Interactive Android-Based Indoor Wireless Tracking using Qr-Code

Snehal J. Borude
Student, Computer Engineering
Smt. Kashibai Navale college of engineering,
Vadgoan ,pune. University of Pune, Maharashtra.

D. H. Kulkarni
Professor
Asst. Professor, Computer Engineering, Smt.
Kashibai Navale college of engineering, Vadgoan,
Pune, University of Pune
Maharashtra

.

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 tablets,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 the displays the path for user for source to destination and also enables the low consumption of smartphone battery for localization..

.Keywords
Wireless indoor localization, fingerprinting, RSSI, smartphones.

1. INTRODUCTION
Finding wireless location is one of the key technologies for wireless sensor networks. GPS is the technology used but it can be employed for the outdoor location. But in case of indoor locations ,GPS does not work. Indoor locations include buildings like hospitals, big malls, parking, universities and Supermarkets under the same roof. In these areas the accuracy of the GPS location is rapidly dwindled. When the GPS is used under the indoor environments,location exhibited on the map is incorrect. But for the indoor localization it requires the highly precise GPS which is not feasible for the current view and also when the GPS is used in the mobile device it consumes a lot of the mobile battery to run the application which causes the drainage of the mobile battery within some hours. So to find out the precise location for indoor environment we use the RSSI-based trilateral localization algorithm[1].

Motivation
The main objective of the proposed a system is to find out the exact location of the mobile device under the indoor environment with the help of Wi-Fi routers and can navigate to the destination using the navigation function and also can enable the low consumption of the smart mobile battery for the tracking purpose. Comparing with outdoor localization, the difficulty of indoor localization lies in that indoor maps pay more attention to small areas, large-scale, high precision and subtly display of the internal elements User tries to search for any specific room then the application displays map of the location along with the current location of the user.

2. LITERATURE SURVEY
Inprevious systems radar was used for the calculation of location. It uses IR wireless networks for the location tracking and power levels to find the location of the device. The drawback with this system was that it can't be useful for the real time tracking of the devices. GPS can be used for the tracking of the outdoor areas but it wasn't effective if the areas are under the same roof. It is used only for the outdoor tracking.

Having identified the common measuring principles, the positioning algorithms and the important performance metrics of location positioning systems, we are able to discuss specific systems. There are two basic approaches to designing a wireless geolocation system. The first approach is to develop a signaling system and a network infrastructure of location measuring units focused primarily on wireless location application. The second approach is to use an existing wireless network infrastructure to locate atarget. The first approach is beneficial as the designers are able to control physical specification and, consequently, the quality of the location sensing results. The tag with the target can be designed as a very small wearable tag or sticker, and the density of the sensor can be adjusted to the required positioning accuracy. The advantage of the second approach is that it evades expensive and time-consuming deployment of infrastructure. These systems, however, may requires to use more intelligent algorithms to reimburse for the low accuracy of the measured metrics. Several types of wireless technologies are used for indoor location. It is beyond the scope of this paper to provide a total overview of systems available till now. The basic focus is on the wireless positioning systems primarily for indoor situations. There are some classification ways for surveying the indoor positioning system, such as application environments (such as 2-D/3-D positioning in office, warehouse, etc.), positioning algorithms, and wireless technologies.

A. GPS-Based
Global positioning system (GPS), or its differential complement DGPS [4], is one of the most successful positioning systems in outdoor environments. However, poor coverage of satellite signal for indoor environments decreases its accuracy and makes it unfit for indoor location estimation. SnapTrack,1 a Qualcomm Company, pioneered wireless helped GPS (A-GPS) to overcome the limitations of conventional GPS, and provide GPS indoors technique with an average of 5–50 m precision in most indoor environments. A-GPS technology uses a location server with a reference GPS receiver that can simultaneously discover the same satellites as the wireless handset (or mobile station) with a

partial GPS receiver, to assist the partial GPS receiver search weak GPS signals. The wireless handset gather measurements from both the GPS constellation and the wireless mobile network. These measurements are united by the location server to yield a position estimation. Recently, Atmel2 and U-blox3 proclaimed the availability of a new GPS weak signal tracking technology, called Super-Sense. With this new GPS software, GPS navigation becomes possible in building interiors and deep urban canyons because of its tracking sensitivity beyond −158 dBm. Part of the "Locata technology" consists of a time-synchronized pseudolite transceiver called a LocataLite. A network of LocataLites forms a LocataNet, which transmits GPS-like signals that allow single-point positioning using carrier-phase measurements for a mobile device (a Locata). The Satellite Navigation And Positioning (SNAP) Group at the University of New SouthWales has assisted in the development of a Locata and testing of the new technology.

