Campus Study Buddy: Collaborative Learning and Resource Sharing App

By

Huang Yifan

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Faculty of Information and Communication Technology
(Kampar Campus)

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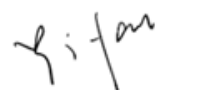# UNIVERSITI TUNKU ABDUL RAHMAN

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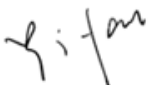
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ABSTRACT

The trend of modernization and digitization of education is developing. Today, many educational institutions are using learning management systems to improve their operational efficiency. However, most of the existing learning management systems focus on improving the administrative and teaching capabilities of educational institutions, and lack the encouragement of students' collaborative learning and the ability to improve students' learning motivation.

This project is aiming to create a mobile application based on Android. Higher education institutions can use this program to provide students with a platform to collaborate and support each other's learning, creating a collaborative learning environment, promoting knowledge sharing, and improving student academic success. The application is developed using Flutter and uses a tag recommendation algorithm to push content that users may be interested in, thereby intelligently providing users with an online learning environment that suits them and improving their learning efficiency. Compared with other LMS, this application provides more interactive social elements and a resource directory that facilitates students' campus life.

An incremental development approach is adopted in the project. The final deliverable of the project is an Android mobile application that integrates Google Cloud and Google Firebase while providing basic functions. The delivered application allows users to get started quickly and allows students to use it as a learning companion to enhance the learning experience. It is also highly customizable, allowing the system to quickly adapt to organizational requirements.

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LIST OF ABBREVIATIONS

LMS	Learning Management Systems
CPU	Central Processing Unit
GPU	Graphics Processing Unit
SaaS	Software as a Service
OS	Operating System
RAM	Random-Access Memory
UI	User-Interface
PIN	Personal Identification Number
AMD	Advanced Micro Devices
SSD	Solid-State Drive
NVMe	Nonvolatile Memory Express
DDR4	Double Data Rate 4
SoC	System on a Chip
IDE	Integrated Development Environment
MVC	Model-View-Controller
WBLE	Web-Based Learning Environment
URL	Uniform Resource Locator
IT	Information Technology
QR	Quick Response
C2C	Client to Client
SDLC	Software Development Life Cycle
FPS	Frame Per Second
JSON	JavaScript Object Notation

CHAPTER 1

Introduction

1.1   Introduction

In recent years, with the vigorous development of information technology and the popularization of smart devices, more and more scenarios are applying these new opportunities to enhance their capabilities. As one of the most important basic fields of human society, education is also accelerating the pace of digitalization. Information technology has changed people's learning methods and methods [1]. Students can take classes online and discuss assignments through the Internet.

The development of mobile Internet and mobile phones makes it possible for people to learn anytime and anywhere, and provides a basis for resource sharing. Students have a more convenient way to participate in learning and improve their academic performance. In this project, an Android application is proposed that supports students' collaborative learning and allows them to share resources. This chapter briefly introduces the background, problem statement, project scope and goals, project motivation, and innovation.

1.2   Project Background

So far, many higher education institutions are using learning management systems (LMS) to support their online learning and teaching abilities [2]. At the same time, many applications allow students to have online collaborative learning, such as Google Classroom, Microsoft Teams, Moodle, etc., which provide students with an online learning environment and necessary functions such as video and voice calls. These information systems help educational institutions facilitate teaching and make it easier to share learning resources.

However, the primary beneficiaries of these applications are educational institutions. Although these online learning applications also provide a certain degree of convenience for students' learning, such as allowing students to take classes online

1

anywhere, they still lack strong support for collaborative learning among student groups. A solid proof to support this view is that most of the permissions of these applications are not open to student users. Student users only have some necessary permissions, such as participating in online classes initiated by teachers, downloading resources released by teachers, and posting comments. Other functions that can help students learn collaboratively, such as question and answer forums, establishing student groups, and classroom groups, are either missing or have limited permissions.

Not only that, because most of the systems mentioned are not specifically created for educational institutions, but are general tools, their functionality in the field of collaborative learning is lacking to varying degrees, especially the lack of interaction between students. For example, Google Classroom, which is used as an online teaching platform, does not have the function to support student collaborative learning. Since chat in conference rooms is time-limited, students' ability to communicate on this platform will be greatly limited. Meeting rooms also provide no real-time user-to-user connection, making it difficult for students to connect with classmates and friends who have similar academic goals. This will limit students' ability to learn collaboratively because the platform offers limited functionality.

Additionally, current learning systems do not provide a one-stop solution for students. Students often need to use multiple systems to meet their requirements due to a single system cannot meet their functional needs, which adds extra trouble to students' learning.

As a result, students lack a dedicated platform to support each other's academic endeavors. This platform should facilitate collaborative learning and resource sharing among students on campus. It should also provide a channel for students to connect, share study materials, collaborate on projects, and support each other's academic endeavors.

1.3   Problem Statement

1.3.1   Existing systems do not meet students' collaboration needs

In order to improve the effectiveness of students' online learning, an effective learning community is necessary, which allows students to feel connected to their peers and teachers and participate in collaborative learning assignments [3], [4], [5]. However, the systems currently on the market lack the construction of learning communities and focus more on providing management convenience for educational institutions. This leads to the lack of social elements and imperfect collaborative learning functions. Students lack an effective collaborative learning environment to improve their learning efficiency.

1.3.2   Lack of dedicated platforms to support collaborative learning among students

A specialized application can handle specific tasks more efficiently than a general-purpose application. At the same time, it often provides a better user experience for its intended purpose. For example, a system dedicated to education can also provide a campus resource directory, allowing students to quickly access campus resources to improve the quality of students' campus life. Existing systems are mostly designed as general-purpose applications, supporting both enterprise and university users, with blurred lines between education and business. Students lack a dedicated system that provides them with a collaborative learning environment and helps them improve their academic performance.

1.3.3   The existing system lacks a knowledge retention mechanism

The retention of knowledge in a learning system is a very important indicator. An excellent learning system should allow the retention of high-quality knowledge generated by past users, and provide an index to allow subsequent users to directly access it. For example, if a student discusses a question, other students should also be able to see the question and its discussion content. This can avoid unnecessary and inefficient repeated questions and improve students' learning efficiency.

1.4   Project Motivation

Many studies have shown that the process of cooperative learning can bring students a better understanding and improve students learning levels. Compared with learning alone, cooperative learning can enable students to retain more new information [6], [7], [8], [9].

Since the current online learning apps mentioned in project background are not specifically created for learning, but for general purpose. The online learning experience for students still needs to be improved. Although the learning platform has been switched from offline to online to provide convenience for students, it sacrifices some of the communication space between students. Students cannot communicate as freely as offline but have to work within the existing system framework. The existing system provides few collaborative learning functions and social functions, resulting in limited communication between students on the Internet. Students cannot quickly get in touch with classmates related to their majors or courses, and it is very troublesome to find classmates with similar preferences. This is not conducive to students' collaborative learning.

Not only that, because the current system mainly focuses on general use, it only provides students with online class-related functions and does not provide students with information about campus resources. Providing students with adequate guidance on campus resources is also a very important function that can improve students' campus life. In the current scenario, students are required to switch between multiple systems to meet their needs.

There are also studies showing that digital learning can improve students' learning motivation, and gamifying learning through digital technology can make it more interesting and diverse [10]. Therefore, the learning platform should improve the fun of learning through some gamification-like means, to encourage students to learn. For example, add more social elements in the system, such as user learning points and learning badges for display, to promote students' initiative in using the system. Existing systems are still lacking in this regard.

At the same time, most of the knowledge storage in existing learning systems is time-sensitive, and it is very inconvenient to query information. For example, in Google Classroom, students' questions cannot be saved permanently. Once the session expires, students' questions and answers will be lost. Even though Microsoft Teams provides the function of saving students' conversation records, the way to review it is very cumbersome. Students need to find what they need among a large number of reply messages in the chat box, which brings additional trouble.

Therefore, this project aims to create a system that will complement the existing system's deficiencies in collaborative learning and provide students with an adequate collaborative learning environment. The system will improve the knowledge retention mechanism to facilitate students' inquiry of past knowledge, and also provide a campus resource directory to improve students' quality of campus life. The project will ultimately provide students with a one-stop learning assistant system that will improve their online collaborative learning experience and ultimately improve their academic success.

1.5   Project Objectives

The project aims to study how to enhance students' collaborative learning experience and improve the quality of their campus life through IT systems, providing a platform for students to connect, share learning materials, collaborate on projects and support each other's academic efforts.

The project consists of the following three objectives.
1. To design and implement a user interface that meets Material 3 Android application design standards to ensure its accessibility and user-friendliness.

2. To develop and implement recommendation algorithms and network functions to enhance interaction between students in online learning activities

3. To develop an Android-based mobile application called Campus Study Buddy to facilitate collaborative learning and resource sharing among students on campus.

1.6   Project Scope

The project will focus on developing an Android-based mobile application targeting university students and staff. The application can provide target groups with online Q&A, online communication, group formation, finding partners with similar preferences, campus resource directory, and AI assistant functions. The application will enhance the online collaborative learning experience of the target group and improve the quality of their campus life.

1.7   Project Contribution

By creating a collaborative learning application specifically for educational purpose, this project can improve the digital level of educational institutions and help their students have a better online learning experience.

A dedicated learning companion app that integrates features designed for collaborative learning and knowledge sharing. The application takes into account both versatility and scalability at the underlying design level, and has good development prospects. The collaborative learning features and social elements integrated into the app will be a huge plus to students' learning experience. By providing a collaborative learning environment, such as online Q&A, knowledge base, online communication, AI assistant functions, and integrating social elements to improve students' learning motivation, improve students' online collaborative learning experience, thereby improving students' academic performance. The provision of a campus resource directory can help students find relevant resources on campus faster and more conveniently, thereby improving the quality of students' campus life.

The recommendation algorithm has not been deeply reflected in the current online learning system. This system makes up for this part. It uses the recommendation algorithm to recommend relevant course knowledge to students, classmates with common preferences, and accelerates students' socialization and learning, thereby improving Student academic performance.

1.8   Report Organization

This report has 7 chapters:

Chapter 1 Introduction, including project background, project motivation, problem statement, project goals, project scope, project contributions, and the organizational structure of the report. Its main purpose is to briefly describe the basic information of the project.

Chapter 2 Literature Review, including a review of similar systems and a review of development methods. This chapter compares the existing system and the system proposed in this project in detail, and proposes a development method suitable for the project.

Chapter 3 System Methodology/Approach, details the system development method, the hardware and software involved in the development process. It also shows the work breakdown structure and Gantt chart of this project, and plans the project timeline and milestones.

Chapter 4 System Design, in this chapter, the overall design ideas, system architecture, system flow chart, and system requirements of the system are described in detail. At the same time, Low Fidelity User Interface Design, Database Design, Use Case Modelling, and Activity Diagram are explained.

Chapter 5 System Implementation, this chapter reports the specific implementation method of the system, shows the results of the system implementation, and analyses the difficulties and challenges encountered during the system implementation.

Chapter 6 System Evaluation and Discussion, includes the testing process of the complete system, shows the availability and reliability of the main functions, and discusses the current status of the system.

Chapter 7 Conclusion and Recommendation, reports the overall situation and completion of this project, and discusses the possible future improvements of the system.

CHAPTER 2

Literature Reviews

2.1   Introduction

Review of past research results and existing systems is necessary for developing new systems. It can provide necessary experience for this project and provide inspiration for project progress.

In this chapter, 5 existing systems are reviewed to enhance the knowledge base of this project and provide a reference for the development direction of the project. Additionally, 4 system development methods were also reviewed to select the development method suitable for this project.

2.2   Review of Existing Similar Systems

2.2.1   Google Classroom

Google Classroom is a typical online learning management system. It comes from Google, a well-known global Internet company. This system has an advantage that other systems cannot match in assisting learning. Relying on Google's Internet capabilities, Google Classroom has an extremely complete supporting program. It allows teachers to start live webcasts for online teaching and also allows students to share files through Google Drive. The integrated Google Calendar can provide users with perfect reminder service. Teachers can quickly start courses. Students can also study anytime, anywhere using any of their devices.
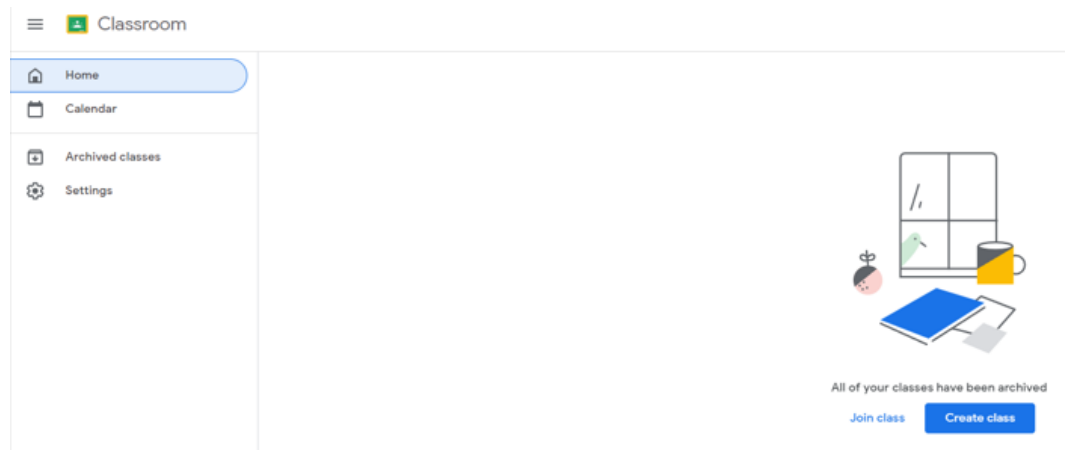
Figure 2.1 Interface of Google Classroom

This system performs well in assisting learning. However, improvements are still needed in building a collaborative learning environment. It is undeniable that with the help of Google Docs, users can jointly modify a document in real-time, which is an important function of collaborative learning. However, this system cannot engage in more interactive collaborative learning, such as forming group learning among classmates and gamifying learning to make learning more interesting.

2.2.2   Hi-Hive

Hi-Hive is a mobile learning management system developed by Silver Lake. The app is widely used among students of Universiti Tunku Abdul Rahman. The app provides students with many features such as digital business cards, personal QR, news notifications, course attendance, digital marketplace, and online chat functionality. The application has a beautiful and simple user interface, making it easier for users to find the functions they need.
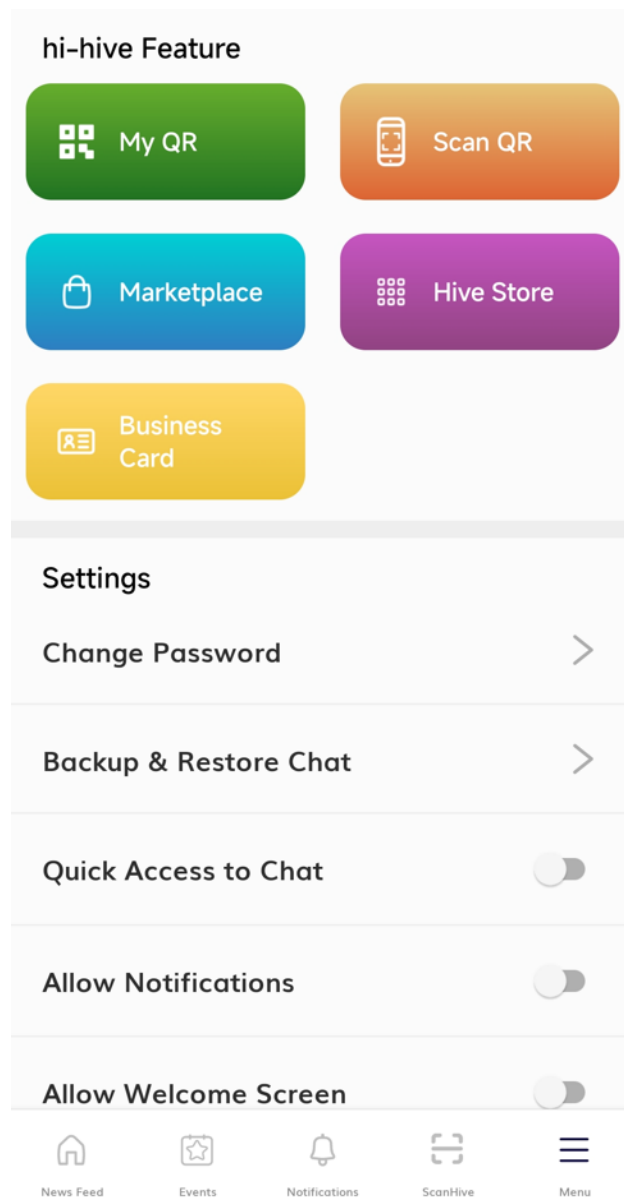
Figure 2.2 Menu of Hi-Hive

Generally speaking, Hi-Hive is mainly committed to improving the administrative management capabilities of educational institutions and reducing the administrative costs of educational institutions. It still has shortcomings in improving students' online collaborative learning capabilities. It has a complete news push function, which can provide students with campus news and notifications. It can also provide a QR attendance function to allow students to take attendance digitally. These functions mainly benefit educational institutions and improve their management models.

Hi-Hive does not provide effective help for students' online collaborative learning. The community forum module it has is mainly used to publish school announcements and other activity information, and has a small number of users. The chat module is also rarely used because its entrance is not obvious and does not provide contact saving and recommendation functions. Users must enter the chat module through the small chat logo in the upper right corner and need to use the address book number to create contacts. Users can only start chatting with people they already know, but cannot find relevant alumni through this application. This clearly demonstrates the application's shortcomings in collaborative learning.
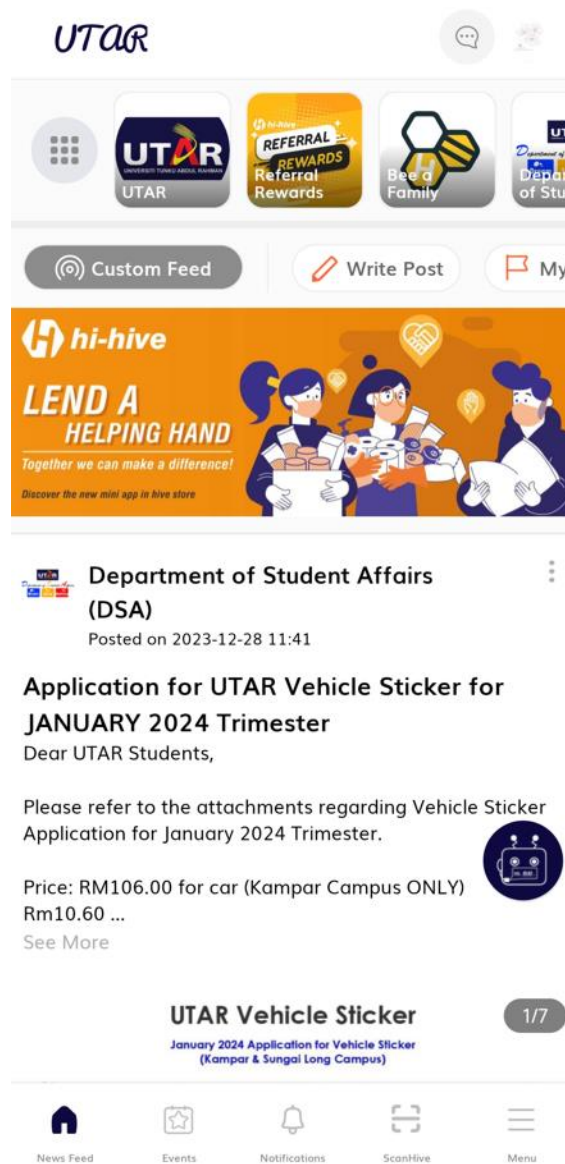
Figure 2.3 News Feed of Hi-Hive

2.2.3 Web Based Learning Environment

Web-Based Learning Environment is a learning management system based on Moodle Web. It is not a stand-alone application, but an online service website, accessed using a browser through a URL. This website provides students of Universiti Tunku Abdul Rahman with the necessary functions to view courses, accept notifications from teachers, download teaching files shared by teachers, and also implements online Quiz and Assignment file submission functions to allow students to take exams on this website.
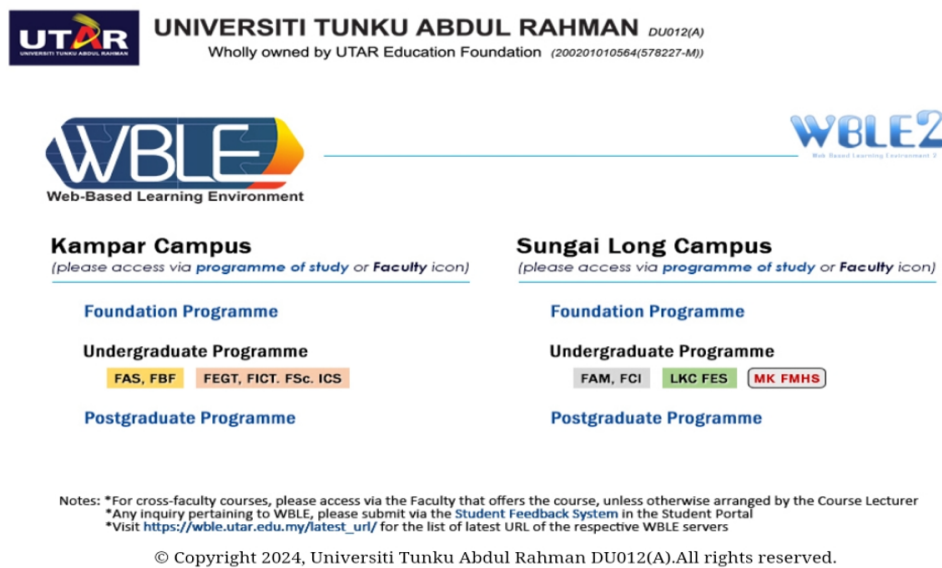
Figure 2.4 Portal of WBLE

Figure 2.5 Login Page of WBLE

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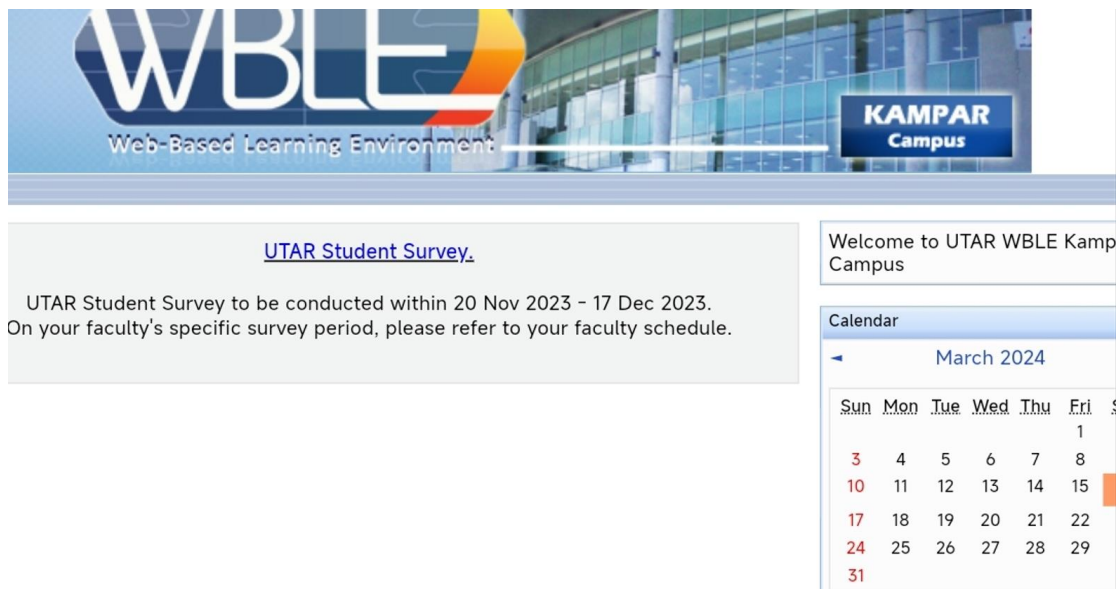
Figure 2.6 Landing Page of WBLE

The learning management system provides students with key course access functionality to allow students to access course-related resources and receive course notifications. At the same time, the system also allows users to view the activities of other users and view all students in a certain course in groups, which provides convenience for students to find classmates in the same course and improves the collaborative learning capabilities of the system.

However, the system lacks ease of use and users can only access it through a browser. Because it does not provide optimization for mobile access, the system has a very poor experience on mobile devices. On mobile devices, the system interface is too crowded and narrow, and the operation logic is completely based on computer keyboard and mouse logic, making user touch interaction very difficult.

2.2.4 Moodle

Moodle is a configurable and feature-rich LMS that is popular with organizations of all types and sizes [11]. It is an open-source learning management system that provides users with convenient learning solutions.
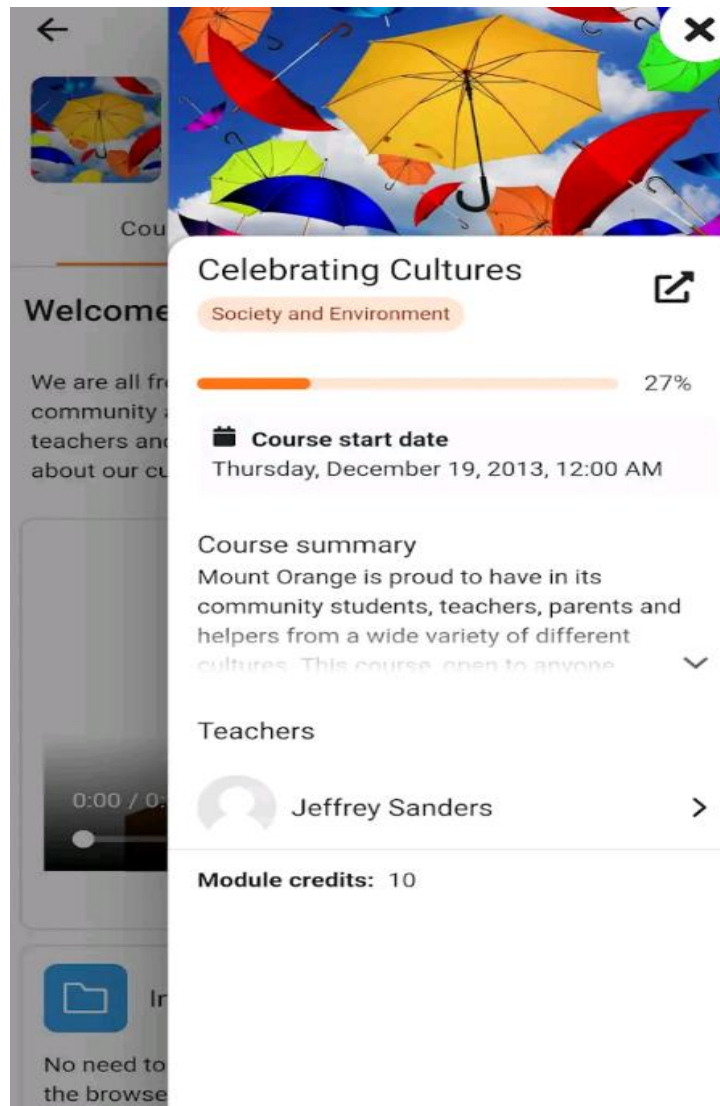
Figure 2.7 Course Learning in Moodle

Moodle has an easy-to-interact, modern user interface that allows users to quickly view the information they need. Moodle is also very functional. It gives users the ability to view grades and make study plans and allows users to create their own blogs for academic discussions.
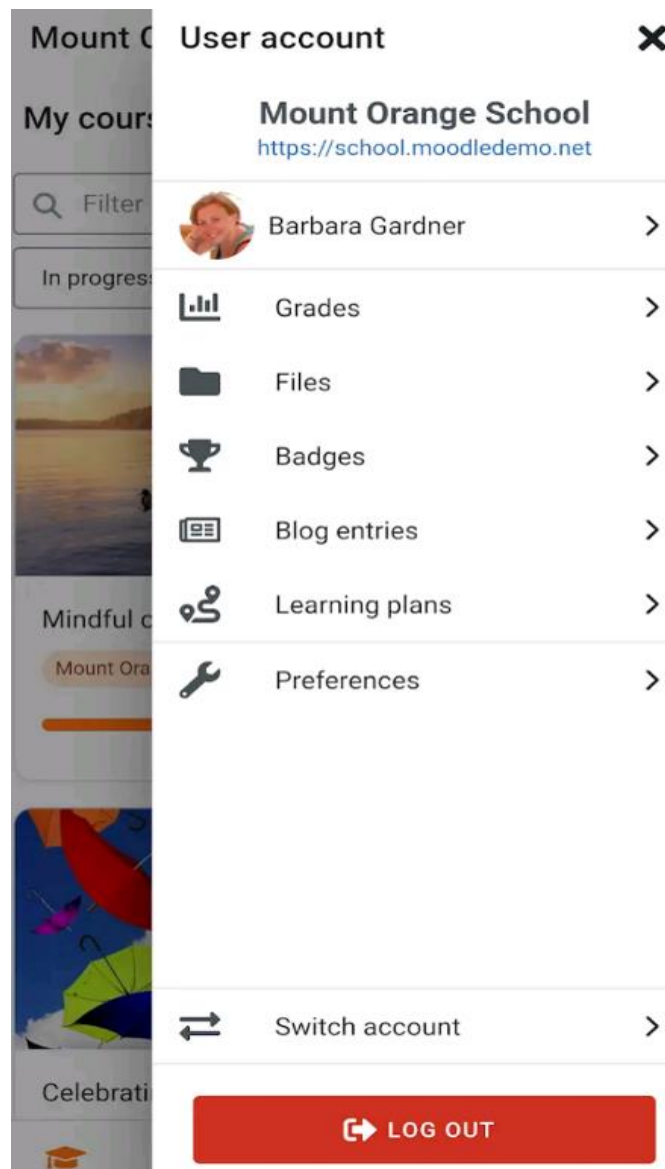
Figure 2.8 UI in Moodle

Moodle also integrates a calendar system and a reminder system, which allows users to add calendar events and send notifications to users according to their schedules.

