

# Enhancing Customer Engagement using Beacons

K.Saranya, S. J. Syed Ali Fathima, Mohd N Azri Ismail

**Abstract:** Most of the people these days use mobile phones for almost everything. Many technologies have been used in a smartphone which provides a variety of services like Social networking, payment, marketing etc. A new way of marketing which uses BLE beacon technology can be incorporated with a mobile application which is used to send personalized notifications to customers using the Indoor positioning system using Beacons. Existing GPS can't be used for Indoor Positioning System, as there are some shortcomings like power consumption and also the accuracy of the system indoors due to obstructions to the satellite. RFID technology is accurate indoors but the range is too small which is only up to 15 meters. To overcome this Beacon is used which is a low-cost, low-energy transmitter equipped with Bluetooth Low Energy or BLE also known as Bluetooth 4.0 or Bluetooth Smart that can end proximity-based, context-aware messages over distances ranging from 15 cm to 70m. The Hardware used here is a beacon which transmits a signal which contains a Unique ID at regular intervals which can be detected within a certain range. A custom Mobile App is developed which receives the signal while in a certain proximity of the beacon and is programmed to calculate the distance. The Custom Mobile App connects to a Web server which makes use of the Unique Id received along with the signal to retrieve information corresponding to that Unique ID. The Web server contains a Database which keeps track of all the Unique Id's and the appropriate information corresponding to each Unique ID.

**Keywords:** Bluetooth Low Energy, Accuracy Positioning, Indoor Positioning, Radio map- based positioning, Practical Path Loss Model

## I. INTRODUCTION

After the widespread of internet and smartphones, almost all business provides services to their customers using a mobile phone. There are different applications which provide different services. But there was no proper technique for the services regarding the Indoor positioning system. Measuring position has been a dramatic success for outdoor navigation systems, and there is a strong push to repeat that indoors. Outdoor navigation is possible using GPS system with the help of satellites. But to locate a person accurately inside a building or a supermarket is not possible with the existing GPS system. We also cannot send context aware personalized multipath signals. Hence the apt technology to locate something indoor is to use a Beacon device.

The beacon device is used for short distance transmissions up to 70 m. messages inside a store using GPS. This is because GPS technology cannot measure the accuracy down to 1 meter as the receivers in the earth struggle with The Hardware used here is a beacon which transmits a signal which contains a Unique ID at regular intervals which can be detected within a certain range. A custom Mobile App is developed which receives the signal while in a certain proximity of the beacon and is programmed to calculate the distance. The Custom Mobile App connects to a Web server which makes use of the Unique Id received along with the signal to retrieve information corresponding to that Unique ID. The Web server contains a Database which keeps track of all the Unique Id's and the appropriate information corresponding to each Unique ID. Section II explains about BLE Technology. Section III discuss the literature survey and the working of beacon. Section IV explains the limitations in the existing system and also Section V explains the proposed system. Section VI explains about the system requirements. Section VI gives the implementation phase. Section VII gives the conclusion and references.

## II. LITERATURE SURVEY

Location based marketing and sending context aware messages based on the customer's location has been increased due to the wide usage of smart phones and technology like Beacon. A number of opportunities may be presented for strategic communicators but the technology has number of challenges to be faced. One such thing is that customers may not be comfortable with push notifications. Now, the customers should download the beacon app and "opt-in" to the services offered by beacon in order to take advantage of the services that are being offered. To overcome this, marketers should organize campaign strategies in order to create awareness among the consumers to increase the engagement in beacon technology.

The beacons do not send notifications to smartphones. A unique location identifier is send to the app and based on the data received, they are programmed to respond differently. The beacons send out these personalized context aware messages as it enters a predetermined location, via the BLE signals received on the smartphone. Beacons are usually very small in size. Any number of beacons can be placed in a store. With the 2 years battery life of Beacon, it can send the BLE signals to smartphones provided, the smartphone having Bluetooth facility. When the mobile phone, which has Bluetooth switches on, is detected by the beacon, it sends the location-aware signals to phone applications, and also the personalized messages. Even several offers and coupons could be send to the customers.

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## Enhancing Customer Engagement using Beacons

For years, the e-commerce giants target their customers using the Big data analytics by taking the customer's browser cookies and displaying the banner ads in which ever app they are using. By using Beacons, we could send the personalized ads to the brick and mortar retails businesses.

The iBeacon was introduced by Apple in 2013. All the iPhones starting from iPhone 4 comes completely beacon-enabled. Google also ensured that from Android 4.3 and later versions had the built-in beacons in them. Giants like PayPal and Qualcomm are creating the hardware. They think that the beacon technology will determine the future of location-based marketing technology.

The other location based technology is very different from the beacons. Other location based technologies like NFC, GPS, QR codes are not capable of being as widely accessible as beacon technology. Most of the cell/Mobile phones does not use NFC as that requires almost physical touch but beacon has the potential to engage upto 200 feet of distance. Most of the smartphone users are familiar with GPS. It is used in Google maps for navigation purposes. It is widely used for outdoor navigation. But when it comes to indoor, it is very less capable. In case of QR code, the customer has to scan the QR code in each location to get the personalized messages. This is more like manually doing the work and most of the customers won't like to move around the store scanning the QR codes. These technologies demand a pull approach instead of a push approach.

