BEACON CONTROLLED CAMPUS SURVEILLANCE

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***Abstract*—In Academic institutions, Handling administrative tasks and interaction with the student is an arduous task. By proximity analysis of Bluetooth beacons, Developed tool will provide a real-time surveillance of an institution which will automate the administrative operations with establishing working discipline and it can also send Web page links and notifications in order to communicate with students.**

***Keywords*—Bluetooth Beacons, Eddystone, Indoor positioning, Bluetooth low energy, iBeacon**

I. Introduction

In the case of location based applications[1] which depends on exact physical location of a user has been on increase. The Global Positioning system is widely used in location specific applications. Since the Global Positioning system (GPS) is associated with the satellite based technology of positioning, the GPS signals fails to work in an indoors area as signals are attenuated due to indoor obstacle like walls. Researcher are developing GPS repeaters in order to increase GPS signals strength in indoors but the cost of these devices would be very higher compared to the use of Bluetooth technology since Bluetooth is available in every Smartphone as well as in televisions. Since the availability of Bluetooth low energy in Smartphone, concept of indoor proximity sensing has been developed which uses the wifi or Bluetooth signals for the positioning of users indoors. Later, Nokia introduced the Bluetooth low energy concept which has replaced wifi signals completely for indoor positioning system. Most of the systems in Internet of things are now based and working on the BLE technology, as it requires a very small amount of power.

The extent of complexity in our daily lives has raised the need for augmented reality in many mundane tasks. The information provided by augmented reality devices has proven in increasing efficiency and making the task easier. Indoor positioning is also one of the location-based applications of augmented reality one of which ameliorate many daily troubles with the use of Beacon technology.

In our proposed system, we have tried to automate the management system of our college campus by using beacons. This system also can applicable on other different scenario of management system like in a company office, in a mall etc. A lot of automated systems of college campus based on Bluetooth technology is already have been proposed by others but most of them are not successful as they need a connection before using which limits the automation. But we have utilized the application of iBeacon technology, apple and Eddystone technology of google. In our proposed system, tracking of each and every student will be executed inside the college campus by using fixed beacons and this location information will be used to automate the management work. Teachers will be able to send text notifications to students to communicate and they can also share WebPages links with students which can keep assignments or any other important document. In our proposed system, Student does not need to create any connection and it will be completely automated without any interruption.

We have explained the working of our proposed system in the rest of paper. The rest of paper has been divided into sections. Section II describes Literature review, III describes System architecture, IV describes Implementation of a system and finally section V is describing the Conclusion and future work related to the proposed system.

II. literature review

A lot of technologies have been developing in the recent years in augmented reality. Indoor navigation has been a major concern. Mobile devices companies using various communication Technologies which includes WiFi, Bluetooth, RFID sector, NFC to develop indoors applications. WiFi has been a major running Technologies since the easy availability of WiFi access points inside institution campus is very common. In 2000 Microsoft implemented indoor positioning system and developed a RADAR positioning System which works on fingerprinting in WLAN approach[2]. Similarly, a new project COMPASS was developed which wanted to get better accuracy by using the orientation data of a device[3]. In 2006 Nokia introduced the Wibree project but Wibree could not get available to masses, Nokia transferred its low power technology to Bluetooth Special Interest Group(BSIG), which was named as Bluetooth low energy.[4] In 2010 DKTOB, was the first Australian company who built the seeknFind attendance solution which used the Bluetooth technology with fingerprinting. To implement the indoor positioning wifi and Bluetooth both are widely used. For the positioning of a mobile device in campus, main criteria are energy consumption to choose in between wifi and Bluetooth. Bluetooth 4.0 or bluetooth low energy requires very less energy whereas wifi needs more.

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A. Bluetooth low energy

Bluetooth low energy is similar to classical Bluetooth as they share the same digital spectrum and modulation technique as well as the bit rate the only difference is the physical layer spacing which is 2 megahertz in classical Bluetooth one megahertz in Bluetooth low energy . As the name implied, Bluetooth low energy used for low power consumption and Bluetooth low energy devices are much cheaper than classic Bluetooth devices.[5]

1) BLE advertisement Service: Bluetooth Low energy has two possible way of communication. As a broadcaster,a BLE peripheral device broadcasts fixed length advertisement packets continuously. The receiver can act on received advertisement information or it can connect to the peripheral device to get more information. The other possible way of communication is by receive packets after creating a connection, where both the peripheral and receiver send data packets to each other. A Number of channels in Bluetooth low energy are 40 but in the classic Bluetooth, Number of channels were 79. the peripheral device will use channels 37,38 and 39 to send advertisement packet and rest of the channels are used for data transmission[6]. channel number 37 and 39 are the first and last channels in the spectrum, while 38 is in the middle of it. When BLE peripheral device works in advertising mode it sends advertisement packets periodically on all three channels. It is optional to use all channels to broadcast. To reduce the power consumption channels can also be blocked to broadcast advertisement packets. These advertisement packets are used for ranging of beacons on the basis of received signal strength and tx or transmission power of a beacon. Tx power is a constant value for a specific beacon. This ranging will decide how far the receiver and broadcast are and what will be the proximity which is based on distance.

