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TRENDS AND FUTURE OF ULTRA WIDEBAND LOCALIZATION IN RFID AND ITS APPLICATIONS

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Abstract - *In the new scenarios foreseen by the Internet of Things (IoT), industrial and consumer systems will be required to detect and localize tagged items with high accuracy using cheap, energy autonomous, and disposable tags. To meet these challenging requirements, the adoption of passive ultra-wideband (UWB) radio-frequency identification (RFID) appears a promising solution to overcome the limitations of current Gen.2 RFID standard. In this paper we provide a survey on recent developments in the field of UWB-RFID by discussing the main advantages and open issues in providing high positioning accuracy with energy autonomous devices. Successively, we envision the possible cutting-edge technologies for next generation UWB-RFID as a key enabler for the IoT.*

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

Radio Frequency Identification (RFID) system have become very popular in industries, purchasing, manufacturing, library database managements, medical applications and wherever the automatic identification procedures is required. Basically RFID is a contactless ID system in which the transfer of power and data takes place (1). The impedance match between an RFID Tag IC and the RFID tag antenna is of critical importance in RFID tag design. A poor impedance match results in less power delivered to the RFID IC, resulting in reduced read range and overall poor Performance. (3) It is well know that the gain, input impedance and resonant frequency of the antenna can be significantly affected by nearby conducting and non-conducting objects, and also affected by the substrate and super substrate properties (2)Impedance matching concept has been discuss in various papers covering wide areas of application as for safety glass applications(2), for implantation in live human brain tissue as the front end for a smart RFID (4), on metallic products in the steel industry (6), etc. As an antenna designer the ultimate goal is to achieve the high gain, with proper impedance match and in turn maximum detection range. Following sections discuss the various methods which can be utilized for impedance matching and the table of comparison is shown (starting with the newest research papers first) describing the same for easier understanding.

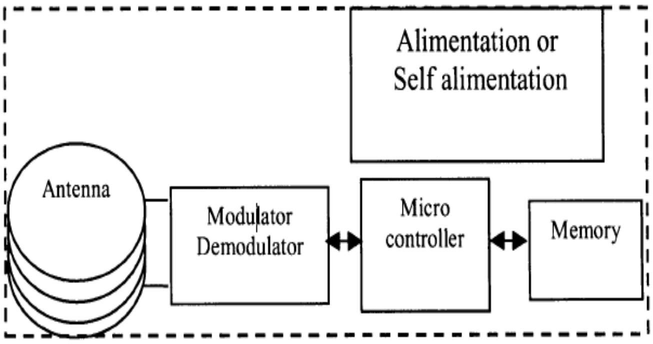

Fig.1.Architecture of RFID Tags

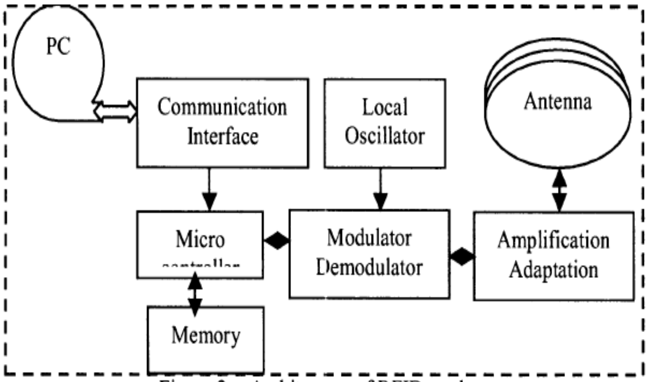

Fig. 2. Architecture of RFID Readers

1.1 MAIN GOAL OF THIS PAPER:

- To introduce the need for localization by using RFID tag.
- To show the open issues and future perspectives of RFID.
- To review some recent and existing techniques for the location tracking system.
- To provide a comparative study of existing techniques with authors remarks.

