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Real Time Indoor Navigation System For Visually Impaired

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Abstract*: Indoor Navigation system is gaining lot of importance these days. It is particularly important to locate places inside a large university campus, Airport, Railway station or Museum. There are many mobile applications developed recently using different techniques. The work proposed in this paper is focusing on the need of visually challenged people while navigating in indoor environment. The approach proposed here implements the system using Beacon. The application developed with the system gives audio guidance to the user for navigation.

***Index Terms*: About four key words or phrases in alphabetical order, separated by commas.**

I. INTRODUCTION

A smartphone in hand allows users to reach their destination efficiently using outdoor GPS navigation mobile apps. However, GPS satellite signals are not accurately traceable in case of in- campus or in-door situations. In large university campuses, offices, malls, multispecialty hospitals, airports, building cover a lot of areas, and thus it becomes challenging for people to find their destination quickly. For visually challenged people, it is even more difficult as they are in need of more accurate information like doors, exact location of lifts, steps to climb up or down, keeping the track of desired path. Most indoor navigation systems available are designed for normal people. Development in technology has made use of smart phones easy, even for blind people. There are many utilities available as screen reader. Job Access with speech (Jaws) being the most popular. IPhones has got voice over screen readers [1-2]. Various methods and devices are proposed and used for indoor position estimation which includes use of wireless fidelity (Wi-Fi), Bluetooth low energy (BLE) Beacons, Zig-Bee communication modules, radio frequency identification (RFID). Out of these technologies, BLE Beacons as well as Wi-Fi are widely used. Indoor positioning is achieved by analyzing the signal strength received from these transmitters.In general indoor navigation system should have an application for showing current positions to the visitors on the map, create the shortest route to a destination, and receive messages from system administrators. Techniques like Augmented Reality, beacons, Wi-Fi fingerprinting are used by the apps to create inclusive indoor maps. These navigation maps mainly have three purposes

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- Positioning: To locate a place in a building
- Navigation : Find shortest path to reach desired location

Push Notifications: To send required messages to user In order to achieve best user experience that is both fast and accurate, it is necessary to have a very good underlying dynamic positioning system platform. I t is necessary to process the data from various sources in order to calculate the position of a user. The various solutions for positioning in indoor scenarios include

- Wi-Fi fingerprinting
- Beacon based solutions
- RFID based solutions

Wi-Fi fingerprinting based solutions need Wi-Fi access points available in the area under development. Wi-Fi Access points are for the purpose of signal transmission. It is not installed considering the localization requirement. RFID, optical sensors, ultra-wideband and infrared are used for the purpose of localization but, these technologies require a specialized reader for operation.Many beacon based solutions are available for indoor navigation which include client based or server based methods. Beacon has advantage of consuming less power and it can be operated by an interface in many current smartphones.

The system can be designed based on

- Information received from inbuilt smartphone sensors like accelerometer, gyroscope
- Signals strength received from a beacon transmitter.
- Building Maps and touch points marked
- Smartphone app developed for Navigation
- RFID reader
- Tagged locations
- Back-end servers
- Ultrasonic sensors

Beacons form the reference line of the indoor positioning technology. Placement of Beacon is a very important element of the project. It is necessary to follow the best practices to achieve optimum results. Deployment of Beacon for positioning system requires consideration of many parameters including

- Number of beacons
- Orientation
- height at which they are placed
- Transmitter power
- Update rate

- Algorithm used for fingerprint creation
- beacon mobility

These parameters are inter-dependent e.g. reducing the power transmitted may need a change in the no of beacon required to maintain coverage. In addition the results are highly dependent on the environmental parameters, other transmitters like Wi-Fi Access points.Orientation of Beacon has a huge impact over the received signal strength. Orienting them correctly is important for best results. The Tx power decides the beacon range and the update rate impacts the stability of the signal. Having a high transmitter power can reduce battery life, increase interference with other beacons and hence reduce location stability. It is recommended to use -77dBm transmitter power and 300ms for repetition frequency, 3 meters height to get a clear line of sight. Obstacles and interference The signal transmitted by Beacons can easily be detected by smartphones and hence can act as tool for positioning in indoor environment, based on the Received signal strength. Compared with Wi-Fi, Beacon devices have the following advantages

- Easy deployment,
- Battery base operation,
- Low energy consumption
- Ease of integrating in an application
- Less power required for scanning

For a system designed with BLE beacon, it is important to optimize use of battery life to make it easily manageable and cost effective.

II SYSTEM IMPLEMENTATION

Figure 1 explains the overall schematic of the proposed system which mainly consist of

1. A smart phone with the app installed for indoor navigation and having sensors e.g mike ,speaker, Accelerometer, compass as well as it must be blue tooth low energy enabled .

