Indoor Navigation using QR code, Pedometer and IBeacon

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Abstract- **In day-to-day life, smartphones are used for navigation to reach the destination. The existing smartphone's application provides navigation which uses Global Positioning System (GPS) and internet. The navigation applications which are present in market gives accurate result for outdoor navigation, however there is challenge for getting accurate result for indoor navigation such as inside closed building, shopping mall, airport terminal, railway stations, etc. There are some application solution are present in the market which uses wifi, Assisted Global Positioning System (AGPS) and Bluetooth, since reliability of existing solution are still challenging ones. The proposed system is giving a solution in terms of application which uses Quick Response (QR) code, Pedometer and Ibeacon for providing indoor navigation. QR codes provides destination location information, QR codes are placed at the entrance of building and Ibeacon is placed at destination to confirm the destination location, pedometer is used to count the steps and calculates the distance (steps) covered and distance has to be covered. The proposed mobile application displays images wherever required during the navigation and also it assists the navigation by outputting voice commands. Proposed application can also be used by Blind and Deaf persons.**

Keywords- indoor navigation, GPS, Wifi, Bluetooth, Navigation using QR code, pedometer, Ibeacon.

1. INRODUCTION

In day-to-days life, Smartphone's applications for navigation are quite essential and useful. Smart phone market has lots of applications which are user friendly and efficient too. There are applications

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which assist current location and provide direction to the specified destination for outdoor locations. This is achieved using Smartphone's GPS unit in most of the scenarios. These Smartphone's have some limitations to locate their position exactly when it is covered under areas like shopping malls, airports, multi storied buildings, railway stations, apartments. In market there are some indoor navigation systems which are available which uses GPS, Bluetooth, Wi-Fi, RFID[1]. Indoor positioning commercially attracting and increasing the interest towards indoor navigation application, Most of commercial organization trying to have indoor navigation for their organization which includes university campuses, museums, office buildings, airports [2][3].

Indoor Navigation refers to the navigation within a limited area or a building. This approach is mainly used to navigate from one place to other place within the buildings. Indoor navigation makes it easy to find the required area and navigate. Since searching unknown places takes more time, proposed approach can be used for searching destination within a large area which reduces the time consumption. There are some existing systems for indoor navigation which are built using 3D (latitude, longitude, altitude), image processing, wifi, but they are not accurate, reliable and cost effective.

QR code has been applied in many ways from marketing products, locating promotional items on shelves, finding stores and etc. The proposed system is built on ios platform and aimed to provide navigation services to locate destination within the organization.

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II RELATED WORK

Now days Technology is helping disability persons in most of situations in daily life, such as

The system [1] is designed using 3D (latitude, longitude, altitude) which helps for indoor navigation with the help of QR code. Challenge of this system is handling impact of change in the floor layout. A change leads to repetition of whole process.

Y. Zhuang, j, Yang [2] discuss about work which focus on wifi and finger print techniques for indoor navigation and indoor positioning. The above stated system is not cost effective since system has to use finger print sensor.

The growing research work concerned with indoor positioning and navigation is driven primarily by the desire to customize/personalize the user experience. The system [3] is designed for indoor navigation and positioning in museums.

The technology is giving solution to physically challenged persons in terms of automatic wheel chair for physical handicaps, which outputs voice for blind persons and visual output for persons with hearing impairment [4]. With the help of technology all type physical challenged persons can carry out activities (Indoor navigation) as normal person. The costs of such technologies are higher.

Vinod Pathangay in [5] discusses an indoor navigation using image processing in which camera is mounted on walker. By using the image processing algorithm, based on matching the graphics data obtained during the run time with already existing saved data, path is measured for correctness and alarm sound is generated while deviation. However most of the time there is false alarm for same paths when there is slight change in angle of camera.

Samreen Anjum in [6] used image processing algorithm in different way to provide solution for indoor navigation for blind people. This project partitioned into two parts, In first part current location is detected accurately by matching the image, Second part contains the path generation and path guidance. The above stated system is not reliable every time.

Indoor navigation [7] became one of the attracting and interesting for commercial organizations. Indoor navigation enhances the user experience. The system in this case uses wifi and fingerprint for finding current location. System is not cost effective.

