

Beacons at university campus, a mobile application to improve learning and bridge diversity

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Abstract—When people move into its quotidian, it is important to them to receive some customized place information. Nowadays it has been difficult to work in things like advertising, notifying, indicating, tracking and many other. The purpose of this project is to implement a solution that allows the sending of information (personalized notifications) to the user, when he approaches different campus locations, using BLE devices known as beacons. To achieve this, a mobile application was developed, that helps user to access and receive information, additionally a web application has been developed for the management operations and its related things. Taking advantage of Beacon technology, we develop an application to notify interest information to the user. We have collected the information of different types of beacons and analyzed them, which will help us while configuring and developing application which will meet the objective we intended. This project represents a groundbreaking initiative in leveraging mobile technology to bridge diversity gaps and promote inclusivity within university campuses. By facilitating meaningful connections, encouraging cultural exchange, and providing resources for understanding, this innovative mobile application seeks to create an environment where all members of the campus community feel valued, respected, and empowered.

Index Terms—beacons, learning, mobile, ble

I. INTRODUCTION

In today's increasingly interconnected and diverse world, fostering inclusivity and promoting cross-cultural understanding is of paramount importance. Universities, as hubs of knowledge and intellectual growth, have a unique opportunity to lead the way in promoting diversity and inclusion among their students, faculty, and staff. To harness this potential and create a truly inclusive campus environment, this project has been developed—a groundbreaking mobile application designed to bridge diversity gaps and facilitate meaningful connections.

This project aims to leverage the power of technology to bring together individuals from diverse backgrounds, cultures,

and perspectives. By harnessing the ubiquity of smartphones, this innovative mobile application will serve as a digital bridge, connecting people across the campus community who may have otherwise never had the chance to interact or understand each other's experiences.

As principal features we can denote the following:

- **Discovering diversity**, the mobile application will provide a platform for users to showcase and celebrate their cultural identities, beliefs, and experiences. Users will be able to create personalized profiles highlighting their interests, languages spoken, hobbies, and cultural heritage, creating a vibrant diversity within the university community.
- **Proximity-based connections**, the application will utilize beacon technology to facilitate real-time, location-based connections. By placing physical beacons at several points across the campus, users will receive notifications when they are in close proximity to someone who shares similar interests, backgrounds, or experiences.
- **Cultural events and workshops**, the application will serve as a hub for sharing information about cultural events, workshops, seminars, and celebrations taking place on campus. Users will receive personalized event recommendations based on their interests, enabling them to actively participate in and learn from various cultural experiences.
- **Language exchange**:, language learning is an essential component of understanding different cultures. The mobile application will offer a language exchange feature, allowing users to connect with others who are fluent in a language they wish to learn. Through virtual conversations, users can not only improve their language skills but also gain a deeper understanding of the associated culture and traditions.

II. MATERIALS AND METHODS

Beacons and learning analytics are two powerful technologies that, when combined, have the potential to revolutionize the educational landscape. Beacons, small Bluetooth devices that transmit signals to nearby devices, and learning analytics, the analysis of data generated from educational activities, offer unique opportunities to enhance student engagement, personalize instruction, and optimize learning environments.

By strategically deploying beacons in educational settings such as classrooms, libraries, or campus areas, we can capture valuable data about students interactions and behaviors. For instance, beacons can track student movement, attendance, and engagement with specific learning resources or physical spaces. This data, when combined with learning analytics, enables educators and administrators to gain deeper insights into students learning patterns, preferences, and challenges.

With the integration of learning analytics, the data collected from beacons can be analyzed and interpreted to inform decision-making and improve educational outcomes. By employing advanced algorithms and statistical models, learning analytics can identify trends, correlations, and patterns in student behavior and performance. This valuable information can help educators tailor instruction, adapt learning materials, and provide targeted interventions to meet individual student needs.

