Performance analysis of fingerprinting method of navigation using beacon based offers offering tool

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ABSTRACT

In this competitive creative world, shopping is an important part related to every human, consider anything say household appliance, clothing, electronic items etc. It can be either online shopping or shopping in stores, markets etc. There is always a dilemma in customer's mind whether to buy such costly products or items and same time checking price through online selling company. Of course, varieties of deals attract humans. So, using a BLE (Bluetooth Low Energy) beacon technology can be helpful to increase retailing business of any stores by providing various offers on different product. Since price has become a major problem in today's world as same product is sold with different prices. Thus, using beacon technology people can get exciting offers within the range of beacon to the products of their choice which can help to increase interest of customer and helps in rising profit of the stores by offering deals to interested customers along with navigation for providing indoor directions. So, with the use of exciting sale amount of window shopping can be reduced and actual selling increases. Thus, to deal with such advantages and defects the application helps to reach with mentioned advantages.

KEYWORDS

BLE beacon technology, navigation method, shopping

1.   INTRODUCTION

A beacon is a small Bluetooth radio transmitter. It's kind of like a lighthouse: it repeatedly transmits a single signal that other devices can see. Instead of emitting visible light, though, it broadcasts a radio signal that is made up of a combination of letters and numbers transmitted on a regular interval of approximately 1/10th of a second. A Bluetooth-equipped device like a smartphone can "see" a beacon once it's in range, much like sailors looking for a lighthouse to know where they are. Beacons are made up of CPU, radio, and batteries. Beacons often use small lithium chip batteries (smaller and more powerful than AA batteries) or run via connected power like USB plugs.

They come in different shapes and colours, may include accelerometers, temperature sensors, or unique add-ons but all of them have one thing in common—they transmit a signal. Beacon hardware is relatively simple, but the way it triggers actions can get a little complicated. Every system is a little different, but here's how a beacon communicates: The beacon sends out its ID numbers about ten times every second (sometimes more, sometimes less, depending on its settings). A nearby Bluetooth-enabled device, like your phone, picks up that signal. When a dedicated app recognizes it, it links it to an action or piece of content stored in the cloud and displays it to the user. Basically usage of beacon is in indoor navigation while here, I mentioned some different method of using same beacon technology i.e. offering varieties of offers [10].

In this world of competition, there is difficulty to sell your product easily. Varieties of options are possible with the customers related to shopping, what to choose, what is best and what will fit best to choice. Hence, due to large number of options, window shopping is increased with the increasing craze of online shopping portal companies.

The main objective of this research is to provide available offers to the customers who are actually interested in shopping and check the prices online. Also advertising of the new product is there which can increase interest in the customer. By adding a new technology in the store, customers get attracted with new possibilities or ideas with navigation signals.

For making this concept work, mainly beacon Bluetooth technology is used. Furthermore, best suitable data mining algorithms are used to make this application idea work. Beacons are small devices that transmit a low-power signal that can be picked up by any nearby Bluetooth-enabled mobile devices/smart phones, and

they are widely used for many purposes. The wide use of beacons are in navigation system, here with offering offers is also a beacon technology but with an aspect of providing offers combining with navigation.

There are beacon located at several places, customer needs to activate Bluetooth option along with application installed to get connected with beacon. Within the distance of approximately 20m, application in the customer's mobile phone get connected if it is in the range of beacon. As soon as it gets connected at every time dependency some new exciting offers of the person's interest are sent in the mobile-phone application along with navigation directions only if person is found in the range as soon as person goes out of range, notifications or message will not be visible. This is carried out using fingerprinting method

WORKING OF BLUETOOTH DEVICE

A beacon is a small Bluetooth radio transmitter. It's kind of like a lighthouse: it repeatedly transmits a single signal that other devices can see. Instead of emitting visible light, though, it broadcasts a radio signal that is made up of a combination of letters and numbers transmitted on a regular interval of approximately 1/10th of a second.

Beacons are made up of CPU, radio, and batteries. Beacons often use small lithium chip batteries or run via connected power like USB plugs. A beacon is designed with three major components - a small ARM computer, a Bluetooth Smart connectivity module and batteries for powering the entire circuit. The CPU of the ARM computer has an antenna attached to it, which broadcasts electromagnetic waves with specific length and frequency [12].They come in different shapes and colours, may include accelerometers, temperature sensors, or unique add-ons but all of them have one thing in common—they transmit a signal. Beacon hardware is relatively simple, but the way it triggers actions can get a little complicated [10].

