An Autonomous Virtual Tour Guide System for Tourists

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Abstract*: *As we know, tourism has been and continues to be one of the most prominent industries in the world. It goes without saying that in many tourist spots there is an ever-increasing rise in the requirement of tour guides and instructors for a total exquisite experience. There are places where robots are doing the job of the tour coordinator, while somewhere else the tour is nothing but a virtual reality or augmented reality experience. In the existing system, either a human is serving the purpose of being a guide or technology is being used to some extent to develop a human-less tourist guide system. In the first case, where a human is serving the purpose of a guide, the main limitation is the knowledge of the guide and the communication capabilities of the guide because of which the tourist may get different and less factually current information about the tourist spot. In the second case, where the technology is being used to some extent to offer a system without human guide, the tourist is required to carry different electronic devices in order to get the information about the place. Carrying these electronics devices becomes cumbersome at times and therefore may not be feasible for all tourists. This research attempts to provide a system which requires only an app to be installed on the tourist's mobile phone through which the tourist can gather all available information about the place.

***Keywords*: GPS Tracking, Flutter SDK, Firebase Framework, BLE, PIC16F877A.**

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I. INTRODUCTION

In this technologically advanced world what we want to bring up is nothing but a new way to experience our tours and trips with our very personal tour guide. What is being traditionally followed is, the travellers or the visitors have to take help of a travel book or a guide for their own enhanced travel experience to get to know about the place's significance, history and likewise.

The problem associated with this is firstly associated with the economic aspect of travelling i.e., the additional expenses that one incurs. Secondly, the travellers are somewhat devoid of flexibility. They're supposed to move along with the guide's space and schedule and leave very little room for self-exploration by the tourists in other words, this leaves them with no self-time to absorb the spots/places as well as to understand the historical and cultural significance of the places. Hence, the aim of this paper is to throw light on these tourist-based problems and find out a way to automate and enrich the experience of tourism.

The rest of the paper is organized as follows - Section (2) describes the various existing solutions of the similar problem. Section (3) presents the solution that we've proposed for the problem. Section (4) briefly talks about the result and compares our result with the existing solutions and finally the last section concludes the paper.

II. EXISTING SOLUTIONS

The area of virtual tour guide is a new but well researched. Many researchers have proposed different techniques to empower the tourist industry. The research work of other researchers in this area is being summarized here.

A. Tourism via QR Code

As shared by Garg in this article [1], the proposed system by the researchers using QR code is claimed to be a low budget and mobile friendly. At any tourist place like museums, city halls, monuments etc. the QR coed can be placed at any desired location from where tourist can access the information about the place. In order to get the relevant information about the place, the user has to read the QR code placed at that location and the user will then be redirected to a website from where the desired information like location, photos, videos, audio clips etc. can be collected by the user. The user can also be given freedom to share this information directly from the website to any other social media platform.

As indicated in another study [2], Government of Kerala took the initiative to use QR code for few tourists place in the year 2015. The QR code technique was later used for linking the tourist places with the official tourism webpage of Government of Kerala. This step not only brought

awareness among the residents of Kerala but also attracted tourism from other states as well as from abroad. In this study author has also shared information about the other places across the world where QR code-based technique has been utilized effectively. For instance, New York city in USA used the QR code technique to initiate the World Park Campaign. The campaign was run in Central Park which was aimed to engage the visitors with the live interactive content related to the park. Later in the year 2012, the Russian Pavilion at the Venice Biennale employed the technology in Skolkovo Innovation center. The aim was to enable the intellectual capital with this new technology by aiming five major areas which includes IT, Biomed, Space, Energy, Nuclear Tech. To enable this, the entire pavilion was driven by the QR code technology. In the year 2013, the same QR coed based technology was used in Rio De Janeiro in their trademarks, white-and-black mosaic sidewalks. Recently in the year 2017, tourism board of Hong Kong initiated this facility for the tourists.

A QR code can be described as a 2-dimensional barcode. In its application in tourist industry as proposed by the researchers [3], it is being used to divert the request of a user on a webpage that the user wants to access. In their research, the researchers have proposed to utilize QR code for storing offline information about a place which can be its location on map or contact details or images related to the place etc.

B. Handy Audio Reach Kit (Hark)

The Hark technology was developed by NIIT Ltd. The system consists of a Transmitter and Receiver along with a headphone. The headphone along with the receiver equipment were distributed among the visitors [2].