Beacons combined with learning analytics can also facilitate personalized learning experiences. By understanding how students interact with learning resources and spaces, educators can deliver content and activities tailored to each student's unique learning style and preferences. For example, if analytics reveal that a student thrives in collaborative environments, educators can create opportunities for group work or collaborative projects.

Furthermore, the insights gained from beacons and learning analytics can support the optimization of learning environments. By analyzing data on student movement and behavior within a physical space, educators and administrators can make informed decisions about classroom layout, resource allocation, and instructional design. This data-driven approach ensures that learning environments are conducive to student engagement, collaboration, and overall academic success.

It is important to note that the implementation of beacons and learning analytics must be carried out with careful consideration of privacy and ethical considerations. Student data should be handled with utmost care, ensuring compliance with relevant regulations and policies. Transparent communication and informed consent processes are essential to foster trust and maintain the integrity of the educational environment.

A. Framework

The main objective of our project is to develop and implement a solution that allows the sending of information through customized notifications to the user, when he approaches the different campus locations, namely canteen, library, classrooms, bar, etc., in a non-invasive way and without any user interaction, using beacon devices.

Our goal of the project is to reduce the user effort by the means of digitized technology and to guide or help one easily by providing them vital information of various location without requiring them to explore anything from internet.

Our project is based on beacon technology, and we develop a mobile application, to interact with different beacons which are present at different locations on the university campuses and show relative and customized information to the users.

Our application is intended to send the information through personalized notifications to the user, when he/she approaches the different campus locations, namely canteen, office, classrooms, bar, etc., in a non-invasive way and without any user interaction, using beacon devices developed on the different spaces.

This application is mainly helpful for all users (Teachers/Students) that move on the campus. This applications helps those users for the easier movements into our campus which is unfamiliar to them, through personalized notification about the classes, canteens and etc.

B. State of the Art

In the IoT market, there are several beacons available. Along with the variety of beacons, there are also various vendors who has a big role in making the beacon market competitive. They are competing for positioning their products in different applications in terms of lower prices, smaller sizes and longer battery life. Here, we have listed some of the notable vendors who have been in front foot in this process [1].

Above we list the diverse beacons manufacturers, we have created a table I that gives comparative analysis of the various manufacturers of beacons along with their features, costs, protocols etc.

III. RESULTS

This project has successfully demonstrated the potential of using mobile applications and beacon technology to improve learning experiences and bridge diversity within the university campus setting. By leveraging beacon technology, this project has provided a unique and innovative solution to enhance the educational journey of students from diverse backgrounds.








Through the mobile application developed as part of the project, students are empowered with personalized and context-aware information, fostering a more inclusive and interactive learning environment. The beacon technology enables location-based notifications, guiding students to relevant resources, events, and opportunities based on their individual needs and interests. This not only enriches their learning experience but also promotes a sense of belonging and inclusivity within the campus community. At the next sections we show some of the developed work.

A. Web Application

This web page is basically for manager or admin who manage the crud operation for all table maintenance of beacons and notification information.

At Figure 1a is the representation of User Management Page. At this page, the manager or admin can see the list of the

TABLE I: Commercial beacons comparison.

Manufacturer	Radio	Image	Battery
Estimote [2]	Bluetooth 4.0/5.0		1-3 years
Kontakt	Bluetooth 4.2		2 years
RadBeacon Dot	Bluetooth 4.0		145 days
OpenBeacon BL	BLE		Unknown
BlueSense [3]	Bluetooth 4.0		Unknown
RedBear Beacon B1 [4]	Bluetooth 4.0		4500+ hours
Gimbal	Bluetooth 4.0		4 months

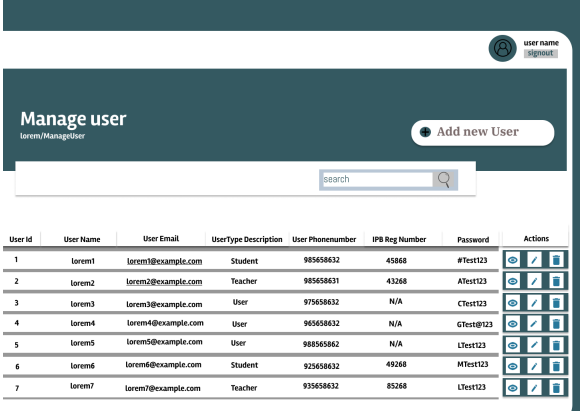
users and also manages the crud operation of user. From the action column admin can view, edit and delete the particular user and also add users from the button add new user.

