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Indoor Position Mapping Using RFID Tags

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Abstract: RFID (Radio Frequency Identification) is technology used as RFID tags to locate the indoor places and easy to navigate and can also be used to track and manage automatically. It has wide application where GPS navigation is not possible at indoor places. RFID has been recognized as the next promising technology in serving the positioning purpose. Existing positioning technologies such as GPS are not available indoors as the terminal cannot get the signal from satellites. To enhance the availability of the positioning systems for indoors, the development of RFID positioning system for locating objects or people.feasibility of using passive RFID tags for indoor positioning and object location detection to provide real time information for tracking movement.

Keywords: Navigation, Satellites, Feasibility, Tracking, Enhancement, RFID tags, Radio Frequency.

I. INTRODUCTION

There are many different kinds of positioning technologies such as Global Positioning System (GPS), cellular phone tracking system, WiFi positioning system and RFID Positioning System. All these technologies have different coverage, applications, accessories and limitations. As GPS is a system developed for outdoor mapping, but for indoor mapping it is not possible due to some construction problems faced by the satellite which contols the GPS signals.

Thus signal does not reach inside a building or a campus due to the architecture. Bluetooth devices can b used for indoor mapping but it faces many problems for distance, as bluetooth has range upto 1m to 10m. Wifi has good range as compared to bluetooth, but not that good which can be used for positioning and mapping and wifi devices installation cost more and it makes the circuit more complicated. Wifi also needs full speed network and also routers installation. when it covers a large area because it requires deployment of expensive WiFi tags for tracking items. Since such tags are relatively expensive, they need to be removed from tracked places for reuse on places to be tracked. If the places to be tracked change frequently, the operation cost of transferring tags for WiFi positioning applications will be very high. For this problem we are developing indoor mapping using RFID tags which is very easy to handle and install and very cost efficient. Deriving an accurate propagation model for each WiFi access point in a real world indoor environment is extremely complex and therefore usually results in a relatively poor positioning accuracy. Designing a cost effective indoor positioning system remains an open challenge at present. This paper presents a real time and low cost indoor RFID positioning system. To offer a low cost indoor positioning solution for locating large number of items, passive tags are chosen rather than active ones.

Typically, a RFID system consists of a reader, tags and a computer that holds and processes the tags information. In general, RFID tags can be classified into active, passive and semi-passive tags. Active tags embed an internal battery which continuously powers themselves and their RF communication circuitry. Readers can thus transmit very low-level signals, and the tag can reply with high-level signals. Tags without battery are called passive tags. Generally, it backscatters the received carrier signal from a reader. Passive tags have a smaller size and are cheaper than active tags, but have very limited functionalities. The third type is semi – passive tags. These tags communicate with the readers in the same way as passive tags but they embed an internal battery that constantly powers their internal circuitry. Low cost systems usually use passive tags instead of active tags

II. PREVIOUS IMPLEMENTATION

Indoor position mapping[6] is very important in large area for the guidance of route, land surveying, for tracking objects in automobile industries, for robot navigation and it can also be used with developed features and technoloy for physically handicapped peoples for guiding the path. Traditionally, location information has typically been derived by a device and with the help of a satellite system (i.e. a GPS receiver).

However, such satellite system lacks the capability in achieving high coverage and positioning precision in indoor environments. Indeed, indoor positioning systems (generally) require cost-intensive installations and are (often) restricted to buildings or even some rooms inside a building. Stimulated by attempts to provide accurate indoor LBSs, interest in the role played by RFID in such applications has started to grow in the late 1990s. A new type of location detection technology and new market interest in data services was heavily researched nowadays.

Non-radio technologies are used for positioning without using the existing wireless infrastructure. This usually provides the accuracy which is being increased at the expense of costly equipment and installations.

- Magnetic positioning

Magnetic positioning which unexpectedly can offer pedestrians, indoor accuracy of 1–2 meters with 90% confidence level with smartphones , without using the additional wireless infrastructure for positioning. Magnetic positioning is based on the iron inside buildings that create

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local variations in the Earth's magnetic field. Un-optimized compass chips inside smartphones can sense and record these magnetic variations to map indoor locations.

