PUSL2021 Computing Group Project

Interim Report

One-Tap Mobile Application

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Group work: please list all names of all participants formally associated with this work and state whether the work was undertaken alone or as part of a team. Please note you may be required to identify individual responsibility for component parts.

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Signed on behalf of the group: _____ (Imaduwa Lakshitha-Group Leader)

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Chapter 1 - Introduction

With the advancement of time, mobile technology has improved even further making the mobile phone an essential component of our daily lives. So, it's no coincidence that the usage of mobile phones has become the focal point of attention in every area, including businesses. This increased the prominence of mobile applications making users demand more and more mobile apps for convenience and an easy lifestyle. Hence by considering the aforementioned factors, we propose the One Tap application, which is designed to gather, analyze, and store all student and lecturer information. One Tap application is designed to assist students, lecturers, and management teams by providing features such as attendance marking and monitoring, a payment gateway, a digital ID, a calendar with lecture material alerts, and a map to help students navigate the campus. The main objective of this project is to introduce mobility and automation to day-to-day activities, making it simpler for students, professors, and the management team to engage with each other. This application contains the functionalities of student information systems and manages all academic, administrative and fee management activities.

Definition of the problem

Nowadays majority of the students are much more familiar with the technology and the use of smart devices. We experienced that the current system at the University premises contains some issues and the current system can be modified with our solutions.

Here are some of the major issues we gathered,

1. Students can accidentally forget or misplace their student id, which can cause trouble entering the university premises and it may take a while to get a new id if they misplace it.
2. New students or guests might have a hard time looking for lecture halls, respective departments etc if they hardly know the university premises.
3. Payments can be made in various methods, but it would be so much easier if we could make all the necessary payments related to the university through one easy method.
4. The current LMS doesn't provide us with any notifications related to updated lectures, assignments or any other upcoming events and this may lead to students missing deadlines and facing much more issues.
5. The current attendance system creates an unnecessary queue at the entrance to the lecture halls since the QR code is placed at the entrance.

Overall, the current system at the university premises isn't up to its full potential and therefore it can be modified.

Project Objectives

1. **Entry using Mobile Phone with NFC Technology**

   Students can accidentally forget or misplace their student id, which can cause trouble entering the university premises. So as a solution, we've planned to enter the student's respective id into the mobile application, which can be used through NFC Technology.

2. **Map using Google API**

   New students or guests might have a hard time looking for lecture halls, respective departments etc, so as a solution we've thought of adding a map using Google API to our mobile application, which covers all the relevant departments, sections, lecture halls, canteens etc in the university.

3. **Payment Gateway using Stripe**

   Payments can be made in various methods, but it would be so much easier if we could make all the necessary payments related to the university through one easy method. Inserting a payment gateway into our mobile application can make that a reality and through this feature, students have the ability to pay semester fees, hostel fees, gym or pool fees etc using the same method.

4. **Calendar using Google Calendar API**

   The current LMS doesn't provide us with any notifications related to updated lectures, assignments or any other upcoming events. A calendar with the use of a database and Google Calendar API will be included in our mobile application to notify the students regarding all the relevant lecture updates, assignment details and deadlines and other upcoming events as well.

5. **Attendance tracking with the use of Geofence Technology**

   The current attendance system creates an unnecessary queue at the entrance to the lecture halls so to provide a solution we've planned on adding Geofence technology to our mobile application. It will automatically compute the attendance of the students who remained in the lecture hall for more than 1.5 hours.

Scope of the Project

Here are some of the limitations and the boundaries of our project.

1. Even though our app covers majority of the issues we found in the current system, we can't guarantee that students and staff would like to adopt into this new system instead of the current one.
2. Developing this mobile application including all the modifications can be challenging since we are still undergraduates and there can be technical challenges when developing this application and there's a possibility of compatibility issues with different types of smart devices.
3. Gathering resources to develop the mobile applications could be challenging. Funds, time, and expertise needs to be maintained thoroughly in order to develop and maintain the application.
4. The application needs sensitive private information of students and staff to provide the services. As a result, the application needs to ensure the privacy of the data which is a complex procedure.
5. The application constantly needs internet connectivity and if the user is in an area with poor connection or any access issues the application won't be able to function properly.
6. The success of this applications relies on user experience and if they find it hard to adopt there might be an issue.
7. The application is limited to the usage of students and staff mostly in the university premises and any outsider won't be able to engage.

Chapter Summary

In conclusion, the above chapter shows what is One Tap mobile application is about and how it solves the current problems and modify the current university system. The major aim of the application is to provide a much more enhanced experience of the services provided by the university for the target users such as internal students and staff to manage their daily work and manage information related to academics and administrative services.

Chapter 2 – System Analysis

Facts gathering techniques.

1. Observation: We observed that the current system contains those issues mentioned above since we as students who constantly engage with the current system.
2. Discussion: The main technique that we gathered information for our project was by discussing with our own teammates. In this way each of us shared our experiences and by that we came up with issues as all of us at some point faced those issues and we as a team discussed what we could do better to enhance the university experience among other students as well and as a result of that procedure, we came across these modifications we described earlier.

