Finding Indoor Position of Person Using Wi-Fi & Smartphone: A Survey

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Abstract

Positioning system can be used for different purposes and for different services, so a lot of research is going on to find a more accurate position with low error techniques with good results. The Positioning techniques have been actively studied recently due to service as well as safety and security matters. Global Positioning System (GPS) is more widely used for outdoor but GPS is not suitable for indoor . There are many localization systems with different architectures, configurations, accuracies and reliabilities Wi-Fi Positioning system (WPS) solves this problem. Here we find out position with the help of Wi-Fi signal strength. We also discuss location fingerprinting in detail since it is used in most current system or solutions. A small program installed on to calculate the position. This will help in many applications for mobile users and network administrators. It will make use of existing Wi-Fi infrastructure, although Wi-Fi system was never designed to find out the location. The smart device regularly scans the signal strengths for surrounding Wi-Fi access points and send information to a central server. This paper try to survey the recent work related to indoor positioning system.

Keywords: Wi-Fi Signal Propagation, Wi-Fi-Based Localization, Location Fingerprinting, GPS

I. INTRODUCTION

Indoor location sensing systems have become very popular in recent years. The primary progress in indoor location sensing systems has been made during the last fifteen years. These systems provide a new layer of automation called automatic object location detection. Location information is an important for the multiple applications, e.g., community settlement planning, travelling, mining, surveillance, monitoring, military applications, and nowadays the development of location-based services (LBS) and engineering. There are many localization systems with different architectures, configurations, accuracies and reliabilities. Wireless technologies have entered in every area like consumer applications, medical application, industrial, public safety, logistics, and btransport1system due to the widespread availability of local wireless networks, the interest in localization based on Wi-Fi signal strengths are increasing because no additional infrastructural costs beyond the existing Wi-Fi infrastructure is required, making it become a promising indoor localization scheme.

Various wireless technologies are used for finding wireless indoor Location. These may be classified based on the location positioning algorithm, i.e., the method of determining location, making use of various types of measurement of the signal such as Time Of Flight (TOF), angle, and signal strength; the physical layer or location sensor infrastructure, i.e., the wireless technology used to communicate with the mobile devices or static devices. There are several methods to measure a geographical location GPS (Global Positioning System) is the most popular system, GPS measure a user's geographical location using radio waves from satellites, However, GPS is not suitable for network administration because maybe users' Mobiles or PC does not have GPS interface. Even if it has the interface, users are indoor. PC or Mobile cannot catch radio waves from satellites that are why GPS is mostly used for outdoor positioning System.

We will develop Indoor Wi-Fi Positioning System for Android- based Phone by making some enhancement to the algorithm used in; we use RSS (Received Signal Strength) of signals from dense Wi-Fi access points deducted for localization. Then we use formula and calculation to measure the distance between Access point (AP) users, so the location we get will be more accurate.

The advance of wireless and embedded technology has fostered the flourish of the smartphone market. Nowadays, mobile phones possess powerful computation and communication capability, and are equipped with different kinds of built-in sensors for various functions. Accompanying with users round-the-clock, mobile phones can be viewed as an increasingly interface

between information between users and environments. These advances lay solid foundations of breakthrough technology for indoor localization. Position system is a system arranged in such a way to find or estimate the location of an object. . A system based on CI is fast and easy to build up. RSS is also well suited for outdoors and delivers even better results. AOA Systems are probably not profitable for larger areas, but they do give good results. Fingerprinting can also be used outdoors. In this case, the use of directional data will improve the accuracy of the results. The aims of this paper are to provide the reader with fingerprinting based wireless indoor localization techniques and systems for indoor applications.