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Figure 2.9 Calendar in Moodle

Not only that, Moodle also has social functions. It provides a basic contact and friend system, allowing users to add each other as friends. Users can also manage their friends in groups. The real-time chat system makes communication between users more convenient.
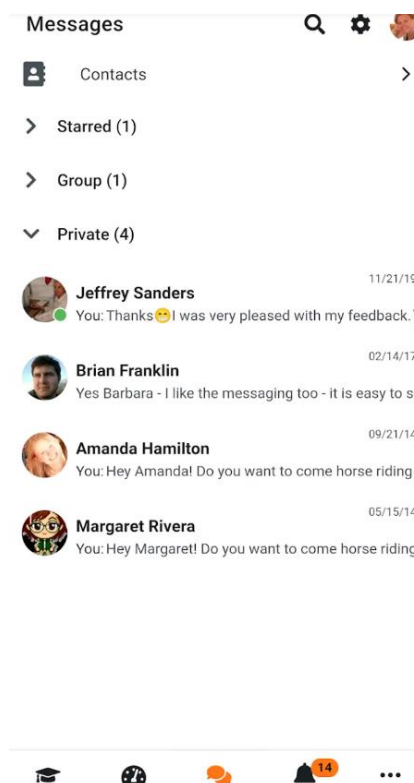
Figure 2.10 Contact System in Moodle

Compared with other reviewed LMSs, Moodle has the most powerful functions, the best configurability, and the most open environment. It is an application that focuses on providing educational services, so it has excellent compatibility in the field of education. But it still has room for improvement.

Due to too much emphasis on the realization of the education field, Moodle lacks some innovations, such as the lack of gamification, the design of an overly official learning method that is easy to easily fatigue to students, and it lacks the function of information sharing in specific educational institutions. This can be improved by adding innovative modules, such as designing a campus resource directory module that allows each educational institution to update its own campus resources and allow students to evaluate them. There is also a lack of a professional question-and-answer community model in terms of academic discussions, which are limited to allowing users to share information and make comments. Users cannot vote on answers or select a particular answer as the best answer for a question, which undermines academic discussion.
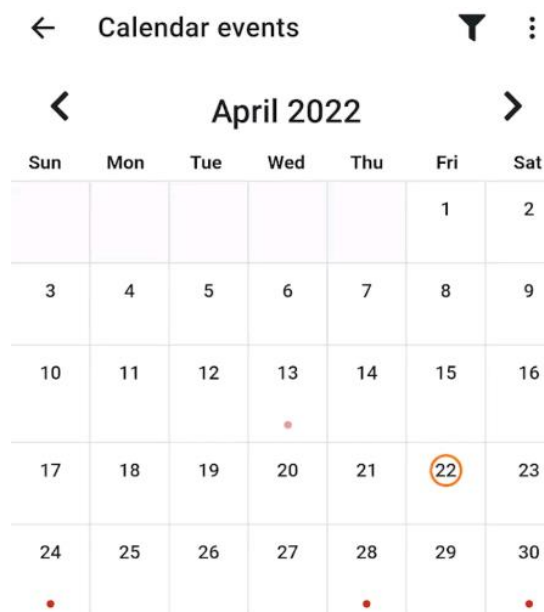
2.2.5 Microsoft Teams

Microsoft Teams is another typical online learning management system. This system integrates many modules that support the learning environment and provides a better one-stop service experience. As the name suggests, it allows users to create different Teams, pooling students with the same course, and allowing students to connect. Such a collaborative learning environment is worth learning.

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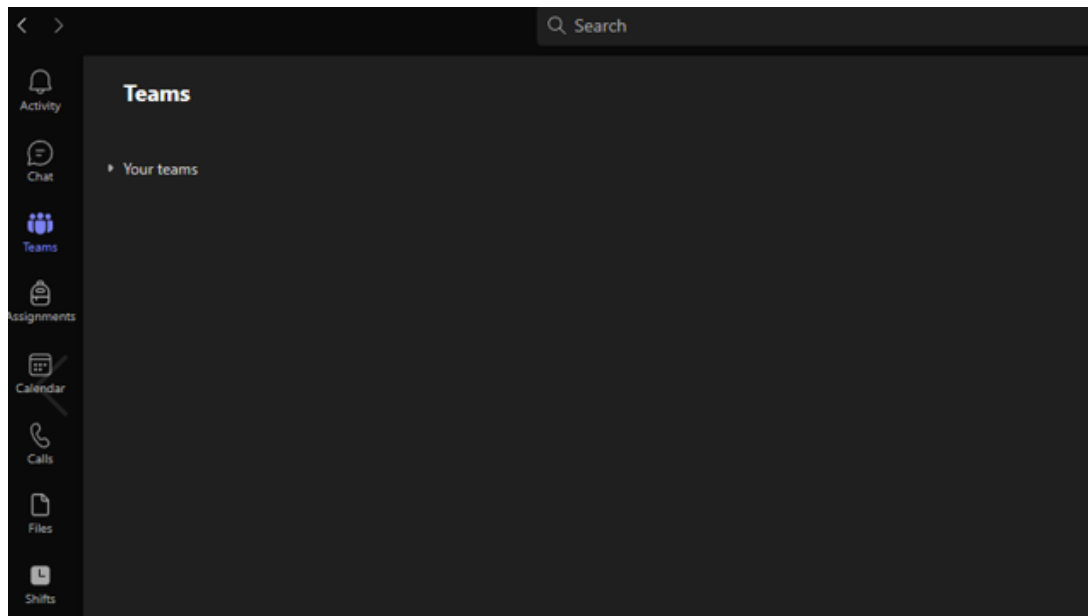
Figure 2.11 UI in Microsoft Teams

Microsoft Teams also allows teachers to live webcast lectures online, not only that, it also allows real-time recording and course playback. During the teaching process, its integrated automatic subtitle function can provide great convenience to students, especially international students who may have language pressure. The built-in file management system in this application allows users to share teaching materials, and students can easily use this application for online collaborative learning.

Although Microsoft Teams does a great job of providing learning functionality and a collaborative learning environment. It has the same problem as Moodle. It focuses too much on implementation in the educational field and ignores the encouragement and innovation of student learning. This LMS does not have any gamified learning modules and does not have online testing capabilities. This makes the use process very boring, lacks the stimulation of students' learning motivation, and is not conducive to students' continuous independent learning.

At the same time, there are also some problems with the usability of this system. For security reasons, Microsoft Teams will require the organization to host data, which has a significant impact on mobile devices. Every time you log in, you must unlock the application by biometric security verification or enter a PIN. This may affect some of its functions, such as calling capabilities. On mobile devices, you will not receive call alerts without unlocking the app.
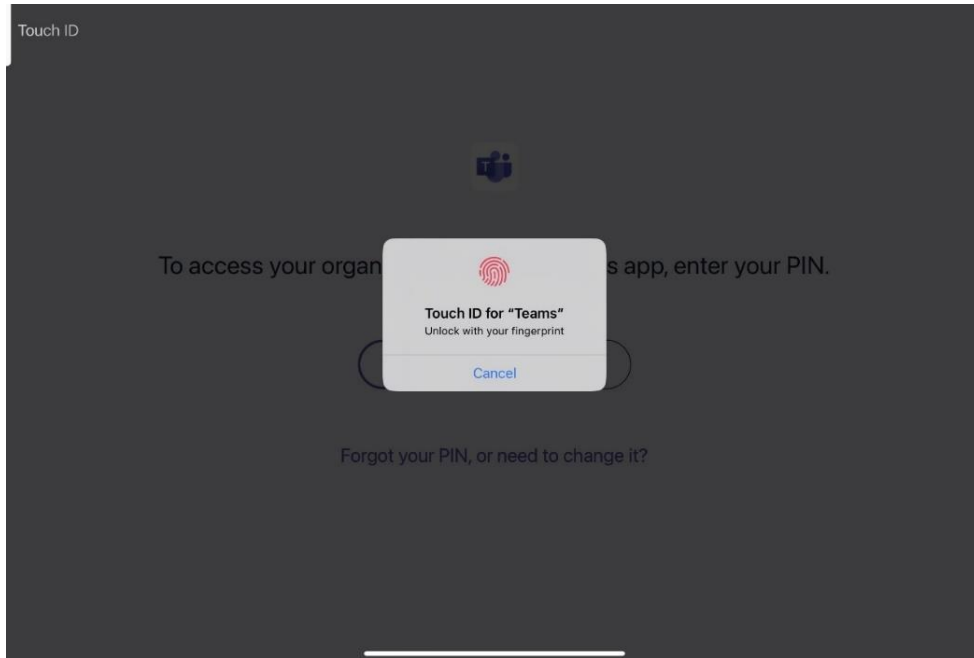
Figure 2.12 PIN Requirement in Microsoft Teams

2.2.6 Feature Comparison between Existing Systems and Proposed System

This project aims to learn the advantages of reviewed LMS and avoid their disadvantages, to create a campus study buddy mobile application that can enhance students' collaborative learning, improve students' online learning experience, and stimulate students' learning motivation. A feature comparison matrix is shown below.

Table 2.1 Feature Comparison between Existing Systems and Proposed System

System / Feature	WBLE	Hi-Hive	Google Classroom	Microsoft Teams	Moodle	Campus Study Buddy (Proposed System)
Personal QR	No	Yes	No	No	No	Yes
Notification Service	No	Yes	Yes	Yes	Yes	Yes
Gamification	No	No	No	No	Yes	Yes
Campus Resource Directory	No	Yes* (Limited)	No	No	No	Yes
Friends System	No	No	Yes	Yes	Yes	Yes
Assignment Group System	No	No	No	Yes	Yes	Yes
File Share	Yes* (Limited Permission)	No	Yes* (External Google Drive)	Yes	Yes	Yes
Q&A Forum	No	No	No	Yes* (Limited Function)	No	Yes
AI Assistant	No	No	No	No	No	Yes
Online Chat	No	Yes	Yes* (No C2C)	Yes	Yes	Yes

Yes*: Has a limitation / condition. Need extra helps to achieve the feature.

2.3   Review of Development Methodologies

2.3.1   Waterfall Methodology
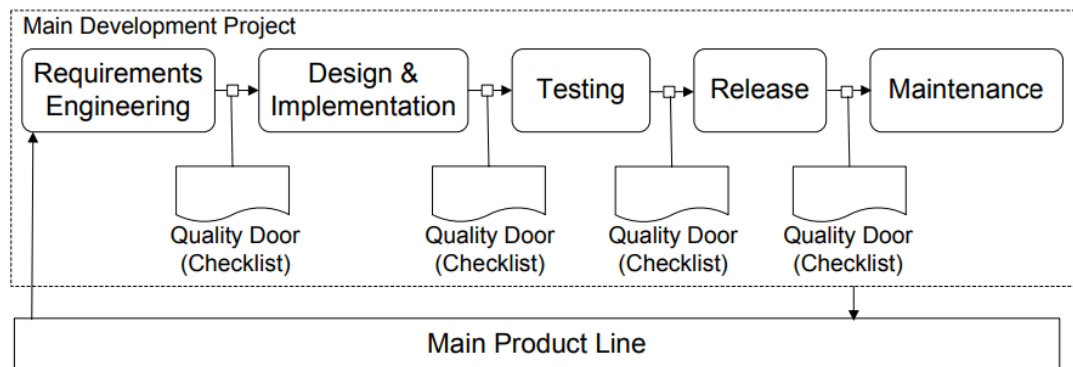
Figure 2.13 Waterfall Methodology [12]

Waterfall development methodology is a traditional software development method. It divides the software development process into 6 different sequential stages through rigorous planning, and then executes the software development process step by step. The waterfall model has strict sequence and documentation requirements, and has clear milestones and quality requirements. It is suitable for use in large and complex software development projects and provides a structured process theory for software development. Applying this approach requires developers to have clear project requirements and the project to have low change expectations.

2.3.2   Incremental Methodology

Figure 2.14 Incremental Methodology [13]

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Incremental development methodology is a software development method suitable for continuous development. This software development method allows developers to first build a simple system that implements basic functionality, which is tested first as a core module. Then, based on this core module, the system is iterated multiple times, the version is updated, and more modules and functions are added to the system, so that the entire system is finally completed and delivered.
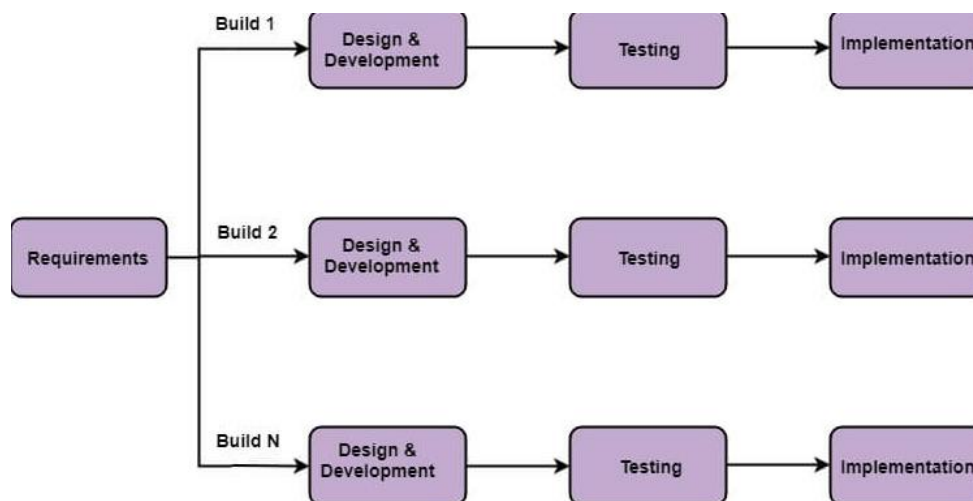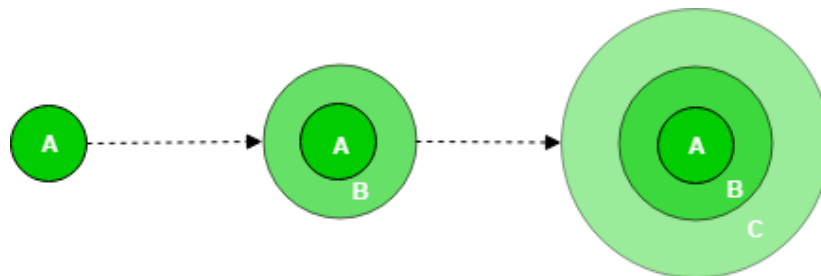

Figure 2.15 Incremental Methodology 2 [14]

This development method is suitable for projects with long development cycles and has relatively low technical requirements for developers. The modular development method and gradually iterative version updates make the project more flexible and adaptable. Developers do not need to design all system functions from the beginning, but can gradually develop incrementally to achieve the expected goals. At the same time, the gradual iteration of functions makes project risk management easier, and different modules can be tested separately, which reduces the overall risk impact on the project when developing a single module. However, a longer development cycle and more version iterations may cause an increase in development costs.

2.3.3   Agile Methodology

Figure 2.16 Agile Software Development Cycle [15]

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The agile software development method is flexible and it focuses on working code rather than documentation. In agile software development, the software development process is cyclical and iterates frequently.

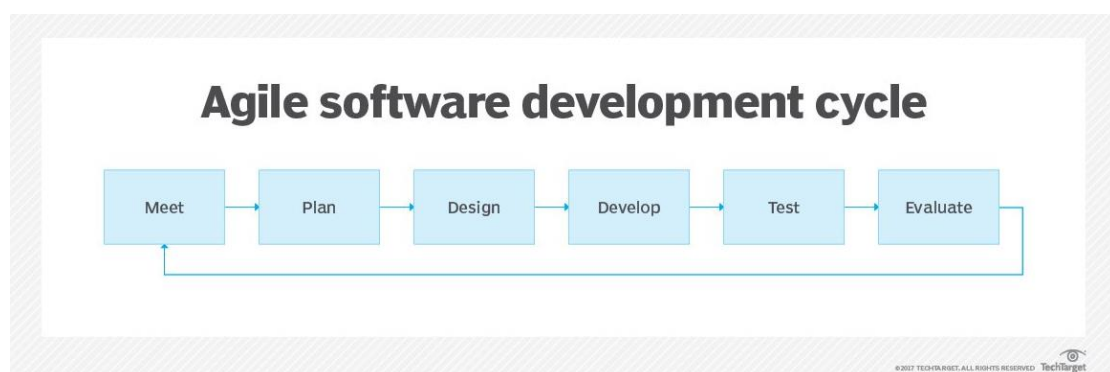This can save document compilation time and quickly carry out code iteration and function updates. Developers don't need to spend a lot of time on documentation. Developers can also continuously test the program during the development process and continuously improve the application through incremental updates to improve the performance of the program. Agile development methods can help developers adapt to changing environments while maintaining efficient development efficiency and version delivery [15].

However, agile development methods have high technical and time requirements for developers, requiring developers to make greater efforts in each agile development cycle. At the same time, agile development methods require continuous user feedback to improve the system. This puts greater pressure on developers and puts demands on the user community.

2.3.4   Conclusion

Each software development method has its advantages and disadvantages. This project will choose the appropriate development method based on the project situation.

First of all, this project is a solo development project. There is only one person in the entire project to support all software development processes, and the time that developers can devote to the development process is limited every day. This makes it impossible to use agile development methods for the development of this project. Because agile development methods involve teamwork.

Secondly, the development cycle of this project is expected to be 8 months. Since this project involves multiple functional modules, and the technologies used by these functional modules are different, the development process of this project must be combined with the learning process of new technologies, which will reduce the actual development process time of the project even more. At the same time, developers have less experience. This makes the traditional structured waterfall development method unable to be applied, because it imposes high technical requirements on developers and has precise milestones for project development time.

Therefore, this project chose the incremental development method, using a modular approach to develop the system, giving priority to the development of core system modules, and then expanding system functions based on this module to ultimately meet the project goals. This approach has fewer technical requirements on developers and allows some flexibility in development time.

2.4   Summary

In summary, in this chapter, 5 online learning systems and 3 software development methods are reviewed.

First, taking these existing learning systems as a reference, in order to meet the project objectives, the system developed in this project needs to have stronger online collaborative learning functions and be more focused on improving students' learning experience and quality of campus life. At the same time, this system also needs to add certain social elements to enhance users' learning enthusiasm.

Secondly, after considering the actual situation of the project and comparing different software development methods, this project finally chose to use the incremental development method to develop the system. This method allows developers to have a certain degree of flexibility and does not require high technical levels of developers.

CHAPTER 3

System Methodology/Approach

3.1   Introduction

In this chapter, the methodology used in this project, the software and hardware equipment that will be used during the development process, as well as the Gantt chart and timeline of the project's deliverables and milestones will be introduced in detail.

3.2   Incremental Development Methodology

3.2.1   Introduction

Incremental development is a flexible software development method. This project chose to use this method to implement the development of this system. In the incremental development method, the overall system is divided into small stages and gradually implemented version by version. This makes system development very flexible, and allows continuous improvement and addition of new functions to adapt to changing needs during the system development process.

Incremental development is a development method for implementing SDLC. In this method, the project development process will be divided into six stages that are consistent with the SDLC, namely Planning, Analysis, Design, Development, Testing, and Closing. The project development process does not involve final project deployment and runtime maintenance. Therefore, deployment and maintenance are excluded in this chapter.

3.2.2 Planning

The planning phase is the first phase of the SDLC and all software development begins from this phase. In this phase, the industry background involved in the project was studied, and the target users and project objectives and scope were identified. At the same time, the technologies that may be involved in the project and the general project structure were determined. The project structure is further broken down into a project work breakdown structure to facilitate subsequent work progress.

The deliverables at this stage are project proposal, project preliminary report, project work breakdown structure, Gantt chart, and schedule of project deliverables.

3.2.3 Analysis and Design

Analysis and design are the second and third phases of SDLC.

In the design phase, based on the results of the planning phase, research on the project's industry background, and a review of existing systems, the project's requirements were analysed and confirmed. At the same time, the modules involved in this project, the basic use cases and requirements of each module are documented and standardized to meet the needs of the design phase. In this phase, the deliverables are, module list, and basic use cases and system functional requirements and non-functional requirements.

During the design phase, module analysis documentation and basic usage cases are expanded. Based on these documents, the overall architecture and organization of the system are further analysed and defined, and the overall flow of the system is also identified. In this phase, the deliverables are, system architecture diagram, system flow chart, low fidelity User Interface diagram, database design, and activity diagram. Since this project adopts an incremental development method, each system module will be gradually updated in version iterations, and this analysis and design phase will go through multiple iterations to meet the project requirements.

3.2.4 Development and Testing

Development and testing are the fourth and fifth phases of SDLC, and these two phases are often bound together. These two phases will put all the results of the design phase into practice and realize them. The specifications described in the module design document will be implemented in code, and each module will first be tested by developers during the development process to meet the document requirements. When each module is developed, it will also be put into functional testing and non-functional testing. Functional testing will focus on whether the functionality of the module meets the requirements of the document, while non-functional testing will focus on the reliability and performance of the module. In this phase, the deliverables are the available modules, and the integrated system.

Since in the incremental development approach, each module is developed gradually, the development and testing phases will also go through multiple iterations to meet project requirements.

3.2.5 Closing

At this stage, project development is coming to an end. The final system will undergo a complete internal system test to ensure that the system functionality is available and that the system meets project requirements and achieves project objectives. At the same time, ensure that all system defects and loopholes encountered during the development process are resolved.

After the internal testing is completed, the developed system will be submitted to the Google Play Store for user Closing Test to prepare for the transition to the system deployment stage. The final project documentation for the system will also be finalized to consider the project successfully completed.

3.3   Tools Involved in This Project

3.3.1   Hardware

The hardware involved in this project is a laptop computer and a mobile device based on the Android system. The laptop will be the primary hardware during development. It is responsible for documentation, UI design, code writing, and testing procedures. Android-based mobile device will be mainly used for project testing and verification at the end of the development phase.

Table 3.1 Specifications of laptop

Description	Specifications
Model	Clevo NH50series
CPU	AMD Ryzen 5-3600
OS	Microsoft Windows 10 64bits
GPU	NVIDIA GeForce RTX 2070 Mobile 8GB GDDR6
RAM	32GB DDR4
Storage	10TB NVMe SSD

Table 3.2 Specifications of android mobile device

Description	Specifications
Model	Huawei Honor 9X
SoC	HUAWEI Kirin 810
OS	EMUI 10.1.0 based on Android 10
RAM	6GB
Storage	64GB

3.3.2 Android Studio

Android Studio is an IDE designed specifically for Android operating system development. It provides many necessary functions for Android development, such as Android Debug tools, virtual device managers, and Android device emulators. It also provides convenience for program development. The built-in error correction function and Android development samples can provide developers with development assistance. This software will play an important role in this project, and the overall framework and development process of the program will depend on this software.

3.3.3 Flutter

Flutter is an Android application framework, which is an open-source UI software development kit. It can greatly reduce the workload in the UI design process and reduce the difficulty of transition from UI design to code. The software also has a large number of extensions for developers to choose from to extend its functionality. This software will play a primary role in the UI design and implementation of this project and the implementation of data functions.

3.3.4 Firebase

Firebase is a cloud data platform that provides a variety of functions. It provides a variety of useful and convenient functions for Android development, avoiding developers from duplicating work in certain areas. In this project, Firebase's real-time database and authentication mechanism are focused. This project will use Real Time NoSQL database as the data storage infrastructure, which is an efficient database and has low cost. At the same time, this project will use Firebase's mature authentication mechanism to build an authentication module to meet higher performance efficiency and security requirements.

3.3.5   Git

Git is a version control and source code management system that has many functions that can help developers complete their development work more efficiently. It allows developers to perform rapid version control and branch or merge source code. This greatly reduces the workload in source code management and reduces the burden of additional documentation requirements during the development process. Developers can focus on system development more efficiently. In this project, a local Git repository will be established to implement version control and code branching functions.

