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Indoor localization and Navigation system using Smartphone

Shweta Shandilya[1], S.R.Idate[2]

PG Student, Department of Information technology, B. V. D. U. College of Engineering, Pune[1]

Associate Professor, Department of Information technology, B. V. D. U. College of Engineering, Pune[2]

Abstract: Smartphones are available to almost everyone nowadays so when a user visits a new place they can easily use their phones to help user in navigation. Many technologies have been used over the years for the purpose of navigation like Bluetooth, GPS, WIF, RFIDs, and external sensors (like inertial sensor). But all these techniques are either not efficient or expensive. The best choice for the navigation purpose inside a building is a WIFI because other technologies have various limitations. So we use WIFI technology which is already inbuilt in user's mobile phone. The proposed system uses WIFI to help user in navigation by providing localization functionality by using triangulation method. The system has two types of user's administrator and the application user. The administrator is responsible for creating and maps of the site if they are not already available. The user utilizes these maps for the navigation through the site by entering a destination. The shortest path is calculated by the system and provided to the user. User can save their location, browse the offers and event calendar of the site. User can also track and communicate with other users of the application.

Keywords: Mobile sensors, Floor plan, Map matching and Triangulation

I. INTRODUCTION

Earlier technologies for navigation had various limitations like GPS work very well for navigation outdoors but the GPS technology is useless inside a building (e.g.: mall and hospitals) also Bluetooth have a very limited range so it can be used for navigation in a wide space likewise RFIDs need to be carried along all the time by user as is the case with any type of external sensors which can be expensive and require extra effort on part of the use. So in the proposed system WIFI technology is being utilized because nowadays it is available everywhere. Two types of users of this system are being proposed an administrator and a user. Administrator is responsible for two types of activities: site creation and site definition. Site creation involves creating a canvas on which the site can be plotted and then if an image is uploaded the pixels of that image a scale so has to match the canvas. The second functionality of the administrator is defining the site which includes specifying the north, defining room, defining paths and then this site map is uploaded for user.

The user has a functionality of downloading site map for the purpose of navigating through the entire building. The user can also upload site image if available which will then be plotted on the canvas for usage. The system at first finds a current location of the user by a method called triangulation. This method requires three or more routers for signals which are used to pinpoint the location of the user which is called current location. Once the current location is identified user just needs to enter our destination and the system would automatically plot and find the best possible path from current location to the destination.

User can always save location because it helps to easily find any particular place very easily if the need arises. For example if user wants to locate a parking spot or a certain outlet user can easily find the way. User can easily browse through the details of the offers provided by various outlets and event; schedules are also available if the user wants to participate in such type of activities. The user can also track and communicate with any person who has the same application installed in their system.

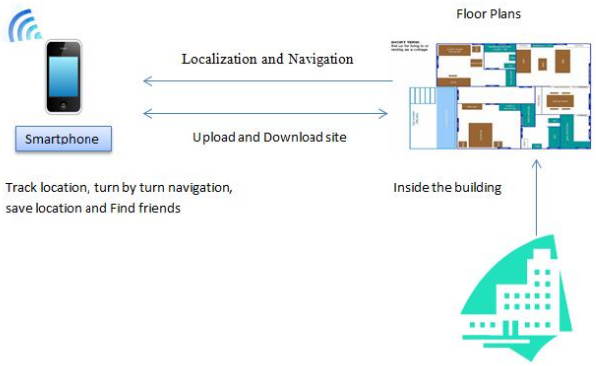

Figure (1) shows the localization and navigation system.

II. BACKGROUND

There was a time when WIFI technology was not available everywhere like it is today. Companies used to launch their proprietary devices to enable services equivalent to wireless LAN (Local Area Network). There are various approach and technologies for the localization and navigation of the user in an indoor environment. In the paper [1-8] all the various technologies over the years that have been used are explained. The potential technologies for indoor navigation have been used and studied. The very first technology having potential was satellite system.

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It has a high degree of accuracy but line of sight (LOS) is required for this system and because of that they cannot be used indoors. So GPS which is a semi accurate navigation system was studied. But it has the same problem i.e. LOS. Even though various measures like pseudolite which help in indoor navigation have been introduced but the right amount of accuracy cannot be achieved. Another technology consisted of using cellular communication network which used cell of origin technique. But the accuracy of this system is very low. Now the need for technologies to work in an indoor environment was very essential so Bluetooth technology was considered but it turned out to be having a very low range and highly expensive implementation. Same is the case with RFIDs which has expensive implementation and need to be carried around by users all the time which is an inconvenience. Another technology namely infrared wireless networking was considered pioneer technology in the field of indoor positioning but turned out to be unsuccessful because of limited range of network and no availability of data networking services. So WIFI (wireless fidelity) technique was approached where signal are received from a router to all devices like mobile phones, laptops etc. Wireless networks are universal. They can be efficiently used indoors with areas having a large amount of population and moreover they are cost effective for implementation purposes. So WIFI is the proposed technology used in this paper.

Various positioning techniques have been used in the area of localization or positioning like cell of origin which is used in cellular wireless communication. This technique is quite efficient outdoors but its indoor accuracy is very poor. Likewise there have been techniques like angle of arrival, angle difference of arrival , time of arrival, time difference of arrival the accuracy of these techniques depend on signal propagation, distance from antenna to device, propagation delay and synchronization between base stations as all these techniques utilize the concept of cellular communication network consisting of antennas and signals from them. Location fingerprinting uses a multiple matrix correlation algorithm where measurements via a grid formation are taken to locate the exact position. Even though it's a highly accurate method but the implementation time adds to its limitation. Another technique is that of triangulation which utilizes the signals from the various routers of WIFI to calculate the position of any individual inside a building. Here signal strength is converted to distance after factoring in the various concepts like antenna gains interference. This method is very simple to implement and accuracy is dependent on the accurate estimation of propagation losses.

