TRIBHUVAN UNIVERSITY

Prime College

Nayabazar, Kathmandu, Nepal

An Internship Report

On

Geofencing

At

BeamLab Pvt. Ltd.

Submitted By

ANIL KUMAL (20467/075)

An Internship Report Submitted in partial fulfillment of the requirement of **Bachelor of Science in Computer Science & Information Technology (BSc.CSIT) 8th Semester** of Tribhuvan University, Nepal

September, 2023

Geofencing

[CSC 412]

An internship report submitted for the partial fulfillment of the requirement for the degree of Bachelor of Science in Computer science & Information Technology awarded by Tribhuvan University.

Submitted By

ANIL KUMAL (20467/075)

Submitted To

Prime College

Department of Computer science

Affiliated to Tribhuvan University

Khusibun, Nayabazar, Kathmandu

September, 2023

MENTOR'S RECOMMENDATION

Date: …….

SUPERVISOR'S RECOMMENDATION

It is my pleasure to recommend that an internship report on "**Geofencing**" has been prepared under my supervision by **Anil Kumal** in partial fulfillment of the requirement of the degree of Bachelor of Science in Computer Science and Information Technology (BSc.CSIT). His report is satisfactory and is an original work done by him to process for the future evaluation.

……

Mr. Sravan Ghimere

Supervisor

Department of Computer Science & IT

Prime College

Date: ……

CERTIFICATE OF APPROVAL

The undersigned certify that he has read and recommended to the Department of Computer Science and Information Technology for acceptance of an internship report entitled "**Geofencing**" submitted by **Anil Kumal** in partial fulfillment for the degree of Bachelor of Science in Computer Science and Information Technology (BSc.CSIT), Institute of Science and Technology, Tribhuvan University.

…….	**…….**
Mr. Narayan Prasad Sharma	**Ms. Rolisha Sthapit**
Principal	**Program Coordinator**
……	**……**
Mr. Sravan Ghimere	**Mr……..**
Internal Supervisor	**External Examiner**

ACKNOWLEDGEMENT

It gives me immense pleasure to express my deepest sense of gratitude and sincere thanks to my highly respected and esteemed guide **Mr**. **Sravan Ghimire** for his valuable guidance, encouragement, and help in completing this work. His useful suggestions for this whole work and cooperative behavior are sincerely acknowledged. I would like to express my sincere thanks to **Mr. Avanish Shrestha**, CEO of BeamLab Pvt. Ltd., for giving me this opportunity to work for his company. I would also like to express my sincere gratitude to **Mr. Bishesh Dangol** for their guidance and mentorship during my internship at Beamlab. Their knowledge and experience were invaluable in helping me to understand the inner workings of the Flutter App Development and to develop my skills as a Flutter Developer. I would also like to thank my colleagues for their assistance and for welcoming me into the team. I feel fortunate to have had the opportunity to learn from such a talented and dedicated group of professionals.

I would also like to thank Prime College for providing me with the opportunity to complete this internship as part of my degree program. The hands-on experience I gained during my time at Beamlab will be invaluable as I continue my studies and pursue my career goals. Thank you all for your contributions to my internship experience. I will always be grateful for the opportunity to learn and grow as a professional.

With respect,

Anil Kumal (20467/075)

ABSTRACT

The geofencing Flutter app project revolves around simplifying the complex world of location-based technology, making it accessible and user-friendly. Its core purpose is to develop a mobile application that has geofencing features using Flutter framework. Geofencing, a technology that sets virtual boundaries tied to physical locations, has vast potential, but its intricacies often pose challenges, particularly for smaller organizations. These complexities can impede the rapid deployment of geofencing apps, limiting organizations' ability to tap into the benefits of location-based services. The project's main goal is to bridge this gap by creating an intuitive and user-friendly geofencing mobile application. This application, developed using an Agile methodology that emphasizes adaptability and customer feedback, aims to simplify the process of tracking user locations and automating actions when they enter or exit predefined geographic areas. The application's features are designed with simplicity and practicality in mind. Users can effortlessly track their location, and the app updates activities based on their geographic movements. An interactive map interface displays available geofences, making the user experience engaging and informative. To achieve this, the project utilizes Flutter for the frontend, FastAPI for the backend, and MySQL for the database, creating a seamless synergy between these components. In conclusion, this project uses flutter framework to create a mobile application for tracking user activities.

KEYWORDS: *Geofencing, Polygons, Flutter, FastAPI, MySQL*

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LIST OF ABBREVIATIONS

API	Application Programming Interface
HTTP	Hyper Text Transfer Protocol
UI	User Interface
REST	Representational State Transfer
ORM	Object Relational Mapping
RDMS	Relational Database Management System
SQL	Structured Query language
SMM	Social Media Marketing

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CHAPTER 1
INTRODUCTION

1.1. Introduction

This report offers an insightful overview of the intern's accomplishments and undertakings during their internship at Beam Labs Pvt. Ltd., specifically in the realm of geofencing Flutter application development. The intern had the privilege of contributing to the geofencing project at Beam Labs, a cutting-edge initiative that aligns perfectly with their passion for innovation and mobile app development. The geofencing Flutter application project at Beam Labs represents an exciting exploration of location-based technology within the Flutter framework. This application uses user location tracking feature to track and update activities of the user entering and leaving a certain place. This helps to track where the user was at what time. The application also shows all the available geofences on google maps in interactive way.

Geofencing flutter application includes many features like live user location tracking, auto creation of activities based on the user location. The uses Fast API python framework for backend API and MySQL for database feature.

1.2. Problem Statement

The world of mobile app development often presents formidable challenges for organizations, especially smaller ones, seeking to create geofencing applications. The intricacies of geofencing technology, coupled with the technical demands of cross-platform app development, can create significant barriers, particularly for non-technical users within these organizations. This complexity can hinder the rapid development and deployment of geofencing apps, impeding organizations' ability to harness the full potential of location-based services. Moreover, the lack of user-friendly tools exacerbates this problem, leaving many smaller entities with limited technical resources struggling to bring their geofencing concepts to life.

Addressing these challenges is critical to unlocking the power of geofencing technology for organizations of all sizes. It can lead to more efficient and accessible geofencing app

development, allowing organizations to tap into the benefits of real-time location-based engagement. By simplifying the process and providing user-friendly tools, our project aims to democratize geofencing app development, ensuring that organizations, regardless of their technical expertise or resources, can harness the full potential of this innovative technology. This project seeks to bridge the gap and empower organizations to bring their geofencing ideas to fruition, ultimately enhancing their ability to engage users in location-specific contexts effectively.

