Indoor Location Based Services using Bluetooth Low Energy

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Abstract: **The scale at which events are held is ever increasing. The difficulties in managing such events increase proportionately with the size of the events. The factor which is common among all these events is the unfamiliarity with the environment and lack of relevant information at the right time. This paper describes an event management system that overcomes the above mentioned drawbacks by providing context aware location based services to the users. The system uses Bluetooth Low Energy (BLE) based beacons, an android mobile app and a web server to provide the right information, to the right person at the right time. The proposed system aims to provide an interactive and engaging experience to the users as well as facilitate ease of event management.**

Keywords: **Bluetooth Low Energy (BLE), Location Based Services (LBS), Web Services.**

I. INTRODUCTION

Traditionally location based services are provided using GPS. However, GPS cannot be used indoor due to signal attenuation and lack of precision. Bluetooth Low Energy(BLE) overcomes these drawbacks by providing high accuracy local-ization in indoor environment as well as substantially reduces the battery drain. In BLE location system, beacons function as signal transmitters that are majorly battery-powered and can be configured with the help of a mobile app. This makes them scalable and highly portable.

Keeping in mind the huge scale at which the events are taking place we propose a system which provides context aware services using BLE beacons. The architecture comprises of Transmitter (Beacons), Receiver (Android mobile app) and Server. The signal transmitted by beacons is intercepted by application installed on the users Bluetooth enabled phone. The mapping of the signal data and its corresponding message is retrieved from the Server.

The system delivers an interactive, engaging and chaos free experience to the users. Also it facilitates the organizers to conduct the event in a smooth manner by providing following features such as configuring Beacons from Remote Location, providing context based Information for the user, automation of manual processes, engaging users with updates of the event, notifications regarding dynamic decisions made during the event, enhancing communication between organizers and participants, providing proximity based reminders, flexibility to accommodate event of your choice and publicize the event using social media.

Thus the proposed system aims at engaging the participants and keeping them updated. It not only provides context aware services to the participants of the events but also reduces the efforts of the organizers by making them automated.

II. MOTIVATION

An event management scenario encompasses a huge crowd and the organizers need an effective system to address such a huge crowd. Starting from the registration itself the organizers need to deal with long queue which involves lot of manual work. The people attending the event are unaware about the nearby happenings as well as the dynamic changes such as modification in schedules. On the organizers front as well it is difficult to convey these dynamic changes quickly. Also it is difficult to maintain consistent data using traditional paperwork and involves substantial amount of human resources thus incurring a higher cost.

These problems can be addressed by providing location based services. GPS however does not fit in the above men-tioned scenario as it fails to deliver precise and personalized indoor location based services. Few of the technologies used to provide indoor LBS are QR codes and NFCs. These technologies are incapable of attending to multiple users simultaneously. BLE beacons on the other hand, being short range transmitters notify all the mobile devices when they come within the range. Beacons are energy efficient devices.

III.   SYSTEM ARCHITECTURE OF PROPOSED EVENT MANAGEMENT SYSTEM

The proposed system provides context aware services with the help of beacons.

Fig 1 shows the overall architecture of the proposed system. It mainly comprises of 2 components:-

1) Beacon:

