# A Smart Parking android application using Bluetooth Low Energy (BLE) Beacons

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***Abstract:***

The proposed work uses a new technology to give an inventive answer for the issue of indoor and outside situating and a direction framework in stopping zones inside urban communities where there is no inclusion of worldwide situating frameworks which rely on the Bluetooth protocol called Eddystone (created by Google). "Smart Parking using Bluetooth based beacons" is intuitive solution for supporting parking facilities which is based on the Eddystone-URL protocol. The proposed system will educate the end users about nearby vacant parking slots which provides cooperation between the various systems and different components of the scheme. It creates a scatter ecosystem which is independent of a manual interaction.

## I. INTRODUCTION

Bluetooth Low Energy technology (generally abbreviated as BLE) is a sort of technology introduced by the Bluetooth Special Interest Group (also known as SIG) in the year 2011, aiming to propose and build pioneering solutions in various industries namely, health, safety, fitness, home entertainment, etc. BLE has already put forward state-of-the-art functionalities that are being adapted in various physical devices such as smart watches, fitness bands and many other kind of everyday appliances [1]. As the name suggests, power consumption to operate BLE devices is quite low, which boosts it's operation duration for months or even years without any intermission and that too with a normal battery. One advantage of using BLE over other wireless communication mediums is that it enables the user to broadcast informative contents like a web address or a unique identification (UID). Smartphones (could be an Android, iOS or a Windows mobile device) supporting Bluetooth 4.0 or higher can be employed to receive and interpret the BLE signals, that could constitute a UID or a URL based on one's requirement or expected application.

**Devices with Bluetooth Low Energy (BLE) support:**

BLE is supported by almost every smartphone and tablet built since 2012. However, there could be some exceptions as Android phones vary widely, thanks to the booming competition among various smartphone vendors that rather still work on Bluetooth classic [2,3]. Tabulated data, as depicted in the table below, enlists the supported iOS versions.

**Table 1: Devices with BLE support**

| **Device(s)** | **Models supporting BLE** |
|---|---|
| iPhone(s) | **i**Phone 4 or higher models |
| iPad(s) | iPad 3rd generation or higher models<br>iPad mini or newer models |
| iPod(s) touch | iPod touch 5th generation or newer models |
| Android phone(s) and tablet(s) | All Android phones with Android 4.3 or those released since. |

**Table 2: Comparison between Bluetooth classic and BLE**

| **Parameters** | **Bluetooth Low Energy (BLE)** | **Bluetooth Classic** |
|---|---|---|
| Transfer Rate | 200 Kb/sec | 2-3 Mb/s |
| Data transfer interval | Approx. 3ms | Approx. 3ms |
| Battery Usage | Typically 15mA | Roughly 30mA |
| Real-life applications | Applications that do not need continuous streaming of data, like proximity marketing campaigns. | Applications that require continuous streaming of data, such as analog audio signal in case of Bluetooth headphones |

## II. LITERATURE REVIEW

The following papers have been followed and analyzed thoroughly throughout our project and has helped us a lot by allowing us to figure out the existing research works that are being conducted in the world using the Bluetooth Low Energy (BLE) beacons and how these works have impacted the lives of general public. Also it has provided a deep insight in the world of BLE beacon devices by nurturing our knowledge regarding the limitations and general application of these smart devices.

| Sr .No. | Paper Title | Author Name | Technology | Outcome | Year |
|---|---|---|---|---|---|
| 1. | Smart Parking System Based on Embedded System and Sensor Network | Faiz Ibrahim Shaikh, Pratik Nirnay Jadhav, Saideep Pradeep Bandarkar | cluster based algorithm | By using WSN (IR Sensor) the proposed system designed cost efficient smart parking system for multi-level parking facility and automatic billing process [4]. | 2016 |
| 2. | A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies | Thanh Nam Pham, Ming-Fong Tsai, Duc Binh Nguyen, Chyi-Ren Dow, And Der-Jiunn Deng | Network architecture based on the Internet-of-Things technology | Designed system improves the probability of successful parking. It also minimizes the user waiting time [5]. | 2015 |
| 3. | Improving indoor localization using Bluetooth Low Energy Beacons | Pavel Kriz, Filip Maly, Tomas Kozel | radio-based indoor localization | Proposed a distributed system for collecting the radio fingerprints with the help of mobile devices which uses Android | 2016 |

