E-ISSN: 2321–9637
Volume 1, Issue 4, November 2013
International Journal of Research in Advent Technology
Available Online at: http://www.ijrat.org

SURVEY ON WIRELESS INTEGRATED WSN AND RFID

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ABSTARCT:
Wireless Sensor Networks are being used in environment that was impossible earlier. WSNs are applicable in battlefield monitoring, underwater deployment and vehicle tracking. Applications areas and security features can be expanded many folds by integrating WSNs and RFID technology. The tracking network is being explored further with these new emerging technologies. This integrated technology enhances secure way to electronically follow an object. To make such tracking network RFID readers are experimented with Freescale Zigbee boards. This network would be able to track unique object passing nearby to the readers.

Keywords: RFID, RFID Tags, WSN, RS232.

1. INTRODUCTION

In recent years the use of monitoring items has augmented to help in all walk of lives. Their areas of applications will increase further as the technology is being explored to enhance manufacturing. Wireless Sensor Networks (WSNs) is a technology that allows monitoring to take place in competent and non-disruptive ways. They do not need putting wires for power or communication. They are cheaper and easier to install in existing developments, and also allow users to set up networks in areas without established power sources. On the other hand a Radio Frequency Identification (RFID) technology allows items to be tagged with electronic ID numbers that can be read or sensed via radio waves

2. BACKGROUND

RFID is a growing field as it allows the unique identification of an object via radio waves, where the tag itself does not need to be visible or touched. Wireless Sensor Networks are a broad area in that they have potential in research, both in the study of WSNs and the things they can record and sense, but also in commercial applications.

2.1 What is Wireless Sensor Netwrok?

The Wireless Sensor Networks (WSNs) consist of small battery powered by devices. WSNs can sense different measures like movement, pressure, temperature etc. These sensing devices work together in real time situation to report the occurring of various activities. Now Wireless Sensor Networks are being used in environments that were impossible earlier. Some of the application areas include battlefield monitoring, wildlife monitoring, underwater deployment and vehicle tracking. Current developments in the field of information technology are capable of providing security to network but WSNs have been benefitted up to limited extent. These sensors are exclusive in nature because they own meagre resources, but still they are deployed in the situations where high level of security is mandatory.

Research has shown that WSNs can be attacked by a variety of attacks, and each attack is unique in nature and needs different techniques to counter the attack. In such scenario the importance of a security protocol for WSN plays a vital role.

As the technology improves, and different approaches are explored, more efficient power saving algorithms and hardware will be developed which will allow longer lasting networks to be deployed, “embedded in

E-ISSN: 2321–9637
Volume 1, Issue 4, November 2013
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the physical environment, operating together in a wireless network [1]"

2.2 What is Radio Frequency Identification?

Radio Frequency Identification - RFID system is one of the most challenging devices in recent years. The primary goal of RFID technology is to automatically identify objects that are contained in electromagnetic fields. RFID tags do not require physical contact for identification. This allows objects to be read in large numbers without physically handling the objects. Most RFID systems contain small and inexpensive passive tags in which it derives its power from the signal. One of the reasons many developers are researching this topic is that the RFID is supposed to replace the bar code systems. It can also be used to discriminate between counterfeits and authentic products. The application areas are open to product supply chains but covers livestock tracking, airline baggage, road toll management, hotel room access and so on. In order to be popular in commercial markets, the RFID system should overcome the restriction of cheap RFID tags. The limited price means limited functionalities and resources in tags. Because of the limitation, using asymmetric or symmetric key encryption algorithm or making memory secure in tags is improper [2]. To solve security problems related with low-cost RFID systems, many authentication protocols were proposed. However, those protocols could not satisfy the RFID security requirements and/or operational requirements. According to the best of our knowledge, there is no published authentication protocol that deals effectively on security and operational requirements.

. This technology was chosen because early radar could detect an aircraft, but could not determine who it was, with the use of RFID a signal could be sent out, and if the correct response was returned the plane was considered friendly. RFID technology has been developed over the years since its introduction to now where there are applications for RFID in manufacturing, distribution & inventory, retail, document tracking, security, and healthcare, to name a few. These are further being developed to allow the realization of intelligent items that will recognize one another from their ID and have the ability to interact through various protocols, some of which have already been developed [3]. However the deployment of RFID within the library is mostly for inventory management, to register if a specific book is checked out and leaves the library, and when it returns and is checked back in. There are many similar products available, but they do not track the location of an object on a real-time basis, but instead on an event-driven schedule.

