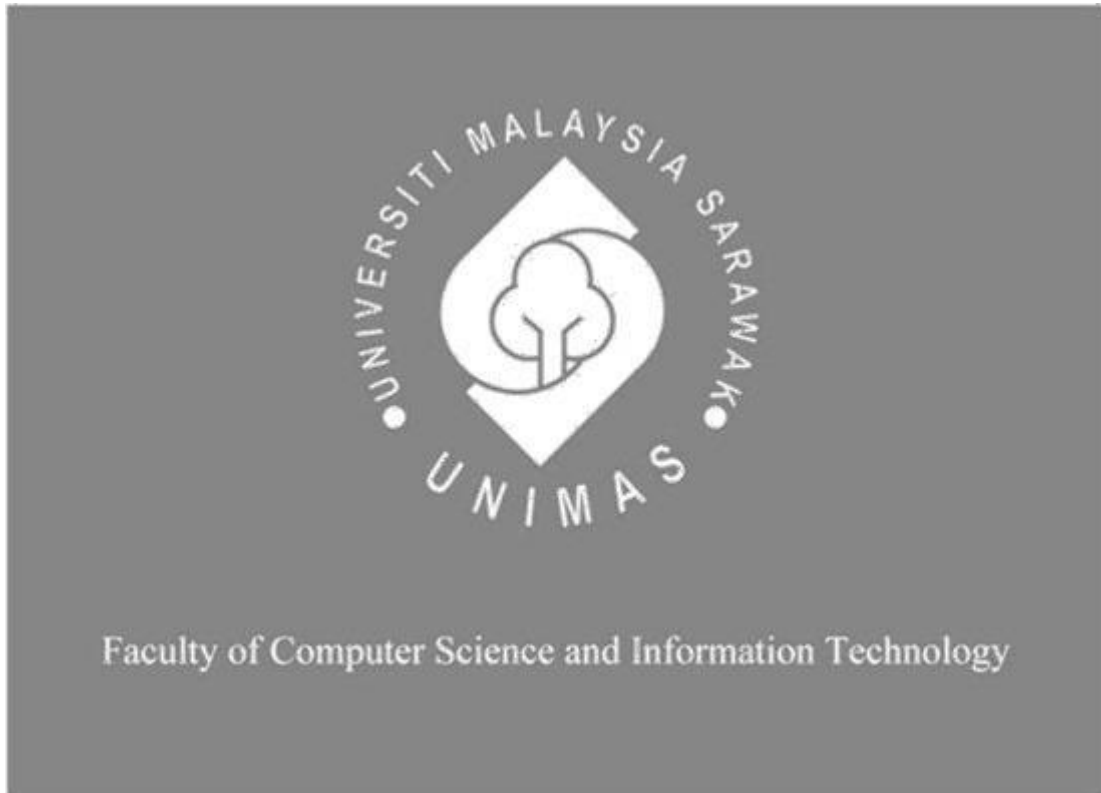




FITFUSION

Ahmad Izzat bin Abdul Taib

Bachelor of Software Engineering with Honours
2025

FITFUSION

AHMAD IZZAT BIN ABDUL TAIB

This project is submitted in partial fulfilment of the requirements for the degree of Bachelor
of Software Engineering with Honours

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK
2025

FITFUSION

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Ijazah Sarjana Muda Kejuruteraan Perisian dengan Kepujian

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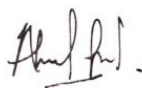
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ABSTRACT

FitFusion is an innovative mobile application designed to help individuals achieve their health and fitness goals through personalized solutions. By leveraging advanced AI technologies and a user-centric approach, the platform offers features like customized meal planning, fitness activity scheduling, and real-time progress tracking. Developed using Agile methodology with Scrum, FitFusion emphasizes iterative development, adaptability, and continuous feedback to ensure the platform evolves to meet user needs. Key functionalities include AI-driven recommendations, and a simple booking and scheduling system for gym classes and activities, enhancing user convenience and engagement. Extensive user feedback and research guided the platform's development, resulting in an intuitive interface and secure cloud-based data management. FitFusion aims to empower healthier lifestyles, promote wellness, and foster long-term community engagement, addressing real-world challenges in health management through modern software practices.

ABSTRAK

FitFusion ialah aplikasi mudah alih inovatif yang direka untuk membantu individu mencapai matlamat kesihatan dan kecergasan mereka melalui penyelesaian yang diperibadikan. Dengan memanfaatkan teknologi AI termaju dan pendekatan tertumpu pengguna, platform ini menawarkan ciri seperti perancangan hidangan tersuai, penjadualan aktiviti kecergasan dan penjejakan kemajuan masa nyata. Dibangunkan menggunakan metodologi Agile dengan Scrum, FitFusion menekankan pembangunan berulang, kebolehsuaian dan maklum balas berterusan untuk memastikan platform berkembang untuk memenuhi keperluan pengguna. Fungsi utama termasuk pengesyoran dipacu AI, dan sistem tempahan dan penjadualan mudah untuk kelas dan aktiviti gim, meningkatkan kemudahan dan penglibatan pengguna. Maklum balas dan penyelidikan pengguna yang meluas membimbing pembangunan platform, menghasilkan antara muka intuitif dan pengurusan data berasaskan awan yang selamat. FitFusion bermatlamat untuk memperkasakan gaya hidup yang lebih sihat, menggalakkan kesihatan dan memupuk penglibatan komuniti jangka panjang, menangani cabaran dunia sebenar dalam pengurusan kesihatan melalui amalan perisian moden.

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
NCD	Noncommunicable disease
AI	Artificial Intelligence
NLP	Natural Language Processing
FYP	Final Year Project
WHO	World Health Organization
UNIMAS	Universiti Malaysia Sarawak
BMR	Basal Metabolic Rate
GI	Glycemic Index
UI	User Interface
AVD	Android Virtual Device

CHAPTER 1: INTRODUCTION

1.1 Introduction

Noncommunicable diseases (NCDs) such as diabetes, hypertension, and obesity are becoming increasingly prevalent among the general population, posing significant challenges to healthcare systems worldwide. According to the World Health Organization (WHO), NCDs are responsible for over 74% of global deaths annually, with many cases linked to preventable factors such as poor diet, lack of physical activity, and unhealthy lifestyle choices (World Health Organization, 2023). re. Alarmingly, obesity rates have risen, with 54.4% of Malaysian adults classified as overweight or obese, reflecting a 10% increase over the past decade. These alarming statistics highlight the urgent need for effective tools to help Malaysians manage their health and reduce the risk of complications associated with these conditions (Hassandarvish, 2024). Despite growing awareness of the importance of preventive healthcare, there remains a lack of accessible, comprehensive digital platforms that cater specifically to the needs of individuals managing NCDs.

