Blind Guide, A smart Indoor navigation system for Blind people using Wifi positioning and BLE-Beacons

By

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CERTIFICATE

It is certified that the contents and form of thesis entitled **" Smart Indoor Navigation App for Visually Impaired "** submitted by

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have been found satisfactory for the requirement of the degree.

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DEDICATION

To Allah the Almighty

&

To my Parents and Faculty

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We are deeply thankful to our advisor and Co-Advisor, Dr. Muneeb Ullah and Dr Asad Anwar Butt respectively for helping us throughout the course in accomplishing our final year project. Their guidance, support and motivation enabled us in achieving the objectives of the project.

This project has been a combined effort, so the credit should not be confined to only students and the advisors committee, So, we are also thankful to our committee members Dr Nadeem Ahmad for his valuable feedback and Sir Shamyl Bin Mansoor for his critical analysis which helped us in achieving our objective.

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ABSTRACT

According to the survey of World Health Organization (WHO), 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision. These are the people who are dependent on others in one way or the other. The science has progressed so much but a very little effort has been put in to make them independent.

The major problems for them is to move from one place to another inside a building, which makes them ask for help at every step they take. This creates problem and risks for blind people and it may be irritating for the people whom they ask as well.

BlindGuide aims at developing a voice enabled smart indoor navigation system for blind people that enables them, to move from one place to another inside a building without needing to take anyone's help. This application makes use of some of the modern technologies, like Wi-Fi-positioning and BLE-signals to guide the person who needs help. The blind person who is using this applications, needs to tell the application through voice that where he would like to move.

The device will take the input, get to know about the present location of that person through Wi-Fi-positioning and will guide the person to the destination through continuous voice commands. For this system we need to have Bluetooth 4.0 enabled device. Version of android must not be older than KitKat 4.4. We need to have at least 3 Wi-Fi routers in range of device, sensors for using compass in mobile and BLE beacons.

INTRODUCTION

Mobile devices are very important to blind people's autonomy and social life. Besides basic communication features, they are able to provide most of the functions that desktop computers do. Moreover, the overlapping concerns between mobile and accessible web domains lead to more accessible mobile applications

GPS is a wonderful technology that allows users in an outdoor environment to find their way and avoid getting lost. But once a handicapped person is inside a building, then GPS can no longer be helpful for him to reach at their desired location independently .In a large building , handicapped people usually waste their time by looking for places and requesting for help by others.

In addition to accessibility and usability issues, Outdoor Navigation Apps (ONA) fit in this kind of applications that contain a large amount of information, but not widely used by blind people. Yet, little efforts have been made to understand the challenges that blind people face as well as the opportunities for improving their interaction with such applications. The exception are studies on blind people's usage of Outdoor Navigation Applications, by the means of surveys, to find out the main uses and accessibility barriers (e.g. dynamic web pages) of specific desktop sites.

Even those that actually evaluate the interfaces, resort to specific (ONA) and tasks. Despite these efforts, an understanding of blind people's difficulties in Social Networking Apps and the opportunities to enhance their experience is lacking, particularly in mobile devices.

Blind Guide give a preliminary insight about the limitations and open research challenges of blind people's interaction with mobile navigation applications. More than looking at the accessibility problems of a particular platform, we identify the difficulties and opportunities which comes up with the navigation applications.

IMPORTANCE

Nowadays most of the commonly used positioning and location detection system accessible via mobile phones are usually targeted to open spaces .Since adopted technologies are mainly based on GPS and satellite tracking ,which are robust for outdoors environment only in the recent years the focus has shifted to indoor venues where people can spend about 80% - 90 % of their time .The goal of indoor positioning in some applications, notably oriented to hospital and malls , is to monitor people into a structure or provide navigation support.

In other words indoor positioning system (IPS) provides location awareness for mobile devices in ubiquitous and pervasive wireless computing system. The need for connectivity, access and navigation has fueled research and investment in the field.

The absence of satellite signals in indoor environment clearly indicates the need for the newer solutions .GPS does not work in the indoor spaces or in buildings surrounded by the dense blocks of high –rise structure , since receivers require a clear view to communicate with satellite. Indeed , GPS signal is attenuated or scattered by the roofs walls and other objects .In addition , GPS is only one third as accurate in the vertical direction as it is in the horizontal ,thus this makes impossible to be adopted in the order locate a person or an object on the doors of buildings.

On the other hand current IPS required a dedicated local infrastructures and in some cases customized mobile units .In practice there are many different applications of IPS and each application has its own requirements and there is no specific positioning system which suits all kinds of contextual requirements and physical environments .As a result the needs and constraints for every application must be analyzed separately to provide an individually tailored solution. Therefore it is important to assess the performance parameters of all the technologies capable of providing indoor positioning support and match them with the user requirements, which should be described precisely for each application.

To tackle this problem with blind people we came up with the idea to make user connect with the mobile phone such that it can interact with it to track map and get and post location based on the user requirements. It connects the smart phone with the user using voice input/ output via android application, tracks user's current location, connects with the server, asks user for the destination, look for the path and guides at every step.

Estimote Beacons

Estimote Beacons and Stickers are small wireless sensors that you can attach to any location or object. They broadcast tiny bluetooth signals which your smartphone can receive and interpret, unlocking micro-location and contextual awareness.

With the Estimote SDK, apps on your smartphone are able to understand their proximity to nearby locations and objects, recognizing their type, ownership, approximate location, temperature and motion. Use this data to build a new generation of magical mobile apps that connect the real world to your smart device.

Estimote Beacons are certified Apple iBeacon™ compatible as well as support Eddystone™, an open beacon format from Google.

Wi-Fi Positioning

Absolute and accurate indoor localization is becoming more important for Wi-Fi based devices due to the increased use of augmented reality, social networking, health care monitoring, personal tracking, inventory control and other indoor location-aware applications.

