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INTEGRATION OF WSNS WITH RFID SYSTEM AND INDOOR POSITIONINIG

MISS. NAMRATA V. KHOPE[1], PROF. DEEPAK C. DHANWANI[2]

1. M.E. 2nd Sem, Department of Computer Science and Engineering, P. R. Pote (Patil) College of engineering Amravati, India.
2. Prof .Department of Computer Science and Engineering, P.R.Pote (Patil) College of engineering Amravati, India

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Abstract: RFID (Radio Frequency Identifications) and Wireless sensor network (WSN) are two important wireless technologies that have wide variety of applications and provide unlimited future potentials .Both are widely used in the industrial field, and have undertaken dramatic development. RFID and WSNs are well known for their capability in identity identification and data transmission, respectively, RFID is used to detect presence and location of objects while WSN is used to sense and monitor the environment. Integrating RFID with WSN not only provides identity and location of an object but also provides information regarding the condition of the object carrying the sensors assist RFID tag. Though the integration of a sensor and an RFID tag was proposed to gather both RFID tag and sensed information. GPS seems to be the best solution to develop outdoor location systems, but performance of these systems is not good enough to locate entities within indoor environments. We design and evaluate a hybrid system which combines WSN and RFID technologies to provide an indoor positioning service with the capability of providing position information into a general-purpose environment.

Keywords: RFID (Radio frequency identification), WSN, Indoor Positioning.

Corresponding Author: MISS. NAMRATA V. KHOPE

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INTRODUCTION

The ever-growing development of emerging technologies in computing field, personal positioning systems that can accommodate to perform well in outdoors and indoors have drawn more and more interest. This is because personal positioning systems featuring personal location awareness anywhere and anytime are fundamental to versatile computing applications, like outdoor and indoor path navigation, outdoor and indoor information guide, marketing advertisement, social networking, and so on. However, global positioning system (GPS), the most popular outdoor positioning system, nowadays, is poor and unsuitable for indoor positioning applications because of its line-of-sight nature [1]. One of the most well-known localization systems in outdoor environments is the Global Positioning System (GPS), a satellite-based navigation system made up of a network of 24 satellites in orbit [2]. GPS is widely used to track moving objects located outdoor. Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of corporation of an RFID reader and an RFID tag. **"**Reader**"** means a device, capable of reading data from a tag or transmitting data to RFID tag. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. WSN and RFID are complementary because they were originally designed with different objectives. For these reasons integrations of WSN and RFID provides a significant improvement on monitoring. WSN operates with low complexity and with low power consumption .The sensors are used to collect and transmit information about their surrounding environment. The basic idea of integration of RFID with WSN is to connect the RFID reader to an RF transceiver, which has routing function and can forward information to and from other readers [3]. Integrated tags with WSN can communicate with other tags and form a multiple loop network. Each integrated node transmits not only its unique ID number but also details of its sensed data to all other nodes.

2. LITERATURE REVIEW

RFID and WSN integration was develop by [4].This research strives to elaborate accurate traceability of different object by means of RFID which are not conveniently identifiable by applying ordinary sensors. Notwithstanding the fact that the condition of item can be achieved by sensor node. To address these issue, both RFID system and WSN are applied together to overcome some difficulties in industrial environment. US Patent 20080030306 A1 [5] describes an RFID device that is an active transponder which includes a transmitter, receiver, and a microprocessor. The invention relates RFID devices to many applications, for example, for

determining the location of objects or person that is tagged with RFID tag. However, the document does not describe any additional solutions on how to monitor or locate the objects or persons especially for an indoor and outdoor location environment, respectively. US Patent 20090085745 A1 [6] describes an RFID tracking device that includes aGPS capable of detecting the unique identification (ID) from the RFID tag of the objects and obtaining the location coordinate provided by GPS. However GPS is unable to work completely indoors or in an environment with obstacles which thus contributes to the weaknesses of the design. The WO 2003050960 A2 [7] is another patented system that combines the RFID and GPS functionality on intelligent label. The system used active RFID reader and GPS to track the location and send the location data information to the RFID reader. The system is however unable to work completely indoors or in an environment with obstacles. The EP 1752908 A2/2006 [8] is another patented system that integrates the GPS functionalities in a portable RFID system to track the location of an object or pallet inside or outside the structures such as warehouses and the factory automation environment.

3. RELATED WORK

Positioning systems generate a lot of interest and effort both in academic and industrial research and nowadays, a lot of technologies can be used and mixed. Each system has addressed the aggregation of sensor data into location estimations via most suitable methods. Positioning and tracking are crucial features in many computing and robotics applications where knowledge about the location of the entities (i.e., people and objects) is required. Hybrid WSN-RFID networks have a huge potential. When integrating the two technologies, depending on these requirements, different options of integration are available.

