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REALTIME INDOOR NAVIGATION SYSTEM

AVESH MISHRA[1], ANITA TANDALE[2], AKSHAY MODAK[3], SAMRUDDHI NATE[4]

[1,2,3,4]*Student, Department of Computer, Sinhgad Academy of Engineering, Pune, India*

Abstract: *Nowadays, a growing number of ubiquitous mobile applications has increased the interest in indoor location-based services. Some indoor localization solutions for smartphones exploit radio information or data from Inertial Measurement Units (IMUs), which are embedded in most modern smartphones. In this work, we propose to fuse Wi-Fi Receiving Signal Strength Indicator (RSSI) readings, IMUs, and floor plan information into an enhanced particle filter to achieve high accuracy and stable performance in the tracking process. Compared to our previous work, the improved stochastic model for location estimation is formulated in a discretized graph-based representation of the indoor environment. Additionally, we propose an efficient filtering approach for improving the IMU measurements, which is able to mitigate errors caused by inaccurate off-the-shelf IMUs and magnetic field disturbances. Moreover, we also provide a simple and efficient solution for localization failures like the kidnapped robot problem. The tracking algorithms are designed in a terminal-based system, which consists of commercial smartphones and Wi-Fi access points. We evaluate our system in a complex indoor environment. Results show that our tracking approach can automatically recover from localization failures, and it could achieve the average tracking error of 1.15 m and a 90% accuracy of 1.8 m.*

Key words **- Inertial Measurement Units (IMUs), Wi-Fi, Received Signal Strength Indicator (RSSI), Particle Filter, Indoor Localization**.

1. INTRODUCTION

Whenever a user visits a new site (place) which has a large perimeter a proper guidance system is needed. When the user is outdoors technology like GPS can easily be utilize but when inside a premises like a hospital, college, mall etc., it doesn't work so it is very difficult for the user to navigate through the place and reach their destination. Various technologies have been used over time for the purpose of navigation like RFID, sensors, Bluetooth, WIFI etc.; while on one hand technologies like RFIDs and external sensors need to be carried around by the user all the time. There is also the issue of cost effectiveness in such devices and on the other hand devices like Bluetooth which is already available in smartphones cannot be used because of their short range. So the most efficient way for navigation is through a WIFI in such conditions. This system works on the same principle where WIFI technology is being utilized to help user to navigate in an indoor environment. Here already available WIFI in the user's smartphone and those inside the different outlets (in case of shopping malls) or departments (in case of college and hospital) are used for the purpose of navigation and tracking on site. Here already made available map (by administrator) are downloaded from the server to user's smartphone. Then this map is plotted with various locations of outlets and then this map is saved to the users' mobile unit. WIFI routers are used to localize (to find the exact position of the user) user through a concept called triangulation method (it requires signals from three or more Wi-Fi routers). Signal strength is an important factor for finding the exact an accurate location of smartphone user because if the strength is weak of even one of the routers then the position would be wrong by some meters. Though it is not a big issue in outdoor environment it is problematic in indoor environment as the user will be standing outside an outlet and the application will show another one. This is highly inefficient and the application won't be of much use. So we need three routers with good signal strength. Now a days most of the people using the smartphones for our daily purpose. Because the android smartphones have the memory capacities, good processing speed and higher data transfer rate. Android is Linux based operating system with java support and it comes with open source software. Many map based android application is available in the Google play store. Map is used to transit the users from one place to another Google map, GPS is used for finding the specific location in outdoor environment. Using this application people can easily find the location such as roads, bridges, airport, shopping malls, etc. GPS (Global Positioning System) is one of the popular navigation system in the world. But it gives higher accuracy for outdoor environment not for indoor environment. Many university campus, shopping malls and organization are very large, so the people are difficult to find the location inside the shopping malls, university campus and organization. There is no effective features for finding the location inside the buildings. In the application, using the indoor location based services is used to find the current location of the mobile clients. Indoor Location Based Services is the extension of location based services. It is used for tracking

the location inside the buildings or campus. Indoor Atlas android SDK is used for indoor navigation. The SDK offers the features like the indoor positioning with higher accuracy and obtaining floor level. In Indoor Atlas to track the desired location then update the floor details for desired location and after fixing the route inside the buildings.