The popularity and low price of Wi-Fi network interface cards is an attractive incentive to use Wi-Fi as the basis for a localization system and significant research has been done in this area in the past 15 years

The most commonly employed localization technique used for positioning with wireless access points is based on measuring the intensity of the received signal (received signal strength indication or RSSI). Typical parameters useful to geolocate the Wi-Fi hotspot or wireless access point include the BSSID,SSID and the MAC address of the access point. The accuracy depends on the number of positions that have been entered into the database.

While triangulation is a technique uses angles to locate points while trilateration uses lateral distances. If we know the positions of three points P1, P2, and P3 as the centre of three circles, as well as their radii as r1, r2, and r3; we can look at the overlapping circles formed to estimate where we are relative to the three points. We can even extend the technique to 3D, finding the intersecting region of spheres surrounding the points.

In this project, we would like to show how we can use the Wifi signal strength, in dB, to approximate distance from a wireless access point (AP) or router. Once we have this distance, we can create a circle surrounding an AP to show possible locations we might occupy. In the next part of the project, I plan to show how we can use three APs to estimate our position in a plane using concepts of trilateration.

Google Voice API

Whether your app uses system or custom voice actions, there might be times when the app would like to ask the user a follow-up question before performing the action. As it will happen in our application that when the user will have to go from one place to another, he will tell the application, e.g “Take me to room number 123”. This will be considered as the input from he blind person and will be interpreted by the application and corresponding commands will be generated.

Google Voice Actions let users quickly complete tasks in your app using voice commands. It's another way to drive usage of your app with Google. Users' voice and text action requests can now lead directly to your Android app, so they can get to your native mobile experiences quickly and easily

To use this feature in our android application we are required to import the library for text to speech i.e in our activity:

i.e Import `android.speech.tts.TextToSpeech;`

Then the activity is required to implement the listener for this library as:

Activity implements `TextToSpeech.OnInitListener`

Google Text-to-Speech is a screen reader application developed by Google Inc for its Android operating system. It powers applications to read aloud (speak) the text on the screen.

Compass

We are using the compass for the purpose of estimating where the person is heading at a particular moment. This is important to be integrated because when a person is standing at a particular position inside a building, the signal strength of the wifi-signal will be same irrespective of where are we facing. At last the application has to convey the “Go ahead” command to the user then what if the person is facing towards north and his destination is towards south.

What the compass does it that it gives us the angles according to the global reference and we can define that at each place in the building in which range of angles the person must be standing to go to a particular place.

Google Compass is a Google Maps tool for the plotting and recording of compass bearings, distances and magnetic declination or variation for single or multiple Google Map routes.

In a typical compass application choose a single-leg or multi-legged route, use the search bar to select the starting point and Google Compass then overlays an interactive Silva compass on a Google Map. The compass can be dragged and positioned to point in any direction and routes can then be plotted.

The compass will automatically adjust for differences between magnetic and true north for any location and also provide the latitude and longitude coordinates of your routes. Your Google Maps Compass routes can be saved and stored for later retrieval.

Compass basically uses geomagnetic field sensors and the vakyes of geomagnetic field sensor are converted to degrees to get the values for compass.

Geomagnetic Field

Estimates magnetic field at a given point on Earth, and in particular, to compute the magnetic declination from true north. This sensor uses a Hall effect transducer, and measures a vector component of the magnetic field near the sensor tip. It has two ranges, allowing for measurement of relatively strong magnetic fields around permanent magnets and electromagnets, as well as measurement of weak fields such as the Earth's magnetic field. The articulated sensor tip allows you to measure both transverse and longitudinal magnetic fields.

PROJECT GOAL AND SCOPE:

Project scope was divided into the following phases:

- Import Estimote Beacons devices from Ireland and configuring it for own use.
- Wi-Fi positioning and reading Adjustments for available network routers
- Developing a network of Beacons and communication protocols on strength on intersection areas.
- Developing a floor for every building and its live tracking.
- Establishing a communication server that carries back log for recent activates and can give services.

Goal:

The foremost goal for our project is to provide more than a navigation system, it should be able to provide complete services to the handicapped people. It should be able to help them in real time and it should be very effective and efficient that can make blind people fully independent. To enlighten the blind community and make people aware of their needs and help them using information technology rapid development. Enable them to forget about their shortcoming and come up with more independent solutions.

