previously used for color edges extraction. We also improved the method using pre-processing and GLCM iterations with six features: mean, diagonal moment, contrast, energy, inverse difference moment, and variance to distinguish breast mass region from other breast area (background), remove breast tissue, and detect masses. Our method was evaluated with a mini-MIAS database of mammograms (MIAS). The results indicated that the improved method was more suitable for detection of well-defined, circumscribed, ill-defined and other mass types. However, our method needed to improve to detect masses that infiltrated into high dense breast area with unclear boundary such as spiculated masses. This case would be taken into account as our future works.

Analysis of Thigh Cross-sectional Proportion Using the Portable Ultrasound Imaging System

Osamu Fukuda, Tatsuma Shimizu, Hiroshi Okumura and Kohei Arai (Saga University, Japan); Kiyotaka Fukumoto (Shizuoka University, Japan); Satoshi Muraki (Kyushu University, Indonesia)

To evaluate capacity of the elderly body and the extremities, we developed a measurement system for thigh cross-sectional image. The cross-sectional images were suitable for observing muscle volume. Some previous studies estimated muscular strength based on muscle volume measured the medical images. However there were no studies that used information regarding proportion in human extremities, e. g. muscles, subcutaneous fat and a bone. In this case, the measurements provide the same results even if the proportion is different among two people. We have investigated changes of thigh proportion by age and gender using the cross-sectional ultrasound images. In the survey, 150 ultrasound echo images and the body measurements (height, weight, and so on) were used. We conducted t-test between two groups that have different age, and discussed the causes of their differences. The statistical analysis revealed that the proportion of human thigh was dramatically changed with aging; the shape of thigh outline was deformed and the position of the thigh bone in the cross-sectional image was moved. We considered that the decreasing of the tissue elasticity with aging is responsible for these changes. The proportion analysis can be expected to be a new approach for developing a novel evaluation technique of the elderly body and extremity ability.

Severe Burns Assessment by Joint Color-Thermal Imagery and Ensemble Methods

Mihai-Sorin Badea (Politehnica University of Bucharest, Romania); Constantin Vertan and Corneliu Florea (University Politehnica of Bucharest, Romania); Laura Florea (Politehnica University of Bucharest, Romania); Silviu Badoiu (Carol Davila University of Medicine and Pharmacy, Romania)

Burns are some of the most severe forms of accidental trauma across the world. Burn injuries require specialized care and an early and accurate distinction between superficial dermal burns and deep dermal burns which require further surgical procedures, as they do not heal spontaneously. This paper proposes a multispectral imaging based diagnosis support system for the identification of severe burns. The acquisition is performed in both visual and infrared domains, simultaneously, with a thermal camera recording in parallel color and thermal images of the unconstrained patient and patient environment. The classification of burns is developed under a supervised scenario, according to a ground truth defined by specialist surgeons from a large pediatric case database, by an ensemble methods that gather votes from both convolutional neural network and standard pattern recognition systems.

GP05-a: Decision-Support & Intelligence

Room: Sofitel: Lehel 5

Chair: Joel J. P. C. Rodrigues (Instituto de Telecomunicações, University of Beira Interior, Portugal)

CorporateMeasures: A Clinical Analytics Framework Leading to Clinical Intelligence

Fadi Nammour (Kingston University, London, Germany); Nashat Mansour (Lebanese American University, Lebanon); Kostas Danas (Kingston University, London, United Kingdom)

Patient information in healthcare organizations is distributed across several systems and data silos. Clinicians make decisions based on data in patient health records. Improving the efficiency of decision-support requires collective knowledge of all patient information. The classical approach of linking patient data from many databases into one data warehouse poses various problems when it comes to building clinical analytics. An implementation of the Performance Measurement and Management approach used in Engineering and Business is adapted to healthcare scenarios, and a new system is developed that allows clinicians that are not technical professionals to develop, test and apply custom analytics to patient health data. Part I of this paper is an introduction to the problems and current situation in healthcare data analytics. Part II states the aim and objectives. Part III explains the system design and its modular components. Part IV presents the results of three performance indicators evaluated through the system, and evaluates the system through technical and clinical usability methods. Part V concludes and discusses future work. (Abstract)

Predicting 30-Day All-Cause Readmissions From Hospital Inpatient Discharge Data

Chengliang Yang, Chris Delcher, Elizabeth Shenkman and Sanjay Ranka (University of Florida, USA)

Inpatient hospital readmissions for potentially avoidable conditions are problematic and costly. In this paper, we build machine learning models using variables widely available in health claims data to predict patients' 30-day readmission risks at the time of discharge. These models show high predictive power on a U.S. nationwide readmission database. They are also capable of providing interpretable risk factors globally at the population level and locally associated with each single discharge. In addition, we propose a model-agnostic approach to provide confidence for each prediction. Altogether, using models with high predictive power, interpretable risk factors and prediction confidence may enable health care systems to accurately target high-risk patients and prevent recurrent readmissions by accurately anticipating the probability of readmission at the point of care.

Summarizing Patient Daily Activities for Clinical Pathway Mining

Xiao Xu, Tao Jin and Jianmin Wang (Tsinghua University, P.R. China)

Clinical Pathway is ubiquitous and plays an essential role in clinical workflow management. The combination of LDA and process mining is an efficient approach to get a non-static and topic-based process model. LDA is used to group the activities of each clinical day into the latent topics, and process mining is used to generate a concise workflow model based on these topics. However, because of the specificity of clinical data, it usually suffers from the performance of LDA. In this paper, we take an important clinical practice, all the same activities in one clinical day tend to represent the same clinical goal, into account to enhance the efficiency of LDA. The experiments on real data show significant performance gains of our approach.

"OntoDrive" A Multi-Methodological Ontology Driven Framework for Systems Analysis of Health Informatics

Vasilios Keramaris (Kingston University, Greece); Kostas Danas (Kingston University, London, United Kingdom)

Nowadays, more than ever, it is evident that we need a series of technological and methodological techniques in order to improve on the systems analysis and design (SAD) of any informational system. Recently, there is a huge demand to create domain vocabularies and semantics that along with cognition are to describe the information of any domain in the form of Resource Description Framework (RDF) and ontologies (OWL), both types of data models, resulting into relational and directed graphs and as a result both humans and machines simultaneously can understand the information offered, with machines using online links and pattern matching in order to interpret the meaning of it in a consistent and meaningful way. Ontologies are great ensuring interoperability and consistency of data, however in order to improve on current Information Systems (IS) such as Hospital Information Systems (HIS), there are many other methodologies that need to be invoked. This could be achieved with the waterfall approach and multiple deployment of systems analysis and design methodologies and of course detailed computational ontologies that will be used as a basis to represent and share domain specific knowledge and data structures ensuring the interoperability of systems and the quality of information within that domain. This multimethodological systems analysis and design framework, named "OntoDrive" is presented here.

A Concept for Consistent and Prioritized Presentation of Surgical Information

Erik Schreiber and Stefan Franke (Universität Leipzig, Germany); Richard Bieck (Innovation Center Computer Assisted Surgery, University of Leipzig, Germany); Thomas Neumuth (Universität Leipzig, Germany)

With each newly developed surgical assistance functionality, more information is available but also required in the operating room (OR). To prevent an information overload and support the surgical workflow, we propose a concept for a prioritized and consistent presentation of surgical information. We identify necessary tasks and requirements to present the right information, to the right time, at the right place and in the right form. For this, rule-based methods to prioritize information in respect to its relevance to the current OR situation and to orchestrate information consistently on a set of OR monitors are designed. Subsequently advantages and disadvantages of the proposed approach are discussed and next required steps for an implementation elucidated.

GP06-a: Self Monitoring & Disease Management

Room: Sofitel: Lehel 6

Chair: Klaus Moessner (University of Surrey, United Kingdom)

A Mobile Health Solution for Chronic Disease Management At Retail Pharmacy

Hongguang Zhang and Kai Liu (Shanghai CareLinker Medical Technology Co., Ltd., P.R. China); Weijian Kong (Shanghai University, P.R. China); Fei Tian, Youren Yang, Chu Feng, Ti Wang and Qi Chen (Shanghai CareLinker Medical Technology Co., Ltd., P.R. China)

This paper presents a mobile solution for the management of chronic diseases, i.e. hypertension and diabetes. This solution facilitates the exchange of health information between patients and pharmacists, supports wellness decision making, and assists behavioral interventions for enhanced self-management and healthcare delivery. Since the beginning of 2015, we have deployed the Software as a Service (SaaS) solution in 3,000 drug stores around China. The one-year trial demonstrated significant improvements in the real-world evidence outcome.

Mobile Health Applications in Bangladesh: A State-Of-The-Art

Muhammad Nazrul Islam, Md. Mahboob Karim, AnnitaTahsin Priyoti, Zaki Tasnim Duti and Nusrat Jahan (Military Institute of Science and Technology, Bangladesh)

The social and economic development of a country is greatly influenced by providing effective health care services. In recent years, mobile health applications (mHealth apps) becoming an increasingly important means for delivering health services in developing countries like Bangladesh. This paper provides an overview of current status of mHealth apps development in Bangladesh. All mHealth apps developed for the users from Bangladesh were explored meticulously to synthesis their services/functionalities, and to depict their development platform and focused end-users. Finally, we outline the research and practical implications of our findings; that could increase our understanding of functional and development requirements of mHealth apps to provide effective health services in Bangladesh.

Cell Phone- Based Diabetes Self-Management and Social Networking System for American Indians

Juan Li and Jun Kong (North Dakota State University, USA)

The epidemic of diabetes in American Indian (AI) communities is a serious public health challenge. The incidence and prevalence of diabetes have increased dramatically with accompanying increases in body weight and diminished physical activity. Daily diabetes care is primarily handled by the patients and their families, and the effectiveness of diabetes control is largely impacted by self-care strategies and behaviors. Thanks to the quasi-ubiquitous use of cell phones in most AI tribes, in this paper we propose a cell phone- based proactive diabetes self-care system, MobiDiaBTs. It is customized for AI patients using a personalized approach that considers the unique social, cultural, political, and demographic characteristic of AIs. The platform effectively and automatically collects users' physical and social behavior data and offers real-time diabetes health recommendations. It also can help a patient to interact with fellow patients in a trust-worthy and privacy-preserving environment.

Wednesday, September 14, 17:00 - 18:00

Workshop: iOR

2nd International Workshop on Intelligent Operating Rooms (iOR'16)

Room: T1a

Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

The operation room is the most expensive area in hospitals. To optimize operating room management, connected devices which are communicating and sharing data with other peripheral devices are necessary. By analyzing available data of these connected devices, actions of surgical staff and other data in the operating room and parallel matching of all available data with dedicated workflow models, will make context-aware operating rooms possible. These context-aware operating rooms could help to prevent surgical errors i.e. by automated detection of deviations from the standard processes or even automate counting of consumables and prevent them from being remained in the patients' cavity.

This workshop covers the acquisition, analysis, as well as modeling and monitoring of surgical processes and the integration of all information acquired during anamnesis, i.e. anatomy of patient, diagnostic information, etc. in process models. To achieve the main goal of a context-aware operating rooms, a close cooperation of clinicians, researchers and engineers is necessary. Therefore this will be an interdisciplinary workshop, interactive demonstrations are welcome.

Wednesday, September 14, 18:00 - 20:30

Welcome Reception

The welcome reception will take place at the Hotel Sofitel Munich Bayerpost.

Thursday, September 15

Thursday, September 15, 09:00 - 09:10

Chair's Welcome

Room: Double Cone
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Thursday, September 15, 09:10 - 10:30

Keynotes: Orange, GS1

Room: Double Cone
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Thursday, September 15, 11:00 - 12:30

GP00: Emerging Topics

Room: Double Cone
Chair: Joel J. P. C. Rodrigues (Instituto de Telecomunicações, University of Beira Interior, Portugal)

Dynamic Fine-Grained Access Control in e-Health
Alois Paulin (Vienna University of Technology, Austria)
This paper describes the use of the Secure SQL Server system (SecSQL) - a system for dynamic fine-grained access control, in the context of e-Health. The system was used in two heterogeneous use-cases of a European project, namely: to govern drugs along the supply chain from the manufacturer to the consumer (to fight counterfeit drugs, and to recall drugs), and to govern the movement of things in the operating theatre. This way, the feasibility of SecSQL to be used as a system to dynamically govern fine-grained access control to Hippocratic data in the e-Health context has been demonstrated.

Determinants of Next Generation e-Health Network and Architecture Specifications
Christoph Thuemmler (Edinburgh Napier University, United Kingdom); Alois Paulin (Vienna University of Technology, Austria); Ai Keow Lim (Celestor Ltd, United Kingdom)
This paper summarizes the determinants for future e-Health network and IT infrastructures in the health care environment. The paper bases on observations conducted as part of a larger study at a university hospital in Munich, and summarizes ongoing discussions, key determinants from relevant white papers, and challenges of the domain. The objective of the paper is to provide a broad overview over the implications of the e-Health domain to provide inputs in ongoing discussion on 5G characteristics.

