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EPRO EMB - 001	An Efficient ECG Lossless Compression System for Embedded Platforms with Telemedicine Applications

This paper presents a method for wireless ECG compression and zero lossless decompression using a combination of three different techniques in order to increase storage space while reducing transmission time. The first technique used in the proposed algorithm is adaptive linear prediction; it achieves high sensitivity and positive prediction. The second technique is content-adaptive Golomb-Rice coding, used with a window size to encode the residual of prediction error. The third technique is the use of a suitable packing format; this enables the real-time decoding process. The proposed algorithm is evaluated and verified using over forty-eight recordings from the MIT-BIH arrhythmia database, and it shown to be able to achieve a lossless bit compression rate of 2.83x in Lead V1 and 2.77x in Lead V2. The proposed algorithm shows better performance results in comparison to previous lossless ECG compression studies in real time; it can be used in data transmission methods for superior biomedical signals for bounded bandwidth across e-health devices. The overall compression system is also built with an ARM M4 processor, which ensures high accuracy performance and consistent results in the timing operation of the system.

EPRO EMB - 002	Automatic Tongue Verification Based on Appearance Manifold Learning in Image Sequences for the Internet of Medical Things Platform

The tongue is the only human organ that can stick out of the body. Using the human tongue is considered to be a novel biometrics method because of its rich individual characteristics. How to represent the dynamic shape changes of the tongue is a challenge for identity verification. A new framework for human tongue modeling and recognition based on image sequences is proposed in this paper. In this framework, we exploit appearance manifold learning to obtain a low-dimensional embedding of the sequence of tongue images, and we propose nearest manifold measurement for measuring the similarities in multiple manifolds. Based on the database of tongue image sequences, the results of our experiments showed that the proposed framework not only can effectively perform tongue biometric recognition but can also provide robustness, which is very important for the internet of medical things platform.

EPRO EMB - 003	Mobile Match-on-Card Authentication Using Offline-Simplified Models with Gait and Face Biometrics

Biometrics have become important for mobile authentication, e.g. to unlock devices before using them. One way to protect biometric information stored on mobile devices from disclosure is using embedded smart cards (SCs) with biometric match-on-card (MOC) approaches. However, computational restrictions of SCs also limit biometric matching procedures. We present a mobile MOC approach that uses offline training to obtain authentication models with a simplistic internal representation in the final trained state, wherefore we adapt features and model representation to enable their usage on SCs. The pre-trained model can be shipped with SCs on mobile devices without requiring retraining to enroll users. We apply our approach to acceleration based mobile gait authentication as well as face authentication and compare authentication accuracy and computation time of 16 and 32 bit Java Card SCs. Using 16 instead of 32 bit SCs has little impact on authentication performance and is faster due to less data transfer and computations on the SC. Results indicate 11.4% and 2.4-5.4% EER for gait respectively face authentication, with transmission and computation durations on SCs in the range of 2s respectively 1s. To the best of our knowledge this work represents the first practical approach towards acceleration based gait MOC authentication.

EPRO EMB - 004	Thumb positioning analysis of new elliptical-shaped microwave sensors for non-invasive glucose monitoring

Diabetes is a chronic disease where millions of sufferers invasively prick their skin over the course of a day to take blood samples. Non-invasive glucose monitoring would bring relief to diabetics because it offers reduced skin damage. Microwave sensors are becoming a good choice for non-invasive glucose monitoring. This Letter presents two designs based on microwave sensors. The sensors have elliptical shapes and consist of a patch reflector and dielectric resonator (DR) that resemble a human thumb. A four-layer thumb model is presented, with a focus on the permittivity of the blood layer. The thumb was moved to various positions on the two microwave sensors to observe the effect it had on the frequency shift with various blood permittivity values. Observations showed that the elliptical DR sensor was less sensitive to errors and thumb positioning when taking glucose measurements than the elliptical patch sensor. The elliptical DR had an error of 55 MHz from the centre frequency, whereas that of the elliptical patch was 140 MHz. The effects of thumbs with various blood permittivity values were explored and explained.

