Bluetooth Low Energy Communication using IBEACON Chip

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Abstract— In this paper we are aiming to work with the Bluetooth Low Energy technology for accurate indoor localization. The use of BLE requires devices that are Bluetooth 4.0 enabled. For Smartphone, health devices. Bluetooth Low Energy technology can be implemented in accessories like watches, and thus data transmission can be made possible to BLE enabled devices such as Smartphone and tablets. In this paper, mobile devices are made to interact with beacon chip using BLE at locations such as restaurant, airport and retail shop. When the beacon chip receives a signal from BLE enabled device, it sends a message to the consumers mobile. The exchange s initiated by beacon; the mobile device collects content for the beacon that initiated the exchange. Any messages that can be sent to a BLE enabled device are stored and can be changed in real time.

Key words: IBEACON Chip, Bluetooth Low Energy Communication

I. INTRODUCTION

Bluetooth Low Energy is a wireless network technology used for transmitting the data's in short distances. The principles are pretty easy. The Beacon chip contains an ARM microcontroller, combined with a Bluetooth Smart connectivity module, and a battery. The BLE differs from normal Bluetooth devices in following categories, 1. Power Consumption: Bluetooth Low Energy has required low energy compared to others.2. It is a low Cost device. BLE is 60-80% cheaper compare to traditional Bluetooth and small in size.3. Application: Highly compatible, hence used in applications requiring small amount of data transfer. For applications requiring more data throughput, classic Bluetooth technology is used. But it is highly costlier when compared to BLE.

II. LITERATURE SURVEY

A. An analysis of the Accuracy of Bluetooth Low Energy for Indoor Positioning Applications

According to this paper, it provides a comparison of Wi-Fi and Blue Low Energy fingerprinting with representative hardware in a large indoor space with a highly-accurate (3 cm in 3D at 95% confidence) ultrasonic ground truth referencing system.

B. Analysis of the influence of radio beacon placement on the accuracy of indoor positioning system

This paper explains parameters that can be very useful to describe the quality of localization of radio landmarks. It presents software for computer aided reference radio stations placement inside the buildings and it shows the results of exemplary simulations carried out with the use of some algorithms. It discuss the factors that are influencing the accurate indoor localization environment.

C. A location-based smart application applied to cultural heritage environments

In that paper, exploiting the indoor location based technologies and services in order to utilize a smart multimedia system. That system is able to detect the closest artworks to a user, make these artworks able to tweet and talk during users visit and capable of automatically telling their details using multimedia facilities.

III. BEACON FUNCTIONALITIES

The BLE advertising packet consists of four main pieces of information.

A. UUID

It is a 16 byte string which is used to bring out the differences between a large group of related beacons. For a illustration, if the Dairy product keeping a network of group of beacons in a chain of dealer stores, for all Dairy product beacons would share the same UUID. It allows Dairy's product intimated Smartphone app to know which beacon advertisements come from Dairy product owned beacons.

B. Major

It is a 2 byte string used to differentiate a smaller subdivision of beacons between the larger group. For illustration, if the Dairy product had four beacons in a particular grocery store, all four would have the same Major. This allows Dairy product to knows the exactly place where the store its customer is in.

C. Minor

It is a 2 byte string meant to identify separate beacons. Keeping with the Dairy product illustration, a beacon at the front of the dealer store would have its own unique ID Minor and Major value. This allows Dairy product's dedicated application to know exactly place where the customer is in the store.

D. TX Power

This is used to find out nearness (distance) from the beacon. TX power is defined as the strength of the signal exactly one meter from the Smartphone device. This has to be calibrated and hardcoded in advance. Then the devices can use this as a baseline to give a rough distance for estimation.

IV. BASICS

The Beacon service is a BLE Service that operates in advertising mode only. A Beacon service advertises 4 things:
1) The company ID
2) Unique UUID (It is unique ID to a retailer)
3) Major number (It means a store number)
4) Minor number (It means location in the store)
5) Signal Strength at transmitter (It requires strength of character per each device)

These small pieces of information are all we need for a iBeacon service to work. The most of the heavy lifting is completed by the smart phone application which are reads these four main fields and then uses a web application or a database of some other to turn these numbers into valuable messages about what is near to us and how near we are to it. That signal strength field is compared to the actual signal strength at the receiver to determine that how close the beacon is to the phone. The number is used the strength of character signal strength one meter from the device for checking signal strength. By doing this one meter increments can be used to measure distance from the Beacon. The distances usually get broken down into 3 ranges:

- Immediate range: It ranges is within a few centimeters.
- Near ranges: It ranges between a couple of meters.
- Far ranges: It ranges are Greater than 10 meters.