The working principle being: The tourist would start receiving the data as soon as he/she approaches an exhibit. IR is used for the indoors and RFs (radio frequencies) are utilized in the outdoors. At the Red Fort, the first major project is already released. As per the article, "A sum of 60 touch screen kiosks were installed at different tourist attractions such as airports, hotels, railway stations, airline booking offices, etc. in Delhi, Kolkata, Chennai and Mumbai. One is a general-purpose multimedia kiosk, whereas the others are GIS-based kiosks that plot road maps and give particular road routes and distances in order to guide the tourists".

C. Locatify

The Automatic Tourist Guide as proposed in [4] is a mobile application which provides the users with tours, local points-of-interest, scavenger hunt games, notifications, events and proximity-based information. The application shows a map of an area with points of interest (sights, shops, facilities etc.) and detects where the user is located. The application then plays the automated guide as soon as the user goes near the already defined points of interest.

Another comprehensive research study on the virtual tour guide system is being presented in [5] where authors have presented comparison between existing techniques and also proposed a training system for the virtual tourist guide system.

Recently another group pf researchers have proposed an Interactive Virtual Reality Touring System [6] in which a dedicated tourism application was developed in Taiwan for the visit of Shulin Ji'an Temple.

III. PROPOSED SOLUTION

In the research we propose a system which is as simple as having a smartphone at the users' end. However, it's quite a task at the developer's end. The system will have an application that can be easily downloaded in all basic smartphones. The app will have a login page - this page will ask for a code, preferably a login id from the user that will be provided to the user at the location he/she is about to explore. Once the user enters the correct details and enters the app, he'll be asked for two options - Indoor/Outdoor. This is done because the app will be programmed differently for both the locations.

A. Workflow of the Outdoor tracking

The workflow of the Outdoor tracking is depicted in Fig. 1. When the user selects 'outdoor', the app reads the GPS location of the user. Now, the app already has a certain database fed to a certain range of GPS locations (threshold range) that are calculated and preprogrammed in the app based on the locations of the artifact/monument.

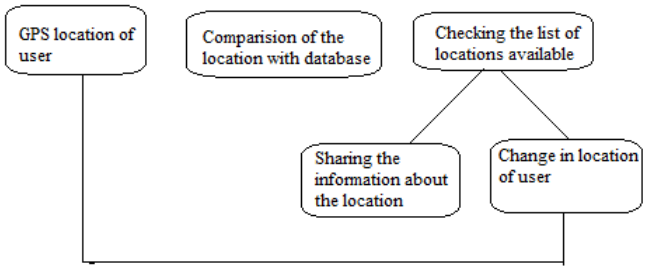

Fig. 1. Flow chart of Outdoor tracking

When the app reads the GPS location of the user, it tries to compare it with the available list of threshold ranges. Based on the threshold range, it scrapes the online data out from the database and appears on the phone screen. Once the user moves away, the GPS location changes, the comparison repeats and the same process continues.

B. Workflow of Indoor tracking

The workflow of the Indoor tracking is depicted in Fig. 2. When the user selects 'indoor' tracking, the app pairs and connects with the BLE module available in that particular location. The app will then get the RSSI value [7] from the bluetooth module and compare it with the available list of threshold ranges of RSSI values that are being hard-coded in the app.

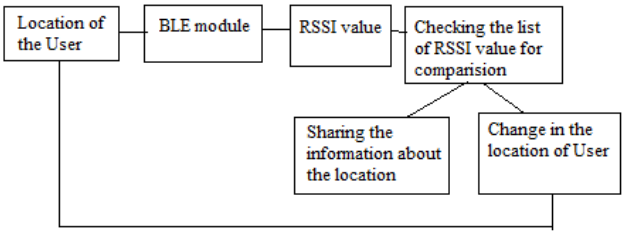

Fig. 2. Flow chart of Indoor tracking

Based on the threshold ranges, it scrapes the online data out from the database and appears on the phone screen. Once the user moves away, the RSSI value changes, the comparison repeats and the same process continues.

C. Technology used in developing the proposed System:

The two major technologies which are Bluetooth and GPS are being used primarily in designing the system. A small briefing is being share here about both above mentioned technologies.

These along with some very reliable microcontrollers like the PIC16F877A along with software technologies like android OS, Flutter Framework and Firebase Support for databases have rendered our research work a huge scope of success.

The app stores and acquires all its data from the cloud using the Firebase Framework and operates smoothly on all mobile platforms without having any kind of package or compatibility issue due to the virtue of being programmed in Dart and provides its extended functionality using Flutter SDK.