EPRO EMB - 005	Viscosity Monitoring During Hemodiluted Blood Coagulation Using Optical Coherence Elastography

Rapid and accurate clot diagnostic systems are needed for the assessment of hemodiluted blood coagulation. We develop a real-time optical coherence elastography (OCE) system, which measures the attenuation coefficient of a compressional wave induced by a piezoelectric transducer (PZT) in a drop of blood, for the determination of viscous properties during the dynamic whole blood coagulation process. The changes in the viscous properties increase the attenuation coefficient of the sample. Consequently, a dynamic blood coagulation status can be monitored by relating changes of the attenuation coefficient to clinically relevant coagulation metrics, including the initial coagulation time and the clot formation rate. This system was used to characterize the influence of activator kaolin and the influence of hemodilution with either NaCl 0.9% or hydroxyethyl starch 6% on blood coagulation. The results show that PZT-OCE is sensitive to coagulation abnormalities and is able to characterize blood coagulation status based on viscosity-related attenuation coefficient measurements. The PZT-OCE can be used as a point-of-care testing tool for diagnosis of coagulation disorders and the monitoring of therapies.

EPRO EMB - 006	ABO/Rh Blood Typing Method for Samples in Microscope Slides by Using Image Processing

The correct determination of blood groups is very important to prevent complications during transfusion practices, since cannot exists incompatibility between donor and blood receiver. The ABO and Rh blood group systems currently are the most used, because allow to get results in a simple and low cost way. This work presents a method for blood typing of lamina samples using digital image processing. During samples analysis (48 samples of 30 different patients with 18 high resolution pictures taken with a 5 Megapixels camera and 30 low resolution pictures taken with a webcam 640x360 pixels), the proposed method presented a hit ratio of 97.92% for Anti- A samples with sensibility of 100% and specificity of 96,3%. The hit ratio presented in Anti-B tests was 89.58% with a sensibility of 83.33% and specificity of 92,86%. During Anti- D reagent analysis, the developed method presented a better efficacy in high resolution pictures analysis, with 88.89% of hit ratio, 84.62% of sensibility and 100% of specificity.

EPRO EMB - 007	A Robust and Secure Palm Vessel Biometric Sensing System Based on Photoacoustics

In this paper, we propose a new palm vessel biometric sensing system based on photoacoustic imaging, which is an emerging technique that allows high-resolution visualization of optical absorption in deep tissue. Our system consists of an ultrasound (US) linear transducer array, an US data acquisition system, and an Nd:YAG laser emitting 1064-nm wavelength. By scanning the array, we could get a 3-D image of palm vasculature. The 3-D image is further combined with our newly developed algorithm, Earth Mover's Distance-Radiographic Testing, to provide precise matching and robust recognition rate. Compared to conventional vein sensing techniques, our system demonstrates deeper imaging depth and better spatial resolution, offering securer biometric features to fight against counterfeits. In this paper, we imaged 20 different hands at various poses and quantified our system performance. We found that the usability and accuracy of our system are comparable to conventional biometric techniques, such as fingerprint imaging and face identification. Our technique can open up avenues for better liveness detection and biometric measurements.

EPRO EMB - 008	Real-Time Monitoring of Soil Compaction Using Piezoceramic-Based Embeddable Transducers and Wavelet Packet Analysis

Quantitative assessment of soil compaction is of great importance to construction work, precision agriculture, and geotechnical research. Currently, measurement of soil compaction is mainly performed through field measurements, and the accuracy is highly influenced by personnel experience. In addition, most of the current methods for soil compaction measurement are capable of real-time monitoring. This paper presents an exploratory study of using a piezoceramic-based active sensing approach coupled with wavelet packet analysis to quantitatively monitor soil compaction in real time. In the active sensing approach, a pair of smart aggregates (SA) consisting of piezoceramic transducers embedded inside a host material are embedded into soil. In the pair, one SA acts as transmitter to transmit a modulated stress wave towards the other SA, which acts as receiver. The attenuation ratio of the stress wave propagating energy in soil is governed by the degree of soil compaction, so that the received wave properties of the smart aggregate sensor can be further characterized by using wavelet packet as an index to evaluate the soil compaction in real time. Integrated with remote sensing technologies, the proposed method has potential to be utilized as a real-time remote-sensing technology, which can offer a solution in the monitoring the degree of soil compaction.