HI-risk: A Method to Analyse Health Information Risk Intelligence
William J Buchanan and Nicole van Deursen (Edinburgh Napier University, United Kingdom)
Information security threat intelligence is a prevalent topic amongst researchers, long-established IT-vendors and start-ups. The possibilities of big-data analytics to security threat and vulnerability scanning offer a phenomenal development in the protection of infrastructures. At the same time, industry research reports continue to state that the main contributing factor in the events leading to a data breach is human error. The common response of information security professionals is to resort to technological solutions to prevent these human errors. However, some very important information security intelligence is not hidden within the network traffic: it's available from the people that work with sensitive information. This article describes the Health Information risk (HI-risk) method to identify non-technical information security risks in healthcare. The method includes risks related to skills, behaviour, processes, organisational culture, physical security, and external influences. HI-risk offers a solution to collect intelligence about non-technical information security incidents from across the healthcare sector to demonstrate past trends and to be ahead of future incidents. A test of a HI-risk forecast proved the feasibility of this approach in healthcare and beyond. It is suggested that HI-risk could become a valuable addition to existing technical threat and vulnerability monitoring tools.

5G-enabled Healthcare: The Case of Multiple Sclerosis
Nikolaos Grigoriadis (Biogenea Pharmaceuticals Ltd, Greece); Christos Bakirtzis (Aristotle University of Thessaloniki, Greece); Christos Politis (Kingston University, United Kingdom); Kostas Danas (Kingston University, London, United Kingdom)
Multiple sclerosis is a chronic and variable disease in matters of symptoms, clinical course and outcome. The ultimate goal of currently used drugs and therapeutic strategies is the control of disease activity and the delay of the ongoing disability. During the last decades, a number of disease- modifying drugs (DMDs), all products of advanced biotechnology are being used. However, these DMDs are yet partially effective since the ongoing disability progression may hardly be prevented. There is growing evidence that these DMDs might be more effective if more accurate monitoring of the disease itself throughout a period of time might be available. In the new era of MS treatment and on the basis of our current knowledge about MS management, it became pretty clear that the overall therapeutic strategy should always be scheduled on strictly individualized basis. To this, MS patients should be encouraged to take control over their own disease and collaborate more effectively with their doctors. The advent of the IoT (Internet of Things) and 5G mobile technologies can support patients in this direction. Since a snapshot of the overall patient's condition during a regular follow-up visit may not represent the every day reality of the patient, the advice given under these conditions may not be that effective. 5G networks are expected to provide the infrastructure and ease in supporting various parameters recording on a real time basis. Relevant clinical studies may further highlight the need of 5G technology in MS management, thus contributing to the overall improvement of patent's quality of life (QoL). This is an absolute necessity for a variable, fluctuating and largely unpredictable disease such as MS.

UML/OCL-based Modeling of Work-Based Access Control Policies for Collaborative Healthcare Systems
Mohamed Abomhara and Mehdi Ben Lazrag (University of Agder, Norway)
Work-based access control (WBAC) model is proposed by introducing the concept of team role and modifying the user-role assignment model. The main goal of WBAC is to be flexible, easy to manage and secure as well as suited to support cooperative work performed by dynamic teams in healthcare environments. One of the major challenges of WBAC is authorization constraints that express the organizational policies. In this paper, we show how an Unified Modeling Language (UML) and Object Constraints Language (OCL) language is utilized to design and analyze the authorization constraints of the WBAC model in cooperative engagements with complex scenarios in the collaborative healthcare domain. We also demonstrate how the authorization constraints expressed in OCL can be implemented, tested and validated using Eclipse Modeling Framework (EMF) tool. Using EMF, the modeling and validation of OCL constraints were smooth and straightforward tasks which can help the policy designers in many organizations during designing or/and analyzing of access control constraints.

GP01-b: Ambient Assisted Living

Room: T1a
Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

System Architecture of Customized Intelligent Lighting Control and Indoor Environment Monitoring System for Persons with Mild Cognitive Impairment or Dementia
Mika Raatikainen and Robert Ciszek (University of Eastern Finland, Finland); Johanna Närväinen, Juho Merilahti and Sami Siikanen (VTT Technical Research Centre of Finland, Finland); Timo Ollikainen (City of Kuopio, Finland); Ilona Hallikainen and Jukka-Pekka Skön (University of Eastern Finland, Finland)
A customized intelligent lighting control combined with an indoor environment monitoring system is presented as a novel system architecture for the help of elderly, especially for people with dementia. Bluish light, which affects human circadian rhythm, is the key element of this study aiming to find ways to enhance patient wellbeing and reduce nursing workload. Moreover, thermal comfort of occupants is monitored and discussed.

Smartwatch Based Tumble Recognition - A Data Mining Model Comparision Study
Klemens Waldhör (FOM Hochschule für Ökonomie und Management & Heartsome Europe GmbH, Germany); Rainer Lutze (Dr.-Ing. Rainer Lutze Consulting, Germany)
Tumbles are one of the key risk factors for elderly people. Studies have shown that one third of all elderly above 65 tumble at least once a year with all its health related problems. In this study we present first a method for detecting tumbles using smartwatch sensor data and second evaluate various data mining models. The goal of this analysis is to find the most effective method for detect-ing tumbles in real time. We have compared nine different data mining models. Our investigations based on data collected from different ADLs and EDLs with a smartwatch show that three models have a comparable high recognition factor: neural nets, logistic regression and linear discriminant analysis while other methods perform less.

Smartphone-based Transport Mode Detection for Elderly Care
Nuno Cardoso (ISEP & Fraunhofer Portugal AICOS, Portugal); João Madureira (Fraunhofer Portugal AICOS, Portugal); Nuno Pereira (Polytechnic Institute of Porto, Portugal)
Smartphones are everywhere, and they are a very attractive platform to perform unobtrusive monitoring of users. In this work, we use common features of modern smartphones to build a human activity recognition (HAR) system for elderly care. We have built a classifier that detects the transport mode of the user including whether an individual is inactive, walking, in bus, in car, in train or in metro. We evaluated our approach using over 24 hours of transportation data from a group of 15 individuals. Our tests show that our classifier can detect the transportation mode

with over 90% accuracy.

Wireless Indoor Low Power Tracking System for Elderly People Assistance in an Urban Environment

Gabriele Di Simone (University of Salerno, Italy); António Espírito Santo (University of Beira Interior, Portugal); Vincenzo Paciello (University of Cassino and Southern Lazio, Italy); Antonio Pietrosanto (University of Salerno & CEO of SPRING OFF srl, Italy); Bruno Ribeiro (University of Beira Interior & Dep. Eng. Electromecanica, Portugal)

Smart cities and smart homes are driving economic growth and improving the quality of people's life by enabling local development and harnessing technologies, especially the ones leading to smart outcomes and connectivity. Application of smart solutions will enable human living environments to use technology, information and data to improve infrastructures and services in the behalf of human beings. The welfare of elderly people living alone, at their homes, or, in rest houses, can significantly be improved with the introduction of these smart solutions. Wireless indoor tracking system is an important feature, above all using low power devices, to assist and monitoring elderly people. However, some issues difficult the implementation in real cases; this paper presents a method that can be suited in a large range of cases thanks to the scene analysis. An indoor scalable infrastructure allows the tracking method to be implemented incrementally with different performances, where optimal accuracy comes from an adaptable threshold. The method has been tested in different environments using both simulations and direct measurements. Result from the proposed method are compared with the KNN method.

Building a Spatial-Temporal Index to Detect the Global Pattern Deviations in Daily Activities of Elderly Subjects

Norbert Noury (University of Lyon & Team Biomedical Sensors, France); Marc Berenguer and Marie-Jeanne Bouzid (Orange Labs, France); Jean-Baptiste Versini (University of Lyon, France)

To follow up the daily activities of elderly populations living independently in their home, is of central importance because the level and variety of activities performed reflect the correct functioning of their homeostasis, thus their health and well being. But the workers, in charge on the field for the remote follow up, need a ready to use and easy to interpret composite information. Our work aims at producing and evaluating this unique index, built from data fusion of heterogeneous information, such as the electrical activities on the power line.

GP02-b: Feature Recognition

Room: T1b

Chair: Norbert Noury (University of Lyon & Team Biomedical Sensors, France)

Development of a Portable Anatomical Obstructive Sleep Apnoea Monitor

Esuabom Dijemeni (Imperial College London, United Kingdom); Oluwatosin Ajewole (Mater Dei Hospital, Malta); Cherry Nzekwu (Mater Dei Hospital & University of Debrecen, Malta)

A portable anatomical obstructive sleep apnea monitor that can simultaneously capture, merge, visualize and store upper airway collapse at oropharynx level with its associated sleep state is proposed for the first time. The proposed system consists of an intra oral camera system, sleep monitoring system, and data management system. At full upper airway opening, complete visualization of the soft palate, uvula, oral cavity, and back of tongue. At partial airway collapse, visualisation of the soft palate, only the base of the uvula, significantly reduced oral cavity, and back of the tongue. At full upper airway collapse, oral cavity and soft palate were no longer visible. Only the hard palate and the back of the tongue was visible. At all stages, the sleep state was recorded. In conclusion, our system provides a tool for assessing dynamic upper airway collapse and its associated sleep state simultaneously in real time.

Sleep Apnea Detection Using a Feed-Forward Neural Network on ECG Signal

André Pinho (Unversidade da Beira Interior, Portugal); Nuno Pombo (University of Beira Interior & BSAFE - Lab, Portugal); Nuno M. Garcia (Universidade da Beira Interior & Instituto de Telecomunicações, Universidade Lusófona de Humanidades e Tecnologias, Portugal)

This paper presents a suitable and efficient implementation for detecting minute based analysis of sleep apnea by Electrocardiogram (ECG) signal processing. Using the PhysioNet apnea-ECG database, a median filter was applied to the recordings in order to obtain the Heart Rate Variability (HRV) and the ECG-derived respiration (EDR). The subsequent extracted features were used for training, testing and validation of a Artificial Neural Network (ANN). Training and testing sets were obtained by randomly divide the data until it reaches a good performance using a k-fold cross validation (k=10). According to results, the ANN classification has sufficient accuracy for sleep apnea detection and diagnosis (82,120%). This promising early-stage result may leads to complementary studies including alternative features selection methods and/or other classification models.

Internet of Things in Sleep Monitoring: An Application for Posture Recognition Using Supervised Learning

Georges Matar (École de Technologie supérieure); Jean Lina (École de Technologie Supérieure, University of Quebec, Canada); Julie Carrier (Center For Advanced Research In Sleep Medecine, Canada); Anna Riley (Riley's 321 Sleep, Canada); Georges Kaddoum (ETS Engineering School, University of Québec, Canada)

In this paper, we propose an Internet of Things (IoT) system application for remote medical monitoring. The body pressure distribution is acquired through a pressure sensing mattress under the person's body, data is sent to a computer workstation for processing, and results are communicated for monitoring and diagnosis. The area of application of such system is large in the medical domain making the system convenient for clinical use such as in sleep studies, non or partial anesthetic surgical procedures, medical-imaging techniques, and other areas involving the determination of the body-posture on a mattress. In this vein, a novel method for human body posture recognition that consists in providing an optimal combination of signal acquisition, processing, and data storage to perform the recognition task in a quasi-real-time basis. A supervised learning approach was used to build a model using a robust synthetic data. The data has been generated beforehand, in a way to enhance and generalize the recognition capability while maintaining both geometrical and spatial performance. Low-cost and fast computation per sample processing along with autonomy, make the system suitable for long-term operation and IoT applications. The recognition results with a Cohen's Kappa coefficient = 0:866 was satisfactorily encouraging for further investigation in this field.

Clinical Validation of a Data Fusion System for Drug Induced Sleep Endoscopy (DISE) Study

Esuabom Dijemeni (Imperial College London, United Kingdom); Oluwatosin Ajewole (Mater Dei Hospital, Malta); Cherry Nzekwu (Mater Dei Hospital & University of Debrecen, Malta); Bhik Kotecha (University College London Hospitals & NHS Foundation Trust, United Kingdom)

Currently during drug induced sleep endoscopy (DISE) study, the ENT/respiratory physician primarily views the anatomical data and ignores the anaesthetic/physiological data. The anaesthetist solely focuses on the anaesthetic/physiological parameters and ignores the anatomical data. Both datasets are stored differently which makes data retrieval and post processing challenging. The primary objective of this paper is to present preliminary results using a data fusion system for drug induced sleep endoscopy. The data fusion system captures, merges, visualises, and stores anatomical data from the sleep endoscope and anaesthetic / physiological data from the anaesthetic monitor simultaneously in real time. At the end of a DISE study, a video with combined dataset is produced with a frame rate of 25 fps. In conclusion, our system provides a better way of capturing, merging, visualising, and storing anatomical data / physiological data during DISE in simultaneously in real time.

Emotion Recognition Using Mobile Phones

Shams Y Shapsough, Ahmed Hesham, Youssef Elkhorazaty, Imran A. Zualkernan and Fadi Aloul (American University of Sharjah, United Arab Emirates (UAE))

The availability of built-in sensors in mobile phones has enabled a host of innovative applications. One class of application deals with detecting a user's emotions. Previous applications have primarily relied on recording and displaying self-reported emotions. This paper presents an intelligent emotion detection system for mobile phones implemented as a smart keyboard. The smart keyboard independently infers a user's emotional state using machine learning techniques. The system uses accelerometer readings and various aspect of typing behavior like speed, number of backspaces, and time delay between letters to train a classifier to predict emotions. Naïve Bayes, J48, IBK, Multi-response linear regression and SVM were evaluated and J48 was found to be the best classifier with over 90% accuracy and precision. In addition to providing emotive feedback to individual users, the system also uses geo-tagged data to collect and display emotional states of regions or countries through a website.