Patrick Dickinson [8] explains work on indoor positioning for users/shoppers by using BLE beacons in large shopping store. Author introduces node graph model for user location, which gives location layout. Getting location every time from server may reduce the performance.

J. Chon, H.Cha [9] expresses that technology of GPS is used in outdoors generally. However a user spends his most of daily time that is 95.55% in indoor areas.GPS signals are week and sometimes not available.

M.Werner,M Kessel [10]expresses, GPS signals are weak and not available in indoor areas like closed buildings. The reason behind lack of signal is blocking objects of buildings like roofs, walls, and also corridors proximity may results in errors for routing.

Ibrahim Arda, Cankaya [11] discuses indoor positioning system that uses accelerometer compass, components, and camera. The application uses, augmented reality applied while routing process by using built in camera. The system is complex to build and requires more analysis during navigation.

The advantages of proposed system are, it outputs the voice commands and displays the images during the navigation, ibeacon conforms the destination with the signal.

III SYSTEM ARCHITECTURE

The design of application contains the system architecture, Use Case Diagrams, Flow Charts as follows:

Figure 1 represents the system architecture of the application, Contains modules and sub modules which are explained in the later part of section.

Figure 2 represents the flow chart of the application, which explains about the flow the modules in the

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application. The detailed explanation is represented in later part of this section.

Figure 3 represents the use case diagram how internal and external entities are interacted with each other, that is how user and admin can interact, further explanation is given in later part of this section.

A. System Architecture

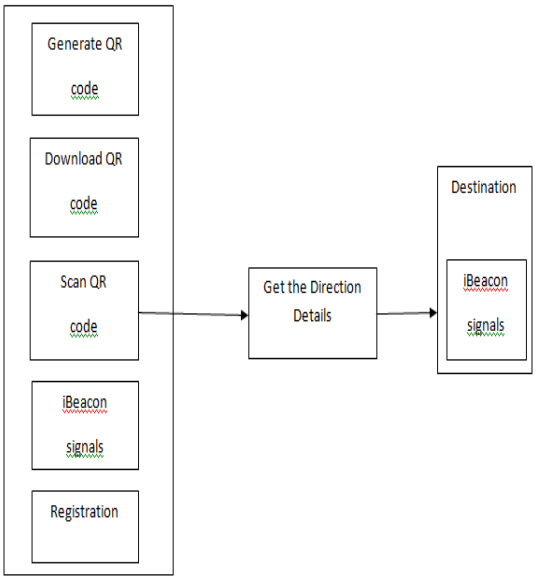

Figure 1 System Architecture.

The system Architecture contains sub modules they are, Generate QR code, Down load QR code, Scan QR code, Beacon signals, Registration. All these sub modules are explained below

QR Code Generation:

QR Code generation is first module of this indoor navigation system. This module helps admin to generate the QR code for the destination address. QR code is the 2D matrix which is filled with white and black dots, we can also change the colors of the QR code dots. QR code contains information attached with it.

In Proposed system QR code contains the destination address of different places and information of pedometer. Admin will be generating the QR code for destination they are displayed to entrance of the building where usually users makes entry to the building.

Download QR code:

Using this module application user can download the generated QR codes for navigation. These are the QR codes which contains the information about the destination.

Scan QR Code:

QR code scanner is an decoder which scans the QR code decodes it gets the information the QR code and uses it for working of an application. Usually QR code scanner contains illuminator which is red color scans across QR code when app requires. Decoder sends the decoded information into app.

This module is responsible for scanning the QR code which is displayed by the admin. The module QR code scanner, QR scanner will decodes the QR code and sends the decoded information to the next module or component of the application.

Pedometer:

Pedometer is a device, which is an electronic or electromechanical and also portable which counts the steps of the person by detecting the motion of person's hip or hand. It also gives the distance covered by person in terms of length as unit.

The proposed system uses pedometer for navigation which counts the steps of person. Distance between source and destination is predefined in the app, such as ten steps straight, five steps to left, and nine steps to right. Once numbers of steps are completed app will alerts the voice message to take the direction as per predefined route.