3.4   Work Breakdown Structure
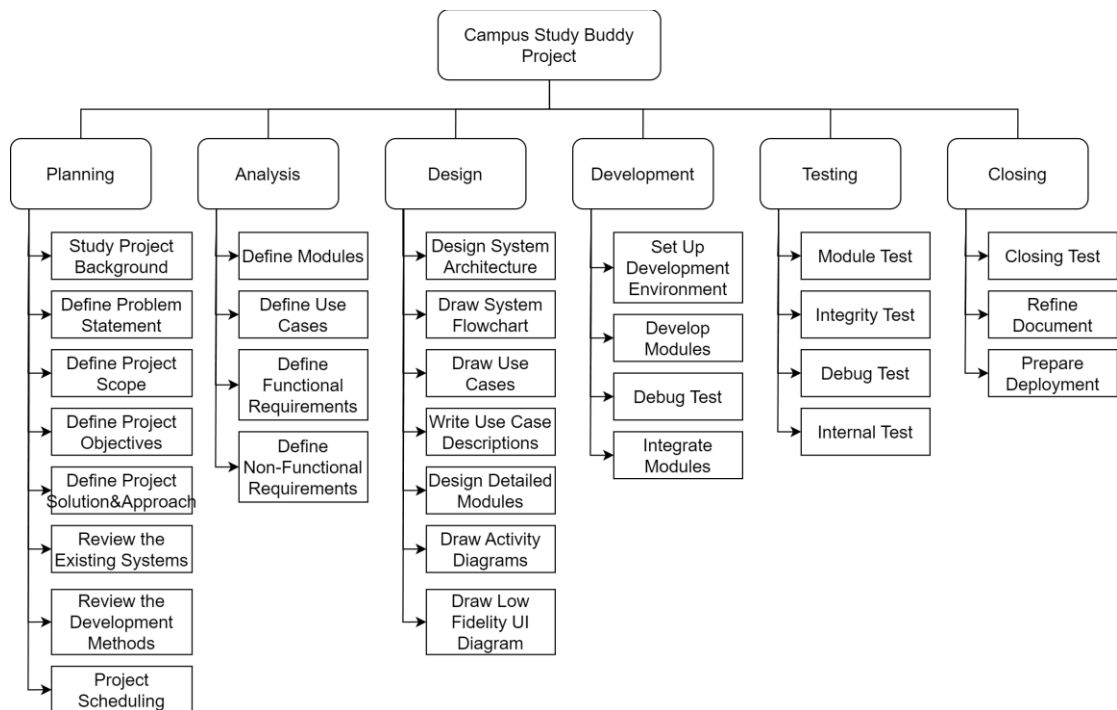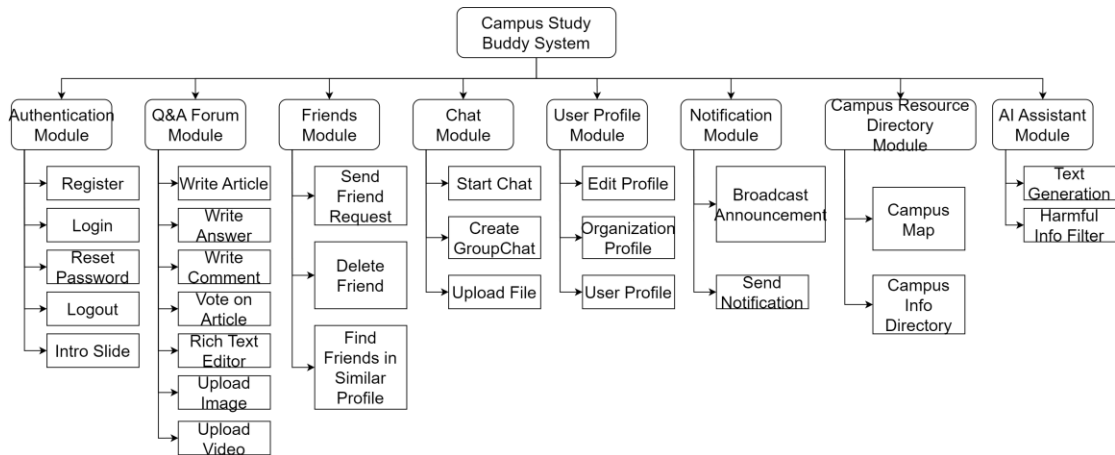

Figure 3.1 WBS of the Project

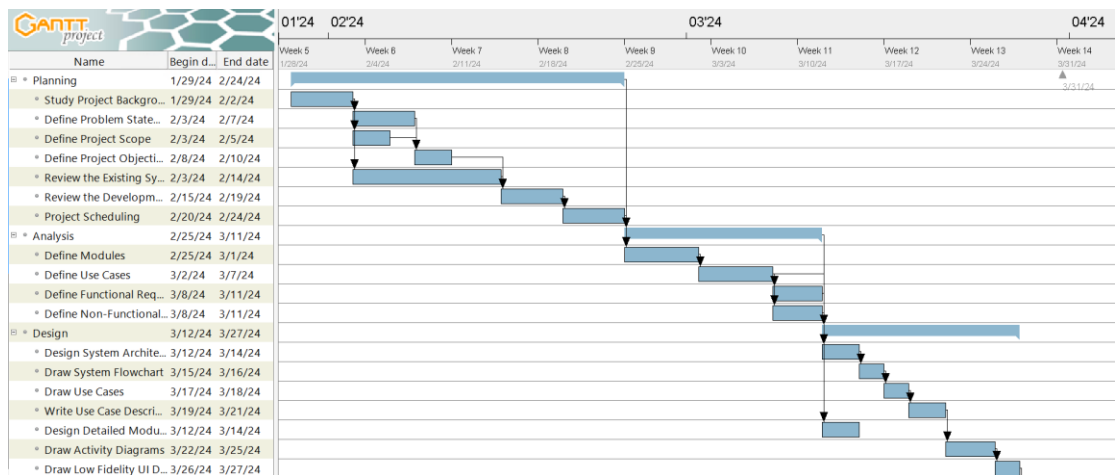Figure 3.2 WBS of the System Development

3.5 Gantt Chart
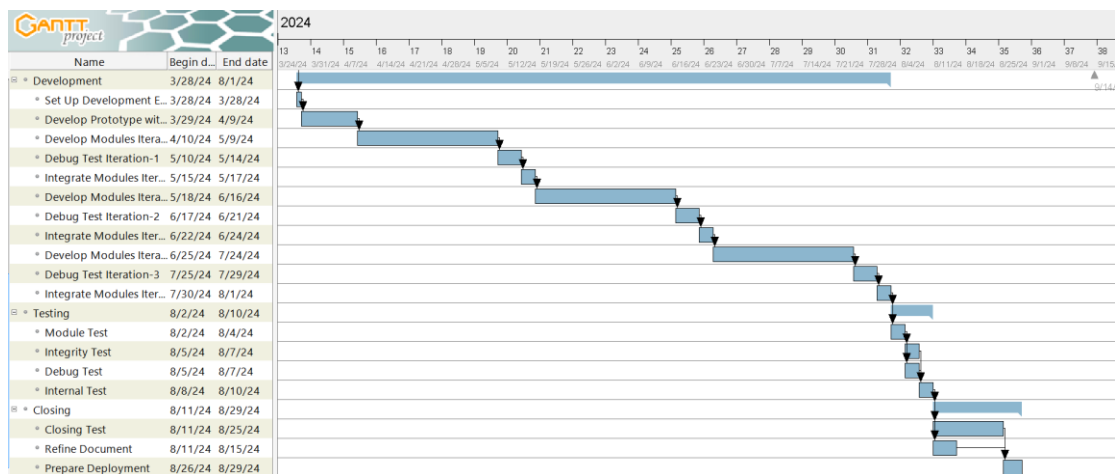

Figure 3.3 Gantt Chart Part 1 of the Project Timeline

Figure 3.4 Gantt Chart Part 2 of the Project Timeline

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3.6   Timeline for Deliverables and Milestones

Table 3.3 Timeline of deliverables

Phase	Deliverables	Duration (Weeks)
Planning	Project Proposal	8
	Work Breakdown Structure	2
	Gantt Chart	1
	Timeline for Deliverables	1
Analysis	Module Definition	2
	Use Cases	
	Use Case Descriptions	
	System Functional Requirements	1
	System Non-Functional Requirements	
Design	System Architecture Diagram	1
	System Flowchart	
	Low Fidelity User Interface Diagrams	1
	Database Design	
	Activity Diagrams	1
Development	Available Modules	16
	Integrated System (Alpha System)	1
Testing	Beta System	1
Closing	Final System	2
	Project Report	1

CHAPTER 4

System Design

4.1 Introduction

In this chapter, the overall architecture, flow diagram and requirements of the system are identified. Low-fidelity UI design diagrams and NoSQL-based database designs are also described in detail.

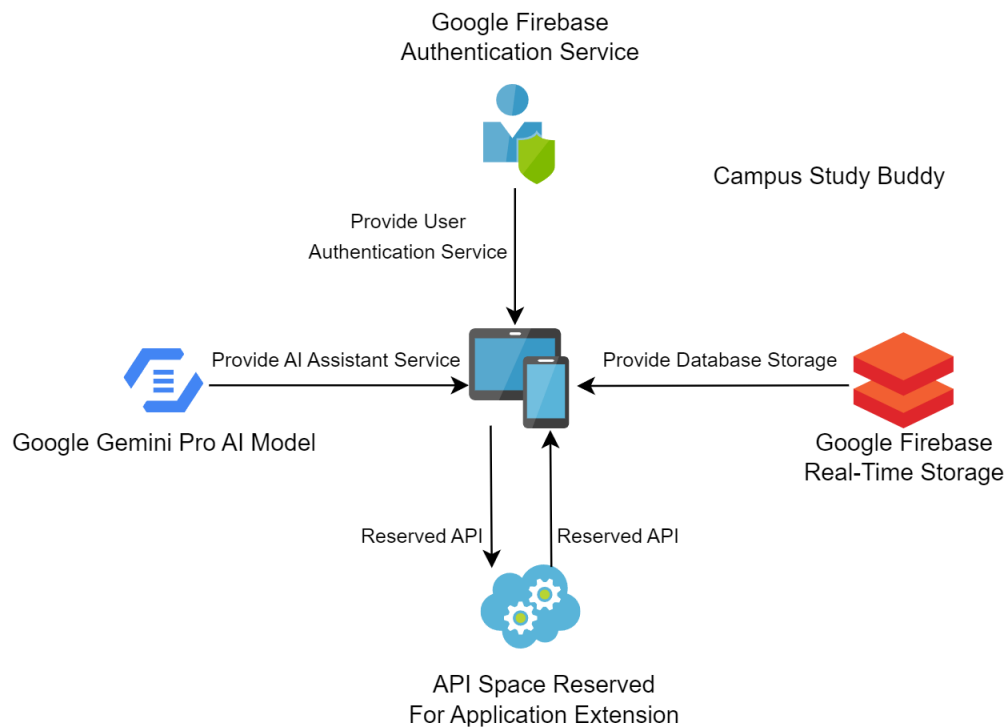### 4.2 Overall System Design

4.2.1 System Architecture

Figure 4.1 Overall System Architecture

This system will use Google Firebase as the authentication and database service provider, and interact through its platform API. The AI assistant function in this system will use Google Gemini Pro Model as a large language prediction model and interact with information through its API. In addition, this system will be designed with built-in reserved API services for upgrades and expansions may occur in future, adding scalability to the system.
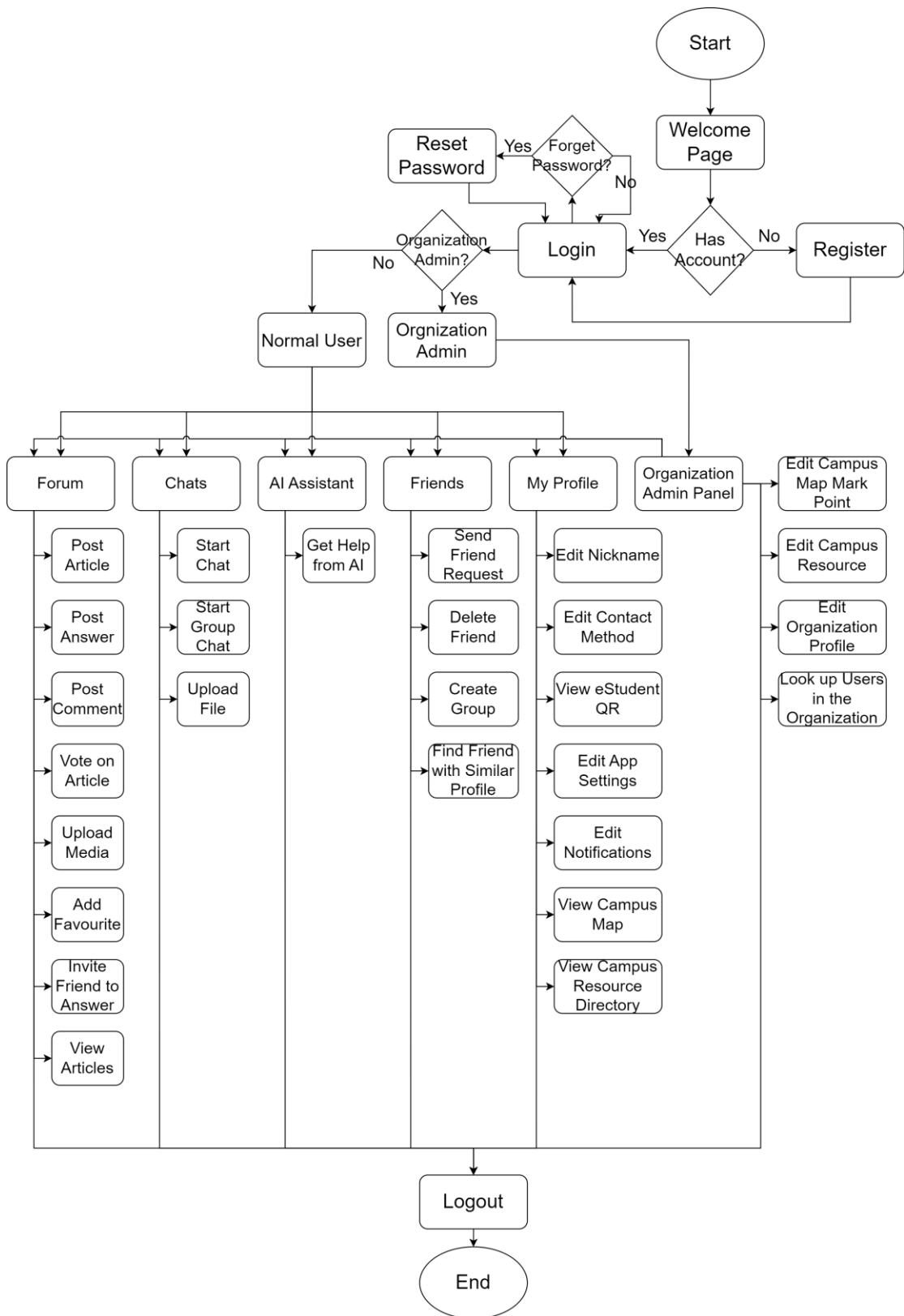
4.2.2   System Flowchart

Figure 4.2 System Flowchart

4.3 System Requirements

4.3.1 Functional Requirements

1. The system should allow users to register and log in using their email address.
2. The system should be able to send an email verification code to the user.
3. The system should allow users to view and post questions and answers.
4. The system should allow users to update their personal information.
5. The system should be able to provide users with AI assistants and use large language models to provide assistance to users.
6. The system should allow users to add questions to favorites lists.
7. The system should allow users to set reminders.
8. The system should be able to push other users that are relevant to the user and may be of interest to the user.
9. The system should allow users to view their campus map and resource directory.
10. The system should allow organization administrators to edit their organization information.
11. The system should be able to allow users to conduct C2C chat.
12. The system should allow users to form user groups.
13. The system should be able to generate a unique QR identification code for each user.

4.3.2 Non-Functional Requirements

1. The system should be able to respond to user input in less than 5 seconds.
2. The system's UI refresh rate should reach a minimum of 40FPS.
3. The system should function normally without crashing.
4. The system should be compatible with Android 10 and above operating systems.
5. The system should verify each user operation to ensure that the operation is valid.
6. The system should block all unauthorized operations.
7. The system should encrypt and store sensitive user information.
8. The system should remain usable and easy to learn, allowing users to get started quickly.

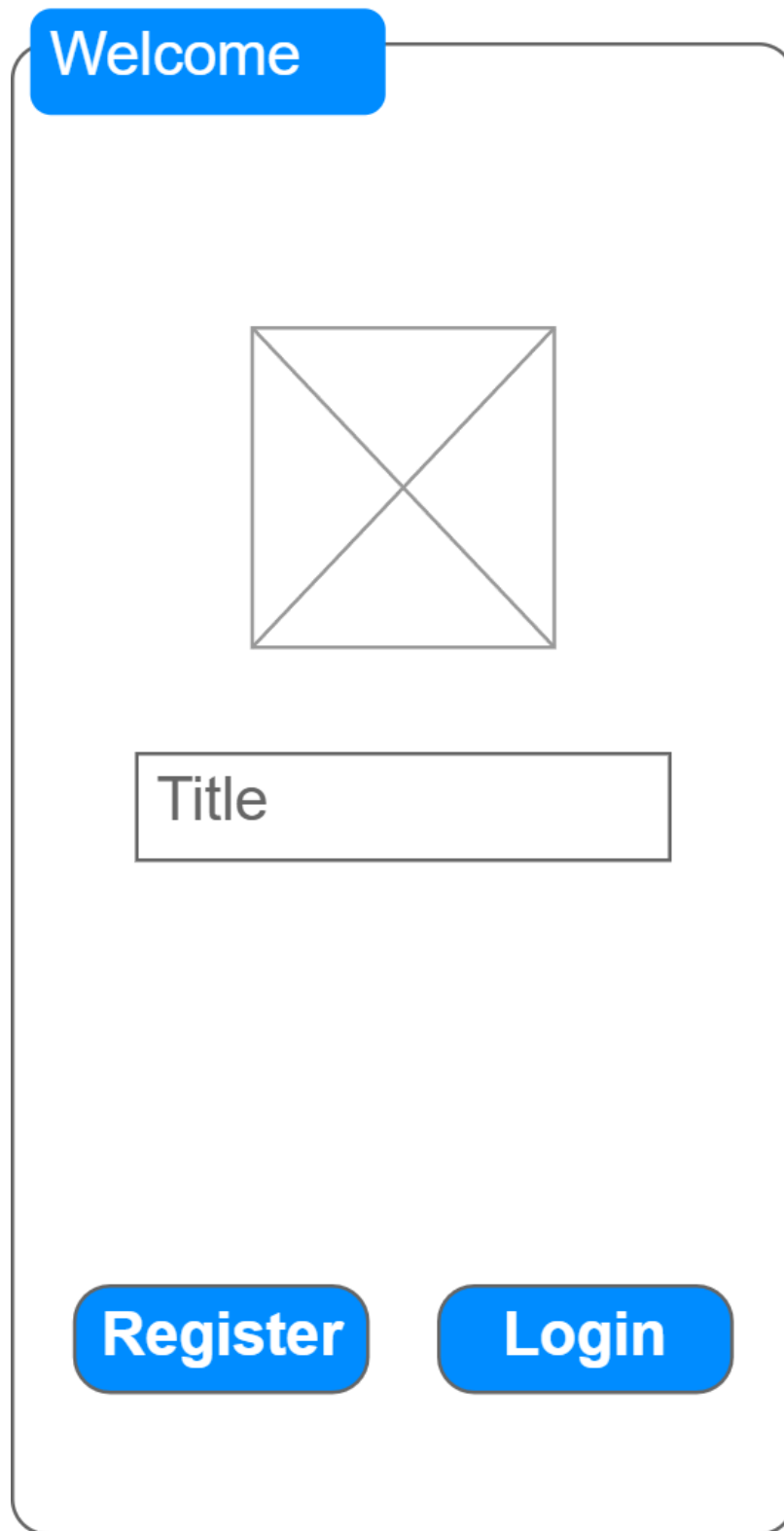**4.4   Low Fidelity User Interface Design**

4.4.1   Welcome Page

Figure 4.3 Low Fidelity Diagram of Welcome Page
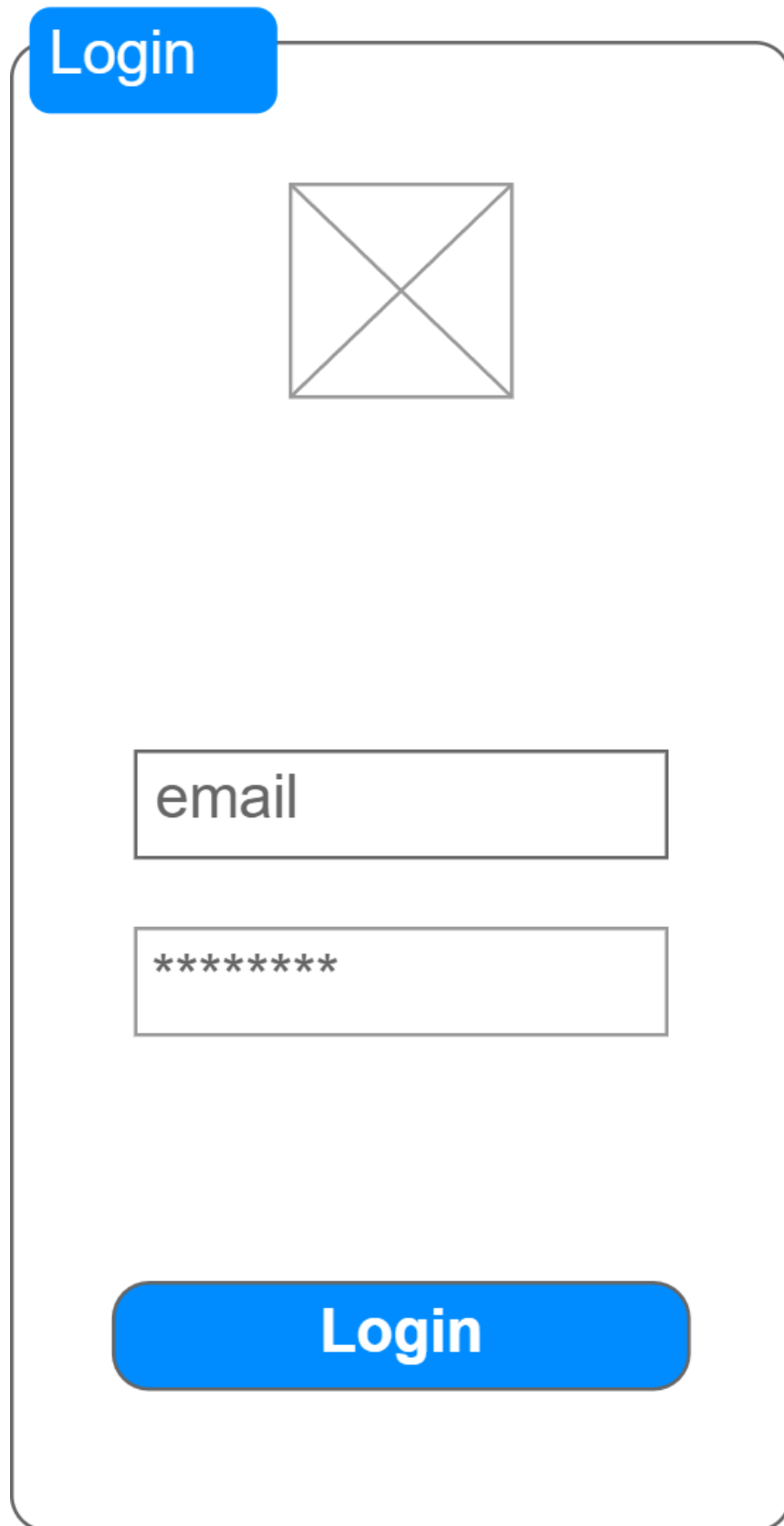
4.4.2 Log in Page

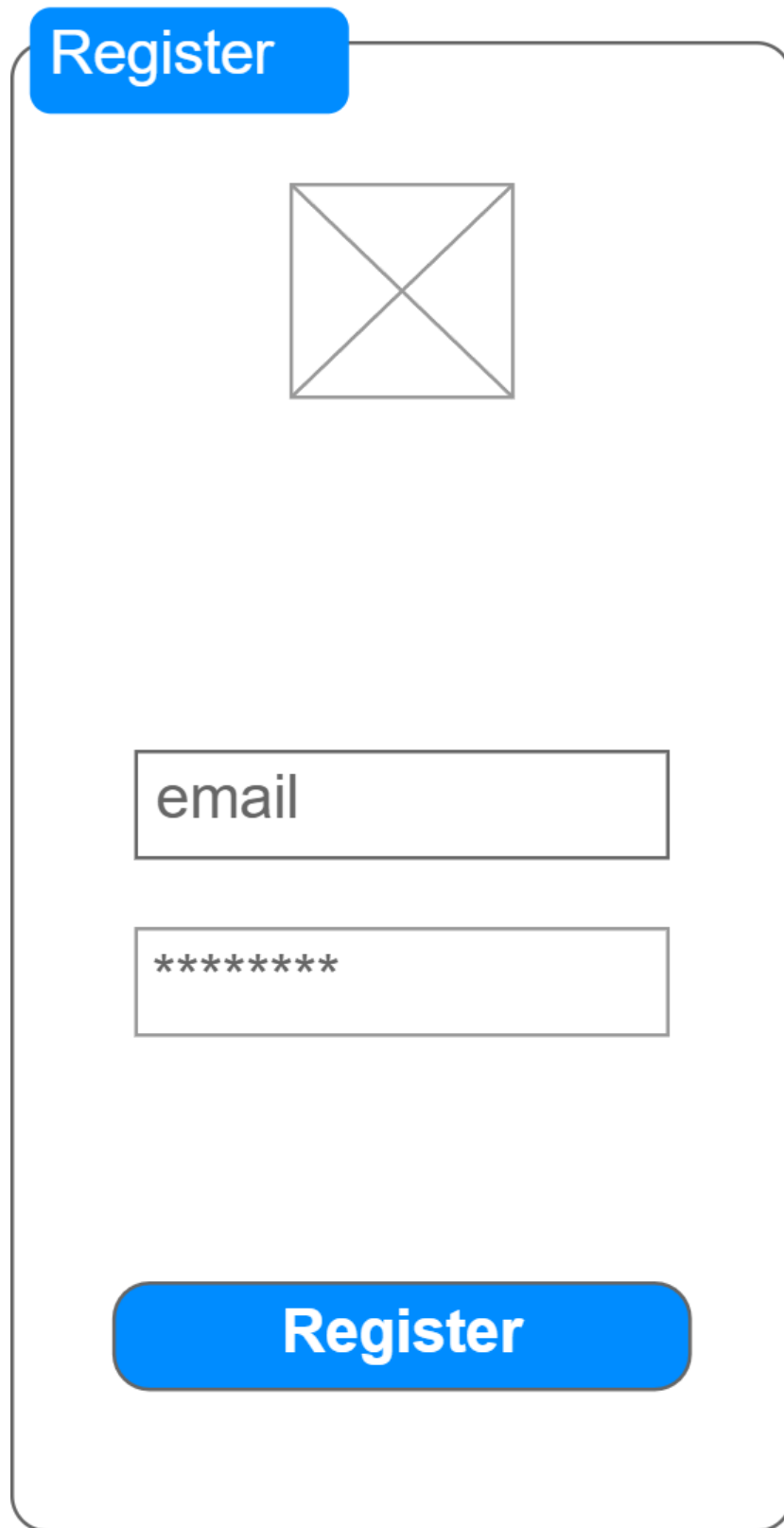Figure 4.4 Low Fidelity Diagram of Login Page

4.4.3   Register Page

Figure 4.5 Low Fidelity Diagram of Register Page
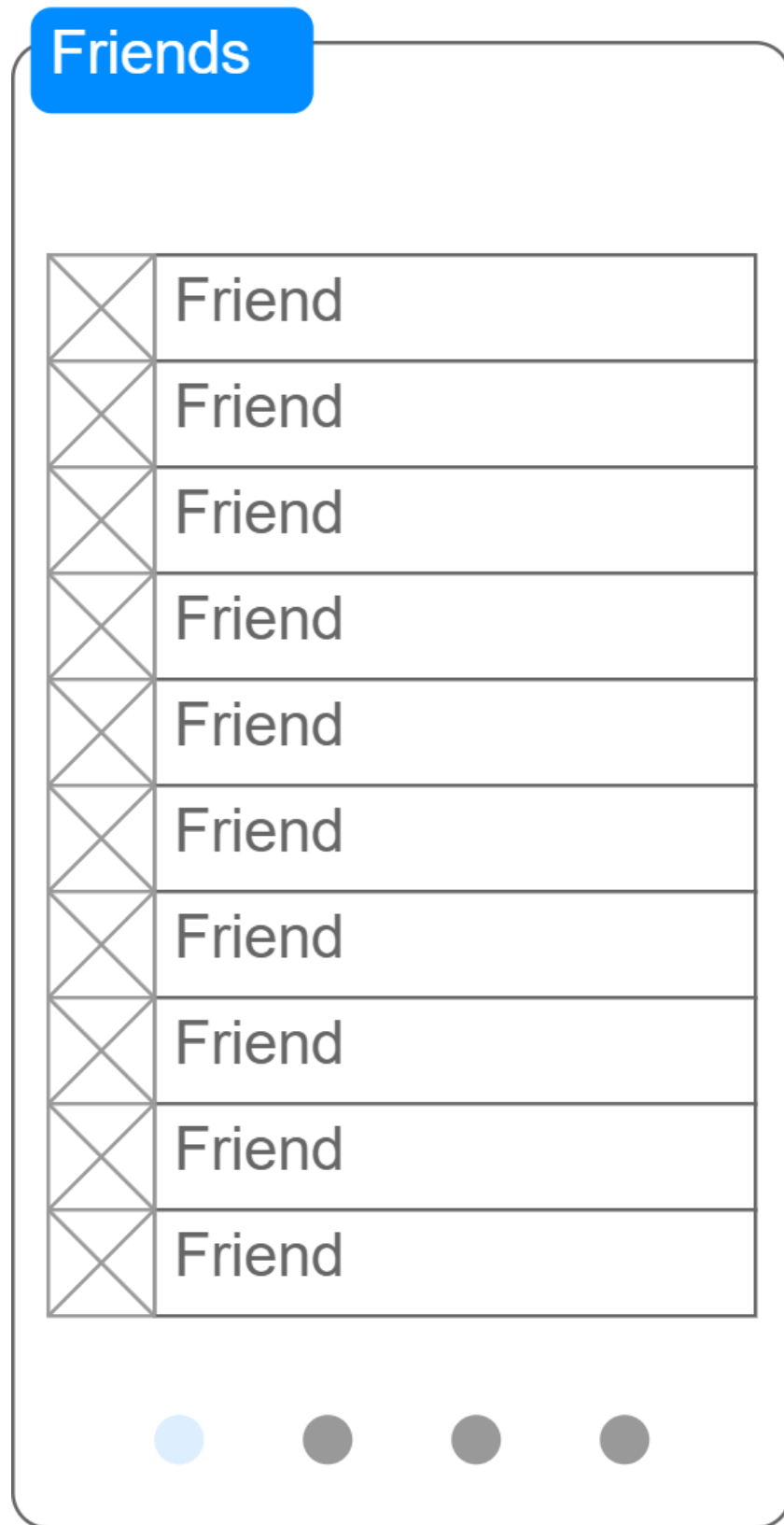
4.4.4   Friend Page