To bridge this gap, we propose FitFusion, an innovative mobile application designed to empower users to take control of their health by providing personalized meals and fitness recommendations tailored to their unique needs. FitFusion leverages advanced artificial intelligence (AI) technology to deliver a holistic approach to health management, combining dietary guidance, fitness tracking, and health monitoring in one convenient platform.

FitFusion aims to transform how individuals manage their health by providing a proactive, AI-driven approach to wellness. It empowers users to make informed decisions, not just by suggesting healthier food options or exercise routines but by creating a personalized health experience that adapts to their lifestyle and goals. This comprehensive, user-centric approach makes FitFusion a valuable tool in addressing the rise of NCDs and promoting healthier living among the general population.

1.2 Problem Statement

Noncommunicable diseases such as diabetes, hypertension, and obesity are rapidly becoming a global epidemic, affecting millions (Ejigu & Tiruneh, 2023). This poses a significant challenge to public health systems, as these diseases often require long-term management and can lead to severe complications, leading to other life-threatening conditions.

Despite the growing popularity of digital health solutions, there remains a critical gap in platforms that cater specifically to the needs of individuals managing chronic conditions like diabetes and hypertension. Existing apps often focus on general health and fitness, with common features such as step tracking, calorie counting, workout routines, and basic diet logging. While these functionalities are helpful for the broader population, they typically lack the advanced personalization necessary for effective management of noncommunicable diseases (NCDs) like diabetes or hypertension (Barbagallo, 2021). For instance, these apps may not account for specific dietary restrictions, medical conditions, or personalized exercise regimens tailored to the unique needs of users with chronic illnesses. This absence of customized digital tools results in missed opportunities for patients to optimize their health and can contribute to the worsening of their conditions due to inadequate lifestyle adjustments.

Currently, there is no comprehensive platform that consolidates information on nearby gyms, fitness classes, and wellness activities, making it challenging for users to discover and book options that fit their preferences and schedules. This lack of accessibility can lead to reduced motivation and lower levels of physical activity. Additionally, the absence of a centralized booking system often results in a disjointed user experience, where individuals must navigate multiple websites or apps to find relevant fitness resources, which can be time-consuming and frustrating. The creation of a unified platform that not only connects users with local fitness options but also integrates with personalized health advice could significantly improve

engagement in physical activities, thereby supporting better management of NCDs and promoting overall well-being.

1.3 Project Description

The proposed project is a mobile application aimed at promoting healthier lifestyles through the integration of AI, focusing on preventing and managing noncommunicable diseases (NCDs) such as diabetes, hypertension, and obesity. The app targets the public, offering personalized health solutions based on users' dietary preferences, activity levels, and specific health risks. Furthermore, the app includes a simple booking system that allows users to locate potential gyms then reserve spots in fitness classes, gym sessions, and various fitness activities available in their local area. AI recommendations assist users in selecting suitable activities based on their fitness goals and preferences, making it easier to engage in regular physical exercise. The application's interface will be kept minimal and user-friendly, focusing on essential features like basic health assessments, meal recommendations, activity reminders, and fitness bookings. A weekly progress tracker will provide users with a clear summary of their achievements, offering motivation to stay consistent in their journey toward better health. This project addresses the growing concern of NCDs and offers a simple, AI-driven solution to help individuals make better health choices in their daily lives, including easy access to fitness activities that support their health goals.

1.4 Scope

The **FitFusion mobile application** focuses on providing personalized solutions for individuals managing NCDs, such as diabetes, hypertension, and obesity. The scope of the project encompasses the following areas:

1.4.1 Personalized Meal Recommendations:

- a. Leveraging AI algorithms to recommend meals based on users' dietary needs, health conditions, and preferences.
- b. Recommendations will consider **calorie limits and dietary restrictions** (e.g., low-sodium

diets for hypertension).

- c. Food categorization and filtering options (e.g., vegetarian, low-carb, low-GI) will enhance user customization.

Limitations: The system will not cater to highly specific or rare medical dietary needs beyond common conditions. User-provided dietary preferences will be the primary input for recommendations.

1.4.2 Fitness Activity Suggestions:

- a. Exercise recommendations are tailored to users' health conditions and fitness levels. For example:
 - i. Low-impact exercises for users with obesity or joint issues.
 - ii. Moderate-intensity cardio for users managing hypertension.
- b. AI algorithms filter fitness activities by category (e.g., yoga, strength training) based on user preferences and goals.

Limitations: The system will only suggest exercises and will not provide advanced metrics like heart rate monitoring or integration with third-party fitness trackers.

1.4.3 Booking and Discovery System for Fitness Activities:

- a. Includes a centralized booking system for gyms, fitness classes, and wellness activities.

Limitations: Only gyms and fitness centers registered within the system will be searchable and bookable. The system will not handle clashing schedules or enforce availability beyond the data provided by gym owners.

1.4.4 Health Data Collection and Monitoring:

- a. Basic health assessment tools will collect data (e.g., weight, age, height, health conditions) to refine AI recommendations.
- b. Progress tracking includes weekly updates on activity levels (steps taken) and calories burned from steps.

Limitations: The system will not integrate real-time health monitoring devices or provide medical-grade diagnostics. Data accuracy depends on user input.

1.4.5 AI and Technology Implementation:

- a. The recommendation system will leverage the OpenAI API to generate personalized meal suggestions based on user preferences and dietary goals. Rather than using traditional collaborative or content-based filtering, the system will rely on GPT's ability to understand and respond to user data in natural language.
- b. NLP powered by OpenAI (e.g., GPT-3.5) will interpret user inputs such as dietary feedback, goals, and restrictions. This allows the system to offer more refined, relevant, and context-aware meal recommendations.
- c. A modular architecture will be used to integrate OpenAI's services through API endpoints, ensuring flexibility for future updates such as chatbot integration, real-time feedback processing, or additional health-focused features.

Limitations: Advanced AI features such as predictive analytics for long-term health trends will not be included in the initial implementation.

1.4.6 Accessibility and usability:

- a. A minimal and intuitive interface ensures the app is easy to use for a diverse user base.

Limitations: The application will be available only on Android devices during the initial phase. Multi-language support will be limited to English.

1.5 Aims and Objectives

- a. **Design** a user-friendly mobile app that is accessible and intuitive, catering to users managing NCDs.
- b. **Develop** a mobile app with AI-powered features for personalized meals and fitness activity recommendations.
- c. **Implement** a booking system to easily find and reserve spots at nearby gyms and fitness classes.

1.6 Brief Methodology

This project adopts Agile methodology, specifically utilizing the Scrum framework, tailored for an individual software developer. Agile methodology emphasizes flexibility, iterative development, and a user-focused approach to deliver high-quality software solutions efficiently.

