Indoor Location Tracking System Using RFID Technology

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Abstract: **Challenge for detecting human beings in big institutions. Whenever we want to find someone in mobile prohibited area, it is difficult to find them within a short period. This kind of circumstances should be avoided by mistreatment RFID technology. Previous analysis and development for indoor localization includes infrared, wireless LAN etc. These technologies suffer from the limited accuracy and lacking of the infrastructure. This paper proposes a method that enables indoor location tracking of staff/student by utilizing RFID technology. RFID technology is often leveraged to realize staff/student location in a reasonable, power efficient and user friendly manner. Indoor location tracking system allows you to track the location with a facilitate of RFID tag, RFID reader and Zigbee in a non-interruptive manner. RFID is an acronym for Radio Frequency Identification is a fast and reliable means for identifying   an individual.**

Keywords: RFID Tag, RFID reader and Zigbee.

I.   INTRODUCTION

In various institutions, the common problem faced is to locate the staff/student immediately when needed. Few methods, which are in use, are the old fashioned traditional announcement systems. The drawback is that the privacy of the staff/student is affected & it also interrupts the regular functioning of the institution. Generally, many institutions have monitoring cameras to monitor the activity of the working environment status, but it leads to certain drawbacks like the coverage area is small & in a crowded place, a camera cannot identify the exact staff/student needed, for it needs a human eye to recognize the presence of the particular staff. In such case, the accuracy and reliability fails. The monitoring unit needs huge supply of televisions and man power for continuous monitoring. Centrex will be available in many institutions but sometimes nobody will attend the call. Later on, we will move to location detection method. As we know, many different location detection technologies are available today, GPS one of the most well known. It is common to use GPS to locate a vehicle or an object in the outdoor environment. However GPS is not suitable for indoor environment because of its limitations such as reflection or attenuation caused by obstacles, occlusion, etc. Hence, we propose a new method that uses Radio Frequency identification (RFID) technology, without causing any disturbance to anyone. . It is also simple & reliable, requiring no man power. The low cost and robust design of RFID Tags makes it suitable, to be attached to the people inorder to track their location in a particular area. RFID is rapidly evolving, and is used with Biometrics technology for security purpose.

RFID has been widely utilized for the automatic identification, inventory and tracking of animals, humans, library books, pharmaceuticals, supply chains, merchandise, and other objects. It is used to prevent the others privacy and the regular course of the institution and also the basic challenges such as delay, accuracy, reliability, non- interruption etc. However, more accurate location information of staff/student could enhance these applications, and enable a large number of other applications. Here each staff is provided with a particular RFID tag. The institutions structure is well planned and each of its location is named for easy recognition. Then these locations are installed with a tracking unit. The system is controlled using a microcontroller and ZigBee is used to communicate. The results are accurate and absolutely reliable.

The remainder of this paper is organized as follows. Section II describes the principle of the system. In Section III, Implementation of the units to locate the staff needed is explained. Thereafter, Section IV shows the Performance of the system. Lastly, Section V will conclude this paper.

II.   SYSTEM PRINCIPLE

The indoor location tracking system is based on wireless communication services between the reader unit and the tracking unit via ZigBee, and identifies the RFID tags to track the location of staffs & students. The RFID Reader emits a low power radio wave field which is used to power up the tag so as to pass on any information that is contained on the chip. RFID is one member in the family of Automatic Identification and Data Capture (AIDC) technologies and is fast and reliable means of identifying objects. The RFID technology is a means of gathering data about a certain item without the need of touching the data carrier, with the use of electromagnetic waves. One important feature enabling RFID for tracking objects is that it provides unique identification.

III.   SYSTEM OVERVIEW

Most RFID systems consist of tags and readers. Tags are attached to an individual to be identified. Each tag has its own "read-only" internal memory depending on the type and application. This memory is to store personal information, of an individual such as unique Identification features. Each Lecture Hall is assigned with the Reader in order to read the contents of the tag specified in the ID cards provided, it generates magnetic fields that enable the RFID system to locate the individual(via the tags) that are within its range. If the data in the tag is matched with the data in program memory, then the result is displayed as "FOUND" along with his/her name, designation, IN Time and OUT Time in the LCD display provided. If data is not matched, then it displays as "NOT FOUND". The high-frequency electromagnetic energy and the corresponding signal generated by the reader triggers the   tags. The frequency of the signal generated could be up to 50 times per second. As a result communication between the tags and reader is established. In other words, in order to control this problem, low pass filters are used. Several protocols manage the communication process between the reader and tag. When the reader is switched on protocols begin the identification process. If the reader is on and the tag arrives in the reader fields, then it automatically replies to the reader by modulating the reader's field. The reader performs these operations one by one on each tag.

