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Real Time Indoor Tracking System using Smartphones and Wi-Fi Technology

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ABSTRACT

Nowadays with the dispersion of wireless networks, smartphones and diverse related services, different localization techniques have been developed. Global Positioning System (GPS) has a high rate of accuracy for outdoor localization but the signal is not available inside of buildings. Also other existing methods for indoor localization have low accuracy. In addition, they use fixed infrastructure support. In this paper, we present a novel system for indoor localization. The solution proposed in this paper makes use of commonly available Wi-Fi networks and runs on ordinary tablet ,smartphones without any additional hardware installation. It comprises two steps i) Steps Calibration. ii) Navigation stage. The calibration step creates a "Wi-Fi fingerprints" for each room of floor. It minimizes the calibration time via waypoints. The navigation stage matches with waypoints and displays the path for user for source to destination and also enables the low consumption of smartphone battery for localization

Keywords: *Localization, Wi-Fi Fingerprints, Indoor Tracking, Smartphones, RSSI*

I. INTRODUCTION

Due to development of the communication networks and mobile computing, location based service (LBS) become very popular in recent years. The Global Positioning System GPS) are the earliest widely used modern system for outdoor positioning service. However, people spend most of their time inside buildings, where GPS has limited functionality. It is expected that in the near future, indoor positioning will gain more demand. The indoor environments are very tedious to track due to that large variety of technologies have been proposed for coping with them. From, available technologies, Wi-Fi technology can be well suit to provide indoor positioning service because most of the commercial infrastructures is well equipped with the Wi-Fi router. An increasing number of indoor positioning system have been proposed such as Bluetooth technique, Computer vision[, cellular networks[1]etc. All this system provide accurate results however, they rely on additional hardware which incurs more cost. Due to significant cost, energy consumption and specific environment range limitations such systems are hard to deploy.

The purpose of this paper is to overcome the limitation in order to provide to practical and accurate indoor Wi-Fi positioning systems (WPSs).

II. PRIOR APPROACHES

A. RFID Tags

Radio frequency identification (RFID) systems works on network of radio beacons and tags. The advantage of these systems are their reliability and accuracy. The disadvantage is the requirement for

numerous tags to be installed, along with a central network server and transmitters.

B. UWB

UWB (Ultra-Wide Band), unlike other technology, uses a sub-nanosecond radio pulse to transmit data in a wide range of bandwidth (normally greater than 500 MHz). Its transmission can be regarded as background noise to other wireless technologies, hence in theory, it can use any spectrum without interfere with other users. It uses small transmission power -41.4dBm/MHz (which is limited by FCC) meaning the power consumption is low. Another advantage of UWB is its immune to multi-path problems in theory.

C. NFC

Near Field Communication (NFC) is a wireless technology for short range communication. This technology has multiple applications such as payment, identification and sharing information. NFC operates in a frequency band of 13.56 MHz and supports various data transfer rates that can reach up to 424 Kbps. The setup time for communication in NFC is very small (less than 0.1 second). Also, it is used with a typical distance of less than 10 cm which is suitable for crowded places and safer in terms of its application.

D. Bluetooth

Bluetooth is a personal area network standard. Bluetooth is widely used for short distance communication like earphones, cell phones. It also uses 2.4 GHz and 5 GHz bands as Wi-Fi does. Bluetooth concerns the power consumption, it uses a very low transmission power. So the coverage of Bluetooth is shorter than Wi-Fi and other WLAN technology. Hence, Bluetooth is not suit for localization for large area.

III. Main Contribution

We proposed the Indoor positioning system which facilitate the location of user with the help of Wi-Fi hotspot feature which are embedded in most smartphone.

The proposed system make use of an improved Fingerprinting method.

The fingerprinting approach consists of a data collection process in which, the signal strengths at each fixed sensor node are measured and stored.

IV. Related work

The developed application is able to find the path to selected destination, the application proposed, in here, can work for Android Smartphones that has the feature of Wi-Fi embedded into it. Also, the proposed application can provide additional features such as its interactive functions with the users. It also provides promotion offers inside the shopping malls and can be operated offline.