1.3. Objectives

The main objectives of the internship are:

- To Develop a user-friendly and intuitive geofencing Flutter mobile application.
- To Implement automation for activity creation upon entering or leaving predefined geographic areas.

1.4. Scope and Limitation

The scope of the project is:

- **User-Friendly Geofencing App Development:**
  The project aims to develop a user-friendly geofencing mobile application using Flutter. It will include features for creating, customizing, and managing geofences within the app.
- **Automated Activity Creation:**
  The app will automate the process of activity creation when user enters or exit the predefined geographic areas, enhancing the user experience and providing real-time engagement.
- **Enhanced User Engagement:**
  The project will focus on enhancing user engagement through location-specific information and services, contributing to a more personalized and enriching user experience.

The limitations of the project may include:

- **Limited Geofence Customization in Initial Version**:

In the initial version of the app, the ability for users to define their own geofences may be limited, with plans for this feature to be implemented in future updates.

- **Resource Constraints**:
  The project's scope may be constrained by available resources, including time and budget, which could impact the depth and breadth of features that can be implemented.
- **Testing and Validation**:
  Testing the app's geofencing functionality in various real-world scenarios may be challenging, and the accuracy of location-based services may depend on the user's device and network conditions.
- **User Adoption**:
  The success of the app may also depend on user adoption and the willingness of users to engage with location-based features, which can be influenced by factors beyond the project's control.

1.5. Report Organization

Chapter 1

It shows the overall description of the project. It contains an introduction, objective, reason to take the project, to whom the project favors, and limitations.

Chapter 2

It contains the details of the organization in which the internship was done. It describes the organization, the type of organization, its hierarchy, its working domain, and the departmental unit within an organization.

Chapter 3

It covers the actual activity performed during the internship. It describes the role and responsibilities of the student, the work the particular student performed weekly, the project in which the student was involved, and the depth of work he/she has done within the internship period. It focuses on the student's technical work within the specified internship period.

Chapter 4

It describes what a student learns within the internship period and what conclusion can be drawn from the project they were involved in.

CHAPTER 2
ORGANIZATION DETAILS AND LITERATURE REVIEW

2.1. Introduction to Organization

Founded in 2019, Beam Lab Pvt. Ltd. emerged with a singular vision: to elevate the AI industry in Nepal and beyond. The origins of Beam Lab can be traced back to a groundbreaking thesis research paper conducted at Assumption University in 2016, focusing on the frontiers of deep learning and computer vision. This seminal work ultimately catalyzed the inception of a thriving startup in Thailand. Beam Lab Pvt. Ltd. was established by the founding member of Baksters, Co., with the core objective of uniting a team of AI enthusiasts and laying the groundwork for the advancement of the AI sector in Nepal. Today, in close collaboration with Baksters, Co., a dynamic startup based in Thailand, and the esteemed Intelligent Systems Research Laboratory of Assumption University, Beam Lab is at the forefront of AI system development. Our journey is rooted in the fusion of expertise and innovation, driven by a collective passion for AI. Beam Lab Pvt. Ltd. stands committed to pushing the boundaries of deep learning and computer vision, creating AI systems that not only redefine possibilities but also empower organizations and individuals to harness the full potential of artificial intelligence. (BeamLab, 2023)

Table 1: Company Details

Official name	Beam Lab Pvt. Ltd.
Type of business	Private Company
Location	Lalitpur, Nepal
Year of establishment	2019
Key service areas	Graphic, Web, Software, Mobile Solutions, Digital Marketing
Staff size	20+ full time employees
Number of current clients	

Location of clients	Nepal, Thailand
Expertise in	Web based application development, mobile app development, Digital Marketing, AI and Computer Vision