2.3 Radio Frequency Identification Tags

The combination of these technologies yields an interesting combination of simple to install data collection infrastructure, with the ability to recognize specific items. Currently RFID tagged objects can be read via a reader often operated to purposefully read the ID of a specific object as in the case of warehouse automation, livestock identification [2]. Real-time object tracking is slightly different in that it doesn't provide its findings directly to the user, but instead operates in the background collecting information and storing it in a database for immediate use by a system or later review by a user depending on the application. An ideal tracking network would be one that operates in such a way that is inconspicuous to those using it. An example application would be one where a user's keys are attached to a RFID tag. When the user enters their house the tag is read and its last known location and time of sighting is logged on a database. As the user walks through the house the key's tag is read at different locations and the database is updated. If the user at some point loses their keys, the database will be able to tell the user where the keys were last detected by the network.Deployments utilizing this same idea are in place in several libraries currently, however these only register the exit points of the building to register which book or media item has been taken. The main difference is the use of a network to register different locations of a single object, as opposed to a stationary reader registering the existence of a specific object.

3. DESIGNING TECHNIQUES

The combination of RFID technology with WSNs allows the advantages of both technologies to be fully

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employed. In essence a WSN will be designed to collect sensor data on the RFID tags it reads by integrating the wireless node with a RFID reader circuit. The advantage of using WSN technology to deploy a tracking network is that it is easily installed, and does not require the installation of extraneous hardware. The benefit of using RFID as a method to track items as opposed to motion sensors orother optical sensors is that objects of interest will be distinguished from one another so many items can be tracked within an environment. The development of such a network includes the combination of wireless sensor nodes with RFID readers, and designing software for communication and transfer of data between them. In addition, data collection software needs to be designed so that the collected data can be recorded at a base location and analyzed. The methods used to do this depend on hardware selected, and the parameters of the network desired.. The advantage of using this higher frequency is the possible communication range of 150-375 feet indoors, with an even greater range outdoors. This would allow the nodes to be deployed at greater distances from one another if an application demanded it. As well these nodes are designed to provide low power operation and functionality for an increased battery lifetime – an important aspect of any WSN. The RFID technology chosen was a development kit purchased from Custom Computer Services, Inc. The EM4095 RFID reader provided with the kit operates in the 125 kHz band allowing a tag within several inches or feet to be read, depending on the style of tag. It is important to note where an application requires the tag be placed. The reader collects data as dictated by the onboard PIC16F876A and sends this data to connected hardware via a RS485 to RS232 converting board, allowing information to be read from its serial port. The tags selected for use were also provided with the kit. These EM4102 tags are read-only, with 64bit memory fields broken up into a header, a 40bit data field for customer ID and tag ID, and several other fields for parity checks. Tags with larger read ranges and different memory capabilities could easily be incorporated into a tracking network; however the ones chosen were adequate for this development of this network.

3.1 Programming RFID Readers

Software designed for a separately functioning RFID reader, that is, one utilizing its own microcontroller, needs to take into account the layout of the data fields on the tag it wishes to read. Depending on the application, a tag may require more memory for storage of data, or may only need a few bits to distinguish itself. The tag may also have error detection build in, in the form of parity bits, to aid in determining if the packet was received correctly. There is also the situation of read/write tags which allow the user to edit the information stored on the tag, sometimes this is used in conjunction with password protection to prevent unwanted access to the information stored on the tag. As these features may or may not be present, the software for the reader will need to be specialized for that type of tag, or those types of tags in the case of heterogeneous tag usage

Customer ID	Tag ID	Tag ID	Tag ID	Tag ID

Figure 4: Structure of data field for EM4102 ta

In the case of the example network the PIC C Integrated Development Environment (IDE) included with the RFID development kit was used to program the RFID reader to collect data in the desired format.
The data fields of the tag can be seen in Figure 4, with the Customer ID accounting for 8 bits of the data field, and the remaining 32 bits being reserved for the Tag ID, allowing over 4 million unique ID numbers The tag is read using the functionality provided by a driver included in the IDE for the EM4102 tag.