A. Objective:

The main scope of the system is to track the location of staffs & students in a huge institution, where mobile phones are being restricted, without wasting time and man power, overcoming all the traditional methods that are in use.

B. System Setup:

The *Reader unit* is placed infront of each class rooms. It consists of PIC microcontroller, power supply unit, MAX232, RFID reader and tag and ZigBee.

TABLE.1 Classification of RFID tag

Items	Passive RFID tag	Active RFID tag (Con.)	Active RFID tag (new)
Comm. Range	70cm/ 3m - 7m	more than 10m	around 10m
Battery life	(no battery)	around 1 year	around 1 year
Security	weak	N/A, or weak	strong
Cost	less than $1	less than $10	around $10
Application	distribution/ inventory control of goods.	tracking person (restricted area)	tracking person (no restriction)

RFID Tags contain microchips that store the unique identification (ID) of each object. The code which is used is a serial number stored in the RFID memory. The tag contains chip that is made up of integrated circuit and embedded in a silicon chip. RFID tags can be different sizes and shapes depending on the application and the environment at which it will be used.

EM18 RFID Readers are electronic devices which can be used as standalone or can be integrated with other devices. The range of the reader is dependent upon its operational frequency. RFID reader works as a central place for the RFID system. RFID reader reads tags data through the RFID antennas at 125KHZ frequency. The Operating voltage is 4.6v to 5.6v. Basically, the reader is an electronic device which produces and accepts a radio signals. The antennas contains an attached reader, the reader translates the tags radio signals through antenna. The readers consist of a build-in anti-collision schemes and a single reader can operate on multiple tags with different frequencies. As a result, these readers are expected to collect or write data onto tag and pass to computer systems. For this purpose readers can be connected using RS-232, is an interfacing unit for connecting it to the various peripherals of the computer system.

The *control unit* is the monitoring device. It is place in a particular place and also portable. It is accessed when its service is needed. When the code is entered, it is processed and a search message is sent via ZigBee to the system unit and the corresponding results are viewed in the LCD display. The control unit consists of a PIC microcontroller, power supply unit, MAX232, LCD display, keypad and ZigBee. ZigBee could be a low rate, low cost and power consumption is low; wireless networking protocol targeted towards automation and remote control applications.

Power supply unit consists of step down transformer, rectifier, low pass filter and regulator. It is used to reduce the voltage level up to 5v.Step down transformer has large number of copper windings & it reduces the voltage from 230v AC to 12v AC. Rectifier converts AC to DC. Low pass filter is used to clear the unwanted pulses. 7805-regulator is used to reduce 12v to 5v.

PIC16F877A is a family of RISC Architectures, that means that it has 35 set of instructions. It contains memory which is a part of the microcontroller whose function is to store data. All the coded programs are stored in the PIC.

The *MAX232* acts as a buffer driver for the processor. The 16F877A has a built in serial port that makes it very easy to communicate with the PC's serial port but the 16F877A outputs are 0 and 5 volts. The MAX232 is an electronic circuit that converts signals from a serial port to signals suitable for microprocessor circuits.

ZigBee compliant wireless devices are expected to transmit 10-75meters, depending on the RF environment and the power output consumption needed for a given application, and can operate within the unauthorized RF worldwide (2.4GHz global, 915MHz Americas or 868 MHz Europe). The data rate is 20kbps at 868MHz. The method uses ZigBee instead of Bluetooth because ZigBee uses a basic master-slave configuration suited to static star networks of many infrequently used devices that speak via tiny knowledge packets. It permits up to 254 nodes. Bluetooth's protocol is a lot of complicated since it is double geared towards handling voice, pictures and file transfers in accidental networks. Bluetooth devices will support scatter nets of multiple smaller non-synchronized networks (piconets). It solely permits up to eight slave nodes in an exceedingly basic master-slave piconet set-up. Once ZigBee node is steam-powered down, it will awaken and acquire a packet in around 15ms whereas a Bluetooth device would take around 3sec to wake up and respond. It communicates using characters which can be understood by the natural use.