A. Block Diagram

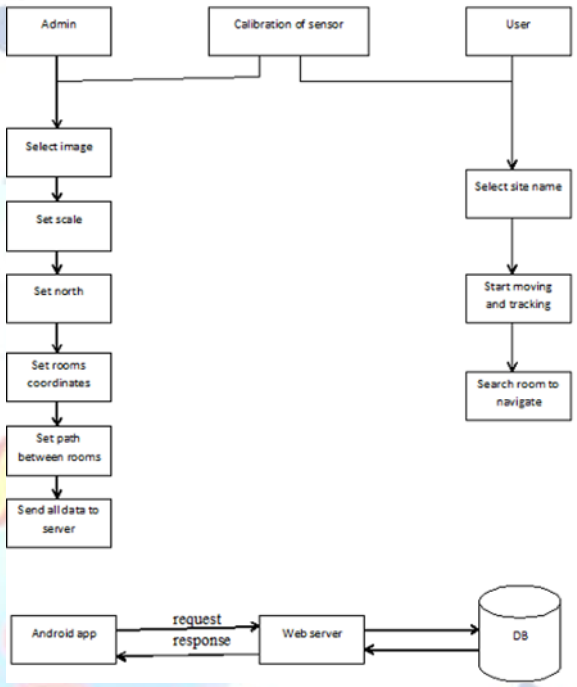


Fig 1: Block Diagram

B. System Implementation

1. Site creation and setup

The offline services consist of various tasks that need to be carried out when the system is in offline mode. This module basically consist the task which has to be carried out by the admin. In this module the admin initially creates the project for any particular building. He then has to create the desired floor map of each floor separately. Then admin has to insert the blueprints or images of the mag on to the server. The admin also has to build the particular path between various rooms.

2. Location identification and Tracking

Once the work of offline module is done, then the online module comes in to action. The online services are basically for the client or the user, who want to track their own location. In this stage the user needs to download the map of the floor in which he wants to track himself. Once the map is downloaded then user can locate his position and track himself from one room to another.

3. Admin Interface

The complete and proper working of the system is shown in this section in image format. The snapshots of each steps are been taken for better understanding of the system.

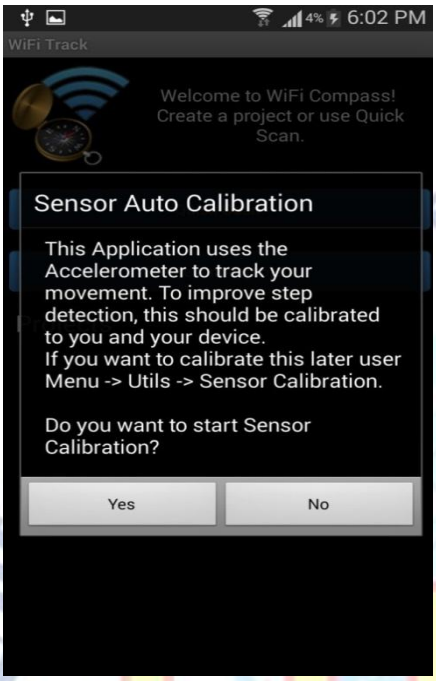
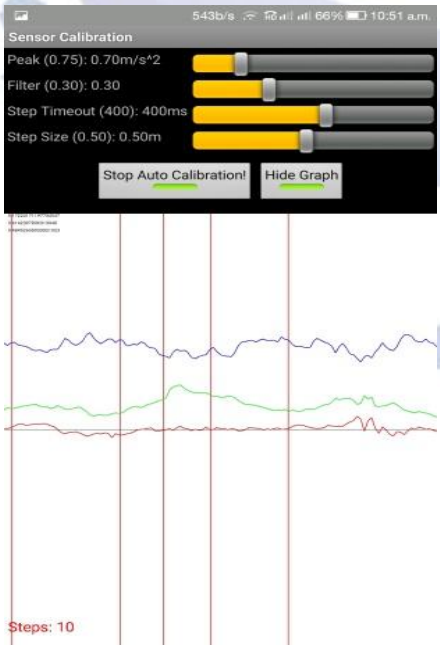


Fig 2. Calibration Stage

Fig 2. shows the image of Sensor Auto calibration. When admin runs the application for first time this window will appears and admin has to calibrate the steps. It can be done by walking in the area and admin has to tap on the screen each time when he takes a step. Approximately fifty steps should be walked to get the accuracy. `



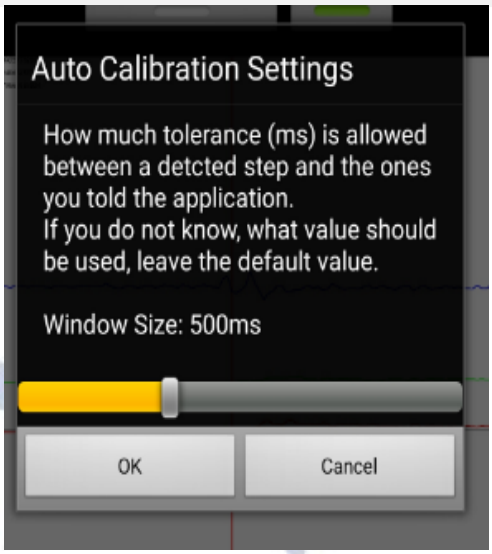


Fig 3. Graph of Sensor Calibration.