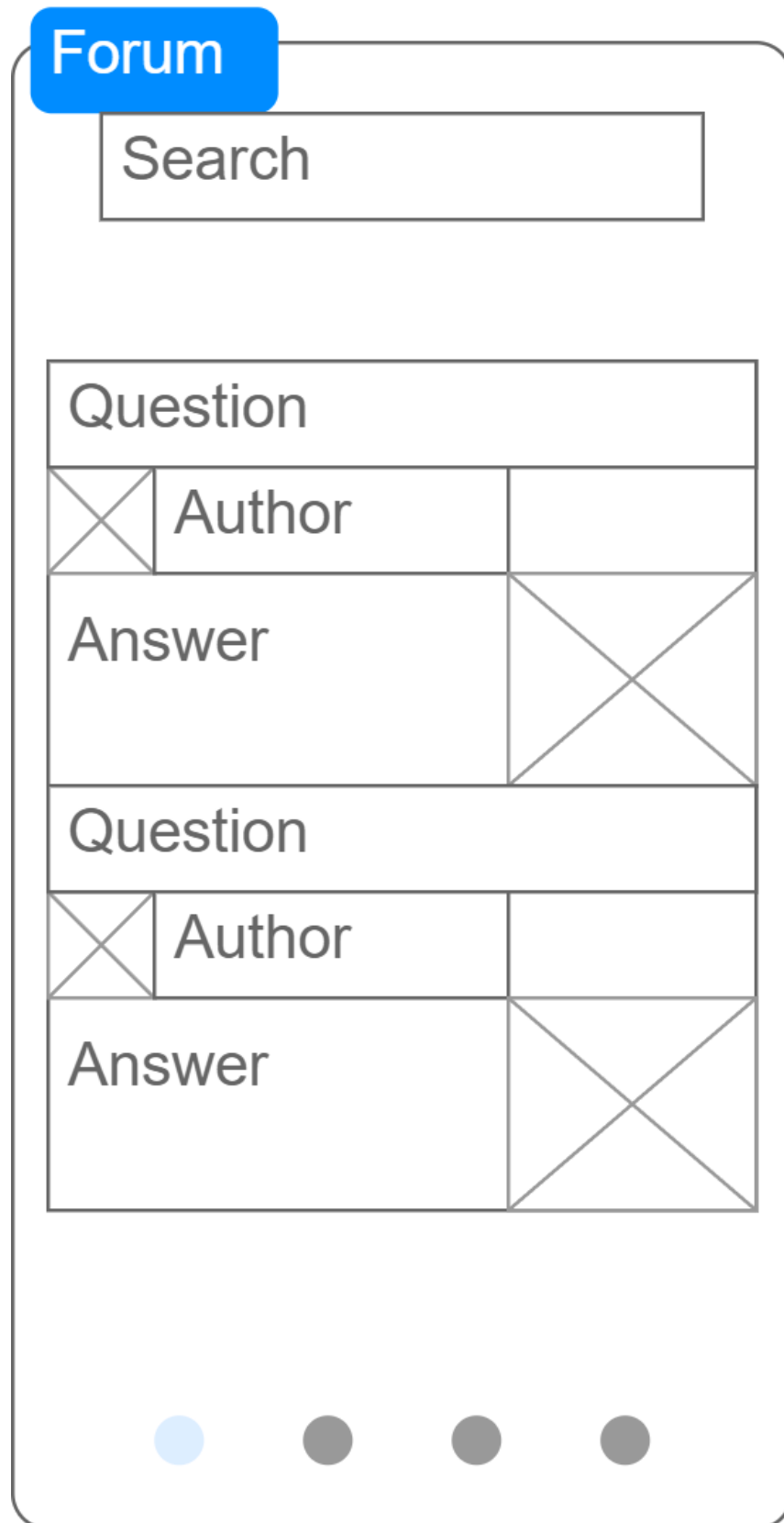Figure 4.6 Low Fidelity Diagram of Friend Page

4.4.4   Friend Page

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4.4.5   Forum Page

Figure 4.7 Low Fidelity Diagram of Forum Page
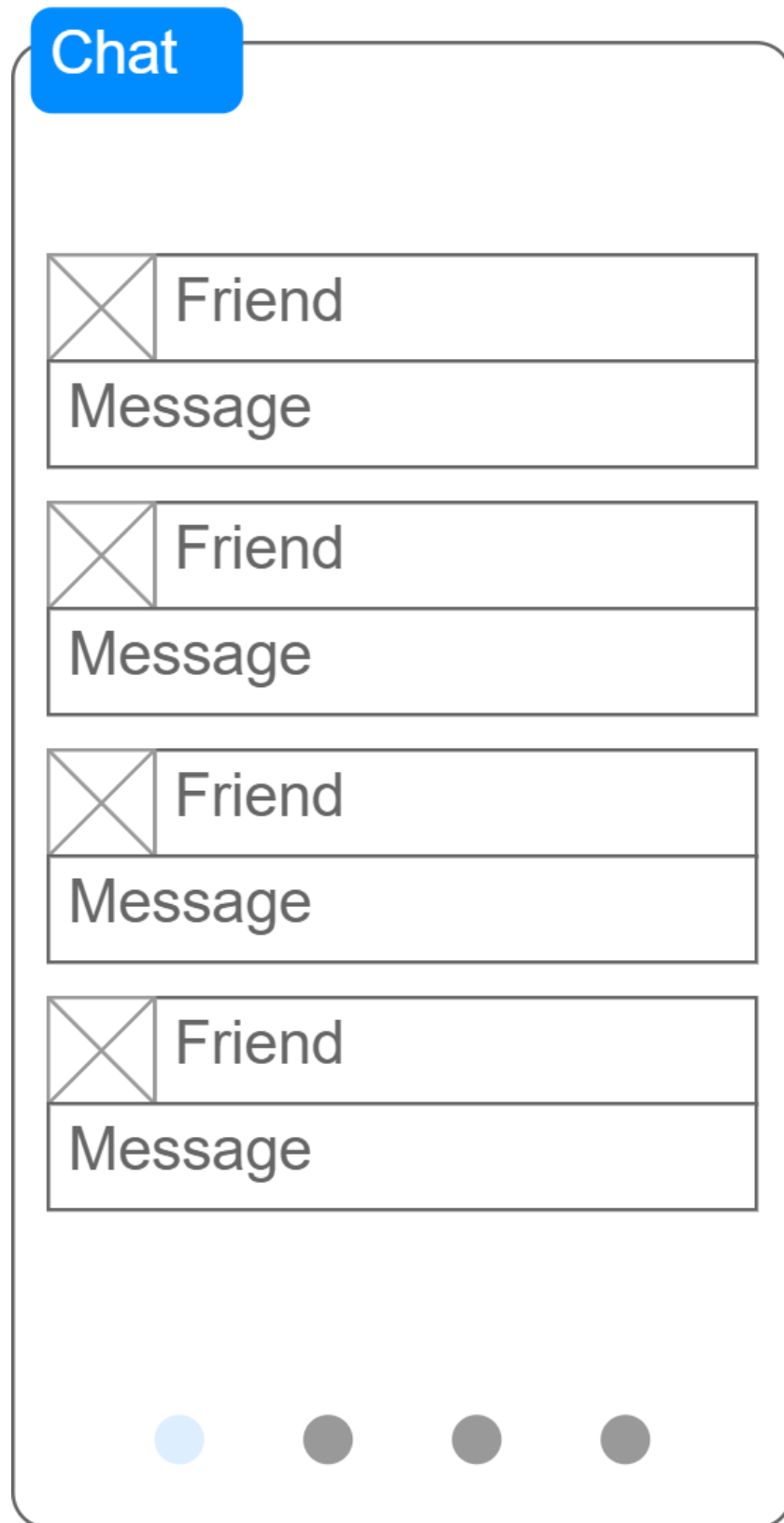
4.4.6   Chat Page

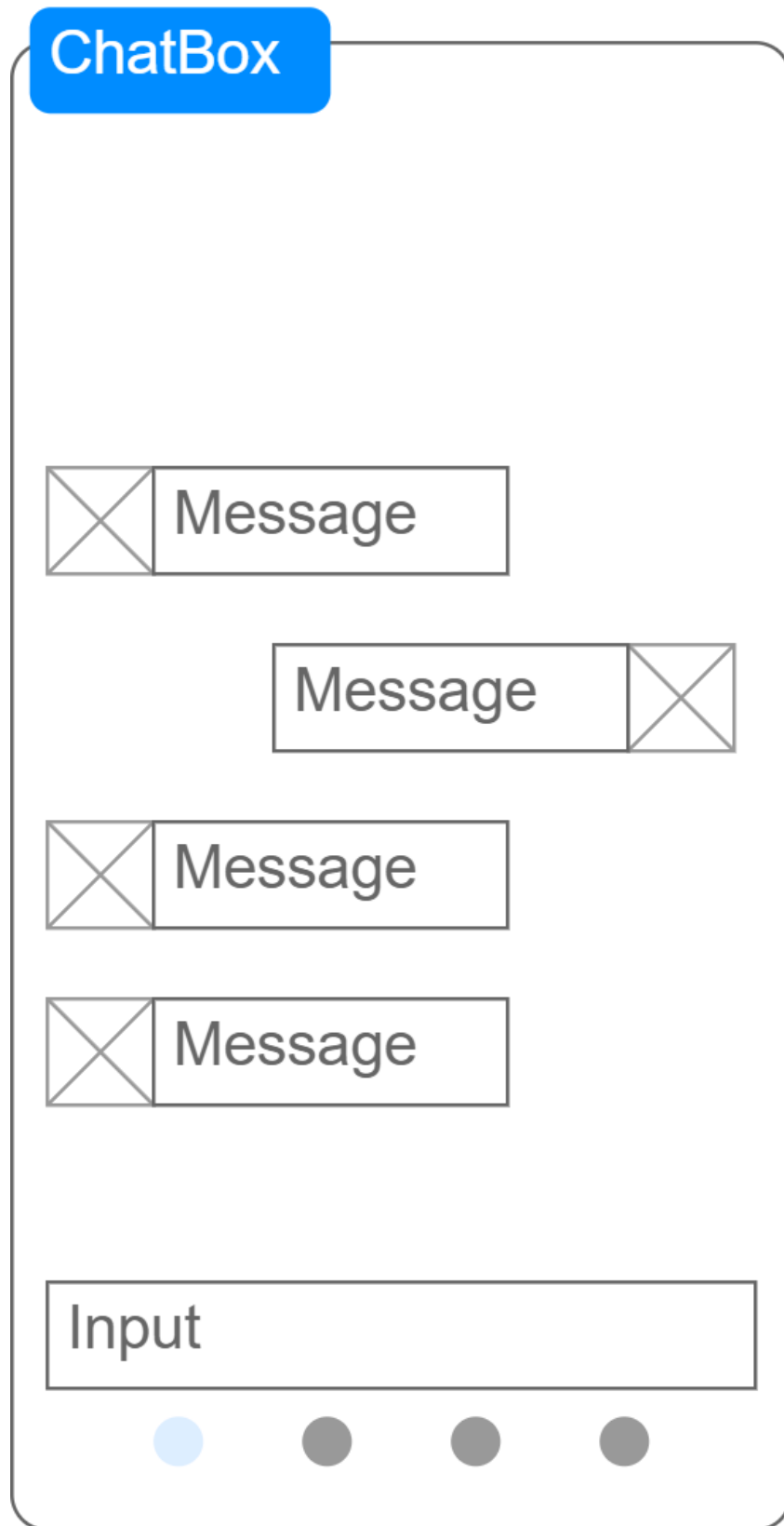Figure 4.8 Low Fidelity Diagram of Chat Page

4.4.7   Chat Box Page

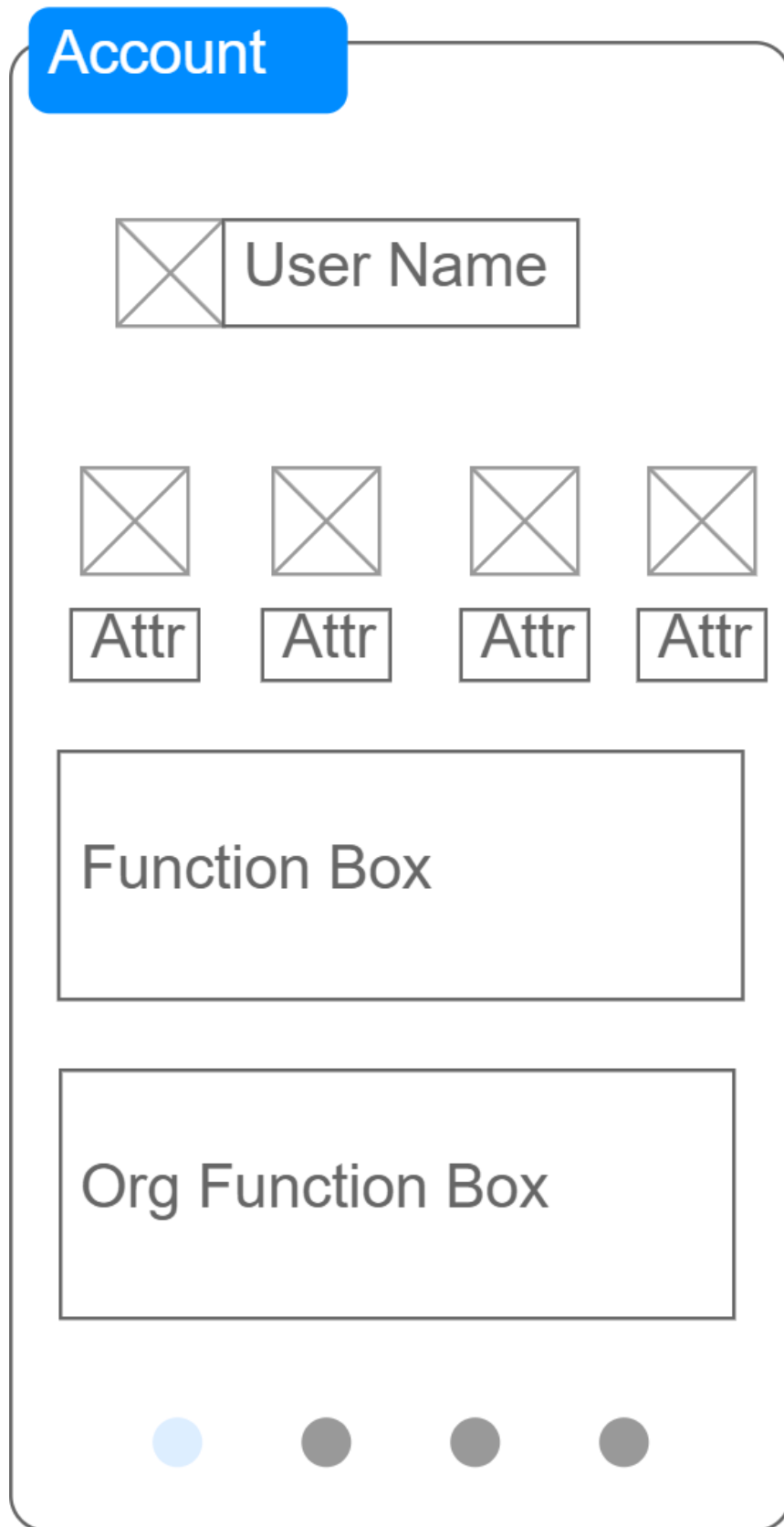Figure 4.9 Low Fidelity Diagram of Chat Box Page

4.4.8 Account Page

Figure 4.10 Low Fidelity Diagram of Account Page

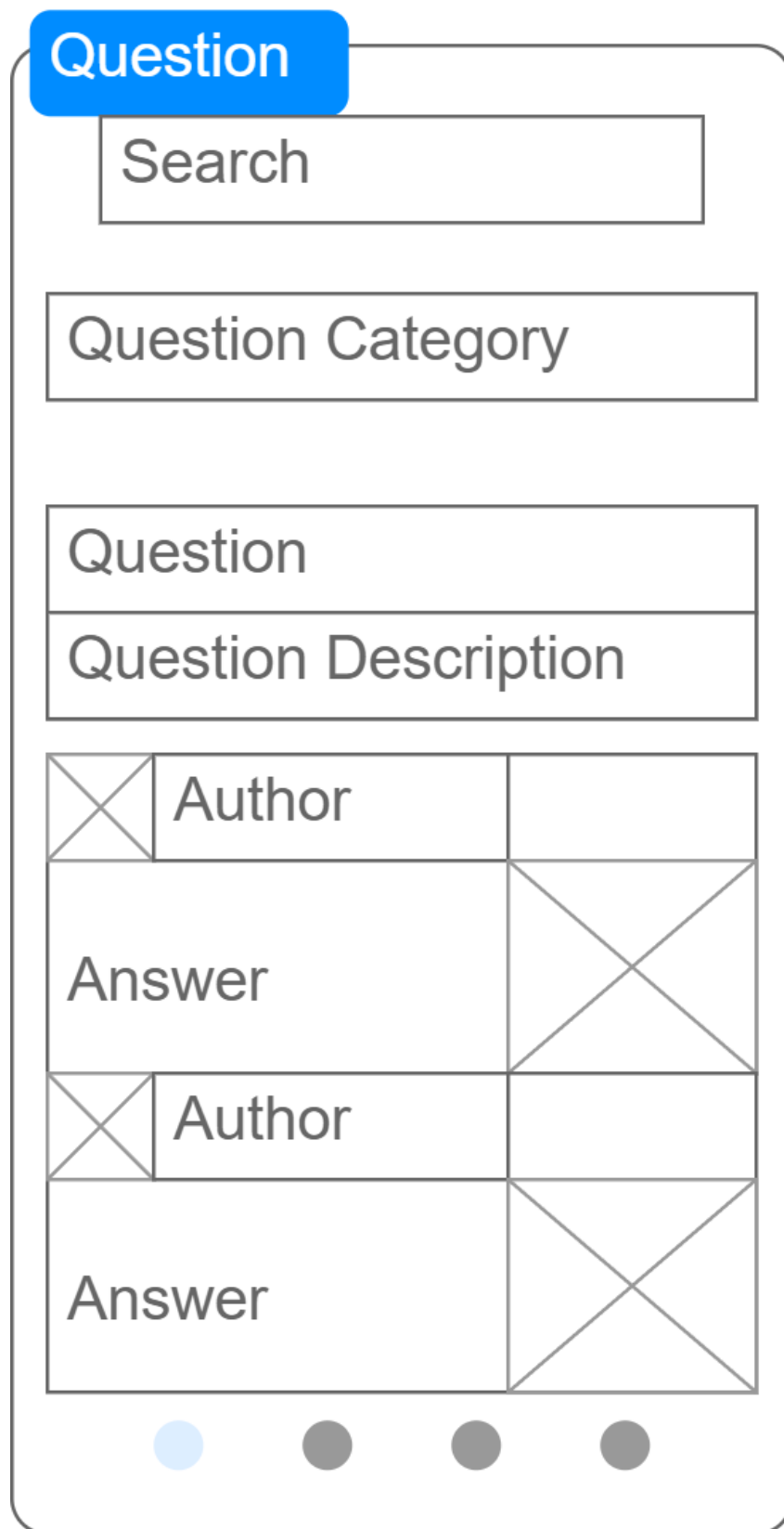Bachelor of Computer Science (Honours)
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4.4.9   Question Page

Figure 4.11 Low Fidelity Diagram of Question Page

4.4.10 Answer Page
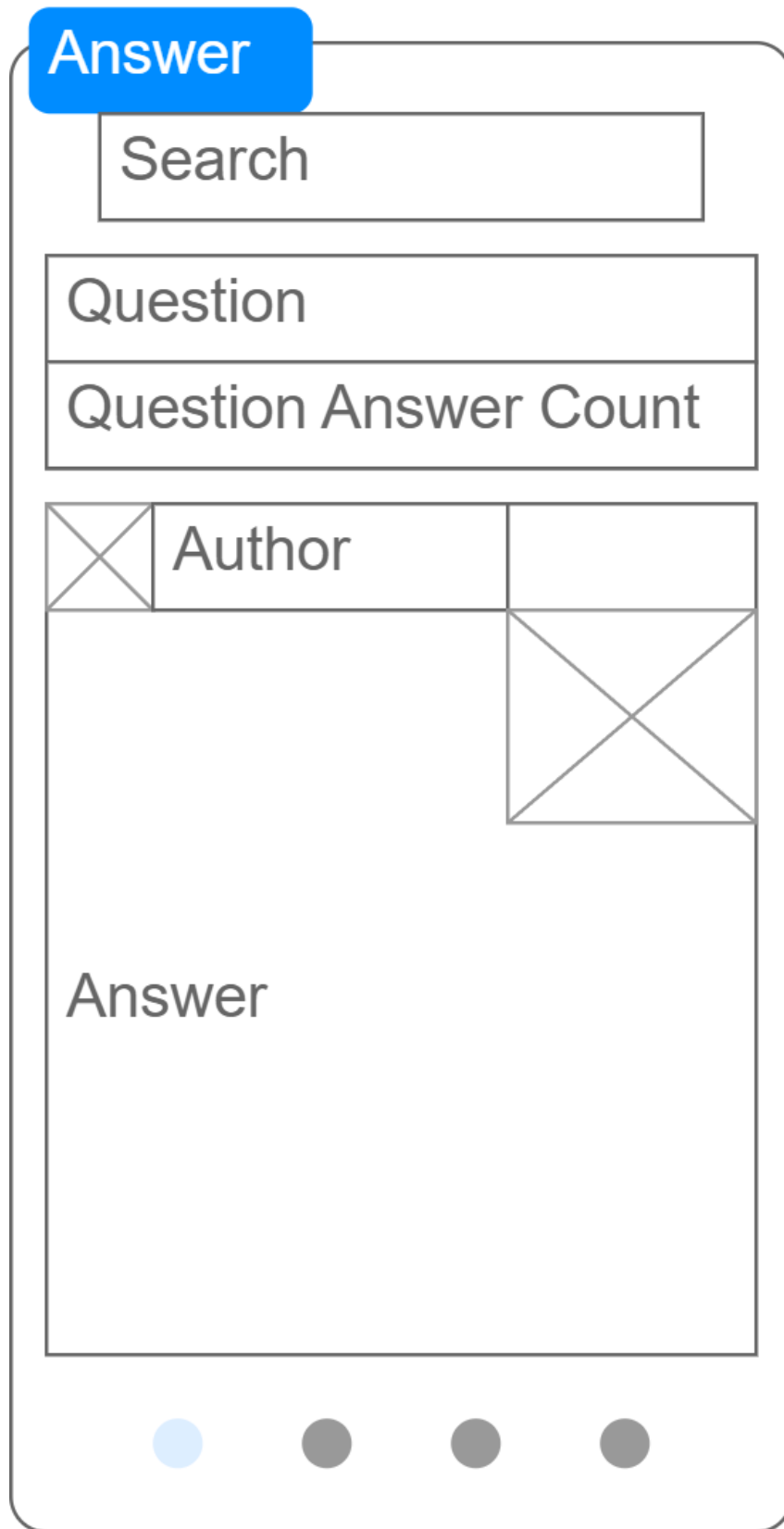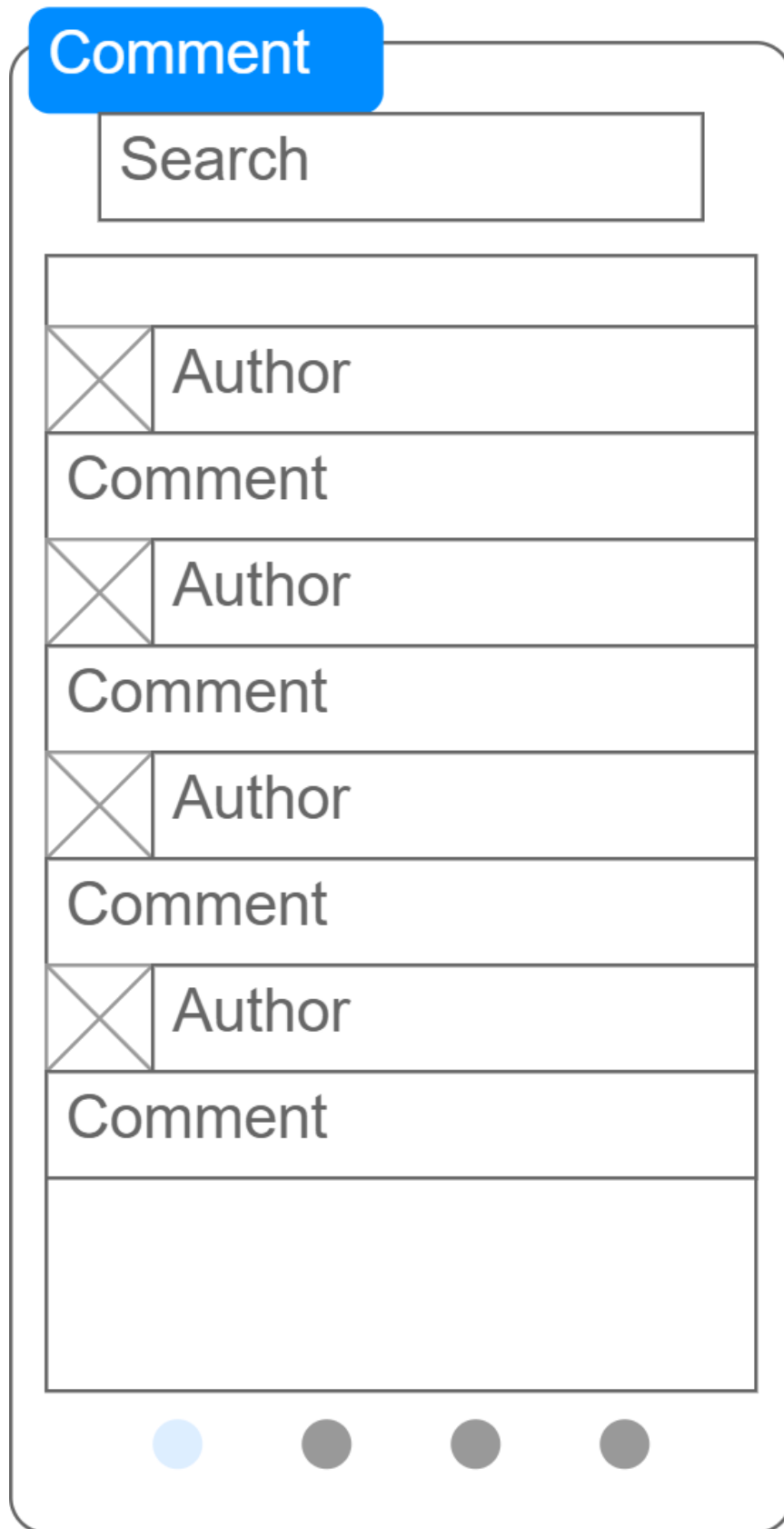

Figure 4.12 Low Fidelity Diagram of Answer Page

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4.4.11 Comment Page

Figure 4.13 Low Fidelity Diagram of Comment Page

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4.4.12 Post Question Page
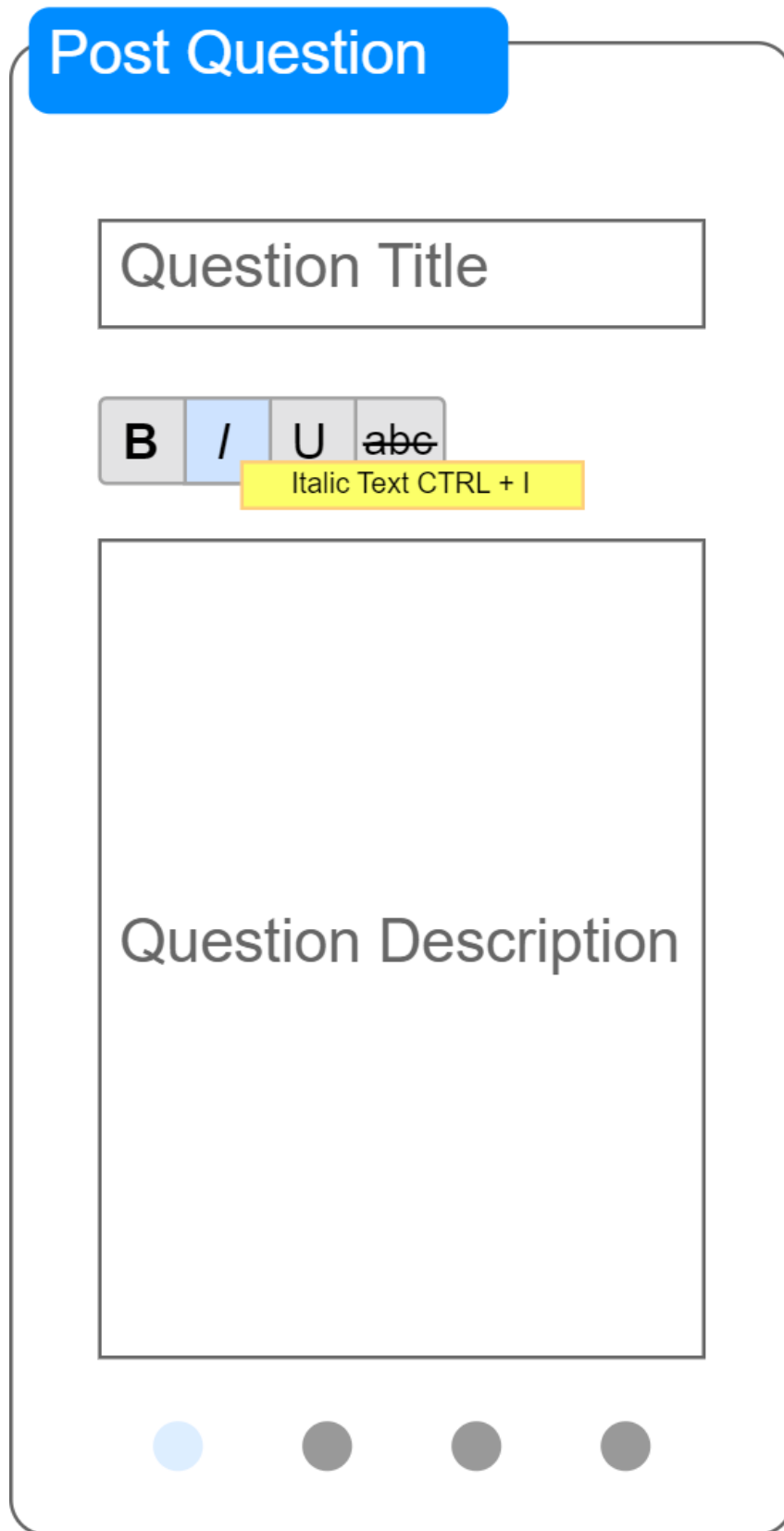
Figure 4.14 Low Fidelity Diagram of Post Question Page

