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Indoor Navigation Systems and Technologies for Guiding the Users

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ABSTRACT

Outdoor positioning utilizes GPS for navigation it made the task of navigating outdoors relatively easy, but due to the lack of signal inside buildings, navigation in indoors has become a very challenging task. So by using smartphone technology and sensors in it we can overcome some problems occurred in outdoor positioning and it gives precise indoor localization. Indoor navigation is a most important innovation for application, for example, finding a ward room, ICU in a hospital, security exit amid a crisis or focused on the retail commercial in a shopping center. To give solid indoor navigation to business structures like shopping centers, hospitals, hospital wards, organization, university this system is utilized. To achieve this, we use audio guidance, shortest path algorithm and Google map.

Keywords : Voice or Speech Map Navigation, Indoor Navigation, Pedestrian Navigation, GPS, Object Tracking, Location Based Services

I. INTRODUCTION

Navigation is the process of correctly establishing the user's position and after that providing directions to guide them through different paths to their exact destination. So now a days Global Positioning System (GPS) is the most common and the most usable satellite navigation system. Earlier every aircraft and ship uses GPS technology. But from the past few years, smartphones have evolved to contain a GPS unit, and this has given birth to location-based mobile applications for the common user. But GPS has its limitations. In particular, we are concerned with the lack of GPS signal reception in indoor environments. GPS satellites fail to deliver a signal to a device if there is a direct obstruction on its path. Therefore, we have to consider alternate methods of achieving indoor navigation on a smartphone.

Indoor navigation actually arises with **navigation within buildings**. Because GPS signals is normally non-existent inside the building, there are some other positioning technologies are utilized when automatic positioning is desired. Wi-Fi or Bluetooth Low Energy (BLE) are often utilized in this case to create an **"indoor GPS"**. They enable us to determine the actual floor level. Most applications require an "indoor routing" functionality that guides people precisely through a building using an indoor navigation app and in this way, automatically determines their position very similar to the navigation systems that we use in outdoor navigation or in our cars. Now a day the utilization of indoor localization methods has turned out to be progressively critical in an extensive number of uses and settings, for example, human services, homecare, checking, following, and so forth.

In the decision of the best innovation of an indoor localization framework, a multiple number of parameters needs to be considered such as cost,

precision, vigor, versatility, and inclusion. Clearly, a solitary arrangement that works fine in any situation does not exist. At that point, it is most important to circumspect the execution parameters all things considered and coordinate them with the client perspective, which have to be divided and portrayed decisively for each application. Also the execution parameters execution is not state able so they are depending on different factors and conditions. So it is most important to locate the correct exchange off among execution parameters in case of indoor navigation such as natural conditions, and user's necessities so as to plan a modified arrangement.

In an outdoor system, the GPS works productively in positioning and focusing on different types of substances. It has been used in various outdoor applications for limiting individuals, just as distinct items. GPS is not effectively utilized in indoor navigation. This is due to presence of hindrances that can debilitate the flag of the GPS (e.g., building engineering, dividers) where the presence of various gear can cause a commotion in the GPS transmitted flag.

Author Pedersen [1] proposed a miniaturized scale positioning procedure that used in indoor conditions for positioning and tracking the exact required objects. Hence he says this would fill in as a trade for the GPS positioning framework.

After that Author, Fhelelboom [2] found that a Wireless LAN (WLAN) can be used to find or position objects in any indoor condition. Here we audit the distinctive positioning conditions, the diverse systems connected for every condition and the estimation used inside every framework. We indicate two situations for positioning individuals and articles inside an indoor domain. Every one of these situations has its very own difficulties, which specialists attempted in the past to moderate by proposing a few arrangements throughout the most recent ten years.