EPRO EMB - 009	Location Privacy Violation via GPS-Agnostic Smart Phone Car Tracking

Smart phones nowadays are equipped with global positioning systems (GPS) chips to enable navigation and location-based services. A malicious app with the access to GPS data can easily track the person who carries the smart phone. People may disable the GPS module and turn it on only when necessary to protect their location privacy. However, in this paper, we demonstrate that an attacker is still able to track a person by using the embedded magnetometer sensor in victim's smart phone, even when the GPS module is disabled all the time. Moreover, this attack neither requests user permissions related to locations for installation, nor does its operation rely on wireless signals like WiFi positioning or suffer from signal propagation loss. Only the angles of a car's turning measured by the magnetometer sensor of a driver's smart phone are utilized. Without loss of generality, we focus on car tracking, since cars are popular transportation tools in developed countries, where smart phones are commonly used. Inspired by the intuition that a car may exhibit different turning angles at different road intersections, we find that an attacker can match car turning angles to a map to infer the actual path that the driver takes. We address technical challenges about car turn angle extraction, map database construction, and path matching algorithm design to make this attack practical and efficient. We also perform an evaluation using real-world driving paths to verify the relationship between the numbers of turns and the time cost of the matching algorithm. The results show that it is possible for attacker to precisely pinpoint the actual path when the driving path includes 11 turns or more. More simulations are performed to demonstrate the attack with lager selected local areas.

EPRO EMB - 010	Acoustic Power Transfer and Communication with a Wireless Sensor Embedded With in Metal

Thick metal barriers prevent the use of conventional electromagnetic wireless power transfer due to Faraday shielding effects. Here, for the first time, we demonstrate power transfer to and communication with a compact wireless sensor transponder fully embedded within a solid piece of metal through the use of ultrasonic waves. This technique is an important innovation for applications, such as structural health monitoring of solid metal structural components, which would be weakened by the presence of holes for wiring. The embedded sensor system consists of a single piezoelectric transducer used for both power and data communication, along with an energy storage unit and associated charging circuitry, as well as a representative sensor and sensor data acquisition electronics. The entire sensor transponder was packaged within a compact volume of 11.9 cm^3(0.73 in^3) and can be further miniaturized to millimeter-scale sizes with the use of widely available system-on-chip technologies. The measured power transfer and sensor data results were found to closely match modeling results, achieving a power transfer efficiency of 33% at 440 kHz, showcasing the feasibility and potential of this approach.

EPRO EMB - 011	Embedded Platform for Gas Applications Using Hardware/Software Co-Design and RFID

This paper presents the development of a wireless low power reconfigurable self-calibrated multi-sensing platform for gas sensing applications. The proposed electronic nose (EN) system monitors gas temperatures, concentrations, and mixtures wirelessly using the radio-frequency identification (RFID) technology. The EN takes the form of a set of gas and temperature sensors and multiple pattern recognition algorithms implemented on the Zynq system on chip (SoC) platform. The gas and temperature sensors are integrated on a semi-passive RFID tag to reduce the consumed power. Various gas sensors are tested, including an in-house fabricated 4×4 SnO_2 based sensor and seven commercial Figaro sensors. The data is transmitted to the Zynq based processing unit using a RFID reader, where it is processed using multiple pattern recognition algorithms for dimensionality reduction and classification. Multiple algorithms are explored for optimum performance, including principal component analysis (PCA) and linear discriminant analysis (LDA) for dimensionality reduction while decision tree (DT) and k-nearest neighbors (KNN) are assessed for classification purpose. Different gases are targeted at diverse concentration, including carbon monoxide (CO), ethanol (C_2H_6O), carbon dioxide (CO_2), propane (C_3H_8), ammonia (NH_3), and hydrogen (H_2). An accuracy of 100% is achieved in many cases with an overall accuracy above 90% in most scenarios. Finally, the hardware/software heterogeneous solution to implementation PCA, LDA, DT, and KNN on the Zynq SoC shows promising results in terms of resources usage, power consumption, and processing time.