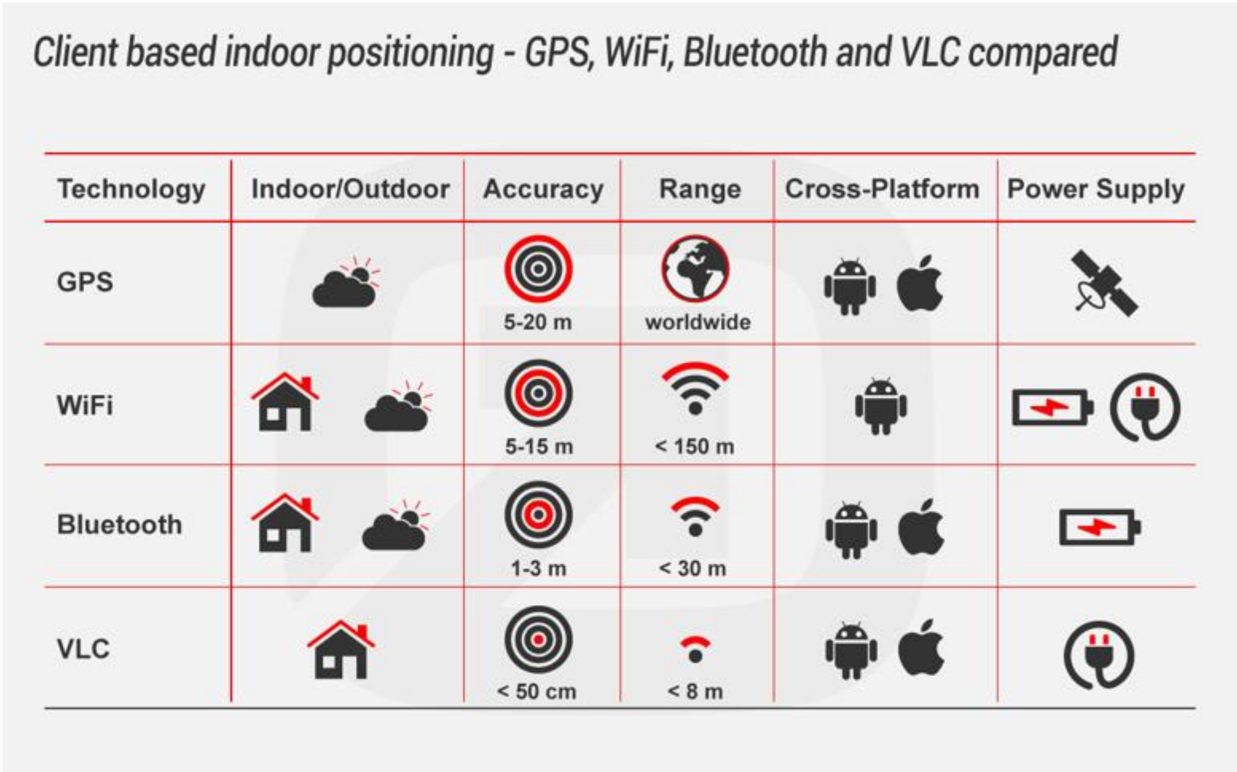
If we summarize the goal of the project in some bullet points, that will be like:

- Facilitating the handicap people to reach their desired locations using BlindGuide.
- Seamless and adaptive change of destinations as user moves from one place to another.
- Guiding the user at every end.
- Compass guide for delivering the exact front and back locations for the user needs.

2. LITERACTURE REVIEW/BACKGROUND INFORMATION

A large number of visually impaired people use state-of-the-art technology to perform tasks in their everyday lives. Such technologies consist of electronic devices equipped with sensors and processors capable of making "intelligent" decisions. Various feedback devices are then used to communicate results effectively. One of the most important and challenging tasks in developing such technologies is to create a user interface that is appropriate for the sensorimotor capabilities of blind users, both in terms of providing input and interpreting output feedback. Today, the use of commercially available mobile devices shows great promise in addressing such challenges. As a result, the largest and most widespread mobile platforms are rapidly evolving into de facto standards for the implementation of assistive technologies.

Designing navigational aids for visually impaired people is an exemplary case where design decisions must in no way detract from users' awareness of their surroundings through natural channels. So here we have our goal is to provide a theoretical and practical solutions to the challenges faced by the visually impaired in various domains of everyday life. Recent developments in mobile technology are highlighted, with the goal of setting out an agenda for future research in CogInfoCom-supported assistive technologies.



Client based indoor positioning - GPS, WiFi, Bluetooth and VLC compared
Technology
Indoor/Outdoor
Accuracy
Range
Cross-Platform
Power Supply
GPS
5-20 m
worldwide
WiFi
5-15 m
< 150 m
Bluetooth
1-3 m
< 30 m
VLC
< 50 cm
< 8 m

OUR DOMAIN AND FINDINGS

What is Estimote Beacons?

Estimote Beacons and Stickers are tiny computers. They have a powerful ARM processor, memory, Bluetooth Smart module, and temperature and motion sensors. Powered by a coin battery, they broadcast radio signals through built-in antennas.

Smart devices in range receive those signals and compatible installed apps can then respond. The exact form of that response - whether a notification or another action - is up to you; our platform is fully flexible.

Estimote's SDK and Cloud tie everything together by granting apps full access to the metadata, including beacon ownership, object type, and precise location. They also enable security and other services on top of the beacons.

Technical Details

Estimote Beacon is a small computer. Its 32-bit ARM® Cortex M0 CPU is accompanied by accelerometer, temperature sensor, and what is most important—2.4 GHz radio using Bluetooth 4.0 Smart, also known as BLE or Bluetooth low energy.

The greatest advantage of Bluetooth Smart over the previous iterations of BT technology is how energy efficient it is. Thanks to that, and to a lot of work our engineers put into power management, Estimote Beacons can last more than 3 years on default settings on a single CR2477 battery.

Don't confuse Bluetooth Smart with the first version of Bluetooth: the one that required pairing and never actually worked. It's a new standard developed by Nokia™, now implemented in all modern smartphones like Apple iPhone™ or

Samsung™ Galaxy S. Other devices, ranging from Fitbit fitness trackers to the Apple Watch, use Bluetooth Smart too.

Technical specification	**Classic *Bluetooth* technology**	***Bluetooth* low energy technology**
Radio frequency	2.4GHz	2.4GHz
Distance/Range	~10-100 meters	~10-100 meters
Symbol rate	1-3Mbps	1Mbps
Application throughput	0.7 – 2.1Mbps	305kbps
Nodes/Active slaves	7	Unlimited
Security	56 to 128 bit	128-bit AES
Robustness	FHSS	FHSS
Latency (from not connected state to send data)	100+ ms	<6ms
Government regulation	Worldwide	Worldwide
Certification body	Bluetooth SIG	Bluetooth SIG
Voice capable	Yes	No
Network topology	Point-to-point, scatternet	Point-to-point, star
Power consumption	1 (reference value)	0.01 to 0.5 (use case dependent)
Service discover	Yes	Yes
Profile concept	Yes	Yes
Primary use cases	Mobile phones, headsets, stereo audio, automotive, PCs etc.	Mobile phones, gaming, PCs, sport & fitness, medical, automotive, industrial, automation, home electronics etc.