Indoor navigation system is also helpful to un visualized peoples because Blind and Visual impaired people face some accessibility and mobility problems in day to day life. Some tasks or situations have physical constraints, sometimes impossible for them to overcome. Those difficulties are related with a lack of autonomy or information that could help them to avoid obstacles. These issues can be overcome by improving the human ability for sensing and recognizing it. In general, urban accidents are influenced by a lack of right signalization or by a chance, and some related causes like public phone booths, mailboxes, poles, dump-carts and twigs of trees. Going through an unknown place becomes a difficult when we can't depend on our own eyes. Because dynamic objects usually make noise while moving, blind people develop their sense of hearing to localize them. However, they are reduced to their sense of touch when the matter is to find where an inanimate object exactly is. The common way for navigating of blind person is using a walking cane. The walking cane is a simple and completely mechanical device dedicated to find static obstacles on the ground, uneven surfaces, dig and steps via simple tactile-force feedback. This device is light, portable, but range limited to its own size and it is not usable for dynamic obstacles detection.

Numerous commercial devices are existing in the market for blind peoples to navigate. But lack of user-friendliness makes them less useful for the customers. Thus ARM processor is designed for the system; which gives an audio output through microphone to the user about the direction in which the user is moving. The system also provides a light source providing ambient light. The purpose of this light is to announce the presence of the user during low light times like night hours. Temperature of the environment can be sensed and output sent as voice. The device can take notes using a touch keypad when needed. It also has a MP3 player to play the user's favorite music when needed and a SD card for storage.

Now a day's large variety of people comprises in world. Some of them rely on others for their living. But in today's fast world, everyone is busy and there are less people to care for the increasing number of elderly and the physically challenged people. Also these people find it tough to even navigate inside the home without external aids. The elderly people find automated wheelchairs as an easy way for locomotion. Having known about these facts, our aim was to bring an automated navigation system which can be used by both the elderly and the physically challenged people in a user-friendly manner using voices for operation.

In this paper, we audit the distinctive positioning conditions, the diverse systems connected for every condition and the calculations utilized inside every framework. We indicate two situations for positioning individuals and articles inside an indoor domain. Every one of these situations has its very own difficulties, which specialists attempted in the past to moderate by proposing a few arrangements throughout the most recent ten years.

II. LITERATURE REVIEW

A large amount of interest has been shown to develop indoor navigation systems for the common user in the past few years. Researchers have explained possibilities of indoor positioning systems that use Wi-Fi signal intensities to find the object position. Other wireless technologies, such as Bluetooth, ultra-wide band (UWB) and radio-frequency identification (RFID) have also been proposed. Another innovative approach utilizes geo-magnetism to create magnetic fingerprints to track position from disturbances of the Earth's magnetic field caused by structural steel elements in the building. Some of these methods have given fairly accurate results, they are either highly dependent on fixed-position beacons or have been unsuccessful in porting the implementation to a ubiquitous hand-held device. Many have approached the issue of indoor positioning by means of inertial sensors. A foot-mounted unit has recently been developed to find the movement of a pedestrian. Some have also exploited the smart-phone accelerometer and gyroscope to build a reliable indoor navigation system. Last year, researchers at Microsoft claim they have achieved metre-level positioning accuracy on a smartphone device without any infrastructure assistance. However, this system depend on a pre-loaded indoor floor map and does not yet support any positioning. An altogether different approach applies vision. In robotics, simultaneous localization and mapping (SLAM) is used by robots to navigate in unknown environments. In 2011, a thesis considered the SLAM problem using inertial sensors and a monocular camera. Recently, a smartphone-based navigation system was proposed for wheelchair users and pedestrians using a vision concept called as ego-motion. Ego-motion finds a cameras motion by estimating the displacement in pixels between two image frames. Besides providing the application with an indoor map of the location, the method works well under the environment which has plenty of distinct features. Localization using markers have also been proposed. One such technique uses QR codes to find the current location of the user. There is also a smartphone solution, which scans square fiducial markers in real time to establish the user's position and orientation for indoor positioning. Some have even looked at efficient methods to assign markers to locations for effective positioning. Although, scanning markers provide high precision positioning information, none of the existing techniques have exploited the idea for navigation. Finally, we also looked at existing commercial indoor navigation systems available on the smartphone. Aisle411 provided a scalable indoor location and commerce platform for retailers, but only displayed indoor store maps of where items were located to the users without any sort of navigation hints. The American Museum of Natural History also released a mobile app (amnh.org/apps/explorer) for visitors to act as their personal tour guide. Although, the application provides the user with turn-by-turn

directions, it uses expensive Cisco mobility services engines to triangulate the device's position.