3.1 Integration of RFID Tags with Sensors

Adding sensing capabilities into RFID tags is a common and important integration method. Integrated tags with sensors communicate with readers under limited communicating capabilities. Each tag with unique ID is equipped on objects, humans or animals, while sensors on it sense concerned information. According to the power mode of tags, this kind integration can be classified into three categories:

a) Passive tags with sensors;

b) Semi-passive tags with sensors;

c) Active tags with sensors.

Passive tags do not use batteries for communication and Sensing, and as such, they are basically maintenance-free. Semi-passive tags use Power-generating circuits to generate power for RF components on the chip and battery power for powering up the rest of the chip. Active sensor tags rely completely on batteries. Passive tags with integrated sensors are used in several applications including temperature sensing and monitoring [9, 10], photo detection [9], and movement detection [11]. Semi-passive tags with integrated sensors could be used in temperature sensing and monitoring, location recording, vehicle-asset tracking, and access control. Active tags with integrated sensors are used in several applications including temperature sensing and monitoring. Vibration detection and blood pressure.

3.2 Integration of RFID Tags with WSN Nodes

This integration method consists of extending the capabilities of WSN nodes by adding features specific to RFID tags The CoBIs tags [12] fit into this category of integration methods. These tags have been designed to monitor environmental parameters. Each tag transmits its unique ID, along with the data acquired from the sensors, to all tags within a 3 meters radius.

3.3 Integration of RFID Readers with WSN Nodes

Another type of integration is the combination of WSN nodes with RFID readers. The integration extends functionalities both on RFID readers and WSN nodes, and has been widely applied in variety of prevalent computing conditions. The integrated readers are able to sense environmental conditions. Sensing part which makes use of kinds of sensor (temperature, pressure), reading part which gathers data from RFID tags, and radio transceiver part which sends data to the sink node. Fixed sensor node with reader architecture system is better suited when there is not a central mobile object among the objects.

4. ARCHITECTURE

The positioning system combines WSN and RFID in order to compensate the limitations of each technology. On one hand, the WSN provides a good radio coverage but with a low positioning accuracy. On the other hand, the RFID technology provides the following: (1) in the case of high-frequency (HF), very precise positioning information but limited coverage and temporal discontinuity; (2) in the case of ultra-high frequency (UHF), good coverage and reliability but high granularity of the location.

The architecture consists of three types of hybrid node as follows:

- **Reader Node: -** periodically receive data from tags within their range, to which they answer by means of acknowledgements (ACK). Reader's forward data received from tags to the network's coordinator node. Reader nodes are always powered-on embedding RFID reader functionality and router functionality Tags connect to this network, but their role is limited.

- **Coordinator Node:-**The acknowledgement mechanism is required in order to solve errors due to collisions that occur in environments with a high tag per reader density. The reader forwards tag data to the coordinator. In its turn, the coordinator acknowledges the successful reception of data, and sends received data to the network's monitoring and control server.

- **Tag Node: -** active RFID nodes, capable of transmitting sensor data alongside the RFID code. Tags broadcast this data periodically to the parent RFID reader located in their range. When it is not transmitting, the sensor node is switched into sleep mode, thus significantly reducing the power consumption and increasing battery life.

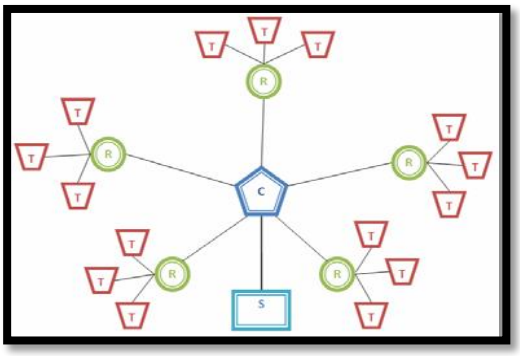

Fig 4.1: Architecture of the hybrid WSN -RFID network [13].

6. CONCLUSION

In this paper, RFID and WSN system that integrates the multi hop transmission mode of WSNs and direct transmission mode of RFID system to improve the efficiency of data collection, hence to meet the requirements of low economic cost, high performance and real time monitoring. This work presented WSN-RFID system for tracking people and object in indoor scenarios. A high-performance indoor positioning system constructing of a real-time portable RFID indoor positioning device and cost-effective scalable RFID indoor positioning structure is developed. The system is based on a sensing surface where entities are going to be located, a RFID reader

attached to the entity that is able to read RFID tags that are part of the sensing surface. Thus indoor positioning systems can effectively benefit from WSN and RFID technologies. Furthermore, the configuration is cost-effective in situations where WSN and RFID devices are already deployed for other purposes such as environment monitoring or access control.

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