B. Ibeacon

IBeacon is a standard protocol by Apple for Bluetooth low energy peripherals devices which use advertisement service exclusively without any connections. So Basically Ibeacon is a Bluetooth peripheral device which works on a standard packet format. With this Technology standard, a beacon can send data to mobile devices which are in the close proximity of that beacon. IBeacon uses Bluetooth low energy proximity sensing technique to send Universal unique identifier (UID) with the use of Ibeacon API implemented in the vendor application code . The device collects information from the beacon which can be used to track or can be used in order to send data to the device. Distance calculation of device from the beacon in Ibeacon standards are different from some of the other Beacon standards as it works in a simplex mode which is one-way transmission to the receiving end. This is done in order to ensure that only device with beacon vendor application is sharing the indoor location. IBeacon transmitter can work on the single coin-size device and these types of IBeacon can work up to 2-3 year. Ibeacon standard uses three type of values UUID, Minor, Major in advertisement packet to provide the identifying information from the beacon.[7]

UUID :- 16 bytes and developer needs to define a UUID specific to their app
Major :- 2 bytes and it defines a region of beacon devices.
Minor :- 2 bytes and it defines a sub divided region into a specific region

C. Eddystone

Eddystone is a low energy protocol developed by Google .Eddystone supports both Android, IOS smartphones. Eddystone is an open source protocol. Eddystone is also a standard protocol like Ibeacon to standardize the Advertisement packet. But Eddystone has been implemented by google to support four data packet types Eddystone-UID, Eddystone-URL,Eddystone-TLM, Eddystone EID. Eddystone-UID consists identifier for the beacon in the data packet. Eddystone URL only keeps the only URL in a complete data packet. And the size of URL defines the size of data packet. Eddystone-TLM supports fleet management through which a packet gives the health information of the beacon like Battery life.This operation can be completed in parallel with a process of Eddystone-URL or Eddystone-UID. Eddystone EID was implemented with the focus on security issues. It can protect packet from hijacking and spoofing. [8]

III. System Architecture

In this, a part architecture of our system will be explained. Campus Surveillance system is a combination of hardware and software. In the hardware system, completed infrastructure has been built by broadcasting beacons whereas its software system has been built on an android platform. Android device of students will be used to track the proximity location of a student on the campus and on the basis of this location information, students attendances record will get updated automatically. With an update of attendance records, these

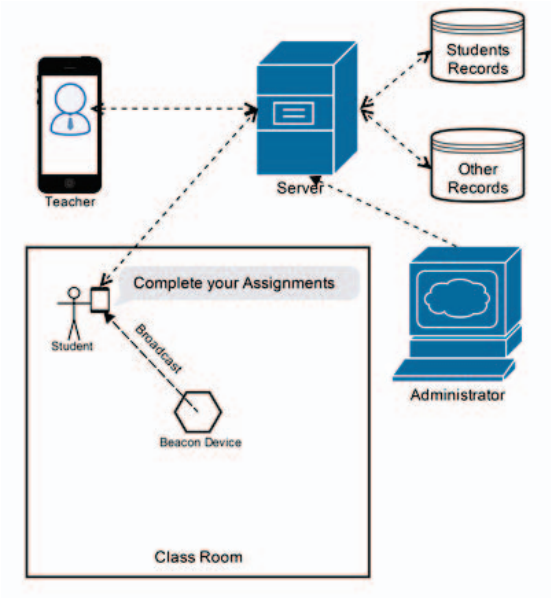

Figure 1. System Architecture

broadcasting beacons can broadcast the text notifications as well as assignment links as their advertisement packets which will be received in the android device of students.

To explain the scenario, a complete system architecture is explained in figure (1). This figure is giving an explanation of working in a single class. One Beacon device is placed in the class room which will be used to track the students.[9] This beacon device will already be setup to broadcast the advertisements packets continuously along with a specific time interval. The complete campus will be connected by multiple beacon system. To identify the beacon device from all beacon devices, it will use the IBeacon protocol to broadcast the signals which are already explained in the previous part. For this protocol, every beacon will get a specific major id and minor id. Major Id will identify the association of beacon with a specific department building and minor id will decide the association of beacon with a specifically addressed location of the institution.