B. RFID

RFID is a means of storing and fetching data through electromagnetic transmission to an RF compatible integrated circuit and is now being seen as a means of enhancing data handling processes [5]. An RFID system has several fundamental components, including a number of RFID readers, RFID tags, and the communication between them.The RFID reader is able to read the data outsen from RFID tags. RFID readers and tags uses a defined RF and protocol to transmit and receive data. RFID tags are classified by as either passive or active. Passive RFID tags operate without a battery. They are mainly used to replace the traditional barcode technology and are much lighter, smaller in volume, and less expensive than active tags. They mirror the RF signal transmitted to them from a reader and annex information by modulating the reflected signal. However, their ranges are very limited. The typical reading range is 1–2 m, and the cost of the readers is somewhat high. Passive RFID systems usually make use of four frequency bands: LF (14 kHz), HF (13.56 MHz), UHF (433, 868–915 MHz), and microwave frequency (2.45 GHz, 5.8 GHz).20 Bewator5 is a known passive RFID manufacturer. Active RFID tags are small transceivers, which can actively transmit their ID (or other additional data) in reply to requests . Frequency ranges used are similar to the passive RFID case except the low-frequency and high-frequency ranges. With the smaller antennae and in the much longer range (can be tens of meters),active RFID is advantageous . Active tags are ideally suited for the identification of high-unit-value products moving through a harsh assembly process. WaveTrend Technologies is one of the famous Active RFID manufacturers. A well-known location sensing system using the RFID technology is SpotON. SpotON uses an aggregation algorithm for 3-D location sensing based on radio signal strength analysis. SpotON researchers built and designed hardware that serves as object location tags. In the SpotON approach, objects are located by homogenous sensor nodes without central control, i.e., Ad Hoc manner. SpotON tags use received RSS value as a sensor measurement for estimating inter-tag distance. They achieve the density of tags and correlation of multiple measurements to improve both accuracy and precision.

C. Cellular-Based

GSM/CDMA mobile cellular network is used by number of systems to estimate the location of outdoor mobile clients. However,depending on the cell size, the accuracy of the method using cell-ID or lifted observed time difference (E-OTD) is generally low (in the range of 50–200 m). Generally speaking, the accuracy in densely covered areas is higher. (e.g, urban places) and much lower in rural environments. If the building is covered by several base stations or one base station indoor positioning based on mobile cellular network is possible with strong RSS received by indoor mobile clients.

Their salient idea that makes accurate GSM-based indoor

localization possible is the use of wide signal-strength fingerprints. The wide fingerprint includes readings of up to 6 additional GSM channels and the six strongest GSM cells, most of which are sturdy enough to be detected but powerless to be used for effective communication. The higher dimensionality enhanced by the additional channel dramatically increases localization accuracy. They present results for experiments conducted on signal-strengthfingerprints collected from three multi-floor buildings using weighted k-NN technique. The results show that their indoor localization system can differentiate between floors. Also achieve median within-floor accuracy as low as 2.5 m. The same technique could be applied in IS-95 CDMA and 3G mobile network.

