Indoor Navigation Using RFID and Development of Android Application

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Abstract: **The advent of new advancements like GPS, RFID, Android, and Arduino has reformed the period of installed framework plan. These days, each client is encircled by shrewd gadgets which make their life more straightforward and agreeable. It has likewise been anticipated by the scientists that by 2020, there will be billions of implanted gadgets conversing with one another when contrasted with people named as Internet of things (IoT).**

This paper describes a system to improve indoor navigation through use of radio frequency identification (RFID) technology. This paper is worried about the advancement of independent portable application utilized for remote control and route. This is outfitted with RFID per user (for perusing the RFID labels to alter the root course), GPS area and Arduino (for computing the briefest way and furnishing orders to coordinate with the RFID and GPS module). This versatile application will be involved wide assortment of utilization for indoor route. The fundamental usefulness of the proposed plan is reproduced on root planned and the total plan is carried out around Arduino microcontroller with required vital connection points.

Furthermore, this paper gives an outline of best-in-class RFID innovation, especially with the end goal of indoor situating. It incorporates a survey of verifiable and current improvement of RFID innovation and its applications, an assessment of cutting-edge RFID-based situating methods and their exhibition as well as an expectation of future psatterns of RFID-based indoor situating procedures.

Keywords: IoT, Indoor Navigation, Android, RFID, Navigation system.

I. INTRODUCTION

Wireless sensor networks are widely deployed in many areas such as military, mining, healthcare, agriculture etc. This WSN consists of many small, low power, intelligent sensor nodes (motes) and one or more base stations. WSN networks generally operate in areas to which man does not have access. The distinguishing factor of WSNs is that they operate unattended over a period. These features have led to the success of the WSNs in real-world deployment [2]. WSNs are typically made of resource-constrained devices that are low-cost, low-power and low-bitrates supporting short-range communications.

Radio frequency identification (RFID) technology was originally invented for military uses. From 1980s, commercial RFID products started to be available, and they were mainly applied in areas of supply chains, transport, manufacturing, personnel access, animal tagging, toll collection etc. Nowadays, RFID has been recognized as an emerging technology for ubiquitous positioning (UP), especially in an indoor environment.

The development and implementation of RFID-based positioning technology are very fast, whilst according to the literature, little comprehensive review and convinced assessment for the latest RFID technology have been conducted, and some of the main features of the latest RFID technology have rarely or unclearly been presented in the literature, for example, the longest reading range of RFID systems, the smallest tag size and overall commercial application fields.

Navigation systems are now commonly used to find the right way between two points, or the shortest route. These systems use the Global Positioning System [5], [6] (GPS) and only work well in the outdoor environment as GPS signals cannot penetrate easily and/or are highly degraded within buildings. Several technologies have been proposed to make it possible to navigate within buildings. Radiofrequency identification [7], [8] (RFID) is one such technology. In the case of external environments, it has been suggested that some hybrid systems use GPS as the main source of information and RFID to minimize corrections and location errors.

A new way to give users location information is to use Radio Frequency Identification (RFID) tags. RFID tags can be embedded almost anywhere without an energy source due to their passive communication circuit. The tag stores positioning details and gives it to any user within a proximity range that for UHF RFID systems can be up to 10–15 meters [2]. We are suggesting an RFID-based navigation system for blind or visually impaired citizens in a house. The system relies on the tag's location information, the destination of a user, and a routing table where the shortest path to the destination from the current location of the user.

RFID technology is a step ahead from other current technologies in terms of accuracy and other advantages. Today, there are some RFID readers and tags which are plug and play on smartphones. These portable RFID readers and tags which can be easily found in market are not widespread because of some disadvantages such as short read ranges, causing mobile devices to run out of charge quickly and making attached mobile device grow. Besides, with the advancement of technology it is expected that RFID readers and tags are placed inside mobile devices in production just like integrated WIFI adapters and this advancement will provide a more effective use of RFID soon. Hence, mobile phones will be able to use RFID based indoor positioning systems and serve various personalized services.

II. THE PROBLEM ARCHITECTURE

The concept of indoor navigation is a development of navigation system which is applied to guide the visually impaired people at an indoor environment. To provide an efficient and user-friendly navigation tool, a navigation device is developed by using passive radio frequency identification (RFID) transponders which are mounted on the floor such as on tactile paving to build such as RFID networks. The developed navigation system is equipped with a digital compass to facilitate the visually impaired people to walk properly at right direction especially when turning process. The idea of positioning and localization with the digital compass and direction guiding through voice commands is implemented in this system.

The purpose of indoor positioning system (IPS) is to determine continuously in real time the position of followed objects and people within defined workspace [3]. There are many different technologies and methods which can be used to create the indoor positioning system. Each of them has some advantages and limitations which are mentioned in further part of this section.