• Inertial measurements
Pedestrian dead reckoning and other approaches for positioning of pedestrians propose an inertial measurement unit carried by the pedestrian either by measuring steps indirectly (step counting) or in a foot mounted approach, sometimes referring to maps or other additional sensors to constrain the inherent sensor drift encountered with inertial navigation. Inertial measures generally cover the differentials of motion, hence the location gets determined with integrating and thus requires integration constants to provide results. The actual position estimation can be found as the maximum of a 2-d probability distribution which is recomputed at each step taking into account the noise model of all the sensors involved and the constraints posed by walls and furniture.

• Wireless technologies
Any wireless technology can be used for locating. Many different systems take advantage of existing wireless infrastructure for indoor positioning. There are three primary system topology options for hardware and software configuration, network-based, terminal-based, and terminal-assisted. Positioning accuracy can be increased at the expense of wireless infrastructure equipment and installations.

• Wi-Fi-based positioning system (WPS)
Wi-Fi positioning system (WPS) is used where GPS is inadequate. The localization technique used for positioning with wireless access points is based on measuring the intensity of the received signal (received signal strength in English RSS) and the method of "fingerprinting". Typical parameters useful to geolocate the WiFi hotspot or wireless access point include the SSID and the MAC address of the access point. The accuracy depends on the number of positions that have been entered into the database. The possible signal fluctuations that may occur can increase errors and inaccuracies in the path of the user. Anyplace[25] is a free and open-source Wi-Fi positioning system that allows anybody to rapidly map indoor spaces and that won several awards for its location accuracy.

• Bluetooth
According to the Bluetooth Special Interest Group. Bluetooth is all about proximity, not about exact location. Bluetooth was not intended to offer a pinned location like GPS, however is known as a geo-fence or micro-fence solution which makes it an indoor proximity solution, not an indoor positioning solution. Micromapping and indoor mapping has been linked to Bluetooth and to the Bluetooth LE based iBeacon promoted by Apple Inc.. Large-scale indoor positioning system based on iBeacons has been implemented and applied in practice.

• RFID
RFID technology is a noncontact and automatic identification technology that uses radio signals to identify, track, sort and detect a variety of objects including people, vehicles, goods and assets without the need for direct contact (as required in magnetic stripe technology) or line of sight contact.

RFID has experienced a rapid evolution and broad implementation throughout the economy. It has become a worldwide and rapid-evolving technology, which has been combined with other emerging technologies worldwide. Today, there are a variety of technical solutions, some being simple and common, while others are complex and expensive but offer better functionality and performance. RFID has substantially increased productivity and efficiency of its associated business (Ramli 2010).

As intelligent RFID technology continues to develop, in conjunction with intelligent sensor technologies, RFID has been becoming the core technology of the Internet of things (IoT) (Holloway 2006b). Research and developments of RFID has been rapid, however, challenges remain, particularly in standards development, security compliance and privacy concerns (Choi et al. 2011).

The implementation of RFID requires diligent assessment of the need for RFID solutions in particular organisations. Therefore, it is important to explore and review this technology in order to maximise its potential benefits and reduce the risk of its implementation.

III.IMPLEMENTATION

Figure 1 shows the work principles of a typical passive RFID system[8],[9],[10],[11]. The power source of a passive tag is provided by the reader. When a radio signal is sent from a reader, when the tag enters the signal field of the reader, it will be powered on by the signal, the reader then captures the ID and data from the tag and sends this information to the host computer. The computer, with RFID middleware installed on, processes the data and sends it back to the reader; the reader then transmits the processed data to the tag. Passive RFID systems are normally used for applications in shorter reading ranges.