At figure 1b, we display the Add New User Page. At this page, manager or admin can add new user. When they are adding new user, they should fill all the required field.

At figure 2a, we display the Beacon management page. Here the manager or admin can see the list of the Beacons and also manage the crud operation of Beacon. From the action column admin can view, edit and delete the particular beacon and also add beacons from the button add new beacon.

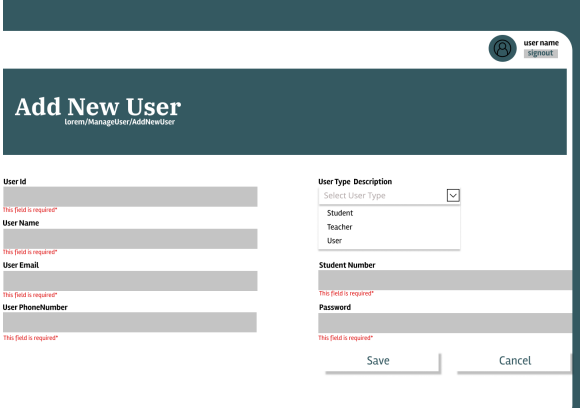
At figure 2b, we display the Add New Beacon Page, where the manager or admin can add new Beacon. When they are adding new beacon, they should go through all the required field.

At figure 3a, we display the Beacon Position Management



The screenshot shows a 'Manage user' interface. At the top, there's a header with 'user name' and a 'logout' button. Below the header, the title 'Manage user' is displayed, followed by a breadcrumb 'lorem/ManageUser'. A search bar is present on the right. The main content area contains a table with columns: User Id, User Name, User Email, UserType Description, User PhoneNumber, IPB Reg Number, Password, and Actions. The table lists 7 users with various details. Each row has three action icons: a magnifying glass (view), a pencil (edit), and a trash can (delete).

(a) User management page



The screenshot shows an 'Add New User' form. The header includes 'user name' and 'logout'. The title is 'Add New User' with a breadcrumb 'lorem/ManageUser/AddNewUser'. The form contains several input fields: User Id, User Name, User Email, User PhoneNumber, and Password. There are also dropdown menus for 'User Type Description' (with options: Student, Teacher, User) and 'Student Number'. Red text indicates required fields. At the bottom, there are 'Save' and 'Cancel' buttons.

(b) Add New User Page

Fig. 1: User Management pages

page, where the manager or admin can see the list of the position of Beacon and also manage the crud operation. From the action column admin can view, edit and delete the particular beacon position and also add beacon position from the button add new beacon position.

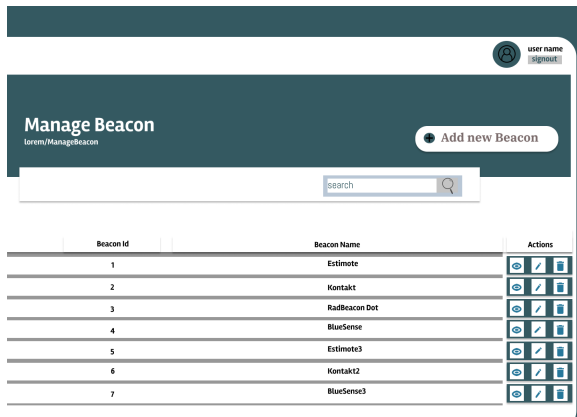
On figure 3b, we display the Add New Beacon Position Page. At this page, manager or admin can add new beacon position. When they are adding new beacon position, they should go through all the required field

