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A Survey on Systems using Beacon technology

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Abstract *- Advanced positioning technology has led to the development of delivery services of automatic advertisements and notifications to the user based on his/her location. For indoor environments, Notification environments developed using beacons are preferred. A variety of applications from shopping malls and museums, prefer Indoor positioning systems using beacons to subject monitoring and tracking.The usability and reliability of these positioning systems are based on their accuracy, cost and the ease of deployment. In an indoor space, Beacons are installed by users, to construct the notification environment. To make setting of notification positions easier, the beacon installed is linked to the notification content. Using this system the customer's time is saved as customer gets notifications on his Smartphone when they pass through any malls, store etc. When the customer finds a notification they react to that and reach to that space. Customer enters into the space and gets more notifications about the space which may help the customer. Although, the Global Positioning System (GPS) is an accurate solution for outdoor space, it cannot be used in the indoor space.*

Keywords: Indoor positioning, Beacons, Bluetooth Low Energy(BLE), iBeacons, particle filtering, Geolocalisation, Kalman Filters, RSSI, Eddystone, particle filtering

1. INTRODUCTION

In a range of contexts including office buildings, museums ,university campuses, , airports and other public spaces, Indoor positioning as a method of augmenting and enhancing user experience is attracting increased interest from commercial organizations . None of the forms of marketing offers personalized marketing based on a user's current location in real time. Shopping is one regular activity that human beings spend significant amount of time. US Bureau of Labor carried out a survey ,according to which, customers spends average of 1.4 hours every day on shopping.[2] Moreover, CISCO Internet Business Solution Group conducted a study , according to which, the four top reasons for users to use new technology are to Find best price (63%),Save time (47%),Find best assortment (26%) and get best quality (25%).[2] SWIRL carried out a survey according to which, shopper behavior are influenced by Beacon marketing campaigns: 73% of surveyed shoppers said that their likelihood to purchase during their store visit increased with beacon-triggered content and offers, 61% said they would do more holiday shopping delivered mobile content and offers at stores while they shop, 61% said they would visit a store more often with beacon advertising campaigns, and 60 % said they would buy more product as a result of receiving beacon-triggered advertising messages.[2]

Literature Survey

In the paper [1], the objective was to add services and data that are location-dependent, which includes navigation information, which the user configures depending on the requirements. About 136 beacons are deployed over a store area of around 6000m^2 but the experimental data which was collected was done over a part of around 800m^2, with about 25 beacons deployed over the area. The objective of the system is to determine the aisle in which the user is, and the user's position along the aisle.This provides with required information to check which products / categories of products are adjacent to the user .The system is primarily interested in determining the closest products to the user which is fully represented by the user's displacement along the occupied aisle's main axis, and the position across the width of the aisle is given less important. Hence it reduces the positioning problem faced to locate the user on an edge of a node graph, which represents the store aisle's map. Three positioning methods which were experimented were, Nearest Beacon: the

baseline method of positioning is to estimate the position of the user to be that of the graph node which is adjacent to the beacon with the current highest recorded RSSI value. Weighted Beacon-Pair Range Estimates: to take different readings from multiple beacons at a time to improve spatial resolution of BLE readings is said to be unreliable. However, the node graph map constrains the position of the user, and the readings from neighboring beacons are used to improve the position estimate. Particle Filter: user positioning is considered as a non-linear Bayesian tracking problem. The state space is constrained to include only positions which lie along node edges of the graph map.

In the referred paper [2], the System based on BLE consists of 3 components: 1. Server Component 2. Smartphone Component 3. BLE (Beacons).The Smartphone component consists of an application where the location of the customer will be identified using BLE technology. The Notification or any advertisements can be viewed in the Smartphone provided based on the customers location inside any store or in any mall. Server Component transfers the data using Wi-Fi and the application in which server is connected sends any promotions or advertisements to the Smartphone. BLE makes the process of collecting any data related to the customer in an easier and in a faster way where it reduces cost and provide enhanced services to the customer according to their preferences.