LCD Display is the output device in the proposed system. The method uses a 20/4 display unit. It simply displays the space to enter the code of the staff needed and then displays the name, designation of staff for conformation and the current location of the staff. It can be further developed by using a computer monitor, which can display further more details.

Keypad is the input device used. Instead of entering the entire name of the staff needed, a particular code of two to three digits is enough. Each code represents a particular staff. To overcome department problems and illegal access, password codes are also provided.

1. Implementation of Reader Unit:

The reader unit is in the classroom, which reads the RFID tag of the staff & student entering into the class. It consists of the power supply unit, PIC 16F877A, MAX 232, RFID reader and tag & ZigBee. All the electronic components work on low voltage DC power supply. The data read from the RFID tag will be stored in the microcontroller and will be transmitted to the tracking unit on demand.
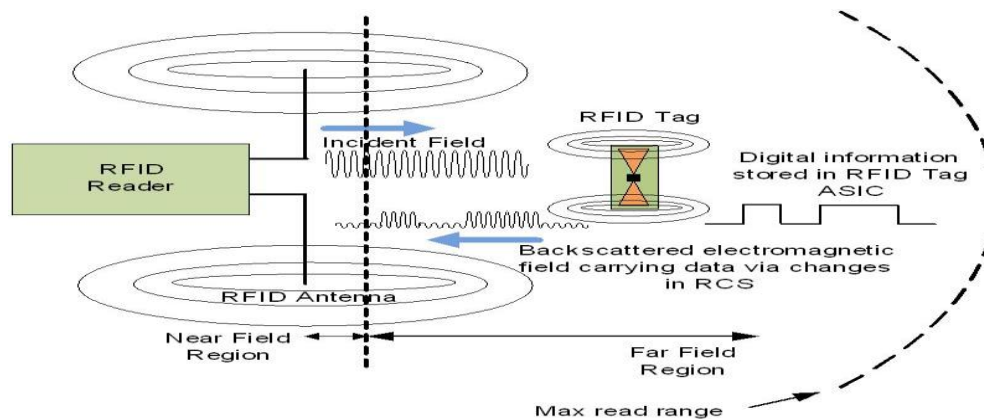
Fig.1 communication between reader and tag

2. Implementation of Tracking Unit:

The tracking unit is in the staff room, which is used to track and display the location of staff & student using the LCD. It consists of the same components as in the reader unit except that the RFID reader and tag is being replaced with the LCD and keypad. When the code that is assigned for the staff & student is entered, it is processed and a search message is sent via ZigBee to the reader unit and the corresponding results are viewed in the LCD display. If no reply comes within a particular time, it displays as not found, which means, the staff needed in not inside the coverage area, that is building or campus etc.

3. Air Interface:

The air interface used here is ZigBee. The main focus of ZigBee is to distribute work among many different devices which reside within individual ZigBee nodes which in turn form a network. ZigBee provides facilities for carrying out secure communications which are accurate and highly effective.