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4.4.13 Post Answer Page
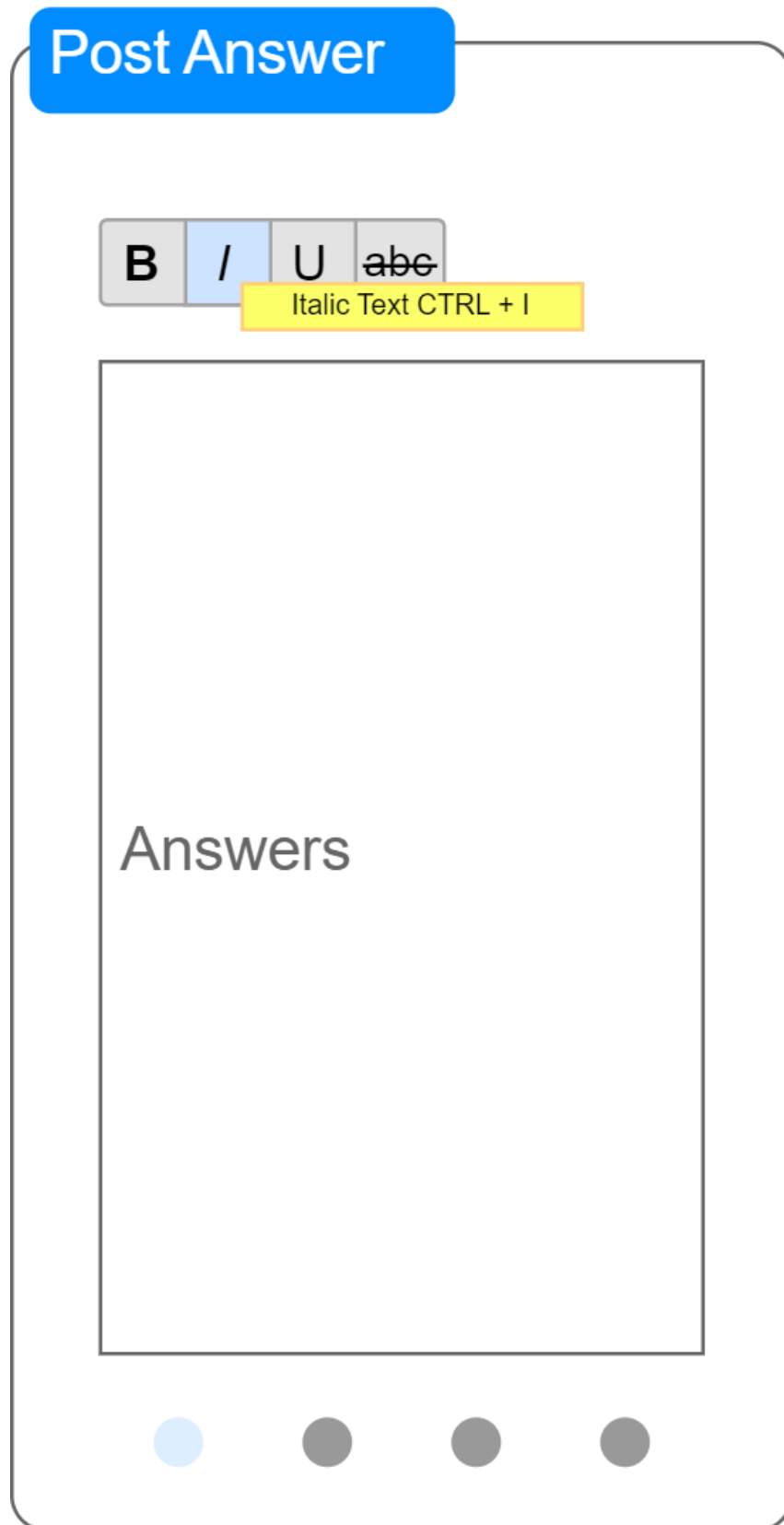

Figure 4.15 Low Fidelity Diagram of Post Answer Page

4.4.14 Search Page

Figure 4.16 Low Fidelity Diagram of Search Page

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Faculty of Information and Communication Technology (Kampar Campus), UTAR
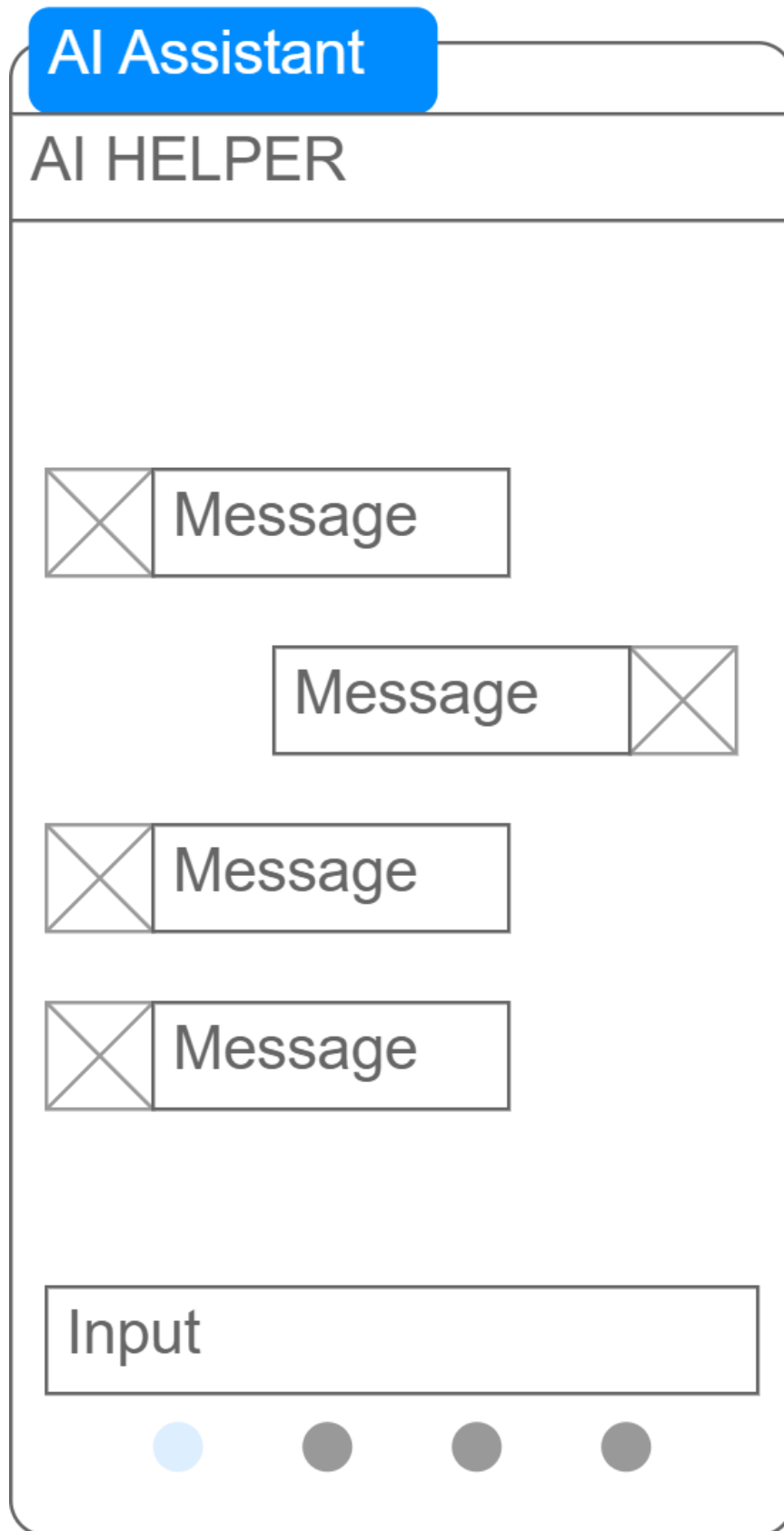
4.4.15 AI Assistant Page

Figure 4.17 Low Fidelity Diagram of AI Assistant Page

4.5   Database Design

In this project, Firebase Realtime Database is used as the data repository. The database is a NoSQL database, and the data structure will be stored in the form of JSON and key-value pairs. The database uses the Index method to process each data to obtain optimized efficiency. In this data design, there are no relationships to consider.
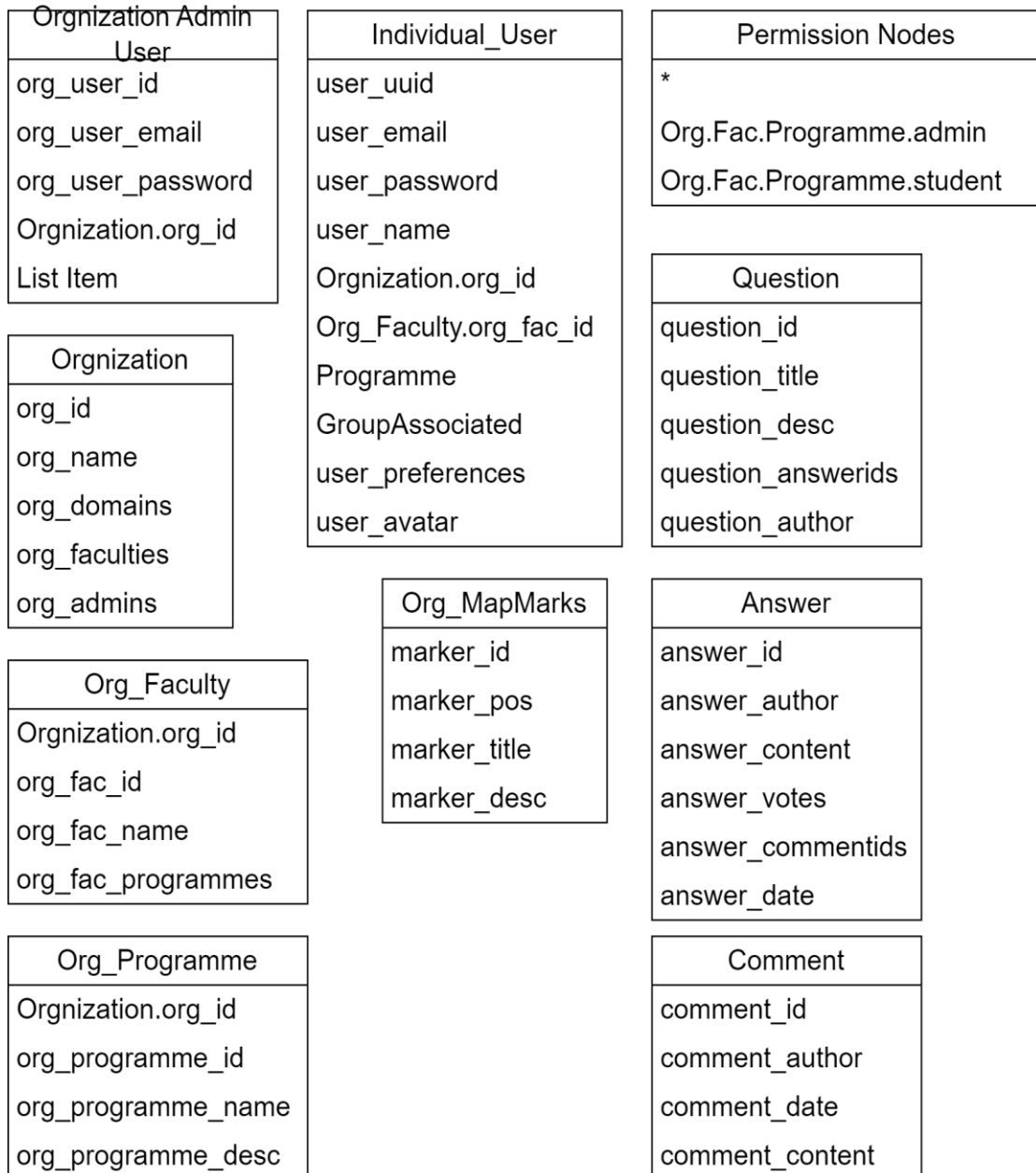
Orgnization Admin User
org_user_id
org_user_email
org_user_password
Orgnization.org_id
List Item

Orgnization
org_id
org_name
org_domains
org_faculties
org_admins

Org_Faculty
Orgnization.org_id
org_fac_id
org_fac_name
org_fac_programmes

Org_Programme
Orgnization.org_id
org_programme_id
org_programme_name
org_programme_desc

Individual_User
user_uuid
user_email
user_password
user_name
Orgnization.org_id
Org_Faculty.org_fac_id
Programme
GroupAssociated
user_preferences
user_avatar

Org_MapMarks
marker_id
marker_pos
marker_title
marker_desc

Permission Nodes
*
Org.Fac.Programme.admin
Org.Fac.Programme.student

Question
question_id
question_title
question_desc
question_answerids
question_author

Answer
answer_id
answer_author
answer_content
answer_votes
answer_commentids
answer_date

Comment
comment_id
comment_author
comment_date
comment_content

Figure 4.18 Data Structures

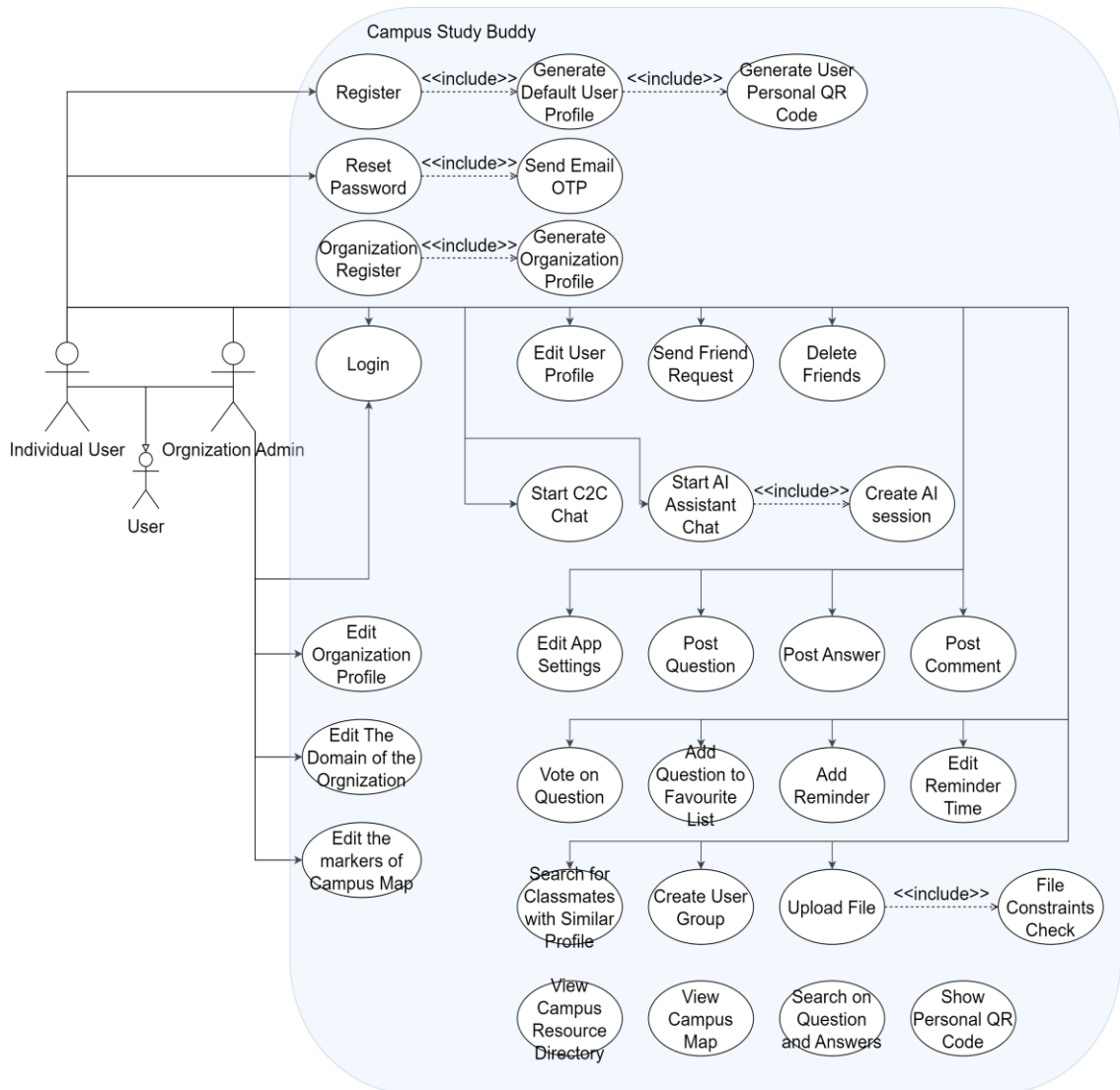## 4.6 Use Case Modelling

4.6.1 Use Case Diagram

Figure 4.19 Use Case Diagram

4.6.2   Use Case Description

Table 4.1 Use Case Description of Register

Name: Register	ID:1	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to register an account.		
Trigger: User click on register button.		
Relationship: • Association: Individual User, Organization Admin • Include: Generate Default User Profile, Generate User Personal QR Code • Extend: -		
Normal Flow of Events: Individual User: 1.Click on register button 2.Submit the email and password 3.System validates the information 4.Jump to Login Page Organization Admin: 1.Click on organization register button 2.Submit the email, password and organization domain 3.System validates the information 4.Jump to Login Page		
Sub Flows: 1.System sends email OTP.		
Exceptional Flows: 1.If information from user is incorrect, the system rejects the operation.		

Table 4.2 Use Case Description of Login

Name: Login	ID:2	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to log in the system.		
Trigger: User click login button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on login button 2.Submit the email and password 3.System validates the information 4.Jump to Home Page		
Sub Flows: 1.System sends email OTP.		
Exceptional Flows: 1.If information from user is incorrect, the system rejects the operation. 2.If information error triggered 5 times, the system will send OTP to validate user.		

Table 4.3 Use Case Description of Edit User Profile

Name: Edit User Profile	ID:3	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to edit his/her profile.		
Trigger: User click edit profile button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on edit profile button 2.Submit the latest information of his/her profile 3.System validates the information 4.Edit success		
Sub Flows: -		
Exceptional Flows: 1.If information from user is incorrect, the system rejects the operation.		

Table 4.4 Use Case Description of Send Friend Request

Name: Send Friend Request	ID:4	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to add new friends.		
Trigger: User click add friend button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on add friend button in other user's profile page 2.Submit the hello message 3.System send hello message to the other user		
Sub Flows: 1.The other user can accept the request. The system will add them as friends. 2.The other user can reject the request. The system will cancel the request and send message to notify the one who send request.		
Exceptional Flows: -		

Table 4.5 Use Case Description of Delete Friend

Name: Delete Friend	ID:5	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to delete the friend.		
Trigger: User click delete friend button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on delete friend button 2.Confirm delete 3.System delete the friend information in database		
Sub Flows: -		
Exceptional Flows: -		

Table 4.6 Use Case Description of Start C2C Chat

Name: Start C2C Chat	ID:6	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to chat with friends.		
Trigger: User click start chat button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on start chat button 2.Select the target friend 3.System create a link between two user 4.User can send message to each other		
Sub Flows: -		
Exceptional Flows: -		

Table 4.7 Use Case Description of Start AI Assistant Chat

Name: Start AI Assistant Chat	ID:7	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to use AI Assistant service.		
Trigger: User click AI Assistant button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on AI Assistant button 2.System create a session for user 3.User chat with AI Assistant		
Sub Flows: 1.System creates AI session		
Exceptional Flows: 1.If user is sending bad words, the system will show warning and reject user's request.		

Table 4.8 Use Case Description of Edit App Settings

Name: Edit App Settings	ID:8	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to edit app settings.		
Trigger: User click settings button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on settings button 2.Adjust application properties 3.Click on apply button 4.System updates with new properties		
Sub Flows: -		
Exceptional Flows: -		

Table 4.9 Use Case Description of Post Question

Name: Post Question	ID:9	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to post question.		
Trigger: User click post question button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on post question button 2.Enter the question title and content 3.Click on post button 4.System validates the information 5.System accepts the question and store it to database		
Sub Flows: 1.System stores the question		
Exceptional Flows: 1.If information is incorrect or not sufficient, the system will promote a message to notify user to re-enter the information		

Table 4.10 Use Case Description of Post Answer

Name: Post Answer	ID:10	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to post answer.		
Trigger: User click post answer button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on post answer button 2.Enter the answer content 3.Click on post button 4.System validates the information 5.System accepts the answer and store it to database		
Sub Flows: 1.System stores the answer		
Exceptional Flows: 1.If information is incorrect or not sufficient, the system will promote a message to notify user to re-enter the information		

Table 4.11 Use Case Description of Post Comment

Name: Post Comment	ID:11	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to post comment.		
Trigger: User click post comment button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on post comment button 2.Enter the comment content 3.Click on post button 4. System accepts the comment and store it to database		
Sub Flows: 1.System stores the comment		
Exceptional Flows: -		

Table 4.12 Use Case Description of Vote on Question

Name: Vote on Question	ID:12	Priority: Normal
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to vote a question.		
Trigger: User click agree button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on agree button which appeared in question page 2.System receives the agree vote.		
Sub Flows: -		
Exceptional Flows: 1.If user click twice, the system will cancel the agree operation.		

Table 4.13 Use Case Description of Search for Classmates with Similar Profile

Name: Search for Classmates with Similar Profile	ID:13	Priority: High
Actor: Individual User, Organization Admin	Type: Essentials	
Stakeholders and Interests: • Individual User: Students or any individual who wants to have a collaborative learning environment, access information about their campus and find like-minded friends. • Organization Admin: Teachers from campus who want to participate in building a collaborative learning environment register records for their organization.		
Brief Description: This use case describes the operations needed for the user to search for classmates with similar profile.		
Trigger: User click find friend button.		
Relationship: • Association: Individual User, Organization Admin • Include: - • Extend: -		
Normal Flow of Events: Individual User & Organization Admin: 1.Click on find friend button 2.System gets user's profile and search in database 3.System return the users with similar profiles		
Sub Flows: -		
Exceptional Flows: 1.If there is no users with similar profile, the system will promote a message to notify user.		