Figure Technical Details

How do Beacons work?

You can think about the beacon as a small lighthouse. But instead of light, it uses radio waves, and instead of ships, it alerts smartphones of its presence. Estimote Beacons have a range of up to 70 meters (230 feet). The signal, however, can be diffracted, interfered with, or absorbed by water (including the human body). That's why in real world conditions you should expect range of about 40–50 meters.

Phones or other smart devices can pick up the beacon's signal and estimate the distance by measuring received signal strength (RSSI). The closer you are to the beacon, the stronger the signal. Remember that the beacon is not broadcasting continuously—it's blinking instead. The more frequent the blinks, the more reliable the signal detection.

And because Bluetooth Smart doesn't require pairing, a phone can listen to many beacons at the same time. This unlocks more opportunities: for example indoor location.

To understand how all this impacts your beacon-enabled app, read our primer on physics behind beacons.

DIFFERNECE BETWEEN WIFI AND BLE BEACONS

1. Consumer Privacy:

In the case of Wi-Fi tracking, mobile devices of consumers who have turned on their Wi-Fi will be on the constant look out for Wi-Fi networks. This is then used by retailers to detect the presence of consumers and to track their physical movements along aisles with unprecedented detail. Pervasive Wi-Fi technology does not explicitly ask consumers for their permission, as it does not require any user intervention. However, the only way out for customer, is to completely disable Wi-Fi on their mobile device.

On the other hand, for beacons to track a consumer, he or she has to turn on his or her mobile phone's Bluetooth, allow location detection through the relevant app and opt-in to receive in-store or indoor notifications. While Wi-Fi technology could help businesses track more consumers, as it does not require them to install an app, it is best to choose a technology that gives consumers total control over the data they are giving businesses access to.

2. Proximity detection:

Wi-Fi is technically designed to accurately point to a device's exact location with wireless access points, by measuring parameters such as MAC address and SSID. Beacons, on the other hand are all about proximity, and not about exact location. These proximity detection devices are designed to detect mobile devices when they are within the specified range of the beacon, provided they have the corresponding app installed in them. And while the proximity data provided by beacons are sure to be more accurate than Wi-Fi, they are not accurate values either. However, this does not matter in most applications.

For example, if you just want to track when a consumer is next to the Kitchen Appliances section in the store, beacons work perfectly well. If you are leveraging beacons to navigate your consumers or visitors around the venue, you may not need as many touch points as required in the case of helping them locate a product within the store.

Deployment costs

Both Wi-Fi and beacon deployment requires marketers to plan ahead on where the devices will be placed and to configure their positions in the software driving them. However, to get Wi-Fi working, you will also need to configure and connect routers to a power source. While the cost of a router generally varies depending on the manufacturer, getting a high-traffic router can be quite expensive.

Beacons, on the other hand, are available at as low as $25 per unit. And if you buy a USB powered beacon, or one that runs on electromagnetic waves, rather than a battery powered one, you can avoid having to go through all the maintenance headache of changing their batteries regularly.

Going ahead, once you deploy beacons in large numbers across the country or across multiple stores or branches remote beacon management will become highly important. For these proximity-detection devices to be managed with ease, beacons should have some sort of network access while empowering brands the ability to detect each beacon, and turn it on or off via the backend. This is one of the main reasons why brands are considering using beacon platforms while deploying beacons on a large scale.

Which one do I use? Wi-Fi or beacons or both?

Now that you have read through the basic differences between these technologies, the next question that pops up is, 'Which one do I use? Wi-Fi or beacons or both?'. The decision should be based on what your company or brand wants to accomplish using them. For example, if you are just looking for employee connectivity or location based analytics, you can go ahead with a location-enabled Wi-Fi infrastructure. On the other hand, if you are looking to engage consumers based on their location within the venue or provide an indoor navigation experience, then you might want to consider beacons.

In fact, in spite of the differences between the two technologies, they work best when used together. For example, at instances where you want to be highly certain of the location of the consumer within a venue, you can use beacons to handle those proximity-based interactions. Meanwhile, you can leverage Wi-Fi network to provide engaging navigational experiences within the venue and collect analytics based on those consumer movements.

The concept of triangulation was the main thing on which we tried to base our project, but due to shortage of time, the concept could not be completely implemented but a prototype has been made that can show what triangulation can do. For the sake of literature, let us discuss what basically this concept is.

Triangulation

A Triangulation consists of a series of joined or overlapping triangles in which an occasional line (called the base line) is measured and all other sides of the triangles are calculated from angles measured at the vertices of the triangles. The lines of a triangulation system form a network that ties together all the triangulation stations at the vertices of the triangles. A triangulation has the following advantages:

- More redundancies or checks are available (i.e. more than one route can be followed to compute the length of a line.)
- There is little tendency for the system to sway or bend (i.e. azimuths can be easily and accurately carried or established throughout system).
- Outstanding landmarks such as steeples, water tanks, etc. can be located by establishing directions from different stations.

Its disadvantages are it needs long-range inter-visibility, which in turn requires the erection of special towers and signals, making the system the most expensive. Moreover, a good weather is required to attain inter-visibility.

With Trilateration, the lengths of the sides of a series of joined or overlapping triangles are measured (usually with the EDM equipment) and the angles are computed from the lengths. It has the following advantages:

- It is more accurate than the other two types due to the fact that distances can be measured more accurately than angles.
- It is generally less expensive than triangulation.
- More checks are available.