The Radio-frequency Identification (RFID) technology ensures a wireless communication between reader and tags (also called transponders). These are two main components of RFID systems. The reading range depends on the RFID technique and operating frequency [6]. Strictly defined radio frequency and protocol are used to transmit and receive the data both, by reader and tags [4]. There are two types of tags: active and passive. The passive transponders are powered only by the electromagnetic field transmitted by reader. No additional battery is needed. This is the main Types of location information Absolute Relative Proximity Technologies used for design of indoor positioning systems Infrared (IR) Radio Frequency Identification (RFID) Wireless Local Area Network (WLAN) Bluetooth Ultrasound Ultra-wideband (UWB) Magnetic Vision systems Hybrid systems IRMES 2019 IOP Conf. Series: Materials Science and Engineering 659 (2019) 012059 IOP Publishing doi:10.1088/1757-899X/659/1/012059 6 advantage of passive tags, as well as small size and low cost. The passive RFID technology has been replacing gradually barcodes [3].

In opposite to the passive tags, the active ones have built-in battery. The tags work as transceivers which transmit their ID or further data (saved in chip) in reply to signal emitted by reader. One of the characteristic features of active RFID tag is wide reading range, even up to 100 m for Super High Frequency technology [6]. Furthermore, active transponders have usually larger memory and smaller antenna than passive tags. The batteries of active RFID tags must be replaced periodically, what can be considered as main of their disadvantage.

III. RFID and GPS Module based Prototype

In this paper, the distance is about 7-10 centimeters. RFID (radio frequency identification) frequency range is low frequency range (30 KHz to 500 KHz). Keil software is used in this project, which is used in the highly efficient ATMEGA 328 microcontroller 3 RFID TAG. The RFID stone block is also used for navigating for blind people. Upon use, the type of RFID tag is selected. It is possible to install the tags along the footpath or at least at the footpath junction. The tag will contain the tag ID and the location of the device.

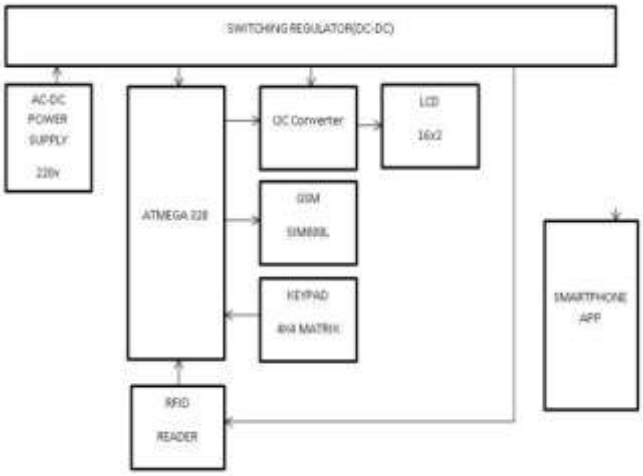

Figure-1: Resource consumption comparison between HTTP and CoAP

The complete circuit diagram as shown in the figure-1 at first the circuit is fueled up by the 220v power supply and beginning status of the circuit starts by requesting that the client enter telephone number and objective by utilizing keypad.

The order from keypad is passed to the regulator which enacts the I2C to save number of pins on microcontroller and to show the entered telephone number and the objective on the LCD.

Then the message is shipped off the approved telephone number with secret phrase with the assistance of GSM SIM800L. Then, at that point, the course guide of the specific division can be gotten to by the versatile application and the following of the individual should be possible by utilizing RFID per user and if there is any difference in course by the client, the client will be demonstrated by a signal sound to take the right course.