EPRO EMB – 012	Embedded System for Motion Control of an Omnidirectional Mobile Robot

In this paper, an embedded system for motion control of omnidirectional mobile robots is presented. An omnidirectional mobile robot is a type of holonomic robots. It can move simultaneously and independently in translation and rotation. The RoboCup small-size league, a robotic soccer competition, is chosen as the research platform in this paper. The first part of this research is to design and implement an embedded system that can communicate with a remote server using a wireless link, and execute received commands. Second, a fuzzy-tuned proportional-integral (PI) path planner and a related low-level controller are proposed to attain optimal input for driving a linear discrete dynamic model of the omnidirectional mobile robot. To fit the planning requirements and avoid slippage, velocity, and acceleration filters are also employed. In particular, low-level optimal controllers, such as a linear quadratic regulator (LQR) for multiple-input-multiple-output acceleration and deceleration of velocity are investigated, where an LQR controller is running on the robot with feedback from motor encoders or sensors. Simultaneously, a fuzzy adaptive PI is used as a highlevel controller for position monitoring, where an appropriate vision system is used as a source of position feedback. A key contribution presented in this research is an improvement in the combined fuzzy-PI LQR controller over a traditional PI controller.

EPRO EMB - 013	Design and Construction of Electronic Aid for Visually Impaired People

The NavGuide is a novel electronic device to assist visually impaired people with obstacle free path-finding. The highlight of the NavGuide system is that it provides simplified information on the surrounding environment and deduces priority information without causing information overload. The priority information is provided to the user through vibration and audio feedback mechanisms. The proof-of-concept device consists of a low power embedded system with ultrasonic sensors, vibration motors, and a battery. To test the effectiveness of the NavGuide system in daily-life mobility of visually impaired people, we performed an evaluation using 70 blind people of the "school & home for the blind." All evaluations were performed in controlled, real-world test environments with the NavGuide and traditional white cane. The evaluation results show that NavGuide is a useful aid in the detection of obstacles, wet floors, and ascending staircases and its performance is better than that of a white cane.

EPRO EMB - 014	Improving Mobility for the Visually Impaired: A Wearable Indoor Positioning System Based on Visual Markers

This article presents an indoor positioning system based on camera and ultrasonic sensors mounted on a pair of glasses that is specifically designed for visually impaired individuals. The proposed system incorporates a recognition algorithm that is able to recognize certain color-coded markers with a detectable range of 15 m in real time on a quad-core embedded processor. In addition, microultrasonic transducers are implemented to detect obstacles in front of the glasses. The positioning system and obstacle detection can be adjusted to work independently or in parallel. The sensor data are then transmitted to a mobile phone to be processed. The results show that the proposed system is able to recognize markers and detect obstacles with low complexity and power consumption.

EPRO EMB - 015	Anatomy of Memory Corruption Attacks and Mitigations in Embedded Systems

For more than two decades, memory safety violations and control-flow integrity attacks have been a prominent threat to the security of computer systems. Contrary to regular systems that are updated regularly, application-constrained devices typically run monolithic firmware that may not be updated in the lifetime of the device after being deployed in the field. Hence, the need for protections against memory corruption becomes even more prominent. In this article, we survey memory safety in the context of embedded processors, and describe different attacks that can subvert the legitimate control flow, with a special focus on Return Oriented Programming. Based on common attack trends, we formulate the anatomy of typical memory corruption attacks and discuss powerful mitigation techniques that have been reported in the literature.

EPRO EMB - 016	Sensing Technologies for Monitoring Intelligent Buildings: A Review

This review presents an overview of the existing state-of-the-art practices of improved performance in buildings required for the algorithmic logic and/or hardware. The main focus is on sensor-actuator-based applications in intelligent buildings like air quality, lighting, heating/cooling, ventilation, power management, water management, cooking gas management, and building health monitoring. The following are some of the major factors that usually rule in the development of intelligent buildings, such as good accuracy of the system, energy efficiency, response time of the sensor module, cost of the overall system, radio frequency interference, adequate signal-to-noise ratio, open interface capability, and intricacy of computation. The importance of the concerned issues and factors are discussed in detail for future research directions.

EPRO EMB - 017	IoT based smart home automation system using sensor node

In recent years, the advancements in Information and Communication Technology (ICT) are mainly focused on the Internet of Things (IoT). In a real-world scenario, IoT based services improve the domestic environment and are used in various applications. Home automation based IoT is versatile and popular applications. In home automation, all home appliances are networked together and able to operate without human involvement. Home automation gives a significant change in humans life which gives smart operating of home appliances. This motivated us to develop a new solution which controls some home appliances like light, fan, door cartons, energy consumption, and level of the Gas cylinder using various sensors like LM35, IR sensors, LDR module, Node MCU ESP8266, and Arduino UNO. The proposed solution uses the sensor and detects the presence or absence of a human object in the housework accordingly. Our solution also provides information about the energy consumed by the house owner regularly in the form of message. Also, it checks, the level of gas in the gas cylinder if it reaches lesser than the threshold, it automatically books the gas and sends a reference number as a message to the house owner. The proposed solution is deployed and tested for various conditions. Finally, in this paper, the working model of our proposed solution is developed as a prototype and explained as a working model.