2.2. Organizational Hierarchy

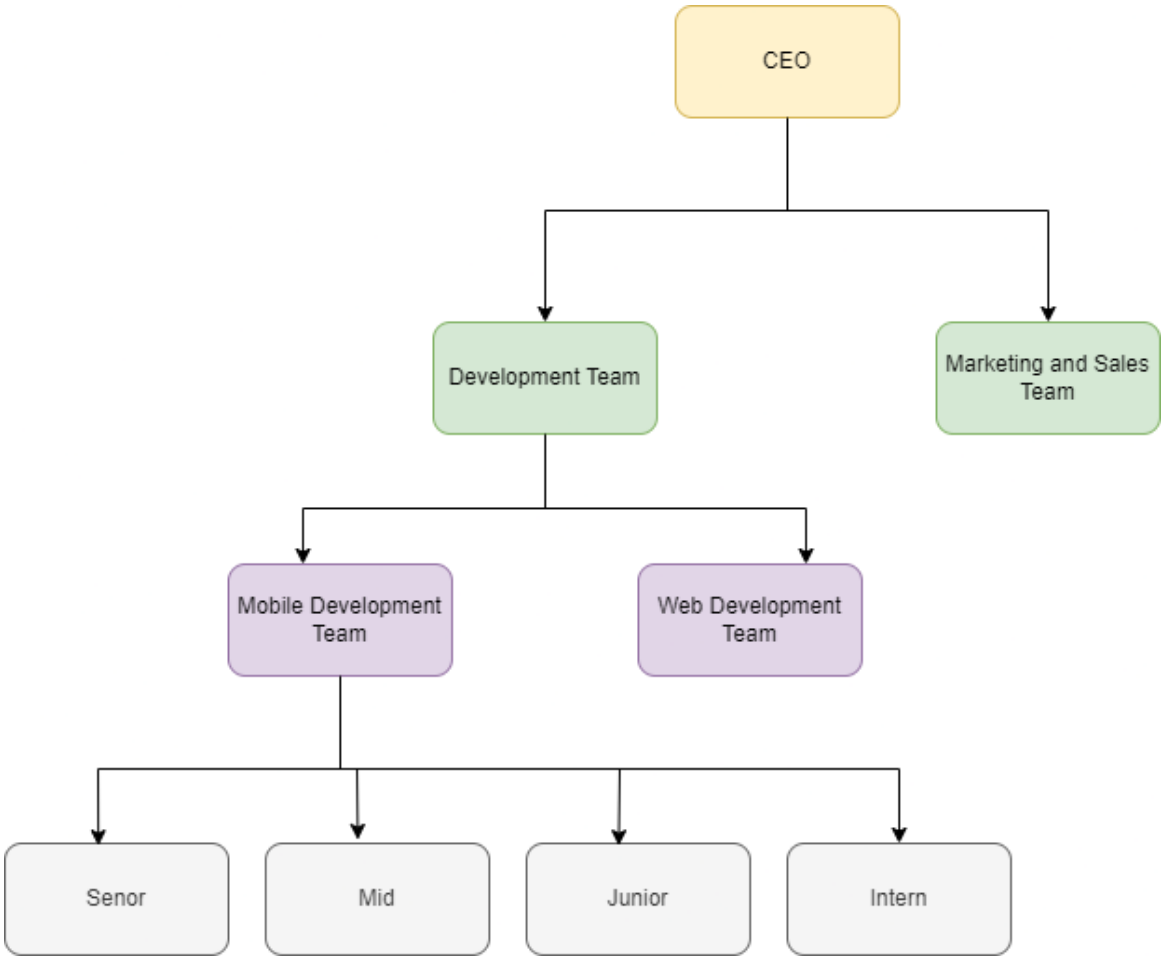

Figure 1: Organizational Hierarchy of BeamLab Pvt Ltd.

Contact Details

Phone Number: +977-980282674

Email: avanish@beamlab.co

Address: Kupondol Road, Lalitpur, Nepal

2.3. Working Domains of Organization

BeamLab offers a comprehensive suite of IT and business communication solutions. Whether your objective is to establish an enhanced online presence through web app development, expand your audience reach with mobile app development, or optimize online visibility and engagement through tailored digital marketing strategies, our dedicated team is poised to deliver innovative solutions. We empower businesses to thrive in the dynamic and ever-evolving digital landscape.

- **Web App Development:**
  Beam Lab excels in the domain of web app development, crafting powerful and user-centric applications that seamlessly operate within web browsers. These web applications are tailored to cater to the unique needs of businesses, delivering comprehensive functionality and engaging user experiences.

- **Mobile App Development:**
  Leveraging the latest advancements in technology and platform expertise, Beam Lab specializes in mobile app development. With a focus on platforms such as Android, the organization designs and creates mobile applications that are not only technically advanced but also user-friendly and intuitive.

- **Digital Marketing:**
  Beam Lab's expertise extends to the realm of digital marketing. They offer a wide range of digital marketing services, Social Media Marketing (SMM), Content Marketing, and Email Marketing. These services are designed to enhance online visibility, engage target audiences, and drive business growth.

2.4. Description of Intern Department/Unit

BeamLab operates its intern department with a unique approach that prioritizes personalized placement and mentorship. Unlike traditional intern departments, BeamLab doesn't have a dedicated unit for interns. Instead, the intern selection process involves a thorough CV screening and interviews conducted directly by the Managing Director.

2.4.1. Placement Process:

Interns are carefully chosen based on their qualifications, skills, and alignment with BeamLab's mission. The Managing Director plays a hands-on role in evaluating each applicant, ensuring that they are a strong fit for the organization.

2.4.2. Role and Task Assignment:

Upon selection, interns aren't assigned to generic roles. Instead, the Managing Director takes a tailored approach, matching interns with roles that align with their strengths and career aspirations. This personalized assignment ensures that interns' experiences at BeamLab are not only valuable but also in line with their professional goals.

2.4.3. Mentorship and Supervision:

Interns at BeamLab benefit from a structured mentorship program. Each intern is paired with a dedicated supervisor and a senior developer mentor. This mentorship structure provides interns with ongoing guidance, support, and insights from experienced professionals throughout their internship journey. BeamLab's intern department may not follow the conventional structure, but its commitment to providing interns with personalized experiences and mentorship sets the stage for their future success in the tech industry.

2.4.4. Duration

The duration and relevant details of the internship are as follows:

Table 2: Internship Duration

Internship Start Date:	16th June 2023
Internship End Date:	18th September 2023
Duration:	3 Months
Office Hour	9:30 AM to 6:00 PM
Working Days:	Monday to Friday

CHAPTER 3
INTERNSHIP ACTIVITIES

3.1. Roles and Responsibilities

The intern was hired as Flutter app developer in BeamLab Pvt Ltd. The internee's role as a Flutter app developer was to explore flutter framework, flutter architecture and flutter state management. The intern worked directly under the supervision of **Mr. Avanish Shrestha**, the Managing Director of the company and flutter mentor **Mr. Bishesh Dangol** and got to know various facts and skills related to mobile app development. And the internee also Learnt about project management through Jira Software under the guidance of **Mr. Nikesh Bhattarai**. During the internship, the internee was given a task to fully develop a flutter app utilizing the geofencing feature. The intern was taught the core fundamentals of the agile software development and the workings of the Jira Project management Software. Following were the roles and responsibilities that were given to the intern:

- Learn Flutter framework and develop dynamic and engaging mobile apps.
- Learn Flutter Architecture.
- Research Flutter state management.
- Research Rest-API integration in flutter application.
- Learn about Git
- Learn project management using Jira
- Complete tasks assigned and update report on Jira software

3.2. Weekly Log

Following table shows the weekly activities I performed throughout my internship period.

Table 3: Weekly Log

Week	Activities
Week 1	• Research Flutter Architecture • Learn Git Basics • Learn Agile development • Learn to use Jira
Week 2	• Learn Flutter MVVM architecture • Learn Figma basic working • Learnt about flutter setup
Week 3	• Learnt Flutter MVVM • Created Basic flutter project with MVVM architecture
Week 4	• Learnt Flutter state management • Learnt Provider Basics • Created a Login Page
Week 5	• Learnt JWT authentication • Learnt about JSON serialization and deserialization • Created a fully working login page with working backend integration
Week 6	• Created basic Homepage with the BottomNavigationBar • Learnt to use Sliding-up Panel • Learnt to use Flutter Stack Widget
Week 7	• Learnt ListView widget • Implemented ListView.builder to generate a number of list
Week 8	• Learnt Pull to Refresh list • Created a static activity list with listview • Created App Bar in homepage
Week 9	• Learnt about IndextStack widget • Modified BottomNavBar with IndexedStack • Used Sliding-up-panel package to create a slide up panel for peoples page • Created Profile Page

Week 10	• Learnt GooleMap integration in flutter • Learnt about location service in android • Integrated fully working Location service into the app • Created map using google_maps_flutter package • Created register page
Week 11	• Integrated Provider for the state management • Integrated backend REST API for login, register • Created API endpoint for Change password • Learnt about Git • Learnt about DialogBoxes
Week 12	• Integrated API for creating polygon on the map • Integrated fully working REST API and Logic for automatic activity creation • Integrated User Session management • Integrated proper periodic user location checking for activity service • Finished work for activity page with the backend and pull to refresh added • Learnt about WillPopScope Widget • Added WillPopScope in homepage
Week 13	• Patched bugs for activity page • Patched bugs for user session management • Fixed and updated backend API for proper integration

3.3. Description of Project Involved During Internship

During the course my internship from April-11 to July-10, the internee had involvement in single project which was assigned solely for him for his growth, proper flutter knowledge development and state understandings. The internee had involvement on following:

- **Geofencing Flutter App**

  Initially the supervisor and internee had discussion regarding the internship roadmap. After proper discussion, his supervisor decided to assign a POF (Proof of Concept)

project of Flutter app with geofencing capabilities. The internee was tasked with creating a fully working flutter app with immersive UI and fluid design.