Current System

Students are supposed to use their student id card at all times when necessary, such as while entering and exiting university premises, to use the library services, to access gym and swimming pool premises etc. If the students or staff doesn't know where a particular building at the university premises are located, they must either ask somebody or they must follow up the map which is placed at each department, which could be a hustle if the person have no idea about the university. Students can make the payments at the admin or via online methods and for gym services they must pay at the gym, so therefore the current system doesn't allow the students to make the all the payment using one method at one place. The current LMS doesn't provide us with any notifications related to updated lectures, assignments or any other upcoming events, we can only see the updated item. The current attendance tracking system is using QR codes at the entrance of each lecture hall and this can be an issue when there's a lot of students lined up to scan the QR code and this way isn't accurate sometimes.

Use Case Diagram
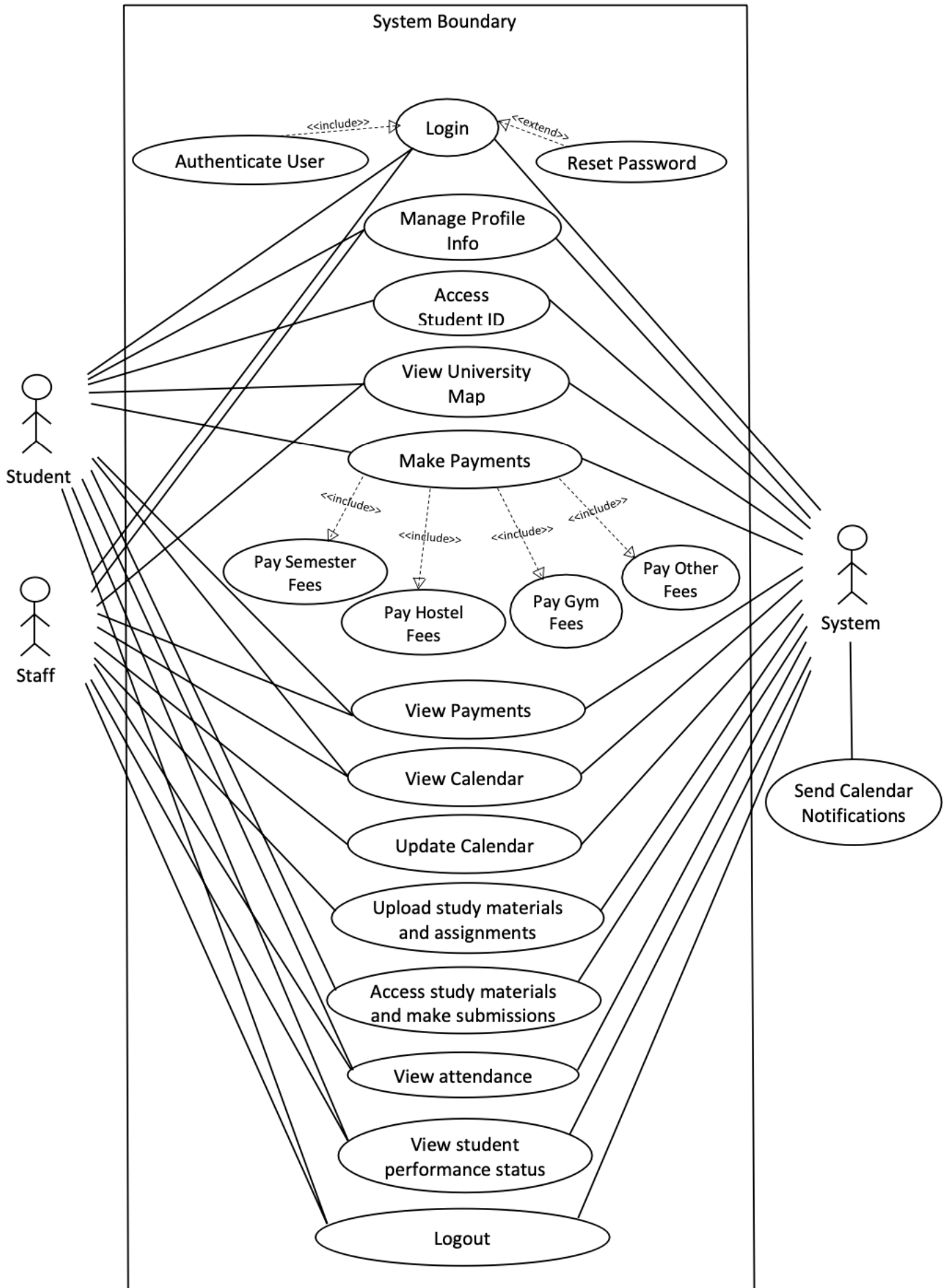
Chapter Summary

The current system at the university contains some errors and we as a group had a discussion and identified how we could modify those for a better experience. Need to use the student id to use the services at the university premises, need to find the buildings or any other location in the manual way, having to make payments at different locations and methods, need to check the LMS to get to know about the updated content since there's no notifications, need to scan the QR code to mark attendance, these are the features of the current system that we came across after our discussion.

