SMART LOCATION SYSTEM

Dr.A.Gnanasekar[1], P.Priyadarshini[2], R.P.Rakavi[3], R.Roobini[4]
[1, 2, 3, 4]Computer Science and Engineering, RMD Engineering College, R.S.M Nagar, Kavaraipettai, Affiliated to Anna University, Tamil Nadu, India

ABSTRACT

This paper proposes an active RFID-based indoor positioning system (IPS) for a constrained environment. The system is quite similar to Global positioning system (GPS). However, GPS can only work if the device is discovered by satellite. This work is to overcome the weakness of GPS capability for tracking an object that did not receive a satellite signal. The methods, technique and technology of tracking system have also been discussed in this paper. However, the work mostly focuses on Time of Arrival (ToA) and Received Signal Strength Indicator (RSSI) technique. Each technique has their own deficiency. Several steps are done such as relate both methods to overcome that deficiency. Ultra-High Frequency (UHF) RFID is used in this development of IPS.

Keywords: RFID, IPS, ToA, RSSI, SHF

I. INTRODUCTION

Nowadays there are many research works on Indoor positioning system (IPS) as field of tracking in a closed area or didn't receive a satellite signal. The Global Positioning System (GPS) was the most accessible service all over the world as long as there are line-of-sight paths between four or more GPS satellites signal and the receiver. However, in indoor scenarios satellite signals suffer attenuation by the construction and multipath reflection off the walls. The GPS service becomes unreliable and sometimes unavailable.

There are three major methods of tracking that is triangulation, Proximity and location fingerprinting. In Triangulation method, geometric properties of triangles are used. There are two categories of triangulation that is alteration and angulations. For alteration, the position of targeting object is estimated by measuring its distance of multiple receivers. There are several techniques in the alteration such as Time-of-Arrival (TOA), Time Different of Arrival, and Received Signal Strength. As everybody knows, the most famous indoor tracking technology nowadays was LANDMARC and other than that are VIRE and LEMT technology. LANDMARC is a Location sensing prototype system that uses RPID technology for locating objects inside buildings. This system is based on

RSS technique such all the RSS value collected by readers Are store and measured to determine the location of the object. The advantage of LANDMARC is that it uses the concept of reference of tags to improve the overall accuracy of locating objects .The Internet of Things (IoT) is –at its most profound levels about creating digital representations of real-world objects. It is a phenomenon that draws on rapid developments within IT, ICT and telecommunications to spark insights and to help companies create entirely new types of services and business areas.

II. MOTIVATION

The motivation behind this was the existing Global Positioning System (GPS) that was the most accessible service all over the world. As long as there are line-of-sight paths between four or more GPS satellites signal and the receiver we could not track the position. However, in indoor scenarios satellite signals suffer attenuation by the construction and multipath reflection off the walls. The GPS service becomes unreliable and sometimes unavailable. It is sometimes unable to pass through solid structures so is difficult to work indoors, underground, under the water, or under a dense canopy of trees. It can be affected by large buildings and is typically unreliable in CBD (Central Business District) areas. All people are accessed using passive RFID. Passive RFID could not detect within a particular range.

III. RELATED WORK

Allen Y. Chang [5] performed evaluation of real-time indoor positioning with active-RFID and CSS-based nano lock system. Various indoor positioning methods have been proposed both in theory and practice. Each method has different degree of accuracy. Due to the smaller indoor venues, the torrent for error is also smaller. Therefore, indoor positioning system requires more precise measurement than outdoor. Active RFID and real-time nano-precision positioning devices are used to assess the feasibility of indoor positioning system. It measures the distance using RSSI and TDOA, and analysis the experimental results.

Tom-Ole Bole [6] used established a multi-platform and multi-lingual on campus-information system. With the help of simplified maps, professional audio tracks, and high resolution panorama pictures a user is guided across the campus and provided with current information about visible and invisible services and options. A content management system allows adding any multimedia content, which will be useful for a visitor. In this way, the system can be used to deliver permanent information about the facilities of different university institutions as well as temporary information about or for certain events. The content can be provided in different languages, which again is of great value to international students and visitors.