D. UWB

On the spectral domain, the system, thus, uses an UWB (even >500 MHz wide). UWB is based on sending ultrashort pulses (typically <1 ns), with a low duty cycle (typically 1 : 1000). UWB location has the following advantages, UWB transmits a signal over multiple bands of frequencies simultaneously, from 3.1 to 10.6 GHz ,Unlike conventional RFID systems, which operate on single bands of the radio spectrum. UWB signals are also transmitted for a much shorter duration than those used in conventional RFID. UWB tags burn less power and can operate across a broad area of the radio spectrum than conventional RF tags. UWB can be used in close proximity to other RF signals without suffering from interference because of the differences in signal types and radio spectrum used. In order to determine which signals are correct and which are generated from multipath, UWB short duration pulses are easy to filter. The signal can pass easily through walls, equipment and clothing. Use of more UWB readers and strategic placement of UWB readers could overcome UWB signal interference cause by metallic and liquid materials. Short-pulse waveforms permit an accurate determination of the precise TOA and, namely, the precise TOF of a burst transmission from a short-pulse transmitter to a corresponding receiver. UWB location take the advantage of thecharacteristics of time synchronization of UWB communication to exploit very high indoor location accuracy (20 cm). So it is suitable for high-precision real-time 2-D and 3-D location. 3-D location positioning can be performed by using two different measuring means: TDOA, which measures the time difference between AOA and a UWB pulse arriving at multiple sensors. The advantage of using both means in conjunction is that a location can be determined from just two sensors deducing the required sensor density over systems that just use TDOA. To date, several UWB precision localization systems have been fielded .The Ubisense system is a unidirectional UWB location platform which comprises conventional bidirectional time division multiple access (TDMA) control channel. AOA and TDOA are used by the tags to transmit and locate UWB signals to networked receivers. Ubisense networks are designed by creating sensor cells. At least four sensors or readers are required by each Ubisense. An unlimited number of readers can be networked together in a fashion similar to cellular phone networks throughout buildings or collections of buildings. The readers receive data from the tags, from as far as 150 ft, and send it through the Ubisense Smart Space software platform.

E. WLAN (IEEE 802.11)

With a typical gross bit rate of 11, 54, or 108 Mbps and a range of 50–100 m, IEEE 802.11 is currently the dominant local wireless networking standard. This midrange wireless local area network (WLAN) standard, operating in the 2.4-GHz Industrial, Scientific and Medical (ISM) band, has become very popular in public hotspots and enterprise locations during the last few years.It appeals to use an existing WLAN infrastructure for indoor location by adding a location server. The accuracy of RSS is approximatly 3 to 30 m for typical WLAN positioning systems, with an update rate in the range of few seconds. Bahl et al. [9] proposed an in-building user location and tracking system—RADAR, which adopts the nearest neighbor(s) in signal-space technique, which is the same as the k-NN. Bahl et al. [9] proposed an in-building user location and tracking system—RADAR, which adopts the nearest neighbor(s) in signal-space technique, which is the same as the k-NN. The authors proposed two kinds of approaches to determine the user location. The first one depends on the empirical measurement of access point signal strength in offline phase. By implementing this experiment, it is reported that user orientations, number of nearest neighbors used, number of data points, and number of samples in real-time phase would affect the accuracy of location determination. The second one is signal propagation modeling. Instead of Rayleigh fading model and Rician distribution model , Wall attenuation factor (WAF) and floor attenuation factor (FAF) propagation model is used, , which are used in outdoor situation. WAF takes into consideration the number of walls (obstructions). The accuracy of RADAR system is about 2–3 m. In their following work RADAR was enhanced by a Viterbi-like algorithm. Its result is that the 50 percentile of the RADAR system is around 2.37–2.65 m and its 90 percentile is around 5.93–5.97 m. Horus system [9],which uses the probabilistic method, offered a joint clustering technique for location estimation. Each candidate location coordinate is regarded as a class or category. In order to minimize the distance error, location Li is chosen while its likelihood is the highest. The experiment results depict that this technique can gain an accuracy of more than 90% to within 2.1 m. Increasing the number of samples at each sampling location could upgrade its accuracy which in turn would improve the estimation for means and standard deviations of Gaussian distribution. Wireless location-sensing is actually a specialized case of a well-studied problem in mobile robotics, that of robot localization—determining the position of a mobile robot given inputs from the robot's various sensors (possibly including GPS, sonar, vision, and ultrasound sensors). In [10], Xiang et al. proposed a model-based signal propagation distribution training scheme and a tracking-assistant positioning algorithm in which a state machine is used to adaptively transfer between tracking and non-tracking status to achieve more accuracy. This system is reported to achieve 2 m accuracy with 90% probability for static position determination. For a walking mobile device, 5 m accuracy with 90% probability is achieved. While most systems like AeroScout (formerly BlueSoft) uses 802.11,based TDOA location solution which based on WLAN are using signal strength. It requires the same radio signal to be received at three or more separate points, timed very accurately (to a few nanoseconds) and processed using the TDOA algorithm to determine the location.