2. BLE Beacons installed on the walls at proper locations so as to get effective coverage and avoid overlaps.

3. Server to process the query coming from the user to find the shortest path for navigation and communicate the same effectively.

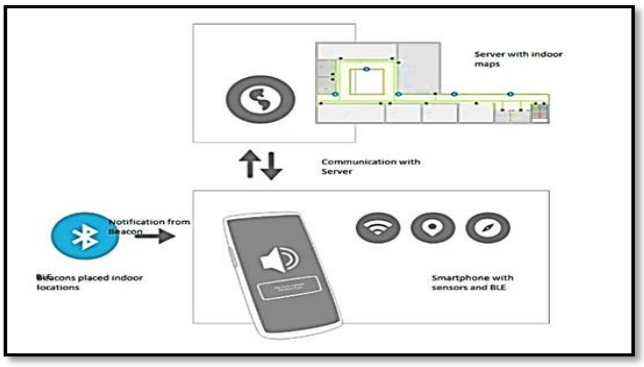

Figure 1 System Block Schematic

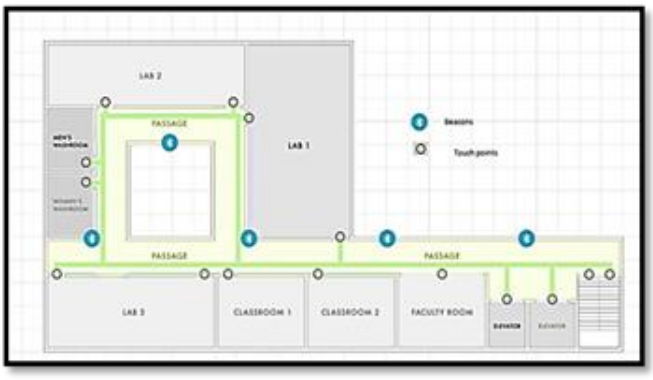

Figure 2 Indoor map showing Beacon Placement and Touch Points

Figure 2 shows the map of area under experimentation .The placement of Beacons and the touch points representing doors of every Lab and other key locations are shown on the graph.Figure3 shows the Beacon used and the coverage of every Beacon. Overlapping of coverage area is minimized by proper placement of the Beacons.

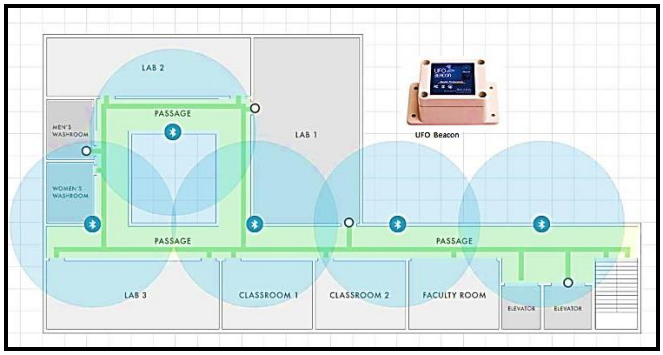

Figure 3 Beacon Coverage

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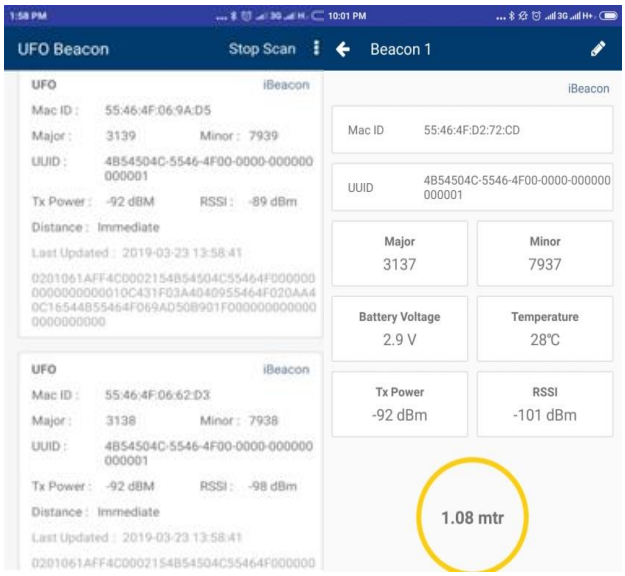
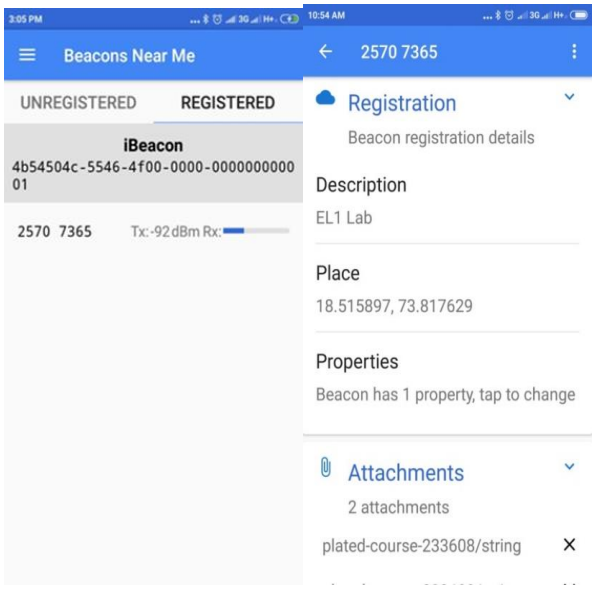
III. RESULTS