Li-Jie Zhen [7] performed Radio Frequency Identification (RFID) positioning based on the signal strength which is well known and feasible method. But the researches based on signal strength usually make unsatisfied positioning error because of the instable of RFID signal. In this paper, we propose an indoor RFID positioning system which is based on the analysis of signal strength, the layout of sensing region, and the tracks of users. Different from the other RFID positioning systems, we use only one RFID reader with user, and the tags are layout in the positioning area systematically. The system integrates two phase work of positioning: analysis of signal strength in overlapping sensing area (Level 1), and analysis of users' movement directions with signal comparison (Level 2). The experiments show that the proposed mechanism improves the accuracy of positioning successfully.

Henry C. B. Chan [8] used RFID based positioning system with P2P network architecture. Radio Frequency Identification (RFID) technology has been designed for identification purposes, it can also be used for location tracking purposes. Here RFID-based location tracking system is used in a peer-to-peer (P2P) network architecture and investigates location estimation methods for the system. It makes three major contributions. First using P2P architecture can facilitate system setup and management. Second, some position estimation methods using radio signal strength, reference tags, and a simple formula with dynamic parameters. Third is the experimental result, which gives valuable insights into the design of an RFID-based position estimation system.

IV. LOCATIONING SYSTEM

The purpose of our project is to implement IPS indoor position system using active RFID.College does not authenticate persons without identity card, so an active RFID circuit is built in the card. RFID reader is placed at the required floors and using the Time of Arrival (TOA) we identify the person's position inside the campus .It also identifies the entering and leaving time of a person and is updated through GSM to the cloud. By specifying the RFID number the location of a particular ward is located and informed to the concerned staff.

V. SYSTEM ARCHITECTURE

The design represents two main sections namely,

- Hardware architecture
- Software architecture

A. HARDWARE ARCHITECTURE

It includes PIC16f877a microcontroller, active RFID reader, tags, GSM module and IoT modem, UART, LCD

1) Microcontroller:

PIC16F877A is an inexpensive single-chip microcontroller. The most important feature of a microcontroller is its capability of storing and running a program. It has some unique features like, a six variants ranging from 3.5K-14 Kbytes of Flash memory up to 256 bytes of RAM and a mix of peripherals including EUSART, CCP and onboard analog comparators. These devices are suited for applications that require more code space. They are looking to increase system performance and code efficiency by employing

hardware motor control and communication capability.

2) RFID Reader:

An RFID (Radio Frequency Identification) reader's function is to interrogate RFID tags. The means of interrogation is wireless and because the distance is relatively short; line of sight between the reader and tags is not necessary. RFID reader types are fixed, mobile or handheld. RFID reading capability is available as PCMCIA card. This card can be partitioned into small PDAs, tablet PCs or even cell phones.

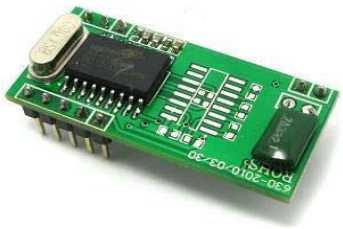


FIG: 1 RFID reader

3) RFID Tags:

The RFID tag consists of a unique identification number. The tag consists of chip and an antenna. The tag is mounted on the top of the vehicle which is accessed by using radio waves. The RFID reader has the capacity to communicate with the RFID tag.

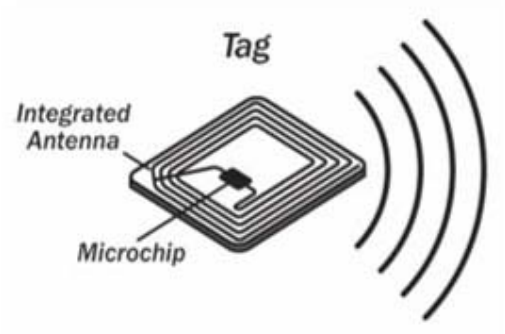


FIG: 2 RFID Tag

4) GSM Module:

GSM (Global System for Mobile communication) is a digital mobile communication modem developed for communication purpose using time division multiple access. A GSM digitizes the data and sends it through a channel with two different streams of client data, each in its own particular time slot. The digital system can carry 64 kbps to 120 Mbps of data rates.