Unlike triangulation, it is not easy to position transmission towers, steeples, water tanks, etc. by the EDM because to do so requires reflectors on these landmarks. These landmarks can be located if angular measurements are made to them. In combined triangulation and trilateration systems all sides and angles in the joined or over lapping triangles are measured. This method provides the strongest control network

Purpose/objective of triangulation

- For establishment of accurate control points for plane and geodetic survey of large areas
- For establishment of accurate control points photogrammetric survey of large areas
- To assist in determination of the size and shape of the earth
- To determine the accurate location for setting out of engineering works such as piers and abutments for long-span bridge.
- Fixing of center lines , terminal points ,shafts for long tunnels and measurement of deformation of dams.

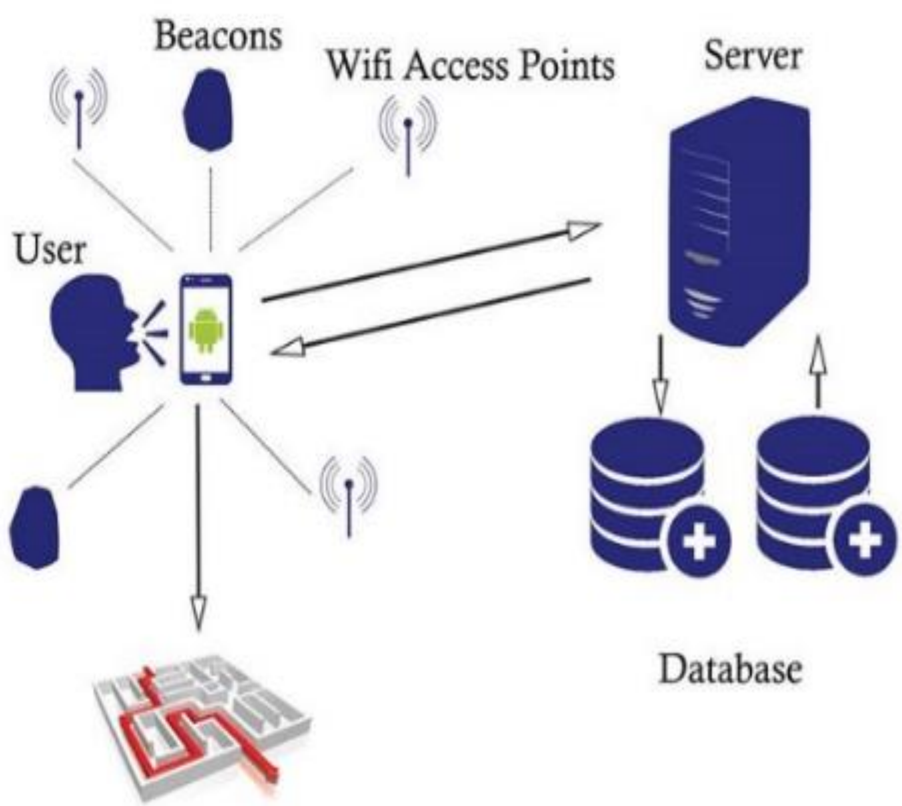
Triangulation Principles and Uses

- From interconnected triangles measuring the length of first side (baseline) and angles other remaining can be calculated trigonometrically.
- If the coordinate and azimuth of any vertices (mostly baseline) is known ,the coordinates of the remaining can be calculated through departure and latitude. Latitude is always measured parallel to meridian or along X-axis while departure is perpendicular to meridian or along Y-axis .

Purpose/uses of triangulation

- For establishment of accurate control points for plane and geodetic survey of large areas
- For establishment of accurate control points photogrammetric survey of large areas
- To assist in determination of the size and shape of the earth
- To determine the accurate location for setting out of engineering works such as piers and abutments for long-span bridge.
- Fixing of center lines , terminal points ,shafts for long tunnels and measurement of deformation of dams.

System Architecture:



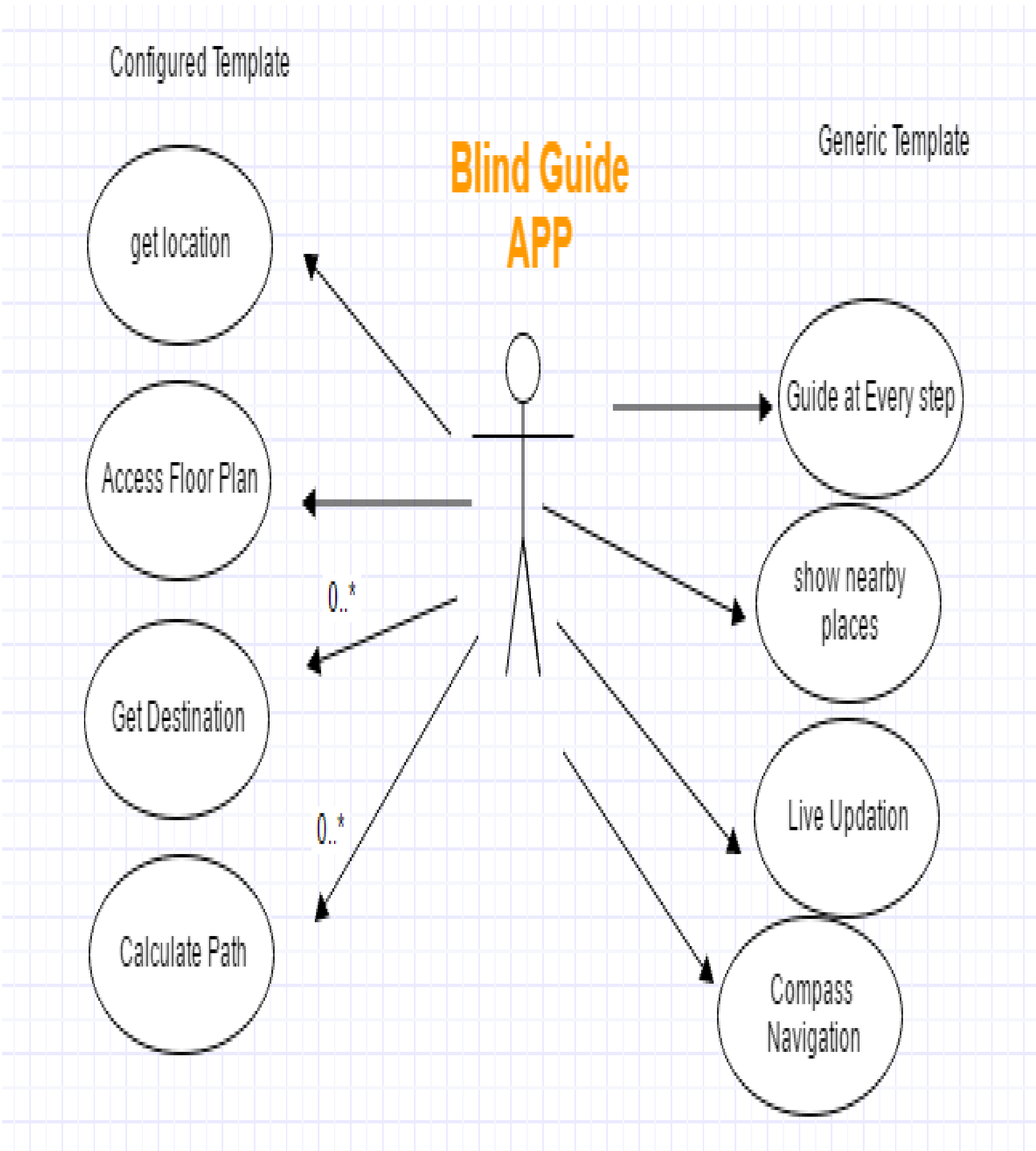
Software specification:

The Beacons have running both server and client in PHP, firstly it was developed in NODE JS as a programming language but then it is unable to collaborate with android platform so we switched to PHP based server .As a server it has to broadcast message or information related to the user needs.

The library we have used is the socket Jason for the communication .All the processing of information acquired from all the other network routers using triangulation and trilateration between user current location and the destination. So as the client gathers all the details based on the user needs it checks the floor plan and push back the current location of the user. By triangulation and trilateration it checks for the SSID readings and match with the database it contains if it does not have the newer one it adds it in the path way.

The purpose behind why the calculation of the averages was not done at very respective Beacons was that to keep Beacon busy in communication and connection with android app and other beacons rather serving as a processing or computational node which could have bring a delay to work major work of it that is a connection. The interface includes the display of the building related information which is being used sent/received from other network routers and Beacons.

Use Case Diagram:



Android Application

An android app that connects to the server and detects the BLE signals check for the nearest one .Once connected the app receives the list of routers available, list of Beacons connected to the device which can guide throughout the session. The app shows the position of the user using free space path loss via Wi-Fi.

The app is also used to receive the broadcast notifications which are trigger by the other Beacons. Here we have developed a GUI of a fully functional android app with hard coded data used for the floor plan. When the app launches, it opens in the generic view, showing the current location asking the user to give your query or desired location where one wants to go. When the phone and the app comes in the proximity of Routers and BLE sensors, it changes to the configured app which in this case is the app for the location specified by the admin.

The Project Listing based on Location and notifications:

The app scans for the Wi-Fi Routers and BLE Beacons, detects the node .The network routers use the technique to precisely detect the position of the User. Based on the readings provided by the routers it uses RSSI ID to get connected to the app. When the user's app connected to the node, the notifications along with the set of upcoming paths between the user and the destination is sent to the application's directory interface to interact with the user. A sequence of steps the app follows is shown in the figures.

The first question that may come to the mind is "Is the disabled person dependant on others to open the application for them?"

The answer is "No". Now in almost all the devices of today's world, they have gestures support and we can specify that after drawing a specific pattern on the screen, this application should open, and that way, the blind person is not depending on others.

Sequence of the activities:

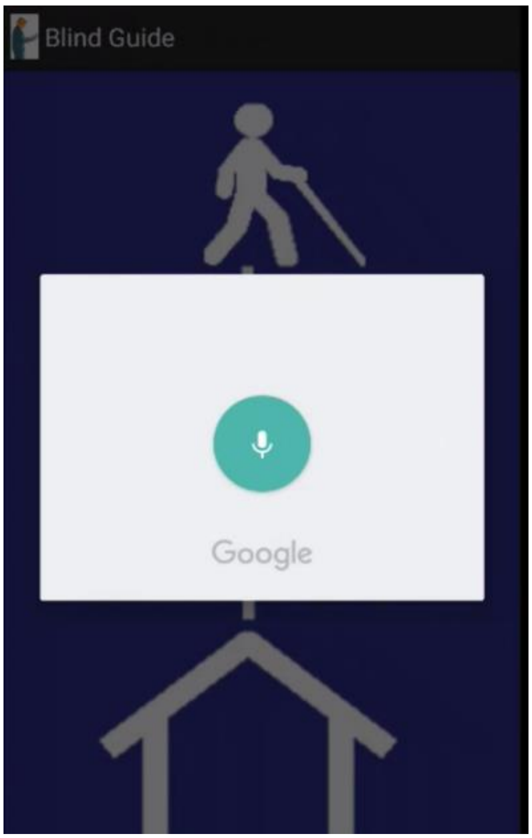
- On the start , visually impaired person is asked about where he wants to go.
- The application takes the command and checks if the destination exists.
- Application estimates the present location of user
- Tells the user about current location and next step.
- Application makes the user set his/her direction and then gives a go ahead command.
- Then step by step, the user is guided about the location and next step to take.
- If the user starts going in wrong direction then he/she is quickly given command to stop.
- Throughout the way, the user is given feedback about the steps he is taking so he knows that he is going into right direction.

How the routing has been done?