GP05-b: Decision-Support & Intelligence

Room: T2a

Chair: Thomas Jell (Siemens AG, Germany)

Patient-Aware Adaptive Ngram-based Algorithm for Epileptic Seizure Prediction Using EEG Signals

Hussein Alawieh, Hussein Hammoud, Mortada Haidar, Mohammad Nassralla, Ahmad El-Hajj and Zaher Dawy (American University of Beirut, Lebanon)

This work proposes a novel patient-aware approach that utilizes an n-gram based pattern recognition algorithm to analyze scalp electroencephalogram (EEG) data and predict epileptic seizures. The method addresses the major challenge of extracting distinctive features from EEG signals through a detection of spatio-temporal signatures related to neurological events. By counting the number of occurrences of amplitude patterns with predefined lengths, the algorithm generates a probabilistic measure (anomalies ratio) that is used as a prediction marker. These extracted ratios are classified using state of the art machine learning algorithms into seizure and non-seizure windows. The efficacy of the prediction model is tested on patient records from the Freiburg database with more than 100 hours of recordings per patient and for a total of 145 seizures. The proposed algorithm is further optimized to obtain the n-gram parameters for enhanced feature extraction. Results demonstrate an average accuracy of 93.83%, sensitivity of 96.12%, and false alarm rate of 8.44%.

Data Fusion for Predicting ARDS Using the MIMIC II Physiological Database

Aline Taoum (Université de Technologie de Troyes, France & Lebanese University, Lebanon); Farah Mourad-Chehade (Université de Technologie de Troyes, France); Hassan Amoud (Lebanese University, Lebanon); Aly Chkeir (University of Technology of Troyes, France); Ziad Fawal (Lebanese University, Lebanon); Jacques Duchêne (Université de Technologie de Troyes, France)

This study aims to predict Acute Respiratory Distress Syndrome (ARDS) in hospitalized patients using their physiological signals as heart rate, breathing rate, peripheral arterial oxygen saturation and mean airway blood pressure. A data fusion approach based on hypothesis testing was developed, and applied on mechanically ventilated subjects in the MIMIC II database. By combining the information extracted from the signals using an aggregation rule, we are able to enhance the sensitivity of the ARDS prediction process. As a result, we obtained a sensitivity going up to 85% for individual signals, reaching approximately 92% using the data fusion rule.

Adaption of Medical Information System's E-Learning Extension to a Simple Suggestion Tool

Petar Rajkovic, Dragan Jankovic and Aleksandar Milenkovic (University of Nis, Serbia)

Developing suggestion tools in the scope of health information systems can be a complex task, followed by a risk of not being accepted by the end users. Thus, we decide to start the implementation around the existing functionality. In this paper we present a case study showing the adaptation of e-learning medical information system extension to a set of simple suggestion tools. While some features of initial system had to be modified, the domain specific knowledge collected for the e-learning extension is used to suppress potential errors. Presented suggestion tool is based on highly configurable lists of pre-defined entities that can be easily selected, and after the verification from the medical practitioner, copied into an active visit. After four years of active use, and several iteration of update, described suggestion tools are mostly accepted among the general practitioners, especially within certain scenarios where faster medication prescription is a must.

Electronic Health Records: Improvement to Healthcare Decision-making

Hamzah Osop (Queensland University of Technology, Australia); Tony R Sahama (Queensland University of Technology & IEEE ACM IBS ACS SSAInc HISA, Australia)

Effective decision-making plays an important role in promoting optimal care delivery. Factors such as availability of data, timely access to data and organised information greatly influences the quality of decision-making as illustrated in a causal loop diagram. The contribution of practice-based evidence thus aims at structuring an approach where healthcare professionals can be consistently assisted in making effective decisions during routine primary care. Through a practice-based evidence e-health scenario and a data-flow diagram of clinical systems in a public hospital from Singapore, we have identified the importance of leveraging electronic health records as ideal resources in the pursuit of improving healthcare decision-making.

An Inference Mechanism Using Bayes-based Classifiers in Pregnancy Care

Mário W. L. Moreira (University of Beira Interior, Portugal); Joel J. P. C. Rodrigues (Instituto de Telecomunicações, University of Beira Interior, Portugal); Antonio Oliveira (Federal Institute of Ceara, Brazil); Kashif Saleem (King Saud University, Saudi Arabia); Augusto J. Venancio Neto (Federal University of Rio Grande do Norte & Centro de Ciências Exatas da Terra, Brazil)

Significant advances on smart decision support systems (DSSs) development have influenced important results on pregnancy care. Nevertheless, even considering the efforts to reduce the

number of women deaths due to problems related to pregnancy, this decrease presented less impact than other areas of human development. Hypertensive disorders in pregnancy, particularly pre-eclampsia and eclampsia, account for significant proportion of perinatal morbidity and maternal mortality. In this context, this paper proposes an inference model that uses data mining (DM) techniques capable for operating in a data set to extract patterns and assist in knowledge discovery. Identifying hypertensive crises that complicate pregnancy, it can impact in a meaningful reduction the incidence of sequelae and death of pregnant women. Comparison between two Bayesian classifiers is performed in this work to better classify the hypertensive disorders severity. Results showed that Naïve Bayes classifier had an excellent performance, presenting better precision and F-measure, compared to the other experimented classifiers. Even finding a good performance to predict hypertensive disorders, other Bayesian methods need to be evaluated, as well as other DM techniques such as those based on artificial intelligence (AI) and tree-based methods.

GP06-b: Self Monitoring & Disease Management

Room: T2b
Chair: Klaus Moessner (University of Surrey, United Kingdom)

Still in Flow - Long-term Usage of an Activity Motivating App for Seniors
Christian Lins (OFFIS - Institute for Information Technology, Germany); Andreas Hein (Universität Oldenburg, Germany); Luca Halder (Bremer Heimstiftung, Germany); Philipp Gronotte (Jade University of Applied Sciences, Germany)
In this paper, results from the long-term usage of a mobile application (app) for seniors that encourages physical and mental activity are presented. The application was designed for elderly inhabitants of senior residences to motivate them to increase their physical and mental activity in everyday life. Usage statistics of 82 users for about two years were processed and show that the active elderly users can be clustered in two groups with either increasing or decreasing and very little constant activity. Users with decreasing activity have also shown decreasing usage errors with the app's user interface which may indicate that they are growing out of the app. The results show insight view about the usage and suggest that the Concept of Flow can be applied here.

Workload Management Through Glanceable Feedback: The Role of Heart Rate Variability
John Munoz Cardona (Universidade da Madeira & Madeira Interactive Technologies Institute, Portugal); Evangelos Karapanos (Cyprus University of Technology, Cyprus); Fabio M-iti Pereira (Madeira Interactive Technologies Institute, Portugal)
The active monitoring of workload levels has been found to significantly reduce work-related stress. Heart rate and heart rate variability (HRV) measurements via photoplethysmography (PPG) sensors have shown a strong potential to accurately describe daily workload levels. However, due its complexity, HRV is commonly misunderstood and the associated measurements are rarely incorporated for workload monitoring in novel technological devices such as smartwatches and activity trackers. In this paper we explore the potential of consumer-grade smartwatches, equipped with PPG sensors, to assist in the active monitoring of workload during work hours. We develop a prototype that employs the SDNN index, a powerful HRV marker for cardiac resilience to differentiate between high and low workload levels along the work day, and presents feedback in glanceable form, by highlighting workload levels and physical activity over the past hour in 5-minutes blocks at the periphery of the smartwatch. A field study with 9 participants and 3 variations of our prototype attempts to quantify the impact of the HRV feedback over subjective and objective workload as well as users' engagement with the smartwatch. Results showed workload levels as inferred from the PPG sensor to positively correlate with self-reported workload and HRV feedback to result to lower levels of workload as compared to a conventional activity tracker. Moreover, users engaged more frequently with the smartwatch when HRV feedback was presented, than when only physical activity feedback was provided. The results suggest that HRV as inferred from PPG sensors in wearables can effectively be used to monitor workload levels during work hours.

Towards Rehabilitative E-health by Introducing a New Automatic Scoring System
Tracey Lee (Singapore Polytechnic & Monash University, Singapore); Joo Ghee Lim and Kee Hao Leo (Singapore Polytechnic, Singapore); Saeid Sanei (University of Surrey, United Kingdom); Mandy Pei Yin Lew (University of Glasgow, Singapore); Effie Chew (National University Hospital, Singapore); Ling Zhao (Senior Therapist, Singapore)
The global adoption of consumer devices capable of wide connectivity like smartphones and tablets have led to improvements in their support infrastructure. These make e- health systems for rehabilitation entirely feasible. Current assessments of patient condition can be subjective and inconsistent as the monotony of repetitious tasks lowers alertness. We propose a system to automate the scoring process for the patient's state. This is done by embedding widely available sensors such as accelerometers sensors into the objects used in a rehabilitative assessment. These sensors introduce signal distortions such as drift and noise which require data driven filtering as the trajectories of human motion are statistically nonstationary. Building on previous work, we compare the use of time and transform domain processing of motion signals by using splines and singular spectrum analysis on the signals and use data analytic techniques for deriving the assessment scores with good results. These form the basis of an e-health system which is evidence-based, and provides the basis for gains in efficiency and higher level of healthcare.

ROAMM: A Software Infrastructure for Real-time Monitoring of Personal Health
Sanjay Nair, Matin Kheirkhahan, Anis Davoudi, Parisa Rashidi, Amal Wanigatunga, Duane Corbett, Todd Manini and Sanjay Ranka (University of Florida, USA)
Mobile health (mHealth) based on smartphone and smartwatches technology is changing the landscape for how patients and research participants communicate about their health in real time. Flexible control of the different interconnected and frequently communicating mobile devices can provide a rich set of health care applications that can adapt dynamically to their environment. In this paper, we propose a real-time online activity and mobility monitoring (ROAMM) framework consisting of a smartwatch application for data collection, a server for data storage and retrieval as well as online monitoring and administrative tasks. We evaluated this framework to collect actigraphy data on the wrist and used it for feature detection and classification of different tasks of daily living conducted by participants. The information retrieved from the smartwatches yielded high accuracy for sedentary behavior prediction (accuracy = 97.44%) and acceptable performance for activity intensity level estimation (rMSE = 0.67 and R2 = 0.52).

A Wearable 1-Lead Necklace ECG for Continuous Heart Rate Monitoring
Aulia A. Iskandar (University of Wuerzburg, Germany); Wolfram Voelker (Unversitaetsiklinikum Wuerzburg, Germany); Reiner Kolla (University of Wuerzburg, Germany); Klaus Schilling (University of Würzburg, Germany)
Nowadays, people are getting more and more concern on their own fitness conditions and it has become a digital healthy lifestyle movement. A basic activity tracker has given many data on the user's movement to fulfill their daily goal of calories burned. An advance tracker can also measure heart rate with accurate activity intense level. However, consider if these fitness devices can be used for clinical diagnosis by adding an ECG, then it can be a daily health monitoring or a health assisted device by connecting it to the internet via a smartphone. To use an ECG as a wearable device, the electrode positions has to fulfill the clinical placement. A new biomedical electrodes placement is proposed in this paper to meet the practicality of a fitness lifestyle device but has a medical ECG result for continuous heart monitoring in a form of a necklace. The device has a single lead ECG analog front end that is connected to an ARM-Cortex M4 microcontroller. It uses a 4 GB memory card, rechargeable battery, and a Bluetooth Low Energy 4.0 to communicate with an Android 4.3 smartphone. The test results were taken from a 32-year-old male subject with normal heart condition. The signal acquired from the electrode placement at the backside of the neck shows Lead I waveform with 10% from the normal position amplitude value. The R-wave of every heartbeat can be seen for heart rate calculation. Therefore, it is able to do a daily heart monitoring with a lifestyle device.

GP12-a: Medical Imagery & Teleradiology

Room: Business Club
Chair: Zviad Kirtava (Tbilisi State Medical University, Georgia)

A Simple and Accurate Matrix for Model Based Photoacoustic Imaging
Francis K j, Pradeep Mishra and P Rajalakshmi (Indian Institute of Technology Hyderabad, India); Ashutosh Richhariya (LV Prasad Eye Institute Hyderabad, India); Sumohana Channappayya (Indian Institute of Technology Hyderabad, India)
Accurate model-based methods in Photo-Acoustic Tomography (PAT) can reconstruct the image from insufficient and inaccurate measurements. Most of the models either make the simplified assumption of spherical averaging or use accurate models that have computationally burdensome implementations. We present a simple and accurate measurement matrix that is derived from the pseudo-spectral PAT model. The accuracy of the measurement matrix is first validated against the experimental PAT signal. We also compare the model against the standard k-wave measurement model and the spherical averaging model. We then highlight several reconstruction strategies based on the nature of the region of interest to further demonstrate the accuracy of the proposed measurement matrix.

Non-local Means Kernel Regression Based Despeckling of B-mode Ultrasound Images
Ramkrishna Bharath (Indian Institute of Technology, India); P Rajalakshmi (Indian Institute of Technology Hyderabad, India)
Medical ultrasound scanning is a widely used diagnostic imaging modality in health-care. Speckle is inherent noise present in ultrasound images reducing the diagnostic accuracy of ultrasound scanning. Speckle noise contributes to high variance between pixels and delineates boundaries of the organs. Effective despeckling involves reducing the variance between pixels corresponding to homogeneous region and to preserve anatomical details simultaneously. Non-Local Means filters are highly successful and produced state of the art results in despeckling ultrasound images. In this paper, we show the effectiveness of Non-Local Means filter with polynomial regression kernel in despeckling ultrasound images. The proposed algorithm is evaluated on software simulated and real time ultrasound images and proved very effective in both despeckling and edge preservation

Human-machine Interface Based on Multi-channel Single-element Ultrasound Transducers: A Preliminary Study
Yuefeng Li, Keshi He, Xueli Sun and Honghai Liu (Shanghai Jiao Tong University, P.R. China)
Ultrasound (US) imaging is a promising sensing technique in the field of human-machine interface, and many positive results have been reported in literature on hand gesture recognition or finger angle prediction based on US imaging. However, in most of these studies linear array ultrasound probes were used to generate US images, which made the US device expensive and bulky. In this paper, a method of extracting forearm muscle information via multiple single-element US transducers is proposed. By using this kind of transducers, a low-cost and small-size human-machine interface can be expected. Preliminary results show that an average recognition accuracy of 96% can be achieved for six motions, including five finger flexions and rest state.