Chapter 3 – Requirement Specifications

Functional Requirements

- NFC Integration: The application needs to connect with the mobile phone's NFC technology in order for the student to use the student Id to enter university premises and so on.
- Map Integration: The application needs to connect with Google Maps API in order to generate the map of the university premises including all the departments, lecture halls, canteens etc.
- Payment Gateway Integration: The application needs to connect with Stripe in order for students to make payments.
- Calendar Integration: The application needs to connect with Google Calendar API in order to generate notifications when lectures, events and assignments are updated.
- Attendance Tracking: The application needs to use geofence technology in order to mark student's attendance when he or she remains in the lecture hall for more than 1.5 hours.
- Performance Tracking: The application needs to have options which will allow students to check their academic performance, attendance status, access study materials and submit assignments etc.
- User Accounts: The application needs to have options which will allow students and staff to create their user accounts, manage accounts and access relevant services.
- User Roles and Permissions: The application needs to have options to choose different roles such as student or staff to manage information precisely.
- Push Notifications: The application needs to be able to send notifications to student and staff regarding updated events, deadlines, lectures etc.
- Database Management: The application needs to have a database in order to store information of student and staff.
- Security: The application needs to have strong level of security using encryption and secure login.

Non-Functional Requirements

- Security: The application needs to be able to store students and staff information securely using encryption methods, secure authentication and secure communication protocols since the data are sensitive.
- Performance: The application needs to be able to respond fast with minimal amounts of lag times ensuring that the features and services execute smoothly.
- Usability: The application needs to be user friendly with a creative interface including clear and precise instructions on how to use the application and this should be simple because

anyone with or without technical expertise should be able to understand how to use the application.

- Reliability: The application needs to be able to maintain its services with minimal service interruptions and errors and it should be able to handle user traffic and user requests.

- Scalability: The application needs to be able to scale up the performance according to user demands and it should be able to handle multiple user transactions and other services without downgrading its performance.

- Accessibility: The application needs to be able to access by anyone without having to be an expert in technology.

- Compatibility: The application needs to be able to use in a wide range of mobile devices across many operating systems without downgrading its performance or services giving the user a better experience.

Performance Requirements

- Entering university premises with the use of a mobile device which is integrated with NFC technology. NFC technology will read the student's id precisely at the entry and this should be much more efficient than using the student id card.

- The map of the university which is integrated using the Google Map API will load into user's mobile phone upon request and it'll allow to search the desired destination. The map should provide accurate information and it should be up to date with the university locations.

- The payment gateway using Stripe needs to be efficient, reliable, and secure. It should provide various payment methods and the transactions must be on time and precise.

- The calendar which is integrated with Google Calendar API should be updated real-time after any changes made to the calendar and respective notifications should be sent to all the students and staff.

- Attendance tracking with the use of Geofence technology should be precise and efficient by recording the attendance real-time and it should be able to handle multiple records at a time without any performance errors.

Security Requirements

- Authentication and Authorization: The application needs to contain a secure login option which only allows authorized users to access the services of the application.

- Data Protection: The application should be able to protect sensitive user data and records by encryption and other secure storage methods.

- Secure Communication: The application should encrypt and secure all the communication among the users and the relevant servers.

- Access Control: The application should only allow access to information based on the user

role.

- Secure Payment Gateway: The application must use secure methods and encryption to protect the financial data and transactions at all costs.
- Mobile Device Security: The application needs to be secured by any form of malware that could come through the mobile device.
- Secure Database: The database which is used to store all the data of the application should be secured through access controls, encryption, and backups.

Hardware Requirements

- A computer which can be used to develop the software application.
- Mobile devices of different types and operating systems to check the performance of the mobile application.
- Mobile phones with NFC Technology
- Mobile phones and devices with GPS and Geofence technology.

Networking Requirements

- Internet Connection: The application needs a constant internet connection while using it to get services from the servers to the application and perform relevant tasks.
- API Integration: The application uses Google Calendar API, Google Maps API and Stripe Payment API and these needs to be connected to a constant internet connection in order to be functional.
- Secure Data Transmission: The application uses and handles sensitive data, and this leads to using encryption protocols to protect data against any type of threats.
- Scalability: The application needs to be able to handle multiple concurrent access without losing its demand and performance by maintaining its server infrastructure.

Chapter Summary

This chapter shows clear and elaborative details about the requirements of our software application ranging from functional, non-functional, performance, security, hardware, and networking requirements. In conclusion, fulfilling the above requirements will definitely help us to build a cross-platformed, functional and successful application while giving a better experience to the user to fulfill their daily needs in a much convenient and an effective way making their lives better and easier compared to the current system.

Chapter 4 – Feasibility Study

Economic Feasibility

The following information shows the costs and benefits associated with the One Tap application and ensures whether the project generate a good revenue that exceeds the costs associated in developing the project.