Beacon provides the customers a push approach in which they only have to opt-in once they enter the store and they get push notifications based on their location. Since 2014, mostly all mobile brands including Samsung, Apple etc. manufacture their mobile phone with the BLE technology. The BLE technology can be used in wide area and its innovations are endless and when it is creatively put in use better communication initiatives are possible.

Than paper fliers, beacon-enabled tools would be the real future. This paper gives idea of how the beacon can replace fliers in shopping malls and supermarkets. Instead of having flyer and boards which display the discount rate and other details, this information could be sent to the customer's phone as they walk through that particular location using Beacon's feature of sending personalized notification, as long as the customer has a mobile phone with BLE in it.

### III. BLUETOOTH LOW ENERGY TECHNOLOGY AND WORKING OF BEACON

Bluetooth Special Interest Group with their continuous effort, developed a new technology named Bluetooth low energy(BLE). It is a part of Bluetooth 4.0 standard but has various functionalities compared to regularly used Bluetooth. The same modulation Scheme and frequency is being used by both Bluetooth and BLE technology. The BLE devices have short signal reachable distance that depends on power usage. The Application throughput of BLE is around 300 kbps which is comparatively very smaller when compared to Bluetooth. Voice transmission will not be supported by BLE due to low transmission capacity. It has an advantage to operate in low power up to 100 times which is highly dependent on the environment that it is used.

The working of beacon is based on a simple principle where a small ARM computer is placed under a silicon casting and along with a Bluetooth module supported by a battery which forms a little circuit board. At situations where the computational power of CPU and memory are limited, it is highly preferable to handle small tasks such as processing sensor data or encrypting a beacon's ID for improved security.

The Antenna is a short wire that is stuck in the thinner side of beacon that is used in broadcasting electromagnetic waves with specific length and frequency as shown in Fig 1. If a beacon is opened and invigilated, one could notice antenna is that which everyone had on radio but it will be zigzag for a reason. The electromagnetic field around a straight wire is shaped like a donut - the waves do not propagate in every direction with the same strength, leaving out sort of blank areas. The best solution to that is to reshape the antenna. The desired outcome is to achieve a perfectly spherical field. But in real world conditions this is not possible so lot of research is going on to find the perfect shape for antenna.

Bluetooth Smart is used by Beacons for communication. The maximum payload of a Bluetooth 4.2 packet is 257 bytes. It's not enough to embed media content and that's why beacons only broadcast their ID's (which in the case of the iBeacon protocol is divided into three values: UUID, Major, Minor) and information about signal power, essential for a nearby smartphone to calculate proximity.

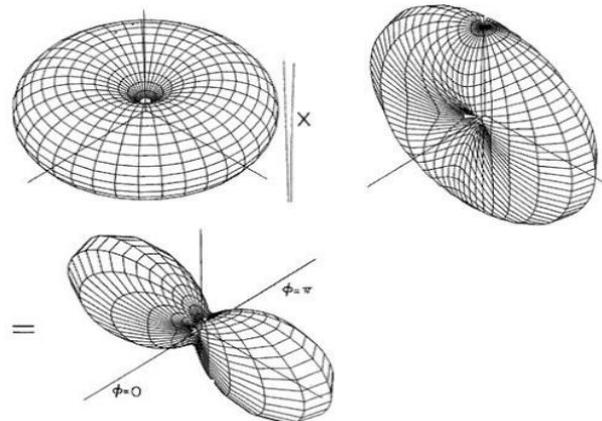


Fig 1: Antenna Inside a Beacon

### IV. LIMITATIONS IN EXISTING SYSTEM AND ADVANTAGE OF BEACON OVER GPS

#### A. Lack of Proximity and context based information

Very often consumers do not get proper and timely information. Information could be about offers for a limited period or availability of a new product in the store. In the absence of information consumers may not be able to make proper decisions of purchasing product or services.

#### B. Difficulty in Locating Stores Indoor

One of the major problems faced by customers is finding a particular store among lot of other stores. Also getting directions to that store is another problem faced as GPS cannot be used for this purpose.

**C. Difficult to Personalize Product Suggestions.**

It is difficult to keep track of previous purchases of a customer and getting personalized after-sale information like offers or discounts or related product suggestions to him the next time he walks into the store.

**D. Difficult in Getting Product Details**

Due to the crowd in a store, it becomes difficult for the customer to get information about the product in case of salesperson shortage. There is also the problem of the salesperson never leaving you alone when you browse through the products.

GPS is Global Positioning System. GPS receives the information from the GPS satellites and then to the device’s geographical location. This information can be viewed in the device by using suitable software. It can retrieve from the GPS system location and time information in all weather conditions. The main disadvantage of using GPS for a long time, is the power consumption. And moreover GPS is not good in indoor positioning. GPS drains the battery fast. Thus when it comes to “always-on” case, GPS is a poor solution.