Figure-1: Beacon device

Every system is a little different, but here's how a beacon communicates: The beacon sends out its ID numbers about ten times every second (sometimes more, sometimes less, depending on its settings). A nearby Bluetooth-enabled device, like your phone, picks up that signal. When a dedicated app recognizes it, it links it to an action or piece of content stored in the cloud and

displays it to the user. Basically usage of beacon is in indoor navigation while here, I mentioned some different method of using same beacon technology i.e. offering varieties of offers. [10]
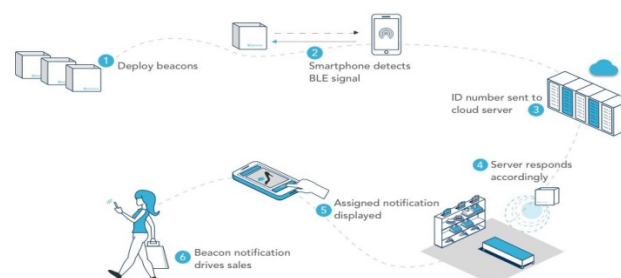

Figure-2: Working of Bluetooth beacon device

2. METHODOLOGY

Application is running on android platform. It has main capability to introduce offers to the customers for the product at a particular clothing store with navigation power. This has been done by beacons which uses Bluetooth connectivity. Beacons are small, low battery devices that can be positioned in almost any area of the store. It broadcasts data to everyone within the devices connected to the range of Bluetooth say mobile phones, tablets etc. The only basic requirement is Bluetooth facility in an android phone. Continuous display of message of offers at different time based on position of device and range notifications will be displayed that is possible through various algorithms.

The model on which the project works is prototype development model because this model easily distinguish difference between every stages of project to improve smoothness.

In the planning phase, scope and boundaries of problem, its scope in business part, analyse feasibility, planning goal and development of working plan.

In the analysis phase, all the pre-gathered requirements are studied further to find the scope of the product. The user who has installed the application has to login whose data will be stored in the database itself. This application will be used amongst the customers who are capable of holding Bluetooth technology into their mobile phones. Implemented application will be used inside the clothing shop where customers find high rates and leave the item which one wants because of same item with low price in online selling companies. Thus, process modelling was started by visualising stores and designing plan was followed by it.

In the designing phase, appropriate working flow of the product was made ready. So, a clear idea about the application can be visualised. The flow diagram is as follows:
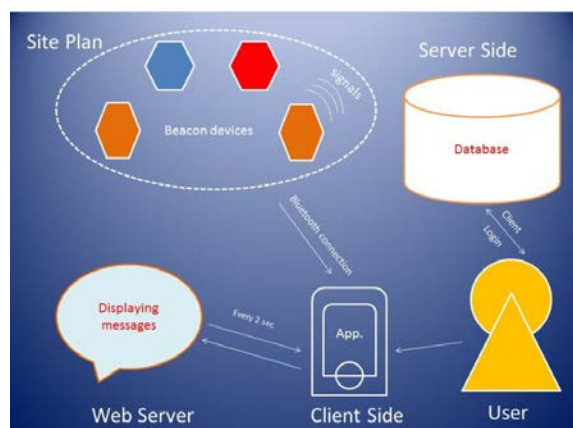
Figure-3: working of beacon

3.1 Steps are as follows:

1) Client installs the application.

2) Client either logins or signup into it.

3) Information is stored into database.

4) By activating the Bluetooth option, client can get connected to nearly located beacon device of its range.

5) At different time limit client can receive messages or notifications about offers than can be offered based on distance.

6) Useful offers can help client to buy product of his/her choice and to move by that side.

7) Once the client moves away from the range of beacon, there will no longer be display of offers to the client's phone.

Once the designing is completed, implementation and testing is moved forward to find whether the product reaches to desires.

3. PROPOSED WORK

Signal strength measurement is made by using a signal parameter known as Received Signal Strength Indicator (RSSI). As it name suggests, RSSI is the measurement of the power present on a received radio signal expressed in dBm ranging from -100 dBm(power ratio in onemilliwatt) for a very low signal level to -50 dBm or more for a strong one. The method used for indoor navigation is: Fingerprinting

3.1 Fingerprinting

Fingerprinting uses the RSSI values of a group of devices to create a signature (Fingerprint) of a specific location. This is done by storing these values, along with the addresses of their corresponding devices, in a database. Once several Fingerprints of different locations are created, continuous scans are performed and a runtime Fingerprint is generated every time. This last one is then compared to each one of the saved Fingerprints in order to obtain the closest match which represents the location where the user is.

