Indoor Person Tracking Using Wireless Technology

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Abstract - *Now-a-days the importance of tracking the persons location indoors i.e. inside a buildings, organization is increasing, as it saves time and reduces delays caused in work. This paper represents real-time tracking of the person using Wireless Technology. This system makes use of Bluetooth Low Energy (BLE) beacons and Raspberry pi micro-controller. The beacons provide the person's identity while the micro-controller provides location. The system architecture and implementation results are illustrated in this paper.*

Key Words: **indoor person tracking, Wireless Technology, Bluetooth Low Energy (BLE), Raspberry Pi**

1.INTRODUCTION

Indoor sensing system has become very popular in recent years. Indoor sensing is basically asset tracking or person tracking. Asset tracking means identifying the position of a particular asset or a thing within particular area. Person tracking means tracking person position after a particular interval. People and assets are tracked in many areas of life to serve a number of purposes, some with good intentions and some bad.

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]. Majority of people spend their time indoors. 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.

2. ARCHITECTURE DESGIN

In this Section, we will briefly describe the system. The structure of the system is presented in the Figure 1. This system contains four major components i.e. Bluetooth Low Energy beacon, raspberry pi 3B microcontroller, central system and a display unit.

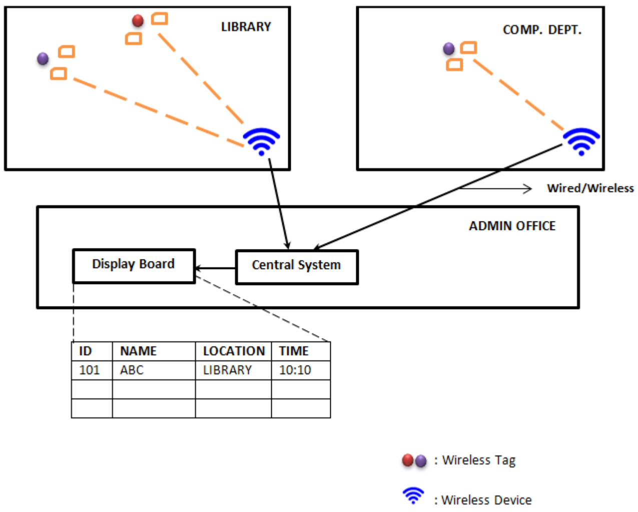

Fig -1: The System Architecture

Bluetooth Low Energy (BLE) beacons are provided to every member of the organization. BLE is a coin sized device that operates in 2.4GHz license free band. Each BLE has a MAC address. The raspberry pi acts a receiver which is installed in every area where the person needs to be tracked. The raspberry pi has both WiFi and BLE modules integrated. The BLE is a device which transmits packets after a given time interval. Let's consider interval of 5 seconds. When the BLE comes in the range of raspberry pi, the raspberry pi receives the packets from BLE. Raspberry pi extracts the MAC address of BLE. It then forms a packet containing MAC address of BLE as well as Raspberry pi and forwards that packet to the central system.

The central system contains database of the members of the organization. The database contains personal as well as professional details. The MAC address of BLE is mapped to the user id, as each user has a unique id. The MAC address of Raspberry pi is mapped to location name. Then latest information from the database is retrieved and sent to the display board.

3. HARDWARE IMPLEMENTATION

The four major components used are: Bluetooth Low Energy (BLE) beacon, Raspberry Pi microcontroller, central system and display unit.

A. Bluetooth Low Energy(BLE):

BLE is a IEEE 802.15.1 standard that uses license free band i.e. 2.4GHz. It consumes less power as well as its range is 100m+. BLE supports two protocol standards Eddystone and iBeacon. Eddystone works in two forms Eddystone UID and Eddystone URL. The one used for this system is Eddystone UID. It is a unique, static ID with a 10-byte Namespace component and 6-byte Instance component.

The main task of BLE is to just advertise the packets after the given interval. The interval can be adjusted from 1second-30seconds. The battery life of the device is from 2 months to 2.2 years. The battery life depends on the time interval set for advertising the packets. The battery used by BLE is CR2032 Lithium battery.

Fig -2: Internal Structure of BLE

B. Raspberry Pi:

The microcontroller used in this system is Raspberry Pi 3 Model B. It is developed by Element9 and launched in February 2016. It has both Wi-Fi module and BLE module integrated in it. This model of Raspberry Pi has 1 GB RAM and 1.2GHZ quad core ARM processor. Raspberry Pi uses raspbian, debain, fedora, ubuntu operating system. We have made use of debian operating system. The raspberry pi acts as a receiver, it receives the packets advertised by BLE.