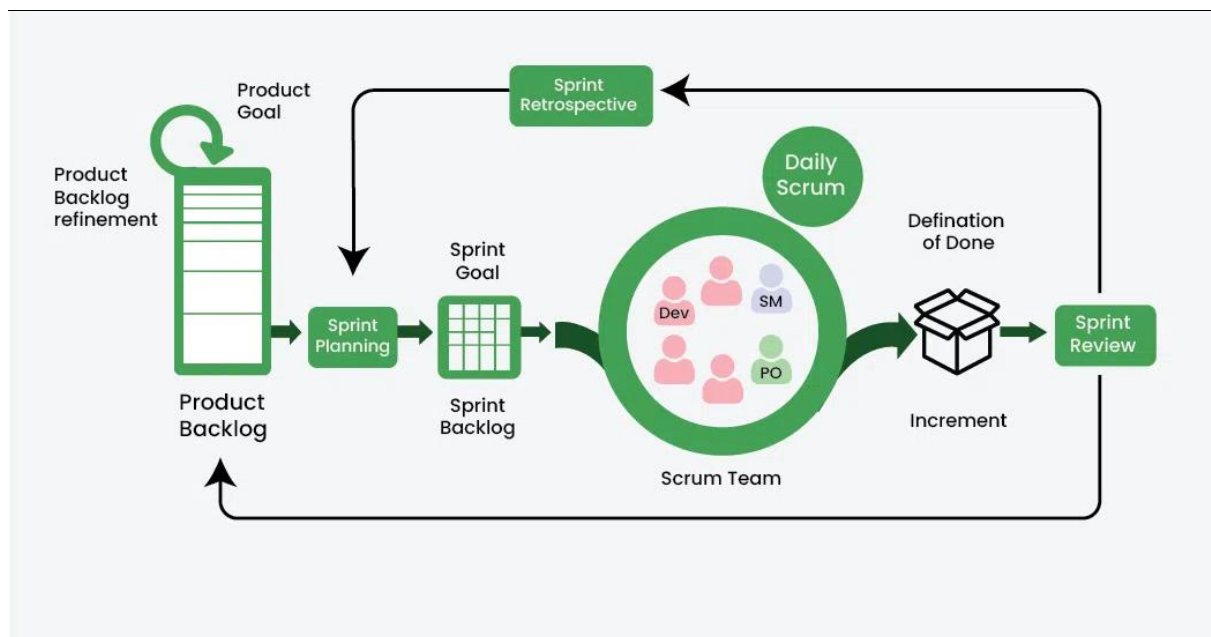


Figure 1.1 Scrum framework (GeeksforGeeks, 2024)

Scrum is a flexible, iterative framework designed to manage and complete complex projects efficiently. It emphasizes collaboration, adaptability, and delivering increments of work in time-boxed sprints (SCRUMstudy, 2024). In this project, Scrum can be tailored to fit an individual workflow by combining roles, such as acting as both the Product Owner and Scrum Master, while focusing on incremental development and regular reflection.

To implement Scrum effectively in a final year project, the process begins by creating a **Product Backlog**. This backlog acts as a comprehensive list of all project requirements and features. For example, it may include tasks such as developing a user login module, designing an AI-driven meal recommendation system, or implementing fitness class booking functionality. Once the backlog is established, tasks are prioritized and grouped into smaller, manageable sprints.

Each sprint is recommended to last 1-2 weeks, aligning with academic timelines. For instance, Sprint 1 may focus on developing the login module, Sprint 2 on creating the database schema and backend, and Sprint 3 on implementing the meal recommendation logic. Breaking work into these short, focused iterations ensures steady progress while maintaining flexibility to adapt as the project evolves.

Progress is tracked using tools such as Trello. These platforms help organize tasks into categories like "To Do," "In Progress," and "Done." Additionally, daily or bi-daily check-ins are scheduled to reflect on accomplishments and identify any obstacles. This practice mimics Scrum's Daily Standups and helps maintain focus and momentum.

At the end of each sprint, a **Sprint Review** is conducted. Features developed during the sprint are tested to ensure they meet the sprint goals, and the project report is updated with completed tasks. Feedback from supervisors or peers is gathered to refine the work. This feedback is incorporated into the backlog, adjusting tasks and priorities as necessary.

Finally, a **Sprint Retrospective** is held to evaluate what went well and what could be improved. Time management, tools, and processes are reviewed, and insights are applied to the next sprint. By following this structured approach, the project maintains organization, adapts to challenges, and achieves consistent progress.

1.7 Significance of Project

The FitFusion mobile application addresses a critical need for effective management and prevention of NCDs such as diabetes, hypertension, and obesity. By providing personalized meals and fitness recommendations, the app empowers users to make healthier lifestyle choices, thereby contributing to better health outcomes. This approach not only helps individuals manage their existing conditions but also plays a proactive role in disease prevention, promoting long-term well-being.

Additionally, the app simplifies access to fitness resources by integrating a centralized booking system for nearby gyms and wellness activities. This feature encourages users to stay active by reducing the barriers to finding and participating in physical exercise. Overall, FitFusion promotes a healthier lifestyle through an accessible, user-friendly digital platform, contributing to a more active and health-conscious community.

1.8 Project Schedule

The project schedule is structured according to the TMF4913 Final Year Project (FYP) course timeline where each phase of software development is carefully planned to align with the course's deadlines, ensuring timely completion of all chapters, deliverables, and reports. This schedule encompasses the entire duration of both FYP 1 and FYP 2. For a detailed breakdown, refer to the Gantt Chart provided in Appendix A.

1.9 Expected Outcome

FitFusion is expected to deliver a mobile application that empowers individuals managing NCDs by providing tools and resources to make healthier lifestyle choices. The app's features aim to enhance accessibility, improve engagement, and promote sustainable health management. Key projected outcomes include:

1. AI-Powered Meal and Fitness Recommendations:

FitFusion will feature an AI-based recommendation engine to provide tailored meal suggestions and fitness plans based on users' dietary preferences, health conditions, and fitness goals, ensuring personalized guidance.

2. Comprehensive Fitness Booking System:

The app will include a booking feature that allows users to book, and manage gym sessions or fitness activities, promoting convenience and encouraging regular exercise.

3. Health and Progress Tracking Dashboard:

FitFusion will provide a dashboard for users to log their meals, monitor fitness activities, and track health metrics such as calories, offering clear insights into their progress.

4. Notifications:

The app will include a notification system to remind users about their fitness activity status

and booked gym classes.

5. User-Friendly Interface:

FitFusion will feature an intuitive interface enhancing user interaction and satisfaction.