B. Mobile Application

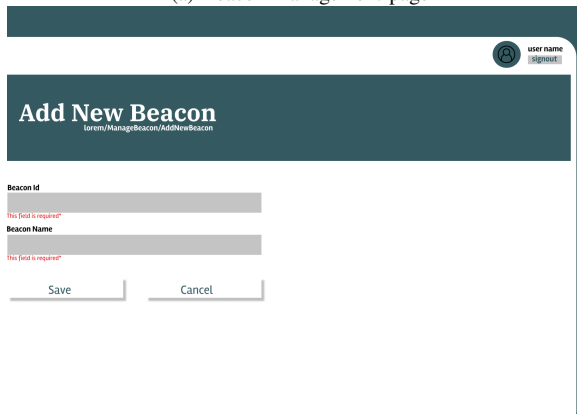
In this section, we demonstrate the mobile application. We use several prototypes for the design of UI in our mobile application.

Below we have represented every pages with their explanation of how our application works.

At figure 4a, we display the Landing Page. Here, if the user is student and when student sign in into the application, then he/she are redirected to the page like below where he/she will be shown the information about the current position of the student. For example if the student is in the canteen, he/she will be shown menu of the canteen at the particular period of time. Teachers will also get the similar information like that of students based on their position.

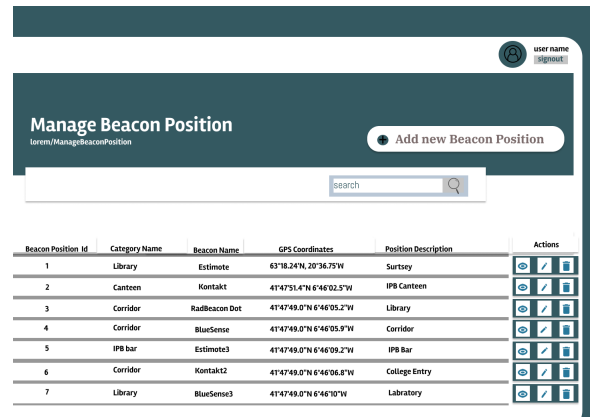


(a) Beacon management page

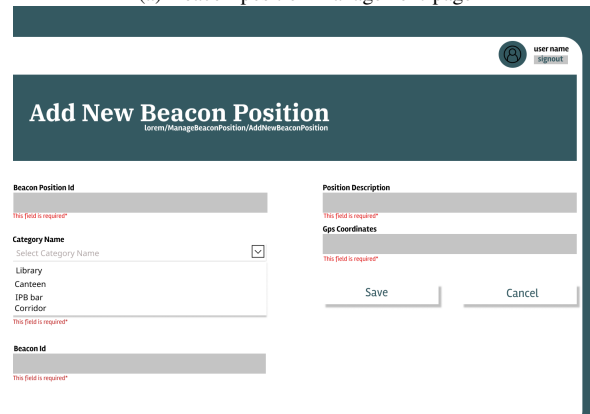


(b) Add New Beacon Page

Fig. 2: Beacon Management pages



(a) Beacon position management page



(b) Add New Beacon Position Page

Fig. 3: Beacon Position Management pages

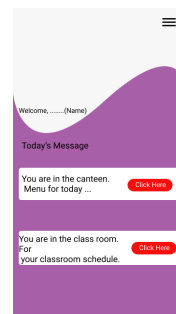
At figure 4b, we display the login page, where after the user opens the application (if not logged in), then the user gets into the login page. And the user will be able to Login if already registered. If he/she is not registered then he/she can register through the register page. To login he/she are asked the email and password with the help of which they registered. This page is for all the user who wants to visit this application.

As our application is based for all type of users, we have a page which helps to identify what type of user is going to register. This is a page only redirected when the user tries to register in the application. There are three choices student, teacher and other user.