The Fig 3 shows the sensor calibration window in which it shows the graph of sensors. Once the walking is done admin has to stop the calibration and then, generated results are saved.

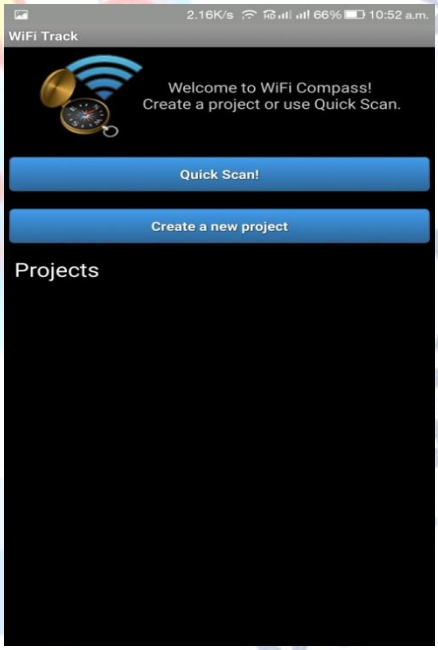


Fig 4. Admin Module

The Fig 4 shows the main screen of the admin side module. Here admin can create the project of any desired building. Admin can also select the option of quick scan and create the path for any site directly.

Fig 5. Map Setting.

In Fig 5 the admin has to select image of the plan of floor for particular site. Once the image of map is selected then admin has to scale the map in proper way.

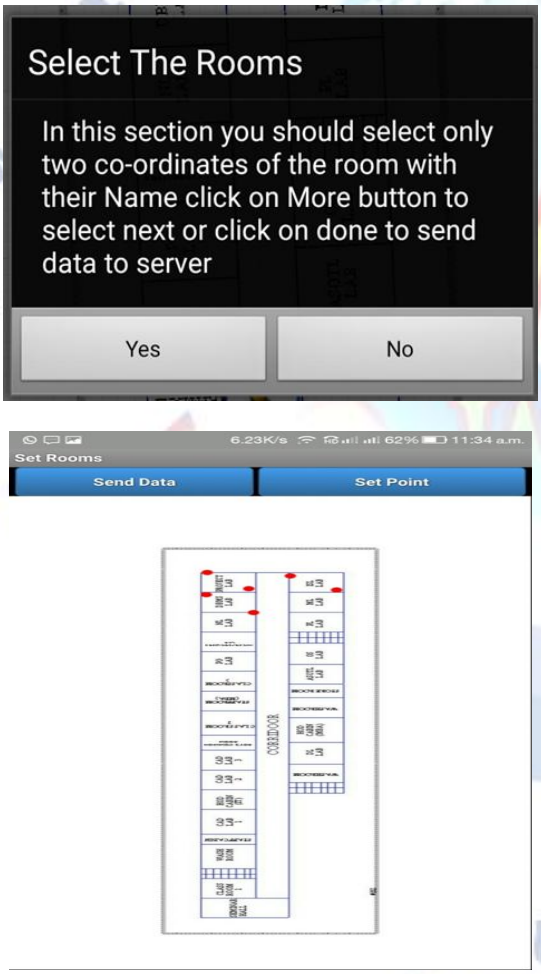


Fig 6. Co-ordinate Mapping.

Fig. 6 the admin has to select only two co-ordinates of the room and set any particular name to that room. Once the admin is completed setting all the rooms, data is send to server.