Assessing the Relational Database Model for Optimization of Content Discovery Services in Medical Imaging Repositories
André Alves (DETI / IEETA - University of Aveiro); Tiago Marques Godinho and Carlos Costa (University of Aveiro, Portugal)
Medical imaging has been an essential contributor to high-quality medical decisions. In the past few years, the production of medical imaging data has grown impressively, thanks to the increasing number of imaging centers and higher resolution modalities. Keeping high availability and acceptable performance in this scenario raises new challenges related to storage, discovery and distribution of imaging data. Nowadays Picture Archiving and Communication System (PACS) must optimize these processes to the limit to cope with Big Data usage scenarios. In this regard, this work explores novel technologies to improve the performance of query and retrieve services in medical imaging context, ensuring always the compatibility with Digital Imaging and Communications in Medicine (DICOM) standard. The focus is the optimization of querying services. Namely, we conducted several controlled experiments to determine the best database model to support these services. More precisely, we studied the performance of a traditional PACS archive, based on a relational database, against a more recent NoSQL database. We used large datasets with 7 million medical images that represent accurately a year of medical practice. The result of this work is a set of guidelines for the correct usage of analyzed databases in big data medical imaging scenarios, including the advantages and limitations of each model.

A Hybrid Quality Evaluation Approach Based on Fuzzy Inference System for Medical Video Streaming Over Small Cell Technology
Ikram Rehman and Nada Y Philip (Kingston University, United Kingdom); Moustafa M Nasralla (Prince Sattam Bin Abdulaziz University)
Small cell technology is expected to be an integral part of future 5G networks in order to meet the increasingly high user demands for traffic volume, frequency efficiency, and energy and cost reductions. Small cell networks can play an important role in enhancing the Quality of Service (QoS) and Quality of Experience (QoE) in m-health applications, and in particular, in medical video streaming. In this paper, we propose a hybrid medical QoE prediction model based on a Fuzzy Inference System (FIS) that correlates the network QoS (NQoS) and application QoS (AQoS) parameters to the QoE. The model is tested on the transmission of medical ultrasound video over small cell technology. The results show that the predicted QoE scores of our proposed model have a high correlation with the subjective scores of medical experts.

Thursday, September 15, 12:30 - 13:30

Lunch

Thursday, September 15, 13:30 - 14:00

Beyond the Wire: how 5G will boost e-Health

Dr. Walter Weigel, Huawei

Room: Double Cone
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Thursday, September 15, 14:00 - 16:00

Workshop: 5G PPP Phase III - Introduction

Room: Double Cone
Chairs: Markus Dillinger (Huawei Technologies, Germany), Halid Hrasnica (Eurescom, Germany)

Thursday, September 15, 16:00 - 17:30

Workshop: 5G PPP Phase III

Room: Double Cone
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

GP01-c: Ambient Assisted Living

Room: T1a
Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

A Data Fusion System to Study Synchronization in Social Activities
Loïc Sevrin (Université de Lyon & INL, France); Bertrand Massot (University of Lyon & INL - INSA Lyon, France); Norbert Noury (University of Lyon & Team Biomedical Sensors, France); Nacer Abouchi (CPE Lyon, France); Fabrice Jumel (INSA de Lyon, France); Jacques Saraydaryan (CPE, France)
As the world population gets older, the healthcare system must be adapted, among others by providing continuous health monitoring at home and in the city. The social activities have a significant role in everyone health status. Hence, this paper proposes a system to perform a data fusion of signals sampled on several subjects during social activities. This study implies the time synchronization of data coming from several sensors whether these are embedded on people or integrated in the environment. The data fusion is applied to several experiments including physical, cognitive and rest activities, with social aspects. The simultaneous and continuous analysis of four subjects cardiac activity and GPS coordinates provides a new way to distinguish different collaborative activities comparing the measurements between the subjects and along time.

Exploiting Riemannian Manifolds for Daily Activity Classification in Video Towards Health Care
Yixiao Yun and Irene Y. H. Gu (Chalmers University of Technology, Sweden)
This paper addresses the problem of classifying activities of daily living in video. The proposed method uses a tree structure of two layers, where in each node of the tree there resides a Riemannian manifold that corresponds to different part-based covariance features. In the first layer, activities are classified according to the dynamics of upper body parts. In the second layer, activities are further classified according to the appearance of local image patches at hands in key frames, where the interacting objects are likely to be attached. The novelties of this paper include: (i) characterizing the motion of upper body parts by a covariance matrix of distances between each pair of key points and the orientations of lines that connect them; (ii) describing human-object interaction by the appearance of local regions around hands in key frames that are selected based on the proximity of hands to other key points; (iii) formulating a pairwise geodesics-based kernel for activity classification on Riemannian manifolds under the log-Euclidean metric. Experiments were conducted on a video dataset containing a total number of 426 video events (activities) from 4 classes. The proposed method is shown to be effective by achieving high classification accuracy (93.79% on average) and small false alarms (1.99% on average) overall, as well as for each individual class.

Sway Analysis and Fall Prediction Method Based on Spatio-Temporal Sliding Window Technique
Kabalan T Chaccour (Antonine University, Lebanon); Hiba Al Assaad (TICKET Lab. & Antonine University, Lebanon); Amir Hajjam (UTBM, SeT, France); Rony Darazi (Antonine University, Lebanon); Emmanuel Andrès (CHU Strasbourg, France)
As people age, they become more fragile and exhibit difficulties in maintaining their gait and balance. Their state of fragility increases their vulnerability to fall incidents. Various analysis methods were developed to detect the abnormality of human gait and balance, and estimate the risk of falling. In this paper, we present a method to estimate the falling risk and alert the patient when a fall is about to happen. The proposed method consists in monitoring and analyzing the amount of sway of the center of mass in the medial-lateral plane by computing the center of pressure displacement at the foot plantar surface. Our proposed method uses the spatio-temporal sliding window processing to generate fall alarms and estimate the falling risk. The method was validated via a two-phase experimental protocol with five young adults who performed a walk of 20 stances with simulated sways using an instrumented shoe with resistive pressure sensors. The threshold of the normal walk TH_N and the risk level RL of the altered walk are determined as well as the risk of falling. The method can be applied in real-life and clinical settings with real-time processing.

A Conceptual Model for Integrating Social and Health Care Services At Home: The H@H Project
Fabrizio Pecoraro, Daniela Luzi, Elaheh Pourabbas and Fabrizio Ricci (National Research Council, Italy)
The increasing demand for home care due to the growing number of older people with an increased incidence of multiple chronic conditions requires the adoption of technological innovation that can improve the integration and coordination of health and social services. This paper presents the H@H platform that aims to improve the coordination and cooperation among stakeholders facilitating the provision of care services in a continuity of care framework. Moreover, a conceptual model that combines the main concepts of the ContSys standard with social care components and with assistive domotics linked to the lifestyle and healthy behavior is proposed. Finally, a scenario that depicts the application of the integrated approach to a subject affected from metabolic syndrome is presented.

GP02-c: Feature Recognition

Room: T1b
Chair: Norbert Noury (University of Lyon & Team Biomedical Sensors, France)

ParkNosis: Diagnosing Parkinson's Disease Using Mobile Phones
Abdulwahab H Sahyoun, Karim Chehab, Osama Al-Madani, Fadi Aloul and Assim Sagahyroon (American University of Sharjah, United Arab Emirates (UAE))
This paper aims to provide a Parkinson's Disease (PD) symptoms assessment tool using an Android smartphone application that allows PD patients to assess their symptoms using both quantitative and qualitative tests. Simple touch screen and motion tests focus on objectively measuring PD symptoms, whereas a questionnaire targets the subjective ones. The concatenation of the collected results will allow the application to accurately target several PD symptoms without visual or traditional assessment. Physicians, hospitals, and clinics will then be able to receive this data over the network for further assessment, analysis, and research. This enables the self-monitoring of patients, as well as remote monitoring from physicians in clinics and hospitals. In addition to this, this application aims to expand PD research and provide improvements to the current treatment process. Ultimately, the aim is to enable thousands of people, anywhere and at any time, to easily diagnose and assess the PD before visiting a specialist.

Smartphone Based Automatic Abnormality Detection of Kidney in Ultrasound Images
Pallavi Vaish (Indian Institute of Technology Hyderabad, India); Ramkrishna Bharath (Indian Institute of Technology, India); P Rajalakshmi (Indian Institute of Technology Hyderabad, India); Uday B Desai (IIT Hyderabad, India)
Telesonography suffers from inherent limitations due to need of all time availability of experts in cloud and data connectivity to the device. Computer aided diagnosis (CAD) used for automatic detection of abnormalities without manual intervention can overcome these limitations. Commercially available ultrasound scanners restrict the installation of new softwares and hence CAD algorithms cannot be integrated into the existing ultrasound scanners. There is a need for external computing device, which can acquire image data from ultrasound scanners, perform CAD and generate result. Smart phones are now widely used in personalized health-care due to its ubiquitous computing capability. Smart phones with embedded CAD can be used as a computing device for automated diagnosis. In this paper, we have developed an Application (APP) for smart phone to automatically diagnose the kidney in ultrasound image. With the developed APP, the smart phone can acquire images from any ultrasound scanner, process it and give the diagnostic result. Automatic abnormality detection of kidney is based on Viola Jones algorithm, texture feature extraction followed by SVM classifier. Stones and cysts are the abnormalities detected using the algorithm. The developed APP resulted with an accuracy of 90.91% in detecting the abnormalities.

ST-segment and T-wave Anomalies Prediction in ECG Data Using RUSBoost
Medina Hadjem and Farid Naït-Abdesselam (Paris Descartes University, France); Ashfaq Khokhar (Illinois Institute of Technology, USA)
Electrocardiogram (ECG) datasets are among the most challenging records that have been widely studied for early automatic prediction of cardiac anomalies. In order to achieve high performance automatic prediction, existing works make use of complex and time consuming techniques and/or show high rates of false positives. In this paper, we introduce a new method to analyze an ECG dataset and perform an efficient prediction of 7 ST-segment and T-wave anomalies related to Myocardial Infarction (MI) or Ischemia. Our method combines both Decision Trees Boosting and Random Under Sampling (RUS) techniques to respectively improve the prediction performance and solve the class imbalance problem. This method, named RUSBoost, has been validated using data of 7 leads, collected from a real ECG dataset [1], and the obtained results show a higher balance between true and false positives for all the 7 leads. Obtained average sensitivity and specificity are respectively 86% and 94.85%, which outperform the existing results of other related works.

An Approach to Localization in Crowded Area
Md Osman Gani, Golam Mushih Tanimul Ahsan, Duc Do, Drew Williams, Mohammed Balfas and Sheikh Iqbal Ahamed (Marquette University, USA); Muhammad Arif and Ahmed Kattan (Umm Al-Qura University, Saudi Arabia)
Every year millions of people gather at Mecca, Saudi Arabia during the Hajj, an annual Islamic pilgrimage. The area at Mecca is small, and the number of attendees increases each year, which has created an ongoing and ever increasing problem of crowd management. In this paper, we present our integrated solution to the localization challenge of tracking specific users in a highly crowded area where GPS signal may be weak or even unavailable. One area of smartphone technology that has been developed in recent years is human activity recognition (HAR). This technology uses various sensors that are built into the smartphone to sense a person's activity in real time. Applications that incorporate HAR can be used to track a person's movements and are very useful in areas such as health care. We also propose a group-tracking mechanism that can be applied when a group member appears to get lost. Other members of the group will be immediately notified and receive an estimation of the lost member's location. Using wireless signals (RSSI) and inertial sensor data, we have developed a mathematical model and a system for both outdoor and indoor localization. The experimental results show that the proposed system is able to detect locations of users with high accuracy, with an error of less than 2.5 meters. The system will be used by millions of users in Mecca, where there have been thousands of reported cases of pilgrims getting lost during the Hajj, however, it is scalable to accommodate any other crowded population.

GP05-c: Decision-Support & Intelligence

Room: T2a
Chair: Thomas Jell (Siemens AG, Germany)

Application of Recommender System Methods for Therapy Decision Support

Felix Gräßer (Technische Universität Dresden, Germany); Stefanie Beckert, Denise Küster and Susanne Abraham (Universitätsklinikum Dresden, Germany); Hagen Malberg (Technische Universität Dresden, Germany); Jochen Schmitt (Universitätsklinikum Dresden, Germany); Sebastian Zanseder (TU Dresden & Institute of Biomedical Engineering, Germany)

In this paper two approaches for facilitating therapy decision support are proposed and compared. Both approaches, the Collaborative Recommender and hybrid Demographic-based Recommender, are based on recommender system methods which origin from the field of product recommendation in e-commerce applications. An exemplary dataset comprising health record excerpts of patients suffering from the skin disease psoriasis is used for evaluating both approaches. The approaches estimate the outcome of a subset of systemic therapies to support the medical practitioner in making therapy decisions for a specific patient and time, i.e. consultation under consideration. Both systems proved to work and are capable of assisting medical practitioners prospectively with making appropriate therapy decisions.