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|---|---|---|---|---|---|
| | | | | operating system [6]. | |
| 4 | Implementation of Android Application for indoor positioning system with estimote BLE beacons | Wook Song, HwaMin Lee, Seung-Hyun Lee, Min-Hyung Choi, Min Hong, | Estimote BLE (Bluetooth Low Energy) beacons | Proposed system calculating the RSSI (Received Signal Strength Indicator) values with 80% accuracy [7]. | 2018 |

## III. IMPLEMENTATION

First of all a rooted analysis of various requirements listed earlier can be handy on the developers' end allowing them to figure a decent plan of action to tackle the project requirements and simultaneously troubleshoot all the problems and errors that might halt the anticipated progress of the project. Now, as per the implementation part, the working of our system quite clearly projects the idea regarding how this process would be undertaken. As per the figure depicted below, the process lifecycle can be visualized as to be conforming to following three main activities i.e., beacon broadcast the URL, identification of the same using Bluetooth enabled smartphones and finally requesting the required information using it.

Figure 6: Proposed parking solution development process flow

The following screenshots depict the initial activity screens that cover the base activity of the android application solution proposed in this research.

The server architecture also needs to be powered by a management system running on it so that the managers can effectively plan out the whole procedure and ensure a smooth flow of vehicles in and out of the facility. So a backend system is also developed harnessing the power of various web development technologies to implement an intuitive information management system which is supposed to run the whole operation from a

centralized system or a server.

So in this proposed work where android application developed which aid the users and the management system installed on the central server would communicate over a network to serve the users with the appropriate information as an answering response to their queries regarding the availability of parking facilities in their vicinity. All the information is stored in a MYSQL database and apache server is utilized to demonstrate the system availability when the URL i.e., the address of the server is requested by the customers using the proposed application.

As per the design of the solution discussed above, the first and the foremost step required for the implementation of the proposed solution is to find and integrate the appropriate software development kit (SDK) from the plethora of options available. In implementation, integrated the physical web project that lets us interact with beacons using eddystone protocol. This integration helps us receive and decode the Eddystone-URL frames and decode the correct URL effectively. Finally, implement a server architecture that can host and communicate the required real-time information about the availability of vacant parking slots.

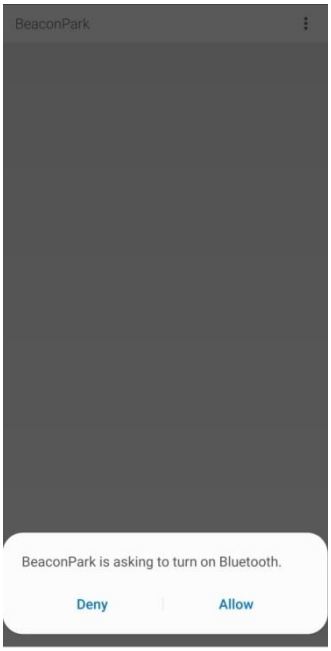


Figure 1: User is prompted to turn on the Bluetooth.

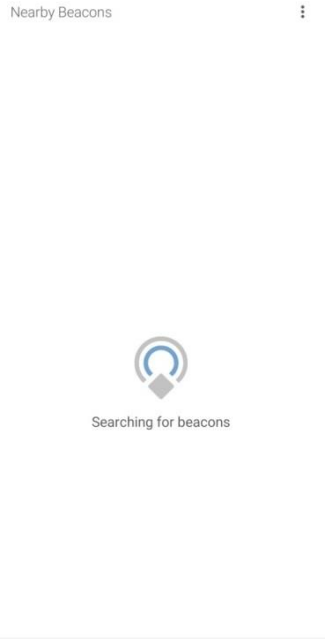


Figure 2: Initiate the search for nearby Beacons.