1.10 Project Report Outline

CHAPTER 1: INTRODUCTION

This chapter introduces the project by outlining its purpose and background. It includes the problem statement, project objectives, and the scope of the study. Additionally, the chapter highlights the significance of the project and its potential impact on stakeholders. A brief overview of the methodology and project timeline is also provided, alongside the expected outcomes to give readers a clear understanding of the goals and importance of the project.

CHAPTER 2: LITERATURE REVIEW

This chapter reviews existing studies, solutions, and technologies relevant to the project topic. It compares current methodologies and tools, analyzing their features and limitations. Through this comparative analysis, the chapter identifies gaps in the existing solutions and justifies the need for the proposed project. These insights serve as the foundation for designing a system that addresses the identified issues.

CHAPTER 3: SYSTEM ANALYSIS AND DESIGN

This chapter focuses on the requirements gathering process and the system design methodology. It details data collection from stakeholders and analyses the findings to establish functional and non-functional requirements. Logical designs, such as data flow diagrams, and interface mock-ups are also included to illustrate the proposed system's structure. This chapter serves as the blueprint for the development phase of the project.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Chapter 2 will review the related existing applications and systems in the fitness and healthcare domain. The different strengths, weaknesses, and unique features of each system will be analyzed. This analysis aims to align with the project objectives and validate the proposed solution for FitFusion. Additionally, the functionalities and technologies employed in these systems will be studied and compared to identify opportunities for improvement and innovation. This approach will help refine the development of FitFusion by determining the most suitable software, tools, and technologies for its implementation.

Several existing systems and applications focus on promoting healthier lifestyles and addressing NCDs. These include fitness tracking apps, AI-driven meal recommendation platforms, IoT-integrated health monitoring systems, and gym appointment scheduling applications. In this section, notable examples of such systems will be used as references to inspire and guide the development of FitFusion.

2.2 Background Study

2.2.1 The Growing Burden of Noncommunicable Diseases (NCDs)

Noncommunicable diseases (NCDs) such as diabetes, hypertension, and obesity are becoming significant public health concerns worldwide (Budreviciute et al., 2020). These diseases, often referred to as "lifestyle diseases," are primarily caused by behavioral risk factors such as unhealthy eating habits, physical inactivity, and stress. Globally, NCDs are responsible for nearly 70% of all deaths, with an increasing number of young adults affected due to lifestyle changes and urbanization (Balwan & Kour, 2021). In Malaysia, the prevalence of NCDs has seen a sharp rise, with national health statistics indicating a growing burden of obesity and Type 2 diabetes, especially among young adults (Akhtar et al., 2022). This trend highlights the

urgent need for interventions targeting this demographic group to promote healthier lifestyles.

2.2.2 NCD Risks Among University Students

University students, including those at Universiti Malaysia Sarawak (UNIMAS), are a particularly vulnerable group for developing NCDs. The transition to university life often leads to significant changes in lifestyle, such as irregular eating patterns, increased consumption of fast food, and reduced physical activity. Students frequently report skipping meals due to academic workloads and resorting to high-calorie, low-nutrient convenience foods (Wadolowska et al., 2019). Additionally, the sedentary lifestyle associated with long hours of study and screen time exacerbates the risk of obesity and other metabolic disorders. Stress from academic pressures further compounds the issue, as it is closely linked to unhealthy behaviors such as overeating and lack of exercise.

2.2.3 The Role of Technology in Addressing NCD Risks

The integration of technology into health and wellness initiatives has proven effective in addressing lifestyle-related health concerns (Chatterjee et al., 2021). Mobile applications that offer features like activity tracking, meal planning, and fitness scheduling have gained popularity for their convenience and accessibility. However, many existing platforms focus on isolated aspects of health, such as calorie tracking or gym scheduling, without providing a holistic approach. AI-driven systems have the potential to bridge this gap by offering personalized, integrated solutions that cater to individual health needs and preferences.

2.2.4 Linking FitFusion to UNIMAS students' needs

FitFusion is designed to address the specific challenges faced by UNIMAS students, particularly in managing their health and wellness amidst their academic responsibilities. The platform integrates features like AI-driven meal recommendations, activity tracking, and gym appointment scheduling, tailored to student needs.

- **Meal Recommendations:** Utilizing AI, the platform generates personalized dietary plans based on individual preferences, health goals, and activity levels. This feature benefits students who struggle with meal planning due to busy schedules or lack of nutritional knowledge, ensuring they maintain balanced and healthy diets.
- **Activity Tracking:** FitFusion promotes regular physical movement by offering activity tracking, which counters the sedentary lifestyle common among students engaged in long hours of study. By providing insights into their fitness progress, the system motivates students to stay active.
- **Gym Class Booking System:** The gym scheduling feature simplifies access to structured fitness routines, enabling students to incorporate exercise seamlessly into their daily lives. This fosters a culture of health-conscious behavior within the university.

By addressing these specific pain points, FitFusion creates a comprehensive, user-friendly solution that supports the health and well-being of UNIMAS students.

2.2.5 Aligning FitFusion with public health goals

FitFusion aligns closely with public health initiatives aimed at combating the increasing prevalence of non-communicable diseases (NCDs) among young adults. By addressing lifestyle factors such as poor nutrition and physical inactivity, the platform supports healthier habits and encourages long-term behavioral changes.

- **Promoting NCD Awareness:** The platform integrates tools to educate users on the risks associated with unhealthy lifestyle choices and the importance of proactive health management.
- **Holistic Wellness Approach:** By combining personalized dietary recommendations, fitness tracking, and fitness activity recommendations, FitFusion enables users to adopt and sustain healthier behaviors.
- **Targeting Young Adults:** FitFusion's design is tailored for the specific needs of young adults, a demographic increasingly at risk of developing NCDs. For UNIMAS students, this personalized system offers an accessible and practical way to improve their quality of life while reducing NCD risk factors.

Through its evidence-based and user-focused approach, FitFusion not only supports the well-being of UNIMAS students but also contributes to broader public health objectives, emphasizing sustainability and preventive care.

2.3 Reviews on Current Technologies Used for Health and Fitness Management

In this section, various technologies used in health and fitness management applications will be discussed and evaluated. Current technologies commonly available in the market include AI-driven meal recommendation systems, activity and fitness tracking system, and online gym appointment scheduling. Each of these technologies offers unique functionalities that inspire the design and development of FitFusion.

2.3.1 AI Tools for the Prevention and Management of NCDs

AI has emerged as a transformative tool in the prevention and management of NCDs, offering personalized interventions, continuous monitoring, and behavior modification support. AI-driven health assistants, such as conversational agents, have shown promise in remote NCD management by providing real-time guidance, medication reminders, and lifestyle recommendations tailored to individual patient needs (Anisha et al., 2024). These virtual health carers can engage users in proactive health behaviors, thereby improving adherence to prescribed treatments and self-care routines.