- **Geofencing Backend with Fast API**

  The internee also had heavy involvement in developing the backend API for the flutter app using Fast API python framework. The internee had to guide his fellow internee to develop the API and help in fixing different bugs.

The internee's daily routine involved attending Scrum meeting at 11 AM, and his responsibility was to develop the flutter app and help in development of the backend API.

3.3.1. System Requirements

Analysis of the system requirements was carried out as follows:

3.3.1.1. Functional Requirements

Functional requirements aim to provide the overview of how the system works. It specifies what a system should do. Functionalities such as services, tasks and functions required for the system is described here. They are:

- **Login / Register**

  The user must be able to register themselves in the app. The user should be able to login with the registered user credentials.

- **View Map**

  Being able to see different fences in the map by the user is one of the main features of the app.

- **View Activities**

  The users should be able to view the activities of themselves in the activities page. Here an activity is an event created whenever a user exits or enters a predefined fences on the map.

- **Add and Update activity**

  This functionality is performed by the app automatically on the basis of user location updates.

Figure 2: Use Case Diagram

The above figure 2 shows the basic functional requirements of the Geofencing flutter app project. The user should be able to register and login with entering the correct credentials required. Once logged in, the user should be able to view the map and different geofences and the list of activities in the activity screen. The activity creation is all done

automatically by the system which is the app, by periodically checking the user location and feeding that information in the activity logic.

3.3.1.2. Non-Functional Requirement

Following points describe the non-functional requirements of the system:

- **Performance:**
  Response Time: The app should have low latency when detecting geofence entry/exit and should respond quickly to user interactions.
- **Scalability:**
  It should be able to handle a growing user base and increasing geofence data without a significant drop in performance.
- **Reliability:**
  Availability: The app should be available and accessible to users 24/7, with minimal downtime for maintenance.

  Fault Tolerance: It should gracefully handle errors and recover from failures without data loss or service interruptions.
- **Security:**
  Data Protection: User location data and personal information should be securely stored and transmitted using encryption protocols.

  Authorization: Access to geofencing features should be controlled through proper authentication and authorization mechanisms.
- **Usability:**
  User Interface: The app's user interface should be intuitive, user-friendly, and adhere to best practices in mobile app design.

3.3.2. System Design

System design is a crucial phase in the product development process where architects and engineers create a comprehensive blueprint for the system. This blueprint includes detailed plans for the system's architecture, interfaces, and components. Essentially,

system design applies the principles of system theory to guide the development of a product, ensuring that it meets its intended purpose, functions efficiently, and is adaptable for future growth or changes. It serves as a roadmap that translates abstract concepts into concrete plans for implementation, facilitating effective collaboration among multidisciplinary teams throughout the development lifecycle.

3.3.2.1. Architectural Design

The Geofencing Flutter App project is thoughtfully designed using a robust client-server architecture, which forms the backbone of the entire system. This architectural framework not only shapes the app's structure but also defines how users interact with its geofencing features. Here, we delve into how this client-server architecture enhances the Geofencing Flutter App:

Client-Side (Frontend):

- **Flutter Framework**:
  At the core of the client-side architecture lies the versatile Flutter framework. Renowned for its cross-platform capabilities and rich widget library, Flutter empowers the app with a visually appealing and responsive user interface.
- **State Management:**
  Flutter's state management solutions, such as Provider and Bloc, play a pivotal role in efficient state management. This dynamic approach ensures real-time updates and a fluid user experience.
- **Communication:**
  The client communicates with the server tier through HTTP requests, adhering to RESTful API principles. This bidirectional data exchange between the app and the server facilitates real-time updates and user-specific interactions.

Server-Side (Backend):

- **FastAPI Python Framework:**
  On the server side, we rely on the FastAPI Python framework, celebrated for its speed, simplicity, and robustness. FastAPI empowers the backend with a well-structured set of API endpoints.

- **Authentication and Security:**

  Robust user authentication using JSON Web Tokens (JWT) ensures data security and controlled access to API endpoints. FastAPI's built-in security features fortify the system against unauthorized access.

- **Database Management (MySQL):**

  MySQL serves as the backend's relational database management system (RDBMS). It efficiently stores user profiles, geofence data, and activity records. The server seamlessly interacts with MySQL to execute Create, Read, Update, and Delete (CRUD) operations.

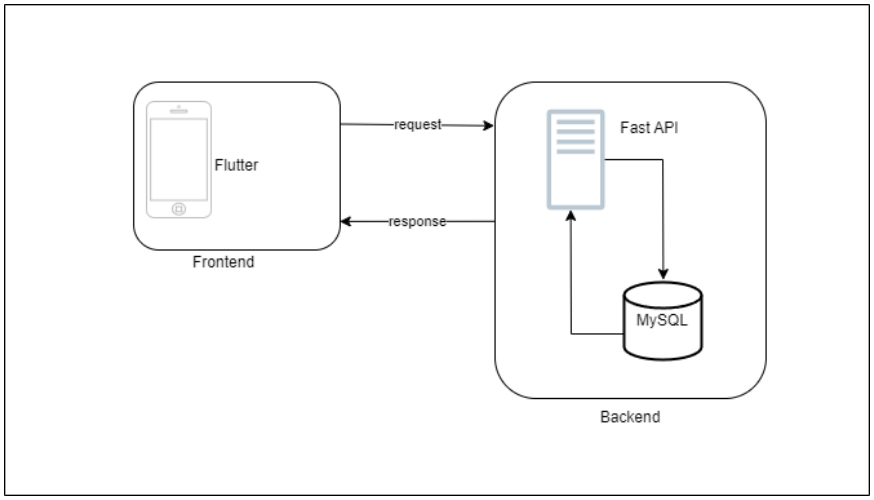

Figure 3: System Architecture of Geofencing

3.3.2.2. System Analysis

System analysis is a crucial phase in the development of complex systems, whether they are software-based, hardware-based, or a combination of both. It involves a comprehensive examination and evaluation of an existing system or a proposed system to identify its goals, functions, components, and interactions. The primary objective of system analysis is to understand the system's requirements and constraints to facilitate effective design and development. Here are the key aspects of system analysis:

Sequence Diagram

A sequence diagram is a type of UML (Unified Modeling Language) diagram that illustrates the interactions and communication between objects or components within a system or between systems over a specific period of time. Sequence diagrams are particularly useful for visualizing the dynamic behavior of a system, including the order of message exchanges and the lifelines of participating objects.