1.2 THE NEED FOR LOCATION-AWARE SERVICES:

In recent years, especially after the introduction of the second generation (Gen.2) UHF standard, the radio-frequency identification (RFID) technology is rapidly replacing bar codes in items tagging thanks to the capability to work even in the absence of direct visibility and to store/retrieve information on/from tags. The cheapest RFID tags with the largest commercial potential are *passive*, in which the energy necessary for tag-reader communication is harvested from the reader's interrogation signal or the surrounding environment and the information is transmitted through backscattered signals. Passive RFID technology has become more and more pervasive due to the availability of extremely low-cost tags (a few cents), thus making the range of actual and potentially new applications practically unlimited. As a consequence, the requirements for future RFID systems are becoming more and more demanding. Specifically, next generation RFID is expected to provide not only reliable identification but also sensing and high-definition tag localization functionalities. On the one hand energetically autonomous and not invasive sensors (tags) could be used for biomedical (e.g., smart plasters), to monitor drugs for efficient hospital management or in the food chain to prevent the risk of food counterfeit and adulteration. On the other hand, the capability to localize in real-time with high-accuracy (few centimeters) tags pervading the environment would enable unexplored context-aware applications and huge market perspectives such as in the field of item searching in logistic or shopping mall scenarios. It is possible to envision that in a near future every object will be tagged to take part of augmented reality-based applications [4], which allow virtual imagery to exactly overlay physical objects in real-time as illustrated in Fig. 3.These perspectives highlight the main limitations of actual HF- and UHF-RFID technologies which were initially conceived just to replace bar codes and hence only for identification at higher distances. Limitations regarded the absence of sensors on tags and localization capability, the limited operating range (below 10m with UHF tags, below 1 – 2m using HF tags), the need of dedicated and energy-hungry hardware to read the tag, and lack of integration with mobile communication standards. Nowadays, such limitations have been in part overcome through the introduction of significant improvements in current standards such as embedded sensors on tags to monitor physical parameters, the integration of HF readers in last generation smartphones (NFC standard1), and the availability of some solutions offering rough localization capabilities. Unfortunately these improvements did not come for free. In fact, they have been achieved at the expense of a further reduced operating range (e.g., NFC smartphones can read tags up to 10 – 20 cm) or more complex readers (e.g., using large antenna arrays to localize tags based on angle-of arrival (AOA) measurements). It is clear that the above-mentioned requirements cannot be completely fulfilled by the current first and second generation RFID. Nowadays, high-performance wireless sensing and localization are offered by distinct technologies such as wireless sensor networks (WSNs) (e.g., ZigBee standard [6]), and real-time locating systems (RTLS) using battery-powered tags.

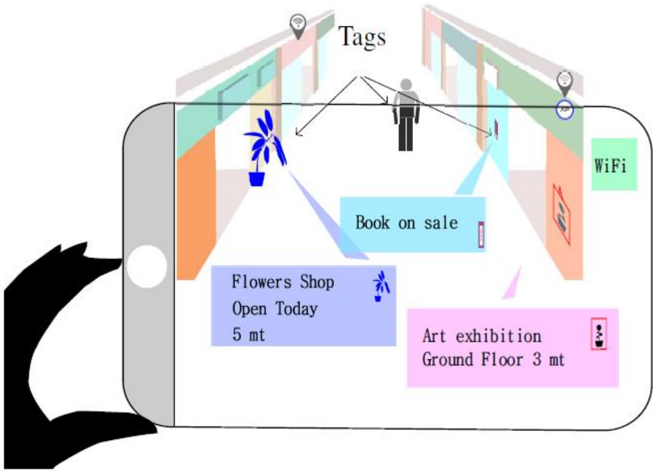

Fig. 3. Envisioned future scenario: a user, with its own personal device, can localize and interact with tagged objects placed in the surrounding environment.