2.LITERATURE SURVEY

Alexey Kashevnik et. Al. proposed [1], Based on technology smartphone is used where all the features like its design, architecture and properties can be carried out. Technology like Wi-Fi, GSM and Bluetooth are inbuilt in the phone. Here comparative analysis of all the various techniques is done. The main concept is to provide user the functionality through which it can position as well as locate them. Here they provide solution for indoor positioning and navigation. By using algorithms like fingerprinting and triangulation they locate the user; maps are created for floor plans to position the user. As using Wi-Fi fingerprinting technology it will give accurate position of the users. It also provides information on special offers for outlets and contextual information to the user.

Amir Nakib [2] refers to indoor location which is static, as for outdoor system GPS is used which works accurately while designing mobile terminals for location tracking GPS is introduced but for obstructed area like inside the building where GPS signal are not found this system will not work and find the path. Now to overcome this different prediction method is used such as linear prediction, kalman prediction and particle prediction. It enhances the mobile phone user accuracy by predicting the trajectory using Digital fractional integration. To improve the performance we use the prediction methods like kalman filter and other existing linear filters.

According to Takamasa Higuchi [3] for indoor positioning it is a big challenge for mobile user to provide exact position to the user. As in indoor, sometimes there is accuracy problem in positioning the user due to mobility errors. “Stop and go” behavior of the pedestrian is evaluated here using cooperative localization. The concept behind this is that to find the movement of the nodes i.e. static or moving. Now static nodes are used to reduce the battery power, the tracking should be done accurately and with energy efficiency. Cooperative localization is a method which is used to ensure the distance between the nodes for evaluating the location of the user.

Lyu-Han Chen [4] concerns with indoor positioning system where the pedestrian dead reckoning PDR system is used which is based on mobile sensors. As mobile sensors are gyroscopes, magnetometer, digital compass and accelerometer. For indoor tracking these sensors are used to locate and estimate the user movement. In this WIFI system makes use of pedestrian dead reckoning system because the disadvantage of WIFI is overcome using PDR system. Using algorithms and methods like intelligent fusion algorithm the user location and its orientation should be determined. Nowadays Smartphones are equipped with a rich set of sensors i.e. inertial sensors. For indoor positioning system this sensors are important to recognize the real time user movement. For accuracy and stability of positing recognition the algorithm called fusion algorithm is used.

Li Geng [5] addresses the indoor tracking using RFID i.e. radio frequency identification system as this system is previously used which is very cost effective here tag ID is used in premises and through the detection of tag Id, the location of user is recognized.

Nicholas D. Lane [6] focuses on Smartphones changes the life style of people, anywhere in location around us people become interactive with mobile device. Mobile phones and smartphones are the center of attraction and people used this phone as their part, Therefore in this paper we conclude the survey of smartphone sensing. Many applications using smartphone for e.g. in corporate world, hospitals, transportation, security etc. in today’s world of technology people don’t have time therefore the mobile device is used for interaction. Smartphones are highly equipped with sensors like GPS, accelerometer, digital compass, microphone, Wi-Fi etc. thus mobile phone sensing is rapidly increasing. Already we know that all people carry mobile phone through which they interact with applications, games, social networking sites and other resources they use to download files and data in mobile phone only. Through smartphones all these actions are possible.

We can view the map, also localization and navigation is done through GPS system. In this growing age of technology many features and applications are deployed which provide location based services. Many sensors like Wi-Fi, GPS accelerometer gyroscopes, orientation sensors and digital compass is used. For outdoor location tracking GPS geo positioning system is used and still it is very limited in some areas due to the signal strength. GPS is not used for indoors therefore for indoor tracking other application and methods are used i.e. Bluetooth, WI-FI, RFID and other proprietary systems.

Lei Zhang [7] Sens-Track it's a service for location tracking where sensors are used. GPS is used when user is outside the building and WIFI is used for indoor environment. Here android smartphone is used which is equipped with sensors to collect the data from the user. This reduces the use of GPS and increase accuracy. As smartphone faces the problem in battery consumption due to its low battery life processing and other features affect. Here solution for battery consumption is implemented. Using GPS user cannot be tracked under indoor environment therefore location sensing techniques is used to obtain the exact position. Using various sensors at a time makes the system accurate and it increases the energy efficiency cost.