A. Fixed Indoor Positioning

The design of Fixed IPS systems is consist of number of Base Stations (BS), which is the fundamental PC. All BS are needs to be known in deployed areas inside the building. Also Wireless Sensor arranges including the sensor hubs are required. In this structure, the sensor hubs are in charge of proliferating the flag got from a portable station to the BS just as doing the basic count of the goal or time of transmissions. This conduct relies upon the structure of the framework. The third principle segment of the settled indoor positioning engineering is the cell phones or labels conveyed by individuals or joined to target objects. These labels give a novel recognizable proof to each item or individual. Along these lines, blunders will be restricted. Next, we list every remote innovation with the systems, which are produced dependent on this innovation.

a) Infrared Positioning System

To transmit signals from sensor hubs to the BS infrared flags are utilised. A standout amongst the most well-known infrared positioning systems is the dynamic identifications. Here clients convey an ID card furnished with an infrared LED. The infrared LED transmit a special code at some intervals. Moreover, there are infrared sensors introduced on a roof and if the IR identification is inside six meters, the sensor can peruse the code. The BS gets the data from the IR sensors eventually. At last, the BS can assemble a guide of each identification area by using the data recovered from the sensors.

b) Ultrasonic Positioning Systems

Ultrasonic reference points are used most commonly than infrared points. Ultrasonic systems give exact positions to subject. Ultrasonic based systems are accurate than Radio Frequency dependant systems.

The Crickets framework [7] created by the Massachusetts Institute of Technology (MIT) is on more outstanding ultrasonic based indoor positioning framework. The Cricket framework has two types of hubs, signals, and audience members. Reference point's areas are deployed and they are inter connected to the roof while the audience are appended to the objective items and individuals. Guides transfer intermittent info to the BS containing its ID, scope of inclusion or physical space related to its directions. Cricket utilizes the Time Difference of Arrivals (TDOA) credit so as to figure the directions of the objective item. That is by ascertaining the contrast between the Radio Frequency flag Time Arrival and the ultrasonic flag Time Arrival. The Difference of the season of the landing of the two signs is find to utilize conditions since the Radio Frequency is a lot quicker than sound.

c) RF Positioning Systems

The forth most used part of remote innovation is Radio Frequency (RF). This is due to the less effort and the high scope of inclusion of the systems created based on RF innovation. Some RF dependent systems that we will analyse in this paper are RADAR, Spot-On, LANDMARC, and UWB systems.

LANDMARC framework based on Radio Frequency signs and RFID labels. LANDMARC reduces the expense of using RFID per users by lessening the quantity of per users and utilizing reference labels. These reference labels have a well-known area and they transmit to the per users the area of the objective items. LANDMARC is a decent framework however its exactness is 1-2 meters.

Author Guang gave a component to increase the execution and accurateness of LANDMARC. This component works by decreasing the quantity of applicants of reference labels while ascertaining the situation of an article. This diminishes the count exertion and results in a quicker computation and a superior precision. When testing LANDMARC

utilizing this component, Guang claims the precision of LANDMARC was preferred using this system over utilizing the conventional LANDMARC.

Author Jiang evolved a framework that gives open air positioning utilizing GPS and UWB to give indoor navigation. Jiang's framework contains PDA, UWB sensor organize and a Base Station. GPS programming is introduced on the PDA just as an interface for the UWB sensor organize. At the point when the client moves outside the building the GPS application is actuated and when the client moves inside the building the system perceives the gadget and the UWB application is initiated to empower the client to explore through the building and enables the Base Station to position this client. The correctness was analysed to be inside 10 meters which require a ton of upgrades later on.

d) Optical Indoor Positioning

Optical Indoor Positioning is another kind of settled indoor positioning where we have a framework introduced in the building and a camera conveyed by the client.