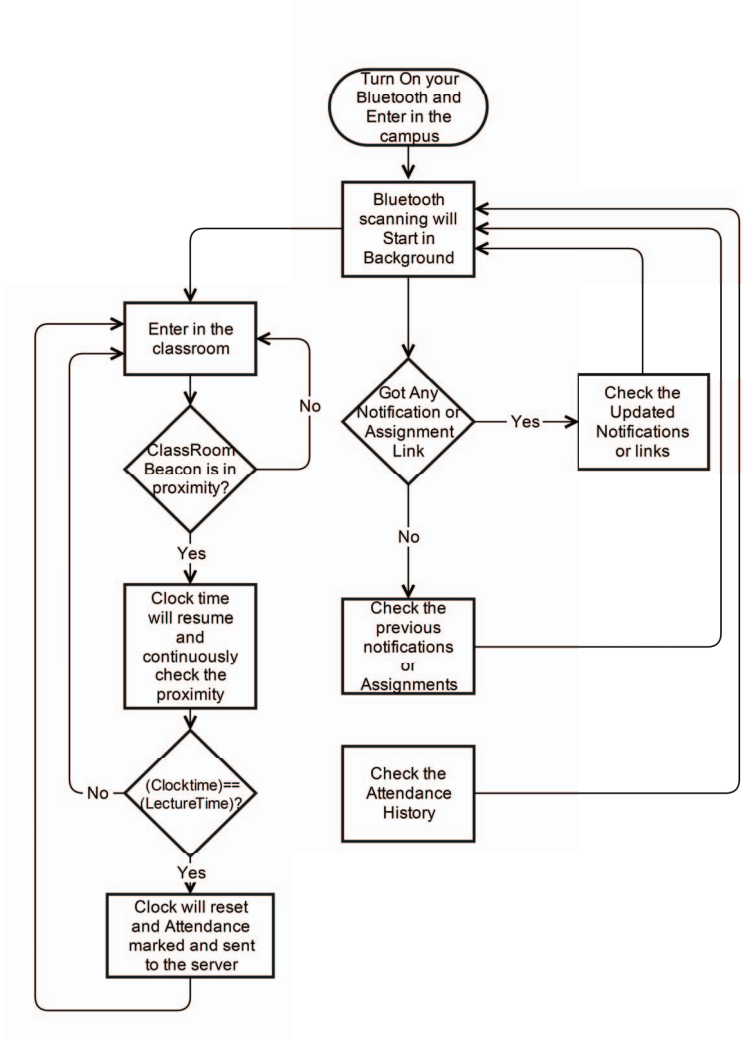

Figure 2. Flowchart of student Application

Whenever the student enters in the campus building, a student needs to turn on the Bluetooth, so the Bluetooth