Beacon is a Bluetooth enabled device which is based on Bluetooth Low Energy Technology. Beacon is expertise in identifying proximity and can be used in public areas for various information.The data which beacons transmit will be in the form of packets and relevant Smartphone can take up the data which is transmitted. A data packet contain four component of information mainly, i. UUID ii major number iii minor number iv TX power. UUID is a 16-byte identifier that can be used to differentiate whenever there are large group of similar beacons. MAJOR NUMBER is used when smaller set of beacons present within the larger group can be differentiated. MINOR NUMBER can be used to identify individual set of beacons. TX POWER determines the nearest distance of beacons present around. Bluetooth Low Energy describes a new role for developing a geomarketing solution which makes the customer's shopping experience easier and efficient. BLE also helps in making decision in-order to strengthen the relationship with the customer's personalized service and keep up the loyalty of the customers. Further the implementation using BLE technology can be done by sending customized messages such as advertisements or e-coupons to customers to their Smartphone as they enter the shop or if they are closer to the shop.

In the referred paper [3], we see that In the current days the technology is being developing to be in its best version. Online transaction and shopping has gained a lot of scope nowadays, but some customer feels the website used for shopping is not feasible. To overcome this problem we can use the Bluetooth Low Energy concept by implementing the triangulation algorithm to calculate the current location of the user through beacons. In the proposed system the customer will receive the notifications and services provided by the vendor when he passes near the store/mall, thus providing the customized advertisement service to the user. BLE beacons is a low-cost, low-power consuming devices that can provide the short range wireless communication. The beacons will be sending the small identification frames that are received by the mobile, thus helping in calculating the distance between the mobile user and the beacon through received strength signal. The beacons protocol is using the 40 channels of 2MHz each which are used for the transfer of advertisements. This proposed system will help the customer by providing the customized services and saves customers time. Most of the indoor positioning techniques are using Wi-Fi and Bluetooth technology, to optimize this system an extended Kalman filter can be used. This is explained below: A) Pre-Process of RSSI values: The RSSI values are unstable even in the well-defines, well-designed indoor scenario/area due to the multipath fading. In order get optimal result the unstable values has to be removed via pre-processing of the received RSSI values. B) Kalman Filtering: The distance between the mobile and the beacon devices are calculated using the Kalman equation, which will be using the prepressed RSSI values for the calculation. C) Triangulation: Once the mobile device gets the distance between the beacon the triangulation technique is used to find out the co-

ordinates, which contain the three circles with beacons are centered at each beacon with the equal radius. Proposed System: The proposed system contain three parts namely 1] Mobile application 2] Shopping mall 3] Server The system will provide the user with mobile application to access the services provided. Once the user installs and initiate the app and turn on the Bluetooth on his/her device, the mobile will get connected with the beacons devices sending the Bluetooth signals. The mobile will get the unique ID of the beacon device and transfer the details required into the server and the services and advertisements will be delivered to the customer. The server contains the services, advertisements loaded to it by the vendor. The server also stores the customer information. All the transfer of the data from mobile to server and from server to mobile will takes place by using Wi-Fi. Thus the customized service Is provided. Hence, The proposed system will help the customer to get information about the special offers and services provided by the retailers when he/she is nearer the hop and information about particular product when nearer to the product

In the referred paper [4], it says that Proximity marketing is a technology where it delivers advertisements to users depending upon the location in which they are present. Customer while shopping find difficulties to take full advantage of different offers provided by many stores because it may be irrelevant when advertisements sent through SMS messages. Advertisements can be directly sent using many technologies like GPS, RFID, NFC and Wi-Fi. System using beacon technology can be used in delivering advertisements to the customer's Smartphone enters the store or who happens to be nearby the store. Technology usually used for location based advertisements is GPS (Global Positioning System). Normal Android Smartphone which uses GPS enabled application like Google Maps drains out phones battery. Location based services which is the beacon Technology is provided by apple which uses IOS platform is a new technology in mobiles. It delivers the relevant content to customers based on their present location and also in public transportation in nearby stations. iBeacon technology is preferable in using GPS since using BLE with this technology consumes less power. Every business aims at obtaining the new customers and also maintaining the current customer in an efficient way. There are traditional methods which are been already in use when it comes to advertising that is through newspapers, radio, television etc. The modern way of technology in advertising is known as Proximity Marketing which delivers advertisements based on the location of the customer which also consist of mobile advertisements. Proximity Marketing can also be known as Location based advertising(LBA).Proximity Marketing can be effective when it is personalized that is personalizing according to the customers interests and delivers it based on the customer's location. It should also be timely effective that targets people at specific domain in the whole advertising. The main goal is to provide advertisements to the customers Smartphone based on their location using iBeacon Technology. It can also deliver advertisements to passengers who are in transportation or any users who are nearby to the station. It also serves as an advantage to the store owners to advertise their products in the store which leads to profit.