5) IOT MODEM:

IoT (Internet of Things) is an advanced connectivity of devices, systems, and services. It covers a variety of protocols, domains, and applications beyond machine –to-machine communication. "Things," in the IoT refers to a wide variety of devices such as heart monitoring implants, electric clams, automobiles with built-in sensors, DNA analysis devices, and field operation devices. It is also known as a mixture of hardware, software, data and services. With the help of various existing technologies these devices collect useful data and flows the data between other devices.

FIG: 3 IOT Modem

6) UART:

The UART (Universal Asynchronous Receiver/Transmitter) plays an important role in interfacing. It is the key component of the serial communication. The UART takes bytes of data and transmits them individually in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. A single wire or other medium is used in the serial transformation of digital information...This is much more cost effective than parallel transmission via multiple wires.

7) LCD:

LCD (Liquid Crystal Display) is used for displaying the necessary the result.16x2 LCD is used for displaying purpose. 16×2 Character LCD is a very basic module which is commonly used in many electronics products. It contains 16 characters displayed in 2 rows. Using 5×8 or 5×10 dot matrix each character is displayed.

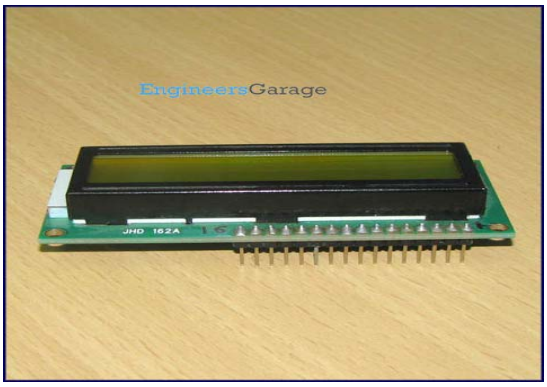


FIG: 4 LCD Display

B. SOFTWARE ARCHITECTURE

The software design uses embedded C language and MP Lab for compilation.

1) Embedded C:

Embedded C is used for microcontroller based application.

We find ourselves to be surrounded by various types of

Embedded systems. Embedded software governs the functioning of embedded systems. They have limited resource constraints like stack space, ROM, RAM, less processing power. Components used in embedded system are different from PC. Embedded systems uses less power consuming components and are more tied to the hardware.

Two salient features here are the code speed and code size. Code speed is based on timing constraints and processing power. Code size is based on the use of programming language and available program memory. Embedded system provides maximum features in minimum space and minimum time. It requires compilers to create files to be downloaded to the microcontroller where it needs to run. An embedded application makes the program code efficient, and satisfies the real time constraints.

2) MP LAB:

MP Lab provides a developing environment for many embedded applications on PIC microcontoller. The PICPgm Development Programmer Software is free and simple system development programmer software for PIC microcontrollers. Graphical User Interface (GUI) and a Command Line interface contains the programmer software. Programming hardware interfaces PC to PIC microcontroller. PICPgm supports a lot of different programs. It can be connected to the PC via the centronics port (printer port), serial COM port or USB.

VI. METHODOLOGY

Active RFID reader is used to identify the RFID tag containing the circuit. It can access up to a range of 10 meters

The detected values are sent to the microcontroller via UART serial communication.It transmits the data into the cloud using IOT modem to the specified server id.At the receiver end, we can access the server using server id and password.This configuration helps to locate the wherebeings of the tag holder within the campus.By using the unique id of each tag search operation can be used to find the location and time of the tag holder.