4.7   Activity Diagrams

4.7.1   Login
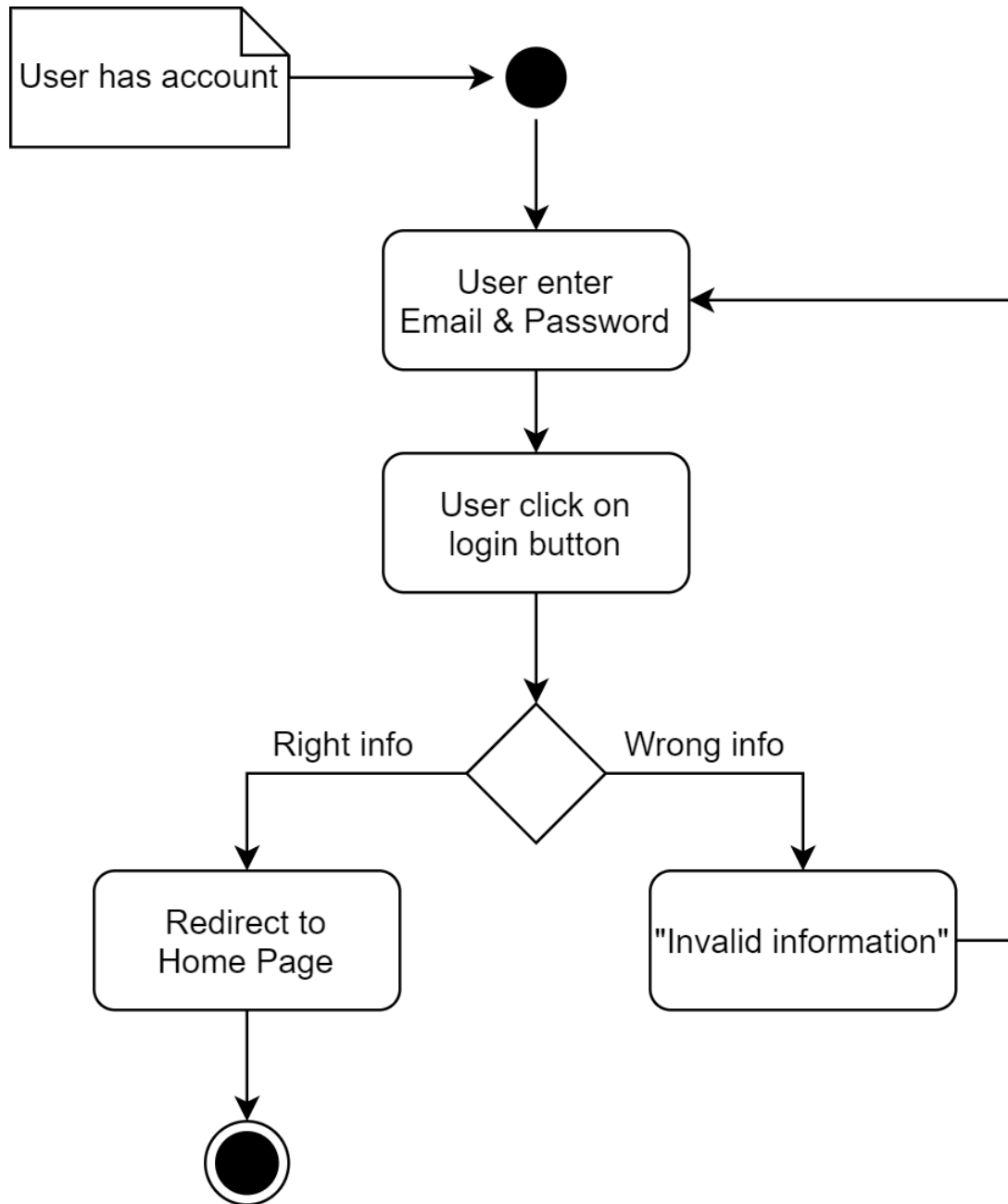
Figure 4.20 Activity Diagram of Login

4.7.2　Register
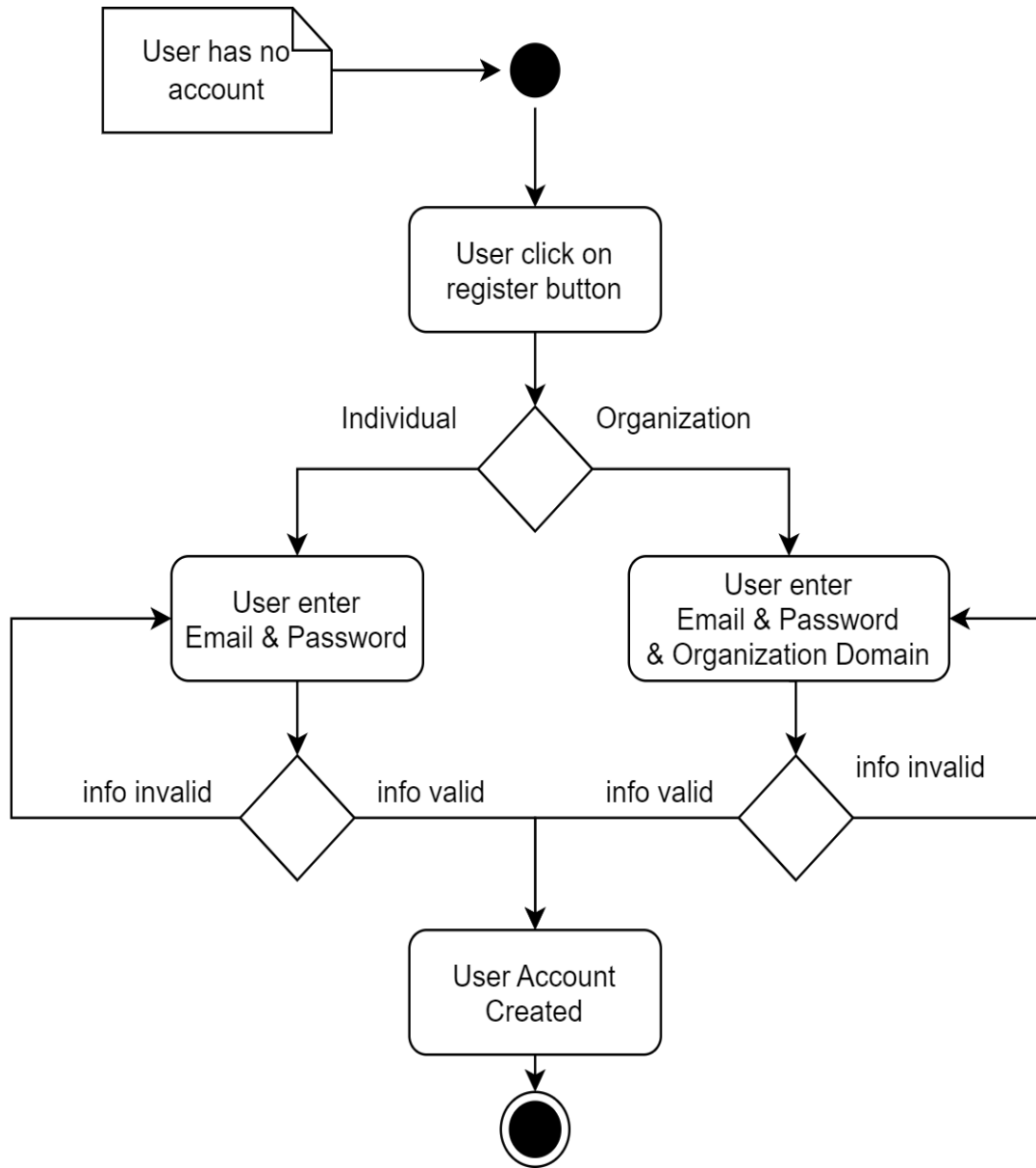
Figure 4.21 Activity Diagram of Register

4.7.3 Reset Password
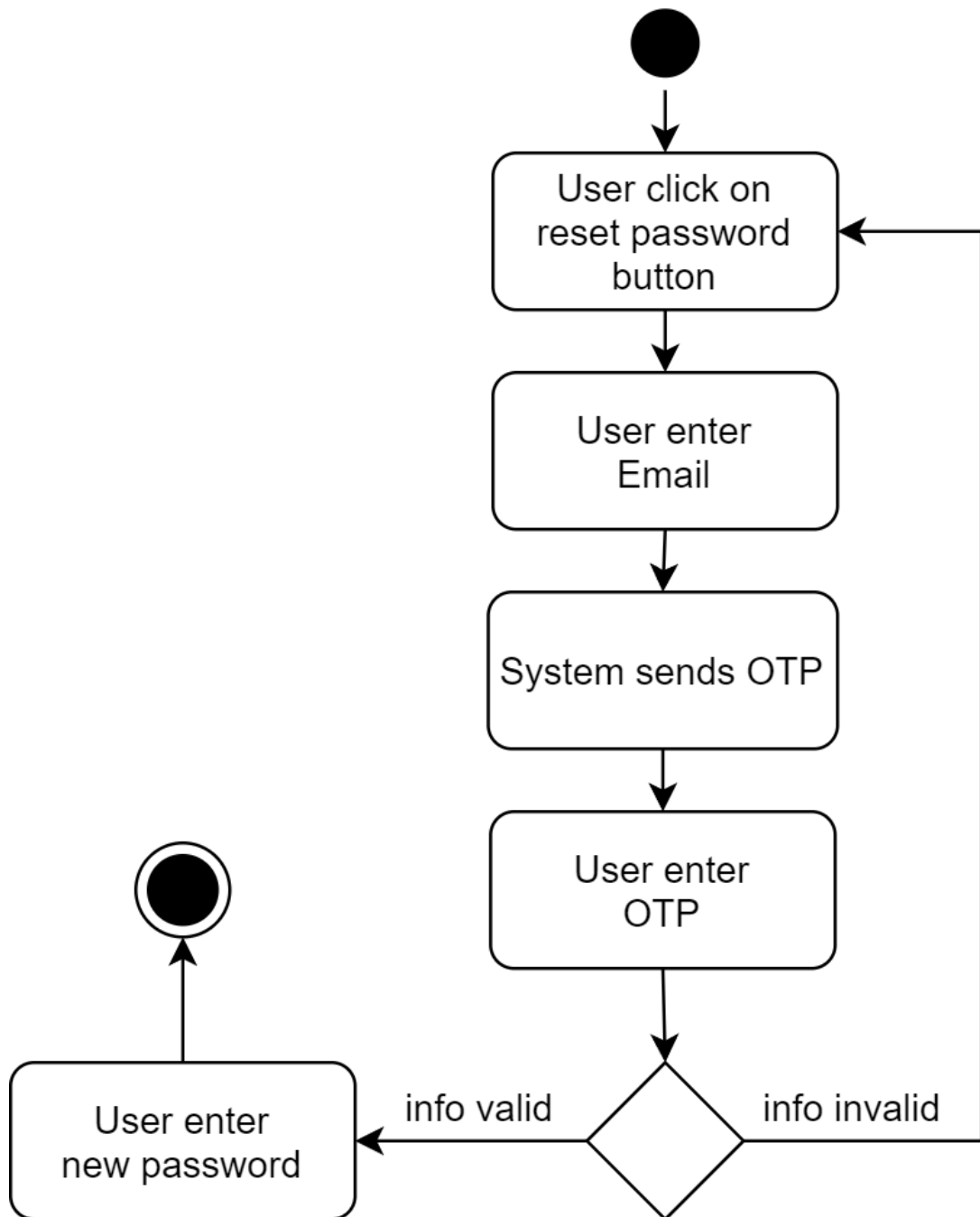
Figure 4.22 Activity Diagram of Reset Password

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4.7.4   Edit User Profile
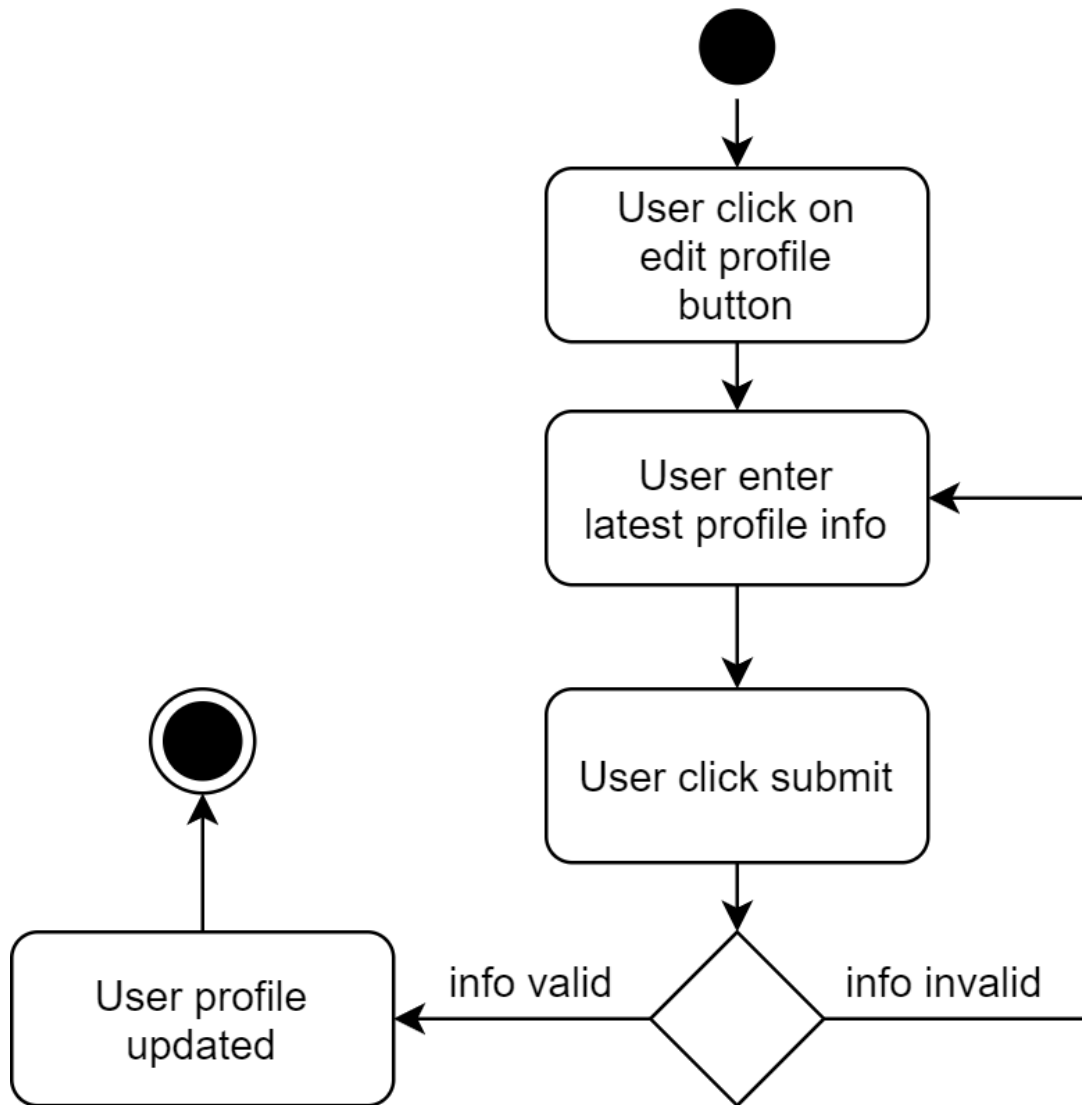
Figure 4.23 Activity Diagram of Edit User Profile

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4.7.5   Send Friend Request
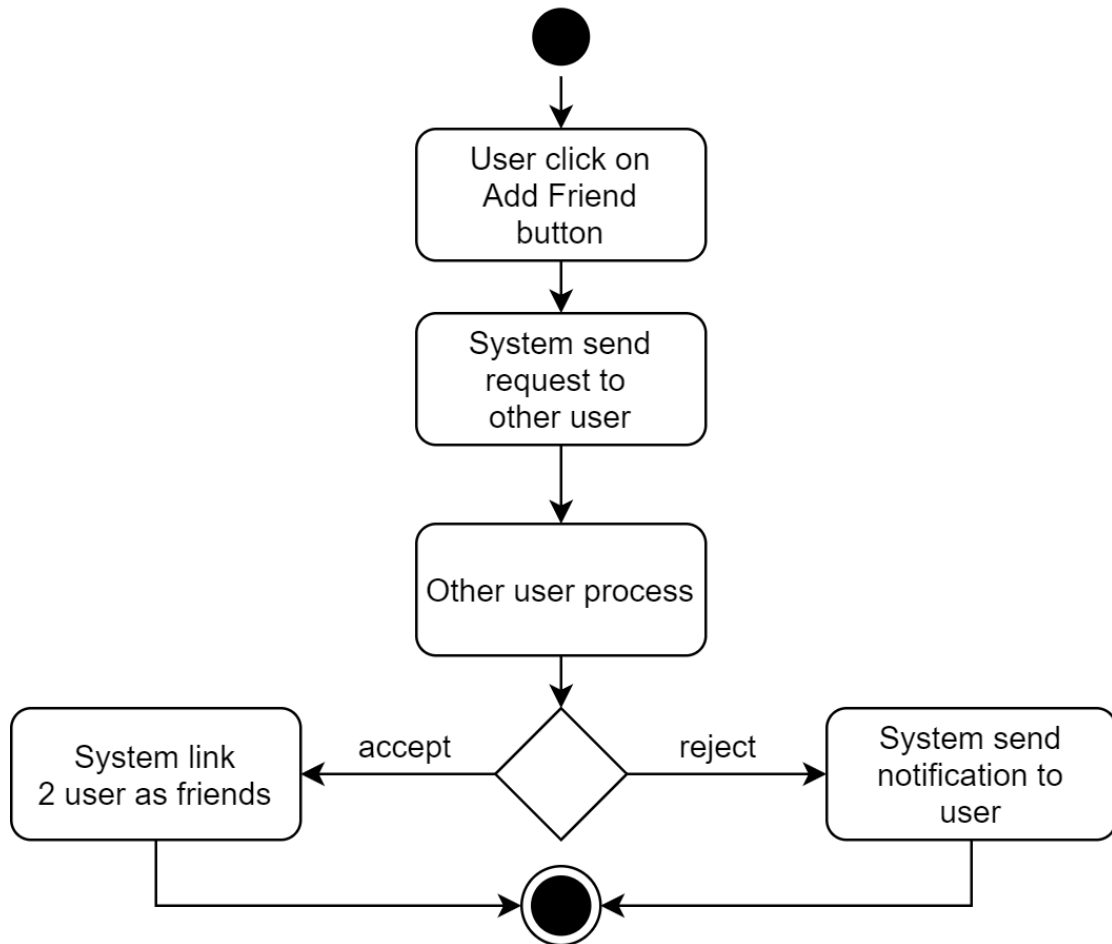
Figure 4.24 Activity Diagram of Send Friend Request

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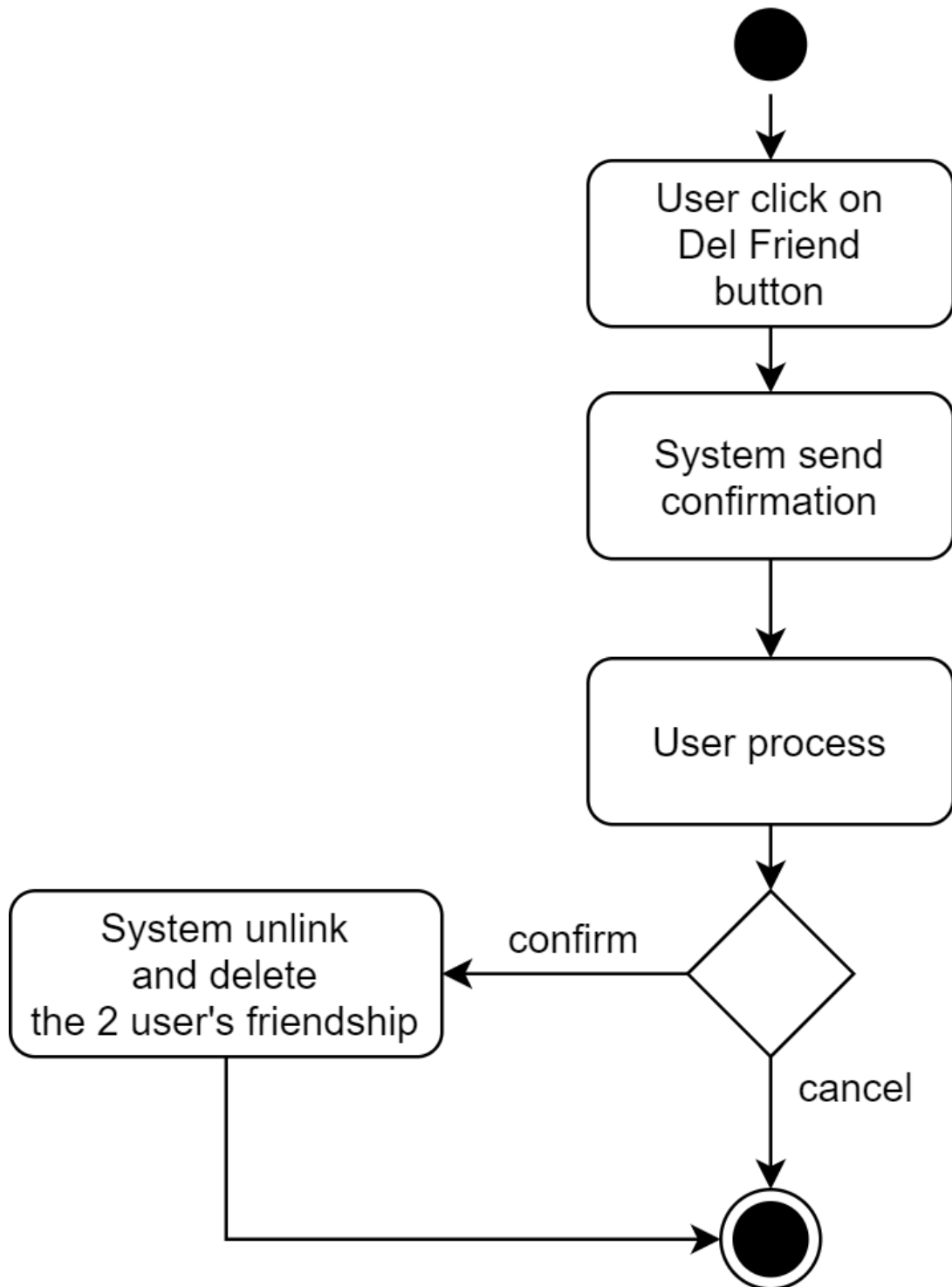
4.7.6 Delete Friend

Figure 4.25 Activity Diagram of Delete Friend

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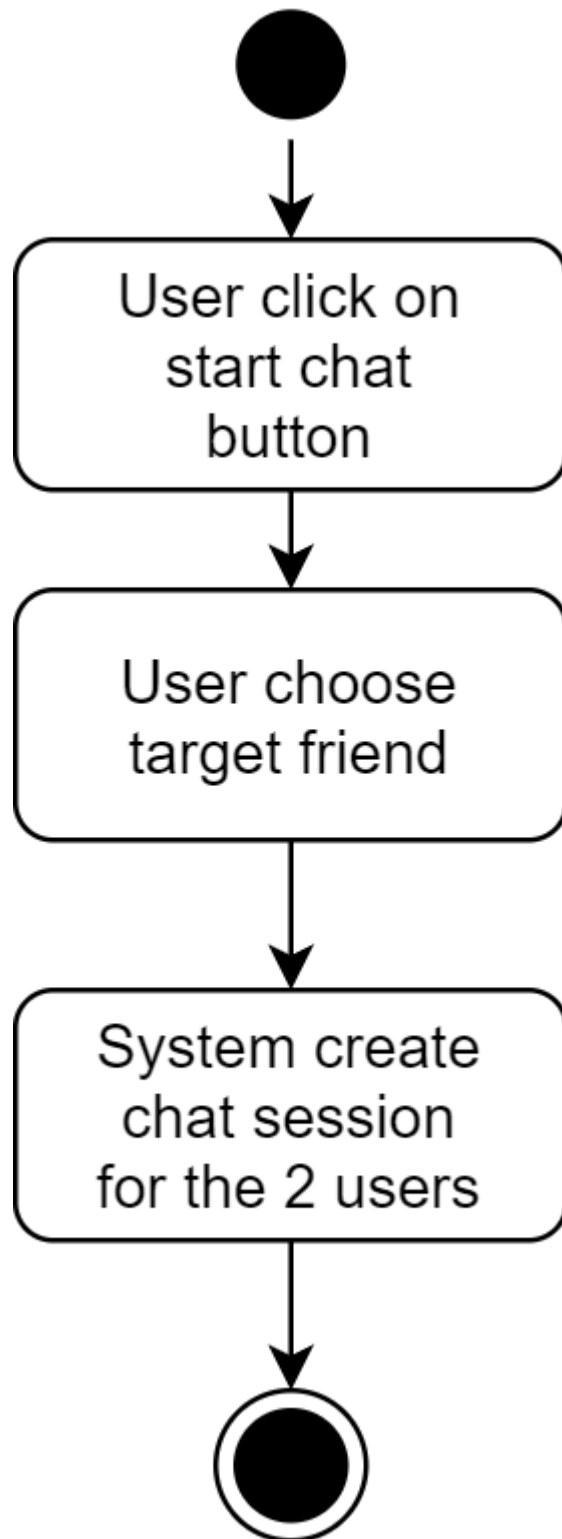
4.7.7   Start Chat

Figure 4.26 Activity Diagram of Start Chat

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4.7.8   Start AI Assistant Chat
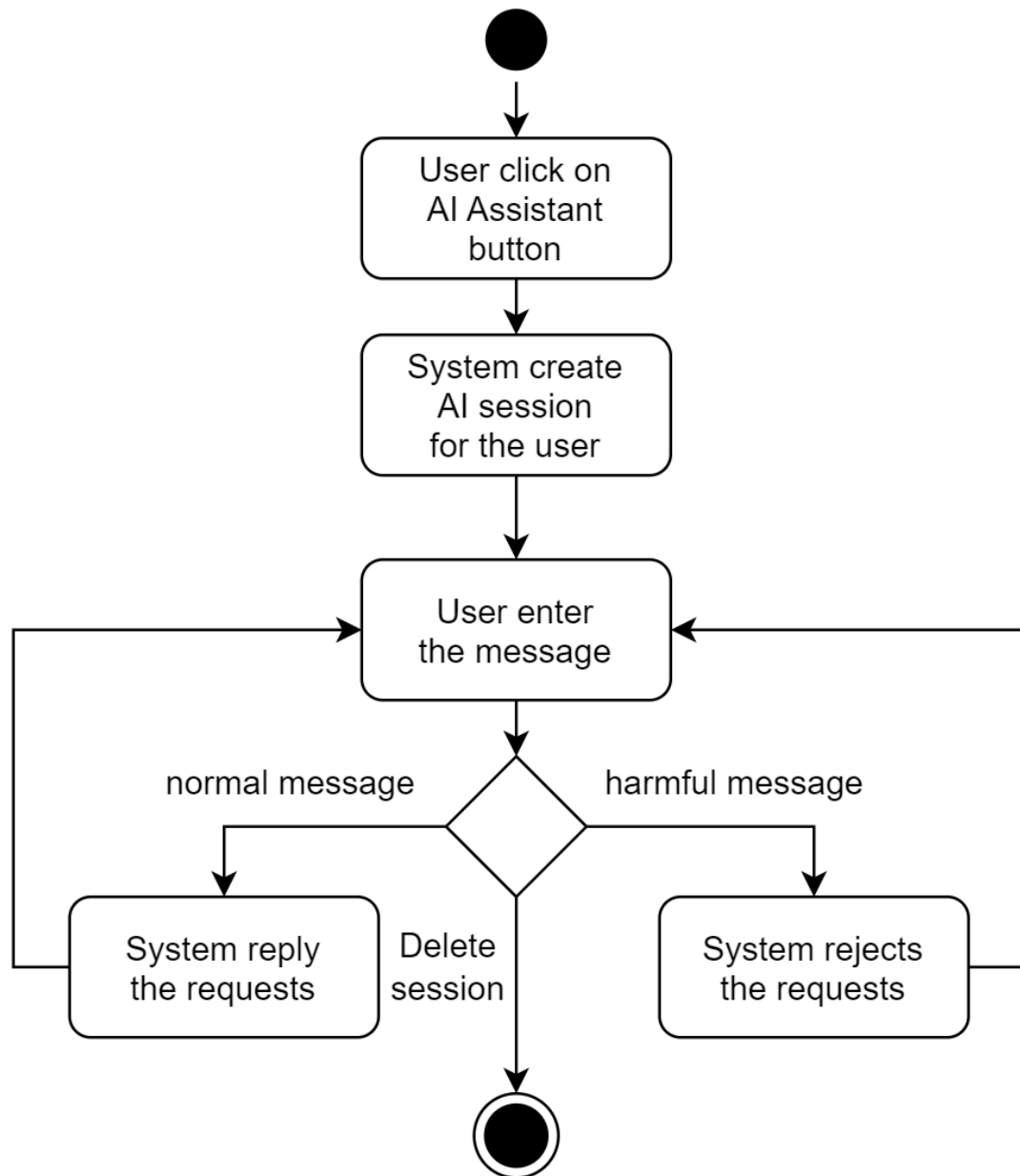
Figure 4.27 Activity Diagram of Start AI-Assistant Chat

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4.7.9 Edit APP Settings
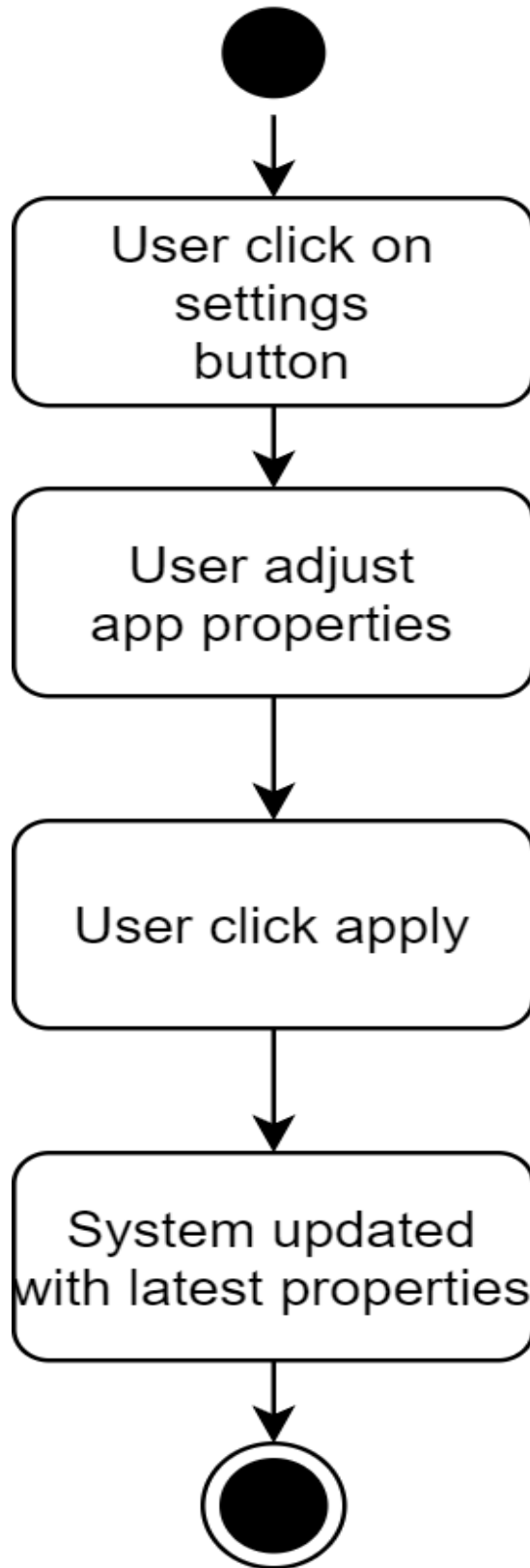
Figure 4.28 Activity Diagram of Edit APP Settings