This is the reason why we move to Beacons. In case of BLE, it is battery powered and can be configured with the help of a mobile application. Hence making the Beacons scalable and portable. Since most of the smartphones these days are equipped with BLE technology, it can act as the receiver for the Beacon.

**V. PROPOSED SYSTEM**

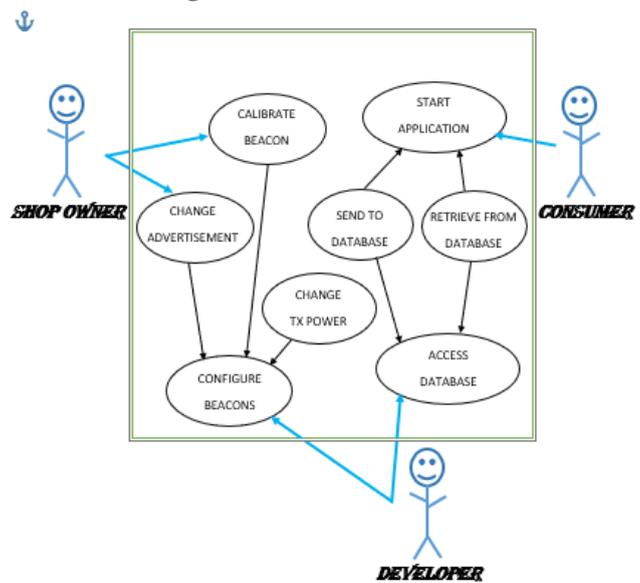
Measuring position has been a dramatic success for outdoor navigation systems, and there is a strong push to repeat that indoors. Outdoor navigation is possible using GPS system with the help of satellites. But to locate a person accurately inside a building or a supermarket is not possible with the existing GPS system. We also cannot send context aware personalized messages inside a store using GPS. This is because GPS technology cannot measure the accuracy down to 1 meter as the receivers in the earth struggle with multipath signals and moreover power consumption is high for GPS.

To overcome this Beacon is used which is a low-cost, low-energy transmitter equipped with Bluetooth Low Energy or BLE also known as Bluetooth 4.0 or Bluetooth Smart that can send proximity-based, context-aware messages over distances ranging from 15cm to 70m. The Hardware used here is a beacon which transmits a signal which contains a Unique ID at regular intervals which can be detected within a certain range. A custom Mobile App is developed which receives the signal while in a certain proximity of the beacon and is programmed to calculate the distance.

The Custom Mobile App connects to a Webserver which makes use of the Unique Id received along with the signal to retrieve information corresponding to that Unique ID. The Webserver contains Database which keeps track of all the Unique Id’s and the appropriate information corresponding to each Unique ID.



**Fig 2 iBeacon Architecture**



**Fig3Flow Chart of Our Solution**

**VI. SYSTEM REQUIREMENTS**

**A. Mobile signal strength**

In order to download the beacon application, the customer must have good mobile signal strength. Or in other case, the shopkeeper must be ready to provide wifi to the customer to download the application.

**B. Beacon calibration**

Physical barriers in front of the beacons may cause disturbances in the Bluetooth signals. Hence each beacon should be calibrated individually in order to avoid any disturbances.

**C. Position of Beacon:**

*Place* the beacons only where it is needed. For example, if many people stand at the bill counter, then place one beacon near that, so that the customers would get the notifications before they bill.

**D. Data security:**

The Unique Beacon ID and encryption of data should be kept secure. Because the competitors may use your data for their own targeting.

### E. Battery life of Beacons,

Check whether the beacon has sufficient battery life before installing. Beacons these days have battery life upto 2 years.

### F. Less is more:

Customers get irritated when they find lots of notifications on their screen. Hence make sure that the information that you want to display is short and crisp.

## VII. IMPLEMENTATION PHASE

Configuring the Beacon:

There are three values to be set in a beacon UUID, Major value and Minor value. The UUID is preset in the mobile application hence the beacon must be configured with the same. If the major value is the same as that of which is coded in the mobile application, the corresponding minor value's advertisement.

Mobile Application Development:

There are two activities. Main activity and First activity. In the first activity, the beacons connected and the advertisements will be displayed.

Connecting the Beacons:

The mobile application gets connected to the nearest beacon. The nearest beacon is found using the proximity calculation in the coding part. The Beacon library is used to code.

## VIII. CONCLUSION& FUTURE WORK

The challenge, however, is delivering a relevant message at exactly the right time to persuade a customer to visit a specific retailer and, once there, to make a purchase. Instead of using fliers and other paper related advertisements, this proposed system gives easier and more personalized marketing to the customers. Beacons have a wide scope in the upcoming years. BLE being a low powered mode for data transmission, could be easily incorporated in any environment. And due to the adverse use of smart phones, people tend to notice advertisements easily at their phones. Hence the application is suitable for any environment which needs personalized advertisements to its customers.

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