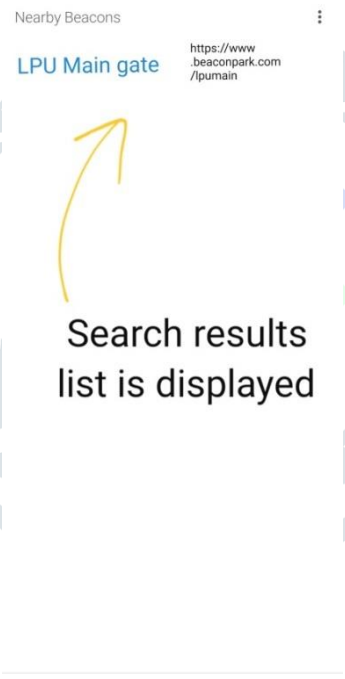


Figure 3: Notifications are displayed

Without adequate signage, it's difficult to locate facilities and slots in parking garages. And if the parking facility is particularly large with hundreds of slots on each level, it can be a very frustrating experience for customers.

Installing robust WiFi and beacons can allow customers to locate vacant slots and other POIs by providing them with directions in real-time.

Now, the network required for communicating could be a local network consisting of routers and a central server hosted locally or cloud architecture accessible via a stable internet connection. If the parking facility is established in remote areas where a proper internet connectivity is not available, a local network could be created such that users can connect to it using various Wi-Fi access points available throughout such a facility.

Here, two tables are created within the database, one to store all the parking slots or the layout of each floor and the other to store information regarding the vehicles entering or leaving the parking facility. The second table also helps us deduce the duration of stay of vehicles within the premises and the corresponding charges accrued as a result. In addition by combining the information in both the tables, availability of vacant slots can be checked by displaying all the slots in table one and filtering out those equipped by vehicles based on the information in the second table.

All these components are interconnected and are supposed to play in sync such that proper information can be conveyed to the users seeking assistance. Once a slot number is assigned to the user, the information regarding that slot is conveyed to the user allowing him/her to easily commute to the destined empty parking space in a hassle-free manner. This helps in smooth and efficient commute for the users without any unwanted chaotic outbreak leading to customer's dismay.

The management solution as proposed above to aid manager in proper management of the parking facility is explained in detail in upcoming pages. PHP programs are used to establish a connection among the database and the apache server and thus store and process data on the server end such that proper information could be made available to the users when required. All the different functionalities required for this scenario are listed in this section along with screenshots of corresponding process screens and snapshots of programs as per the implemented solution. These activities or functionalities include creation of a new virtual parking environment based upon it's practical counterpart, the ability to allow new vehicles signified the park facility, un-park the vehicles ready to leave and calculate the respective charges [8,9].

In the upcoming snapshots, management system screenshots are presented along with the corresponding code snippets. Thus, one can easily understand how the implementation of the backend system is achieved.