Tilch evolved CLIPS (Camera and Laser based Indoor Positioning System). This system consolidates the two advances to position objects indoor. The camera goes about as the cell phone for positioning articles.

B. Indoor Pedestrian Positioning

The person on foot positioning, as referenced prior in the paper, happens when finding individuals who are conveying localization sensors while the building is not furnished with an indoor positioning framework. In these kinds of systems, Inertial Navigation Systems or dead retribution are for the most part utilized. Dead Retribution is characterized as a navigation procedure that begins with an outstanding area [13]. At that point, includes the position changes in the directions of the beginning stage. It likewise adds the progressions to the heading (course), speed or separation. Besides, Pedestrian Dead Reckoning (PDR) is characterized as assessing the speed of development and the heading or bearing of development. We will demonstrate a portion of the intriguing commitment to this sort of positioning.

A few methodologies in Indoor Pedestrian Positioning Use Particle Filters, for example, Bayesian Filter and Kalman Filter. A Bayesian channel [14] is utilized to appraise the progression of the passer-by at a specific time when knowing the past strides of a similar walker at a number of times before it. Kalman Filter [15] is a scientific model which is utilized to precisely appraise the situation with the presence of commotion.

III. PROPOSED SYSTEM

C. System Architecture

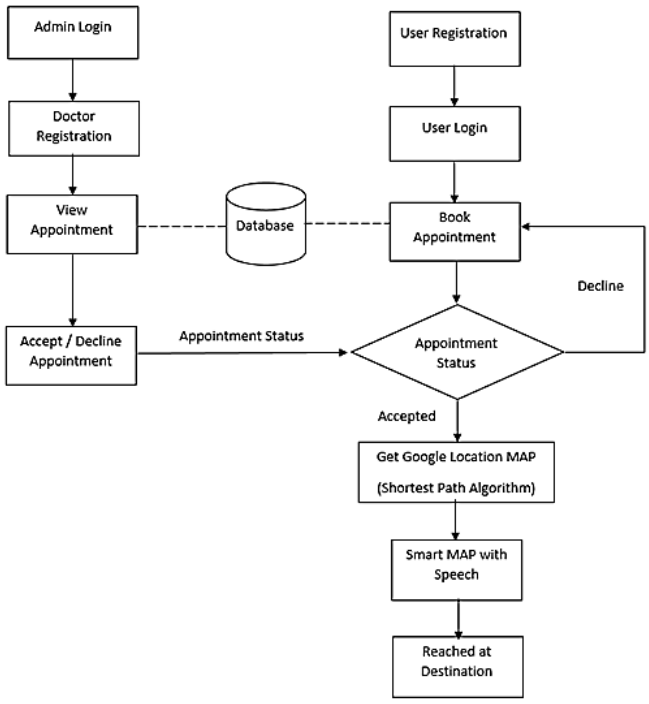

Fig 1. Proposed System Architecture

Worldwide situating framework find adjacent area Street Address, City, Country and Zip code. Likewise, Show, your approach to achieve the place with speed of voyaging. This application is utilized for crisis case we ready to discover an area of adjacent healing facilities and contact details. It's giving naturally development call to the specific area. Google outline

separation of the two spots. Additionally, know driving heading of the two urban communities and Traveling time and separation of the place. The application is finding Hospital Location by means of the GPS and Speech Navigation.

The above figure shows the proposed system flow diagram. Initially Admin Login to the system with its credentials. Then he registers doctors with their name, age, gender, specialty, experience. Then User / Patient do the registration with user personal information fields and login to the system and book the appointment with doctor. If doctor accept the appointment, then the patient can view the google map path from current location to the destination (hospital). After reaching near to the destination for better accuracy our proposed system uses speech navigation. With the speech navigation user can accurately reach at desired location without asking to anyone and wasting time for GPS / MAP Navigation.

D. Indoor Positioning

Wi-Fi access points, which means that the solution can easily be transferred to other buildings. By being easily transferable to other buildings, it will be easier for governments to impose rules that forces building owners to support indoor navigation for the visually impaired [24].