Another critical application of AI in NCD management is enhancing medication adherence. AI-powered solutions, such as intelligent reminders and predictive analytics, can help identify patients at risk of non-adherence and provide timely interventions. Studies have shown that AI can analyze patient behaviors and medical histories to optimize medication schedules and reinforce adherence strategies (Babel et al., 2021). These technologies not only reduce the burden on healthcare providers but also empower individuals to take greater control over their health.

Moreover, AI-enabled monitoring tools can integrate data from wearable devices, electronic health records, and patient-reported inputs to generate personalized insights. By leveraging machine learning algorithms, these systems can detect early warning signs, recommend

lifestyle adjustments, and facilitate timely medical interventions. The integration of AI into health management platforms holds significant potential for improving long-term health outcomes for individuals living with NCDs (Anisha et al., 2024).

In summary, AI-powered tools provide innovative solutions for managing NCDs by offering personalized support, improving medication adherence, and enabling continuous health monitoring. As AI technologies continue to evolve, their integration into healthcare systems will likely lead to more effective and scalable strategies for preventing and managing chronic conditions

2.3.2 AI Driven Meal Recommendation System

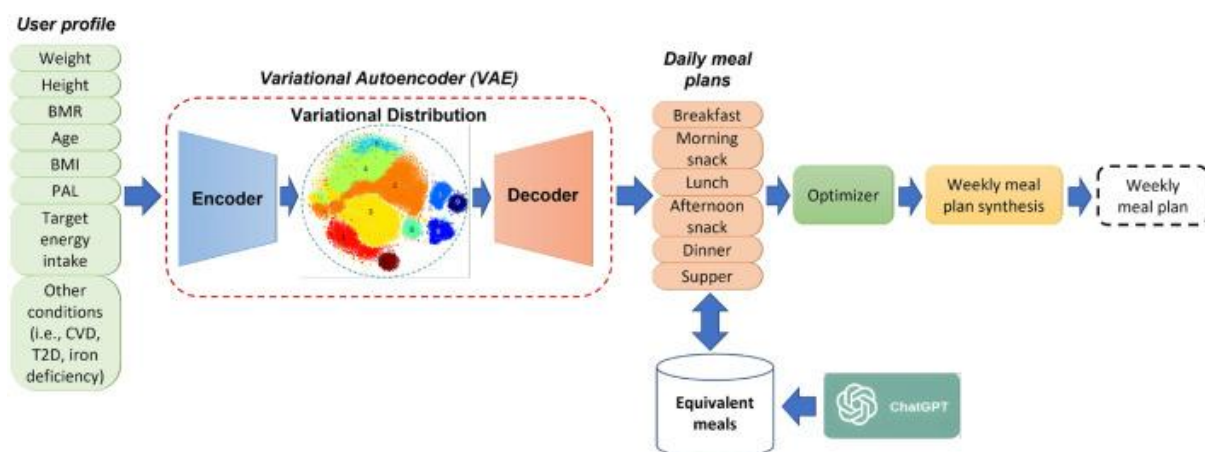


Figure 2.1 Overview of existing AI-based diet recommendation method (Papastratis et al., 2024)

AI-driven meal recommendation systems leverage advanced machine learning algorithms to deliver personalized meal suggestions tailored to individual dietary needs, preferences, and health goals. By analyzing data such as user-provided inputs, dietary restrictions, and real-time health metrics from wearable devices, these systems offer actionable recommendations that promote better health and convenience. For instance, they can assist individuals with specific conditions, such as diabetes or hypertension, by tailoring meals to meet unique nutritional

requirements (Tsolakidis et al., 2024).

A key component of these systems is their reliance on collaborative and content-based filtering techniques. Collaborative filtering uses data from similar users to suggest meals that have been positively received within peer groups, while content-based filtering focuses on nutritional properties and user preferences to align recommendations with specific health objectives. This dual approach ensures that suggestions are both relevant and personalized, offering significant value to users managing chronic conditions or adopting new dietary habits (Tsolakidis et al., 2024).

Another strength of AI-driven meal recommendation systems is their adaptability. These systems continually refine their suggestions by incorporating user feedback and external factors, such as seasonal ingredient availability and cultural preferences. This dynamic learning capability not only enhances the user experience but also fosters long-term adherence to healthier eating practices. The integration of these features into health-focused platforms has demonstrated significant potential for improving dietary behavior and overall wellness (Tsolakidis et al., 2024).

2.3.2 Activity and Fitness Tracking System

Activity and fitness tracking systems are integral components of modern health management platforms, providing users with detailed insights into their physical activities and overall fitness levels (Jin et al., 2020). These systems utilize data collected from wearable devices, smartphones, or dedicated fitness trackers to monitor parameters such as steps taken, distance traveled, calories burned, and heart rate (Vijayan et al., 2021). Advanced systems integrate this data with AI algorithms to deliver personalized feedback and suggestions tailored to the user's health goals (Tsolakidis et al., 2024).

Recent advancements in activity tracking technologies have introduced features that go beyond

basic metrics. Many systems now include GPS tracking for outdoor activities, sleep monitoring, and exercise categorization to analyze specific workout types, such as running or weightlifting (Boulos & Yang, 2021).

In addition to tracking, fitness systems often employ AI-driven analytics to identify patterns in user behavior and recommend actionable strategies for improvement. For example, these systems can suggest optimal times for workouts, recovery periods, or intensity adjustments based on the user's performance trends and goals. This dynamic feedback mechanism enhances user engagement and supports sustainable fitness routines (Papastratis et al., 2024).

Moreover, the integration of activity tracking systems with nutrition platforms enhances their utility. Data from fitness trackers can be used to adjust dietary recommendations, ensuring that energy intake aligns with caloric expenditure (Ulfa et al., 2022). This synergy creates a holistic approach to health management, where activity tracking and nutritional planning work together to achieve user-specific goals. Such systems represent the future of personalized fitness and wellness solutions.

2.3.3 Online Gym Appointment Scheduling

Online gym appointment scheduling systems enable users to book, manage, and track their gym sessions and fitness classes through digital platforms. These systems streamline the process of reserving gym sessions or group classes, ensuring a smooth and efficient user experience. By providing real-time availability and scheduling options, these systems reduce overcrowding and optimize resource allocation for gym operators (Ala Ebrahimi et al., 2017).

A key advantage of online scheduling systems is their ability to personalize the user experience (Booking Live, 2021). Many platforms allow users to create profiles that include their fitness preferences, goals, and scheduling constraints. This information helps the system recommend suitable time slots, classes, or trainers based on user needs, increasing convenience and user

satisfaction. Integration with mobile applications further enhances accessibility, enabling users to manage bookings from anywhere (Lim & Teo, 2024).