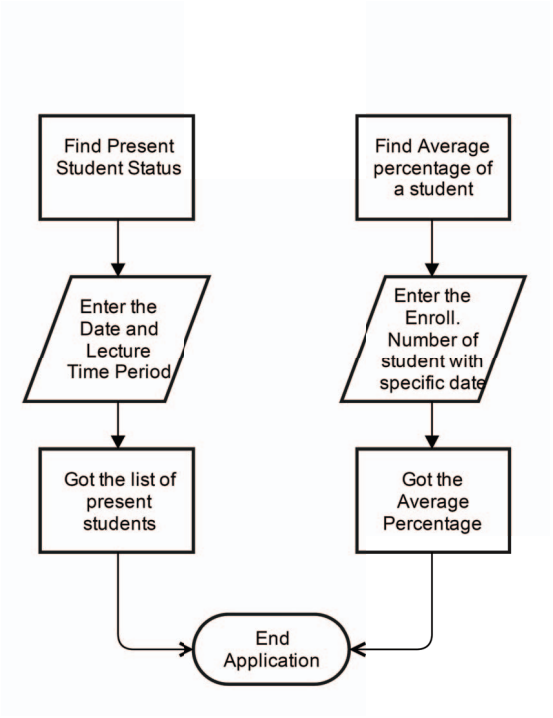

Figure 3. Flowchart of Teacher Application

low energy scanning for broadcasting beacons will run in the background. To make this energy efficient, scanning will work with a specific time interval and this timing interval should be less than the broadcasting time interval of a beacon. So it could detect the beacon always. When the student will enter in the classroom, Bluetooth Low energy scanner will detect the Class Beacon and then a clock time will start in the background automatically. It will check the proximity of class beacon continuously. In the case of ”near” or ”immediate” proximity, Local clock-time will increase continuously with time but if the student leaves the classroom, proximity will become far or it will not detect the beacon, at that time clock time will get stopped. When the clock time will be equal to the lecture time period, attendance will be sent to the server and server will update the attendance in the database. Lecture timing is a static element so it will be stored in the local database so it could fetch easily. These attendance records will be stored in the local database as well as at the server. Local database will be used to show the attendance status to the student but a student would not be able to edit the data. This data will only be available for read only purpose. Now if the teacher wants to share an assignment with all students available in the class, So Beacon could be used by a teacher to broadcast the assignment links to all present students in the class and beacon will broadcast the assignment link with using the google-edystone protocol which is already explained in the previous section. If any staff member wants to give notifications messages or any short information they can use the UUID part of the IBeacon protocol and this will receive by the android application. These text notifications and messages

will receive as a notification element, so it could be noticed by the student easily.

Now the teacher will use the application to fetch the information from the records to find the status of students present in the class and to find the average percentage of a student. To access the present student in the class, teacher needs to enter the date and class timings. When the teacher needs to access the average percentage, a teacher needs to enter the enrolled number of the student.

IV. IMPLEMENTATION

In this part implementation of system has been explained. To implement the system in real world environment, a prototype has been built by considering a single class out of all classes in the college campus. To implement the system, one beacon has been placed on the geometrical center pointer of the class which will broadcast the packets. To show the complete system working, android apps for student got installed inside student devices and the second app will be used by the teacher to find the attendance records and status from the server.

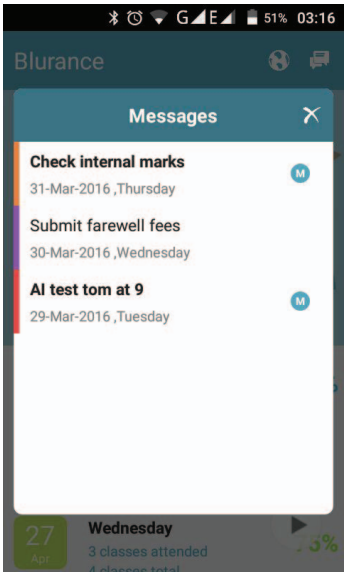

Figure 5. Text Notifications on App

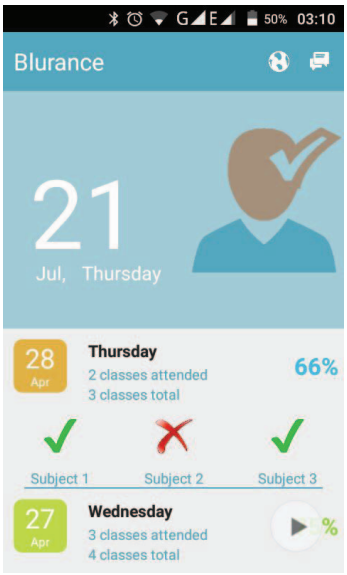

Figure 4. Timeline of student application

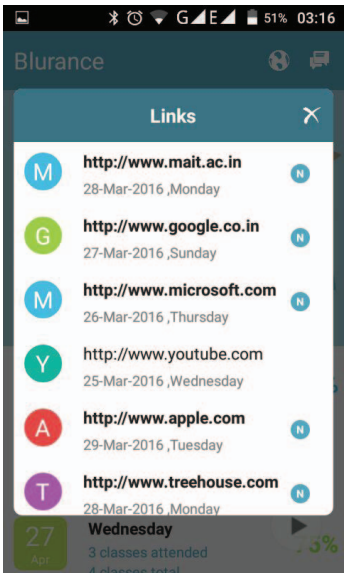

Figure 6. Links received from Beacon

Figure (4) is showing the working off student app, which is showing the attendance according to the lecture timing with their average percentage. These attendances will be sent to the database on the server. The database was implemented by using php with mysql. On the Top right side corner, two buttons are used, one button is used for all the received text notifications from the beacon and the other button is used for assignment link box.

V. CONCLUSION

Most of today's mobile social applications use absolute location to locate nearby peers, which is often difficult to obtain with reasonable accuracy in indoor environments. In this paper, we have described a Campus Surveillance System which utilizes the relative locations of different students. Based on locations data, each and every student gets tracked and attendance of student has been marked automatically. This system is also sending assignments links and small text notifications to students.

VI. FUTURE WORK

A key area of future work is to use distance and proximity from the beacon, to build applications that automatically infer of the social context of such interactions. The application could monitor and analyze the interactions and provide a strategy to improve the effectiveness of studies. It would enable the faculty to know the attendance of each student, provide automated assignments, analyze the attendance history, and lots more.

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