Immediate and Long-term Effects of 2016 Zika Outbreak: A Twitter-based Study

Aparup Khatua (University of Calcutta, India); Apalak Khatua (XLRI Xavier School of Management, India)

Twitter is becoming a popular tool for syndromic surveillance. We probed the 2016 Zika Outbreak in Latin American context. Zika virus can have severe long-term (such as microcephaly in newborns) effects and not so serious immediate (such as fever or a headache) effects. We probed whether the Twitter discussion, regarding Zika virus, effectively captures the severity of these long-term concerns. We performed volumetric and text mining analysis (such as co-occurrence of words and hierarchical clustering) to explore the underlying themes in the Twitter discussion regarding immediate and long-term concerns. Our findings suggest that the concerns related to long-term consequences are dominant and consistent across different methods, but this is not the case for immediate effects.

Big Social Data Analytics for Public Health: Facebook Engagement and Performance

Nadiya Straton (Copenhagen Business School, Denmark); Kjeld Hansen (Westerdals - Oslo School of Art Communication & Technology); Raghava Rao Mukkamala and Abid Hussain (Copenhagen Business School, Denmark); Tor-Morten Grønli (Westerdals - Oslo School of Art Communication & Technology, Norway); Henning Langberg (University of Copenhagen, Denmark); Ravi Vatrapu (Copenhagen Business School, Denmark)

In the recent years, Social media provides new opportunities for interaction and distribution of public health information within and across organizations. In this work, we analyzed data from 153 public Facebook walls pertaining to various public health organizations using unsupervised machine learning techniques to understand the characteristics of user engagement and post performance. Our analysis indicates an increasing trend of user engagement on public health posts during recent years. Based on the clustering results, our analysis shows that Photo and Link type posts are most favorable for high and medium user engagement respectively.

Patterns for Conflict Identification in Clinical Trial Eligibility Criteria

Christina Schweikert and Bonnie MacKellar (St. John's University, USA)

Patients with serious diseases, such as cancer, often must consider and choose between multiple clinical trials. Patients are often concerned that participation in one clinical trial may preclude their participation in another trial. We are developing a system to help patients in this decision making process, focusing on pediatric cancer where clinical trial participation is very high. In this paper, we present a detailed description of the approach used to process and analyze the eligibility constraints, using a pattern-based approach from the literature. We show how the semantic categorizations produced by these patterns can be used to determine which eligibility constraints can produce conflicts, as well as to guide an analysis algorithm. This work contributes to research on using eligibility criteria and other clinical trial information to better support patient decision making and to improve accrual of patients into clinical trials.

Evaluating the QoE of a Mobile DSS for Diagnosis of Red Eye Diseases by Medical Students

Marta Manovel, Miguel Maldonado, Isabel de la Torre, José Jimeno and Miguel López-Coronado (University of Valladolid, Spain); Joel J. P. C. Rodrigues (Instituto de Telecomunicações, University of Beira Interior, Portugal)

This paper aims to evaluate OphthalDSS, a new mobile Decision Support System (DSS) for red eye diseases diagnosis, and presents the results after evaluating the Quality of Experience (QoE) by medical students of the University of Valladolid, Spain. OphthalDSS offers a study guide for physicians and medical students, and a clinical decision support system for primary care professionals. The decision algorithm will be implemented by an Android mobile App and the QoE will be evaluated through a short survey. The OphthalDSS algorithm is capable to diagnose more than 30 eye's anterior segment diseases. A total of 67 medical students have evaluated the QoE of the proposed solution. The different parts of the survey achieved, at least, a mean value score. Most of the surveyed students agree with that OphthalDSS does the function that they expected, its information is totally reliable, it is intuitive and presents an appropriate appearance, and highlight the decision algorithm's effectiveness.

GP06-c: Self Monitoring & Disease Management

Room: T2b

Chair: Klaus Moessner (University of Surrey, United Kingdom)

Midwifery E-Health:From Design to Validation of "Mammastyle - Gravidanza Fisiologica"

Grazia Tommasone (ISTITUTO SUPERIORE MARIO BOELLA, Italy); Valentina Solinas (Università di Torino, Italy); Marco Bazzani (ISTITUTO SUPERIORE MARIO BOELLA, Italy); Paola Serafini (Università di Torino, Italy)

Health education for pregnant women is one of the aims chased by using mobile applications for health prevention and healthy lifestyle promotion. The literature claims the lack of mobile applications with evidence-based information and supported by health professionals. This paper deals with the design, implementation, and evaluation of service for healthy women with normal pregnancy aimed at promoting healthy lifestyles, monitoring eating habits and physical activity, for educational purposes and overweight and obesity prevention in pregnancy.

Wireless Solution to Prevent Decubitus Ulcers: Preventive Weight Shifting Guide, Monitor, and Tracker App for Wheel Chair Users with Spinal Cord Injuries (Phase II)*

Arshia A Khan (University of Minnesota Duluth, USA); Michael Reuter (Essentia, USA); Nam Phung and Syed Hafeez (UMD, USA)

Pressure ulcers pose a huge financial burden on the economy. Pressure ulcers cost between $9.1 to 11.6 billion a year in the United States. Each individual pressure can cost from $20,900 to $151,700 per pressure ulcer. Wheelchair users with spinal cord injury have a higher risk of developing pressure ulcers due to limited mobility and the countless hours they spend in the wheelchair, exerting pressure on the points of interface between the bony structure and the wheelchair cushion. The areas of interface that are under prolonged pressure lack blood flow, causing the tissue to breakdown, leading to a decubitus or pressure ulcer. Approximately 28.9 % wheelchair users in communities, 27% in nursing homes, and between 5 and 30% of hospitalized patients develop pressure sores. Nearly 70% of elderly patients develop pressure ulcers, which in turn significantly increase the healthcare management and costs and can be a cause of pain, discomfort, loss of independence and mobility in not only the elderly but also the younger patients. Mobile technology can be exploited to provide a technological solution to preventing pressure ulcers. An app was designed and developed to notify, walk through the process of weight shifting and also track the movements of the patient performing weight shifting using the accelerometer. The app was tested to find that the forward lean movements can be tracked accurately using the accelerometer but the lateral movements although tracked could not verify that the weight shifting was correctly performed. In order to fix this issue the pressure map is used as an additional sensor to track and monitor the weight shifting accurately. This paper discusses the design and development of the app in two phases.

Activating Long-Term Care eHealth Accessible Application for Visually Impaired Users

Chung Wei Kan (Institute for Information Industry & IDEAS, III, Taiwan); Po Wei Tseng (Project Assistant, Taiwan)

As reported by the Department of Statistics in 2014, 29,000 elderly people had registered for a Visually Impaired Card, which was 51.2% of all visually impaired people in Taiwan. This number increased by 1,100 people, an annual growth rate of 1.56%. According to the WHO, in 2012, 285 million people worldwide were estimated to be visually impaired, which is 4.24% of the overall population. From an age distribution point of view, visually impaired people above the age of 50 accounted for 2.76% of overall population. On average, there are 7 visually impaired people in every 100 people above 50 years of age. In Taiwan, 549,000 people over age 50 were estimated to be visually impaired. Therefore, we expect there is a large amount of visually impaired people requiring accessibility services. The main purpose of this research is to collect adaptability information on the cognitive model of senior visually impaired people, from their work status, social participation status, and leisure activities obtained via questionnaire survey. Furthermore, descriptive video service is to be tested as an accessible long-term care application for visually impaired senior users. The research aims to solve disability circumstances and improve home care quality through visually impaired APP Proof-of-Concept (POC). The result of this research will serve as an important basis for other studies in related fields; a reference for practical application. As a result, profit-seeking enterprises will be encouraged to design user oriented products. This will provide an opening for a mobile accessibility services benchmark on technological social care for disability and senior users.

Experiment Design of Free Pregnancy Monitoring mPHRs Quality Evaluation

Ali Idri and Mariam Bachiri (University Mohamed V of Rabat, Morocco); José Luis Fernández-Alemán and Ambrosio Toval (University of Murcia, Spain)

In order to improve the management of the patients' health data and promote the exchange between the patients and healthcare providers, mobile personal health records (mPHRs), as mobile applications, are used to access, store and manage these data. In this paper, a design of the software quality evaluation of free mPHRs for pregnancy monitoring is introduced. Ten mobile applications (4 for iOS and 6 for Android) are selected for the evaluation. A list of tasks is set to be executed in order to answer a quality assessment questionnaire that is developed for this purpose, covering the four quality characteristics: Functional suitability, operability, performance efficiency and reliability, by using the ISO/IEC 25010 quality model. This evaluation aims to analyze the degree of meeting these quality characteristics, in addition to the compliance between the users' ratings in the apps stores and the fulfillment of the quality characteristics by the mPHRs for pregnancy monitoring. This study is intended to be developed by conducting the proposed design of the evaluation, which will be of great use for the developers of these apps for further improvements.

Mobile Self-Management Application for COPD Patients with Comorbidities: a Usability Study

Drishty Sobnath, DS (Kingston University & Kingston University, United Kingdom); Nada Y Philip, Reem Kayyali, Shereen Nabhani-Gebara and Barbara Pierscionek (Kingston University, United Kingdom); Andreas Raptopoulos (EXUS SA, Greece)

This paper presents the design and evaluation of a COPD mobile application which forms part of the WELCOME project (Wearable Sensing and Smart Cloud Computing for Integrated Care to COPD Patients with Comorbidities). A first prototype of this application has been implemented and is currently being evaluated with patients, human computer interaction experts and healthcare professionals in the UK and the Netherlands. The application allows COPD patients suffering also from different comorbidities to self-manage their disease by taking regular measurement, fill questionnaires requested by their healthcare professionals and follow different programs remotely. The usability and acceptability of the system by COPD patients in the UK are discussed in this paper.

Thursday, September 15, 16:00 - 16:40

GP09: Nano Technologies

Room: Business Club

Chair: Kashif Saleem (King Saud University, Saudi Arabia)

QoS Aware Molecular Activation and Communication Scheme in Molecular Nanoscale Sensor Networks

Hong-Hsu Yen (Shih-Hsin University, Taiwan); Xinheng Wang and Dong Wang (University of the West of Scotland, United Kingdom)

Molecular Nanoscale Sensor Networks (MNSNs) introduce a new molecular routing paradigm where the molecular communication is enabled by activating the nanosensors on the routing path to release the molecules. This new molecular activation mechanism is a new many-to-many scheme where the transmitter node transmits molecules to multiple receiver nodes and the receiver node receives the molecules from multiple transmitter nodes. Molecular activation mechanism poses a new capacity constraint where the received molecules must be above a threshold to activate the receiving node and the molecules released from the transmitter should not exceed its molecular capacity. In addition, molecular activation and communication scheme should carefully consider the long molecular propagation time so that the activation time at the sink node is bounded. These three new criteria (many-to-many, capacity and time) make the molecular activation and communication scheme a very challenging issue in an MNSN. In this paper, for the first time, we propose a sound mathematical model to capture the many-to-many communication scheme, molecular capacity constraint and molecular activation time constraint in the MNSN. We then propose a novel QoS (cost, capacity and time) aware algorithm, EADAMA, to identify the cost efficient molecular activation and communication path in the MNSN. From the computational experiments, it shows that the EADAMA algorithm is superior to other two heuristics, SP and MCST, in all network settings.

Adaptive Code Width Protocol for Mitigating Intersymbol Interference in Diffusion-based Molecular Communication with Mobile Nodes

Yao Sun and Masaki Ito (The University of Tokyo, Japan); Kaoru Sezaki (University of Tokyo, Japan)

Molecular communication (MC) is a promising technique to enable the communication among nano machines for various applications in healthcare industry such as targeted drug delivery. In

this paper, we focus on the inter symbol interference (ISI) problem in diffusion-based MC. In this kind of communication, the ISI is notably influenced by communication distance and bit width. On this basis, we propose an adaptive code width (ACW) protocol to mitigate the intersymbol interference. In this protocol, a 'distance feedback' is used to measure the communication distance. We adopt a signal attenuation model to accomplish this task. According to the measured distance, the transmitter can adapt the modulation using an appropriate bit width in order to mitigate the ISI. Moreover, the ACW protocol improves the transmission efficiency when communication distance is short and ISI does not affect bit error rate. Finally it is verified that this protocol is feasible to control the ISI at a low level even when the channel varies due to the mobility of the transceivers.

Thursday, September 15, 16:40 - 17:30

GP13: Mixed e-Health

Room: Business Club

Economic Evaluation of m-Health: Case of e-Ambulance in Japan

Masatsugu Tsuji (University of Hyogo, Japan); Yoshihisa Matsumoto (The Graduate University for Advanced Studies, Japan); Masaru Ogawa (Kobe Gakuin University, Japan)

This study aims at evaluating the economic effect of a e-ambulance project, or emergency telemedicine in the rural areas in Kouchi Prefecture in Japan. Ambulances equipped with ICT devices which transmit images of acute patients to remote hospitals are focused on. Kouchi Prefecture started the e-ambulance project in Aki and Muroto Cities in 2012. From two cities, it takes approximately one hour to reach emergency hospitals located in Kouchi City, the prefectural capital. One of the merits of e-ambulance with the image transmitting system is that doctors in accepting hospitals can monitor real time situation of a patient and prepare for necessary treatment prior to the time patient arrives. They thus save time and effort. In measuring benefit, this study employs different methodology; the e-ambulance project enhances wellness of residents since they perceive more secure. Thus the CVM (Contingent valuation method) is applied and WTP (willingness to pay) is used as an index of benefit and estimated based on surveys to residents, which amounts to 1,747 yen per resident per year. Total cost calculated is 381,792,228 yen over three years, and accordingly, B/C ratio amounts 0.459.