Costs

The cost of the NFC technology will be about 5,000 LKR for development purposes, and the database will be a recurring expense of 3,500 LKR per month for testing and maintenance. In addition, there won't be any hardware costs.

Benefits

- ✓ Revenue generation – This app has the potential to show targeted ads to students for revenue generation. In addition to the free resources for students we can offer premium features that give students exclusive access to online study materials and other resources
- ✓ Cost savings – As this app automates certain processes such as payment processing it may lower the operational costs and increase the efficiency.
- ✓ Customer retention – This app provides a simple and easy way to access all the services which may help in increasing customer satisfaction and loyalty

The above-mentioned factors depict the cost and benefits associated with the One Tap application. Through this cost benefit analysis, we can ensure that the benefits outweigh the costs. Hence, we can conclude that this project is economically feasible.

Operational Feasibility

By utilizing available technology, resources, infrastructure and can implement this project into the university. In the operational feasibility analysis following factors were considered

1. Compatibility – We are developing this app to be compatible on various devices which helps to reach larger audience and provide a better user experience.
2. Accessibility – We are following the and adhering to the accessibility standards and guidelines to make the app accessible for all users
3. User-friendly – The app consists of simple and interactive interfaces so all the users including the staff, students and admins can easily use the app without any prior learning.

4. Training and support – If necessary required training support and resources can be provided for you. The support team is responsive to all user questions and concerns. This ensures that the everyone in the university utilize this app.

All the aforementioned factors contribute to the operational feasibility of this application and to provide a better user experience.

Technical Feasibility

We have examined all of the technologies and tools available during the technical feasibility analysis process to make sure that this application can be developed using the technology currently in use. The following details showcase that the application can be developed with the available technology

The target users in this scenario are most likely to be using android or iOS. So, we have planning to develop this application for these platforms using the necessary programming languages.

With the use of database architectures and optimization techniques we are designing this application to handle large number of users and data volumes without any performance instability.

Furthermore, this app is developed in a way that is easy to update and maintain and we will be providing newer versions of the application to optimize the app further and provide a smooth user experience.

So, we are utilizing the modern to make this app technically viable and this can be developed and maintained with the available technology.

Organizational Feasibility

To consider the organizational feasibility of this app we have analyzed all the resources and skills to develop and launch this application. Here are some factors we considered to confirm the organizational viability of this app.

1. Resources and expertise – We have all the necessary software and members who are qualified for every aspect of our project. Therefore, it is certain that we can create and release this app without experiencing any issues caused by limited resources or expertise.
2. Marketing and distribution – We have identified the target users of this app which are students, lecturers, and admins. So, this app will be marketed among the above-mentioned target users.
3. Legal and regulatory considerations – We are developing this app by meeting all the legal standards related to app development. Hence, we guarantee all the legal standards such as data privacy, intellectual property rights and terms of use.

Outline Budget

There will be no hardware costs for this project because no hardware tools are required. Both Android Studio IDE and Visual Studio IDE, which we will be using, are free to use. In addition, there will be a monthly maintenance fee for the database of about Rs. 3500 and some fees for third party libraries.

Chapter Summary

The viability of the One Tap app in terms of business, operations, technology, and organization has been examined. Due to cost savings and potential revenue generation, the app is economically feasible. It is accessible, user-friendly, and operationally feasible. Technically speaking, the app using available programming languages. We have analyzed and confirmed the organizational feasibility of this app by considering the legal standards such as data privacy, intellectual property rights and terms of use.

Chapter 5 – System Architecture

The system architecture of One Tap Mobile Application is divided into 3 main categories.

1. Front-end: Front-end is the user interface that the users interact with in order to use the services of the mobile application. The front-end will be developed using modern cross-platform compatible mobile application development frameworks such as React Native.

2. Back-end: Back-end is the server side of the mobile application which is responsible for data storage and processing. The back-end will be developed using Node JS and MySQL database which will maintain the performance and standards of the application making it a success.

3. Third-party API Integration: One Tap mobile application uses third party APIs such as Google Maps, Google Calendar, and Stripe to enable location services, calendar notifications and payment options to improve the user experience and deliver a better performing application.

Class Diagram

ClassName
property_name: type
method(): type
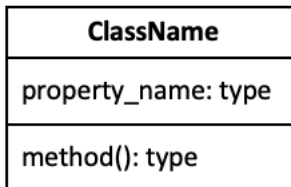
Class: Class contain properties and methods.
        Abstract classes are defined by *italic* class names.

<<enumeration>> EnumerationName
EnumerationLiteral1 EnumerationLiteral2 EnumerationLiteral3
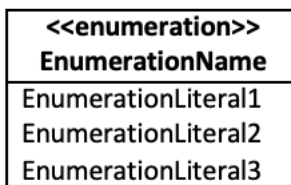
Enumeration: Enumeration contains a list of named identifiers.