C. Location Tracking Mechanism:

This mechanism shows the operation of the system in a detailed manner.
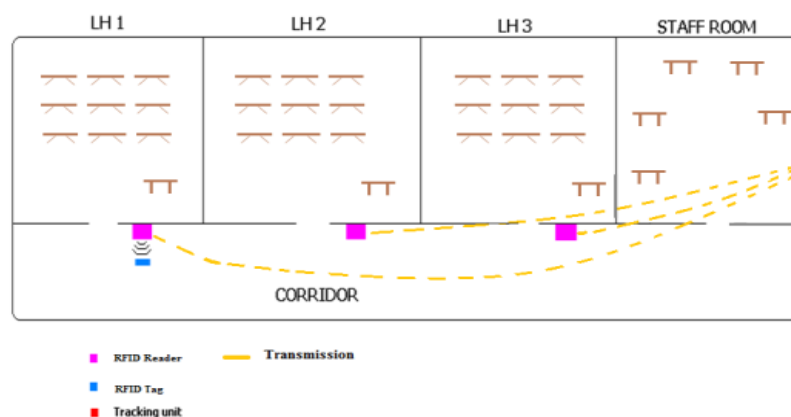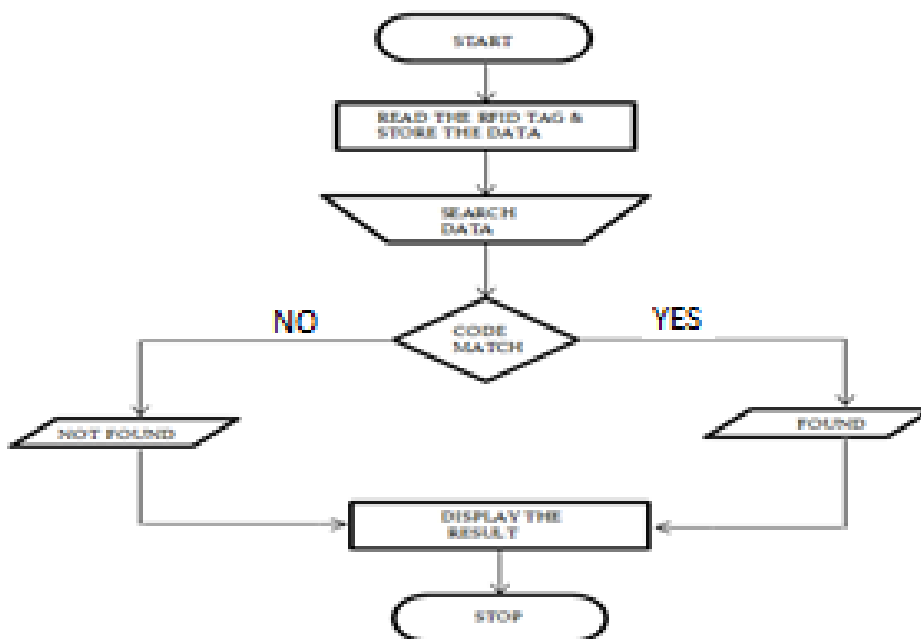
1. Layout of the location tracking system:

Fig.2 Layout of location tracking system

The indoor location tracking system has two units, namely, Reader Unit and Tracking Unit. So the mechanism works in two phases. In the first phase the reader unit collect the data of the staff/student's current location using the RFID tags and readers and instantly pass the message to the tracking unit which is stored the collected data's. In phase two, the tracking unit helps to retrieve the data about the staff/student's current location.

When the search message is received, the microcontroller checks for the same. If found it sends a reply message, with the staff name, designation, the spot name and IN time and OUT time. The check process is to compare the desired search signal from the controlling unit and reader unit. The reply messages are pre-programmed.

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2. Flow Chart:

A Transponder in the location tracking system receives a radio signal and in response sends out a radio signal. In the RFID tag an antenna and a small chip that can store data are present. When the Tag is brought near the RFID Reader, it reads the data in the tag. When we search the person enter the code in the keypad. If the data in the tag is matched with the data in program memory, then the result is displayed as "FOUND" along with his/her name, designation, IN Time and OUT Time. If data is not matched, then it displays as "NOT FOUND". RFID is based on storing and retrieving information as it consists of RFID tag & RFID reader.

IV.   SYSTEM PERFORMANCE

Power: The proposed system is a power efficient method. The operating power is only 5volt.The system work on main power supply. The method use batteries for backup supply. All electronic components works on low voltage DC power supply. But the actual power supply available is high voltage AC. So the unit sends the power from normal power supply panel say 230volt/50Hz, to a step down transformer (230v/ circuit.12v) AC. Then it is sent to the rectifier circuit to convert it into a DC power. A low pass filter is used and continued by a regulator.

TABLE.2 Performance of the system

RFID PERFORMANCE		
Attributes	RFID	BAR Coding
Cost	Low	High
Read rate	Tags can be read and stored the information in the reader unit	Tags can be read and cannot be store
Line of sight	Not required	Required
Security	High	Low
Amount of information transmitted	High	Low
Real time location tracking	Excellent	Poor
Distance of transmission	High	Low
Reusability	Yes	No
Technology	Radio frequency	optical