Using UFO Beacon app, the details of the beacons are found. The important parameters are shown in figure 4.The performance of beacons is tested by checking RSSI variation with distance in various indoor locations. The beacons are registered under project and the required information to be notified to the user is added as attachment. Figure 5 shows the details of Registered Bacons found in the range of smart phone and Parameters obtained which are major and minor value as well as received power.



(A) (B)

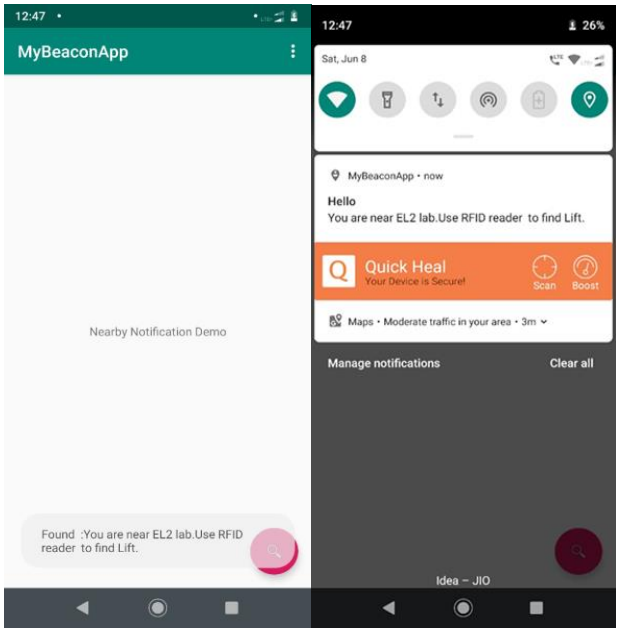
Figure 4 (A)Becons found in the range of smart phone with their details (B).Parameters obtained for Beacon1



(A) (B)

Fig 5 A Registered Bacons found in the range of smart phone with their details B. Parameters obtained

This location is also transmitted to the server to ease the navigation. Depending upon the destination touch point provided by the user the shortest path is found using Dijkstra's algorithm and communicated to the user.



(A) (B)

Figure 6 (A)screenshot of APP showing message found (B). Message received as notification

II. CONCLUSION:

The system developed gives accurate positioning and navigation guidence to the user.Beacon has advantage of long battery life.The android application developed will be helpful to the users to navigate in unknown indoor environment.

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REFERENCES

1. S. Traini, L. Sciullo, A. Trotta and M. Di Felice, "Practical Indoor Localization via Smartphone Sensor Data Fusion Techniques: A Performance Study," 2019 16th IEEE CCNC, Las Vegas, USA, 2019, pp. 1-7.
2. D. Liu and C. Hsieh, "Study of Indoor exhibitions using BEACON's Mobile Navigation," 2018 IEEE International Conference on Advanced Manufacturing (ICAM), Yunlin, 2018, pp. 335-337.
3. Z. Yang and A. Ganz, "A Sensing Framework for Indoor Spatial Awareness for Blind and Visually Impaired Users," in IEEE Access, vol. 7, pp. 10343-10352, 2019.
4. H. Xia et.al "Indoor Localization on Smartphones Using Built-In Sensors and Map Constraints," in IEEE Transactions on Instrumentation and Measurement, vol. 68, no. 4, pp. 1189- 1198, April 2019.
5. W. Liu et al., "Indoor Navigation With Virtual Graph Representation: Exploiting Peak Intensities of Unmodulated Luminaries," in IEEE/ACM Transactions on Networking, vol. 27, no. 1, pp. 187-200, Feb. 2019.

6. S. K. Meghani, M. Asif, F. Awin and K. Tepe, "Empirical Based Ranging Error Mitigation in IR-UWB: A Fuzzy Approach," in IEEE Access.
7. D. Pedro et al., "Algorithms for estimating the location of remote nodes using smartphones,"in IEEE Access. \
8. Reza Zekavat; R. Michael Buehrer, "RFID-Based Autonomous Mobile Robot Navigation," in Handbook of Position Location: Theory, Practice, and Advances , , IEEE, 2019, pp.1089-1120

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