<<dateType>> PropertyName
Value: type Value: type
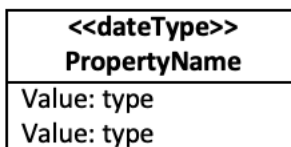
Date Type Classifier: Contains multiple values of a property.
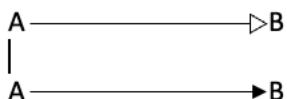
A ————————▷B   Inheritance: A inherits from B, A "is-a" B.

A ————————►B   Uni-directional Association: A can call B, but B can't call A.

A◆————————B   Composition: A "has-an" instance of B, B can't exist without A.

Map
+placeId: string
+placeName: string
+placeType: string
+placeLocation: string
+description: string
+searchMap (): string

Person
+name: string
+email: string
+nic: string
+phone: string
+dob: string
+address: string
+joinedDate: date
+username: string
+password: string

+isActive(): bool
+registerAccount(): bool
+resetPassword(): bool
+editProfile(): string
+viewMap(): list<Map>
+viewPayment(): list<Payment>
+vewCalendar(): list<Calendar>
+viewStudyMaterial(): list<Study_Material>
+viewAttendace(): list<Attendance>

Study_Material
+name: string
+module: string
+assignedBy: string
+description: string
+addSubmission: string

use 1 / * *access* 1

1 *uses* *

Calendar
+date: date
+eventList: Event
+lectureList: Lecture
+assignmentList: Assignment

Student
+studentId: string
+studentEmail: string
+degree: string
+batch: string
+accessStudentId(): string
+attendanceRecorded(): list<Attendance>

extends

Staff
+staffId: string
+staffEmail: string
+responsibility: string
+qualification: string
+previousExperience: string
+salary: double
+updateCalendar(): list<Calendar>
+updateStudyMaterial(): list<Study_Material>
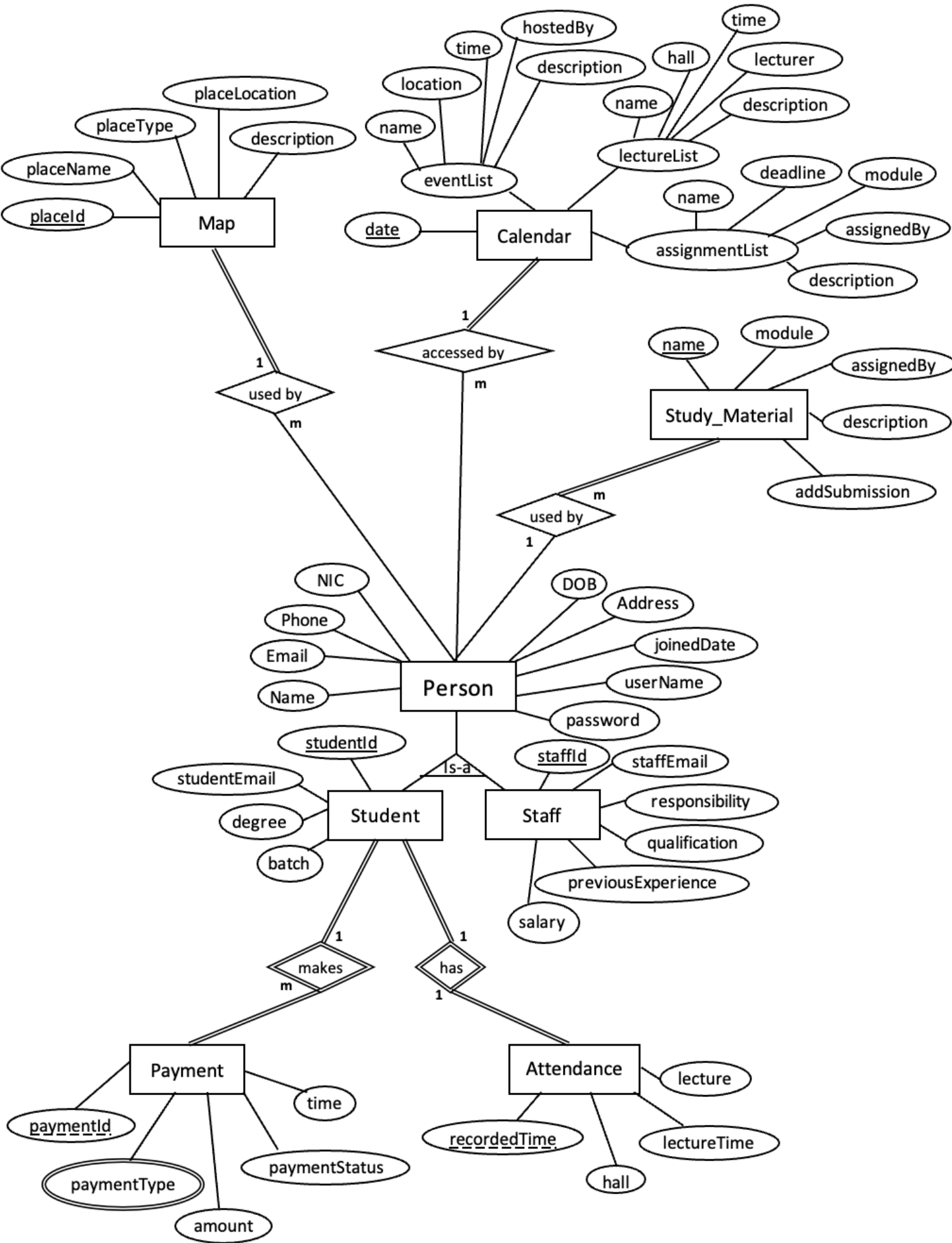
extends

makes 1 / * — *has* 1 / 1

Payment
+paymentId: string
+paymentType: Pay_Type
+amount: double
+time: datetime
+paymentStatus: string