Thursday, September 15, 18:00 - 23:00

Banquet (Hofbräuhaus)

Venue is in Munich old town. Busses will be provided.

Friday, September 16

Friday, September 16, 09:30 - 10:30

Keynotes (TBD)

Room: Double Cone

Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Friday, September 16, 09:30 - 15:30

Workshop: WWRF

Setting the Scene for the 5G-enabled Health Ecosystem

Room: T2a

Chairs: Kostas Danas (Kingston University, London, United Kingdom), Christos Politis (Kingston University, United Kingdom), Bin Zhen (Huawei Technologies Co., LTD, P.R. China)

Mobile health (m-Health) covers health applications that are enabled by mobile communication devices such as smart phones, tablets and laptop computers. The forthcoming 5G (fifth generation of mobile communications) will enable the independent communication of intelligent devices (known as the Internet of Things IoT) providing an ecosystem where such devices will have the autonomy to monitor the health related issues of individuals and update the Electronic Patient Record (EPR) that is centrally controlled by the healthcare system. This ecosystem will provide amazing opportunities for innovative applications that could transform the quality and efficiency of healthcare delivery and personalised support. It is envisaged that together with prescribed medication we will be prescribed a mobile application system that will provide support on the way that we treat our health conditions. It is also important to point out that this ecosystem is predicted to create jobs and economic growth combining ICT, smart medical devices, and smart pharmaceuticals all working together for the delivery of healthcare encouraging prevention and leading to a healthier lifestyle.

The aim of this workshop is to present the vision of m-Health under 5G, provide experts' views on the development of this future ecosystem of intelligent devices and demonstrate with the presentation of case studies and short demos the benefits to the healthcare industry and the individuals.

Workshop: Project ALFRED

Room: T2b

Chair: Peter Merz (TieKinetix, Germany)

ALFRED - Personal Interactive Assistant for Independent Living and Active Ageing - is a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 611218. It will allow older people to live longer at their own homes with the possibility to act independently and to actively participate in society by providing the technological foundation for an ecosystem.

Friday, September 16, 11:00 - 12:30

GP04-a: Sensor Networks, Wearables, and IoT

Room: T1b

Chair: Markus Dillinger (Huawei Technologies, Germany)

Distributed Scheme for Interference Mitigation of WBANs Using Predictable Channel Hopping

Mohamad Ali (Paris Descartes University, France); Hassine Moungla (University of Paris Descartes, France); Mohamed Younis (University of Maryland Baltimore County, USA); Ahmed Mehaoua (University of Paris Descartes, France)

When sensors of different coexisting wireless body area networks (WBANs) transmit at the same time using the same channel, a co-channel interference is experienced and hence the performance of the involved WBANs may be degraded. In this paper, we exploit the 16 channels available in the 2.4 GHz international band of ZIGBEE, and propose a distributed scheme that avoids interference through predictable channel hopping based on Latin rectangles, namely, CHIM. In the proposed CHIM scheme, each WBAN's coordinator picks a Latin rectangle whose rows are ZIGBEE channels and columns are sensor IDs. Based on the Latin rectangle of the individual WBAN, each sensor is allocated a backup time-slot and a channel to use if it experiences interference such that collisions among different transmissions of coexisting WBANs are minimized. We further present a mathematical analysis that derives the collision probability of each sensor's transmission in the network. In addition, the efficiency of CHIM in terms of transmission delay and energy consumption minimization are validated by simulations.

Performance Improvement of the Wireless Body Area Network (WBAN) Under Interferences

Sarra Essafi (SysCom, Communication System Laboratory, Tunisia); Tahar Ezzedine (Tunis El Manar University, Tunisia)

WBAN offers promising and innovative applications that enhance the quality of services provided by the healthcare system; it improves patient's quality of life and saves his lives in many situations. WBAN is composed of tiny medical devices on or implanted in the human body and continuously monitors patient's health. The wireless interface and the mobility of the body network enable easier, practical and less cost applications. WBAN provides uninterrupted distantly health monitoring of patient while he is doing his daily activity and it expect to efficiently deliver emergency collected vital signs to the concerned medical entity. However, the high contention level inside the WBAN, the presence of external collocated wireless network and the use of a shared medium, invoke packet collisions and thus affect the communication quality and reliability of the WBAN. Our goal in this article is to analyse the interference problem of the WBAN based IEEE 802.15.4 protocol in the presence of Wi-Fi transmitters. We opt also for an adequate simulator and configurable mobility model to investigate different effects of the WBAN density as well as the increase number of Wi-Fi transmitters on the performance of the WBAN. We finally propose a simple, no cost and convenient parameters adjustment method to improve the WBAN's capacity, packet delivery, packet transmission and packet delay.

Buffer-aware and QoS-effective Resource Allocation Scheme in WBANs

Zhiqiang Liu and Bin Liu (University of Science and Technology of China, P.R. China); Chang Wen Chen (State University of New York at Buffalo, USA)

Wireless Body Area Network (WBAN) represents one of the most promising networks to provide health applications for improving the quality of life, such as ubiquitous e-Health services and real-time health monitoring. The resource allocation of an energy-constrained, heterogeneous WBAN is a critical issue that should consider both energy efficiency and Quality of Service (QoS) requirements with the dynamic link characteristics, especially when the limited resource cannot satisfy the expected QoS requirements. In this paper, a buffer aware Energy-efficient and QoS-effective resource allocation scheme is proposed in which the sensor queue buffer states, constraints of QoS metrics and the characteristics of dynamic links are considered. Specifically, a buffer aware sensor evaluation method is designed to dynamically evaluate the sensor state with considering the sensor buffer states for improving the system performance. We then formulate the resource allocation problem for optimizing the transmission power, the transmission rate and the allocated time slots for each sensor to minimize the sum mix-cost, which is defined to characterize the energy cost and QoS cost between attainable QoS support and QoS requirements. Simulation results demonstrate the effectiveness of the buffer aware sensor evaluation method and the proposed energy-efficient and QoS-effective resource allocation scheme.

Performance Improvement of the Wireless Body Area Network (WBAN)

Sarra Essafi (SysCom, Communication System Laboratory, Tunisia); Tahar Ezzedine (Tunis El Manar University, Tunisia)

The introduction of the Wireless Body Area Network (WBAN) grows significantly regarding its flexibility, accuracy, costs efficiency and mobility. It supports a huge range of innovative applications

that improve the quality of life and enhance services. In the health care system, the majority of WBAN applications are responsible of handling critical data in order to monitor the patient health state and to save his live in many cases. That's why WBAN should efficiently deliver patient's vital signs to specialized medical entity (doctor, emergency, ..). However, the particular architecture of WBAN and the movement patterns of the body part affect the communication quality. Moreover, the number of WBAN nodes increases the contention level to access to the shared wireless medium; this consequently produces packets collisions and the loss of critical data. We evaluated in this article the performance of the WBAN within different scenarios. We investigated different effects of the number of nodes as well as the different body state (standing, running) on the WBAN reliability. We, finally, proposed a simple, no cost and convenient Adaptive Transmit Power Mechanism (ATPM) to improve the WBAN link quality without consuming unnecessary energy.

Sensors and Mobile-Based System for Patients Who Suffer From Congenital Insensitivity to Pain with Anhidrosis

Nader Rahman (Esprit School of Engineering & ESPRIT, Tunisia); Salma Sayah and Karray Gargouri (Esprit School of Engineering ESPRIT, Tunisia)

There are many cases of congenital insensitivity to pain with anhidrosis (CIPA), a genetic disease, which generally strikes infants, eliminates the sense of touch, hence, the inability to feel pain and temperature, and decreased or absent sweating (anhidrosis). This genetic disease is incurable, even though there are some medical treatments and therapies to treat it, but they are not considered as a reliable solution for this illness. This paper discusses the use of Smart garments that can help persons with CIPA to prevent danger on their daily life in order to allow them to live better with their disease. Home monitoring solution based on sensor and mobile system deem to be the suitable key to detect the body temperature (fever) and helps them to avoid burning themselves on hot surfaces. This system is a crucial solution that paves the way to the patients to cope well with their incurable disease.

GP07: Augmented Reality, Virtual Reality, Tools and Methods

Room: T1a

Chair: Armin Schneider (Klinikum Rechts der Isar der TU München, Germany)

Language Therapy of Aphasia Supported by Augmented Reality Applications

Daniela Antkowiak (RWTH Aachen University & Institute of Information Management in Mechanichal Engineering, Germany); Christian Kohlschein (RWTH Aachen University, Germany); Roksaneh Krooß and Maximilian Speicher (Bitstars GmbH, Germany); Tobias Meisen (RWTH Aachen University, Germany); Sabina Jeschke (RWTH Aachen University & Institute Cluster IMA/ZLW & IfU, Germany); Cornelius Werner (University Hospital RWTH Aachen, Germany)

In Europe there are more than 580 000 people who suffer from aphasia - an acquired speech and language disorder that occurs because of brain damage, primarily as a result of a stroke. Especially with regards to demographic change, health care systems have to face present and future challenges to improve aphasia therapy. Thereby, immediate therapeutic measures are decisive for best possible and long-term success in language therapy. Regarding essential requirements, on the one hand, therapy intensity and frequency have to be increased significantly while on the other hand, measures need to be adjusted along everyday activities. A very promising approach to meet this requirements are augmented reality applications. They can be used to create a highly natural exercise situation, in which patients interact and practice with their personal possessions at home. This facilitates the successful and continuous transfer of learnings for the patient, contrary to being solely dependent on clinical therapy units. This paper gives an overview of the concept of a real-time software providing augmented and dynamic language therapy, which is interactive and utilizes simple user interface design, for home-based training.

PhysioVR A Novel Mobile Virtual Reality Framework for Physiological Computing

John Munoz Cardona (Universidade da Madeira & Madeira Interactive Technologies Institute, Portugal); Teresa Paulino (University of Madeira, Madeira-ITI & M-ITI, Portugal); Vasantharajah Harryharasuthan (Madeira Interactive Technologies Institute & University of Madeira, Portugal); Karolina Baras (University of Madeira, Madeira-ITI, Portugal)

Virtual Reality (VR) is morphing into a ubiquitous technology by leveraging of smartphones and screenless cases in order to provide highly immersive experiences at a low price point. The result of this shift in paradigm is now known as mobile VR (mVR). Although mVR offers numerous advantages over conventional immersive VR methods, one of the biggest limitations is related with the interaction pathways available for the mVR experiences. Using physiological computing principles, we created the PhysioVR framework, an Open-Source software tool developed to facilitate the integration of physiological signals measured through wearable devices in mVR applications. PhysioVR includes heart rate (HR) signals from Android wearables, electroencephalography (EEG) signals from a low-cost brain computer interface and electromyography (EMG) signals from a wireless armband. The physiological sensors are connected with a smartphone via Bluetooth and the PhysioVR facilitates the streaming of the data using UDP communication protocol, thus allowing a multicast transmission for a third party application such as the Unity3D game engine. Furthermore, the framework provides a bidirectional communication with the VR content allowing an external event triggering using a real-time control as well as data recording options. We developed a demo game project called EmoCat Rescue which encourage players to modulate HR levels in order to successfully complete the in-game mission. EmoCat Rescue is included in the PhysioVR project which can be freely downloaded. This framework simplifies the acquisition, streaming and recording of multiple physiological signals and parameters from wearable consumer devices providing a single and efficient interface to create novel physiologically-responsive mVR applications.

Prediction of Anatomical Exposure to Solar UV: a Case Study for the Head Using SimUVEx V2

Arianna Religi (University of Geneva, Switzerland)

Excessive exposure to solar ultraviolet (UV) radiation is the main cause of skin cancer. The dose-response between UV exposure and skin cancer occurrence is not yet fully understood since UV exposure is highly heterogeneous and strongly influenced influenced by host and behavioural factors, such as posture, orientation to the sun, skin complexion and clothing. To address this issue, a three-dimensional (3D) numeric model (SimUVEx) has been developed to assess dose and distribution of anatomical UV exposure. The model uses 3D computer graphics techniques to compute UV radiance on the basis of postural information and ambient irradiation data, without necessitating time-consuming individual dosimetry, ensuring a wide potential use in skin cancer prevention and research. With the purpose to improve simulation capabilities in order to obtain more realistic scenarios and quantify effective sun protection strategies, a new version has been released, SimUVEX v2. Among new features, a specific morphology for the most sun-exposed body area, the head, has been added. We selected three different styles of hat (cap, wide-brimmed hat and helmet) to compare scenarios with and without solar protections considering the relative contribution of the direct, diffuse and reflected radiation. It was found that, sites directly covered apart (e.g., forehead and top of the head), hats with a wide brim are necessary in order to provide reasonable protections around facial zones on which non-melanoma skin cancers commonly occur, such as nose and cheeks.

Ergonomic Surgical Practice Analysed Through sEMG Monitoring of Muscular Activity

Amandine Dufaug and Christine Barthod (Université Savoie Mont Blanc, France); Laurent Goujon (University Savoie Mont Blanc, France); Nicolas Forestier (Université Savoie Mont Blanc, France)

The success of any surgical intervention is narrowly linked to the operating comfort of the surgeon. Nicknamed "chicken wings", the typical posture adopted by a practitioner during a laparoscopic intervention leads to cervical, shoulders and back pains. To avoid such a posture is one of the main challenge of medical devices designers. Instruments length, lack of articulations as well as non-adapted tables heights have to be reconsidered to surgeon's benefit. Moreover, the smoothness of the gesture is of great deal for the surgeon. It allows a more accurate gesture by reducing the disjointed contractions of the muscles. It has been observed that the recourse to an articulated instrument, the Dex™, leads to shoulder's adduction. The influence of its articulations, especially handle's one, on the surgeon's comfort, has to be quantified. This influence is confronted to several working conditions representative of operating room situations. An optimal surgical environment is proposed through the analysis of electromyography on shoulder's muscles and of elbow's acceleration.