All the points in the building i.e rooms, stairs, corridors etc have been arranged as the nodes and sub-nodes and have been connected as a network of nodes. When the user requests for a destination then the route from the current location to the destination is made as the backend of the application and application starts guiding accordingly. Then the wifi- access points in the way validate whether the user is going into the right direction or not. Then the user is given go ahead commands or is told where he is going wrong or how he should now set his direction.

This is the splash screen that shows up when the application is started:

Figure Startup and Home screen.



This is the point where the Google voice API comes into action and asks the user that where would he like to go. The Blind person just needs to tell the application that where he wants to go. The application interprets the command and sets the destination as the target.

Following is the function that we can use to activate this feature of voice API:

```
private void promptSpeechInput() {
    Intent intent = new Intent(RecognizerIntent.ACTION_RECOGNIZE_SPEECH);
    intent.putExtra(RecognizerIntent.EXTRA_LANGUAGE_MODEL,
            RecognizerIntent.LANGUAGE_MODEL_FREE_FORM);
    intent.putExtra(RecognizerIntent.EXTRA_LANGUAGE, Locale.getDefault());
    intent.putExtra(RecognizerIntent.EXTRA_PROMPT,
            getString(R.string.speech_prompt));
    try {
        startActivityForResult(intent, REQ_CODE_SPEECH_INPUT);
    } catch (ActivityNotFoundException a) {
        Toast.makeText(getApplicationContext(),
                getString(R.string.speech_not_supported),
                Toast.LENGTH_SHORT).show();
    }
}
```

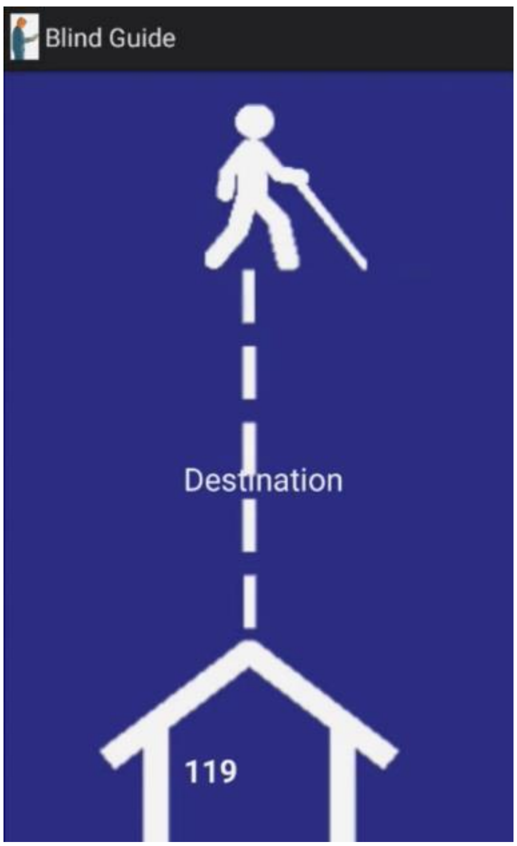
Using this function and getting its results in onActivityResults(), we can play with it, like,

```
protected void onActivityResult(int requestCode, int resultCode, Intent data) {
    super.onActivityResult(requestCode, resultCode, data);

    switch (requestCode) {
        case REQ_CODE_SPEECH_INPUT: {
            if (resultCode == RESULT_OK && null != data) {
//Do whatever you would like to do with the results of the speech you conveyed to
//mobile phone
}
```

Figure Route to destination and Initial detection of the current location..

After the command has been given to the mobile application's first screen and the command has been translated to mobile understandable format, this is the screen where the confirmation for the destination is shown. User doesn't need to press any buttons or do some processing explicitly to move on, the application does it itself after giving confirmation of the destination.



Then after the destination has been confirmed, the application starts the main functionality:

The wifi comes into action, the values from the access points are taken and the distance from each access point is calculated:

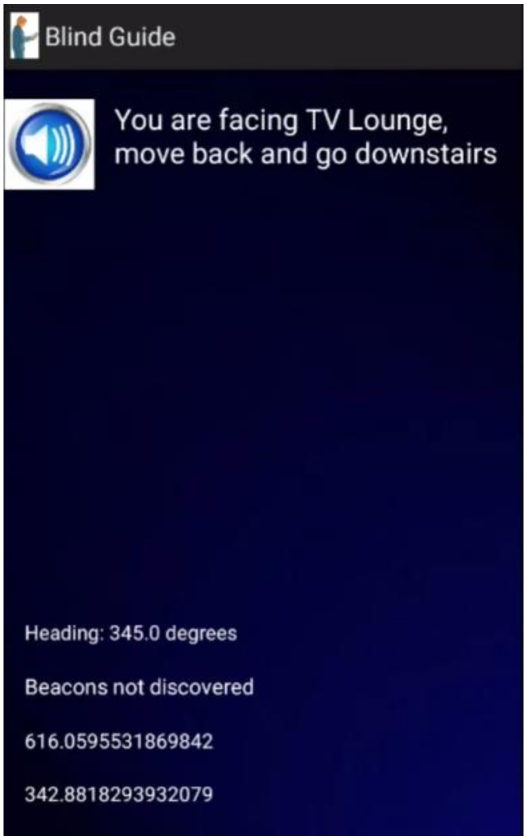
We had gone through some research papers and were lucky enough to have an equation, which takes values of RSSI and frequency of Wifi signal and translates it to the distance from that particular access point:

Equation:

```
public double calculateDistance(double levelInDb, double freqInMHz) {
        double exp = (32.44 - (20 * Math.log10(freqInMHz)) + Math.abs(levelInDb)) / 20.0;
        return Math.pow(10.0, exp);
    }
```
[7]

The value is a “double” value formed after calculations.

Based on the distances calculated from each of the routers, the application determines where the person is standing at the present moment.