Additionally, online gym appointment systems often incorporate features such as reminders, notifications, and cancellations, ensuring users remain informed and engaged with their fitness routines. Advanced platforms may also include analytics tools that track attendance and progress, providing valuable insights for both users and gym operators. These systems benefit gym management by automating administrative tasks, improving operational efficiency, and fostering better user engagement (Ala Ebrahimi et al., 2017).

2.4 Reviews on Similar Existing Systems

This section focuses on analyzing notable health and fitness management systems to understand their usability, strengths, weaknesses, and features relevant to the objectives of the proposed FitFusion application. The systems under review include MyFitnessPal, Cronometer, ClassPass, and Yazio. Each system will be evaluated based on its core functionalities and how they align with or diverge from the goals of FitFusion.

Given the project's focus on usability, the analysis will explore how each system ensures ease of use, accessibility, and effective feature integration. Special attention will be given to mechanisms that engage users, such as progress tracking and reminders. These insights will help refine FitFusion's design to address the gaps in existing systems, ensuring a superior and user-friendly experience.

2.4.1 MyFitnessPal



Figure 2.2 MyFitnessPal logo (MyFitnessPal, n.d.)

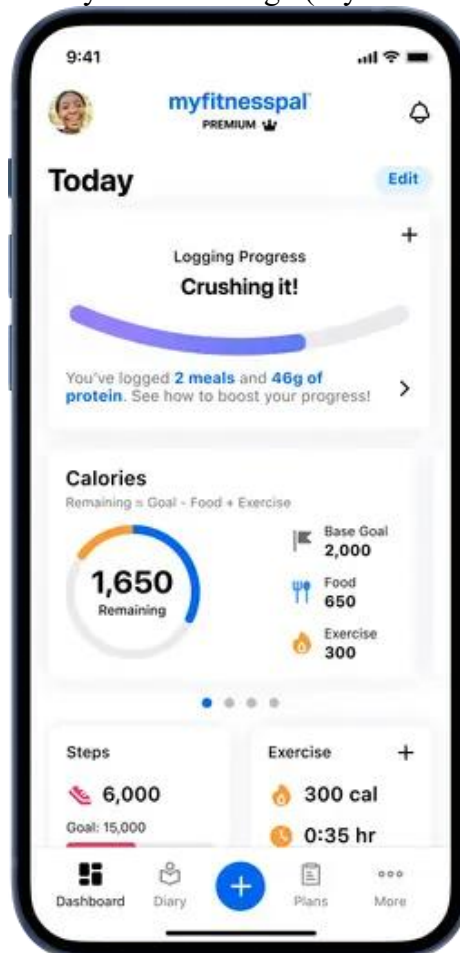


Figure 2.3 MyFitnessPal homepage UI (MyFitnessPal, n.d.)

MyFitnessPal is a widely used health and fitness platform designed for calorie and nutrient tracking. It offers a robust database of over 18 million foods, enabling users to log their meals, snacks, and beverages easily. Users can also track macronutrients, vitamins, and other micronutrients through the platform. MyFitnessPal integrates with wearables and third-party fitness apps such as Fitbit, Garmin Connect, Apple Health, etc., allowing users to monitor calories burned and compare them with their daily intake. The app also provides a Basal Metabolic Rate (BMR) calculator and a Body Mass Index (BMI) estimator to help users set weight and fitness goals. Despite its strengths, the platform lacks AI-driven meal recommendations and advanced fitness scheduling features, which limits its adaptability for specific dietary needs or fitness goals (*MyFitnessPal*, n.d.).

2.4.2 Chronometer



Figure 2.4 Chronometer logo The Most Accurate Nutrition Tracking App | Cronometer, n.d.)

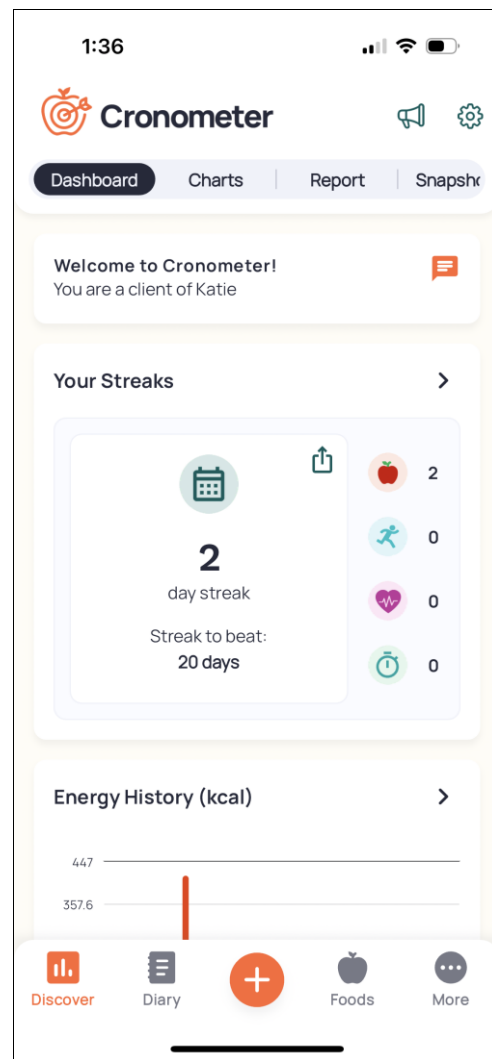


Figure 2.5 Chronometer discover page The Most Accurate Nutrition Tracking App | Cronometer, n.d.)

Cronometer is a nutrition and fitness tracking platform designed to provide highly detailed insights into users' dietary intake and health metrics. (*The Most Accurate Nutrition Tracking App* | Cronometer, n.d.) Unlike many other calorie tracking apps, Cronometer emphasizes micro-nutrient monitoring alongside macronutrient tracking, making it a valuable tool for users aiming to optimize their overall nutrition. The platform draws from verified nutrition databases, including lab-analyzed sources like the USDA, ensuring the accuracy of its food data. It also supports custom foods, recipes, and biometric tracking, enabling users to tailor the app to their specific dietary and health needs. Despite its strengths, Cronometer has certain drawbacks. For instance, its free version lacks some advanced features, such as detailed trend analysis and data

export options, which are only available in the premium version. Additionally, the platform may feel overwhelming for casual users due to its highly detailed interface and extensive focus on micro-nutrient data, which could be more beneficial for advanced users or those with specific health goals.

2.4.3 ClassPass



Figure 2.6 ClassPass logo (ClassPass | Book Fitness Classes & Salon Appointments, n.d.)