LaureaPOP is a system for the visually impaired that uses Wi-Fi access points for indoor positioning, presented in Rajamäki et al. [25]. This system combines both indoor and outdoor navigation for the visually impaired, by switching between WiFI location and GPS depending on the user's location. In order to convey information to the user, the system will read out instructions, while accepting voice commands. The paper also presents the issue with the lack of standardization of indoor maps, which affects systems's ability to provide indoor navigation. Another issue is that the solution's accuracy can vary. Improvements to the Wi-Fi indoor positioning was proposed in Yang and Shao [26]. Their solution sends multiple predefined messages which reduces the number of antennas needed, as well as the bandwith required. In simulation, their solution gave Wi-Fi positioning an accuracy of 1 meter without the need to modify the Wi-Fi access points.

The Drishti system uses machine learning to do image sequence matching for indoor positioning. This is done by training the system to detect its position in specific locations based on what the camera can see. Training the system will require a lot of resources since it will require training data for every single room, otherwise the system will not be able to help the user detect their location [27].

Machine learning was also used with wearables in Golding and Lesh [28]. Here, users of the system wear several sensors and based on the input provided from these and the paper's 'data cooking' module, the system can detect the user's location with an 98 percent accuracy. However, this obviously require training data from the locations the system will support. Another issue is, as said in Hesch and Roumeliotis, is the inconvenience the user can experience by requiring them to wear hardware. WebBeep, an indoor location service using audio, was developed and discussed in Lopes et al. [30]. By using audio to send signals to other devices, it is possible to triangulate the position of the user. However, this solution can become inaccurate due to noise, and can cause annoyances for other people in the room.

E. Our Contribution

1. We propose to develop a Voice based navigation system for patient visiting the Nagpur Government Medical Hospital.
2. Here we will first classify the data of location gates and builds of medical.
3. From this classified pattern we will generate the shortest path from the gate.
4. For navigate the path will be described to the user through a voice alert.
5. For shortest path we propose to use Dijkstra's shortest path algorithm.

F. Algorithms

1) Shortest Path Algorithm

D. Dijkstra's Algorithm Let the node at which we are starting be called the initial node. Let the distance of node Y be the distance from the initial node to Y. Dijkstra's algorithm will assign some initial distance values and will try to improve them step by step.

1. Assign to every node a tentative distance value: set it to zero for our initial node and to infinity for all other nodes.
2. Mark all nodes except the initial node as unvisited. Set the initial node as current. Create a set of the unvisited nodes called the unvisited set consisting of all the nodes except the initial node.
3. For the current node, consider all of its unvisited neighbors and calculate their tentative distances. For example, if the current node A is marked with a distance of 6, and the edge connecting it with a neighbor B has length 2, then the distance to B (through A) will be 6+2=8. If this distance is less than the previously recorded distance, then overwrite that distance. Even though a neighbor has been examined, it is not marked as visited at this time, and it remains in the unvisited set.
4. When all the neighbors of the current node are considered, mark the current node as visited and remove it from the unvisited set. A visited node will never be checked again; its distance recorded now is final and minimal.
5. The next current node will be the node marked with the lowest (tentative) distance in the unvisited set. 6. If the unvisited set is empty, then stop. The algorithm has finished. Otherwise, set the unvisited node marked with the smallest tentative distance as the next "current node" and go back to step 3.

IV. CONCLUSION

Here we did research on indoor positioning systems, the parameters of positioning and estimation required in different conditions. Also we discussed some issues faced during planning of an indoor navigation system. We proposed framework to overcome these difficulties and provided improved version of indoor positioning systems. We saw areas where this application is used. Some commercial market used this system for navigating from one position to another. This system also useful to blind peoples to navigate by using audio guide without any obstacles in the roof and need not depend on other peoples.

V. REFERENCES

[1]. Solrun Furuholt Pedersen, "Micro Positioning". Master Thesis. ITEM NTNU, Jun 15, 2014.