The information of the location has already been fed into the application through a backend algorithm and is given accordingly.


Blind Guide
You are standing in front of dining hall, move back, walk straight
Heading: 66.0 degrees
Beacons not discovered
69.12301876248183
342.8818293932079

Step by step guide of the scenario.

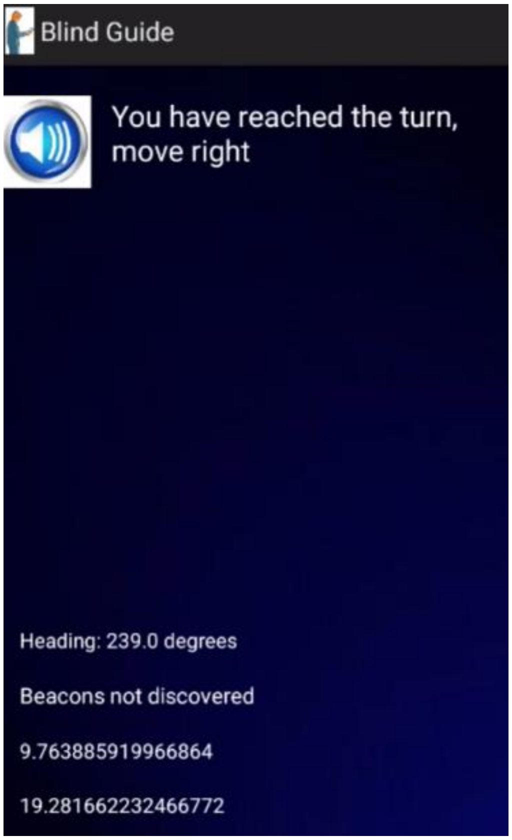

Blind Guide
You have reached the turn, move right
Heading: 239.0 degrees
Beacons not discovered
9.763885919966864
19.281662232466772

Figure Step by step guide of the scenario.

So how are we basically determining in which direction do we have to move and what is that “heading 314 degrees” thing in the figures we are going through.

This is done through the compass we are using which makes use of the built-in sensors of the mobile application and the values are converted to degrees:

The main activity must implement the Sensor Event listener to make use of this feature of the application, i.e:

public class MainActivity extends MainActivity implements SensorEventListener

Then the value is taken as follows:

```
@Override
        public void onSensorChanged(SensorEvent event) {
            // get the angle around the z-axis rotated
            degree = Math.round(event.values[0]);

            tvHeading.setText("Heading: " + Float.toString(degree) + " degrees");
        }
```

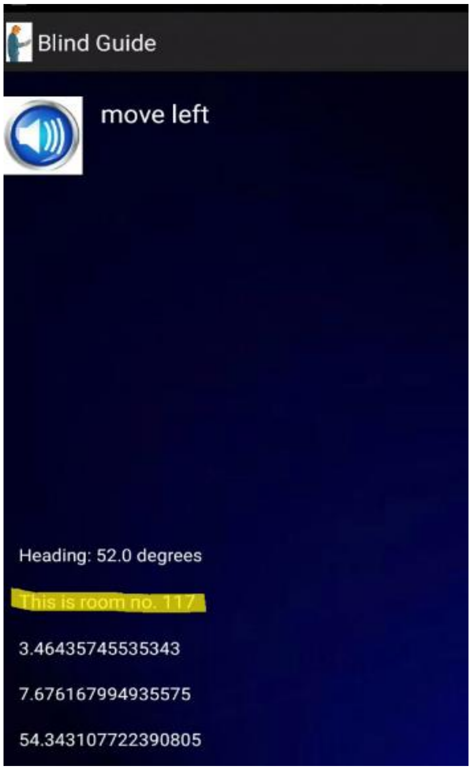

Blind Guide
Walk Straight
123
Heading: 314.0 degrees
Beacons not discovered
1.5474716326522402
12.165906399361269

This is the feedback we are getting from our application about the location or pathway we are passing by, in this way this can be validated that the person is going into the right direction.

Figure Step by step guide of the scenario.

This is when the person has reached the destination and final command has been spoken to him.

Figure Final Notification reached your destination and beacon is detected.



BLE-Beacons are installed at the sharp edges or into the rooms to validate if the person has reached at that sharp point because wifi signals may not be 100 percent accurate and BLE-beacons will accommodate for this and will enhance the results.

Conclusion

We have been successfully able to develop the core structure to indoor positioning and approximate navigation. Where Beacons are configured and some of the services are being implemented over the google voice api , google compass and Wi-Fi positioning. Handicapped people can see their approximate position .He/she will be kept updated about the route one passing through and nearby rooms, offices etc. Compass is integrated so that if in any case blind gets lost or starts going into the wrong direction, the compass will guide the about where the blind wants to go.

The routing configuration we have designed is stable because of the layering architecture and less downtime.

This is yet to be converted to a complete product but the prototype has given a very good explanation of the idea about how the system will work and is able to guide a person in a specified range in an indoor building.

Future improvements

Right now at this stage of the project we have implemented the basic concept of positioning using only the RSSI values anf frequencies and converting them to the distances from the routers. In the near future we would like to implement the complete process of trilateration and will try to show the live visuals of the indoor of the building. Moreover we will like to broaden the concept of the project to some of the following domains:

- **Shopping malls**
  Such a system can be very helpful in shopping malls where people have to ask the store crew for the things they need. This can help them find their desired items, make the lists of the things they need and guide them accordingly.
- **Hospitals**
  Hospitals are also one of those places where people have to ask others alot when going from one place to another or from one ward to another. Such a system can be very helpful in such an environment also.

- **Railway station ,subways airports:**

  Railway stations are getting larger in size and places like hotels and cafeterias are also being set up there. Such a navigation system can be very helpful at those places as well.

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