The reader detects a tag by querying for a tag within range, when a response is generated the reader listens until it has heard nine consecutive 1's signifying the presence of the desired tag type. It then listens to the data transmitted and decodes it by parsing the data until 40 data bits and 10 parity bits have been found. When a cycle of querying has been done the driver returns a 1 bit integer to the calling program signifying if it

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was successful or not in finding a tag.

For the example network a simple program was written to collect data from the tag ID fields and send it over the RS232 connection. The logic for this program can be seen in Figure 5. The software for the reader simply cycles through the program checking if a tag has been read, and relaying information when it has collected some. This code was written to simplify the data processing that would need to be done by the wireless node to which it would be connected.

3.2 Software for the WSNs

Software development for the network is truly the most important part, as it determines its functionality, efficiency in data collection, and lifetime assuming it is operating off a limited power source. These parameters dictate appropriate power saving techniques be used in addition to effective programming. If data needs to be collected more often by the nodes, efficient power usage will be paramount. However if data only needs to collected when a certain event occurs, the focus can be more directed at reliably recognizing that event. These issues must be considered in a tracking network because if nodes are powered down often and there is an abundance of tags in the environment there will be many sightings that will need to be declared to the base node. The same is also true if the nodes are awake for longer periods and there are few objects to be observed. Simply put, it is important to understand the environment and to adapt to changes.

The software development for the example network proved to be much more involved that that of the reader because of its multipurpose usability. Initially the boards were programmed to read data from the general purpose I/O pins, however because data needed to be received from the reader via a serial connection the software needed to be adjusted to collect information from its serial port. In addition, the baud rate at which the serial port of the boards operated at needed to be changed so that it could communicate with the readers which operated at a baud rate of 9600.

3.3 Integrating Hardware

During the development phase of a network such as this, existing hardware can be used to create and test the concept. Once this has been completed a single piece of hardware can be created which would integrate the previous components, removing need for extraneous connections. However during development hardware needs to be programmed to function with other hardware it was not originally intended for. This may prove to be simple or more difficult depending on the hardware selected. Software was developed for the RFID Reader board that would transmit its collected information over this serial connection to any hardware attached.

A WSN with RFID reading capabilities is not that far beyond creating a WSN to sense temperature, the main difference being what is sensed. In fact the difference between an active RFID tag enabled with sensors and a wireless node with sensors is rather small[6]. A single piece of hardware could be created to include all the functionality of an RFID reader and wireless sensor node. As well a RFID reader could be packaged as an external node and added to existing wireless sensor nodes like a sensor.

4. TRACKING

Tracking of objects is a possible application for both WSN and RFID technology separately. RFID has been used in the past for event tracking of objects.

Object tracking has been explored as well with various methods involving infrared, ultrasonic, and RFID. One such application developed an Ultrasonic Sensor-driven Position System (USPS) which they deployed within a building. This network operates by the user carrying a transponder which emits ultrasonic waves on demand, and sensors deployed through the structure calculate their distance from the transponder. This allows

E-ISSN: 2321–9637
Volume 1, Issue 4, November 2013
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objects to be found within a range of 1cm accuracy. The drawback of this method is that at least 3 sensors must recognize the presence of the transponder in order to locate it.

5. SECURITY

Many things must be taken into account when an object tracking network is being developed. Among these considerations is security and privacy of users and information. As technology such as this is deployed in realms where controlled access to information is of paramount importance, methods must be developed which allow efficient use, but also protect that information from unauthorized access. This is especially important in applications such as healthcare where medical privacy is of tremendous importance. When a patient's confidential information is stored electronically, a secure system architecture must be in place such as a Public-Key infrastructure[8], in addition to storing medical information in a location only those authorized may access it.

6. CONCLUSION

The development of a tracking network utilizing WSN and RFID technology, although a challenge to develop initially, allows for many practical applications and ease of use once developed. As both these technologies are further researched they will be seen more often in every day applications. The use of RFID in sales is increasing and it is believed it, or a similar technology, will replace bar code use in the next 10 years [9].. WSNs are also being further developed for a large range of applications, and will be seen on a more frequent basis over the coming years as well.

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