Accuracy: The method proposed is highly accurate and reliable. The results displayed are easy to understand the location of the individual in a particular institution. Tags may obtain their power in several different ways. The facility power supply is a necessary property of a tag, since it can confirm a tag's potential read range, lifetime and what kind of functionalities it's going to provide. The power source will also be important in determining however a tag could also be orientating and what physical forms it's going to take. There are three main classes of tag power sources: active, semi-passive, and passive. Large asset and livestock tracking applications often use active tags, since the items they are attached to (e.g. railcars, shipping containers, or cattle) are high in value and have physical space for a bulkier, rugged tag. A key feature of active tags is that they are able to initiate their own communication with readers. One useful application of active tags is in shipping containers, suppose it may fall off ships over rough seas. These missing containers generally don't seem to be accounted for till well once the ship has docked. An active tag with an associated degree measuring sensing element might observe once it had been drop off a stack of containers and broadcast a log of its demise before it sank into the ocean. Active tags could also function as security alarms using the same functionality. By contrast semi-passive (or semi-active) tags have an internal battery. This ensures that semi-passive tags are only active when queried by a reader. Because semi-passive tags do have an internal power source, they do offer a longer reader range than passive attacks, but at a higher cost. An example application that often uses semi-passive tags is electronic tollgate. Semi-passive tags are typically affixed to the inside of a car's windshield. once the car passes through a tollgate, it will initiate a question to the semi-passive tag. The on-board battery lets the tag be scan from a substantial distance. However, since the tag only needs to broadcast when queried, it can remain idle most of the time and save power. It is used in pallet-level tracking or tracking components like automobile parts during manufacture. Passive tags obtain energy by harvesting it from an incoming RF communication signal. At lower frequencies, this energy is typically harvested inductively, while at higher frequencies it is harvested through capacitance. While passive tags have the shortest read range of all three powering types, they are the cheapest to manufacture and the easiest to integrate into products.

Search Time: The search time is the time taken by the Zig Bee to communicate between the reader and tracking unit. The proposed method responds within 1seconds from the time of search.

Range & Update Rate: The coverage range is a term specified for Zig Bee and reader in our proposed system. The ZigBee has a range of around 100meters and the reader is a device to read the tag also has some coverage range. The range of reader depends on cost. The minimum range is around 12cm and runs upon 600meter. The updating of location happens in 0.25seconds as the individual moves around. The display unit is refreshed within 1second and it is done manually.

A. Trial Study:

The Indoor Location Tracking system's reader unit was implemented in each lecture hall, say, LH1, LH2...The staffs were provided with individual RFID tags. The tracking unit was placed in the staff room for easy access purpose. There are particular codes assigned to all staffs. These codes were entered in the tracking unit and the corresponding staff's location was identified. The staff's locations were monitored successfully at low cost and the results were accurate.

B. Application Scenario:

RFID System is most preferred technology in the future due to its vast application in several fields and is advantageous other systems

- Track student activities.

- Automate student and staff attendance records.

- Monitor patients in different rooms.

- Libraries have used RFID to switch the barcodes on library thinks.

- RFID technologies area unit currently conjointly enforced in end-user applications in museums.

- Locating landmarks in a city.

- Managing items in a warehouse.

- Locating personal objects.

V.   DISCUSSION

A. Summary:

Radio frequency identification (RFID) is a rapidly growing technology that has the potential to make great impacts on economic of many industries. There are more recent advancements in chip manufacturing technology that makes RFID practical for new applications and settings. At its most basic, RFID systems consist of small tags, attached to staff\student. When wirelessly interrogated by RFID transceivers, tags, readers, respond with some identifying information that may be associated with arbitrary data records. Thus RFID systems are one type of automatic identification system, similar to optical bar codes. And hence using this simple & efficient method, we can track the location of staff/student by just staying in a particular place and without wasting human power & time. RFID tags may soon become the most pervasive microchip in history.

B. Conclusion & Future Works:

This study has identified and explained the nature of RFID technology evolution with respect to RFID applications. RFID applications could reduce the number of errors by tagging an individual and by tracking the location in a timely manner. RFID based timely information about the location of a person would increase the efficiency and effectiveness of the tracking system. RFID technology will open new doors to organisations & companies to make them more secure, reliable, and accurate. The system should enable the integration and optimization of resources while improving accuracy and minimizing time leading to improvements in tracking the location.

In future this idea, which is beneficial to both the student and the staff, can be done in large scale, depending upon its effective implementation as it shows in the seeds to develop various real projects.

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