Navigation:

Navigation is termed as route map to the destination from the location. The proposed system uses QR code information of destination which is scanned by QR code scanner. And also uses pedometer for navigation, app collects information from pedometer such as steps count to move and direction. When phone reaches to the destination, iBeacon transmitter sends the signal to the app and confirms the destination.

Web services:

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To communicate or transfer the data from one electronic device to other electronic device through a web service is used by World Wide web. The web services uses technology like HTTP. It is mainly used for transferring data, in specific formats like JSON and XML. A web server provides Object Oriented web based interface for database server, And it is utilized by other web server and other mobile apps, which provides interface for user to end user.

The proposed system uses web services to get the information from the database. The application uses that information for further processing.

Admin:

Admin can login using the credentials and can check the registered candidates.

Registration form:

Candidates need to enter the details to register. All the Details will be saved to the Database. Only Admin can view these saved details.

B. Flow chart diagram

Flow chart diagram in Figure 2 gives brief idea about how each module are connected to each other and what is flow of the application.

Following explains about the flow of the system.

- Start the application.
- Once you start the apploiaction, choose the aption among follow
    - Generate the QR code.
    - Scan Qr code.
    - Download QR code.
- If you select download QR code option, Download the QR code.
- If you select scan QR code,
    - Open the navigation with pedometer.
    - Follow instruction for navigation.

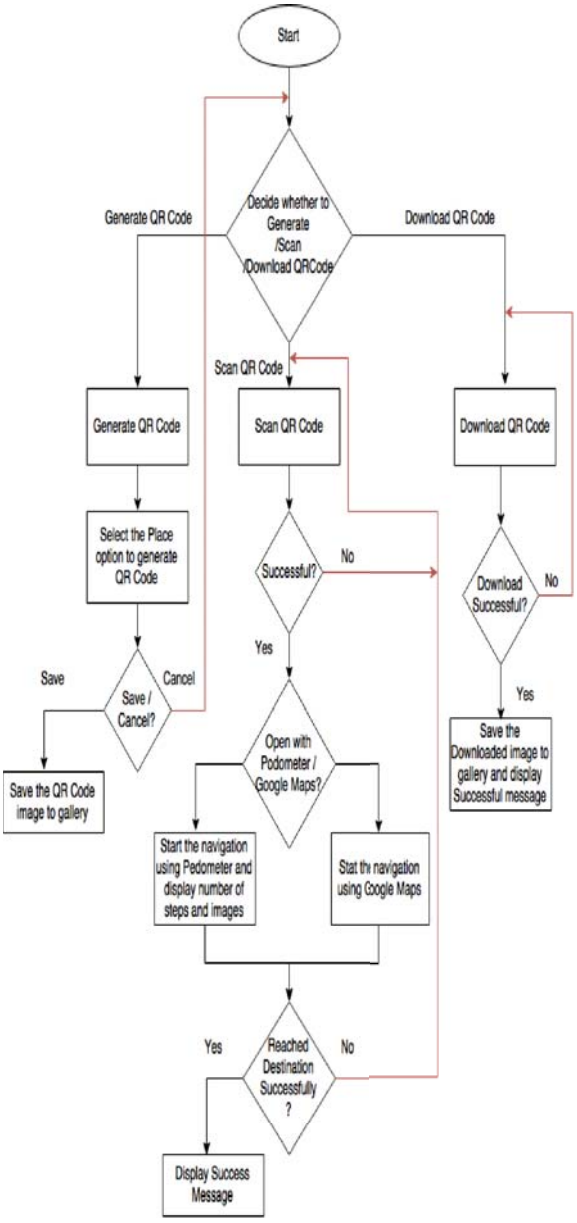

Figure 2 Flow Chart.

- Once you reach the destination you will get succesfull message.

C. Use Case Diagram:

Use case diagrams are called as behavioral diagram, they explain about set operations that have to be performed by external users.

