HYBRID GEO FENCING AND MOBILE SENSING: COMPARISON ANALYSIS

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Abstract: In current scenario mobile phones are one of the most important part of our life, it is not only used for just making calls but also for many different activities these days. With the rapid growth of technologies smart phones also comes with a lot of interesting features such as fingerprint sensors, which can be used for different purpose such as marking attendance of the students as well as employees in schools, colleges, universities and offices. Many different available technologies such as: - Global Positioning System (GPS) for outdoor environment and Wi-Fi for indoor environment can be used to make an attendance system and reduce the chances of proxies in schools and colleges and for tracking students' location. Also if by any means there is chances of proxies then proxy detection is very important, which can be done by using few proxy detection methods.

Keywords: Wi-Fi, GPS, Cell Tower, RSSI, Geo Fence.

1. INTRODUCTION

If we compare today's current situation from 15 to 20 years back we'll notice a huge difference in terms of technologies. The rapid growth of technology has changed many things around us. If we talk about mobile phones few years back it was just used for the purpose of texting and making calls, and now we can do almost everything using mobile phones. There are number of things which can be done using a mobile phone. Mobile phones have become more than a necessity for almost every people in the world.

If we talk about the attendance system of any School, College or University few years back there were a common technique to mark the attendance of the students either by calling their names or by taking their signature but now we can mark attendance using different Biometric techniques such as fingerprint, face recognition etc. By using GPS for outdoor positioning of the device and Wi-Fi positioning technology for indoor positioning of a device by using its nearby access points that uses RSSI (received signal strength identification) and if incase Wi-Fi is not available then we can use Cell Tower for making an attendance system.

A. *Global Positioning System*

It is a system using which we can detect the location using mobile phone, tablet etc. It was started between 1970-1980 when US Air Force launched few GPS (Global Positioning System) satellite for their army navigation purpose. But later in 1983 when Russia damaged the civilian Air craft because it was in there area by mistake, then US government decided to available the GPS for common peoples and it will be used in Air craft's as well for navigation purpose.

Then later after 12 long years in 1995 first time GPS (Global Positioning System) was launched for common peoples, but it was not that accurate at that time. Then after in 2000 GPS

(Global Positioning System) was completely launched for public. Then after between 2005-2015 US Air forces have launched almost 50 GPS.

It is a world-wide radio navigational system which provides time information as well as location information in all weather conditions. It gives the exact location of mobile phone.

B. *Wi-Fi Positioning System*

Wi-Fi is the most common technique positioning with wireless access point is based on measuring the intensity of the received signal (RSSI- Received signal strength indication) and the method of fingerprinting.

The indoor position of the mobile device can determined by its nearby access points determined using the received signal strength and the distance between the access point and the device then applying the trilateral algorithm.

C. *General Packet Radio Service*

GPRS is a mobile data service for wireless communications. GPRS uses principle of packet radio for efficient way transferring of user data packets. In this data is split into different packets and transmit separately to receiver over the network and these data packets are resembled at the receiver site.

GPRS provides immediate and continuous connection to the internet. In GPRS the existing GSM infrastructure is reused to provide end-to-end packet switched services.

D. *Cell Tower Based Positioning*

In Cell Tower query is send to Google location server through locator, and returns the location. If the data are not included in their databases, no results will be returned. All the cell towers have their own coverage area called cell. They can provide service to mobile devices within this range only. Mobile device periodically has to check for optimal signal strength from the cell tower and based on the received signal strength, nearby cell towers are identified and that

will help for finding the current location of the device. Even when the cell phones are not on call it constantly broadcast a radio signal.

2. LITERATURE REVIEW

Ting-Ting Xiao [14] had proposed an idea where to get accurate indoor positioning "fingerprint localization algorithm based on Wi-Fi" is proposed. In this paper smart phones are used as the target node and multiple wireless routers are used as Wi-Fi signal source. Then after sample groups of Wi-Fi signal strength values and then the value and the physical coordinates form a fingerprint database. During the localization process, the value of multiple Wi-Fi signal strength which is detected by the target node then matched with fingerprint databases to find out which grid vertex is closest with the target node. To improve the positioning accuracy of the algorithm, the target node which received the Wi-Fi signal has put into a filter and then for correcting the error least square method is used when the target nodes coordinates are calculated.

Yu Zhou [13] In his paper he used trilateration algorithm for estimating the position of an object. In this algorithm the standard linear algebra techniques are used due to which the computational complexity is low and the operational robustness is high.

Ruixue LI [18] comes with the concept based on ZigBee. In his paper, he adopted ZigBee technology for implementation of monitoring system. For localization system a testing environment was constructed and the results showed that the users requirements are fulfilled by the indoor wireless localization system, but many problems have not resolved in his paper.