Fingerprinting offers reasonable accuracy and is easy to implement. In the case of Wi-Fi, existing APs in a building are used. One disadvantage, however, is that the availability of the APs used to create the Fingerprint cannot be assured. Even though this issue can be easily addressed by replacing missing RSSI values with arbitrary measurements, this could decrease the accuracy significantly, especially if more than one of these values are missing.

BLE Beacons are also used for Fingerprinting. They can be positioned strategically in order to obtain as many necessary readings as possible and offer lower power consumption. Having dedicated devices for this purpose is definitely favourable; however, a large quantity of them must be purchased in order to cover a large area.

Regardless of the type of signal being used, Fingerprinting has some drawbacks. First of all, the collection of Fingerprints around a building is time-consuming.

When using Beacons, a survey of the building is needed to evaluate the best locations to place them and, in the case of Wi-Fi, the places where the samples for the Fingerprint must be collected. Changes in the building can also affect the signal readings and many times the Fingerprints need to be re-calibrated [11].

Kind of algorithm used:

```
if (savedTime == null || (savedTime != null &&
savedTime.getTime() < currentTime.getTime())) {
        savedTime = currentTime;
        ArrayList<Beacon> tbeacons = new
ArrayList<Beacon>(beacons);
        Log.e("Time", "savedTime => " +
savedTime.getTime() + " < " + currentTime.getTime());
        Calendar calendar = Calendar.getInstance();
        calendar.setTime(savedTime);
        // Add 30 minutes to the calendar time
//       calendar.add(Calendar.MINUTE, (int)
Math.round(tbeacons.get(0).getDistance())*2);
        calendar.add(Calendar.SECOND, (int)
Math.round(tbeacons.get(0).getDistance())*2);
        savedTime = calendar.getTime();
    }
    Log.e("Time", savedTime.getTime() + " < " +
currentTime.getTime() + "  value = " +
(savedTime.getTime() < currentTime.getTime()));
    }
    Log.e("", "this.beacons.size() = " + beacons.size());
    Intent intent = new Intent("getbeaconList");
    intent.putExtra("message", "get beacon List!");
    intent.putParcelableArrayListExtra("beaconsList",
new ArrayList<Beacon>(beacons));

LocalBroadcastManager.getInstance(getApplicationCont
ext()).sendBroadcast(intent);
    }
```

4. IMPLEMENTATION DETAIL

When the beacon is near to the device, notification will arrive in speed (fast) manner rather than the device goes far away delay in time is observed. So, there is some difference in time observed when the beacon is near and beacon is far away from device. Change in distance, range and time parameters are taken in consideration. Thus, the research shows a relationship between different parameters using a method fingerprinting.

For this application I had used beacon device of range of about 4m for practically testing purpose.

Figure-4: Beacon internal circuits

The android device on which application was tested is Lenovo Tab 7.

Specifications are: OS: Android 7.0, Platform: CPU: Quad-core 1.3 GHz Cortex-A53, Memory: Internal: 16 GB, 1 GB RAM

5. RESULTS

Following Graph shows a relationship between time and distance in beacon when notifications are sent as observed while performing practically:
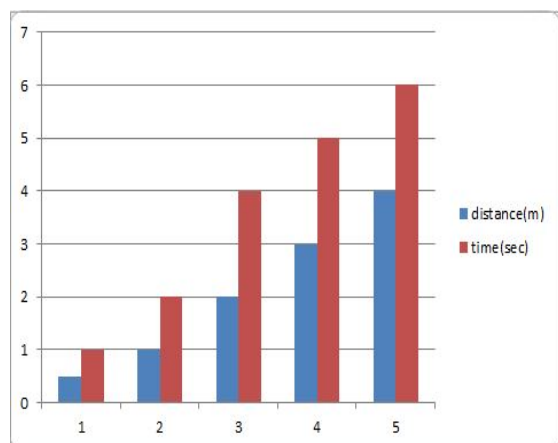

Figure-5: Graph showing relationship

6. LITERATURE REVIEW

Vidanapathirana et.al states that the major capability of the „HospiX" android application is finding location or providing navigation directions to the users while they are at hospital premises. HospiX application has a limitation of not able to use it in IOS platform since it is implemented only for Android users [1].