EPRO EMB - 018	A new low cost power line communication solution for smart grid monitoring and management

Modern smart grids require the improvement of measurement and communication infrastructures of distribution networks, at both medium voltage (MV) and low voltage (LV) levels. Distributed sensing and measurement systems are needed to provide all necessary data for grid monitoring, control and management, as well as for the implementation of a number of smart functionalities, such as remote control of distributed generators (DGs), real time analysis of power flows, automatic meter reading (AMR), demand side management (DSM), grid automation and so on [1]-[6]. Acquired network data include typical electrical network quantities and status variables (such as powers, voltages, currents, switches status, DGs power production, and remote commands) and also environmental and other parameters (temperatures, security or safety warning signals, etc.).

EPRO EMB - 019	Multiband Ambient RF Energy Harvesting Circuit Design for Enabling Batteryless Sensors and IoT

Ambient radio frequency (RF) energy harvesting (RF-EH) allows powering low-power electronic devices without wires, batteries, and dedicated energy sources. Current RF-EH circuit designs for ambient RF harvesting are optimized and fabricated for a predetermined frequency band. Thus, a single circuit is tuned for a given band with simple extensions to multiple circuits operating individually in distinct bands. Our approach is different in the sense that it designs and implements a common circuit design that can operate on multiple different RF cellular and ISM bands. This paper makes two contributions. First, it presents a study of ambient RF signal strength distribution conducted in Boston, MA, USA, indicating locations and associated RF bands that can point toward the practicality of ambient RF-EH. Second, it demonstrates an adjustable circuit for harvesting from LTE 700-MHz, GSM 850-MHz, and ISM 900-MHz bands with one single circuit. Our circuit design is fabricated on printed circuit board with comprehensive evaluations at each associated frequency to test the power conversion efficiency (PCE). In addition, we characterize the charging performance, and feasibility of powering sensors outdoors such as TI eZ430-RF2500. Results reveal more than 45% PCE for our prototype.

EPRO EMB – 020	Personalized Health Monitoring System of Elderly Wellness at the Community Level in Hong Kong

Rapid advances in information and sensor technology have led to the development of tools and methods for personalized health monitoring. These techniques support timely and efficient healthcare services by tracking the vital signs, detecting physiological changes and predicting health risks. In this paper, we propose an integrated system to monitor the wellness condition of elderly. This system is conceptualized to provide a computer-aided decision support for clinicians and community nurses, by means of which they can easily monitor and analyze an elderly's overall activity and vital signs using a wearable wellness tracker and an all-in-one satiation-based monitoring device, offering an efficient solution with a reduction in time cost and human error. We design a data-preparing scheme for acquiring data and processing data from multiple monitoring devices, and propose a personalized scheme for forecasting the elderly's one-day-ahead wellness condition via data integration and statistical learning. We conduct a pilot study at a nursing home in Hong Kong to demonstrate the implementation of the proposed system. The proposed forecasting scheme is validated by the collected data.

EPRO EMB - 021	A Novel Signal Acquisition System for Wearable Respiratory Monitoring

In this paper, a novel human respiration detection method based on angular velocity is proposed for continuous acquisition and analysis of respiratory signals. Using patient-specific information derived from a wearable sensor, our proposed system is capable of monitoring human respiration and assists in identifying potential respiratory disorders by relying on pre-defined simple procedures. Specifically, our signal verification platform is equipped with a carbon dioxide concentration detection device in order to acquire a synchronous signal. In addition, a median filter method is used to extract the respiratory waveform from the original signal. The obtained angular velocity waveform pertaining to human respiration is then compared to the respiratory carbon dioxide concentration waveform, and the validity of our designated parameters is verified. The test results demonstrate that our implemented system is appropriate for unobtrusive respiratory signals acquisition and analysis; therefore, it can be considered a potential alternative for physiological monitoring and respiratory disorders screening.