[3] comes with another new idea in which compressive sensing theory is used for an accurate RSS based indoor positioning system; by which scattered signal is recuperate from a small noisy measurement by solving l_1-minimization problem.

Carlos E. Galvan-Tejada [15] then tells about the accuracy. He said that there are many location-based services for positioning individual but it is important that there should be very high accuracy for positioning an individual. For accurately positioning an individual no perfect solution is proposed. So many attempts have been made for high accuracy positioning of an individual but achieved an accuracy of about 2 meters only. In this paper, Bluetooth and Wi-Fi is used for indoor environment are used to get more accurate distance measurement.

[16] presented a design of portable user authentication system in which he discussed that student overall academic performance depends on attendance; somehow short attendances can affects students' performance. Taking attendance by calling students name is prone to proxies. So smart phones with built-in fingerprint scanner can be used for marking students' attendance and it decreases or completely removes the chances of proxies. The proposed system is another type of biometric attendance system. It can also be used in offices to take the attendance of employees. The authentication of the user is validated by the system by comparing the fingerprints of a user. A hexadecimal format key is provided by the smart device with which the process of taking the attendance becomes much easier and proxy free. Only one time registration by

the students or the employees is required on the system and the information in the database.

Kejiong Li [1] then suggested location estimation in multi-floor buildings, in his paper; Wi-Fi and cellular RSS (Received Signal Strength) are collected on the electronic engineering building. In his experiment it is shown that a good accuracy of can be provided when Wi-Fi and RSS is integrated with GSM RSS for positioning. A hybrid RSS-based room estimation is proposed in multi-story indoor environment.

Jungmin So [10] later comes with the concept of location estimation. A location estimation algorithm is able to locate users more accurately. In location estimation the most commonly used method for finding the nearest neighbor is by using Euclidean distance but Euclidean distance fails to differentiate between strong and weak signals, which can misdirect location estimation. A different way to control the nearest neighbor is proposed. In this paper, an algorithm called location estimation is proposed that chastises unreliable access points and mark strong signals. The proposed algorithm reduces location error.

Further [17] proposed a technique which improved the hybrid indoor positioning which uses Bluetooth as well as Wi-Fi together. He proposed an algorithm in which limited number of Bluetooth hotspots are deployed after identifying the location also he added three architectures in which different users needs and user hardware constraints are served in hybrid indoor positioning.

Chenshu Wu [7] later discussed about the wireless indoor localization without site survey in which he focused on the work which do not involve site survey as site survey involves costs, time, man power etc and in his paper he combined users' movement and Wi-Fi fingerprints together.

Kaishun Wu [25] worked on indoor localization which is based on Channel State Information (CSI). In this paper, he proposed an approach called it FILA, in which the fingerprint receiver and propagation model is built by breaking CSI. By his experiment he showed that by using CSI the accuracy can be enhanced.

Rafael Saraiva Campos [4] focused on improving the accuracy in multi-floor indoor environment which include floor identification, in his paper the positioning of Wi-Fi nodes are shown. The effects of proposed solution on Database Correlation Methods are shown experimentally by using actual measured data. In his paper he combined supervised and unsupervised technique to provide high floor identification accuracy.

Hongbo Liu [5] tried to give accurate localization using peer assistance. In his paper, he investigated about the accuracy of Wi-Fi localization and find out that few percentage errors will always exist in it, and he proposed the approach of peer assistance localization to reduce the errors.

Zane Bicevska [9] discussed about the techniques to improve the maintenance of smart technologies. He said that day by day increasing the complexity of software systems are not easy to understand and the configuring them is difficult if one is not having proper IT knowledge. We can improve the complexity by making our software system smarter. In his paper, various smart technologies are described with which it will be easier to manage and configure the software systems.

Then further [12] added a concept of RFID with Wi-Fi together. There are few advantages and limitation of

combining RFID and Wi-Fi technology. In his paper discussed the advantages as well as limitations of combining them for approximation of the users' location in an indoor environment. His paper depends on the mirroring environment, where there are one or several RFID readers and various Wi-Fi devices. The combination of Wi-Fi and RFID fingerprints in high density Wi-Fi environment bulge to an approximation error below 4m for 95% of times which Wi-Fi and RFID used together. Compared to when only Wi-Fi is used   85% of times. But when talking about low density Wi-Fi environment is approximation error is below 4m for 70% when Wi-Fi and RFID used together and when only Wi-Fi is used
30% of the times.
Chen Chen [11] discussed about the ranging, The Global positioning System provides time and location information. But currently people spend their maximum time indoor rather than in outdoor environment, due to that accurate

indoor positioning is important and unfortunately GPS only works in outdoor environment. Many indoor positioning systems have been developed but most of the systems are based on ranging technique. With ranging the distance from one location to another is determined. And for this these system requires multiple anchors at known locations and devices to detect and get accurate position or rang.