III.SYTEM ARCHITECTURE

Proposed method makes use of android smartphone. Wi-Fi is used here for the purpose of navigation through the method of localization utilizing the triangulation involving signal strength from at least three routers as input. The site map is provided to the user which can be easily uploaded to the server database by administrator and downloaded by user. The system automatically provides user with the best path available between current location and required destination.

Figure (2) shows the localization and navigation system architecture where the user makes use of handheld device. For navigating through the building system uses a technique called triangulation methods which involve strong signals from at least three Wi-Fi routers to localize the user. Maps from the server are downloaded, plotted, save and ultimately used for the purpose of guiding user to the entire structure to the places they want to visit all the information related to this outlets as in there offers and deals are available for user to scroll through

And save for future usage.

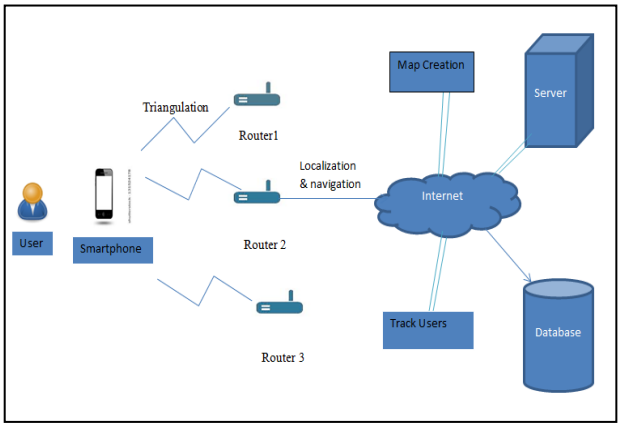

Fig (2) Localization and Navigation System Architecture

IV.METHODOLOGY

The proposed system works on the technology of Wi-Fi, i.e., Wireless Fidelity which makes use of a smart phone for the purpose of navigation in an indoor environment. For the purpose of navigation the first thing that is required is a site map on which each and every sector of the building is plotted properly and the paths between them are well defined. This task of creating and defining maps for a new site is done by an administrator who is responsible for all the activities like plotting of rooms, defining the path. Also when the maps are fully functional they are uploaded to a data based shared by the entire system, i.e., both the administrator and user of the system. If a user uploads an image it is required that the scaling of the pixels of image is done to that of meters on the site map.

Whenever a user needs to reach a required destination inside a building like malls, hospitals, etc. his position is calculated, which is termed as current location. For identification of the current location a technique known as triangulation is used. Triangulation is a method which requires signal strength above a threshold from at least three Wi-Fi routers to calculate the current position of the user. This process is called as localization which helps in finding the exact co-ordinates of the user in the XY plane. User is provided with the functionality of uploading the site image if available or be able to download one if it is not. Once the map is plotted the most appropriate path between the current location and destination required by the user is provided automatically by the system. It has a functionality because of which the system has the ability to

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identify for itself the best possible option and choose it for use. As soon as the path is provided the user can use it to travel to various locations and has the option of saving locations for future use. For example, if the user has parked the car in a spot in the parking lot than its location can be saved and can very easily traversed back.

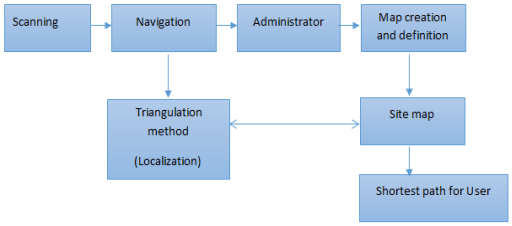

Figure (3) depicts the path detection.

This provides the user with the flexibility of wandering around the building without the limitation of remembering their way through the site.

User can easily access the information about the upcoming events and about offers provided on site on the present day or some day in the future. Another functionality processor consists of allowing the user to communicate with and track any other user of the application.

IV. APPLICATIONS

1.Localize the user in an indoor environment such as mall, buildings, campus etc.
2. Turn by turn navigation is provided to the user.
3. Save the current location of the user.
4. Floor plans are easily mapped and created.
5. Track the user who is in the premises using this application.
6. Offers the shortest path automatically for the user's convenience.
7. Inform about the offers, schedules and events held in the premises

V. CONCLUSION

The proposed paper details out the methodology for user indoor navigation system. It aids the user to find way through the places like malls and hospitals to reach a desired destination without getting confused it allows for the creation of new site map as well as plotting pixels of an image uploaded by the user to a canvas. This system supports the user to efficiently find their way through indoor premises without much fuss. This system is easy to deploy and use for the purpose of turn by turn navigation. It reduces the efforts required by the user when visiting a new place by a considerable amount.
User can easily find way to a new destination and to an already visited one (by saving location). Access to the information about offers and events is available to the interested person. Communication and tracking of other user of this system is also available. All these properties make the system very reliable, easy to use and cost effective

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BIOGRAPHY

Shweta shandilya pursuing mtech (I.I) from Bharati Vidhyapeeth deemed University College of engineering; she completed her bachelor degree from KCB technical Academy, Indore (M.P) in information technology. The areas where she worked or completed her projects are networking, Pervasive systems, database management system and mobile computing.