Beacons are short range transmitters which broadcast data packets at regular intervals of time using Bluetooth Low Energy. These data packets are in Eddystone format (Eddystone UID and URL). The Eddystone-UID frame broadcasts an opaque, unique 16-byte Beacon ID composed of a 10-byte namespace and a 6-byte instance. The namespace portion of the ID may be used to group a particular set of beacons, while the instance ID identifies individual devices in the group.
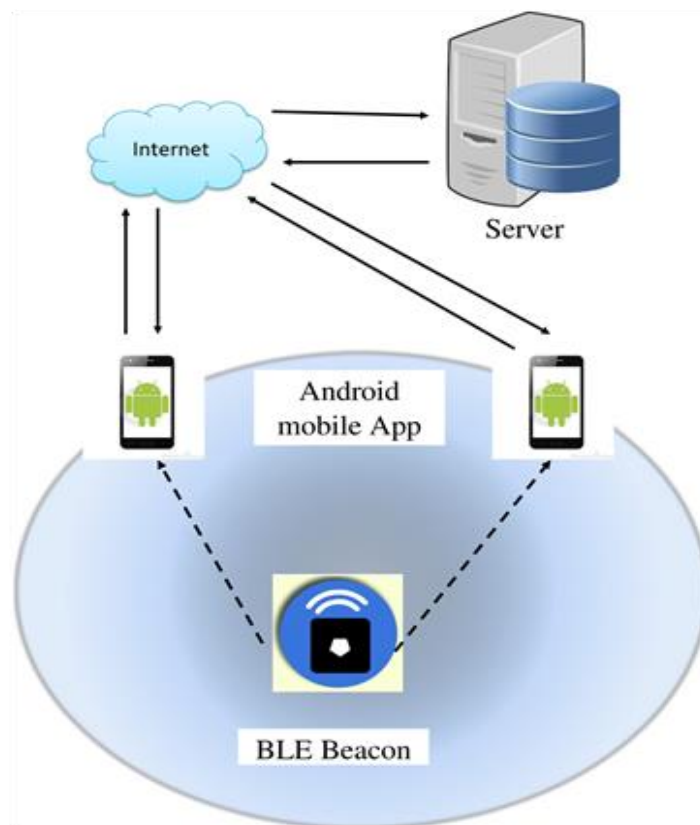
Fig. 1. System Architecture

The Eddystone-URL frame broadcasts a URL using a compressed encoding format in order to fit more within the limited advertisement packet [2]. Since beacons use BLE they consume less power. Low power consumption in beacons is achieved by keeping the transmission time as short as possible allowing the device to go into sleep mode between transmissions [1]. Hence these beacons work on coin sized batteries which are inexpensive.

2) Android Mobile Application:

The mobile application scans for nearby beacons in the background. It extracts the namespace ID and instance ID from the intercepted beacon. This instance ID is sent to the server. The server maintains a mapping of the instance ID and its corresponding message in its database. This message is sent to the app in the form of a notification.

IV. IMPLEMENTATION

The tools used in developing the system are Android Studio, Eclipse WTP, Apache Tomcat 7.0.67. Consider an inter-college technical event taking place in an educational institute. Various competitions are held during the event such as project exhibition, Hackathons, RoboWars, Quiz, Gaming etc. Most of the participants who come to the event are unfamiliar with the college campus and unaware about the other competitions taking place on the campus. Fig. 2 shows the deployment example of beacons in the above mentioned scenario. A number of beacons are deployed throughout the campus at key places such as the entrance, on each floor, near various competition arenas.
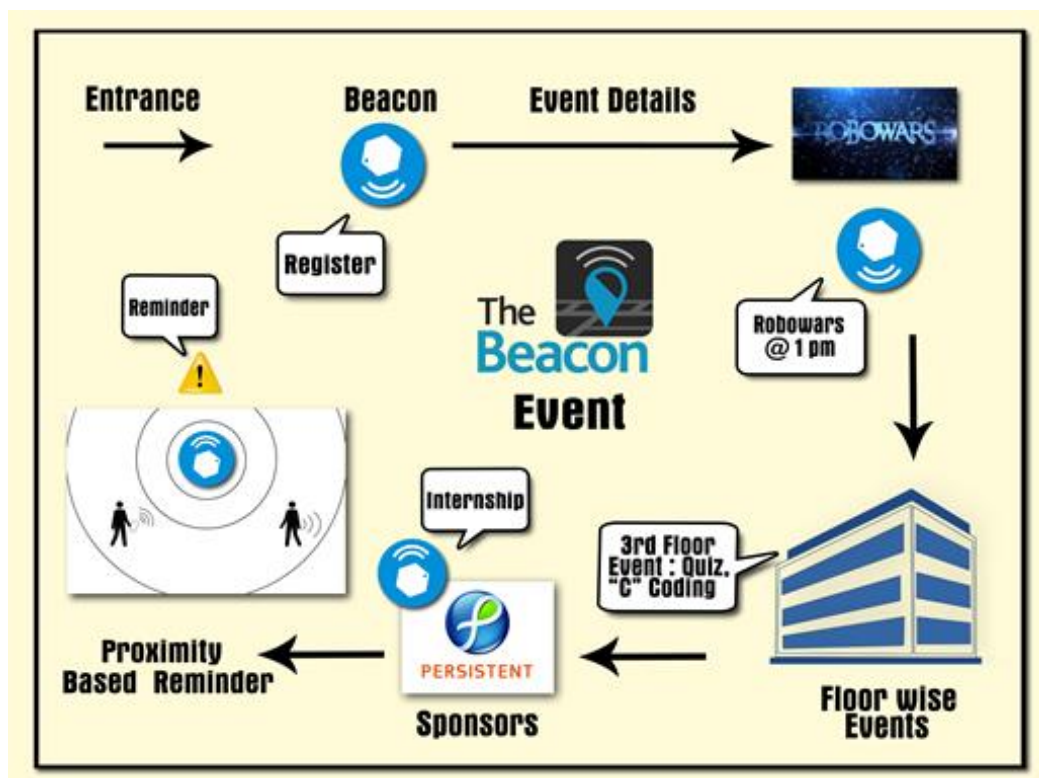