Then after [2] proposed the idea of Smart University tracking system for safety of students. In his paper, he combined Global Positioning System (GPS) and Google Map API for outdoor and Wi-Fi for indoor environment and Cell Towers as well. He proposed the idea of tracking the students' activities and location within the University.
Further, the concept of Artificial Intelligence & Fuzzy model [6], Machine Learning [19] [20], Cloud Computing [21], Sentimental Analysis [22] [24] and various other techniques may be applied in Smart University [23], that is beyond the scope of present research.

Table 1: Comprehensive Review of Algorithms used.

References	Algorithm	Approach	Solution	Technique Used
13] Yu Zhou.	Trilateration Algorithm	Nonlinear least-squares trilateration formulation has been solved.	To solve such kind of problems an algorithm called search-based optimization are used.	(a)Local optimization, E.g. Steepest descent method, Newton-Raphson method. (b)Global optimization algorithm, E.g. Simulated annealing, Genetic algorithm.
[2] Syed Imtiyaz	Trilateration Algorithm	For determining the location of the user Trilateration method has been used.	After solving the quadratic equation, we get the coordinates that is the indoor location of the device.	Quadratic equation has been solved to find the location of unknown point.
14]Ting-Ting Xiao	Location fingerprint positioning Algorithm	N group of Wi-Fi signal sources are disputed on each floor. And then the fingerprint database is established.	In the result it is shown that the positioning accuracy stable.	(a)K nearest neighborhood (KNN), (b)Probabilistic method.
[8]Pei Jiang	IAP-FP Algorithm	The location of the fingerprint with highest matching degree will be chosen as the final estimated location.	In this paper, the final room will be the room in which there will be the highest similarity of fingerprints.	(a)NN (Nearest Neighbor), (b)KNN (K Nearest Neighbor), (c)WKNN (Weighted KNN)
[10] Jungmin So.	Location Estimation Algorithm	Euclidean distance is susceptible to errors if the access point is unstable.	If we compare the original Euclidean distance-based algorithm and the Proposed algorithm then we will see that the proposed algorithm	………………………………..

			diminishes localization errors.	
[1] Kejiong Li	Cluster-Based Deterministic Algorithm	Indoor Localization estimation that unites RSS data from Wi-Fi and GSM networks.	If we use the hybrid RSS then the estimation accuracy can improved in multi-story building as compared with regular algorithms.	(a)Hybrid RSS data (Wi-Fi RSS and GSM RSS) is used.
[4] Rafael Saraiva	Unsupervised Clustering	Unsupervised and supervised expert systems are concatenated.	The proposed system shows a very good performance with actual data collected in a multi-floor building.	(a)K-medians Layer (b)Kohonen Layer
[15] Carlos E.Galvan-Tejada	Wi-Fi Bluetooth based combined positioning Algorithm	In achieve more accurate distance measurement the methodology is proposed which is worthy for Bluetooth.	Method outperformed the 4 methods with which it was compared.	(a)Transmitters Distribution (b)Measurements Average
[17] Artur Baniukevic	Deployment Algorithm	To achieve better positioning accuracy RFID, Wi-Fi, and Bluetooth are combined together.	When the proposed systems are compared with the manual deployment then the result showed that the Bluetooth deployment algorithm is effective and contributes to better positioning accuracy.	……………………………

3. PROPOSED WORK

A student tracking system has been proposed within a university for marking attendance of students using Wi-Fi for indoor environment and Global Positioning System for outdoor environment and Android mobile phones with fingerprint sensors for fingerprint purpose and a technique called Geo-Fencing is used for making a fence around the university due to which when any student will enter the university area or roam anywhere within the university then we will be notified, with that we can get the idea that at the time of the attendance whether the student were available in the class or not. In this work, we have added a proxy detection method with which if there will be any proxy, then that will be detected.

4. CONCLUSION

Rapid growth of technologies not just provides us various new features but also demands the maintenance, accuracy etc. For tracking purpose we need the accurate localization which is a challenging task. After so many attempts and applying different algorithms 100% accuracy in localization is yet to achieve. If we combine two or more technologies together then that results in better localization accuracy as compared to the single technology. [12]If in low-density Wi-Fi environments Wi-Fi and RFID fingerprints are combined then accuracy is improved by 40%. [15]When Wi-Fi and Bluetooth are combined together it reduces the error to 0.87.

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