2. OPEN ISSUES AND FUTURE PERSPECTIVES OF RFID:

2.1Main Challenges:

Despite the recent progresses obtained, the UWB-RFID technology is not mature yet for a widespread adoption in context-aware applications. In fact, several aspects, most of them in common with UHF RFID, have to be addressed to make it an appealing and users-accepted solution. The most critical one is related to energy efficiency; in fact when a tag is interrogated only about 1% of the energy emitted by the reader is captured by the tag while the remaining 99% is wasted in the environment. In addition to the scarce power transfer efficiency, the localization of tags still requires ad-hoc devices and costly infrastructures that makes the integration of RFID readers in future smartphones not feasible yet. Associated to the low power transfer efficiency, the limited reading range (less than 10 meters) obliges the deployment of a network of dense readers to localize and track items in large areas (e.g., in stores). Backward compatibility with Gen.2 RFID is another important aspect that might significantly condition the market acceptance of new technologies. Last but not least, the potential introduction of billions of tags should be sustainable from an eco-compatibility point of view, in other words, tags should be disposable, which is in contrast with the need of high performance electronic circuits to manage UWB signals.

2.2 Future Perspectives:

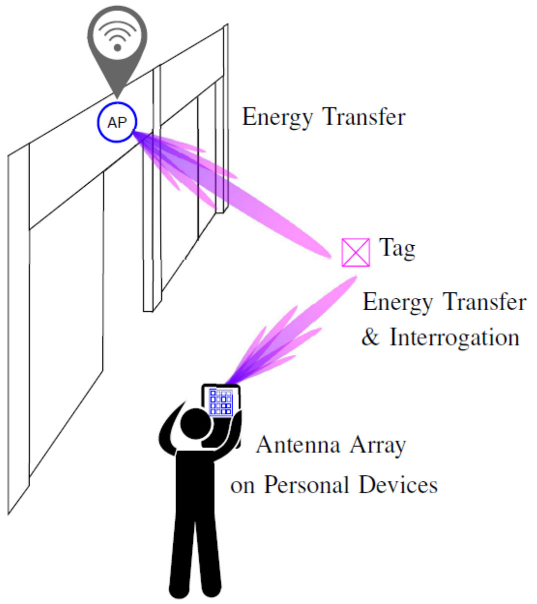

Fig. 4. Energy transfer mechanism to energize passive tags using mmW/THz massive antenna

One of the key technologies for future RFID is represented by millimeter waves (mmW) and, more in perspective, by the THz band [7]. The incoming fifth generation (5G) smartphones will integrate mmW interfaces to boost the communication data rate beyond 1Gbps. A part from the extremely large bandwidth available at such frequencies, which is beneficial for accurate positioning, mmW technologies offer also other interesting opportunities, the small signal wavelength (5mm at 60GHz) allows to pack hundreds of antenna elements in a small area, even integrable into smartphones. An example of existing 400-elements array is given by [8]. Such large number of antenna elements permits to realize a near-pencil beam that is electronically steerable. Thanks to the extremely narrow beam formed, the possibility to focus the power flux towards the tag and transfer the energy at several meters will become possible with much higher efficiency than that achievable with today's technology. Therefore there will be the possibility to energize, detect and localize tagged items using smartphones at several meters of distance enabling augmented reality applications. Moreover, no dedicated infrastructure would be required as large antenna arrays already used for communication could be employed as reference nodes with the advantage of permitting both accurate TOA and AOA estimates (see Fig. 4). In another possible scenario, access points deployed for indoor communications and equipped with mmW antenna arrays localize the tags present in the surrounding environment, and focus the beam to allow the tag to accumulate the energy (e.g., during the night) so that they will be operative whenever a mobile device interrogates them, as shown iFig. 4 [9]. Efficient and smart energy transfer together with high-performance energy accumulation (e.g., using super caps [10]) could open the possibility to exploit efficient active communications (active tags) in place of backscatter communication. arrays. As previously stated, tags have to be eco-compatible. In such a context, the use of paper for the implementation of microwave components and systems is receiving an increasing attention, as it is a cheap, renewable and biocompatible material [6]. Among the available technologies for the manufacturing and integration of microwave components, the substrate integrated waveguide (SIW) technique is a potential candidate to deal with high frequency and UWB signals [11].