Fig. 2. Deployment Design

The first task the user does when he enters the campus is look for a reporting desk to check in. The volunteers at the reporting desk make an entry of the participant against the receipt ID and direct the participant to the allocated room where the event will take place. This manual process can be automated using a beacon kept at the reporting desk. When the mobile app of the participant intercepts this registration beacon, he can directly enter his receipt ID and check in. A single beacon is able to address all the participants within the range of the beacon and hence avoiding long queues. The participant can then view details regarding the competitions for which he checked in such as the schedules i.e. the duration of the competition, lunch timings.

As the participant explores the campus he receives notification about the nearby events such as RoboWars. The beacons can also be deployed floor-wise to inform the participants about the events taking place at respective floors. The data transmitted by the beacons can be changed by administrator to inform the participants about the dynamic changes such as change in competition location.

Detailed information can be broadcasted by beacons in the form of URL. Sponsors of the event can use this feature to educate people at the event about their upcoming products and career opportunities at their firm.

Proximity based services can also be provided using beacons by configuring it as a reminder beacon. For example, when a participant exits the range of the reminder beacon he/she will receive a notification reminding him/her to collect certificates.

The user can also save the data received from beacon by adding it to favorites to review it later on. Participants can also share their event experience on social media and rate the app.
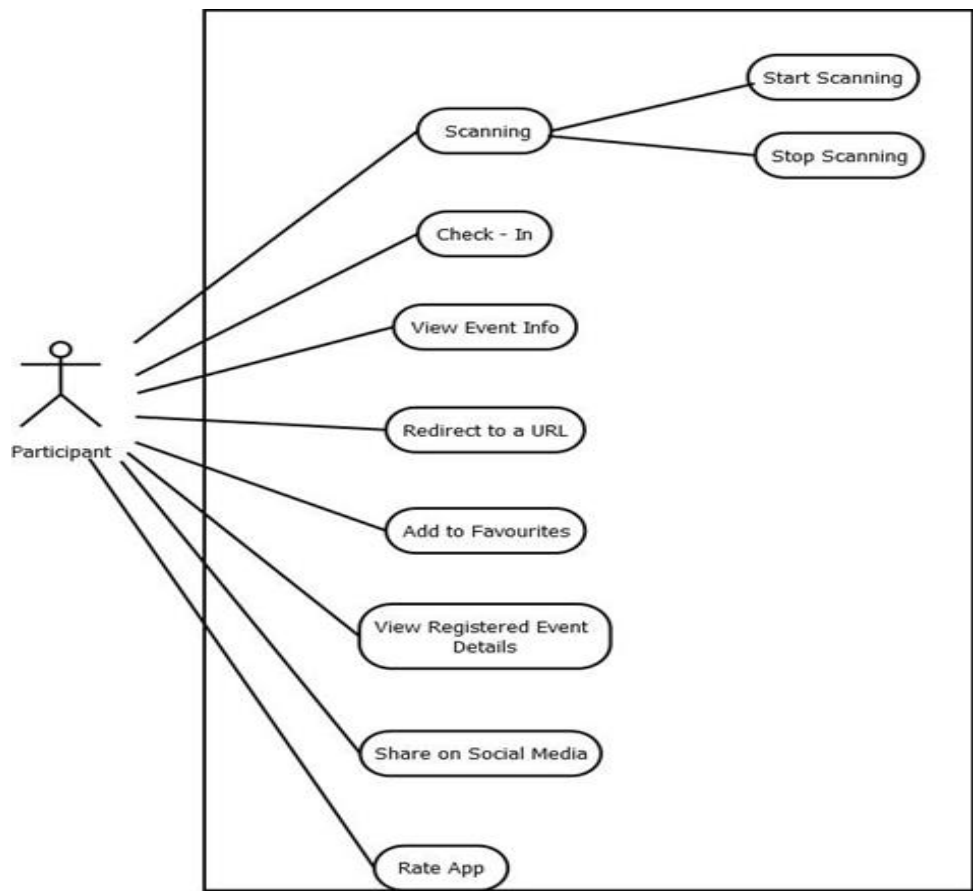
Fig. 3. Usecase Diagram: Participant