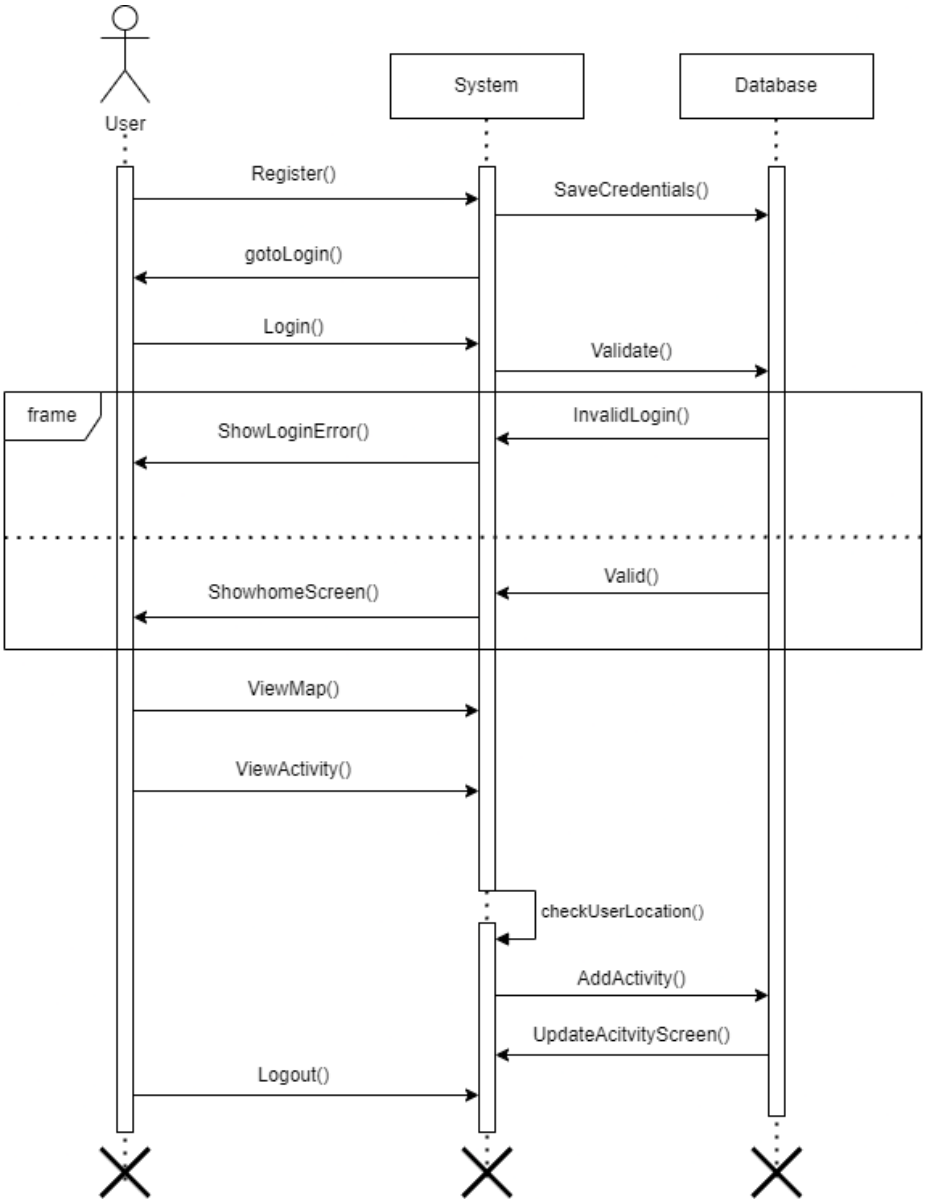

Figure 4: Sequence Diagram for Geofencing

The above sequence diagram shows the working of the geofencing flutter app. It has User, System and Database. The user is greeted by the login screen and users will have to

register if not registered yet. In register, after the registration the API call is made and the system will validate the information with the database. The app will either show error or show success and go to the login screen. The users can see the map with different geofences and see the activities in activity screen. The system will periodically check the user location for activity creation process.

Activity Diagram

An activity diagram is a type of UML (Unified Modeling Language) diagram used to model the dynamic aspects of a system, particularly the workflow or sequence of activities within a process, use case, or business process. Activity diagrams help visualize how various activities or actions are coordinated and flow from one to another, making them useful for process modeling, business process improvement, and system design.

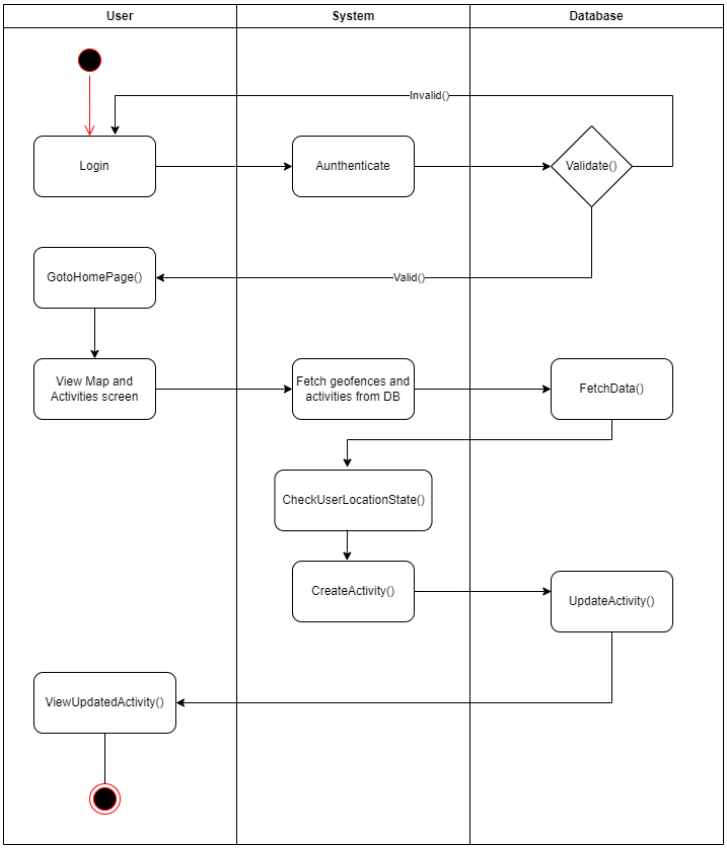

Figure 5: Activity Diagram for Geofencing

Above figure represents the activity diagram of the geofencing flutter app. The user first logins into the app, after successful login the users can view google map and different fences on the map. Users can see activity in activity screen. The details of fences and

activity is fetched from the database. The system will periodically check the user location for activity creation.