3. COMPARISON

TABLE:

TITLE	YEAR	COMMENTS
An Indoor Multi-Tag Cooperative Localization Algorithm Based on NMDS for RFID	2017	A novel range-free algorithm named non metric multidimensional scaling (NMDS)-RFID(F), which combines NMDS algorithm and the fingerprinting localization algorithm to achieve indoor RFID multi tag cooperative localization.
Passive UHF RFID Tag Designs for Automatic Vehicle Identification	2017	Passive UHF tag designs for vehicleidentification, namely the Detachable Windshield Tag and the Thin-wire Vehicle Headlamp Tag
An Efficient and Easy-to-implement Tag Identification Algorithm for UHF RFID Systems	2017	Use the modified maximum a posteriori probability (MAP) method for estimation of tag quantity to improve the accuracy. To reduce the computation complexity
Uncertainty-aware RFID network planning for target detection and target location	2016	We formulate a non-linear integer programming (NLIP)model to minimize the cost on a grid-based field while satisfying the given coverage requirement for the target detection and target location. Then, an exact p-order polynomial approximation(POPA)algorithm and heuristic algorithms are designed to solve the model.

STPP: Spatial-Temporal Phase Profiling-Based Method for Relative RFID Tag Localization	2016	We propose an approach called spatial-temporal phase profiling (STPP) to RFID-based relative object localization. STPP achieves about 84% ordering accuracy for misplaced books and 95% ordering accuracy of misplaced books in a library and determining the baggage order in an airport
Real-Time Locating Systems Using Active RFID for Internet of Things	2016	iLocate, which locates objects at high levels of accuracy up to 30 cm with ultra long distance transmission. To achieve fine-grained localization accuracy, iLocate presents the concept of virtual reference tags. To overcome signal multipath, iLocate employs a frequency-hopping technique to schedule RFID communication. To support largescale RFID networks, iLocate leverages the ZigBee.We implement all hardware using 2.45-GHz RFID chips so that each active tag can communicate with readers that are around 1000 m away in free space.
Fast and Adaptive Continuous Scanning in Large-Scale RFID Systems	2016	We analytically unveil the fundamental relationship between the performance of continuous scanning and the size of overlap, deriving a critical threshold for the selection of scanning strategy. Further, we design an accurate estimator to approximate the overlap. Combining the estimate and a compact data structure, an adaptive scanning scheme is introduced to achieve low communication time.
A 2D localization technique for UHF-RFID smart bookshelves	2016	The SARFID technique proposed in has been applied to proof its 2D localization capabilities when the tagged objects to be located are distributed on a shelf reader antenna trajectories will be investigated, to reduce the complexity of the scanning mechanical system while preserving the assigned localization accuracy.
Towards industrial internet of things: Crankshaft monitoring, traceability and tracking using RFID	2016	The proposed solution involves the attachment of bolts with embedded RFID functionality by fitting a reader antenna reader to an overhead gantry that spans the production line and reads and writes production data to the tags. The manufacturing, assembly and service data captured through RFID tag sand stored on a local server, could further be integrated with higher-level business applications facilitating seamless integration within the factory

4. APPLICATIONS OF RFID:

- Get fans inside quickly inside the event hall, 120 scans per minute and practically 30 peoples at peak entry traffic. Also used for multiday events.
- Go cashless for events.
- Eliminate counterfeit tickets.
- Improve the supply chain – Import & Export.
- Track vehicle – RFID school bus tracker.
- RFID shoe tag – To calculate the racing time of the athlete's.
- Health care – patient's details.
- Smart shopping carts-These carts download the shopping list digitally and RFID guide us to the location where the items are. This can also help us to easily checkout and not having to stay in the long queue.

5. CONCLUSION:

In this survey we have highlighted that a technological shift is essential to satisfy the demanding requirements of future IoT systems offering high-accuracy localization. UWB-RFID is a promising candidate in this direction because it conjugates the high-resolution discrimination of UWB signals with the backscatter principle of passive RFID. However, for its widespread adoption as next generation RFID, a significant research effort and synergy between different but tightly intertwined fields such as low power electronics, antenna design, communication theory and signal processing, is required.