Figure 2.7 ClassPass UI (ClassPass | Book Fitness Classes & Salon Appointments, n.d.)
ClassPass is a subscription-based service that provides access to thousands of gyms, fitness studios, spas, and wellness centers worldwide. Users can select from a variety of fitness classes,

ranging from yoga and pilates to strength training and boxing. ClassPass works on a credit-based system, where users purchase credits that can be redeemed for classes and appointments. These credits are allocated monthly, and the platform allows users to book sessions at various locations and times, offering flexibility for diverse fitness preferences (ClassPass | Book Fitness Classes & Salon Appointments, n.d.).

A unique feature of ClassPass is its vast network of fitness studios and wellness services, which enables users to try different fitness modalities. The system also allows users to track their reservations and cancellations, offering a convenient way to manage their fitness schedule. However, ClassPass does not provide meal planning or health tracking features like some other apps, making it more specialized in class scheduling rather than comprehensive fitness management.

2.4.4 Yazio



Figure 2.8 Yazio logo (Healthy Weight Loss & Eating: Lose Weight Fast With YAZIO, n.d.)

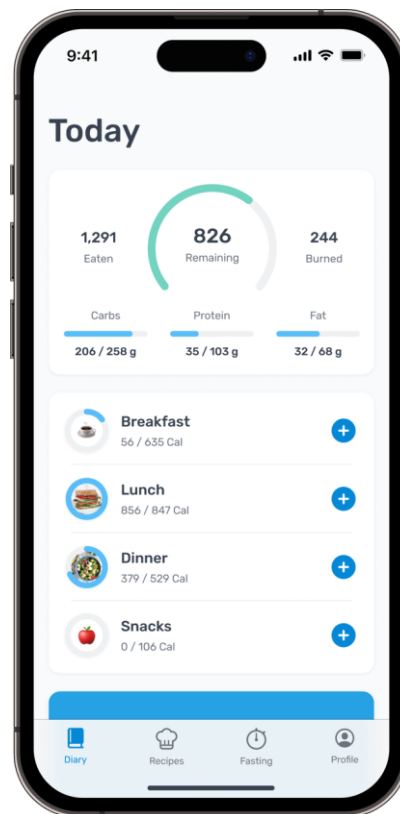


Figure 2.9 Yazio home page (Healthy Weight Loss & Eating: Lose Weight Fast With YAZIO, n.d.)

Yazio is a nutrition and diet tracking app that helps users manage their food intake and achieve health goals such as weight loss or muscle gain. The app offers personalized meal plans based on the user's dietary preferences, fitness goals, and health conditions. Yazio's strength lies in its user-friendly interface and its ability to generate customized meal recommendations. It provides tracking tools for both macro-nutrients and micro-nutrients, ensuring users can monitor their complete nutritional intake (Healthy Weight Loss & Eating: Lose Weight Fast With YAZIO, n.d.). However, Yazio has some limitations. While the app's free version allows basic tracking, many of its premium features, such as detailed meal plans, recipe ideas, and extended progress analysis, require a subscription. Additionally, the app has a limited database of food items compared to some competitors, which may require users to manually input custom foods. This can make it less convenient for users who consume a wide variety of international or lesser-known foods.

2.5 Comparison Between Similar Existing System

This section provides a detailed comparison between the proposed system and similar existing systems currently available in the market or academic research. The comparison highlights key features, functionalities, and limitations of the existing systems to evaluate their effectiveness and relevance in addressing the identified problem. By analyzing factors such as usability, system performance, features, user satisfaction, and scalability, this section identifies gaps or shortcomings in current solutions.

The proposed system's advantages are discussed in relation to these gaps, demonstrating how it offers improvements or innovative features. This comparison serves as a foundation for justifying the need for the new system and ensures that it delivers significant value over existing alternatives. Additionally, it emphasizes how the proposed system addresses specific user needs and requirements more effectively.

Table 2.1 Comparison of existing system

Features and Functionalities	MyFitnessPal	Chronometer	ClassPass	Yazio	Proposed System (FitFusion)
Personalized Meal Suggestions	No	Yes	No	Yes	Yes
AI Integration for meal Recommendations	No	No	No	No	Yes
Gym session booking	No	No	Yes	No	Yes
Activity Tracking	Yes	Yes	Yes	Yes	Yes
Health Monitoring (e.g., calories)	Yes	Yes	No	Yes	Yes
Portability (Mobile App Availability)	Yes	Yes	Yes	Yes	Yes

Table 1 shows the comparison of features and functionalities between four existing systems, namely MyFitnessPal, Cronometer, ClassPass, and Yazio, and the proposed FitFusion system. They are compared based on criteria such as personalized meal suggestions, AI integration for meal recommendations, workout session booking, activity tracking, health monitoring (e.g., calories), portability (mobile app availability), and progress reports.

2.6 Proposed System Justifications

MyFitnessPal does not provide personalized meal suggestions or AI-based meal recommendations but supports activity tracking, health monitoring, portability, and progress reports. In contrast, Cronometer offers personalized meal suggestions and supports activity tracking, health monitoring, and portability but lacks workout session booking, AI integration, and progress reporting.

ClassPass focuses primarily on workout session booking, a feature it shares with the proposed FitFusion system but does not support personalized meal suggestions, AI integration, activity tracking, or health monitoring. Yazio provides personalized meal suggestions, activity tracking, health monitoring, and portability but does not offer AI-based meal recommendations, workout session booking, or progress reports.

The proposed FitFusion system integrates all the features analyzed, including AI-based meal recommendations, drawing inspiration from recent research on deep generative models for personalized nutrition, as exemplified in the Scientific Reports article by Papastratis et al. (2024). This AI-driven approach to meal personalization is a novel addition absent from existing systems. FitFusion stands out as a comprehensive platform combining meal personalization, AI integration, fitness tracking, and scheduling functionalities in one system.

2.7 Summary

This chapter provided a comprehensive review and comparison of existing systems and the proposed FitFusion system. By creating a comparison table, the differences and similarities among MyFitnessPal, Cronometer, ClassPass, Yazio, and the proposed system were highlighted. Key shared features, such as portability and activity tracking, demonstrate the usability and accessibility of modern fitness applications. However, unique features like AI-driven meal recommendations and workout session booking set FitFusion apart as a tailored solution for promoting healthier lifestyles. This analysis serves as a reference to refine and enhance the functionalities of the proposed system, ensuring it meets the needs of its target users effectively.

CHAPTER 3: REQUIREMENT ANALYSIS AND DESIGN

3.1 Introduction

This chapter will describe the requirement analysis and design for the proposed FitFusion mobile application. The requirements of this application are identified and analyzed to ensure the development is aligned with the project's goals. After that, the design of the system is carried out. The requirement analysis is illustrated using a use case diagram, while the system designs are presented through sequence diagrams, class diagrams, activity diagrams, architecture diagrams, database design, and wireframes.