F. Bluetooth (IEEE 802.15)

Compared to WLAN ,Bluetooth operates in the 2.4-GHz ISM band., the gross bit rate is lower (1 Mbps), and the range is shorter (typically 10–15 m). On the other hand, Bluetooth is a "lighter" standard, highly ubiquitous(embedded in most phones, personal digital assistants (PDAs), etc.) supported by several other networking services in addition to IP. Bluetooth have small size transceivers called as tags. As any other Bluetooth device, each tag has a unique ID. This ID can be used for locating the Bluetooth tag. [11]. The BlueTags tag is a typical Bluetooth. The Topaz local positioning solution is based on Tadlys' Bluetooth infrastructure and accessory products. This modular positioning solution consists of three types of elements: positioning server(s), wireless access points, and wireless tags. The system's performance is appropriate for tracking humans and assets. This system avails room-wise accuracy (or, alternatively, 2-m spatial accuracy), with 95% reliability. The positioning delay is 15–30 s. The performance is further enhanced in their new generation Topaz system that integrates infrared and other transducers, with the Bluetooth positioning and communication capabilities. Antti et al. present the design and implementation of a Bluetooth Local Positioning Application (BLPA) [12]. First, they transform the received signal power levels to distance appraises according to a simple propagation model, and then, they use the extended kalman filter (EKF) to compute 3-D position estimate on the basis of distance estimates. The accuracy of BLPA is reported to be 3.76 m.

3. ARCHITECTURE DESIGN

In the system the user has an android application installed on the smart phone. The user first scans the QR using smartphone. Then the map of the site where he wants to carry out the tracking get downloaded on phone. Once the map is downloaded the location of the user is calculated using the data from the wi-fi routers and from the sensor of the smart phone and the location is plotted on the map. Using the searching functionality the user can search the desired location and can enable the animated path to reach to the destination.

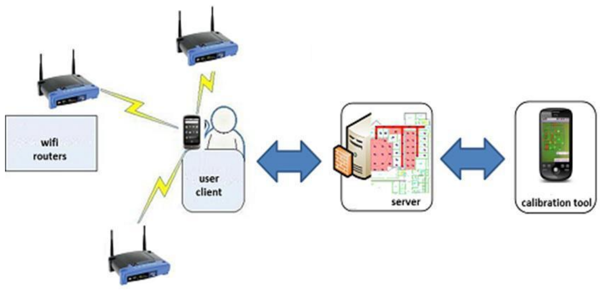

Fig 1: Architecture of system

In the system we are also taking assistance from the smart phone sensors. The sensors are accelerometer and the orientation sensors. As the user moves the values of these sensors changes. We are taking the continuous values form sensors in just to check the user movement. These is the extra functionality which we will be providing to find out the exact location and to have the live tracking of the path.

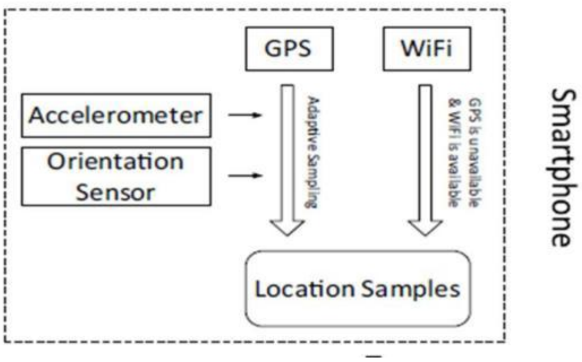

Fig 2. Mobile Sensor.

4. PROPOSED ARCHITECTURE DIAGRAM

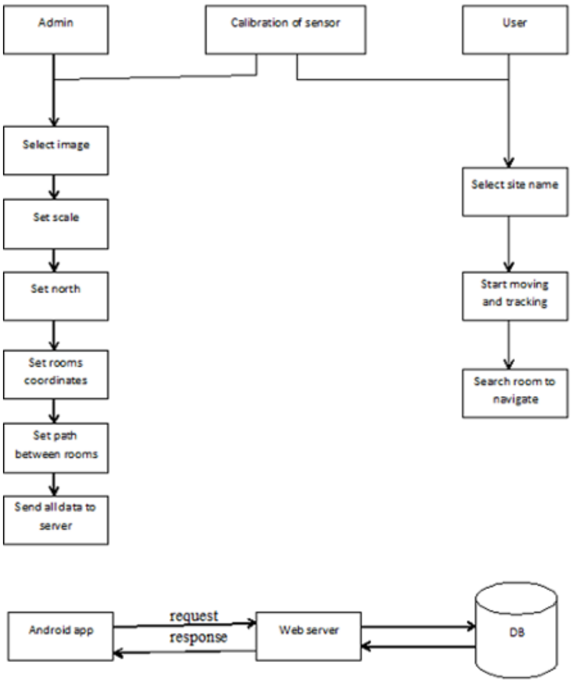

Fig. 3 Block Diagram

5. MATHEMATICAL MODEL

System Specification :

S= {s, X, Y, T, fmain, DD, CPUcount}

-S (system):- Is our proposed system which includes following tuple.