3.4. Tasks/Activities Performed

During the internship the internee worked on Geofencing project both frontend and backend. The intern was doing frontend in flutter framework and backend in python framework Fast API. During the internship the intern had to research and learn different flutter widgets and their implementation on working project.

The intern was assigned a solo project on Geofencing flutter app under the supervision of the managing director and guidance of senior developer. Among the tasks following are the main parts of the projects.

- **Google Maps Module**

  The internee used this module to show google map on the application. The internee used this module to show different polygon on the map and user location on the map. The internee used this module for live user location tracking by periodically tracking user location.

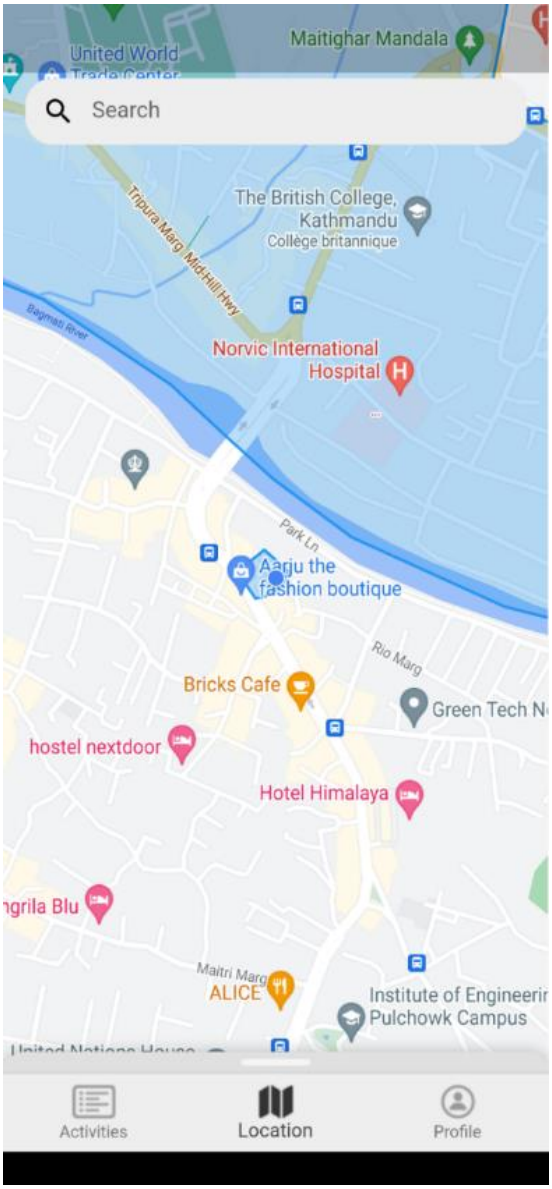

Figure 6: Google Map Module

- **Activity Module**

  The intern used this module to create a list of activities to show on the activity screen. The list was fetched from the Fast API as JSON and JSON serialization was performed to format the activity list.

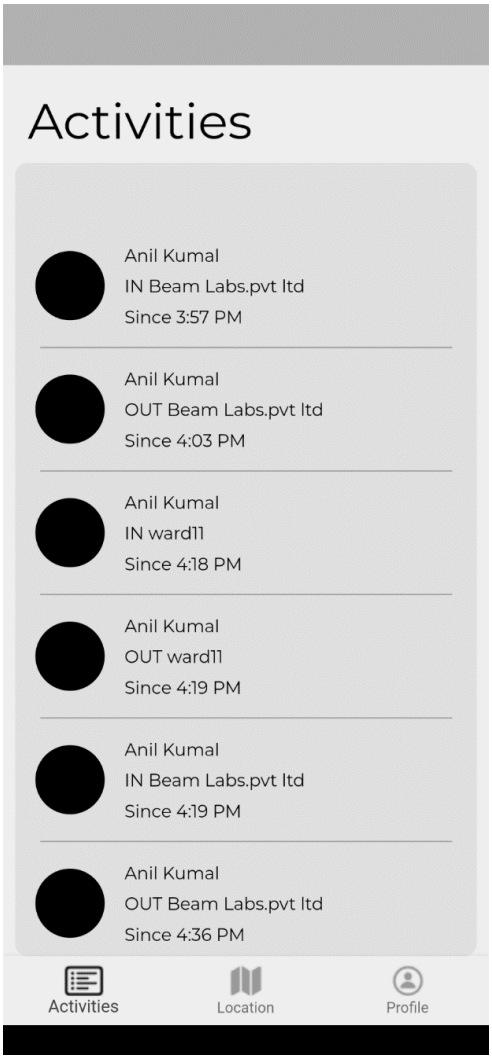

Figure 7: Activity Module

3.4.1 System Implementation

3.4.1.1. Front End Tools

- **Flutter**

  Geofencing project uses flutter for developing IOS and Android application. Flutter is an open-source framework by Google for building beautiful, natively compiled, multi-platform applications from a single codebase. It allows developers to write code once and deploy it across multiple platforms, reducing development time and effort.

3.4.1.2. Back End Tools

- **Fast API**

  Geofencing project uses python framework Fast API for creating the backend. Fast API is a modern, fast (high-performance), web framework for building APIs with Python 3.7+ based on standard Python type hints.

- **MySQL**

  For database the geofencing project uses MySQL to create and manage database. MySQL is an open-source relational database management system (RDBMS).

3.4.1.3. Development Methodology

Geofencing project deploys Agile Development methodology. Agile development is a popular and flexible software development methodology that focuses on iterative and incremental development. It emphasizes collaboration, customer feedback, and the ability to adapt to changing requirements. Agile methodologies, including Scrum and Kanban, can be effectively used in the development of geofencing applications. Here's how Agile is being applied:

- **Iterative Development:**

  The project is divided into manageable iterations or sprints, allowing for the release of a minimum viable product (MVP) with basic geofencing capabilities. Continuous refinement and improvement follow based on real-world usage and user feedback.