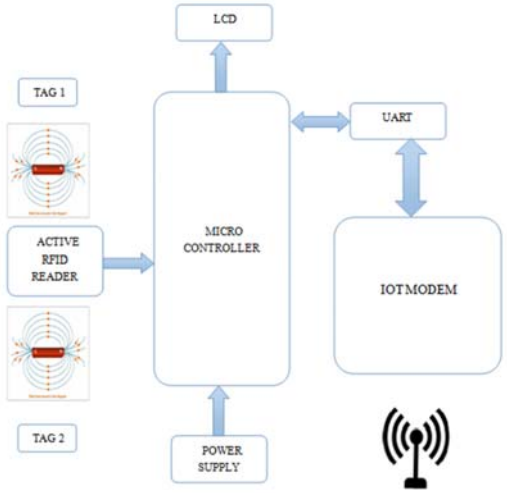


FIG:5 Transmitter Mode

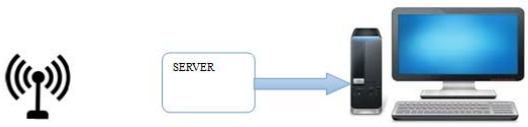


FIG: 6 Receiver Modes

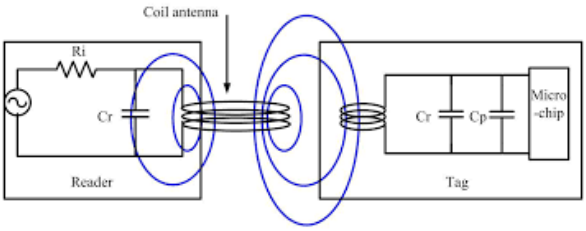


FIG: 7 RFID Configurations

RFID CONFIGURATION:

RFID reader and reader antennas together read the tags. Reader antennas convert the electrical current into electromagnetic waves. These waves are then radiated into space where they can be received by a tag antenna and converted back to electrical current.

VII. EXPERINMENT

To get a precise data, an experiment had been conducted with lab equipment to view the relationship of distance against those methods. The first experiment is measuring the time taken of data from transmitter (MISO) to receiver (MOSI). Figure 6 show the initial result of the close distance between transmitter and receiver. The green and yellow spectrum indicates to the transmitter and receiver respectively. As shown on screen the unit for the time taken is in microsecond. The distance between transmitter and receiver for this experiment start from 0.5 meter until 3 meter as far can get while using the oscilloscope due to the limitation of cable length. However, the result from first to last distance has been determined and the different of data get shown a very small change.

FIG 8 is close-up the spectrum to get more exact value. All the data had been record as shown on *FIG 9*.

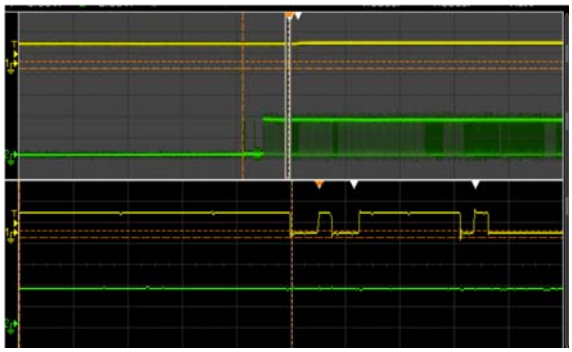


FIG: 8 Close-up spectrum

Based on *FIG: 9*, the delay and distance are increased simultaneously. Mean that is will be good to ensure the correct distance or location an object in a positioning system.

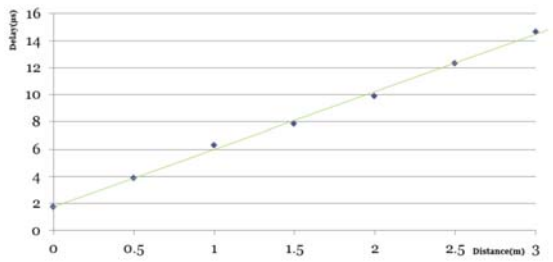


FIG: 9 Delays against Distance

The next experiment is to measure the signal strength of the transmitter related to their distance with a receiver. For this experiment, a standard 2.4 GHz monopole antenna been used as the receiver. *FIG 10* shows the power level of a transceiver to the receiver. The power lever for first distance is about -26 dBm and for last distance the power level down to around -44 dB transceivers been tested and the result shows that each transceiver has different power gain. The result of each transceiver is recorded as shown on *FIG 11*.