-s (initial state at time T) :-GUI of wireless indoor tracking.

-X (input to system) :- scan QR-code and search for room user wish to navigate.

-Y (output of system) :- Route to destined location

-T (No. of steps to be performed) :- 6. -fmain(main algorithm) :- It contains Process P.

-DD (deterministic data):- It contains Database data i.e the fingerprint database.

Subordinate functions:

Identify the processes as P.

S= {I, O, P....}

P= {SM, SR}

Where,

SM is floor map.

SR is site route.

P is processes

SM= {U, MAX, SC}

Where,

U= x,y co-ordinates for rooms

MAX = {1, 2, 3, … , n}

SC site created with number of rooms.

SR= {SC, Trilateration Algorithm, Info}

Where, SC is input which contains rooms and path information

Trilateration algorithm is used to calculate users current x,y co-ordinates from current user location and reference point. The path loss model is used to calulate the distance between user position and reference point

$PL(d)= PLo + 10\ n\ \log_{10} \frac{d}{d_o}\ d \geq d_o$

Where, do= reference point PLo= path loss at reference distance n = path loss exponent (residential indoor environment is 3.9-3.21).

6. 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.

7. REFERENCES

[1] Xiuyan Zhu, Yuan Feng*, "RSSI-based Algorithm for Indoor Localization Communications a Network",2013,5,3742 doi:10.4236/cn.2013.52B007 Published Online May 2013 (http://www.scirp.org/journal/cn)

[2] Indoor Tracking-http://www.ijraset.com/

[3] Anthea Wain Sy Au, Chen Feng, Shahrokh Valaee, Senior Member, IEEE, Sophia Reyes, Sameh Sorour, Member, IEEE, Samuel N. Markowitz, Deborah Gold, Keith Gordon, and Moshe Eizenman, "Indoor Tracking and Navigation Using Received Signal Strength and Compressive Sensing on a Mobile Device", IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 12, NO. 10, OCTOBER 2013

[4] P. K. Engee, "The global positioning system: Signals, measurements and performance," Int. J. Wireless Inf. Netw., vol. 1, no. 2, pp. 83–105,1994.

[5] RFID, (2002, Mar.). [Online]. Available: http://people.interactionivrea.it/c.noessel/RFID/research.html

[6] L. M. Ni,Y. Liu,Y. C. Lau, and A. P. Patil "LANDMARC: Indoor location sensing using active RFID," Wireless Netw., vol. 10, no. 6, pp. 701–710, Nov. 2004.

[7] J. J. Caffery and G. L. Stuber, "Overview of radiolocation in CDMA cellular system," IEEE Commun. Mag., vol. 36, no. 4, pp. 38–45, Apr. 1998.

[8] P. Bahl and V. N. Padmanabhan, "RADAR: An in-building RF-based user location and tracking system," in Proc. IEEE INFOCOM 2000, Mar., vol. 2, pp. 775–784.

[9] M. Youssef, A. Agrawala, and A. Udaya Shankar, "WLAN location determination via clustering and probability distributions," IEEE Int. Conf. Pervasive Comput. Commun., Mar. 2003, pp. 143–151.

[10] Z. Xiang, S. Song, J. Chen, H. Wang, J. Huang, and X. Gao. (2004, Sep./Nov.). A WLAN based indoor positioning technology. IBM J. Res. Develop. [Online]. Available: http://researchweb.watson.ibm.com/journal/rd/485/xiang.html

[11] P. Prasithsangaree, P. Krishnamurthi, and P. K. Chrysanthis, "On indoor position with wireless LANs," 7 in Proc. IEEE Int. Symp. Pers. Indoor, Mobile Radio Commun., Sep. 2002, vol. 2, pp. 720–724.

[12] A. Kotanen, M. Hannikainen, H. Leppakoski, and T. D. Hamalainen,"Experiments on local positioning with Bluetooth," in Proc. IEEE Int. Conf. Inf. Technol.: Comput. Commun., Apr. 2003, pp. 297–303.