Organizing of the paper in this as section II describes the literature review, Section III describes the algorithm, Section IV provides the proposed work, Section V conclusion and future trends‖

II. LITERATURE REVIEW

Nidhi Verma [1], Proposed a new approach to improve the accuracy of localization algorithms in sensor networks, which were previously too used and these are very useful in calculation-intensive to use. The Euclidean instance, has great probability of giving right distance measurement. The experiment could be run on different environments as a polygon. She has presented a way to use this information by defining sensor's position. Trilateration gives the new way to calculate their locations in an easier way. This method is presented the effective localization algorithm to increase the accuracy of position of mobile user. To overcome the drawbacks of this trilateration technique more efforts are needed, especially for the position estimation phase in the future research.

Chenshu Wu, Zheng Yang, Yunhao Liu and Wei Xi [2], indoor localization approaches mostly rely on laborintensive site survey over every location. Here , they presented WILL, an indoor logical localization approach without site survey or knowledge of AP locations and power settings. The main idea is to combine Wi-Fi fingerprints with user movements. Fingerprints are partitioned into different virtual rooms and a logical floor plan is accordingly constructed. Localization is achieved by finding a matching between logical and ground-truth floor plan. They implement WILL in a typical office building and it achieves an average room-level accuracy of 86 percent, which is competitive to existing designs.

Tareq Alhmiedat, Ghassan Samara [3], have designed and implemented a segmentation process in order to divide a tracking area into small areas. The proposed autonomous method only works well in open environments and cannot be used in complicated ones. Manual segmentation can be used in any environment, but it requires additional effort and time, in addition to experience regarding the system and how to divide the tracking area. One of the most important developments and improvements that should be added to research in the future is to improve the autonomous segmentation process by adopting Artificial Intelligence, in addition to increasing localization accuracy by adopting other localization methods.

Jun MA, Xuansong LI, Xianping TAO and Jian LU [4], proposed the work where the performances of LBS applications are mainly dependent on the precisions of their Positioning Systems. As Wireless LAN (WLAN) costs less and is easy to access when compared with other indoor positioning techniques (IR, Ultrasonic, RFID, etc.), using WLAN for indoor positioning has become one hotspot of research. In this paper, author briefly introduced the keystones and main methods of WLAN-based indoor positioning. Author further pointed out the typical scheme KNN could be improved if some selective preprocessing could be done. To validate this, they proposed a scheme called ―Clustering Filtered KNN‖, which utilizes lustering to filter out some of the neighbors. And finally, with the experimental results, we showed that CFK does outperform KNN in most cases.

P. Prasithsangaree, P. Krishnamurthy, P.K. Chrysanthis [5, had provided a framework for systematically analyzing indoor position location using WLANs. Author had addressed some of the issues, but more data need to be collected and analyzed to establish models and methodologies for deploying a positioning system. Author only have preliminary results on the tradeoffs in the positioning system and how they relate to the physical building architecture. They are investigating further these issues - how many access points are required to provide a given accuracy with a given granularity of the grid in the database, how the database should be organized for better searching speed, whether matching distributions of RSS as in locations that are severely obstructed from APs is preferable to simply matching the average RSS, etc.

Zahid Farid, Rosdiadee Nordin, and Mahamod Ismail [6], surveys the recent advances in wireless indoor localization techniques and system. Different technological solutions for wireless indoor positioning and navigation are discussed, and several tradeoffs among them are observed. Regardless of the plenty of approaches which exist to handle the indoor positioning problem, current solutions cannot cope with the performance level that significant applications required. In short, requirements for different application environments are accuracy/precision, coverage, availability, and minimal costs for local installations. To achieve this shortcoming, a good portion of research approaches is required to handle these challenges. :

Hui Liu, Houshang Darabi, Pat Banerjee, and Jing Liu[7], they surveys the current indoor positioning techniques and systems. Different performance measurement criteria are discussed and several tradeoffs among them are observed. For example, the one between complexity and accuracy/precision needs careful consideration when choose positioning systems and techniques in different application environments such as warehousing, robotics, or emergency. Usually, location fingerprinting scheme is better for open areas while Active RFID is suitable for dense environments. In terms of scalability and availability, these positioning techniques and systems have their own important characteristics when applied in real environments. The proposed method serves as a preliminary step that could be integrated in future work where it is envisaged that the method can be applied by taking into account transmission barriers such as walls or blocks of large items.