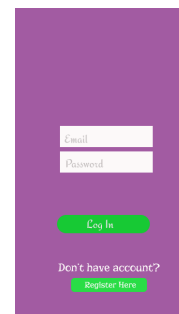
At figure 4c, we display what type of User is signing up.

As our application is mainly focused on student and teacher, we have a different register page for student/teacher and other users where the students or teachers will be able to input their school number: student(student number) and for teacher(teacher number). Along with that number, they are asked to input their name, email, phone number and password for entry. Then, they are able to register and validate their account. At Figure 5a, we display Student/Teacher Register Page.

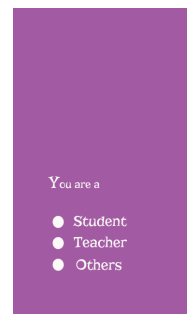
But if any other user (like guardian of any student) wants to register, then they can do with the help of page giving their



(a) Landing Page



(b) Login Page



(c) User Type

Fig. 4: Landing/ login and user type page

name, email and phone number like the figure shown below. However, they will not be able to use the full functionality of the application like that of student and teacher registered here. Figure 5b, displays the other user registration page.

IV. CONCLUSIONS

This project has been an inspiring and transformative endeavor in fostering diversity and inclusivity within the university community. By harnessing the power of mobile technology, this innovative mobile application has successfully bridged diversity gaps and created a vibrant ecosystem where

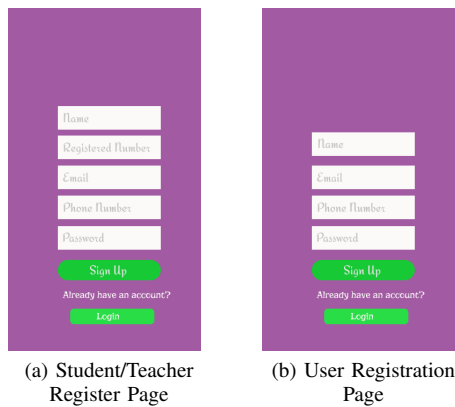


Fig. 5: Register Page

individuals from different backgrounds, cultures, and perspectives can connect, learn, and grow together.

Throughout the project, the mobile application has proven to be a catalyst for meaningful interactions and cross-cultural understanding. By leveraging beacon technology, users have been able to discover and engage with others who share similar interests, fostering organic connections and breaking down barriers that may have previously hindered meaningful relationships.

Furthermore, the application has served as a comprehensive resource hub, providing users with access to educational materials, cultural events, and language exchange opportunities. This has facilitated a deeper understanding of diverse cultures, languages, and traditions, leading to a more enriched and inclusive learning environment.

The impact of the project extends far beyond the digital realm. It has nurtured a sense of belonging and empowerment among individuals who may have felt marginalized or isolated. By promoting dialogue, empathy, and acceptance, the project has created a campus culture where diversity is celebrated, and every voice is valued.

As the project moves forward, continuous efforts should be made to refine and enhance the mobile application, ensuring it remains an effective tool in bridging diversity. Collaborations with student organizations, faculty, and staff can further strengthen its impact and reach, making it a central component of the university's commitment to inclusivity.

This project success serves as a testament to the transformative power of technology when coupled with a genuine commitment to diversity and inclusion. By embracing this mobile application, universities can continue to nurture an environment where differences are celebrated, perspectives are broadened, and individuals are empowered to thrive in a diverse and interconnected world.

In conclusion, the integration of beacons with learning analytics offers a powerful framework for optimizing educational practices. Beacons provide rich data about student interactions and behaviors, while learning analytics allows for the meaningful interpretation and application of this data.

By leveraging these technologies, educators can personalize

instruction, enhance student engagement, and create dynamic learning environments that support student success and promote lifelong learning. However, it is important to approach the implementation of these technologies with care, ensuring privacy and ethical considerations are at the forefront of the process.

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