C. Central System:

Central System contains the database with all the employee entries. The personal as well as professional details are present. Also it contains the location information where the microcontroller is installed.

D. Display Unit:

Display Unit is basically screen used to display the current logs i.e. the current information about the employee. The information includes the employee ID, employee name, current location and time. The employee ID and employee name are static fields while the location and time are dynamic fields.

4. RESULTS AND SNAPSHOTS

Let us consider example of an organization. As mentioned above in Section II, every person has a BLE beacon. The beacon is embedded on every person's identity card. Each person has a unique user id. And every BLE has a unique MAC address. The Raspberry Pi is deployed at every location where the person needs to be tracked. The MAC address of Raspberry Pi is mapped to the location name.

The BLE beacons continuously broadcasts packets after a particular interval. These packets are received by Raspberry Pi present at particular location. At Raspberry Pi, packet is formed that contains MAC address of BLE and Raspberry Pi. Raspberry Pi acts as client, so it then forwards the formed packet to the server.

Central System acts as server which receives the packet. The data present in the packet is mapped with the database. BLE's MAC address is mapped with user id and Raspberry Pi's MAC address is mapped with location name. The system time is considered as the timestamp. The timestamp is used to denote the person with the particular user id is present at particular location at that point of time.

User ID	User Name	Location	Time
102	DEF	Admin Office	09:15:20
102	DEF	Computer Lab	09:20:00
101	ABC	Admin Office	09:30:05
101	ABC	Computer Lab	11:00:17
102	DEF	Admin Office	11:30:27
102	DEF	Computer Lab	11:45:45
102	DEF	Computer Lab	12:23:23
101	ABC	Computer Lab	12:30:34
101	ABC	Computer Lab	12:55:00
102	DEF	Admin Office	01:30:00
102	DEF	Computer Lab	01:45:23
101	ABC	Computer Lab	02:00:00

Fig -3: Logs at Central System

The Fig-3 shows how the logs are stored in the central system. For example, 1st record in the figure indicates User ID 102 whose name is DEF is present at Admin Office at 09:15:20. These records keep updating as the packets are received by the server.

User ID	User Name	Location	Time
101	ABC	Admin Office	09:30:05
101	ABC	Computer Lab	11:00:17
101	ABC	Admin Office	12:00:48
101	ABC	Computer Lab	12:30:34
101	ABC	Computer Lab	12:55:00
101	ABC	Computer Lab	01:34:34
101	ABC	Computer Lab	02:00:00

Fig -4: Logs of User ID 101

User ID	User Name	Location	Time
102	DEF	Admin Office	09:15:20
102	DEF	Computer Lab	09:20:00
102	DEF	Admin Office	11:30:27
102	DEF	Computer Lab	11:45:45
102	DEF	Computer Lab	12:23:23
102	DEF	Admin Office	01:30:00
102	DEF	Computer Lab	01:45:23

Fig -5: Logs of User ID 102

The Fig-4 and Fig- 5 shows the logs of User ID 101 User ID 102 respectively. For example, administrator and higher authority of any particular organization can check the whole day logs of any user. It is helpful for higher authority to analyze the performance of employee working in his organization. 1st record in the figure indicates User ID 102 whose name is DEF is present at Admin Office at 09:15:20. These records keep updating as the packets are received by the server.

User ID	User Name	Location	Time
101	ABC	Computer Lab	02:00:00
102	DEF	Computer Lab	02:02:23
103	PQR	Admin Office	02:05:26
104	XYZ	Computer Lab	02:08:12

Fig -2: Logs at Display Unit

The Fig-6 shows the logs on the Display Unit. The logs are updated on display board after the logs are updated in the database. The User ID and User Name are static fields. Location and Time keep on changing accordingly.

5. CONCLUSIONS

This system implements an architecture in which a person searches a user by seeing the display board. Due to which the time consumes by person to find out a particular user gets reduced. The display board consists of User ID, User Name, Location and Time retrieve from database. Graphical user interface is also provided to higher authority to check the particular details which has connection with database. Using this information stored in the database higher authority is able to check the performance of user such as how much time is spent by particular user at particular location in his organization in his working hours.

In big organization like school, colleges and government offices to find a particular person is a time consuming task, so this system can be implemented in such organization. Also to keep track of person and the whole day analysis can be perform using this system.

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