EPRO EMB - 022	A SPR Glucose Sensor Based on Immobilized Glucose Oxidases and Silica Mesocellular Foams

An improved glucose-sensitive membrane (GSM) was prepared by immobilizing glucose oxidases (GODs) onto silica mesocellular foams and trapping them in a polyacrylamide gel. This gel was then coated on a gold/glass sheet to realize surface plasmon resonance (SPR) sensors. A series of sensing experiments was conducted to obtain the optimized parameters with the improved GSM. The experimental results showed that the improved SPR glucose sensor has a sensitivity of 0.0135 degree/(mg/dL) and a linear range of 0-160 mg/dL. This linear range is twice that obtained with the GSM by immobilizing GODs on SiO_2 nanoparticles.

EPRO EMB - 023	Combining Solar Energy Harvesting with Wireless Charging for Hybrid Wireless Sensor Networks

The application of wireless charging technology in traditional battery-powered wireless sensor networks (WSNs) grows rapidly recently. Although previous studies indicate that the technology can deliver energy reliably, it still faces regulatory mandate to provide high power density without incurring health risks. In particular, in clustered WSNs there exists a mismatch between the high energy demands from cluster heads and the relatively low energy supplies from wireless chargers. Fortunately, solar energy harvesting can provide high power density without health risks. However, its reliability is subject to weather dynamics. In this paper, we propose a hybrid framework that combines the two technologies - cluster heads are equipped with solar panels to scavenge solar energy and the rest of nodes are powered by wireless charging. We divide the network into three hierarchical levels. On the first level, we study a discrete placement problem of how to deploy solar-powered cluster heads that can minimize overall cost and propose a distributed $1:61(1+\epsilon)^{2}$ -approximation algorithm for the placement. Then, we extend the discrete problem into continuous space and develop an iterative algorithm based on the Weiszfeld algorithm. On the second level, we establish an energy balance in the network and explore how to maintain such balance for wireless-powered nodes when sunlight is unavailable. We also propose a distributed cluster head re-selection algorithm. On the third level, we first consider the tour planning problem by combining wireless charging with mobile data gathering in a joint tour.

EPRO EMB - 024	Wearable Wireless Sensor System with RF Remote Activation for Gas Monitoring Applications

Nowadays, the safety standards for industrial plants are tougher with respect to employee state monitoring and monitoring of working environmental conditions. Combining wireless sensor with wearable technology is possible to significantly improve safety delivery capability of such systems and add new functionality to them. Since wireless sensors use batteries as the sole energy source, the energy efficiency becomes critical. One of the solutions to reduce the energy consumption of the wireless sensor nodes is to use appropriate control for radio data transmission. In this paper, we have developed a wireless sensor system which can be attached to a uniform and used for working condition monitoring in places which could be prone to gas leakage. The main feature of the system is the possibility to be activated remotely by an RF control signal at a frequency of 866 MHz. It performs various functions of wearable sensor system, such as switching the system from sleep, measurement, and data transmission modes when external RF signal is available and its power is greater than an appropriate level. The experimental data demonstrate that the activation distance is about 2.75 m from an RF-generator that has a power of 30 dBm. The wearable sensor system is able to signalize about employee presence in relation to working facilities and to monitor temperature and combustible gases concentration. It consists of light-weight distributed parts attached to clothes and has low power consumption.

EPRO EMB - 025	Compact Multiband Wireless Energy Harvesting Based Battery-Free Body Area Networks Sensor for Mobile Healthcare

This paper demonstrates a prototype of a selfsustained body area networks (BAN) sensor, which consists of the electrically small triple-band rectenna, the direct current (dc) energy management and storage module, the microcontroller, and the sensing and communication module. The proposed antenna is composed of corrugated metal-insulator-metal plasmonic structures, which covers triple frequency bands, including GSM-900, UTMS2100, and TD-LTE bands. Its electrical size is only 0.21 $\lambda \times 0.2\ \lambda$ at 900 MHz. The gains reach 1 dBi, 2.64 dBi, and -0.19 dBi at 0.9 GHz, 2.025 GHz, and 2.36 GHz, respectively. A triple-band rectifier for low power application is designed to convert the harvested radio frequency (RF) power into dc power. The maximum RF to dc conversion efficiency of the rectifier reaches 59% when the input power is -10 dBm. The proposed compact BAN sensor based on multiband wireless energy harvesting is suitable for human body self-monitoring and mobile healthcare.