Attendance
+recordedTime: datetime
+studentId: string
+lecture: string
+lectureTime: datetime
+hall: string

<<datatype>> Event
name: string
location: string
time: datetime
hostedBy: string
description: string

<<datatype>> Lecture
name: string
time: datetime
hall: string
lecturer: string
description: string

<<datatype>> Assignment
name: string
deadline: datetime
module: string
assignedBy: string
description: string

<<enumeration>> Pay_Type
Semester_Fee
Hostel_Fee
Gym_Fee
Other_Fee

18

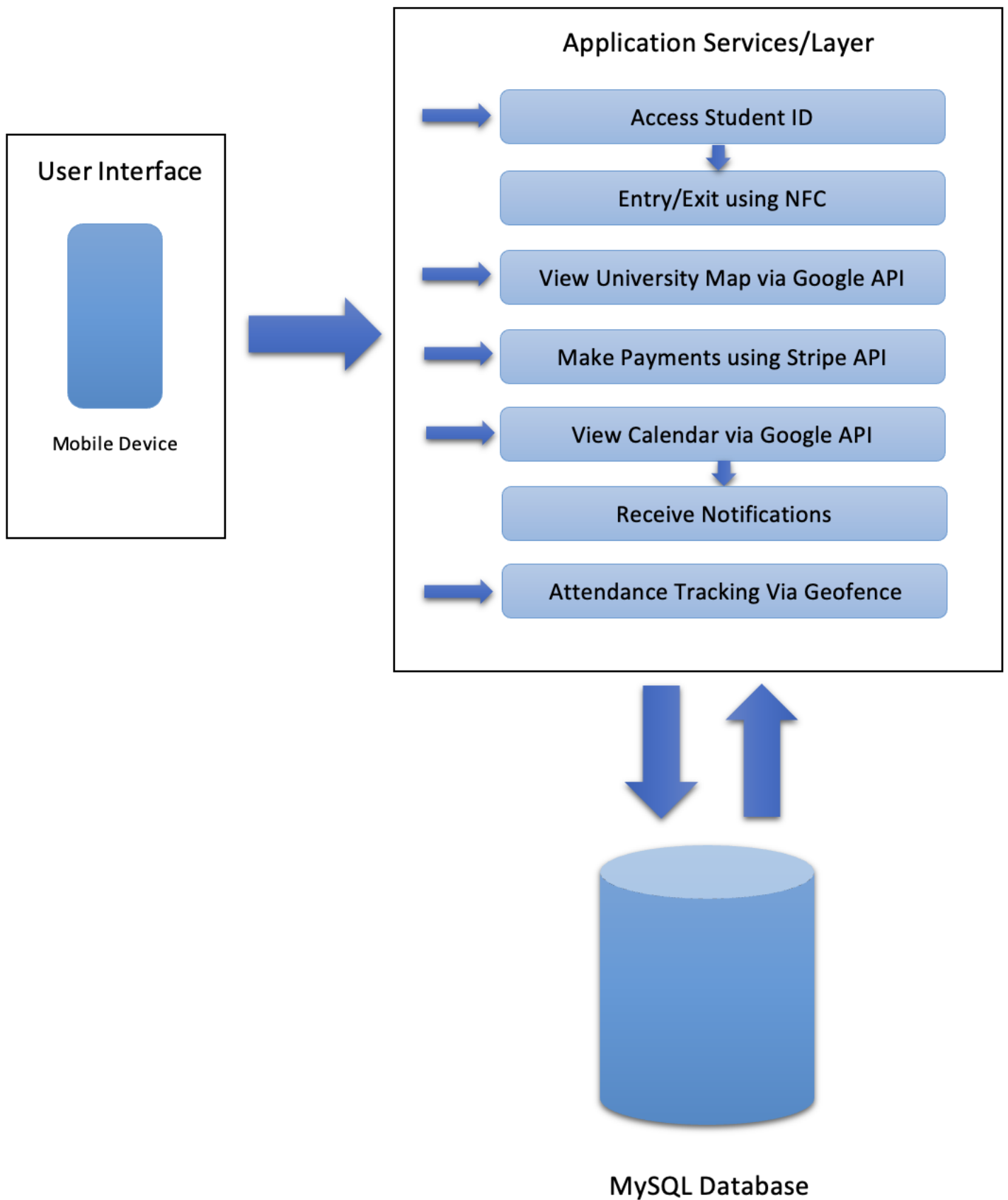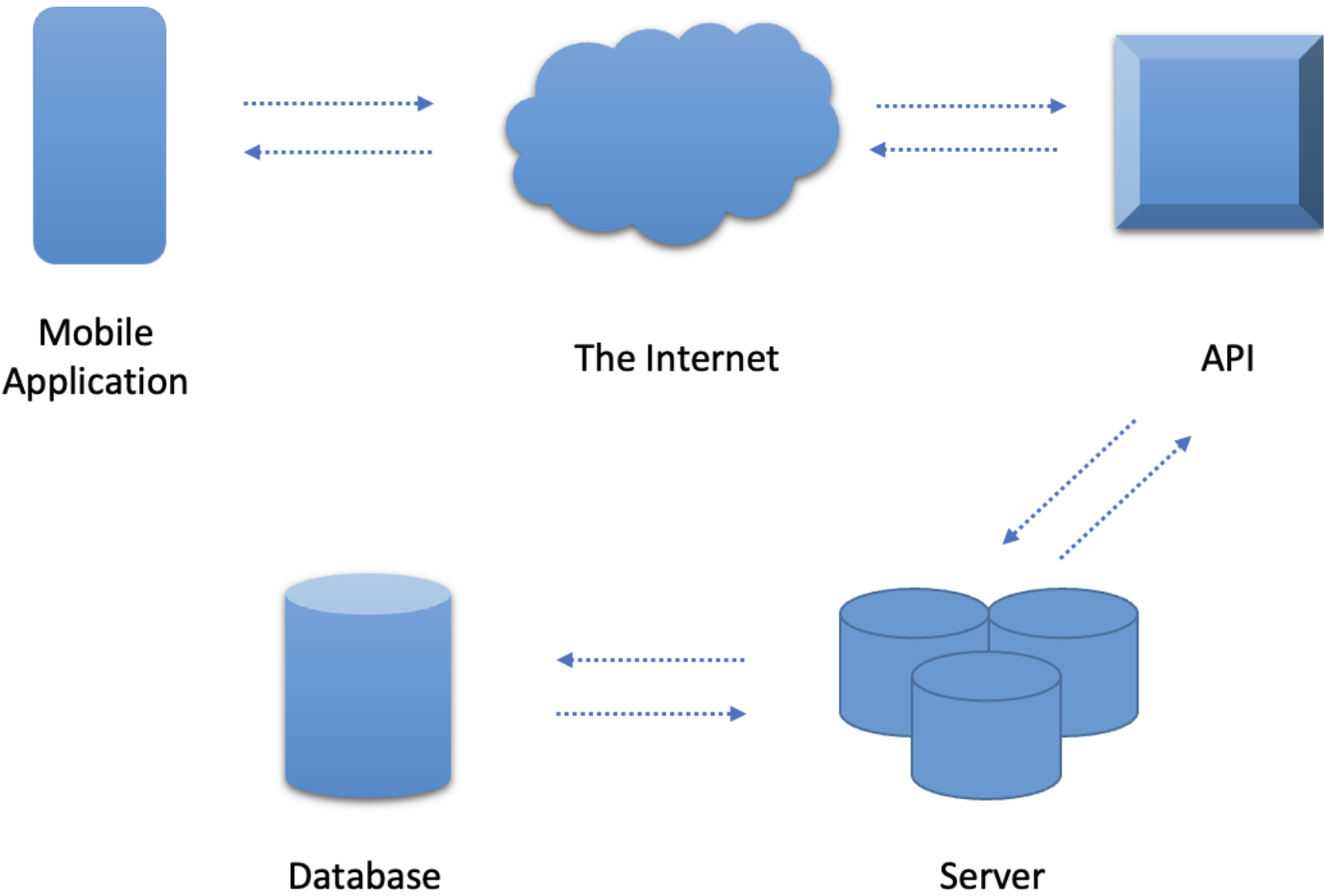## ER Diagram

Assumptions

1. One map is used by many persons.
2. One calendar is accessed by many persons.
3. One person uses many study_material.
4. Many persons use one study_material.
5. One student makes many payments.
6. One payment is made by only one student.
7. Many students make many payments.
8. One student has only one attendance per lecture.
9. One student has many attendances overall.
10. Many students have many attendances.

High Level Architectural Diagram

Application Services/Layer

- Access Student ID
- Entry/Exit using NFC
- View University Map via Google API
- Make Payments using Stripe API
- View Calendar via Google API
- Receive Notifications
- Attendance Tracking Via Geofence

User Interface

Mobile Device

MySQL Database

Network Diagram (Optional)

Mobile Application

The Internet

API

Database

Server

Chapter 6 – Development Tools and Technology

Development Methodologies

Based on the features and functionalities of our application the agile development model would be the ideal development methodology. One of the main reasons to select the agile development model is the flexibility. unlike other development technologies the agile development enables to add ongoing user adaptation and changes. When developing a mobile application, we should be able to alter the requirements and make changes even during the development process. The agile development model allows us to alter the requirements. Design and functionality at any time during the development process.