Is There a Relationship Between Frailty Indices and Balance Assessment in Older People

Aly Chkeir (University of Technology of Troyes, France); Safieddine1 Doha (Inserm UMR 1099 Campus de Beaulieu Bat. 22 Rennes F-35042 France, France); Farah Mourad-Chehade (Université de Technologie de Troyes, France); David Hewson (University of Bedfordshire, United Kingdom); Jacques Duchêne (Université de Technologie de Troyes, France); Moustapha Drame (CHU de Reims - Hôpital Robert Debré, France); Delphine Bera (Arcades, France); Michèlle Collart (Hopital, France); Jean-Luc Novella Novella (CHU de Reims - Hôpital Robert Debré, France)

Grip-strength, walking-speed and weight-loss are keys measurements in the evaluation of frailty. According to L. Fried, these quantities are compared to thresholds, leading to associated frailty items that would be combined afterwards for a global decision. One of the consequences of frailty is an increasing risk of falls, which occurrence is a major cause of death of older people. The purpose of this study is to examine the relationship that could exist between grip-strength, walk time, weight-loss and some parameters extracted from balance quality assessment for older subjects. The study shows that a relationship exists between the balance quality parameters and the frailty indices.

GP11: Hippocratic Data: Access Control and Legal Implications

Room: Business Club

Chair: Alois Paulin (Vienna University of Technology, Austria)

An Attribute Based Access Control Scheme for Secure Sharing of Electronic Health Records

Harsha S Gardiyawasam Pussewalage and Vladimir Oleshchuk (University of Agder, Norway)

Electronic health records (EHRs) play a vital role in modern health industry, allowing the possibility of flexible sharing of health information in the quest of provisioning advanced and efficient healthcare services for the users. Although sharing of EHRs has significant benefits, given that such records contain lot of sensitive information, secure sharing of EHRs is of paramount importance. Thus, there is a need for the realization of sophisticated access control mechanisms for secure sharing of EHRs, which has attracted significant interest from the research community. The most prominent access control schemes for sharing of EHRs found in literature are role based and such solutions have the drawback of requiring the users to be registered in the system. Therefore, we propose a secure attribute based EHR sharing scheme using selective disclosure of attributes, which can meet the security requirements of EHRs. The proposed model is policy based and the access decisions are made based on the possibility of a user for being able to provide a proof that the user possesses a set of attributes that satisfies the access policy referenced to the access requested resource. Furthermore, the proposed model is capable of granting access for registered users in the system as well as unregistered but legitimate users, paving the way towards realizing a secure and flexible EHR sharing scheme.

Computer-Aided Diagnosis in Medical Imaging: Review of Legal Barriers to Entry for the Commercial Systems

Ting-Wei Lin and Po-Yu Huang (School of Medicine, Taipei Medical University, Taiwan); Claire Wan-Chiung Cheng (Taipei Medical University, Taiwan)

The goal of this paper is to explore whether the premarket regulatory system of the United States functions ideally in facing the emergence of commercial computer-aided diagnosis (CAD) systems for medical imaging. To outline the current commercial CAD systems available in the United States, clinical trials published in PubMed and EMBASE from 2012 to 2016 that investigated the clinical competence of commercial CAD products were obtained, and the product information provided in these studies was searched in the Establishment Registration & Device Listing database, the Releasable 510(k) Premarket Notification database, and the Premarket Approval (PMA) database of the FDA to trace the processes through which such CAD systems entered the healthcare market. A review of current premarket regulatory system for medical devices, and the potential problems that may hinder the social and clinical integration of CAD systems are presented. We noticed expansion of regulatory definitions and variation of device classes and product codes among similar CAD systems, which may compromise the efficacy of such regulatory controls. The results suggested ineffectiveness of current premarket regulatory controls for CAD systems in the United States.

Blockchain Technology in Healthcare - The Revolution Starts Here

Matthias Mettler (Boydak Strategy Consulting AG, Switzerland)

Blockchain technology has shown its considerable adaptability in recent years as a variety of market sectors sought ways of incorporating its abilities into their operations. While so far most of the focus has been on the financial services industry, several projects in other service related areas such as healthcare show this is beginning to change. Numerous starting points for Blockchain technology in the healthcare industry are the focus of this report. With examples for public healthcare management, user-oriented medical research and drug counterfeiting in the pharmaceutical sector, this report aims to illustrate possible influences, goals and potentials connected to this disruptive technology.

U-Prove Based Security Framework for Mobile Device Authentication in eHealth Networks

Khan Zeb and Kashif Saleem (King Saud University, Saudi Arabia); Christoph Thuemmler (Edinburgh Napier University, United Kingdom); Jalal Al Muhtadi (King Saud University, Saudi Arabia)

Cybersecurity in the health care domain is one of the most important and critical issues of this era. In fact, it was reported in 2014 that on the black market medical records are worth 10 times more than credit card details [1]. Datasets experience a particularly high risk when shifted to a different domain for the documentation of therapeutic or diagnostic procedures. U-Prove is a token based security concept whereby a user may disclose safely and securely a limited amount of information for authentication and verification purposes. In this paper, a U-Prove based security mechanism is proposed for mobile device authentication and authorization in the eHealthcare environment. The complete architecture of the proposed security mechanism and its detailed methodology with process flow is presented. In addition, a generic security analysis is performed to show the strength of the proposed security mechanism.

GP12-b: Medical Imagery & Teleradiology

Room: Double Cone
Chair: Zviad Kirtava (Tbilisi State Medical University, Georgia)

Echocardiography to Cardiac CT Image Registration
Azira Khalil (University Of Malaya, Malaysia); Yih Miin Liew (Universiti Malaya, Malaysia); Siew Cheok Ng (University Malaya, Malaysia); Yan Chai Hum (Lee Kong Chian Faculty of Engineering and Science, Universiti Tunku Abdul Rahman, Malaysia); Lai Khin Wee (Universiti Malaya, Malaysia)
This study proposes a registration framework to register 2D echocardiography images with cardiac CT volume. The registration realizes the fusion of CT and echocardiography with the aim to aid the diagnosis of cardiac diseases. The image registration framework consists of two major steps: temporal and spatial registration. Temporal registration utilizes the ECG data to identify frames at similar cardiac phase as the CT volume. Spatial registration is an intensity-based normalized mutual information (NMI) method applied with pattern search optimization algorithm to produce interpolated cardiac CT image that matches the echocardiography image. Our proposed registration method has been applied on the short axis "Mercedes Benz" sign view of the aortic valve. The accuracy of our fully automated registration method were 0.81 ± 0.08 and 1.30 ± 0.13 mm in terms of Dice coefficient and Hausdorff distance. This accuracy is comparable to gold standard manual registration by expert. There was no significant difference in aortic annulus diameter measurement between the automatically and manually registered CT images. Without the use of optical tracking, we have shown the applicability of this technique for effective registration of echocardiography with cardiac CT volume.

Architecture of a Web-Based DICOM Viewer Showing Segmentations and Simulations
Roland Ellerweg and Dominic Reuter (Fraunhofer FIT, Germany); Phil Weir (NUMA Engineering, Ireland)
In teleradiology clinicans view the image data of a healthcare institution from a remote site. To do so they typically connect to an image repository, download the necessary data and finally view it in a locally installed DICOM viewer. Recent research activities in teleradiology focus on the implementation of ubiquitously accessible web-based DICOM viewers which simplify the access and the collaboration among radiologists. However, these solutions either have a weak performance, they run on the client side only, or they are not as feature rich as their desktop counterparts. In this contribution we present an architecture of a web-based DICOM viewer which has both good performance and advanced features such as the visualization of anatomical structures. On the client side only native web technologies are used. The whole architecture has been implemented and evaluated in the GoSmart environment, a planning tool for minimally invasive cancer treatment.

Generic Features for Fundus Image Quality Evaluation
Zhenjie Yao, Zhipeng Zhang and Li-Qun Xu (China Mobile Research Institute, P.R. China); Qingxia Fan and Ling Xu (Shenyang He Hospital, P.R. China)
Fundus image is important for the medical screening and diagnosis of variety ophthalmopathy. The effectiveness of such a process, however, depends very much on the quality of the fundus image captured. This paper aims to asses in real-time the quality of a fundus image by first extracting a multitude of generic features, including statistical characteristics, entropy, texture, symmetry, frequency components and blur metric, which is then followed by a support vector machine (SVM) trained to filter out the poor quality image for clinic usage. The method was tested on a dataset of 3224 images collected from an eye hospital's practical screening project in rural areas in Northeastern Region of China. With the detection rate achieved being 0.9308, the corresponding false alarm rate is 0.1127, and the overall accuracy is 0.9138. The area under an ROC curve is as high as 0.9619. It is shown that the fundus images of a poor quality can be automatically detected on the spot to ensure a clinically meaningful ophthalmopathy screening and diagnosis by a human expert or even an artificial intelligence software.

Accessing Image Resolution and Frame Rate Effects in Radiology From a Human and a Machine Point of View
Roland Ellerweg (Fraunhofer FIT, Germany); Tuomas Alhonnoro and Mika Pollari (Aalto University, Finland); Peter Voigt (Leipzig University, Germany); Phil Weir (NUMA Engineering, Ireland)
In teleradiology a vast amount of medical images is sent from one location to another location. If the network infrastructure between the locations is poor, users experience long download times or, if a client application is used, application lags. To solve this issue lossless compression algorithms can be used as a first option. Unfortunately these algorithms can only compress the data to a certain degree which is most of the time not enough for the heavy requirements in teleradiology. As a second option the image data can be compressed lossily by reducing the image quality. This however can have an impact on the work of the user and also on image processing tools, when the images are post-processed. In this contribution we give a first impression of frame rate and resolution effects on the work of both, humans and machines, using the example of tumor diagnosis.

Integrating Multiple Data Sources in a Cardiology Imaging Laboratory
Tiago Marques Godinho and Eduardo Almeida (University of Aveiro, Portugal); Luís Bastião Silva (BMD Software, Portugal); Carlos Costa (University of Aveiro, Portugal)
Nowadays, medical imaging laboratories are supported by heterogeneous systems, including image repositories, acquisition devices, viewer workstations and other administrative information systems. They hold tremendous amounts of data resulting not only from imaging modalities, but also from patient diagnosis, treatment, and services management. Unfortunately, the interoperability between the different medical information systems is still a major limitation. Despite the existence of standards to support the distinct RIS and PACS applications, such as DICOM and HL7, the interoperability between them is, in most cases, limited to a few sets of information elements. As a result, the establishment of cooperative workflows or the integrated visualization of patient data is still compromised. Moreover, this scenario severely constraints the usage of these data for research and business analytics purposes, commonly referred as secondary uses of data. In this document, we propose a method for transforming echocardiography reports held by proprietary information systems into DICOM Structured Reports (SR), the gold standard for interoperability in medical imaging. As a result, reports, images, and associated metadata can be accessed and shared by all PACS applications in an integrated and structured manner. Furthermore, the large-scale federation of those elements has a tremendous interest for data analytics and secondary uses of data.

Friday, September 16, 12:30 - 13:30

Lunch

Friday, September 16, 13:30 - 14:00

Cybersecurity in Health Care

Prof. Bill Buchanan, Edinburgh Napier University

Room: Double Cone
Chair: Christoph Thuemmler (Edinburgh Napier University, United Kingdom)

Friday, September 16, 14:00 - 15:30

GP04-b: Sensor Networks, Wearables, and IoT

Room: Double Cone
Chair: Markus Dillinger (Huawei Technologies, Germany)

Towards Semantics in Wearable Sensors: The Role of Transducers Electronic Data Sheets (TEDS) Ontology in Sensor Networks
Olamidipupo Ajigboye (Kingston University, United Kingdom); Kostas Danas (Kingston University, London, United Kingdom)
Sensors, actuators and event sensors are the major types of transducers recognized by the IEEE 21451 standards for Smart Transducers, these contain information embedded in the Transducer Electronic Data Sheets (TEDS) that helps describe the transducer and identify it in a network. Advancement in sensor and information technologies has led to various designs and development in wearable medical devices e.g. wireless Electrocardiogram (ECG) monitoring devices used to measure heart physiological parameters for diagnosis and monitoring of patients' health remotely. Most wearable were designed based on IEEE 11073 standards, while, advances in implementation and application of smart transducers are based on ISO/IEC/IEEE 21451 standards. Therefore, seamless integration and interoperability between sensing technology in wearable and Health Information Systems (HIS) requires attention on the interoperability opportunities at the semantic level. This paper constitutes our work towards the use of semantics in standards for integration between wearable sensors and health information systems through Transducer ontology with TEDS at the core for describing and identifying a transducer to a network and to the users, the development and evaluation of TEDS ontology for searching, describing, and for further use in data fusion of heterogeneous sensor network data is presented. The proposed ontology was implemented using Protege, SPARQL was used to evaluate it, and the performance analysis shows the greater description of the transducers with improve rate of recall and enhance interoperability at the semantic level.