Mohammed A H Lubbad, Mahmoud Z. Alkurdi, Aiman Abu Samra [8] , had added some enhancement to Positioning Algorithm proposed, to find the distance between AP and mobile user and author use algorithm with small android application which used to provide users with details about the position in a building of three floors, this algorithm can be used also for network administrator to find the position of mobile users who connect to System network.

Trung-Kien Dao, Thanh-Thuy Pham, Eric Castelli [10], proposed model is based on the empirical equation of radio frequency signal strength in environments without obstacles by taking account of walls and floors and the uncertainty of RSSI. A hybrid robust localization method using Wi-Fi RSSI is introduced, which takes the advantages from both well-known geometrical-calculation based and finger-printing based techniques. The principle of this method is to search for the point with the maximal sum of probabilities accounted from individual access points. Experiment results within a building with multiple floors, rooms and walls using Android smartphones show that significantly high accuracy of user localization is achieved. Further methods to improve the accuracy include tracking algorithms, smoothing and filtering methods (e.g., Kalman and particle filters), combining with map and historical information.

III. ALGORITHM

A. Wi-Fi-Based Indoor Localization

One of the advantages of using Wi-Fi Positioning Systems is to locate the position of almost every Wi-Fi compatible device without installing extra software or manipulating the hardware. Beside this, in WLAN, line of sight is not required. Due to this advantage, Wi-Fi positioning systems have become the most widespread approach for indoor localization. Most positioning systems based on WLAN (Wi-Fi) are available as commercial products as prototypes based on measurements on the received signal strength (RSS). Wi-Fi based positioning systems have several advantages. Firstly, in terms of cost effective WLAN infrastructures implementation of position algorithms does not need any additional hardware as network interface cards (NICs) measure signal strength values from all wireless access points in range of the receiver. Therefore, signals needed for positioning can be obtained directly from NICs available on most handheld computing devices. Due to the ubiquity of WLANs, this mode of positioning provides a particularly cost-effective solution for offering LBS in commercial and residential indoor environments. Secondly, WLAN positioning systems offer scalability in two respects: first, no costly requirement of infrastructure and hardware, and second the number of mobile devices subscribing to positioning services.

Beside this, there are also certain WLAN limitations: signal attenuation of the static environment like wall, movement of furniture and doors

B. Fingerprinting Based Indoor Localization

Most indoor localization approaches adopted fingerprint matching as the basic scheme of location determination. The main theme is to collect features of the scene (fingerprint) from the surrounding signatures at every location in the areas of interest and then build a fingerprint database. The location of an object is then determined by matching online measurement with the closed location against the database.