3. PROPOSED SYSTEM DESIGN

3.1 OBJECTIVES

- To implement a system to measure the distance of user on each Wi-Fi point.
- System provides every specific time interval of location details to user. With the help of longitude and latitude.
- Deploy the system on real time environments.
- Improve the location accuracy of user with minimum time complexity.

3.2 PROBLEM STATEMENT

In the proposed work to design and implement a system that can be provide floor base user location tracking and recommending system under the Wi-Fi as well GPS on own grid.

3.3 PROJECT OVERVIEW

Indoor Atlas is used in proposed system. Indoor plan infrastructure to identify the campus indoor structure. The application server is responsible for identifying the policy corresponding to a particular location and performing the necessary action. Indoor Location based services is used to specify the current location tracking indoor position helps to navigate the users. Conference, seminars, symposium information are described by college event information. Apart from this, it notifies the user if he comes near the library or the seminar hall.IndoorAtlas MapCreator for Android is used to create maps to test the indoor navigation and also to record the sensor data. Indoor plan infrastructure is 2D plan for constructing the indoor structure of the college. Indoor plan infrastructure is main requirement for indoor location tracking system. Based on the infrastructure to develop the indoor application on the android platform. It is used to find the indoor location.

3.4 DEVELOPMENT METHODOLOGY

The software packages used for implementing the system use Android SD and languages used in the proposed system are php in server side, java in client side. Android is an operating system based on Linux with a Java programming interface. The Android Software Development Kit (Android SDK) provides all necessary tools to develop Android applications. This includes a compiler, debugger and a device emulator, as well as its own virtual machine to run Android programs. Android Software Development Kit

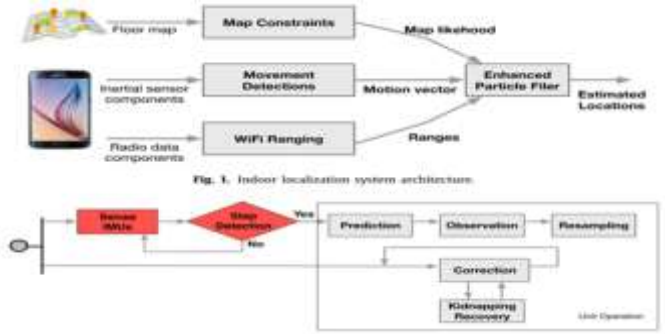

Fig-1 :proposed system architecture

4. RESULTS AND DISCUSSION

In recent years with the help of Google maps, location searching becomes a new trend, when people are not aware of their location. Google maps provide lots of functionalities like showing any location, alternative path from any location to other location and estimates time to reach the location. But it is not well developed for indoor navigation. It is very difficult to find and get shortest path from current location to any location inside university like entrance gates, departments, canteen, library, playground and parking lots etc. for the new admitted students and visitors. To reduce this pain inside the campus, implement the campus indoor location tracking system on android platform has been designed, implemented and tested successfully in this work. This application provides shortest route guide for users from his/her own location to desired location and event updates with its proper place. API is the navigation module to conclude the location of user. Indoor location tracking system is implemented in Indoor Atlas Android SDK where the floor structures are placed on the outdoor map of the institution. Each single floor details are placed in it, to

prepare the Indoor plan infrastructure map. Now the user can view their source position in the indoor plan. During the time, API key will generate at server side. With the help of API key, can implement the coding part in client side. Indoor location-based search (LBS) is growing as a natural extension of location-based search and marketing. Location-based services (LBS) provide personalized services to the mobile clients according to their current location. People can track own location and also navigate from one location to another location very easily.

5. ALGORITHMS

Analytic Hierarchy Process (AHP)

AHP is carried out in following five steps:

(a) Structuring a problem as a decision hierarchy of independent decision elements.

(b) Collecting various information about the decision elements.

(c) Comparing the decision elements pair wise on each level in the point of their importance to the elements in the level above.