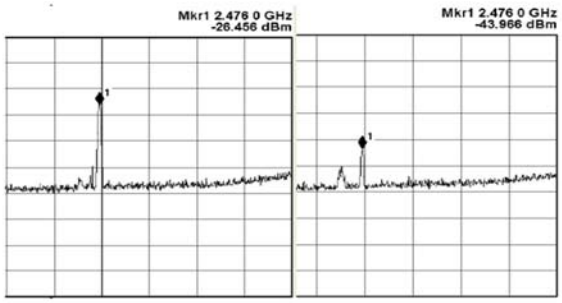


FIG: 10 Power level of transceiver

The *FIG 11* shown the measured power level of transceiver related with their distance to a receiver. The distance between the transmitter to the receiver star with 0.2 meters and increase by 0.2 meters until reach 5 meters distance. The red, yellow and green indicate transceiver 1, 2 and 3 respectively. Each of that transceiver gives a different value of power level. Transceiver 2 give a quite smooth value than the others two transceivers.

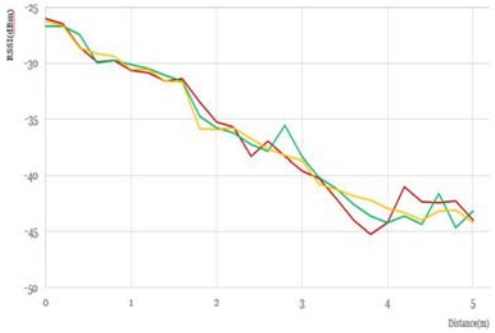
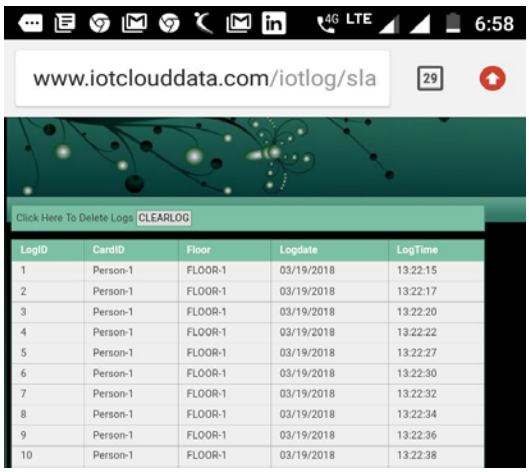


FIG: 11 RSSI against Distance

VIII. RESULT



IX. ADVANTAGES

- It provides continuous position values.
- Less power consumption.
- Numerous security related applications.
- Provides attendance related details.
- Cost efficient.

X. DISCUSSION

All those experiment doing by using a single transmitter and single receiver. When multiple of transceivers used in that experiment, the resulting change are detected. The result so unstable and sometimes cannot be determined. While testing the reader, one tag already counts by 100 times but other tags are only counted about 80 to 90 times. The tag collision happens when multiple tags are energized by the reader simultaneously. Whenever a large number of tags even just two tags been read together in the same field, this problem will occur. The reader is unable to differentiate these signal and tag collision confuses the reader.

XI. CONLUSION

To be a conclusion, ToA method seen good to be used in positioning system but when the delay happens can cause the error for the system. For the RSSI method, the system will be good to use unless the power of the tags being weak. So, each method had their own weaknesses such as delay of data receives high power consumption, crash or missing data and etc.

REFERENCES

[1] Y. Huang, "A study of re-over-fibre based active RFID Indoor Location System" *Department of Electronic and Electrical Engineering,* pp. 37-41, Feb. 2011.

[2] Xu Chen, Yasir Alfadhl, K. Keong Chai, "An Indoor Item Finder with Active RFID Tags," *communication Technology and Application (ICCTA),* pp 675-683, 2011.

[3] A. Y. Chang, Tsung-Chi L., I-Horng J., Dwen-Ren T., Chun- Jung C., "Performance Evaluation of Real-time Indoor Positioning with Active-RFID and CSS-based Nano Lock System," *fifth international joint conference on INC,IMS, and IDC.* pp. 1897-1898, 2009.

[4] Ching-Sheng W., Chun-Hong H., Yong-Si C., Li-Jie Zheng, "An Implementation of Positioning System in Indoor Environment based on Active RFID," *Dept. of Computer Science & Network Engineering,* pp 71-76, 2009.

[5] Felix C., P. Hui, Henry C., B. Chan, S.H. fung, " RFID-Based Location Tracking System Using a Peer-to-Peer Network Architecture," *International Multi Conference of Engineers and Computer Scientists(IMECS),* 2014.