In the referred paper [5], Handling the operations of the administration of the education institutions involving the interaction between the students and the faculties is a tedious job. One of the solutions that can be suggested is using the Bluetooth beacons that provide the analysis based on the proximity. These beacons can provide the surveillance of the institution area in real-time, helping in automating the administrative operations. It also helps to communicate with the students and other staffs. Today we are very much depended on the location-based applications for our various operations. The GPS serves as an excellent location-based application, but it cannot operate in the indoor areas. We can overcome by this problem by using the proximity sensing using the Bluetooth. Initially the Bluetooth in the smart phones used the WIFI signals for the sensing purpose, which was then replaced by the concept of Bluetooth low energy developed by the Nokia. In the proposed system attempt to automate the institutions operations using the beacons are done. Every student will be tracked inside the campus and the relative location details are used to automate the management tasks. Web page links can be used to communicate with the student. Indoor navigation is being done by using the various

technologies like NFC, Wi-Fi, Bluetooth, RFID etc. As the availability of Bluetooth and Wi-Fi is easier they are widely used in indoor positioning .The criteria to be considered is the energy consumption which is less in case of using the Bluetooth low energy

Bluetooth Low Energy:

Bluetooth low energy devices are similar to the other Bluetooth devices. As the name indicates these devices will consume the low energy. The BLE devices can transmit and receive the data. These are capable of sending the fixed length advertisements. One of the difference between the Bluetooth low energy and classic Bluetooth device is that the former have 40 channels where latter have 70 channels. The channels 37,38,39 are used for sending the fixed length advertisement where the other ports used for data transmission.

Ibeacon: It is the standard protocol for the Bluetooth low energy peripheral devices designed by the APPLE. This make use of the BLE to send the UID through the Ibeacon API which has been implemented on the code of vendors application. This beacon uses three types of values:

1 .Major values: 2 bytes defining the region of the beacon.

2.Minor values:2 bytes defining the subdivided region into specific region.

3. UUID: 16 bytes which is specific for the app.

Eddy stone: This is open source standard protocol for the BLE devices designed by Google. This supports four data packet types

1.Eddystone-UID: contain the UID for the beacon

2. Eddy Stone-URL: contain only the URL in the complete data.

3. Eddy stone-TLM: it will give information about the battery life of beacon

4. Eddy stone EID : used to deal with security risks like hijacking spoofing.

In the proposed system the Ibeacons are placed in the classrooms as well as the other required places. Here multiple beacons are connected together and form a beacon network and a particular beacon will be identified or accessed by using its unique id. In the background the low energy scanning of the broadcasting beacons will be running. When the student enters the class these scanner will detect that class room beacon and it will continuously check for the proximity. If the proximity is “near” then the attendance will be issued, when the student leave the class the proximity will be “far”. This attendance records will be stored in the local database which can be accessed by the students but cannot be altered by them. The teachers can use the broadcasting beacons to share the assignments or other document links through the google eddy stone protocol with the student as the beacon can transmit the data packets.

It improve the effectiveness of the studies by monitoring and analyzing the interactions between the students and the teachers.

The BLE concept can be used to automate the tasks like attendance maintenance, sharing the document, tracking the students details by utilizing the proximity sensing in indoor area.

In the referred paper [6], three technologies are mainly used in the proposed application. To target and detect customers beacons are used, to create a digital platform for user interactions android application is used and to deliver personalized shopping experience data analysis algorithms are used. Preceding to the three main parts of the system, A process called Geofencing is used where the user is tracked using his GPS location. The proposed system with all its attributes was implemented using Java programming language for its front end and R programming language for its back end. It performs predictive data analysis which is done on the historical data of the user which is obtained from the store which is transactional sales data. In the desired form, the outputs were generated. The intermediate results include a total clusters’ tag count and their previously bought respective products by the detected user. A section wise discount coupon list is produced by the back end system which includes the current discount and Product-Id of each product

which is viewable to the user. To create a suitable activity that displays all the results, previous list is used by the front end. For a specific user in some specific section, the output generated by the back end system is then sent to the front end as the listed products. The final list is then displayed as the products in a beacon enabled section.

CONCLUSION

In these survey paper, we discuss about various systems using beacon technology which helps save time and energy of mankind and make various purposes easily available and approachable. Recently, iBeacon technology is being used for improving services in different sectors such as, public transportation, shopping and healthcare which is showcased in this paper. This paper provides different contributions. This Advanced positioning technology has led to various developments of automatic notification delivery services based on user's location using beacons.

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