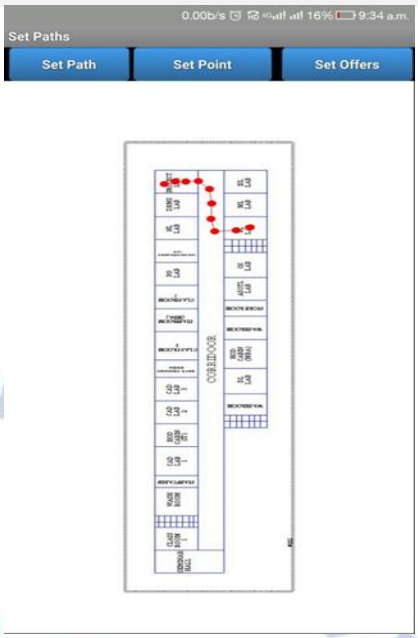
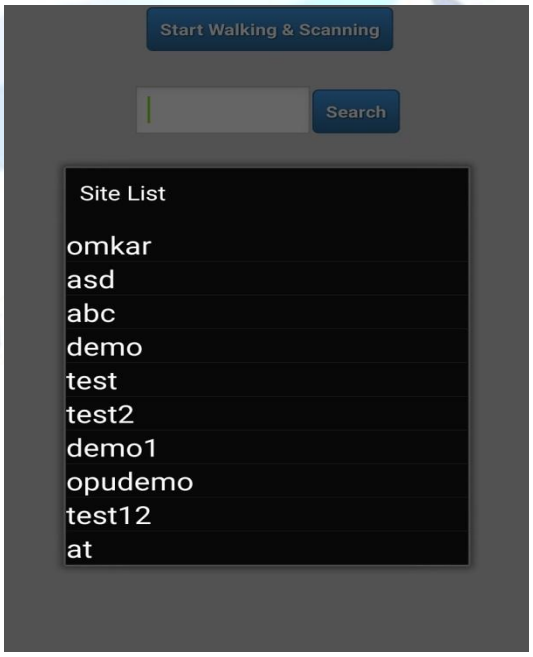


Fig 7. Set Path

In Fig 7 the admin has to set the path between rooms that were defined in previous step. Path can be set using multiple points and placing them in between the two rooms. After setting the coordinate's for room the pop up will be automatically generated which will display the list of pats that needs to be set up and any notice in case of college/school can be set or offers in case of Shopping malls can be set by admin.

4. Client Interface

. When the client application is opened the list of available sits is displayed as shown in Fig 8. Client has to select the desired site for localization and tracking.



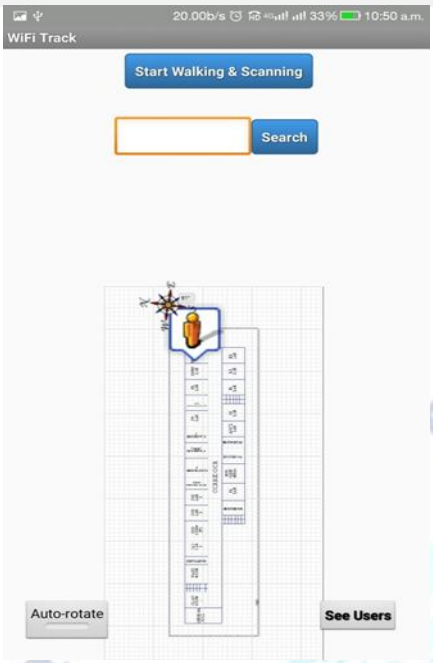


Fig 8. Client Interface

. Client has to select the desired site for localization and tracking.

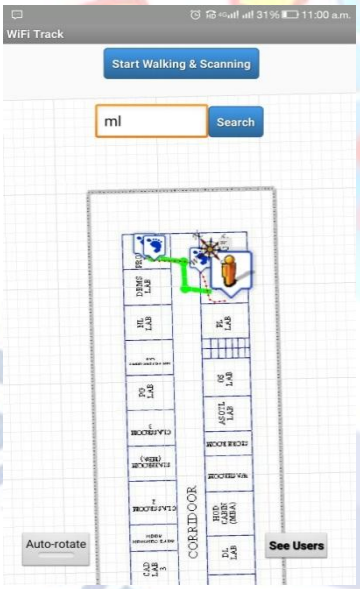


Fig 9. Path Displayed from source to destination

V. Result Analysis Table

Sr No	AP Number	Actual Distance	Existing System
1	1	7	8
2	2	10	15
3	3	15	17
4	4	4	6
5	5	6	11
6	6	7	9
7	7	20	18
8	8	16	17
9	9	18	20

The results of first table were obtained from nine access points from different distances. The values of actual distance and calculated distance between mobile user and access points are measured and compared. The comparison does not show the major difference between the actual and calculated distances. The actual distance is measured physically, by using measuring equipment's, while the calculated distance is measured by the system. The application is been developed which shows this calculated distance.

VI. Conclusion

This system leverages Wi-Fi system for tracking indoor rooms for user. User tries to search for any specific room then the application displays map of the location along with the current location of the user. Path from the user's current location to the user entered destination is displayed. In addition, it also detects user's current movement based on step calculation. These techniques don't require any additional hardware and as the sensors require very less battery consumption than the GPS. It can be used to save the battery. life. In future, the application may include features which are able to receive different angles of android users in real time and assist calculation of user steps. This could provide direction navigate service in real time. A voice over navigator can also enhance user experience in locating room.

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