A Survey Paper on Indoor Person Tracking Using Wireless Technology

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Abstract: -- In a day of 24 hours, people spend most of the time indoors, such as schools, colleges, government and corporate offices. In big organizations, there is need to track the person and manually tracking the person is very time consuming task. Some of the solutions for this are GPS and wireless technology. In this paper, a detailed study of the existing system is carried out. This paper also includes comparative analysis of existing system based on the parameters such as power consumption, range, scalability and cost.

Keywords— indoor person tracking, Wireless Technology, Radio Frequency Identification Device(RFID), Global Positioning System(GPS), Ultra Wide Band(UWB), Bluetooth Low Energy(BLE)

I. INTRODUCTION

An indoor person tracking system is a system to track person inside buildings using sensory information advertised by tags and collected by wireless devices. Wireless technology constitutes a popular area research in indoor person tracking system[2]. In big organizations, like schools, colleges, government and corporate offices it is difficult to track latest indoor position of the person which is time consuming task. Indoor person tracking is technical challenge because Global Positioning System(GPS) does not work reliably within interior space. GPS uses the triangulation method but it produces approximate error of 10m. This error is tolerable outdoor but not indoors. The GPS signals don't. penetrate through the walls of the buildings. GPS and maps are great but they only work outdoors and with clear line of sight to the sky.

II. EXISTING WORK

Positioning can be classified into two types-outdoor positioning which is carried outside the buildings and indoor positioning inside the building such as schools, colleges, government and corporate offices.In this section existing system for tracking person indoor as well as outdoor are discussed.

One of the person tracking system that is in existence use Wireless Sensor Network using Radio Frequency Identification Device(RFID) and Passive Infrared(PIR) sensor. RFID technology is used in automated tracking and it provides the ability to read multiple tags simultaneously. RFID has three components: a reader, an antenna and a tag. RFID reader contains radio frequency module (a transmitter and a receiver), a control unit and an interface to forward the data which is placed in sensor node. Sensor nodes are spread throughout the area either randomly or uniformly, to detect and track objects[2].

In general, an RFID sensor will be in sleep mode and become active upon the entry of a person into coverage area. The node contain PIR sensor and RFID reader, a GPS receiver, a timer and an ARM processor. A RFID tag which contains the unique employee Id is used for tracking the person. The timer provides the sensed time information of the person. The RFID tag information is read by RFID reader and the sensor location information is obtained from the GPS receiver. RFID-R, GPS-R and PIR sensor are integrated with an ARM processor. A person is detected by PIR sensor and the location of the sensor gives the current location of the person detected by that sensor. A KalmanFilter(KF)is used to predict the next position of the person using the current location co-ordinates and time information. The error in sensor location measurement is filtered using KF [2].

M. Mohandes and K. Balakrishnan[4] developed a system which is helpful for pilgrim tracking. Mostly Muslims are crowded at place of Hajj to meet the relatives

and perform kind of rituals. Because Muslims are obliged to have Hajj in their life atleast once or more if they like it. So we need to keep a track of people that go to Hajj.

Solution to this problem is to use RFID and GPS. By using this solution they made a system which will be helpful for tracking. Every pilgrim in Hajj has its own identity card. RFID provides services using RFID technology. The packets are received by user or receiver. Every single RFID tag ahs its own set of information. Sensors are fixed and communicating with mobile units that are carried by pilgrim to make queries and accessing location and UID information. GPS receiver receives the signal from the tag processes it and produces output. In output it contains the UID of the pilgrim person, location of that person with its timestamp. So this system is useful to find pilgrim location in Hajj.

Lijun Jiang [5] designed one system in which integrated UWB and GPS is used for location sensing in hospital environment. One of the widely used system for location sensing is GPS for outdoor environment. GPS uses triangulation to compare position from signals which are sent by satellites. Due to the poor coverage of satellite signal, GPS does not work properly indoors.

The use of GPS with UWB together in a portable device provides mobile, real time indoor outdoor position tracking.
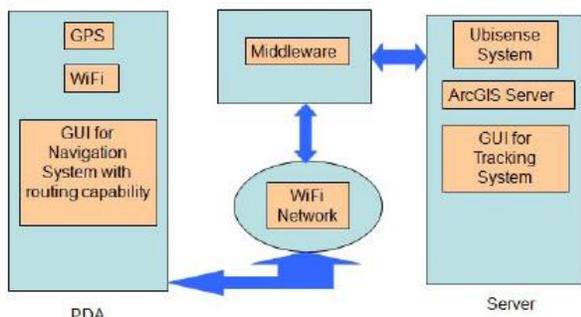

Fig 1: Patient tracking using GPS and UWB[5]

Fig. 1 shows the application scenario, when he/she is outdoor, user is located by GPS. Still there are many challenges in this system, as the system depends on Wi-Fi network to transmit data. And sometimes the update rate is low due to the traffic jam.