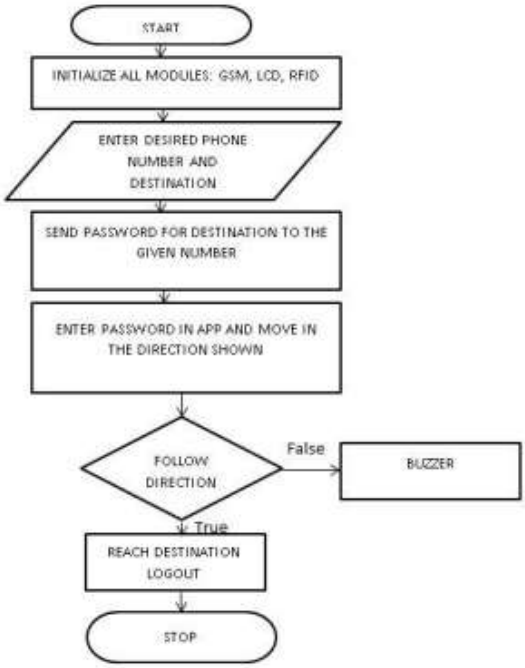

Figure-2: The flow diagram of indoor navigation system

As show in an above flow diagram -2, labels will be put on the floor in specific headings looking like that of a way to different workplaces or various structures in a ground. The guest will be given a RFID per user.
The heading to the specific office or structures in a ground will be displayed on a guide in his/her android PDA.
If the guest goes amiss a few times from the way displayed in the android PDA, the microcontroller will pass message to the android PDA by means of Bluetooth. On getting this message the android PDA will enact a predefined voice yield, subsequently recommending the guest to follow the right way.
On the off chance that the guest veers off from the way, for the third time, the microcontroller will pass this message to the android PDA by means of Bluetooth and as expected a voice result will likewise be made.
Right away, after the voice yield is given, a message will be passed to the security place on those grounds from guest's android PDA. As found in the block graph an LCD is added.
The LCD is utilized to show any occasion occurring among microcontroller and peripherals associated with it. An android application is made for this venture, to show the course guide of the grounds on any guest's android advanced cell. At the entry of the grounds the safety officer will be responsible for introducing this android application on any guest's android cell phone.
Programmed communicating of message to security focus is essential for the android application highlight. If guest follows right way or wrong way, an affirmation as voice result will be given through the guest's android telephone. The complete RFID system with GPS module integrated to the ATMEGA microcontroller module is as shown in the figure - 3.

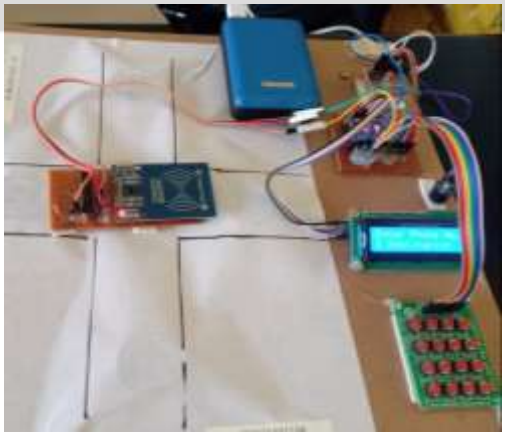

Figure-3: The Complete Hardware Module Design

MOBILE APPLICATION MODULE

The application is aimed at Android Mobile Operating System that has a widespread user and developer groups on the world (Dimarzio, 2008). Since the Android Application is generally developed based on Java programming language, Eclipse Interactive Development Environment (IDE) is used as a development environment. This study is realized in three basic steps. In the first step,

the database of the application is designed and provided a sample indoor environment's data. In the second step, the Android mobile application that works on client (smart phone) is developed.

An android application is made for this venture, to show the course guide of the grounds on any guest's android advanced cell. At the entry of the grounds the safety officer will be responsible for introducing this android application on any guest's android cell phone.

Programmed communicating of message to security focus is important for the android application include. Assuming guest follows wrong way, the bell begins to blare. As found in the block chart an LCD is added. The LCD is utilized to show any occasion occurring among microcontroller and peripherals associated with it.

The application connects to the server by using http protocol. The script on the server will run and send the photo frames back to the smart phone. The android application snaps as shown in the figure – 4.

Figure-4 a: Login Screen with User Credentials

Figure-4 b: Destination Selection Screen

Figure-4 c: Destination Reached Screen

IV. CONCLUSION WITH FUTURE WORK

In this study, an RFID based indoor positioning system has been introduced. An RFID (Radio-Frequency Identification) device was integrated to the indoor navigation system for smartphones. The pedestrian needs to carry an RFID device during his/her tour in the building. RFID device is used to determine the exact position of the pedestrian in indoor environments whose all floors, corridors, passages, and rooms are equipped with RFID tags. The RFID device, handed by the pedestrian, reads the tags, and find out pedestrian's 3D position in the building. The RFID device will send this position data to the server directly in every two seconds periodically. As soon as the script on the server gets the position data from RFID device and destination points from the smartphone, then it finds out the shortest path from departure point of the pedestrian to the destination point. The script sends visual navigation information to the client to inform the pedestrian on his/her way. The success of the mobile RFID device in estimating positions is 76%. In the case that position estimation error has been considered ± 1 meter, 87 measurements out of 90 which approximately correspond to 97% of total has provided the criteria. In the worst case, position estimation error has been obtained 2 meters. In 3 measurements out of 90 which approximately correspond to 3% of total, position estimation error has been observed 2 meters. Each indoor environmental photo could be loaded to the smartphone in two seconds by the script on the server via Wi-Fi internet connection. So, the pedestrian will get a real-time working indoor navigation system that is running on smartphone.

V. ACKNOWLEDGEMENT

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