(d) Calculating the relative priorities of decision elements in each level.

(e) Synthesizing the above results to find the overall weight of each decision alternative.

AHP PROCESS:

Step 1: Decompose the problem into hierarchy of criteria and alternatives.

Step 2: Normalization: Each entry divide the column and take the overall row average. Normalization is very important step because every criteria/attribute has a different unit.

Step 3: Calculation of Consistency Ratio(C:R)

Step 4: Rating of each alternative is multiply by weight of the criteria/sub crteria.

GRA based network selection method can be performed by using following steps:

Step 1: Classify the network parameters (smaller the better, larger the better).

Step 2: Define upper and lower bound of parameters.

Step 3: Normalize the parameter.

Step 4: Calculate grey relational coefficients (GRC).

Step 5: Ranking the networks according to GRC values.

A) TRIANGULATION:-

Input: User Longitude U[Li], Latitude U[Lt], WiFiid list wID[k].

Output: current weight of each wID with location details

Step 1: Track the current C=U[Li][Lt]

Step 2: Calculate each Wi-Fi id distance from C using below formula

$$w(x)\sum_{n=1}^{w}(D[n])$$

Step 3: identify the Wi-Fi id.

Step 4: check the location with LBS server location details and provide the label to

Users location.

Step 5: Return the user's location with floor id

B) Evaluation and selection Algorithm:-

Step 1: Classify the network parameters (smaller the better, larger the better).

Step 2: Define upper and lower bound of parameters.

Step 3: Normalize the parameter.

Step 4: Calculate grey relational coefficients (GRC).

Step 5: Ranking the networks according to GRC values using below formula.

$$GRC\frac{1}{[(\sum_{j=1}^{K}Wj|Si*(J)-1|)+1]}$$

6. RESULTS AND DISCUSSION

The accuracy of the Wi-Fi fingerprinting based localization approach depends on several environmental factors, such as the number of Wi-Fi access point's deployed and spatial

differentiability and temporal stability of the radio environment. It is simple to notice that areas with low spatial differentiability are the borders between rooms, especially doors. Room recognition accuracy decreases considerably in these areas. Therefore, the localization failure recovery process can be launched erroneously inside these zones. We have defined these zones as complicated areas. Table 4 summarizes the average of tracking errors, standard deviation and 90% accuracy

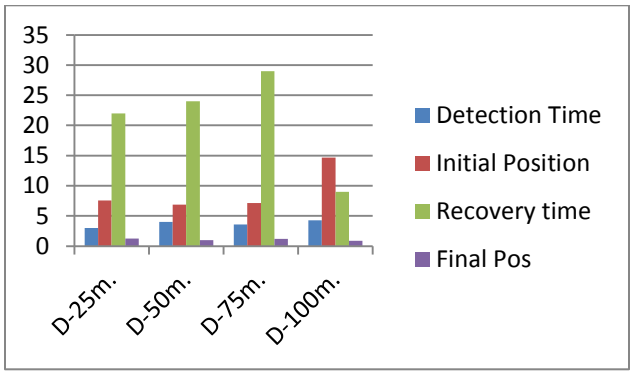

Fig-2: failure recovery

In figure 2 we measure the ability of the failure recovery method to recover the system from a possible localization failure. In this experiment we simulate a localization failure by setting up the initial position of the set of particles in p0 = (18.4, 4.7). It is important to notice that p0 is outside of the floor plan computationally effort is compensated by including the discrete state model with graph-based floor plan representation. In our previous approach the time required to process 1500 particles is approximately 51.9 us, whereas the processing time in the tracking approach presented in this work is approximately 59.4 us. Thus, the processing time in both tracking approaches remains almost stable

7. SUMMERY AND CONCLUSION

In this work we introduced the primary technologies used in indoor localization systems. Both commercialized products and research prototypes are discussed. System for pedestrians is proposed in this system. The system integrates a traditional PDR system with SRP adaptive drift calibration at access control points and a particle filter map matching algorithm. The information derived from SRP subsystem enables PDR to offer drift-free tracking and by taking advantage of existing access control systems, it offers a natural way to integrate user interactions at no additional cost. The map constraints, introduced by a simplified particle filter with LTR mechanism, further enhance the accuracy and keep the computation complexity acceptable for real-time processing on mobile devices with limited resources. The long-term experiment verified the robust and reliable tracking of the proposed system with 0.13% final position error with respect to a total travelled distance of over one kilometer. Moreover, the accurate tracking performance is independent of travelled distance and the system covers both corridor and rooms of indoor environments, offering a more practical way for pedestrian navigation.