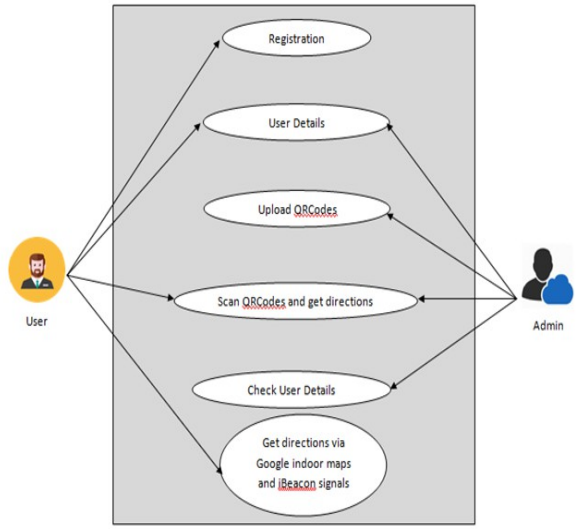

Figure 3 Use Case diagram

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The Above use case diagram shows how external entities user and Admin interacts with each other.

IV. LIMITATIONS AND TESTING

There are few limitations and constrints which are to be followed, The steps distance is assumed as one and half foot at an average. The application gives acuurate result when users steps about one and half foot. The application uses Ibeacon for confirming destination location so iBeacon has to be fixed at destination.

The proposed application was tested for information science department of RV college of engineering, application gave accurate result (gave visual and speech output) when steps are about one and half foot. The results are satisfactory when steps distance is not as specified.

ADVANTAGES:

- It helps to navigate indoor locations with respective Images and distance of destination in terms of meters.
- No need enter destination because user can scan destination using Camera and QRCode.
- It gives the exact location and each and every area of the building can be covered by implementing more number of iBeacons.
- It gives real time Images of Building.
- Internet is not required for indoor Navigation
- As it does not deals with latitude and longitude, the difference between the locations can be found easily.
- It helps to traverse each step of the user towards the destination.
- As iBeacons uses Bluetooth, It can be used in absence of GPS.
- Even if a single iBeacon fails to send the signals, the next iBeacons helps to continue the navigation Process.
- iPhones and iPads can be used as iBeacon Tx and Rx.

Table 1 Comparison of different approaches

Technique	Accuracy	Deviation Detection	Blind Navigation	Maintenance cost	Infrastructure cost
AGPS	Low	High	Medium	High	High
Bluetooth	Mudium	Medium	Low	Medium	High
RFID	Medium	Medium	Low	High	High
Image Process	Low	Low	Low	Medium	Medium
QR code with Ibeacon	High	High	Medium	Low	Medium

Table 1 shows the comparison of advantages and disadvantages of different technique for indoor navigation.

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V. CONCLUSION AND FUTURE WORK

The proposed system of indoor navigation uses Iphone smartphone, Ibeacon BLE is placed at destination location. Results are as expected when user's steps are as specifid. And if user steps are not as specified then also results are as expected unless user is not blind, if user is not blind by watching real time images of buildings and directons on display.

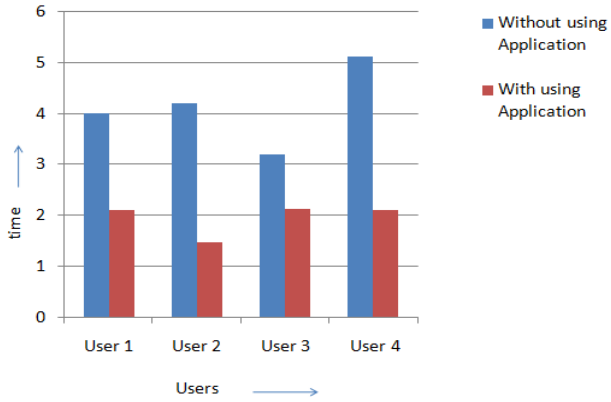

Figure 4 :Comparision of users with time.

The results are taken from different users and time is recoerded. Figure 4 shows the comparision of different users with respect time (minutes) taken to reach the staff room at second floor. Results clearly tells that, time consuption is less when user uses the application.

There are many number of future work can be done they are as follows, 1)For blind people an additional module can be added for fingerprint scanning instead of QR code scan. 2)With the help of GPS, Apllication can enhanced for both outdoor as well as indoor navigation. 3)Different languages speech can be provided. 4) Presnce/Absence of employee/person can be identified, when we scan the QR code in entry location only, by using set of Ibeacon interaction.

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