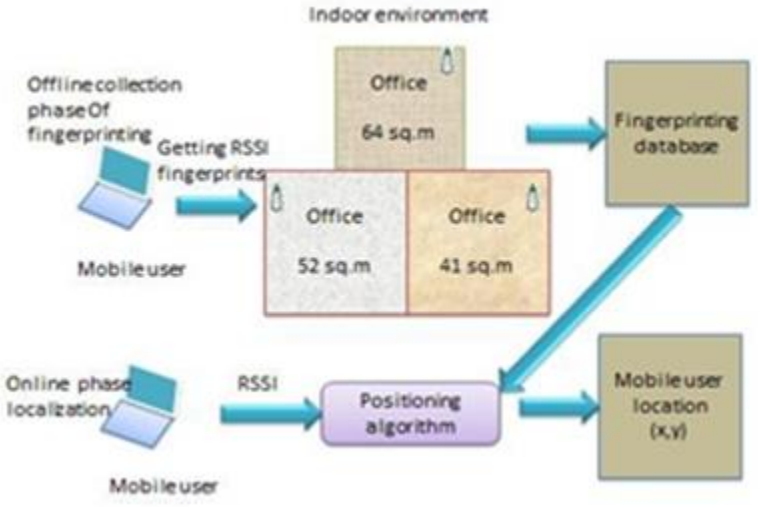

Fig. 1: Fingerprinting Based Positioning

This method does not require specialized hardware in either the mobile device or the receiving end nor is no time synchronization necessary between the stations. It may be implemented totally in software which can reduce complexity and cost significantly compared to angulation or purely time-based alteration systems. The location fingerprinting also called a fingerprinting method consists of two phases. Phase 1 is the so-called calibration phase, offline phase, or training phase, and phase 2 is the localization phase or online phase. In the offline phase, maps for fingerprinting are set up either empirically in measurement operations are computed analytically (signal strength reference values (anchor point) can be computed using a

signal propagation model). In the first phase, a creation of radio maps for site survey where the positioning is supposed to work must be recorded. Basically, radio map is a database of spots at predefined points (coordinates) coupled with various radio signal characteristics, for example, RSS, signal angles, or propagation time called signal fingerprints.

Distance Calculation

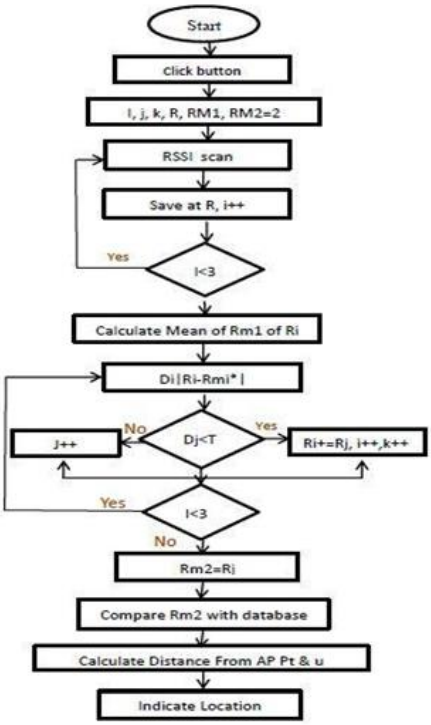

Fig. 2: Flow Chart of Positioning Algorithm

Rm1 : The mean of Ri	Rs : Sum of available data Rj
Rm2 : The mean of available data	Rj i, j : The number of iterations
D : Difference between Rj and Rm1	T : Threshold of difference
k : The number of available data Rj	R : Training values of RSS

IV. PROPOSED WORK

This paper proposes an indoor position detection using Wi-Fi signal strength and a formula to determine position of a user. Based on the concept of GPS, minimum of three access points (AP) are needed to determine the position of a user in an indoor location. The Wi-Fi signals are in the form of radio wave where the movements of the signals are highly dependent on the frequency. Signals with different diameters are transmitted by APs in all direction according to the respective signal strength. Since wireless routers provide coverage of about 100 feet (30.5 meters), signal strength is used to find the collision point in order to specify the accurate position of an object.

We proposed the implementation of trilateration technique to determine the position of users in indoor areas based on Wi-Fi signal strengths from access points (AP) within the indoor vicinity. In this paper, percentage of signal strengths obtained from Wi-Fi analyzer in a smartphone were converted into distance between users and each AP. A user's indoor position could then be determined using a formula proposed based on trilateration technique.

In our proposed system we suggest Robust WLAN Positioning System based on Probabilistic Propagation Model, we considered Wi-Fi router and the smart phone is connected to that Wi-Fi router ,we use too many router then with the help of signal strength we calculate or find the location of any android mobile system/ device. In this paper, a probabilistic propagation model of Wi-Fi signals is proposed. This model is based on the empirical equation of radio-frequency signalstrength in environments without obstacles by taking account of walls and floors and the uncertainty of RSSI. We developed a new technique with the help of combination of robust localization method using Wi-Fi RSSI, which takes the advantages from both well- known geometrical-calculation based and finger-printing based techniques. The principle of this technique is to search for the approximate position of an object with the help of maximal sum of probabilities found from individual access points.