REFERENCES

1.RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification, Second Edition Klaus Finkenzeller.

2. Yi-Fang Lin; Shu-An Yeh; Hua-Ming Chen; Sue- Wei Chang, "Design of an Omnidirectional Polarized RFID Tag Antenna for Safety Glass Applications," Antennas and Propagation, IEEE Transactions on , vol.60, no.10, pp.4530,4537, Oct. 2012.

3. Reich, M.T.; Bauer-Reich, C., "UHF RFID impedance matching: When is a T-match not a T-match?," RFID (IEEE RFID), 2014 IEEE International Conference on , vol., no., pp.23,30, 8-10 April 2014.

4. Bakore, R.; West, J.C.; Hutchens, C.; Ahmed, R., "Design of a proposed folded dipole antenna for use with an implantable RFID tag at 915 MHz," Antennas and Propagation Society International Symposium (APSURSI), 2013 IEEE , vol., no., pp.2085,2086, 7-13 July 2013.

5.Chye-Hwa Loo;et el. "RFID tag antenna matching to frequency dependent microchip impedance," Antennas and Propagation Society International Symposium, 2008. AP-S 2008. IEEE , vol., no., pp.1,4, 5-11 July 2008.

6. R. Verdone et al., Wireless sensor and actuator networks: technologies, analysis and design. Academic Press, 2010.

7. P. Pursula et al., "Millimeter-wave identification - a new short-range radio system for low-power high data-rate applications," IEEE Trans. Microw. Theory Tech., vol. 56, no. 10, pp. 2221–2228, 2008.

8.H. Kaouach et al., "Wideband low-loss linear and circular polarization transmit-arrays in V-band," IEEE Trans. Antennas Propag., vol. 59, no. 7, pp. 2513–2523, Jul. 2011.

9.A. Guerra et al., "Energy sprinklers for passive UWB RFID," in Proc. IEEE Int. Conf. on Ultra-Wideband (ICUWB), Paris, France, Sep. 2014,pp. 1–6.

10. S. Sudevalayam and P. Kulkarni, "Energy harvesting sensor nodes: Survey and implications," IEEE Commun. Surveys & Tutorials,, vol. 13, no. 3, pp. 443–461, 2011.

11. S. Moscato et al., "Compact substrate integrated waveguide (SIW) components on paper substrate," in 45th European Microwave Conference (EuMC), Paris, France, Sep. 2015.

12.Daqiang Zhang, Laurence Tianruo Yang, Min Chen, Shengjie ZhaoMinyi Guo and Yin Zhang," Real-Time Locating Systems Using Active RFID for Internet of Things", IEEE SYSTEMS JOURNAL.

13.D. Zhang, J. Zhou, M. Guo, J. Cao, and T. Li, "TASA: Tag-free activity sensing using RFID tag arrays," IEEE Trans. Parallel Distrib. Syst.,vol. 22, no. 4, pp. 558–570, Apr. 2011.

14.J. Maneesilp, C. Wang, H. Wu, and N.-F. Tzeng, "RFID support for accurate 3D localization," IEEE Trans. Comput., vol. 62, no. 7, pp. 1447–1459, Jul. 2013.

15.A. Shirehjini, A. Yassine, and S. Shirmohammadi, "Equipment location in hospitals using RFID-based positioning system," IEEE Trans. Inf.Technol. Biomed., vol. 16, no. 6, pp. 1058–1069, Nov. 2012.

16.Z. Zhang et al., "Item-level indoor localization with passive UHF RFID based on tag interaction analysis," IEEE Trans. Ind. Electron., vol. 61,no. 4, pp. 2122–2135, Apr. 2014.

17.C. Zhou and J. Griffin, "Accurate phase-based ranging measurements for backscatter RFID tags," IEEE Antennas Wireless Propag. Lett., vol. 11,pp. 152–155, Jan. 2012.