By using this development methodology, we can break down the project into smaller sprints and each sprint will produce a specific set of functionalities. After producing the functionalities in iterative cycles that functionalities will be tested at a time which helps to identify the issues on the early stages of development. As this application consist of various user groups like students, lecturers and admins we should be able to communicate between the designers, developers and other stakeholders. Furthermore, we can gather user feedback from the user groups and develop the application with the most suitable features and functionalities.

By using this agile development model, we can keep the customer engaged throughout the project. This makes sure that all the group works towards achieving one specific goal. The agile approach allows frequent feedback and communication with the customer, and it also allows test the product on a regular basis. This ensures higher customer satisfaction and ensures that the app meets the accurate user requirements.

The aforementioned factors clearly state why using the agile development model for the One Tap application is the ideal solution as its ensures that the product is developed successfully in order to deliver a high level of customer satisfaction.

Programming Languages and Tools

For the application development process, we use different programming languages and tools for the front-end and back-end.

1. Front-end development
- ✓ React Native – We use react native to design the front-end to improve development productivity, reduce bugs and to ensure that the app is compatible with cross - platform development tools.

- ✓ VS Code IDE – We use VS Code IDE because it can be easily use with a software development kit and the emulator. This helps to make sure that the code works perfectly on various kinds of devices.

2. Back-end development
- ✓ Node.js – We use Node.js as a server-side scripting language
- ✓ SQL – For the backend purpose we are using Relational Database Management System like SQL for the data storing, retrieving and management purposes

3. API's
- ✓ Google API – We are adding the map of the university using the google API
- ✓ Google Calendar API – We are using the Google Calendar API to display the calendar with schedules, events, and reminder notifications
- ✓ Stripe API – Through the stripe API we are creating an online payment gateway

Third Party Tools and Libraries

1. Maps – For the tracking purposes a third-party map like google maps should be used.
2. Push notification – For the push notification feature of this app we are planning on using Firebase Cloud Messages.
3. Payment gateway – In order to add the fee payment feature, we will use Stripe payment gateway.

Algorithms

Based on the requirements and functionalities of our One Tap application project we should use the following algorithms.

1. Algorithm for authentication – An algorithm is required to authenticate the users when they log into the app. The user login details will be compared with the credentials stored in the database to grant access to the app
2. Algorithm for notifications – An algorithm should be used to notify the users about new messages, schedules, events etc.
3. Algorithms used in geofencing – We are setting up virtual boundaries of the university premises using this algorithm. So, when the user enters this virtual boundary we can send notifications, alerts, updates etc.

Hardware Tools

In order to successfully produce and launch this app the following basic hardware tools are required

- Computers (To write, test and manage the code)
- Mobile devices (To check the compatibility and user experience of the app)
- Networking tools (To establish connectivity to develop the app and to test the app's connectivity to internet services)
- External storage devices (To backup app data)

Chapter Summary

This chapter gives out a detailed description on how One Tap mobile application will be developed. To conclude, we will use agile development methodology, along with front-end and back-end development tools such as react native, node js, sql and the third party APIs such as google maps, google calendar and stripe payment gateway to make our mobile application executable.

Chapter 7 – Discussion

Overview and Summary

In conclusion, we have elaborated what is the project about, it's objectives, the solutions we have gathered for the problem scenarios, how the new modifications will improve the user experience compared to the current system, how we gathered the necessary facts and requirements, what are the specific requirements such as; functional requirements, non-functional requirements, performance requirements, security requirements, hardware requirements, network requirements and how feasible our project is in terms of economic, operational, technical, organizational and what type of development tools and technologies we use. Therefore, we believe that through this report we have provided a detailed summary of our project, One Tap Mobile Application.

Challenges Faced

Gathering facts, considering and suggesting modifications, learning new technologies and using them to develop a mobile application, believing that users will adopt the new application, delivering an application with new modifications are some of the challenges we faced while developing this application.

Development Tasks

User interface design, NFC integration, map integration, payment gateway integration, calendar integration, push notification integration, attendance tracking with geofence technology, database integration and backend development and quality assurance are the major development tasks we have to carry out in order to develop One Tap mobile application.

Future Plan

We as a team are hoping to deliver the application with the modifications mentioned and we are hoping to update the application and keep it up to date in future as well giving its users a better experience with modern features.

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Team Plan and Responsibilities

Member	Plymouth Index No	Name	Tasks Carried out	Future Plan	Comments by the group leader
1	10819581	Basnayake Basnayake	Backend Development, Documentation	Backend Development, Documentation	Contributed as a part of the team.
2	10818166	Weerathunga De Seram	Backend Development	Backend Development	Contributed as a part of the team.
3	10818122	Leo Felcianas	Backend Development	Backend Development	Contributed as a part of the team.
4	10818458	Hettige Fernando	Frontend Development, Documentation	Frontend Development, Documentation	Contributed as a part of the team.
5	10818149	Imaduwa Lakshitha(Group Leader)	Frontend Development	Frontend Development	Contributed as a part of the team.