A Queue-Size & Channel Quality Based Adaptation of the Energy Detection Threshold in IEEE802.15.6 CSMA/CA
Vladimir Marbukh (National Institute of Standards and Technology, USA); Martina Barbi (National Institute of Standards and Technology (NIST), USA); Kamran Sayrafian (NIST, USA); Mehdi Alasti (Time Warner Cable, USA)
IEEE802.15.6 is a radio interface standard for a wireless connectivity of wearable and implantable sensors and actuators located inside or in close proximity to the human body i.e., Body Area Network (BAN). Medical applications impose stringent requirements on BAN Quality of Service (QoS), including reliability and on-time availability of data. However, interference from other co-located BANs or other nearby devices sharing the same spectrum, e.g., due to BAN mobility, may cause unacceptable QoS degradation. This paper suggests that the impact of such QoS degradations can be minimized with a queue-size and channel quality based adaptation of the Energy Detection Threshold (EDT) at the transmitting nodes. Guided by known results for Q-CSMA/CA, we propose an adaptive EDT algorithm for use in the IEEE 802.15.6 BAN standard. Our preliminary simulation results demonstrate the performance gain of our algorithm compared to using a fixed EDT, and thus warrant future efforts in the adaptive EDT optimization as a mechanism to maintain QoS in various interference scenarios.

SDN-TAP: An SDN-based Traffic Aware Protocol for Wireless Sensor Networks
Hossein Fotouhi and Maryam Vahabi (Mälardalen University, Sweden); Apala Ray (ABB, India); Mats Björkman (Malardalen University, Sweden)
Congestion control is a challenging issue in wireless sensor networks with limited channel bandwidth. Thus, many protocols have been designed to provide a distributed traffic control during packet forwarding. However, all these approaches are applied to single-hop communication networks, ignoring the multi-hop restrictions. In this work, we take advantage of software defined networking paradigm by devising a controller node in such a way that it collects all the necessary information from wireless sensor network nodes. Thus, based on hop count and local traffic information, controller decides for possible flow path changes to evenly distribute the traffic. The evaluations revealed that the SDN-TAP outperforms conventional routing protocols by reducing packet loss rate up to 46%.

Healthcare Security Collaborative Model Based on Internet of Things (IoT) Cloud Technologies
Danco Davcev (University Ss Cyril and Methodius, Macedonia, the former Yugoslav Republic of); Goran Jakimovski (Faculty of Electrical Engineering and Information Technologies, Macedonia, the former Yugoslav Republic of)
Medical data are more and more transferred onto servers and cloud systems to enable fast access to patient's medical record by creating Electronic Health Records (EHR). Almost each patient has mobile devices with bio sensors; mobile devices are often connected to the EHRs and transfer data between Medical Cloud and mobile devices. Since medical data are sensitive by nature and must be secured, different approaches are used to achieve basic and advanced level of protection of these data. All mobile devices and bio-sensors form the IoT part of the Medical Cloud System. The main contribution of this paper is the layered security services. These services include NFC tagging and layered encryption using Radxa Rock board. In the Medical Mobile Cloud model (MMC) we are using NFC to authenticate and send data to a NFC reader, which then sends the data to a service interface of the MMCS. Later, these data are analyzed MMC and the analysis is sent back to the user's mobile device. This communication is secured using the layered secure services that are collaborating to provide multi-layered security. We are using Ergonomics-based QoE metrics to evaluate and improve the system design based on users' perspective.

A Framework for Modularised Wearable Adaptive Biofeedback Devices
Yonghee Ahn, Dhammika Jayalath and Adekunle Oloyede (Queensland University of Technology, Australia)
The demand for assistive living technologies is rising rapidly due to ever increasing aging population around the world. Advancements in wearable device technologies have paved the way to patient-centered ubiquitous health monitoring at home. Despite the increasing availability of continuous patient monitoring by integrating various sensors and Body area networks (BAN), little work has focused on automated intervention at multiple levels. On the other hand, certain personal medical treatment devices such as insulin injector and pneumatic compression therapy device provide treatments without monitoring the personal health. In this research, we propose a framework to enable continuous monitoring and control of a personal treatment device seamlessly. Proposed framework assimilates inertial sensor-based activity recognition, intelligent control algorithms, and BAN in a modularised hardware architecture. Consequently, the proposed system can monitor activities of daily living and provide automated intentions. The modularised hardware architecture facilitates the use of single sensing and controller platform for

multiple treatment devices. We validate the proposed framework by implementing and testing a prototype automated compression therapy device

GP08: Implantable Sensors

Room: T1a
Chair: Joel J. P. C. Rodrigues (Instituto de Telecomunicações, University of Beira Interior, Portugal)

Exploiting Dental Implants for Creating Wired Implantable Health Monitoring Devices
Saied Hemati (University of Idaho, USA); Sepideh Rahmani (Pickard Orthodontics, USA)
In this work, we propose a physical gateway, which resembles a modified dental implant that goes directly through gum or other soft tissues inside the oral cavity, to establish a secure and permanent connection to wired implantable health monitoring and controlling (IHMC) devices and systems. The proposed physical gateway has parts acting as external access points that have terminals for cables, wires, fiber optics, or tubes that go through the gateway to IHMC devices and systems to allow transmission of signals or materials to or from the implanted devices. This novel feature can be utilized for powering IHMC devices and systems with high functionality and computational power. Furthermore, it facilitates securely communicating with IHMC devices and systems with vital duties and allows transferring materials for refilling the tanks inside these devices and systems or transferring some samples and substances from inside body to outside without requiring additional invasive operations.

Implantable Microdevice with Integrated Wireless Power Transfer for Thermal Neuromodulation Applications
José Fernandes (DEI- University of Minho, Portugal); Hugo Dinis, Luis Goncalves and Paulo Mendes (University of Minho, Portugal)
Medication resistant neurological and psychiatric disorders, RNPD, are devastating multicausal chronic diseases that cannot be adequately controlled using conventional pharmaco and/or psychotherapies, being epilepsy a well-known RNPD. Wireless biomedical devices' availability is growing at an impressive rate, and the systems' miniaturization, integration and complexity is also increasing, enabling to unveil new therapies based on such new devices. This paper presents a new wireless implantable device as a solution for thermal neuromodulation of brain cells, which can be used to treat or study the brain's behavior when cooled down. The obtained results shows that, despite these systems may be power hungry, they may operate within acceptable electrical power values, while reaching the required neuromodulation temperatures.

Reliable Listen-Before-Talk Mechanism for Medical Implant Communication Systems
Selman Kulac (Duzce University, Turkey); Huseyin Arslan (University of South Florida, USA)
Health care applications of wireless communication have been finding places dramatically. One of these applications is communication of implantable medical devices (IMD)s. It is expected that the number of IMDs will increase greatly in the near future. As a result, significant congestion will be experienced in medical implant communication service (MICS) band, leading to interference problems. In this study, we propose reliable listen-before-talk (LBT) mechanism at low signal-to-noise ratios (SNR)s for medical implant communication systems in order to mitigate the interference effects. In our method, we have just brought out power difference between mean peak and mean lowest power spectral values and it provides reliable and simple monitoring of MICS channels' occupation fastly. Our proposed method has superior performance when threshold power level is considered according to the federal communication commission (FCC) Part 95 regulatory standard.

Wireless Optogenetic Neural Dust for Deep Brain Stimulation
Stefanus Arinno Wirdatmadja, Sasitharan Balasubramaniam and Yevgeni Koucheryavy (Tampere University of Technology, Finland); Josep M Jornet (University at Buffalo, USA)
In recent years, numerous research efforts have been dedicated towards developing efficient implantable devices for Deep Brain Stimulation (DBS). However, there are limitations and challenges with the current technologies. Firstly, the stimulation of neurons currently is only possible through implantable electrodes which target a population of neurons. This results in challenges in the event that stimulation at the single neuron level is required. Secondly, a major hurdle still lies in developing miniature devices that can last for a lifetime in the patient's brain. Recently, the concept of neural dust has been introduced as a way to achieve single neuron monitoring and potentially actuation. In parallel to this, the field of optogenetics has emerged where the aim is to stimulate neurons using light, usually by means of optical fibers inserted through the skull. Obviously, this introduces many challenges in terms of user friendliness and biocompatibility. We address this shortcoming by proposing the wireless optogenetic neural dust (wi-opt neural dust). The wi-opt neural dust is equipped with a miniature LED that is able to stimulate the genetically engineered neurons, and at the same time harvest energy from ultrasonic vibrations. The simulation results presented in the paper investigates the behaviour of the light propagation in the brain tissue, as well as the performance of designed circuitry for the energy harvesting process. The results demonstrates the feasibility of utilizing wi-opt neural dust for long term implantation in the brain, and a new direction towards precise stimulation of neurons in the cortex.

GP10: Data Processing and System Interoperability

Room: Business Club
Chair: Kashif Saleem (King Saud University, Saudi Arabia)

Clinical Validation of a Data Management System for Glottic Narrowing and Flow Limitation Studies
Esuabom Dijemeni (Imperial College London, United Kingdom)
The aim of this study was to develop a data system capture system to capture, merge, visualise, and store dynamic laryngeal barrowing, mouth pressure, oesophageal pressure, gastro intestinal pressure, and CPAP flow simultaneously in real time. A laryngoscope was used to capture the dynamic laryngeal narrowing of the airway. A CPAP device was used to vary airflow. A mouth pressure sensor, oesophageal pressure sensor, gastro-intestinal pressure were used to measure the mouth pressure, oesophageal pressure, and gastro-intestinal pressure respectively. A video recording showing dynamic laryngeal narrowing and its associated oesophageal pressure, gastro intestinal pressure, and CPAP flow in real time at 25 frames per second was achieved. In conclusion, a data system for capturing, merging, visualising, and storing dynamic narrowing and flow data provides a better systematic way of visualising and store the data for post processing analysis.

A Maturity Model for Interoperability in eHealth
Lex Van Velsen (Roessingh Research and Development, The Netherlands); Wendy Oude-Nijeweme d'Hollosy and Hermie Hermens (University of Twente, The Netherlands)
Interoperability, the ability of different technological applications to exchange data, is viewed by many as an important goal for eHealth, as it can save money and improve the quality of care and patient safety. However, creating an interoperable infrastructure for eHealth is a difficult task. In this paper, we present a maturity model that aids eHealth developers to determine what level of interoperability they should strive for, and that allows researchers to benchmark interoperable eHealth infrastructures in terms of maturity. For each level in the model, we illustrate what the interoperable infrastructure looks like from the technical point of view, we list implications for working procedures and we discuss the role of standardization. The maturity model has five levels. At level 0, there is no interoperability: The eHealth application is a silo. At level 1, Peer-to-peer systems, single applications are linked for simple data exchange. At level 2, Distributed systems, multiple applications are linked to achieve a common objective. At level 3, Integrated systems, applications from different suppliers are linked in a closed infrastructure. And at level 4, Universal interoperability, finally, applications are linked in an open infrastructure from which everybody is free to (dis)connect. We demonstrate the application of the maturity model via the case of an interoperable eHealth infrastructure for primary care. Reaching the most technically advanced form of interoperability (level 4) is not a goal eHealth developers should always strive for. They should set their goal with regard to the desired interoperability level for their situation and should then determine what they should do in terms of technique, working procedures, and standardization.

Constellation: A Secure Self-Optimizing Framework for Genomic Processing
Cody Bumgardner, Victor Marek, Caylin Hickey and Kannabiran Nandakumar (University of Kentucky, USA)
The Constellation framework is designed for process automation, secure workload distribution, and performance optimization for genomic processing. The goal of Constellation is to provide a flexible platform for the processing of custom "write once run anywhere" genomic pipelines, across a range of computational resources and environments, through the agent-based management of genomic processing containers. An implementation of the Constellation framework is currently in use at the University of Kentucky Medical Center for clinical diagnostic and research genomic processing.

Dynamic EEG Compression Approach with Optimized Distortion Level for Mobile Health Solutions
Mohammad Nassralla, Ahmad El-Hajj, Fady Baly and Zaher Dawy (American University of Beirut, Lebanon)
The development of a neurologically-oriented mobile health system involves significant challenges in terms of the proper sensing and efficient transmission of electroencephalogram (EEG) signals, and the faithful reconstruction of these signals at the receiving node. EEG compression has been widely used to reduce storage requirements, improve the real time processing of the sensed signals, and provide a better and timely feedback to the concerned patients. The non-stationarity of the EEG signals and the large volumes of data being continuously processed mandate the development of data reduction schemes that provide a good tradeoff between compression performance and the preservation of the signal quality and integrity. To this end, we propose in this work a dynamic and effective compression approach for EEG data that relies on a sequence of compression and decompression phases to optimize the compression rate while maintaining a distortion level below a target threshold. Simulation results using real EEG data segments show that even with stringent quality requirements, a notable compression ratio can be attained with minimal processing overhead.

Cross-cutting Concerns: Improving an Intelligent System for Decision Making in Healthcare
Leonardo Gardini (State University of Ceara, Brazil); César de Moura, Filho (IFCE, Brazil); Odorico Andrade (UFCE, Brazil); Antonio Oliveira (Federal Institute of Ceara, Brazil)
This paper proposes a better way to represent the architecture of LARIISA, an intelligent system for decision making in healthcare. The proposed representation weaves health and computational domains in a multidimensional architecture, which facilitates the visualization of specialized applications added to the LARIISA framework. New concepts as Big Data, Internet of Things and Linked Data are also introduced to the proposed architecture. Acquiring new data from different sources to the LARIISA database, and making use of it, will permit a more efficient decision-making process for the system.

Friday, September 16, 15:45 - 16:30

Closing Ceremony