D. Flutter SDK

The Software Development kit that we used to make our app is Flutter. In Flutter, to get the GPS location, the process is quite simple as all we have to do is import some plugins and location is easily accessible to us with giving proper permissions to it.

E. Firebase

Firebase provides us a complete backend solution for our app. From authentication to storing data, everything can be achieved using it. Gives us a real-time database to track everything. Data will be stored as JSON i.e. in the form of {key:value} pair. Data will be preserved in local storage, and although one goes offline, real-time event will be captured and thus give the user an interactive session. As soon as connection is back on the device, the Database in Realtime will synchronize with the data-changes, in local, along with the remote updates which were recorded while offline interaction with the client, thus doing away with the data conflicts if any.

F. Bluetooth Technology

Bluetooth is a wireless-technology standard. It is used to exchange data in between fixed devices and mobile devices over short distances with the help of short-wavelength UHF radio waves in industrial, scientific, medical radio bands, from 2.402 GHz - 2.480 GHz and for building personal area networks or PANs. Originally, it was adapted as a wireless alternative to RS-232 data-cables. Bluetooth technology with its accuracy for short ranges and its signal strength variation will help us achieve the goal of indoor tracking and pinpointing locations of interest.

In this research, it is proposed to use the RSSI (Reverse Signal Strength Index/Indicator) for determining the distance and location of a mobile device. In tele-communications, the received signal strength indicator (RSSI) is defined as a measurement of the power which is present in a received radio signal. Our main objective is to somehow replicate the job Bluetooth beacons at a cheaper and easily replaceable way.

The RSSI value decreases as the receiver moves away from the transmitter. This occurs because of the reduction in the power received by the receiver circuit. In this research work, it is proposed to design the transmitter using PIC16F877A and HC05 Bluetooth modules. This will continuously send a data packet to the receiver on the reception of which we can actually get the exact RSSI value range for a particular location.

Now that we have the RSSI value of every location indoors we can set the location name and data in the database such that whenever we receive that particular RSSI range value, the data against that location will be displayed on the screen of the Mobile device via our application. Another transmitter device will be placed at a distance from the first transmitter such that they do not interfere and are placed exactly at the point where the RSSI Value of Transmitter1 is nearest to zero. Thus, getting and creating a complete network inside a building to pinpoint our/ the mobile device's location with maximum accuracy.

One important question is why not use WiFi instead of Bluetooth. Well, in case of indoor applications we need not only fast connectivity rather instant connectivity but also a mobile device working on a battery. Thus, the primary goal will be to achieve least power consumption which is enabled by Bluetooth technology. Secondly what we don't want is a single access point or in a broad sense, Wi-Fi is an asymmetrical client-server connection, usually access point-centered, with all traffic routed through the access point. While Bluetooth is generally symmetrical between the two Bluetooth devices. Simple applications can be easily built with Bluetooth, where a couple of devices are required to connect to each other with minimum user interference, similar to a button press. Whereas Wi-Fi is more preferred in applications requiring some user-end configuration and moderate to high speeds are necessary, exclusively for accessing a network through an access node. In-short, It is true that Bluetooth access points exist, but, ad-hoc connections are not impossible with Wi-Fi, though it would be not as simply as working with Bluetooth.

IV. RESULTS

We have tested the designed system at NIIT University, Neemrana. When the user opens the app in the mobile phone, the page shown in Fig. 3 is displayed to the mobile screen.

Fig. 3. Sign-in page of the mobile app

User is then requested to register and login to the mobile app. The Login page is as displayed in Fig. 4.

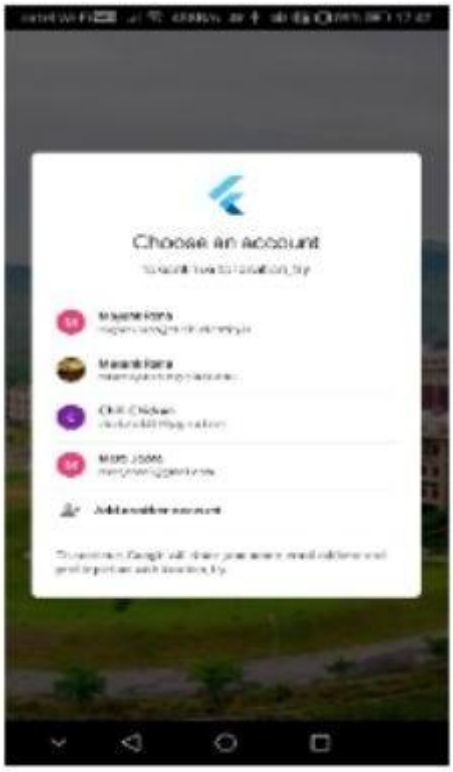

Fig. 4. Login page of the mobile app

After login, user is directed to the home page where the option to select between Indoor and Outdoor visit is made available. User is also given the option to manually see all the places of NIIT University which are available in the mobile app. The home page view is displayed in Fig. 5.