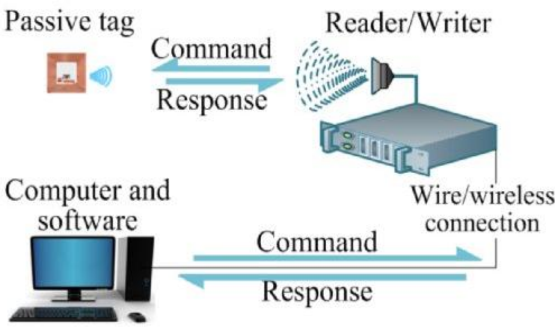

Fig. 1. Etypical passive RFID system

The principles of a semi-passive RFID system are similar to that of the passive system, except that there is a battery embedded in the semi-passive tag. The battery provides an on-board power source for the telemetry and sensor asset monitoring circuits of the tag so that the tag have more power to communicate. However, the on-board power is not directly used to generate radio frequency (RF) electromagnetic energy.

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• *Raspberry pi Model*

Suitable raspberry pi model can be used as per the requirement. We need the peripherals port for the connection of other devices like LCD, RFID reader module and some other devices can also be connected in future for measure implementation of the project. We will be interfacing LCD for the display of map with raspberry model. Map will be stored offline in the software created on desktop. RFID reader module will also be interfaced with raspberry model to communicate with RFID tags and to set the co-ordinate update as per the location of user changes.

• LCD interface with raspberry pi

LCD which is cheap and widely available for any project useful for displaying information. LCD is interfaced using I2C bus with IC PCF8574 and characters can be displayed on LCD. PCF8574IC is general purpose bidirectional 8 bit I/O port expander that uses I2C bus.

For implementation of this system, we are using the algorithm named Dijkstra algorithm[12] for shortest path. In map there may be many routes to reach a single destination but only one shortest path form the user acquired source which can be found using Dijkstra algorithm. This saves user time to find path in no time

I. as this will be beneficial for user.
II. Steps to create Dijkstra algorithm
III. Create sptSet (shortest path tree Set) setting the co-ordinates of rfid tags.
IV. Take initially all the co-ordinate as infinity.
V. Set null as start sptSet.
VI. Set all the weight from each co-ordinate to other.
VII. Assign v as start co-ordinate and u as destination

All the weight is calculated from v-u and shortest path is calculated.

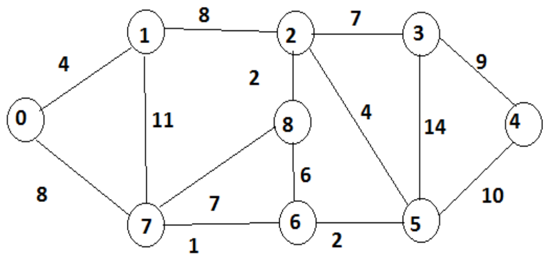

Fig. 2. Example of Dijkstra algorithm

Let us create the example graph discussed above

graph= {0, 4, 0, 0, 0, 0, 0, 8, 0},
{4, 0, 8, 0, 0, 0, 0, 11, 0},
{0, 8, 0, 7, 0, 4, 0, 0, 2},
{0, 0, 7, 0, 9, 14, 0, 0, 0},
{0, 0, 0, 9, 0, 10, 0, 0, 0},
{0, 0, 4, 0, 10, 0, 2, 0, 0},
{0, 0, 0, 14, 0, 2, 0, 1, 6},
{8, 11, 0, 0, 0, 0, 1, 0, 7},
{0, 0, 2, 0, 0, 0, 6, 7, 0}

In fig. 3, actual haradware implementation of project is shown. In which raspberry pi board with TFT display and RFID reader with RFID tags are shown. We can increase the number of RFID receiver for actual implentation of this project.

Fig. 3. Actual Hardware Impletation

IV. CONCLUSION

As we can observe that GPS is not applicable in indoor navigation, so many problems are faced for indoor navigation. Not only for tracking the location but also for tracking any object at indoor places such as automobile industries etc. Places where people need directions for navigation takes more time to find where the person need to go according to his requirements. This is very time consuming and very difficult.

Solving this problem will ease the work and it will manage time. People will easily reach their destination easily without any help and fast and accurate. This will also help to track the object easily. Physically challenged people will reach their destinaion without second person helps with ease.

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