- **User-Centric Approach:**

  Agile encourages collaboration with potential users and stakeholders throughout the development journey. This ongoing dialogue ensures that the geofencing app aligns with user requirements and preferences.

- **Frequent Deliveries:**

  Regular updates and releases of the geofencing app are integral to Agile. This approach keeps users engaged and allows them to benefit from new features and enhancements promptly.

- **Cross-Functional Teams:**

Agile teams are designed to be cross-functional, encompassing various expertise areas, including development, design, testing, and product ownership. This diverse composition ensures a comprehensive approach to geofencing app development.

- **Flexibility and Adaptation:**

  Geofencing requirements may evolve over time due to changing user needs or newly discovered use cases. Agile's adaptability allows the development team to easily adjust priorities and plans in response to new insights.

- **Continuous Testing:**

  Given the critical role of accurate location-based features, the project emphasizes continuous testing throughout the development process to identify and address issues early on.

- **Backlog Management:**

  A well-maintained product backlog serves as the cornerstone of Agile development. In the case of the geofencing app, the backlog lists all features, enhancements, and bug fixes, prioritized based on user requirements and business value.

(Learn, 2020)

Figure 8: Agile Development

One of the sprints of the geofencing project:

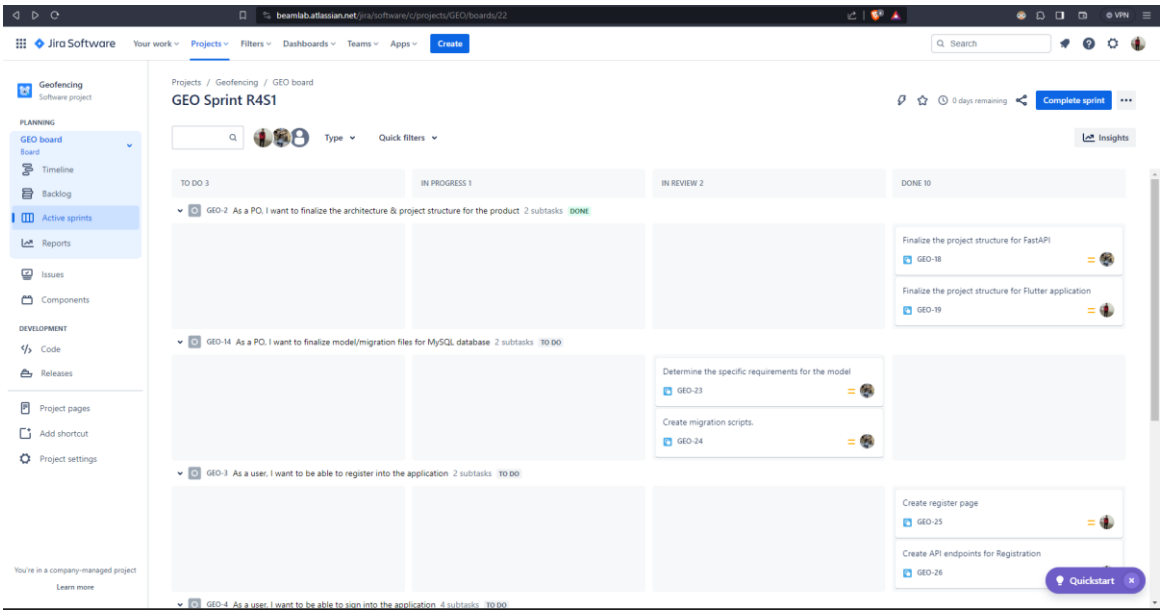

Figure 9: Geofencing Sprint

3.4.2. System Testing

For testing test data was used and corresponding output was observed. The developed modules were tested individually to ensure it meets its intended requirements. The test case for maps and activity is given below:

Table 4: Test Cases for Activity Module

S.N.	Test Procedure	Expected Result	Outcome	Remarks
1	Move user into a geofence on the map	Activity creation with status "IN"	New activity was created	Pass
2	Leave a geofence	Activity creation with status "OUT"	New activity was created	Pass
3	Leave one geofence and enter into another	Activity creation with status "OUT" from previous geofence and another activity with status "IN" in new geofence	Two activity was created successfully both status	Pass

Table 5: Test Cases for Google Maps Module

S.N.	Test Procedure	Expected Result	Outcome	Remarks
1	Go into the Homepage	Show Google map with user location and geofences.	Map was shown with many geofences.	Pass
2	Update user location	Update user location on the map	User marker was updated with new location	Pass
3	Add new geofence in the backend	Show new geofence on the map	New geofence was shown on the map.	Pass

CHAPTER 4
CONCLUSION AND LEARNING OUTCOMES

4.1. Conclusion

During the internship at Beam Labs, the focus was on honing their skills in Flutter app development. The experience allowed the intern to gain practical insights into the complexities of developing location-based applications and how they can be tailored to meet specific user needs. Under the guidance of the Beam Labs team, they had the opportunity to work on a variety of tasks related to geofencing app development. This included hands-on experience with Flutter, a versatile framework for creating cross-platform mobile applications. They delved into the intricacies of geofencing, learning how to create and manage geographic boundaries and trigger events based on user location.

Additionally, they gained valuable exposure to backend development using the Fast API Python framework, which plays a critical role in handling the server-side logic of the geofencing app. This involved working with databases, particularly MySQL, to store and manage user data and geofencing-related information.

4.2. Learning Outcome

The learning outcomes from the internship at Beam Labs in geofencing app development were as follows:

- **Proficiency in Geofencing:**

  Through practical experience, the intern has acquired proficiency in geofencing technologies, including the ability to create, manage, and trigger events based on geographic boundaries.

- **Flutter Framework:**

  The internship provided an opportunity to gain expertise in using the Flutter framework for cross-platform mobile app development. This includes understanding Flutter's widget library and its role in creating visually appealing and responsive user interfaces.

- **Backend Development:**

  The intern gained hands-on experience with backend development using the Fast API Python framework. This encompasses designing and implementing server-side logic, handling API endpoints, and working with databases like MySQL.

- **Database Management**:

  Proficiency in database management, particularly with MySQL, was acquired. This includes the ability to store, retrieve, and manage user data and geofencing-related information efficiently.