Divya Tomar and Sonali Agarwal states that Data Mining is becoming popular in healthcare field because there is a need of efficient analytical methodology for detecting unknown and valuable information in health data. In making efficient healthcare policies, constructing drug recommendation systems, developing health profiles of individuals, detecting frauds in health insurance, detecting causes of diseases and identifying medical treatment methods data mining techniques can be very useful. Concerning about that, the use of Data Mining techniques provides benefit to the implemented mobile application "Offering Offers" by providing accurate suggestions to the selected item [2].

Pavel Kriz, FilipMaly, and Tomas Kozel states that for the outdoor roaming GPS system provides efficiency to the people to reach at their positions while for the indoor localization people face problems to find ways, so, the methods are provided to improve indoor localization to find the way fast and easier in a crowded place using low energy beacon technology [3].

Ravi Ramakrishnan, Loveleen Gaur, Gurinder Singh states that Inventory Management is a key area for customer service and cost optimization in any manufacturing setup. As companies turn global and have thousands of components and hundreds of warehouses the inventory becomes a nightmare and a lot of time is spend in tracking inventory and ensuring right shipments. This paper technically suggests an approach of managing inventory using low energy blue tooth beacons and also does a statistical case research on two groups of the same organization one before the pilot run where traditional barcode scanners are used to track inventory and other one where the pilot trial BLE beacon technology was used [4].

Marisa moody states that into the forward-thinking opportunities presented by location-based marketing technologies. Through a quantitative research survey and a review of literature on existing applications and concerns, she explored how marketers can make the most of beacon-based communication strategies. Overall, this study found that if brands are vary of consumer hesitation and keep consumer benefits top of mind, strategic and creative location-based implementation has great potential to increase brand relevancy in the digital age [5].

In the paper named Beacon-based tourist information system to identify visiting trends of tourists, research team proposed a system that provides tourist information and obtains trends of visiting tourists using beacons and cloud service. A low energy Bluetooth device is used as a

beacon to transmit a universally unique identifier. Beacons are placed at sightseeing spots and tourist facilities. Our proposed system comprises two application programs; one is a client-side application program that provides area-specific tourist information corresponding to the detected beacon. The other is a server-side application to record time and location information of the detected beacons. In this paper, we describe the scheme of our system, and present the results of experiments conducted using the prototype system in the local tourist area. In addition, we discuss an open platform for information collection services using beacons [6].

Ankit .S. Barapatre, Vishal .A. Shelake, Gurudev .Y. Pawar, D.R.Anekar in their paper states that the traditional

systems does marking of attendance, handling lectures by paper signing pattern which disturbs the concentration of students but on research, proposedidea does task like automated marking attendance by use of BLE (Bluetooth Low Energy) beacons and the involves usage of automated tools like Selenium which will be reducing the paper work and error like proxy, missing attendance. The system also gives the idea about many events and programs by advertising their details and providing details of examinations in the college campus on reaching the place so system alerts the students if the lecture starts and they are outside the classroom. For making better decisions and keeping eye on everyone and to save students time and reduce their disturbance in lectures [7].

Tiantian Han and Lei Ding stated that this paper designs a kind of payment method based on Bluetooth beacon. Through the Bluetooth beacon broadcast consumption, consumers only need to open the relevant APP in the Android client, and you can get Bluetooth via mobile phone Bluetooth the amount of consumption of the standard broadcast, in accordance with the corresponding payment platform to complete the payment process, which pay less time to improve the efficiency of payment [8].

In the paper, "Pick My Dress" the application provided accurate navigations inside the shopping store with the aid of Beacons and Beacon Stickers which provides directions to relevant dresses which customer prefers most which remains crowded 24x7 [9]

7. CONCLUSIONS

Using "Performance analysis of fingerprinting method of navigation using beacon based offers offering tool", I concluded that with the help of one beacon with more distance more message notification are passed and based on that navigating to next beacon and with more distance less message notification are passed. Thus, with fingerprinting one beacon is allotted to specific area while with triangulation method more range and area can

be covered as there are beacons arranged in triangular manner to navigate from one to another. Hence, navigation and offering offers can work well with triangulation method as more number of beacons are arranged at specific area then fingerprinting method which can be concluded from graph readings and practically performed.

8. FUTURE WORK

- In this research work time, distance and range are taken into consideration; there are many other parameters that can be considered such as number of obstacles, frequency etc.
- This research is carried out by short range beacon, also long range beacon and its extra features can work out here.
- One method of navigation that is fingerprinting is discussed and results are shown while other navigation methods can also be taken while considering notification tool.
- It can also be applied on IOS platform. Here, research is performed in android platform.

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