Fig. 5. Home page of the mobile app

Once the user selects the indoor or outdoor tracking option, the mobile app starts tracking the movement of the user and displays relevant information about every location as share in section III. Indoor tracking and Outdoor tracking pages are shared in Fig. 6 & 7 respectively.

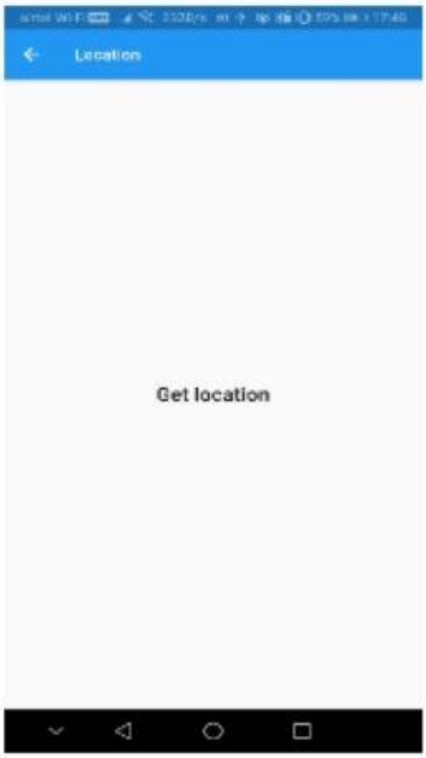

Fig. 6. Indoor tracking page of the mobile app

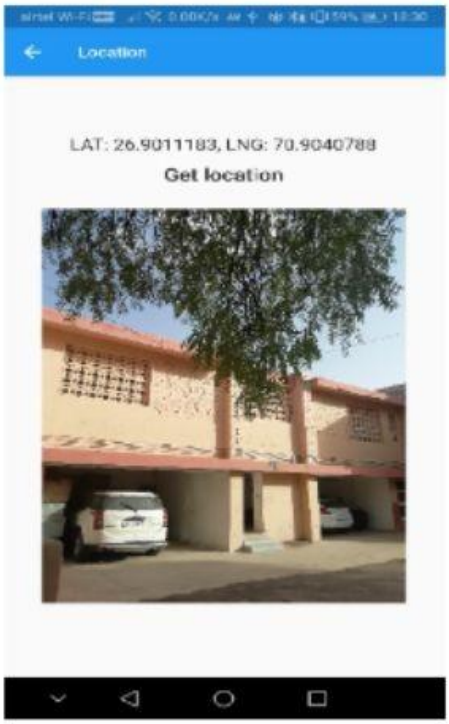

Fig. 7. Outdoor tracking page of the mobile app

User account information also can be accessed by the user which is shared in Fig. 8.

Fig. 8. User account information page of the mobile app

V. CONCLUSION

The proposed system works at all places irrespective of the size of the place. The proposed system also proves to be superior as compared to existing solutions like QR code-based systems or Hark system. The proposed system doesn't require tourist to go to any specific place to read the QR code. The location of user is automatically detected in the proposed system in the outdoor as well as indoor environment making the tourism experience very agile for the tourist. The proposed system requires only an app to be installed on the tourist's mobile phone which makes the system more accessible and user friendly as compared to the Hark system where tourist is required to carry a receiver unit everywhere during the tour. The existing Interactive Virtual Reality Touring System proves to be more computationally and economically costly as compared to the system proposed in this research.

As of now, the proposed system is specifically tested at NIIT University, Neemrana. The system can be used for any important visitor's spot. In addition to the basic functioning in this research, we are also planning to make our app multilingual for better accessibility and to dissolve the language barrier in many cases. As of now, the app works only for a single language i.e English.

Also, this research paper is just the first phase of the proposed solution, to ignite the light of the idea and form the base for more furnished and polished end products. The research work has the scope of development in many aspects both horizontally and vertically with further research and analysis.

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