- **Collaboration and Mentorship:**

  Collaboration with mentors and the Beam Labs team fostered a deeper understanding of industry best practices, teamwork, and communication skills.

- **Problem-Solving:**

  The internship provided opportunities to tackle real-world challenges in geofencing app development, enhancing problem-solving skills and the ability to troubleshoot issues.

- **Agile Development:**

  Exposure to Agile development methodologies enabled the intern to understand the value of iterative and user-centric approaches in software development.

- **Practical Application:**

  The intern gained practical experience in translating geofencing concepts and theoretical knowledge into functional and user-friendly mobile applications.

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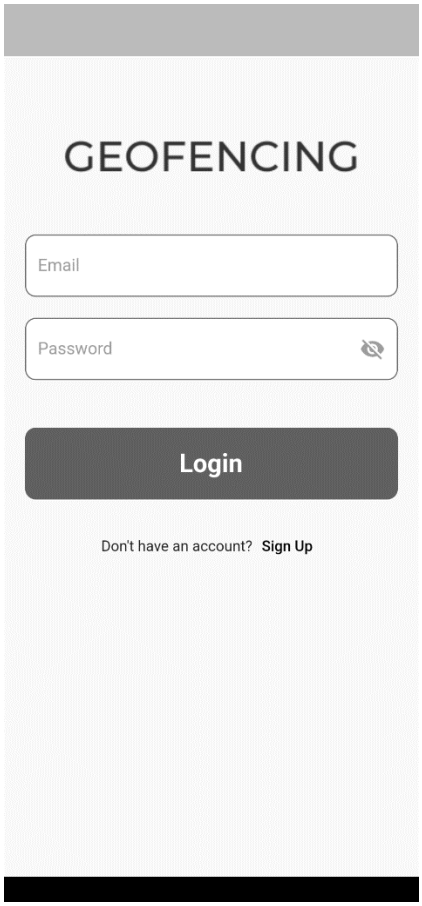
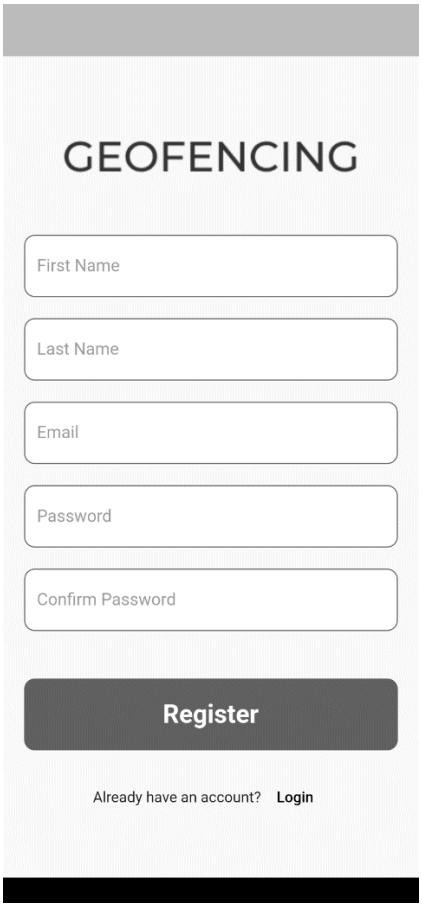
APPENDICES

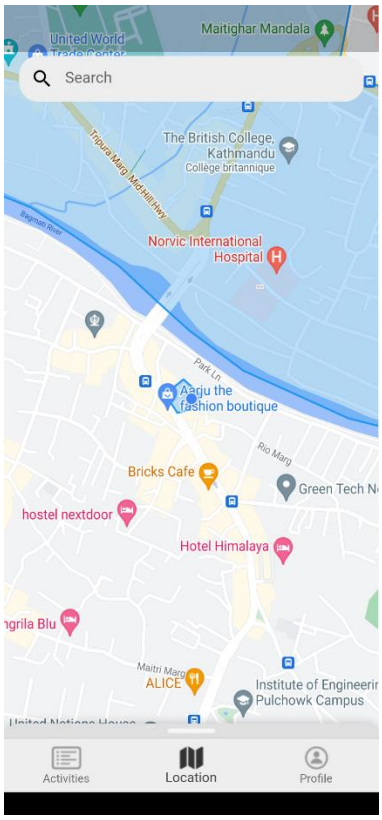
Login Screen



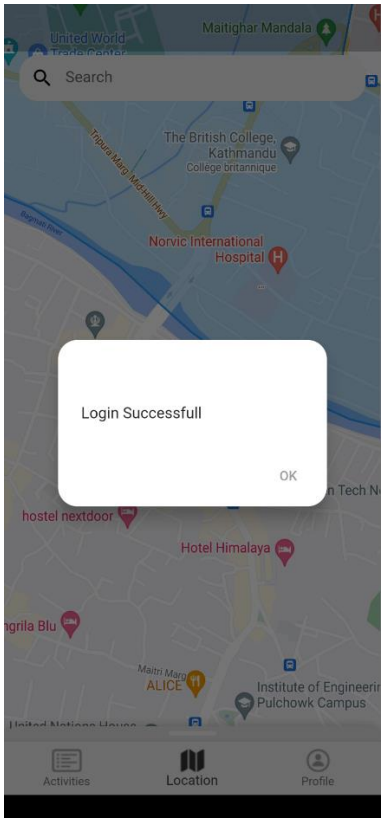
Register Screen



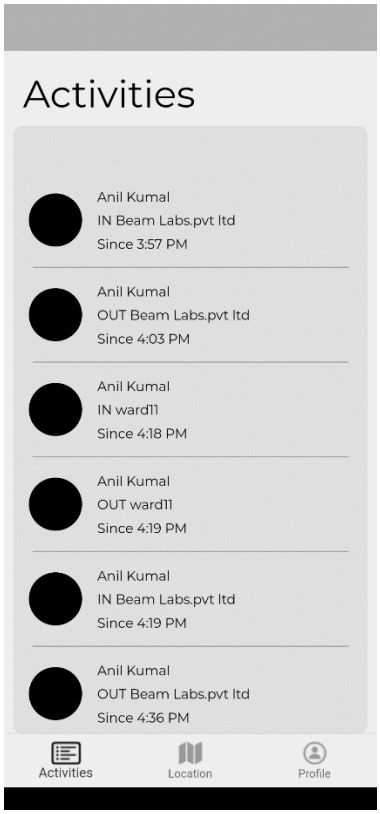
Home Screen



Successful login dialog



Activity Screen



Profile Screen