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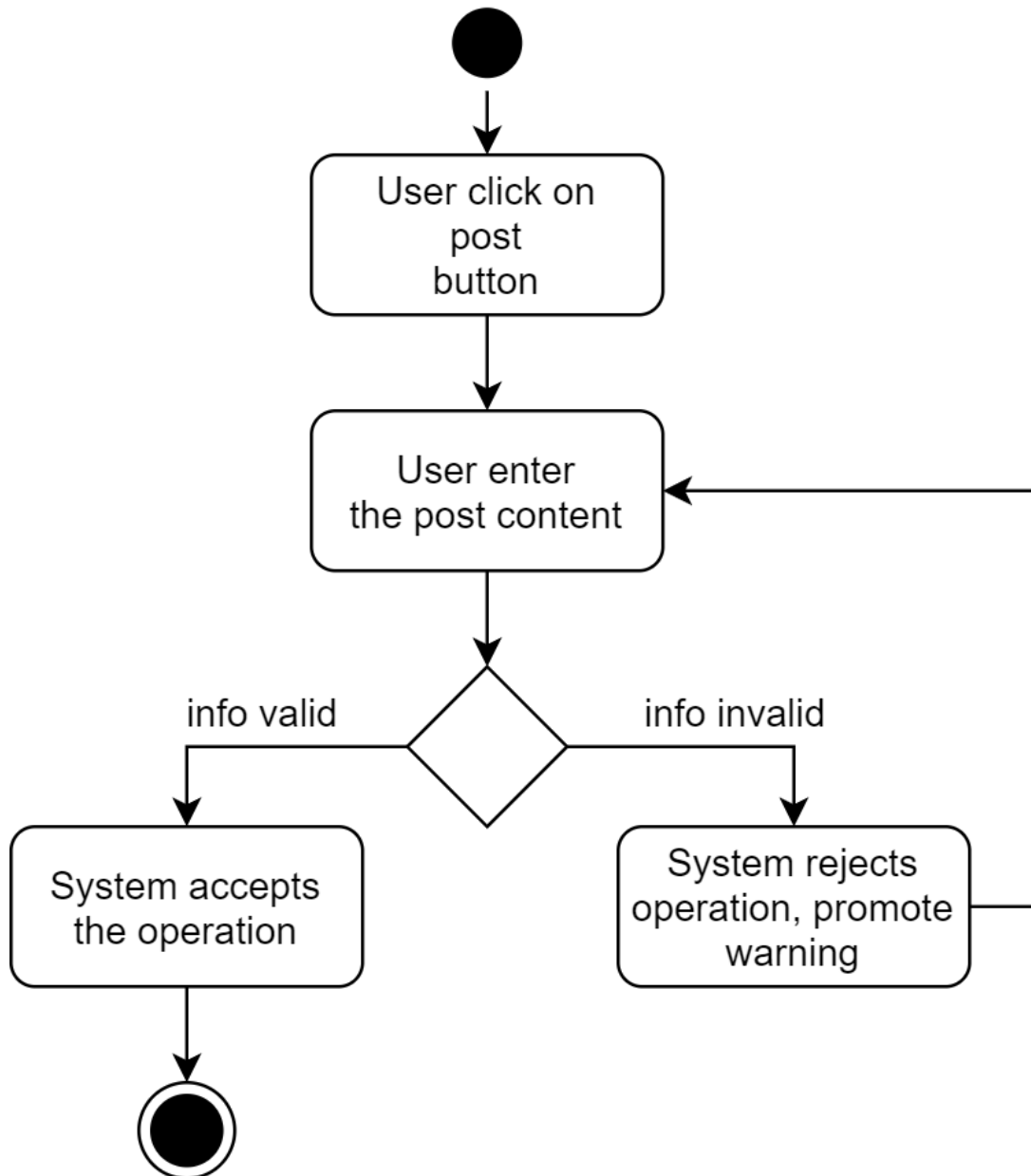
4.7.10 Post Content

Figure 4.29 Activity Diagram of Post Content

4.7.11 Find Classmates with Similar Profile
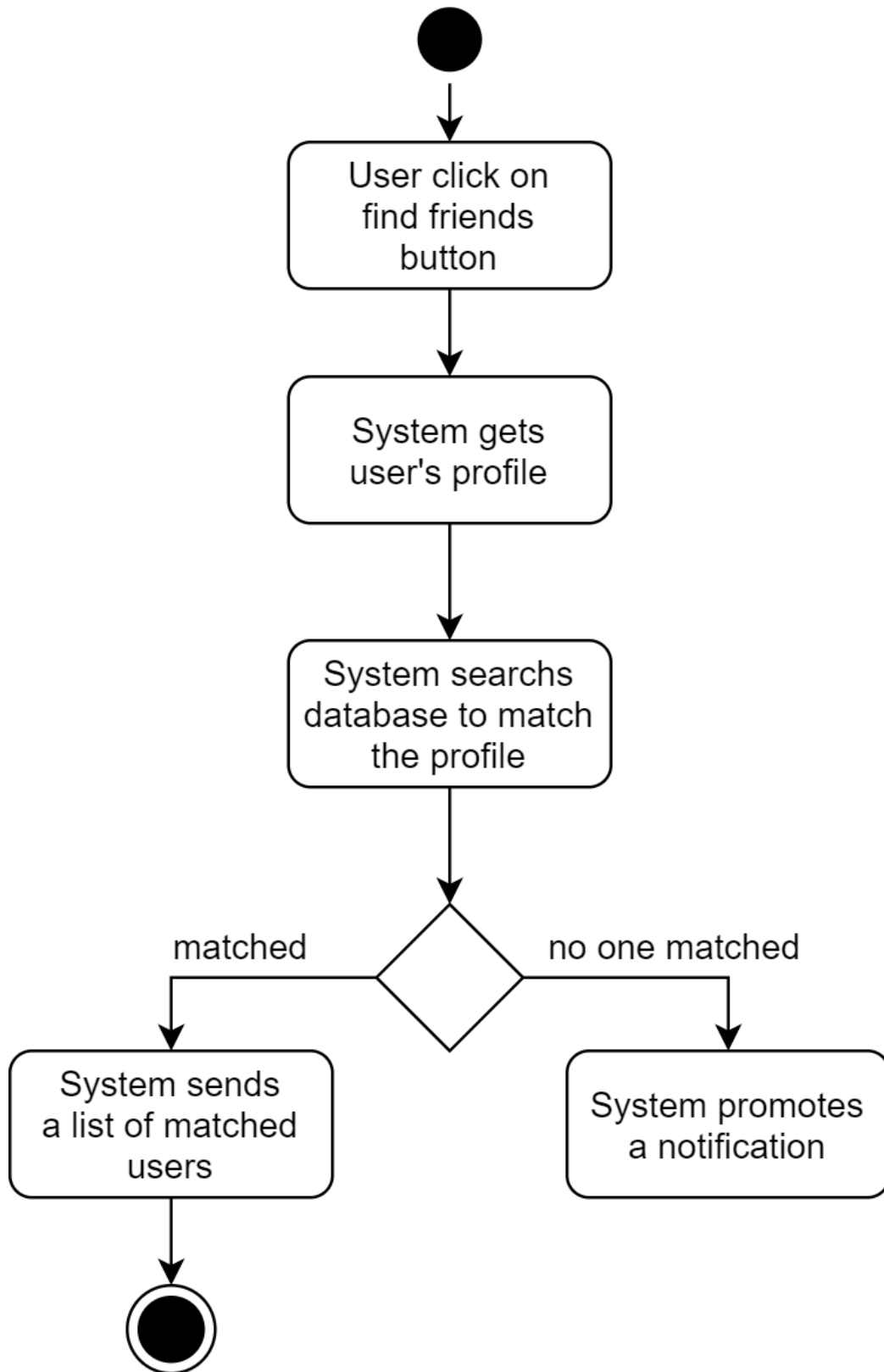
Figure 4.30 Activity Diagram of Find Classmates with Similar Profile

4.7.12 Upload File
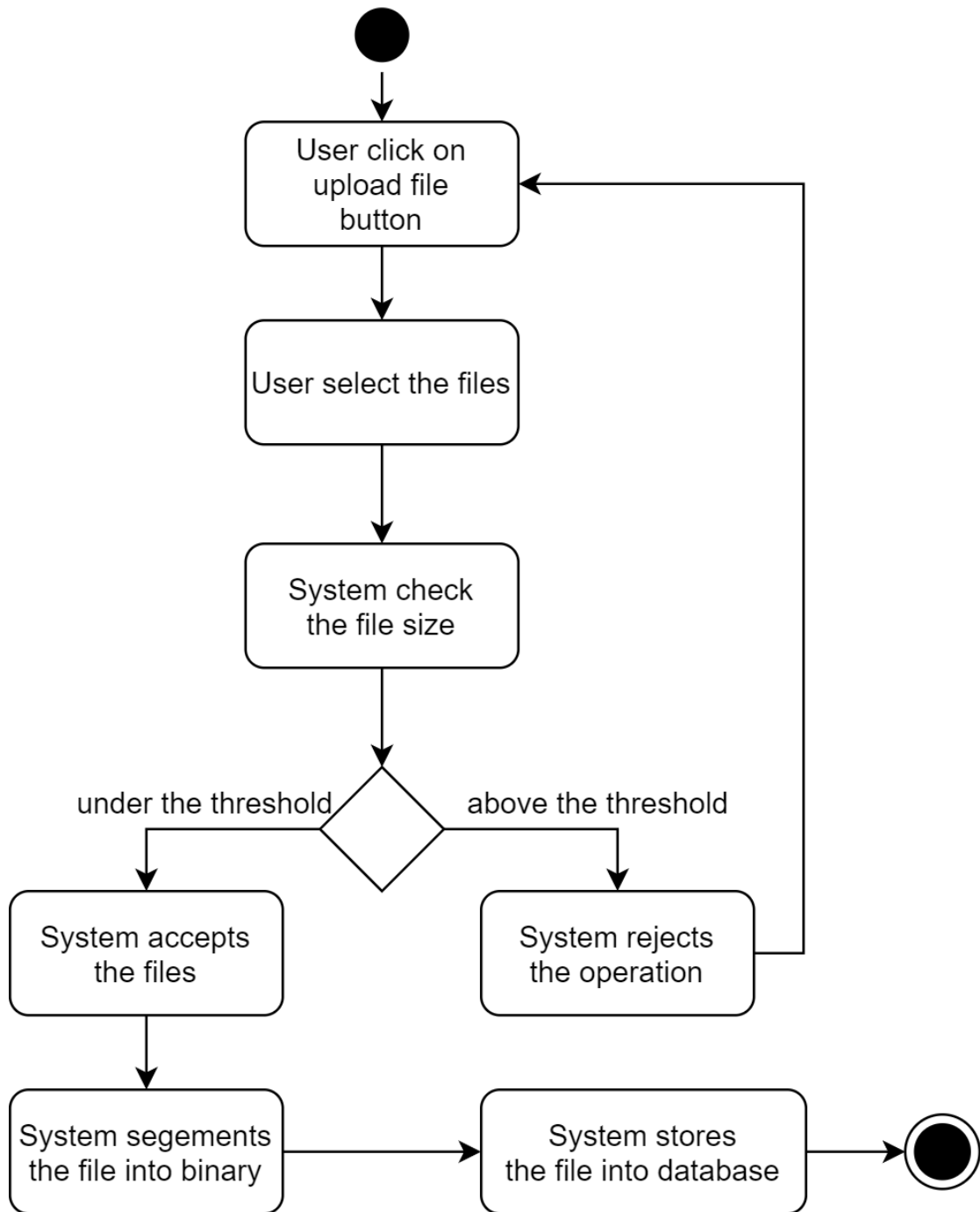
Figure 4.31 Activity Diagram of Upload File

CHAPTER 5

System Implementation

5.1   Introduction

In this chapter, a preliminary prototype of the system is presented. Based on the proposed methodology, this project successfully advanced the development of the system. The data used in the system prototype is virtual data generated by the code, and the test database and user verification module are back-end simulators deployed locally.

5.2   Implementations

5.2.1   Welcome Page

Figure 5.1 UI Implementation of Welcome Page

The welcome page adopts Material3 design and uses ElevatedButton and Column layout. The system LOGO uses my personal picture as a placeholder.

5.2.2 Login Page
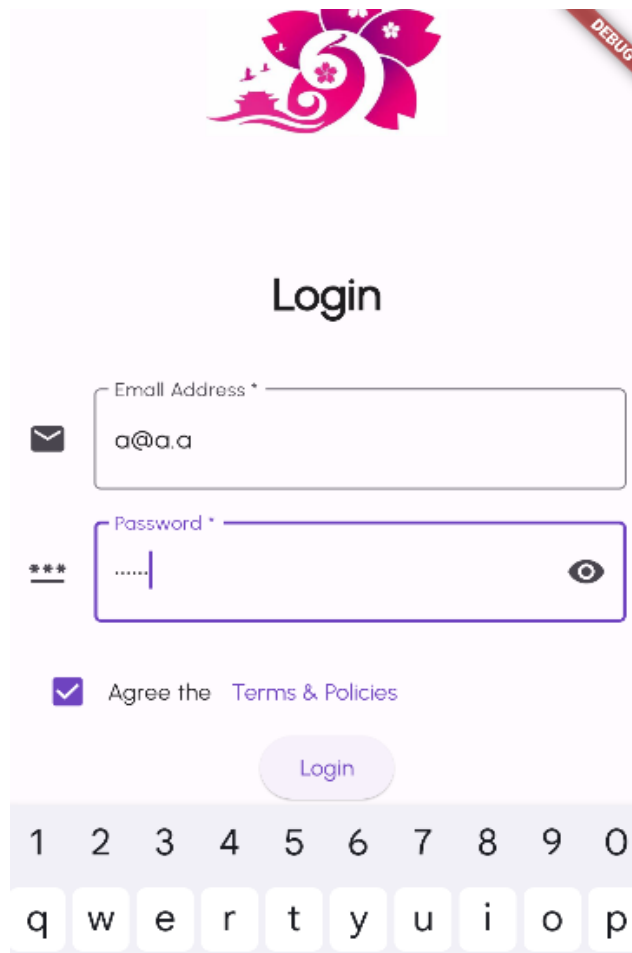
Figure 5.2 UI Implementation of Login Page

The login page is designed with a login box and a password input box. The Enter Password box allows users to show and hide their passwords. The account used to log in is a test account, and the data is stored in the local backend.

Figure 5.3 Backend Implementation

The local backend uses Firebase-Local-Emulator, and the log records during login can be seen in the console.

5.2.3   Register Page

Figure 5.4 UI Implementation of Register Page

The registration page is similar to the login page and is used to test the backend system. The authentication module is currently performing well, allowing users to register using email and password, and checking user input. After the user registers, a unique user ID will be generated for the user for system identification.

5.2.4   Forum Page
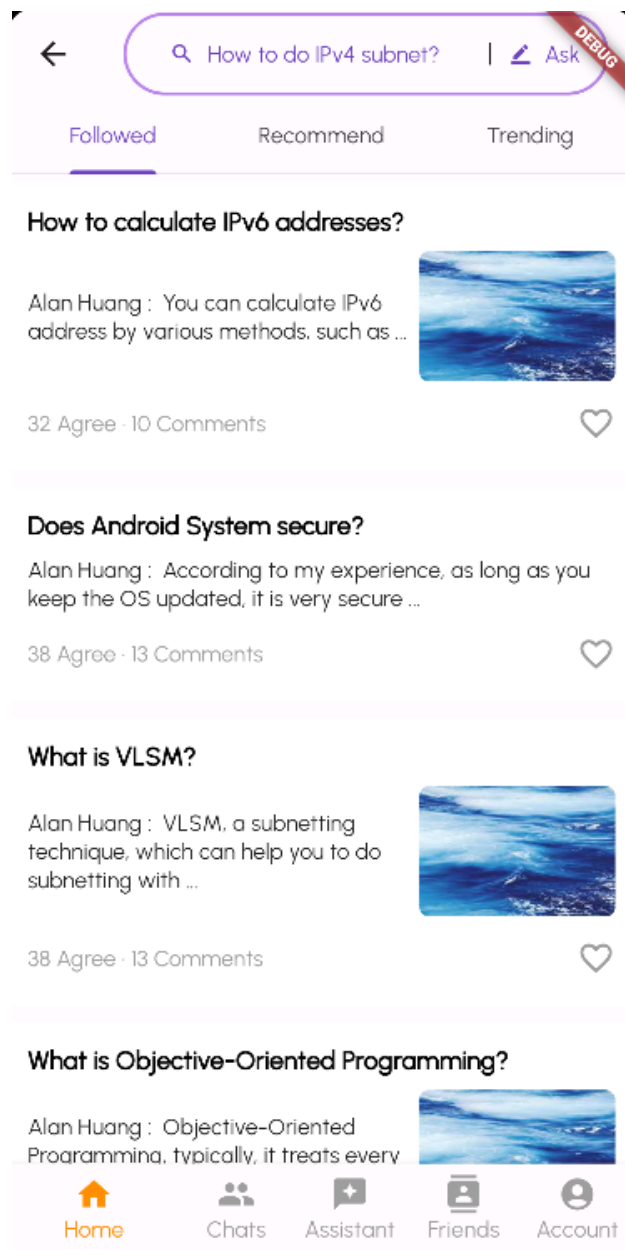
Figure 5.5 UI Implementation of Forum Page

The forum Q&A page is the homepage of the system, where the questions in the database will be displayed in a list, and the answers to the questions will be randomly displayed, allowing users to click to enter the question to view the content.

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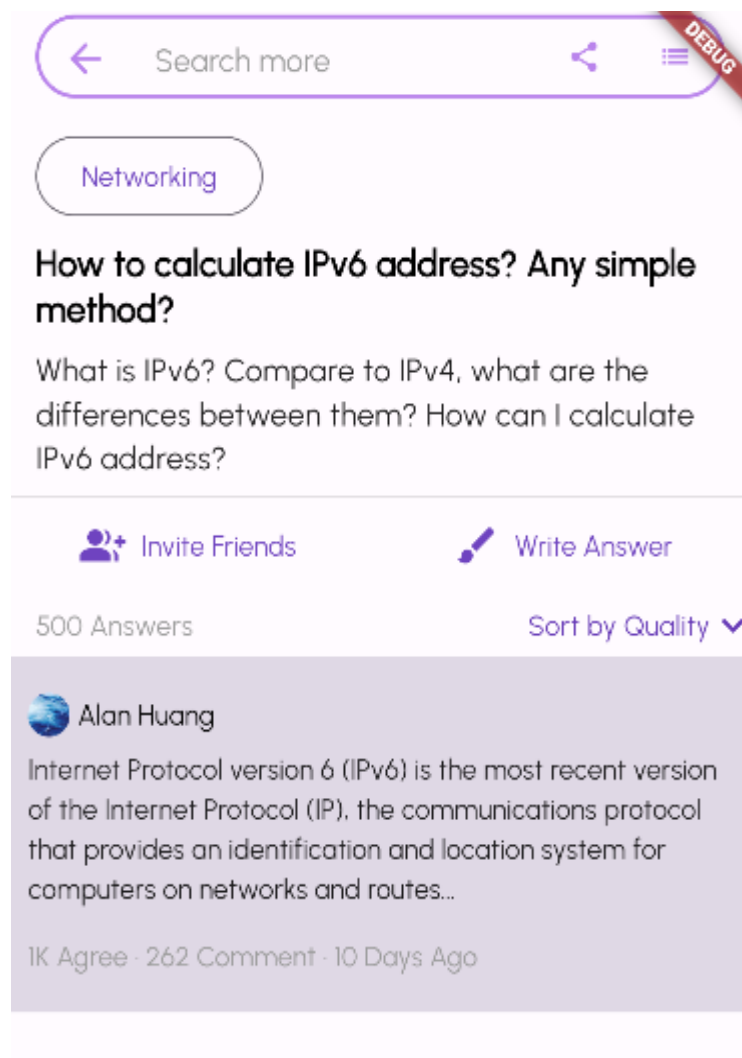
5.2.5 Question Page

Figure 5.6 UI Implementation of Question Page

The question details page will display the title of the question, the content of the question, and the classification of the question. Users can invite their friends to answer questions on this page, or they can answer questions themselves. All answers to the question will be displayed here and the user can sort the answers.

This is one of the main modules of collaborative learning, which allows users to ask each other questions, and all Q&A records will be stored for anyone to query.

5.2.6   Answer Page
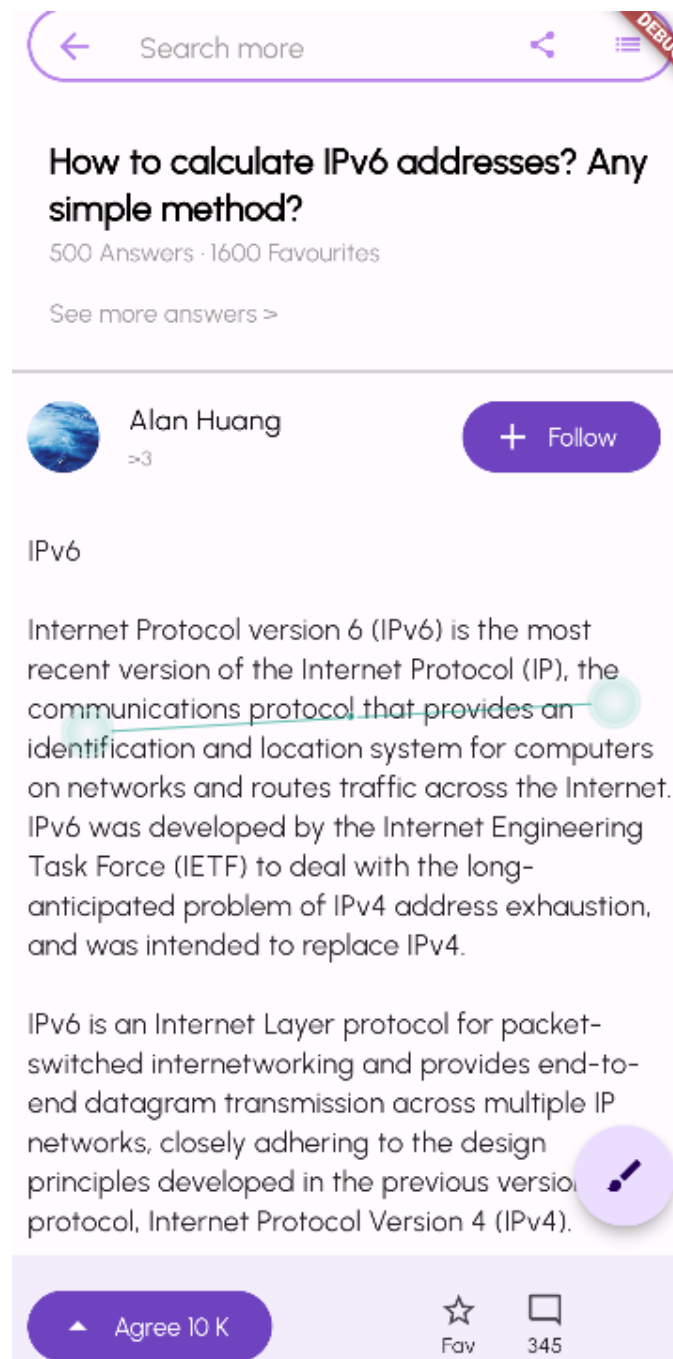
Figure 5.7 UI Implementation of Answer Page

On the answer details page, users can view a specific answer. Users can click the Agree button to vote for the answer, or click the Fav button to favorite it. Users are also allowed to comment on answers.

There is also a floating button that allows users to quickly enter the answer page.

5.2.7 Post Question Page
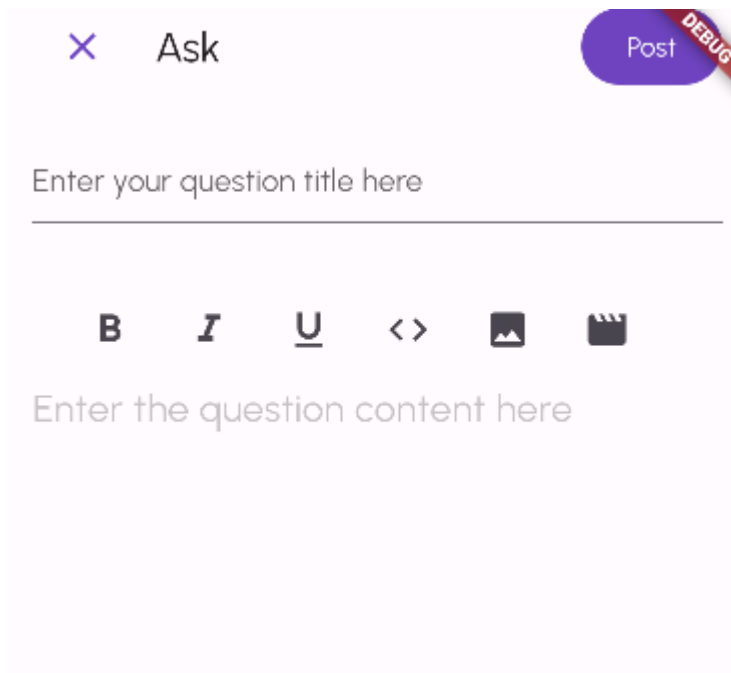
Figure 5.8 UI Implementation of Post Question Page

The post question page allows users to enter the question title and question content, and then publish it to the system. This page implements a rich text editor, which currently allows users to format the text they enter and also allows users to insert multimedia content such as images and videos.

5.2.8 AI Assistant Page
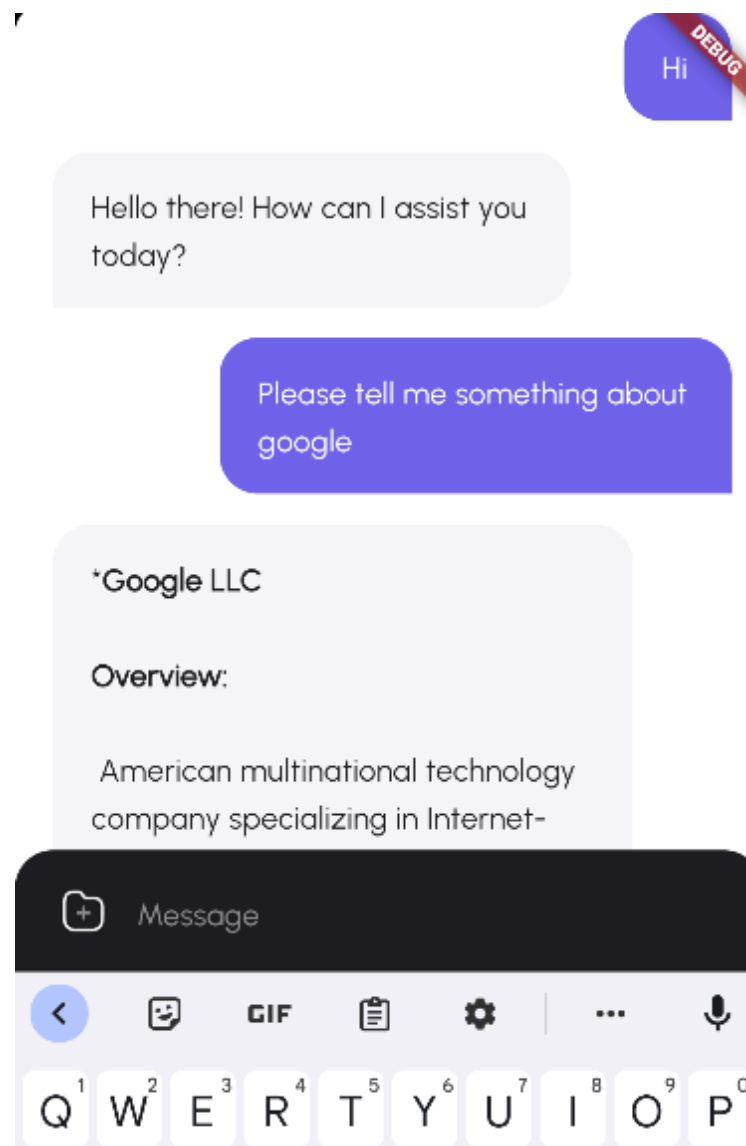
Figure 5.9 Implementation of AI Assistant Page

The AI assistant page allows users to talk to the system's AI model. This page implements the Google Gemini Pro large language model, allowing it to process user input and output corresponding content. After testing, this feature performs well.