Fig.3 summarizes the functionalities provided to the participants.

In an unfamiliar place it may happen that we lose track of our friends. If the event is taking place on a huge campus the possibility of such an incident happening is high. Beacons can be used for tracking our lost friend. We can obtain the location at which our friend was last seen. But however this is Possible only when your friend has enabled tracking and accepted your request to access his/her location. Privacy being an utmost concern it is necessary for your friend to accept your request.
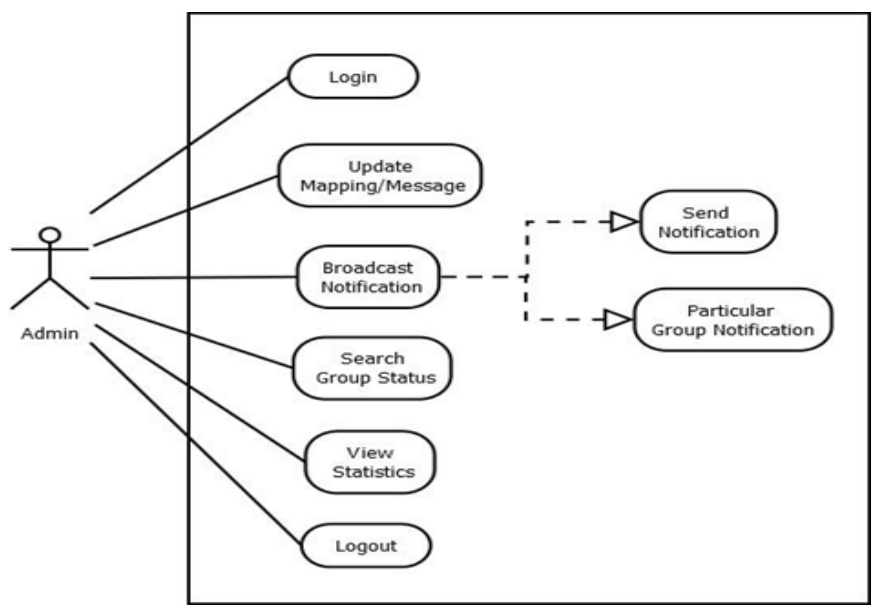
Fig. 4. Usecase Diagram : Administrator

Fig. 4 gives an overview of the administrator/organizer functionalities which are discussed further. In order to keep the users updated about the event the organizer can remotely change the data transmitted by beacons. They can communicate the requirements to the committee members by altering the data of remote beacon which is allocated to a particular committee room. They can also alter the data of beacons in their vicinity by scanning for nearby beacons.

Information and check-in status of participants can be searched by the organizers; this helps organizers to keep track of the participants on campus. Popular events on campus can be traced easily with the help of visual aids such as bar graphs. To enable organizers to communicate updates to participants not in the vicinity push notifications can be either broadcasted or sent to individual participants.

V.   CONCLUSION AND FUTURE SCOPE

Thus the proposed event management system uses BLE bea-cons and a mobile app to provide context aware information and enables automation of manual processes. The system facilitates availability of runtime data and enhances communication between organizers. Future work will consider better overall control over the deployed beacons, finding a location of a user and integration of an online payment system to allow cashless registrations.

REFERENCES

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