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EDITORIAL

IEEE ACCESS SPECIAL SECTION: RADIO FREQUENCY IDENTIFICATION AND SECURITY TECHNIQUES

Radio Frequency Identification (RFID) systems have been receiving much attention in the last few decades due to their effective role in our everyday life. They propose different solutions to many vital applications. Moreover, RFID systems are the backbone of modern Internet-of-Things (IoT) and Near-Field Communication (NFC) systems. Extending the capacity of such systems and making them more secure is the desired objective of the research community.

Meanwhile, RF security systems are being considered as a potential solution to data security and counterfeiting problems. Hardware embedded and on-chip security systems, based on physical unclonable functions (PUFs), can be cost-effective and simple in realization. Relying on the 3D chip integration techniques, PUFs can be implemented within the process of chip fabrication. Nanostructured hardware security has recently been proposed as a promising PUF security solution for such purposes as well.

The response to the Call for Papers for this Special Section was enthusiastic. There were 29 articles submitted from many recognized research groups all over the world. During the review process, each article was assigned to multiple experts in the field with a rigorous two-round review process. This resulted in 12 accepted articles that cover different, interesting aspects of RF identification, security challenges and research fields.

In the following Editorial, we briefly identify these articles and highlight their main contributions.

In the first article, by Wan *et al.* ''Optimum design of low-cost dual-mode beam-steerable arrays for customer-premises equipment applications,'' two novel designs of array antennas operating at 2.45 GHz and 830 MHz for Customer-Premises Equipment (CPE) applications are investigated. The design uses the method of maximization of power transmission efficiency to determine the optimal distribution of excitations along with a beamforming network. This design method ensures that the best possible gain performance can be achieved for fixed configuration while the array size is kept small.

In the second article, by Ali *et al.* ''Innovative method for unsupervised voice activity detection and classification of audio segments,'' a method to detect the speech-presence and speech-absence segments of an audio segment is presented. This method is unsupervised and does not need any training data to differentiate between voiced and unvoiced segments, a positive feature of the method. Two databases are used to evaluate the performance of the proposed method. The performance evaluation of the method suggests that it labels the segments accurately even for different languages.

In this article, ''Towards extended bit tracking for scalable and robust RFID tag identification systems,'' Fahim *et al.* introduced the relationship between the position of the false collided bit error and the identification delay. It was proven that it does not affect the identification process if its location is after the location of the first real collided bit in a collision slot. In addition, the authors proposed a zero overhead novel algorithm that tackles false collided bit errors. Second, a novel algorithm that accelerates the identification process in ''error free'' multi-reader RFID systems was proposed.

This article, ''Securing Internet-of-Things systems through implicit and explicit reputation models,'' by Bordel Sánchez *et al.*, presents a hybrid reputation model based on both an implicit reputation calculation and an explicit definition of reputation. Both amounts are considered in a geometric mean. Explicit reputation is obtained from explicit recommendations made by IoT components trusted by the module under study. Recommendations are processed through an algorithm based on the token bucket paradigm. On the other hand, direct and indirect observations about external IoT components are employed to obtain an estimation of the implicit reputation.

In this article, ''Optimal card design for non-linear HF RFID integrated circuits with guaranteed standard-compliance,'' by Rizkalla *et al.*, the authors demonstrated that designing HF RFID cards based on a maximum power transfer criterion alone is not suitable, as it does not render a standard-compliant card. They have rather shown that the main design parameter is the IC's delivered voltage, which is limited by the IC's non-linear behavior in addition to the IC's dynamic range. They have proposed and described a de-embedding method to accurately determine the IC's equivalent circuit model for the loaded and unloaded states in order to identify the IC's dynamic range.

This article, ''Secure capacity analysis for magnetic inductive coupling-based SWIPT system,'' by Han *et al.*, studies a Magnetic Inductive Coupling (MIC)-based SWIPT system in the aspect of physical layer security using the secure capacity. When the location and angular positions of information and potential eavesdropping power receivers are given, a transmitter can maximize the secure capacity by appropriately adjusting its angular position with a minimum power transfer constraint to the potential eavesdropping receiver.