EPRO EMB - 026	A review of sensorless control methods for AC motor drives

In recent years, the application of sensorless AC motor drives is expanding in areas ranging from industrial applications to household electrical appliances. As is well known, the advantages of sensorless motor drives include lower cost, increased reliability, reduced hardware complexity, better noise immunity, and less maintenance requirements. With the development of modern industrial automation, more advanced sensorless control strategies are needed to meet the requirements of applications. For sensorless motor drives at low-and zero-speed operation, inverter nonlinearities and motor parameter variation have significant impact on the stability of control system. Meanwhile, high observer's bandwidth is required in high-speed region. This paper introduces the state of art of recent progress in sensorless AC motor drives. In addition, this paper presents the sensorless control strategies we investigated for practical industrial and household applications. Both advanced sensorless drives of induction motor (IM) and permanent magnet synchronous motor (PMSM) are presented in this paper.

EPRO EMB - 027	SensePods: A ZigBee-Based Tangible Smart Home Interface

Low-cost sensors and ubiquitous wireless networking is enabling novel ways in which homeowners can interact with their smart homes. Many complementary approaches like using voice commands, direct interaction by using touch or weight, or by using body gestures are emerging. This paper shows the design and implementation of a novel low-power, low-cost, hand-held wireless device called a SensePod. SensePods can be used by a consumer to interact with a smart home using simple gestures like rubbing, taping or rolling the device on any home surface like a dining table. The device is only 4.5 cm long, forms an ad-hoc wireless network using the ZigBee protocol, and can be easily interfaced to existing home management systems using a universal serial bus port. The gestures in each device can be programmed to control various objects of a smart home like smart curtains, for example. Hidden Markov models were used to train the device to recognize various gestures. The device was tested with a variety of gestures and has a recognition rate of over 99.7%, and a response time of less than two milliseconds.

EPRO EMB - 028	A Two-level Traffic Light Control Strategy for Preventing Incident-Based Urban Traffic Congestion

This work designs a two-level strategy at signalized intersections for preventing incident-based urban traffic congestion by adopting additional traffic warning lights. The first-level one is a ban signal strategy that is used to stop the traffic flow driving toward some directions, and the second-level one is a warning signal strategy that gives traffic flow a recommendation of not driving to some directions. As a visual and mathematical formalism for modeling discrete-event dynamic systems, timed Petri nets are utilized to describe the cooperation between traffic lights and warning lights, and then verify their correctness. A two-way rectangular grid network is modeled via a cell transmission model. The effectiveness of the proposed two-level strategy is evaluated through simulations in the grid network. The results reveal the influences of some major parameters, such as the route-changing rates of vehicles, operation time interval of the proposed strategy, and traffic density of the traffic network on a congestion dissipation process. The results can be used to improve the state of the art in preventing urban road traffic congestion caused by incidents.

EPRO EMB - 029	Attribute-Based Credentials for Privacy-Aware Smart Health Services in IoT-Based Smart Cities

Smart city–based IoT devices enable collection of vast amounts of data, which can be used to provide more efficient public and private services. Among these, healthcare is especially relevant, and smart health (s-health) models are already being deployed. The authors propose attribute-based credentials (ABCs) to cope with s-health privacy issues and to set the stage for the further adoption in other privacy-aware IoT-based smart cities' services.

EPRO EMB - 030	Intrusion Detection and Prevention for ZigBee-Based Home Area Networks in Smart Grids

In this paper, we present a novel intrusion detection and prevention system for ZigBee-based home area networks in smart grids, HANIDPS. HANIDPS employs a model-based intrusion detection mechanism as well as a machine learning-based intrusion prevention system to protect the network against a wide range of attack types. The detection module extracts network features and analyzes them to decide whether the network is in a normal state. We use smart energy profile 2.0 specification as well as IEEE 802.15.4 standard to precisely characterize the expected normal behavior. A set of defensive actions are defined for the prevention system which are effective in stopping various attack types. HANIDPS uses Q-learning and through interactions with environment learns the best strategy against an attack. Use of model-based approach for intrusion detection and dynamic learning for intrusion prevention, as well as employment of effective mechanisms to stop the attacks, provide a high performance for HANIDPS without the need for prior knowledge of the attacks. Soundness of the proposed method is evaluated through extensive analysis and experiments.

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