At the same time, the assistant page also displays the chat box page of this system. The chat box of this system allows users to have conversations and allows users to upload and share files.

5.2.9 Git Repository
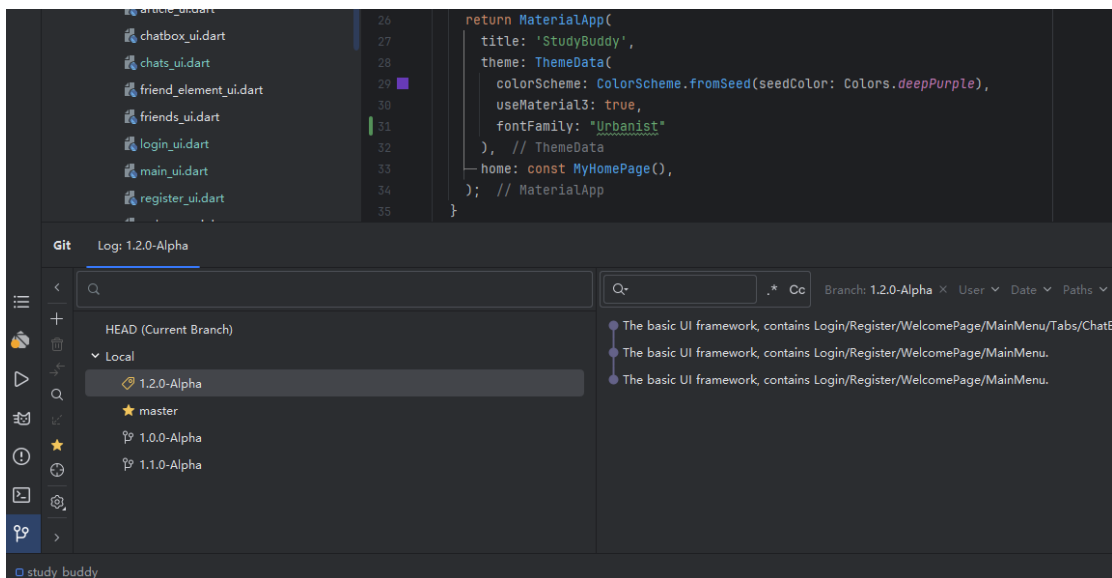
Figure 5.10 Local Git Repository

During the development process, Git is used to manage code versions. A local Git repository is established to store iterative versions of the code. Git improves the efficiency of the development of this project.

The local git repository ensures code privacy and security and provides real-time, delay-free code version control without the need for a network connection.

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5.2.10 Google Firebase
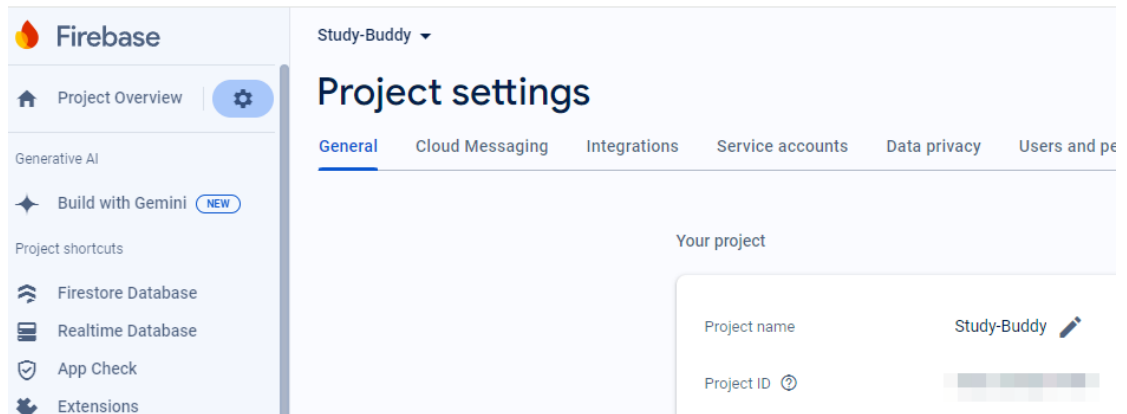
Figure 5.11 Firebase Setup
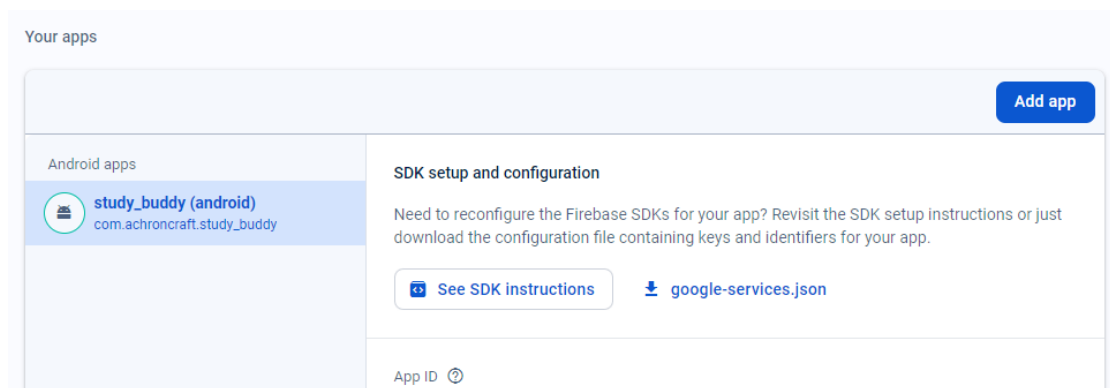
Figure 5.12 App Linked to Firebase

Firebase is a backend platform provided by Google that does not require server deployment. The platform can save a lot of time required to develop the backend and provide basic data interaction functions. A Google Firebase account is activated, and the Flutter project is successfully associated with the Firebase account.

In this project, Firebase Storage, Firebase Authentication, and Cloud Firestore will be used to provide the system with necessary information cloud storage, user verification, and file storage functions.

5.2.11 Google Gemini AI
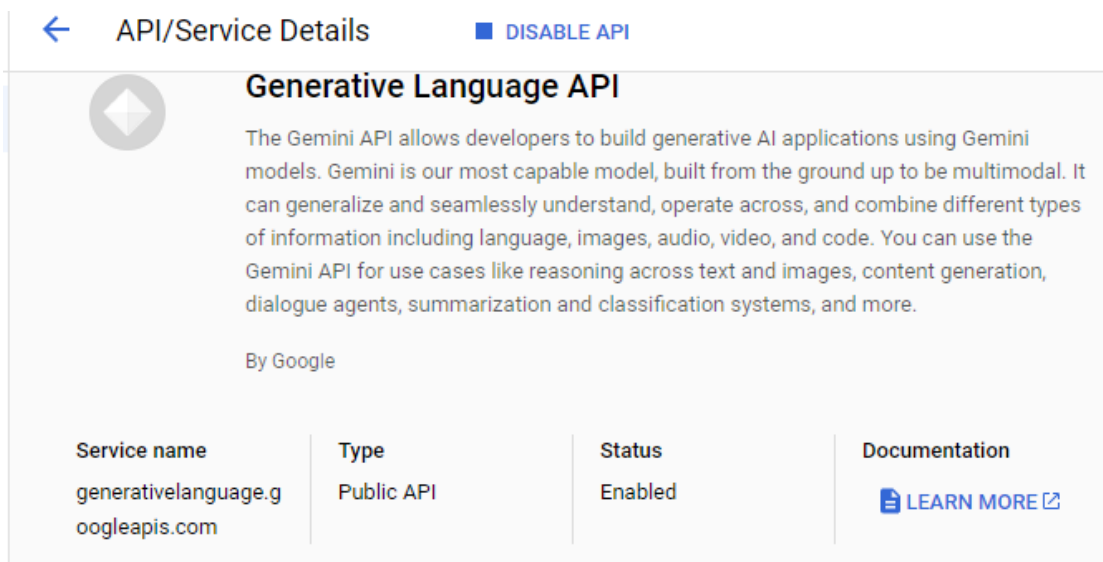
Figure 5.13 Gemini API

Gemini AI is a large language artificial intelligence model provided by Google. This generative artificial intelligence can provide consulting services to users and has a high accuracy rate. The model will be integrated in this system, allowing users to interact with the model and get real-time help. An API Key is generated, which is bound to the system App ID. The API Key allows Flutter to call the large language model.

5.2.12 Firebase Emulator Suite

Figure 5.14 Configure Emulator
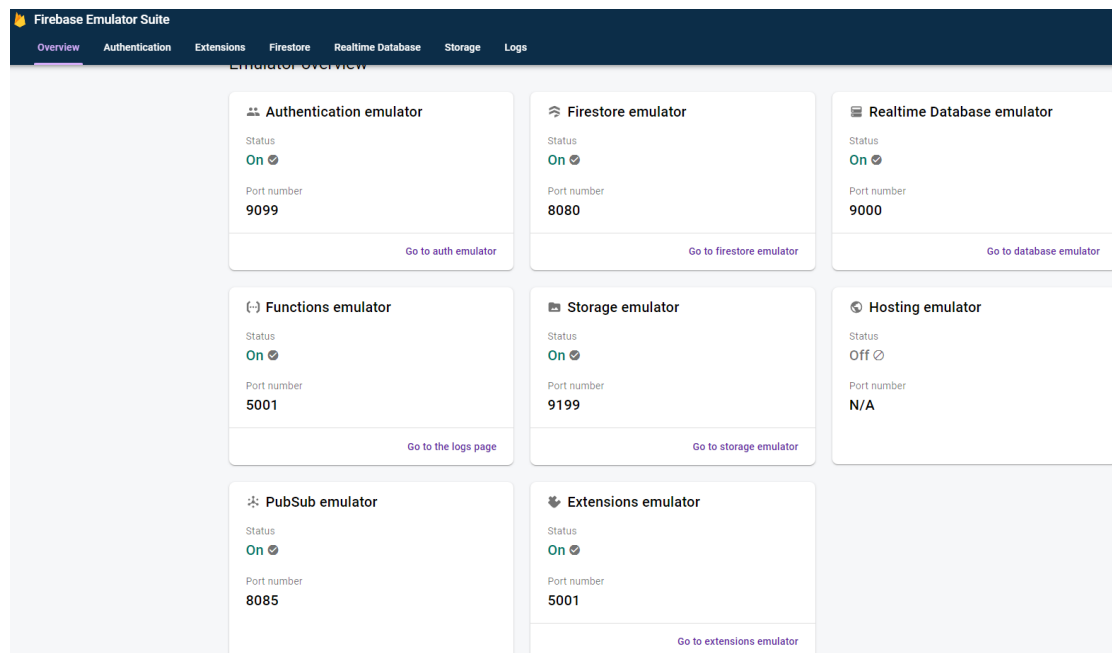
Figure 5.15 Firebase Emulator Suite

During system development, it is very important to test data interactions and get real-time feedback. Firebase Emulator Suite can build a simulated backend on a local device. The program can simulate all expected behaviours of Firebase without the need for a network or a complete production environment definition. Local deployment of the program can greatly facilitate the development process. All interactive functions of the system will be tested for availability through the local Emulator.

5.2.13 Recommendation Algorithm

Figure 5.16 Tag Based Recommendation
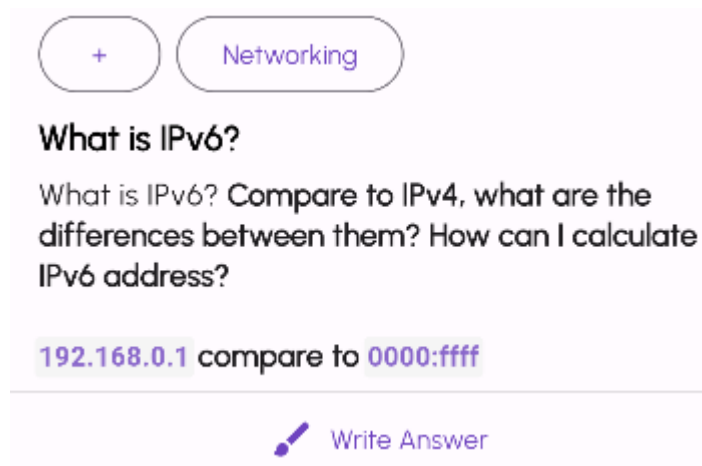
Figure 5.17 Tag Based Recommendation

Tag Based Recommendation and User Interaction Based Recommendation are used for the recommendation function of this system. For each content posted by a user, the user can add or delete tags for it. The backend system will collect user interaction information and count the frequency distribution of tags. There are different weighting algorithms for different user types. For example, when a computer science student browses tags related to the Internet, the weight calculation score will be higher than that of a Chinese literature student. The client will calculate the weight when pulling and displaying data, and sort the content according to priority.

5.2.14 QR Function

Figure 5.18 QR Profile

Each user has a QR code generated based on his or her unique ID. The QR code page will display the basic information of the user and some verification information.

Figure 5.19 Scanner Function

The implementation of the QR scanner allows users to scan any QR code. The scanner will detect the content of the QR code scanned by the user. If the QR code data is generated by this system, the scanner will navigate to the corresponding page. As shown in Figure 5.19, navigate to the corresponding user's information page. If the QR code data is generated by a third party, the scanner will return the plain text after the QR code is decoded.

5.2.15 Campus Resource Directory
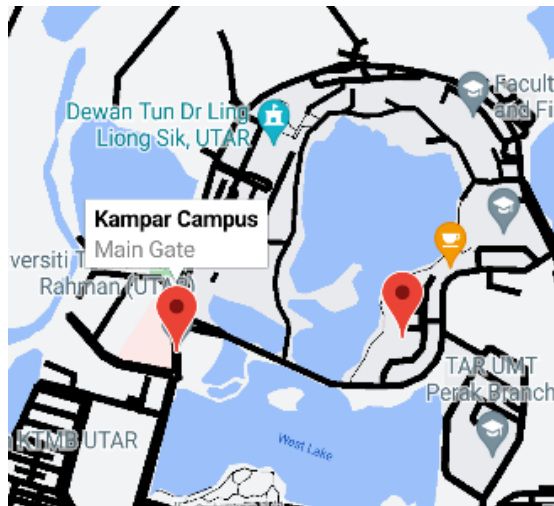
Figure 5.20 Campus Map

This system integrates the function of Google Map to provide users with campus map information. The map marker can be edited by the organization administrator in the backend.

Figure 5.21 Campus Info

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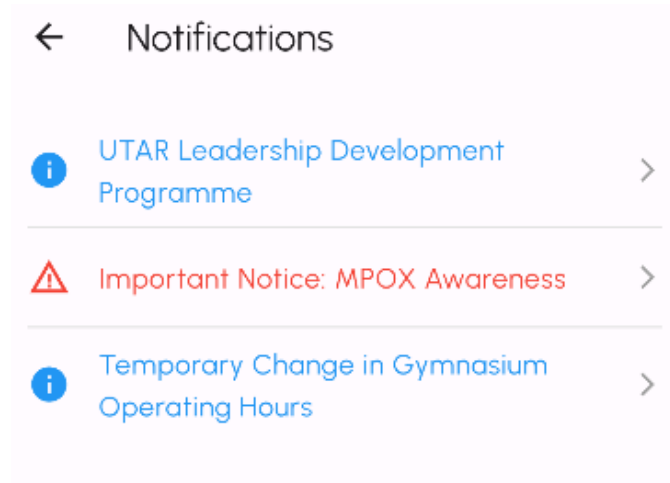
Figure 5.22 Campus Notification

This system also provides campus information and notification functions, allowing the client to obtain the latest data from the database to update information and provide users with the latest information.

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5.3   Implementation Issues and Challenges

During the development process, the first difficulty is that the developer has no previous Android development experience. Developer has been struggling for a period of time in choosing the appropriate development model and development language.

Developer is not yet proficient in using Firebase API and AI models, and some of the functions have to be debugged many times before they can be implemented.

The second difficulty was the lack of sufficient data support when implementing the recommendation function. When developing the system, the recommendation algorithm needs to be designed based on the application data.

The implementation of a high-quality recommendation algorithm requires a large amount of actual measured data for testing, but the system does not have actual measured data, so developers need to use simulated data for testing. This brings difficulties to algorithm development.

CHAPTER 6

System Evaluation and Discussion

6.1   System Testing

This section describes the comprehensive testing that the system undergoes to ensure that the system functions as per the design specifications and meets the project objectives. There are three types of testing performed, namely unit testing, integration testing, and performance testing.
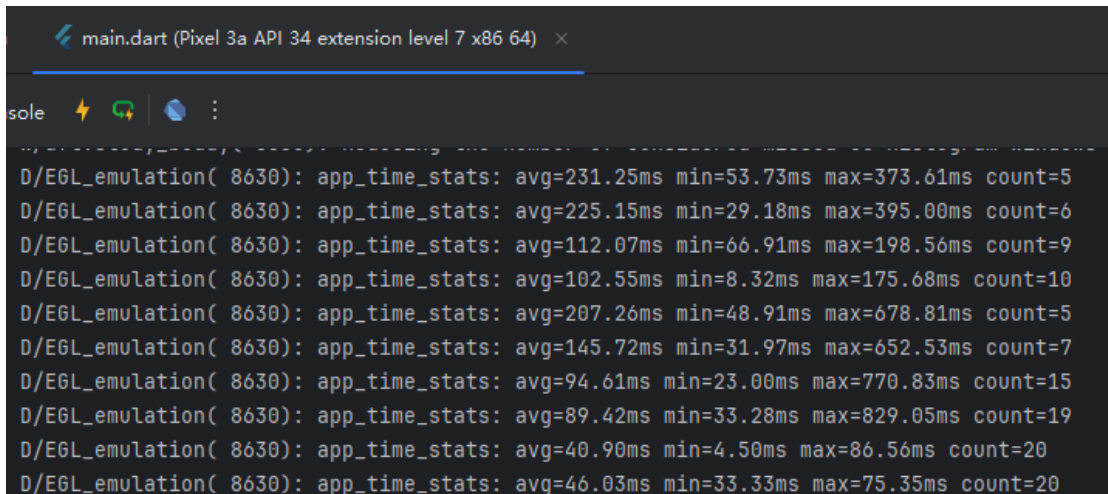
Unit testing: Each key module of the system is individually functionally tested to ensure that it operates as expected.

Integration testing: Testing the integration reliability of the front-end and back-end to ensure that information transfer is stable and that the modules cooperate well.

Performance testing: Evaluating the performance of the system in common scenarios and recording the response time of the system.
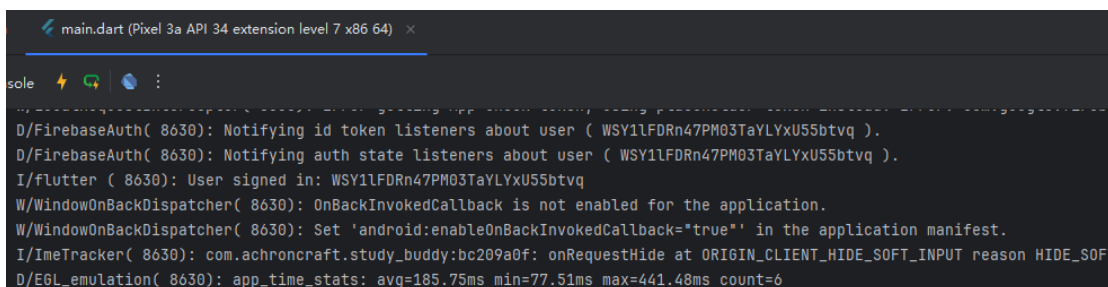
6.2   Testing Setup and Result

The test environment is based on Android Studio, with Android virtual devices enabled, and the Android system version and SDK version set to 14.0. The test backend is built using Firebase Emulator Suite to ensure consistency of front-end and back-end tests.

Figure 6.1 Run test in Android Studio

After the test environment is set, and complete system is developed, run the system in Android Virtual Device. The system can run smoothly in the virtual device, with an average response time of milliseconds.

Figure 6.2 Auth Module Test

Use Firebase Emulator to build a local test backend and communicate with it to test the availability of the user verification module. The test results are good, and the user verification module can work as expected, providing users with registration, login, authentication, and UID generation functions.
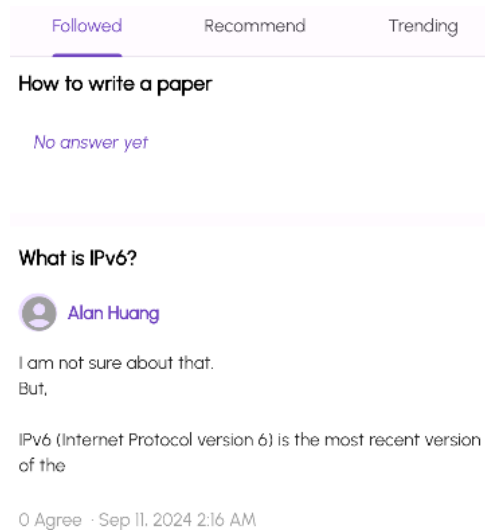
Figure 6.3 AI Module Test

Figure 6.4 Forum Module Test

Other key modules, such as the forum module and AI assistant module, can run stably. Functions all work as expected and have good responsiveness.

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6.3   Project Challenges

Throughout the development and testing process, there are many difficulties and challenges. The most critical ones are the synchronization of data structures between the front-end and back-end, the integration of third-party APIs, and the design of recommendation algorithms.

Since Firebase data is asynchronously read and written over the network, data synchronization is an important issue. During testing, some data synchronization anomalies would cause front-end rendering anomalies. By setting data read locks and applying data integrity checks, the rendering anomaly problem was solved.

The integration of third-party APIs requires a lot of learning, and the unclear documentation of some APIs requires multiple attempts to implement some functions. This situation is very time-consuming and takes up a lot of development time.

The design of the recommendation algorithm needs to be combined with actual user data to achieve the best results. Due to the lack of users for testing during the development process, the algorithm must be designed using simulated data. This results in the algorithm possibly performing poorly in the actual production environment.

6.4 Objectives Evaluation

The main goal of this project is to develop a collaborative learning platform that can provide students with online communication and collaborative learning environment. The system can also provide students with relevant campus information and AI exchange services.

According to the test results and content, it can be found that the system has an intuitive and concise user interface, and the response time is at the millisecond level, providing users with high availability and user experience. Key modules of the system, such as user verification, AI module, run as expected and perform well. The recommendation algorithm can recommend content to users based on tags and user interactions.

Overall, the project objectives are achieved.

CHAPTER 7

Conclusion and Recommendation

The current education management system focuses too much on improving the administrative efficiency of educational institutions, resulting in major deficiencies in meeting students' collaborative learning needs. In order to improve students' learning motivation and enhance students' online learning experience, this project developed a Campus Study Buddy mobile learning system, which allows students to conduct online collaborative learning, provides students with a community for communication, and enhances students' social experience in online learning. At the same time, the system also provides students with campus guidance and improves the quality of students' campus life.

This project adopted an incremental development approach and applied modern Material3 design to design and implement the user interface. During the prototype development test, this project successfully developed a system prototype and verified the feasibility of the project. Compared with traditional online learning platforms, the system proposed in this project will be richer in social and collaborative elements, allowing users to use this system for efficient collaborative learning. Compared with the traditional education management system, the system of this project weakens the support for the administrative efficiency of educational institutions.

The final deliverables of this project basically met the project goals and were completed within the expected time frame. In the future, the system will be further developed to be more in line with modern computer industry standards and explore possible commercial scenarios, such as advertising, to support highly customized front ends to meet specific organizational needs.

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APPENDIX

FINAL YEAR PROJECT WEEKLY REPORT
(Project II)

Trimester, Year: Y3T3	Study week no.: 4
Student Name & ID: Huang Yifan & 21ACB02494	
Supervisor: Cik Ana Nabilah Binti Sa'uadi	
Project Title: Campus Study Buddy: Collaborative Learning and Resource Sharing App	

1. WORK DONE
FYP1 Reviewing finished.
Basic Module finished
Future Work Direction cleared.
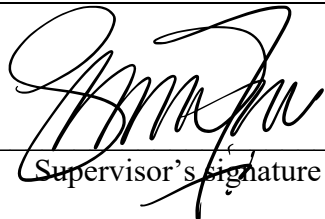
2. WORK TO BE DONE
Add Organization Function.
Add Profile Editor.
Add QR Scanner.
Refine Data Structure.
Recommendation Algorithm

3. PROBLEMS ENCOUNTERED
No problem.

4. SELF EVALUATION OF THE PROGRESS
Good. The development is proceeding as plan.

_____
Supervisor's signature

_____
Student's signature

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Trimester, Year: Y3T3	Study week no.: 8
Student Name & ID: Huang Yifan & 21ACB02494	
Supervisor: Cik Ana Nabilah Binti Sa'uadi	
Project Title: Campus Study Buddy: Collaborative Learning and Resource Sharing App	

1. WORK DONE
QR Function Implemented.
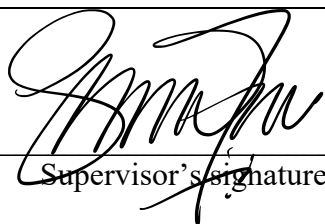Chat Message Storage Implemented.

2. WORK TO BE DONE
FYP2 report.
Recommendation Algorithm

3. PROBLEMS ENCOUNTERED
Limited Time. With a lot of other coursework, time is very tight.
No data to design recommendation algorithm, use artificial data instead.

4. SELF EVALUATION OF THE PROGRESS
Moderate.

_____   _____
Supervisor's signature   Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT
(Project II)

Trimester, Year: Y3T3	Study week no.: 11
Student Name & ID: Huang Yifan & 21ACB02494	
Supervisor: Cik Ana Nabilah Binti Sa'uadi	
Project Title: Campus Study Buddy: Collaborative Learning and Resource Sharing App	

1. WORK DONE
Recommendation Algorithm

2. WORK TO BE DONE
FYP2 report.
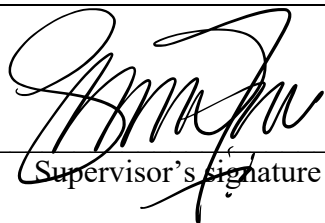Refine the data exchange process Front-End and Back-End.

3. PROBLEMS ENCOUNTERED
Limited Time.
Some integration problem with third party API (Google Firebase).

4. SELF EVALUATION OF THE PROGRESS
Good. Can finish as expected.

_____
Supervisor's signature

_____
Student's signature

A-3

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PLAGIARISM CHECK RESULT

21ACB02494_FYP2_Chapters.docx

ORIGINALITY REPORT

7%	5%	3%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	**Submitted to Cranfield University** Student Paper	2%
2	**umpir.ump.edu.my** Internet Source	1%
3	**"Application of Big Data, Blockchain, and Internet of Things for Education Informatization", Springer Science and Business Media LLC, 2024** Publication	1%
4	**azpdf.org** Internet Source	<1%
5	**Submitted to Chester College of Higher Education** Student Paper	<1%
6	**Submitted to University of Greenwich** Student Paper	<1%

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PLAGIARISM CHECK RESULT

Form Title: Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1of 1

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Huang Yifan
ID Number(s)	21ACB02494
Programme / Course	CS / PROJECT II
Title of Final Year Project	Campus Study Buddy: Collaborative Learning and Resource Sharing App

Similarity	**Supervisor's Comments** **(Compulsory if parameters of originality exceed the limits approved by UTAR)**
Overall similarity index: 7 % **Similarity by source** Internet Sources: 5 % Publications: 3 % Student Papers: 4 %	
Number of individual sources listed of more than 3% similarity: 0— 2	Not applicable
Parameters of originality required, and limits approved by UTAR are as Follows: (i) **Overall similarity index is 20% and below, and** (ii) **Matching of individual sources listed must be less than 3% each, and** (iii) **Matching texts in continuous block must not exceed 8 words** *Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.*	

Note: Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

_____   _____
Signature of Supervisor   Signature of Co-Supervisor

Name: Ana Nabilah Binti Sa'uadi   Name: _____

Date: 13/09/2024   Date: _____

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FYP 2 CHECKLIST

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	21ACB02494
Student Name	Huang Yifan
Supervisor Name	Cik Ana Nabilah Binti Sa'uadi

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
√	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
√	Appendices (if applicable)
√	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)
√	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

_____
(Signature of Student)
Date: 2024 / 9 / 12

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