This article, ''Spectral efficiency increase for passive backscatter communication based on discrete pulse shaping,'' by Ferdik *et al.*, shows a way to use pulse shaping techniques for active radios in passive UHF RFID transponders without significant impact on its range. Common approaches are based on the realization of a continuous pulse which involves the use of extensive hardware and therefore increases power consumption drastically. The presented approach of a quantized pulse offers the possibility to make a compromise between spectral and energy efficiency by using only 200 nW. The required control voltage can be realized on the chip by a simple voltage divider.

Another interesting article: ''A versatile flexible UHF RFID tag for glass bottle labelling in self-service stores,'' by Liu *et al.* proposed a versatile, flexible UHF RFID tag for glass bottle labeling. The tag antenna is based on a simple loop structure, which is less affected by liquid compared with conventional dipole-based RFID tags. The tag is compact and flexible, and it maintains a stable operating band and reading ranges for different amounts and types of liquid, as well as different shapes and thicknesses of the bottles. Its features of low profile, compact size, easy installation, reusability, low cost, satisfactory and robust performances make the tag feasible for almost all kinds of liquid products with glass bottles in self-service stores.

This article, ''Design and analysis of a novel time- and energy-efficient M-ary tree protocol with collision window for dense RFID systems,'' by Hoang *et al.*, introduces a novel tag identification protocol for dense RFID systems. The proposed protocol, namely MCwT, was optimally designed in terms of both identification time and energy consumption. In particular, a new transmission mechanism was proposed using a collision window where only a small number of bits within the window was sent from tags for colliding bits' detection.

This article, ''Fabrication and characterization of flexible spray-coated antennas,'' by Thielens *et al.*, investigates a method for spray coating antennas. The methodology has advantages over the current state of the art in printed antennas in terms of flexibility in design and production time for small to medium sized numbers of antennas. The methodology is demonstrated by fabricating two types of folded dipole antennas in the UHF RFID band: one with and one without a ground plane on two different flexible, plastic substrates.

In this article, ''Hybrid chipless RFID tags-A pathway to EPC global standard,'' by Babaeian *et al.*, a summary of recent research on the improvement of hybrid chipless RFID was provided. All reported encoding techniques were based on only two dimensions, frequency and polarization. Although these approaches have increased encoding data capacity in a compact size as compared to one-dimensional chipless RFID tags, they have limitations in data capacity per element, tag detection algorithm, and reading range. These are significant challenges in practical applications. Therefore, a novel hybrid chipless RFID tag with higher encoding data capacity is required. Three dimensions of encoding can increase the data capacity, and reduce the size of the tag significantly.

Finally, this article, ''A high gain dual polarized ultra-wideband array of antenna for chipless RFID applications'' by Babaeian *et al.*, proposes a high gain dual polarized ultra-wideband antenna with aperture coupled microstrip patch antenna for enhancing the reading range in chipless RFID application. This structure is planar with high front to back ratio all over the bandwidth. The operating frequency of this antenna is 4.2 to 7.1 GHz in the absence of the metal back reflector and 4.5 to 7.2 GHz in the presence of both reflectors. Moreover, the maximum realized a gain of 26 dBi at both ports. The isolation between two ports is more than 32 dB.

We wish to express our appreciation to all the authors who responded very positively to our Call For Papers. Many thanks to the expert reviewers who have done a great job in selecting the highest publication quality throughout both review rounds. Finally, we appreciate the support and the courtesy of the Editor-in-Chief, Prof. Derek Abbott, the Managing Editor, and of course the editorial staff, in particular Mrs. Margery Meyer, for their constant assistance. In addition, special thanks go to Prof. Xiali (Sharon) Hei, University of Louisiana at Lafayette, USA, for her valuable support during the early stage of this editorial work.

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