We will experiment this system within a building with multiple floors, rooms and walls using Android smartphones show that more accuracy of user positions is achieved. Further steps to improve the accuracy; include tracking algorithms, smoothing and filtering methods map and historical Information.

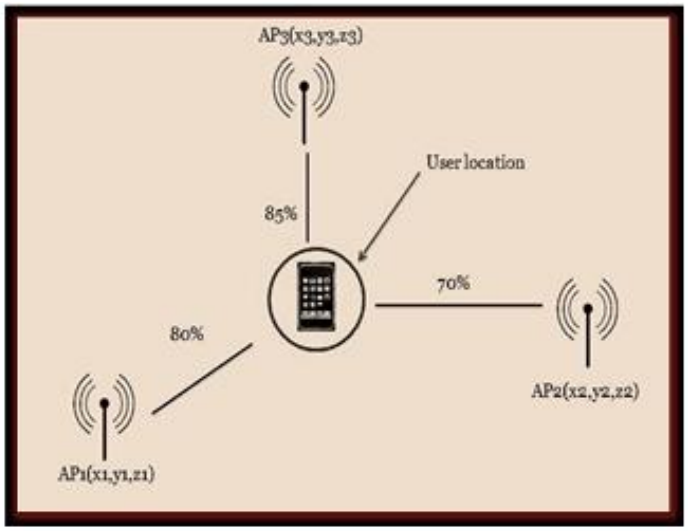

Fig. 3: Illustration Wi-Fi Signal Strength From Three Access Points

In fig 3, we use three access points and these three AP are placed in different-different place when our smart phone is come in range of these it connect to the nearest wifi router and our system store the user location after every 5 sec in our data base so in this way we can easily find out or locate the position of the user . our data base scan the user location after every 5 sec. that's why we can also know his last position as well as his current location

Assume that the coordinates of the three APs as Based on three coordinates of the APs, the coordinate of the user's position that is represented as smartphone can be determined. The main idea is to find the location with the maximal sum of probabilities corresponding to the visible APs,i.e., maximizing.

In our system we use routers & smart phone which is Wi-Fi enable.Let's assume that a user have a smart phones that serves as a receiver of the signals transmitted from the access points. Application of Wi-Fi analyzer in the smart phone presents the signal strength in terms of percentage. The highest percentage of signal strength indicates that Smartphone is closest to the AP whereas the lowest percentage implies that Smartphone is maximum range of AP. The main concern of the proposed method is its critical speed due to the complexity of the search algorithm, which is proportional to the number of Wi-Fi wall crossing calculations and Gaussian function evaluations. To overcome this challenge, a precalculation of Wi-Fi signals crossing walls are proposed to reduce the number of calculations, hence improve the algorithm speed.

V. CONCLUSION AND FUTURE TRENDS

Our paper surveys the recent advances in the area of wireless indoor localization techniques and system. It gives Different technological solutions for wireless indoor positioning and navigation Regardless of the plenty of approaches which exist to handle the indoor positioning problem, current solutions cannot cope with the performance level that significant applications required. In short Our paper surveys the recent advances in the area of wireless indoor localization techniques and system. It gives Different technological solutions for wireless indoor positioning and navigation Regardless of the plenty of approaches which exist to handle the indoor positioning problem, current solutions cannot cope with the performance level that significant applications required. In short requirements for different application environments are accuracy/precision, coverage, availability, and minimal costs for local installations. To achieve this shortcoming, a good portion of research approaches is required to handle these challenges. Some of the future trends of wireless indoor positioning systems are as follows:

(1) New hybrid solution for positioning and tracking, estimation in 4G with the currently available position system,
(2) Need of cooperative, mobile localization which will help mobile nodes among each other to determine their locations, Journal of Computer Networks and Communications
(3) New innovative applications for mobile in which location information can be used to improve the quality of users' experience and to add value to existing services offered by wireless providers.

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