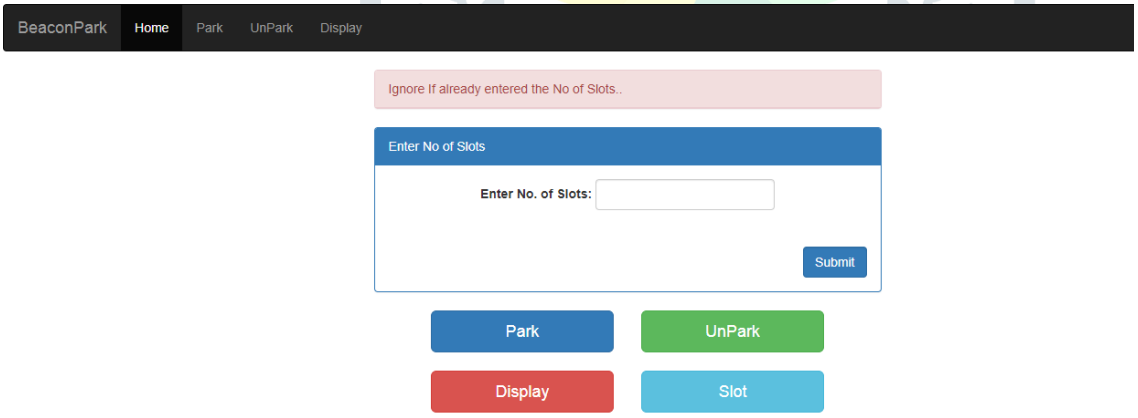


Figure 4: System asks about capacity so that appropriate database schema can be constructed.

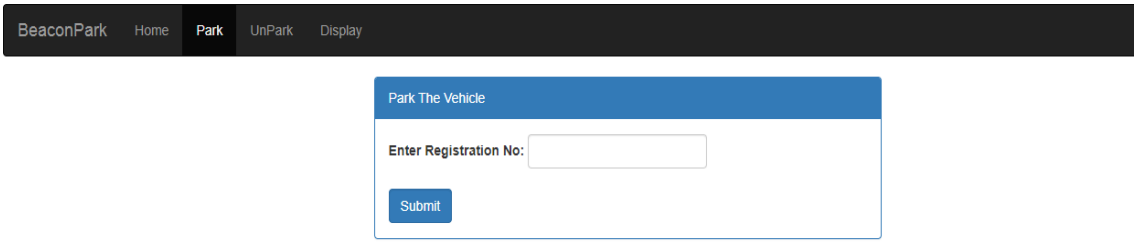


Figure 5: The manager can enroll a new vehicle as it enters the parking facility, saving the timestamp.

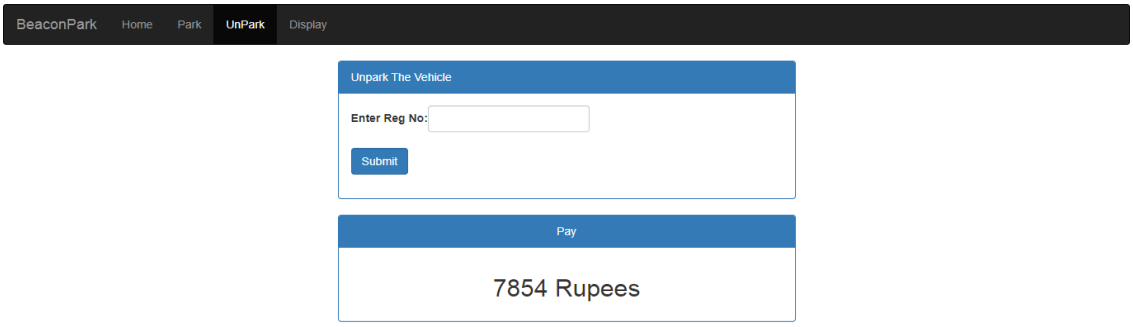


Figure 6: When the vehicle is un-parked, appropriate charges are displayed based upon the duration of stay within premises.

## IV. CONCLUSION

This paper implemented an effective parking solution with the aid of BLE beacons that could be really effective in streamlined flow of vehicles in and out of the parking facilities. Also this application act as a handy tool providing the information about the available choices and provide the user to choose the best possible option suited for his/ her needs. Our app will notify the user about the available free parking spot saving their trip to an already filled parking lot. For this, the person just needs Bluetooth technology enabled on their phone which is not a big deal these days. Hence, we can infer that a fully functional beacon detection system is available to be deployed in various parking facilities all around the cities suffering from the problems pointed in earlier sections.

**References:**

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