V. BLE COMMUNICATION WORK

BLE communication primarily consists of "Advertisements", or small packets of data, broadcast at a regular interval by Beacons chip or other BLE enabled devices via radio waves. A Bluetooth low energy device can operate in four different roles. Depending on the role, the devices behave differently. Bluetooth Low Energy signals are a one-way communication method. Beacon chips are that want to be "discovered" can broadcast, or "Advertise" self-contained packets of data in set of intervals. Those packets or data's are meant to be collected by devices like Smartphone and tablet, where they can be used for a variety of Smartphone applications that may be android OS or iOS to trigger things like push messages, app actions, and acting without delay. The iBeacon standard calls for an optimal broadcast interval of 100ms. The broadcasting is more frequently uses and more battery life but it allows for quicker discovery by Smartphone and other smart devices. The standard Bluetooth Low Energy has the broadcast ranges from 10 to 100 meters, which makes the perfect model beacon for accurate indoor location tracking and informed of the localization. For enclosed spaces with thick walls, such as those in museums, using GPS is problematic. The GPS receiver relies on unceasing signal transmission from several satellite sources. So the physical obstructions such as thick walls can cause significant signal interference. Beacons, although a relative newcomer to the location-technology space, have proven themselves to be a seamless and robust solution for large indoor spaces.
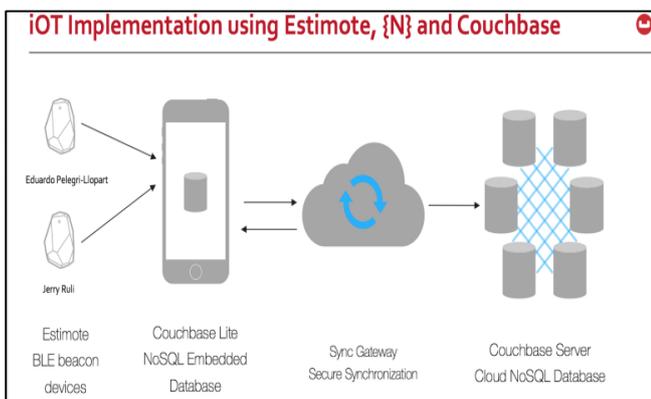
VI. ARCHITECTURE

Fig. 1: IoT implementation using Estimote

The static indoor positioning algorithm and a nonlinear filter were used for evaluation of user localization. The distances of the data sets are most similar to the input are selected.

As a unfinished bring nearest of fingerprint spatial variability in the site radio map. The interpolated map of maximum values recorded by reference points value. In the experiment field sampling density varies from 0.7 reference points value per square meter in museum halls to one point each four square meters in the courtyard.

VII. BEACON BATTERY LIFE AND TEMPERATURE

The most and important advantages of beacons is supposedly their fairly long time battery life and it may be up to two years. The temperature changes it seem to have a intimation produce on the battery life. For example, moving the beacons from the "ideal" temperature environment at the Media Lab to a considerably colder and less predictable lecture-hall space adversely impacted their battery life. Moreover, some beacons in the Estimote developer kit arrived only partially charged, a problem that was mentioned in a number of blogs across the web. Keeping in mind the relationship between the beacon's battery performance and the temperature will be important when choosing appropriate venues for future presentations, or when considering the placements within the gallery space. It will also be interesting to compare Estimote's battery performance to that of its competitors such as Gimbals. Increasing a beacon's broadcasting power and advertising potential may also adversely affect the battery life. In a favorable temperature environment (like the Media Lab), changing advertising potential or broadcasting power did not seem to have any sizable effect on the battery life. However, when beacons were moved to a lower-temperature environment, the battery power of the sample with a high advertising interval was noticeably depleted over a period of several days.
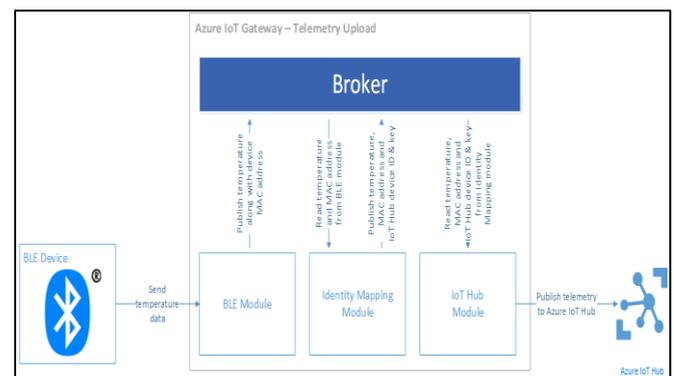
VIII. PLACEMENT AND HUMAN TRAFFIC

Fig. 2: Observation at point (since not enough evidence has been collected), having a group of people between the beacon and the BLE smart device

Although just an observation at this point (since not enough evidence has been collected), having a group of people between the beacon and the BLE smart device may interfere with the broadcasting of the beacon set to an immediate or near regimes. The application may be either start showing another beacon chip set to a far or nearness range or start switching back and forth between beacon chips in the near mode of rule that are in the area.

IX. SOFTWARE DESIGN

ARM mbed OS is a platform which are used in operating system for the internet of things. There are three ways to get started with mbed OS. The most important easiest and quickest way is to use mbed OS platform in online Compiler. Another possible option is there that we can use command-line interface (mbed CLI) for a third party development environment for it.

X. DEVELOPMENT TOOLS

The offline development tool is the mbed CLI, a command-line tool. This development requires a tool chain installed on our computer.

The mbed Online Compiler write and build the applications using just a web browser which means URL and USB connection.

If we're working with third party tools which means unauthorized party, look at send to another instructions for the most famous ones. This is communicating and monitoring the board.

XI. CONCLUSION

As mobile technology is developing, the dividing line between the physical and the digital user. This experience is rapidly vanish from sight. The visitors who enter the enclosed public spaces such as galleries, malls, airports, retail shops, railway stations and museums are expecting to receive a mobile experience that is highly relevant, convenient, and delivered in a timely and seamless manner. The beacon dependent application and the beacon are to communicate properly, it is important to establish the optimal points for the beacon's broadcasting power (TX Power) and their advertising interval. The broadcasting power is most necessary for this. Because it collect each different beacon's recognizing information and add it to the application of the Smartphone or tablet.

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