When the user enters into the indoor area or environment, the UWB beacons that are installed goes into UWB mode for indoor tracking,. Then both indoor as well as outdoor location information is transferred to a server, and the map and location of user is displayed on server and a handheld device[6].

RFID is wireless identification technology which is used in many applications related to Wireless Sensor Network. One of the solutions for bus monitoring system is RFID. They used RFID, GPS, GPRS and GIS that are integrated together to develop system. The purpose to build the system, to develop intelligent system to handle the situation without interference of humans. They make use of auto positioning system to monitoring, controlling and vehicle management [6].

For tracking purpose they make use of RFID and sensing technologies. The interfacing of RFID, GPS, GPRS and GIS is done to analyse the location of bus, information about driver and bus status whether bus is in working state or not and to check bus follows schedule or not. The sensing elements like RFID reader, GPS and GPRS transmitter are kept together in black box attached to moving bus. Every bus station has RFID tag associated with it[6].

As the distance between bus and station decreases, the interaction between them gets starts. At the same time GPS module gets activated and it provides the location of bus. The data generated by RFID and GPS both are sent to database through the web server over GPRS network. Transmitter continuously sends data until it received by the receiver. After receiving the data it is stored into the database with timestamp. Data in the database is updated regularly until system gets shutdown or off[6].

Xin-Yu Lin [8] proposed a system that consists of a iBeacon(Apple's beacon), a app installed on patients mobile and a server. The system computes patient's medical information, patient's location information and staff information. The app is installed on patients mobile after the registration is done. The app gets the signal from the nearest beacon and it then helps to identify the real time location of the patient. The medical staff can then see the patient's location on the mobile devices.
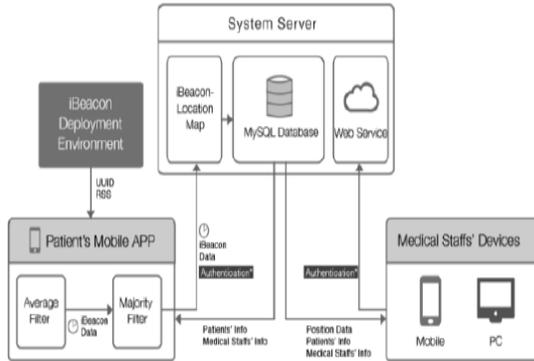
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Fig 2: Patient Tracking using iBeaconTechnology[8]

Ben AmmarHatem and HamamHabib[9] designed one system which can monitor bus traffic under large scale bus stations and provide information/give information to administration about arrival time of bus. Many emerging technologies can help administrator to monitor bus traffic and giving satisfaction to bus users. Some known technologies for identification like closed-circuit television(CCTV) and GPS.

At every bus station CCTV can be deployed by using image processing technique arrival of buses can be identified. To detect bus in the traffic image recognition was performed. The result of all this performance showed poor performance in tracking based detection.

GPS was also used to monitor bus traffic. Before giving the actual position of the but, GPS communicates with atleast 4 satellites.. As clear line of sight is required between the receiver and the satellites to give accurate position otherwise signals gets attenuated. While monitoring bus traffic underground gives main limitation of this system.

The drawbacks of the existing system can be summarized as follows:
- ♣ While reading several tags at a time results in signal collision and data loss. So to prevent this anti-collision algorithms are used which requires more cost
- ♣ If RFID active tags are used, it consumes lot of power.

- ♣ The GPS signal is unable to pass through to solid structure, so it doesn't work indoor underground or under dense trees.
- ♣ The GPS signals reflect from the buildings, grounds. So this causes inaccuracy or delay in the signals. To gain accuracy Global Navigation Satellite System (GNSS) receiver is under development which is very costly.
- ♣ To use GPS system, internet connectivity is required. And the technology is very power hungry, most system will last only 8-12 hours before needing a battery replacement or recharge

III. COMPARISON

Technology	Power Consumption	Scalability	Cost	Range	Drawbacks	Applications
GPS	Very High	Yes, but for outdoors only	Expensive	Miles	The signals cannot penetrate through walls	To track the items outdoor
RFID	Active(High) Passive (Moderate)	Yes	Expensive	Several metres	Along with tags it requires other components like reader	To track the items.
BLE	Low	Yes	Cheap	100m+	They need to be regularly checked for battery levels.	To track the items indoor

IV. CONCLUSION

This paper provides survey on the existing indoor positioning tracking system. It also provides comparative analysis of the technologies that are used to design the indoor and outdoor system. As this survey paper is on indoor tracking, from overall survey performed it is clear that BLE is suitable for indoor person tracking system as it consumes less power, it works efficiently. It covers a large area because of its range. And thats why it is best for indoor positioning.

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