[2]. Fhelelboom, Zuher. "Equipment tracking and security systems for hospitals". Master Thesis Universitiy Teknology Malaysia. May, 2017.

[3]. I. Guvenc, C.-C. Chong, "A Survey on TOA Based WirelessLocalization and NLOS Mitigation Techniques", IEEE Communications Surveys and Tutorials, vol. 11, no. 3, 2009, Pages: 107-124.

[4]. R.Want, A.Hopper, V.Falcao and J.Gibbons; The active Badge location system, ACM Transactions on Information systems Vol. 40, No. 1, pp. 91-102, January 2012.

[5]. Hazas, M., Hopper, A; A Novel Broadband Ultrasonic Location System for Improved Indoor Positioning, IEEE Transactions on mobile Computing, Vol. 5, No. 5, May 2006.

[6]. Michael Popa, Junaid Ansari, Janne Riihij¨arvi, and Petri M¨ah¨onen. 2008. Combining Cricket System and Inertial Navigation for Indoor Human Tracking. WCNC proceedings.

[7]. Priyantha, N. B; The cricket indoor location system: PhD Thesis, Massachusetts Institute of Technology. 199 p, June 2005.

[8]. Fukuju, Y.; Minami, M.; Morikawa, H.; Aoyama, T.; Dolphin. 2003. An autonomous indoor positioning system in ubiquitous computing environment, in Proc of the IEEE Workshop on Software Technologies for Future Embedded Systems.

[9]. Lionel M.NI, Yunhao Liu, Iu Cho Lau, Abhıshek P. Patil; LANDMARC: Indoor Location Sensing Using Active RFID

[10]. Guang-yao Jin, Xiao-yi Lu, Myong-Soon Park. 2006. An Indoor Location Mechanism Using Active RFID. Proceedings of the IEEE International Conference on Sensor Networks, Ubiquitous and Trustworthy Computing.

[11]. Lijan Jiang, Lim Nam Hoe, Lay Leong Loon. 2010. Integrated UWB and GPS Location Sensing System In Hospital Environment. IEEE International Conference of Sensor Networks.

[12]. Tilch, S. Mautz, R. 2010. Current investigations at the ETH Zurich in optical indoor positioning. IEEE Positioning Navigation and Communication (WPNC) conference.

[13]. S. Beauregard and H. Haas. Pedestrian dead reckoning: A basis for personal positioning. In Proceedings of the 3rd Workshop on Positioning, Navigation and Communication, 2006.

[14]. V. Fox, J. Hightower, L. Lin, D. Schulz, and G. Borriello, "Bayesian filtering for location estimation," IEEE Pervasive Computing, vol. 2, no. 3, pp. 24–33, 2003.

[15]. Matthies, L. H., Szeliski, R., and Kanade, T. (1989). Kalman filter-based algorithms for estimating depth from image sequences. International Journal of Computer Vision, 3, 209–236.

[16]. Beauregard, S., (2006). A Helmet-Mounted Pedestrian Dead Reckoning System. Proceedings of IFAWC2006, TZI University Bremen, Germany, pp. 79-89

[17]. Robertson, P., Angermann, M, Krach, B., Simultaneous Localization and Mapping for Pedestrians using only Foot-Mounted Inertial Sensors. In Proc. Ubi Comp 2009, ACM (2009) 93-96.

[18]. C. Fischer et al., "Ultrasound-Aided Pedestrian Dead Reckoning for Indoor Navigation," Proc. Int'l Workshop Mobile Entity Localization and Tracking in GPS-Less Environments, ACM Press, 2008, pp. 31–36.

[19]. O. Woodman and R. Harle. Pedestrian localisation for indoor environments. In Proc. of the UbiComp 2008, Seoul, South Korea, Sept. 2008.

[20]. SHAO W., TERZOPOULOS D.: Autonomous pedestrians. In SCA '05: Proceedings of the 2005 ACM SIGGRAPH/Eurographics symposium on Computer animation (New York, NY, USA, 2005), ACM Press, pp. 19–28.

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