Future work will focus on extending the system to support different ways of carrying the smartphone during walking. Also, a more comprehensive system will be studied combining both outdoor and indoor environments to provide seamless tracking of the pedestrians.

REFERENCES

[1] Alexey Kashevnik, Maxim Shchekotov, Compa.rative Analysis of Indoor Positioning Systems Based on Communications Supported by Smartphones. Saint-Petersburg Institute for Informatics and Automation of Russian Academy Science Saint-Petersburg, Russia. _PROCEEDING OF THE 12TH CONFERENCE OF FRUCT ASSOCIATION.

[2] Amir Nakib, BoubakerDaachi, Mustapha Dakkak, and Patrick Siarry, Mobile Tracking Based on Fractional Integration, IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 13, NO. 10, OCTOBER 2014.

[3] Takamasa Higuchi, SaeFujii, Hirozumi Yamaguchi, Member, IEEE, and TeruoHigashino,Mobile Node Localization Focusing on Stopand-Go Behavior of Indoor Pedestrians, IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 13, NO. 7, JULY 2014.

[4] Lyu-Han Chen, Eric Hsiao-Kuang Wu, Ming-Hui Jin, and Gen-Huey Chen,Intelligent Fusion of Wi-Fi and Inertial Sensor-Based Positioning Systems for Indoor Pedestrian Navigation, 1530-437X (c) 2013 IEEE.

[5] Li Geng, Mónica F. Bugallo, AkshayAthalye, and Petar M. Djurić, Indoor Tracking With RFID Systems,IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING, VOL. 8, NO. 1, FEBRUARY 2014

[6] Nicholas D. Lane, Emiliano Miluzzo, Hong Lu, Daniel Peebles, Tanzeem Choudhury, and Andrew T. Campbell, Dartmouth College, A Survey of Mobile Phone Sensing, IEEE Communications Magazine • September 2010.

[7] Lei Zhang, Student Member, IEEE, Jiangchuan Liu, Senior Member, IEEE, Hongbo Jiang, Member, IEEE, and Yong Guan, Member, IEEE SensTrack: Energy-Efficient Location Tracking With Smartphone Sensors,

IEEE SENSORS JOURNAL, VOL. 13, NO. 10, OCTOBER 2013.

[8] Alessio Colombo, Student Member, IEEE, Daniele Fontanelli, Member, IEEE, David Macii, Member, IEEE, and Luigi Palopoli, Flexible Indoor Localization and Tracking Based on a Wearable Platform and Sensor Data Fusion, IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 63, NO. 4, APRIL 2014.

[9] Alejandro Correa, Marc Barcelo, Antoni Morell, and Jose Lopez Vicario, Enhanced Inertial-Aided Indoor Tracking System for Wireless Sensor Networks: A Review, IEEE SENSORS JOURNAL, VOL. 14, NO. 9, SEPTEMBER 2014.

[10] AntheaWainSy Au, Chen Feng, ShahrokhValaee, Senior Member, IEEE, Sophia Reyes, SamehSorour, 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.

BIOGRAPHY

Avesh Mishra
Pursuing Bachelor of Engineering (B.E) in Computer from Sinhgad Academy of Engineering,
SavitribaiPhule Pune University (S.P.P.U)

Akshay Modak
Pursuing Bachelor of Engineering (B.E) in Computer from Sinhgad Academy of Engineering,
SavitribaiPhule Pune University (S.P.P.U)

Anita Tandale
Pursuing Bachelor of Engineering (B.E) in Computer from Sinhgad Academy of Engineering,
SavitribaiPhule Pune University (S.P.P.U)

Samruddhi Nate
Prof. in Sinhgad Academy of Engineering, SavitribaiPhule Pune University (S.P.P.U)