3.2 Functional Requirement

To address the problem statements outlined in Chapter 1, a detailed requirement analysis was conducted to gather insights and understand the needs of the target users. For this project, data collection was carried out through a questionnaire distributed using Google Forms, targeting students at Universiti Malaysia Sarawak (UNIMAS). The purpose of this questionnaire was to identify the challenges, preferences, and expectations of university students regarding health and fitness mobile applications. Refer to Appendix B for the pre-filled questionnaire.

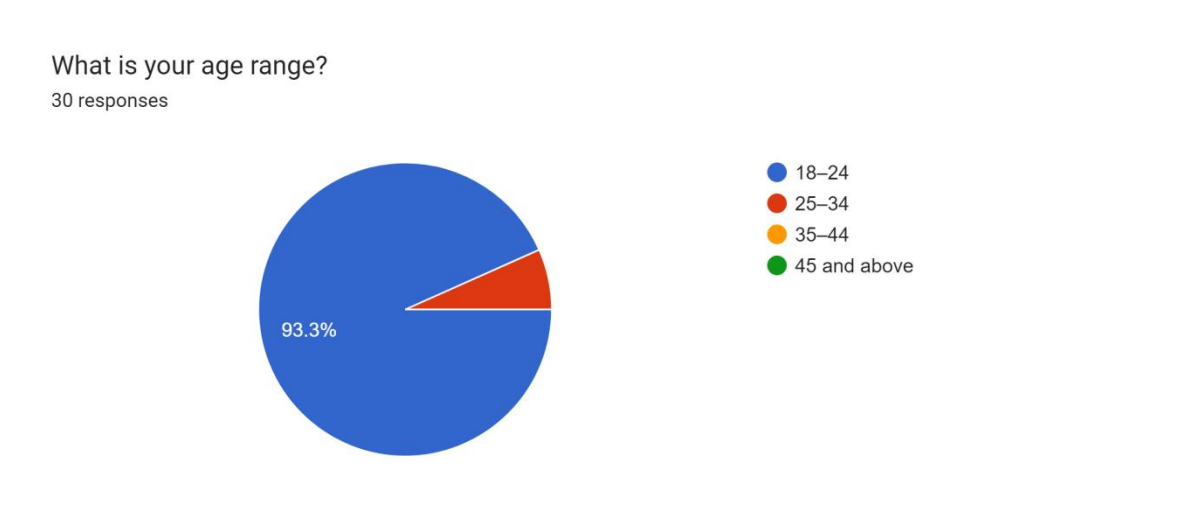


Figure 3.1 Pie chart of respondents' age range

The survey indicates that 93.3% of respondents fall within the 18–24 age range, while only a small proportion (6.7%) belong to the 25–34 age group. This shows that the majority of participants are young adults, emphasizing the need to design FitFusion with features and interfaces tailored to the preferences and lifestyles of this demographic. Addressing the specific needs of this dominant age group can enhance user engagement and satisfaction.

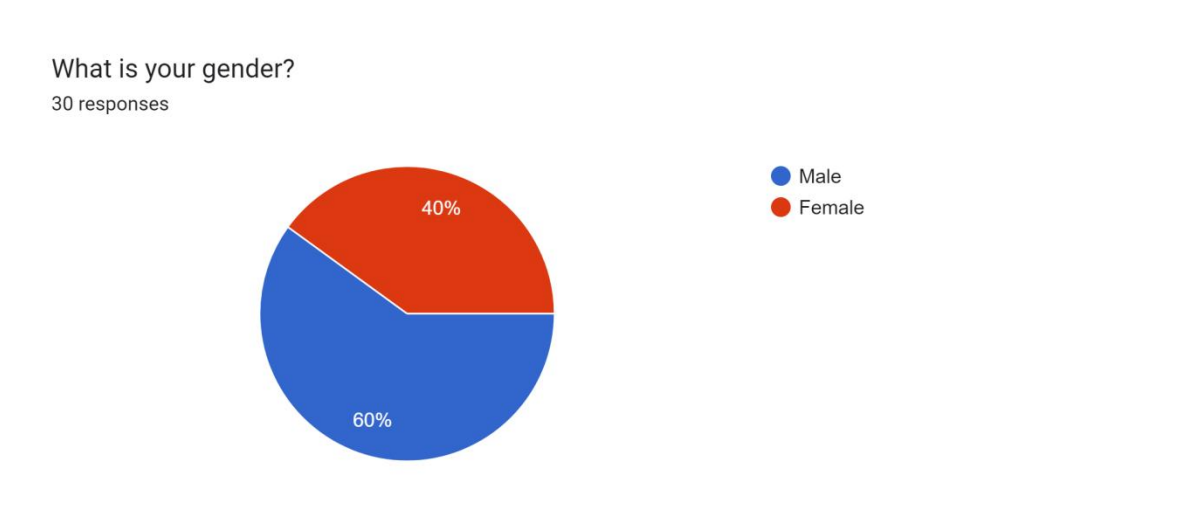


Figure 3.2: Pie chart of respondents' gender

The survey shows that 60% of respondents are male, while 40% are female, indicating a slightly higher participation rate among males. This demographic insight is essential for FitFusion, as it highlights the need to design a platform that caters to both genders equally. By understanding

the preferences and fitness goals of both male and female users, FitFusion can offer personalized features and inclusive functionalities, ensuring a more balanced and engaging user experience for everyone.

Do you have any diagnosed Non-Communicable Diseases (NCD)?
30 responses

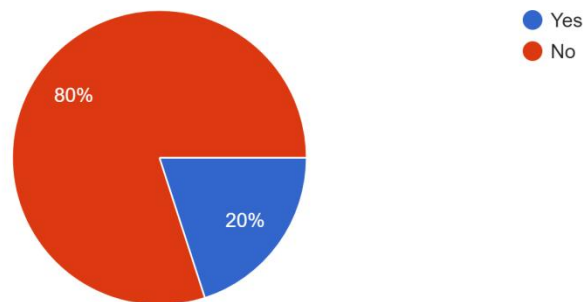


Figure 3.3: Pie chart of respondents' diagnosis for Non-Communicable Diseases (NCD)

The survey reveals that 20% of respondents have been diagnosed with Non-Communicable Diseases (NCDs), while 80% do not have such conditions. For UNIMAS students, this highlights the importance of having a platform like FitFusion that caters to both general fitness and specific health needs. Students with NCDs can benefit from personalized fitness programs and health tracking tools to manage their conditions effectively. At the same time, the majority without NCDs can use the platform to maintain a healthy lifestyle, reduce the risk of developing such diseases, and balance their academic and physical well-being. FitFusion can play a vital role in supporting the diverse health needs of the UNIMAS student community.

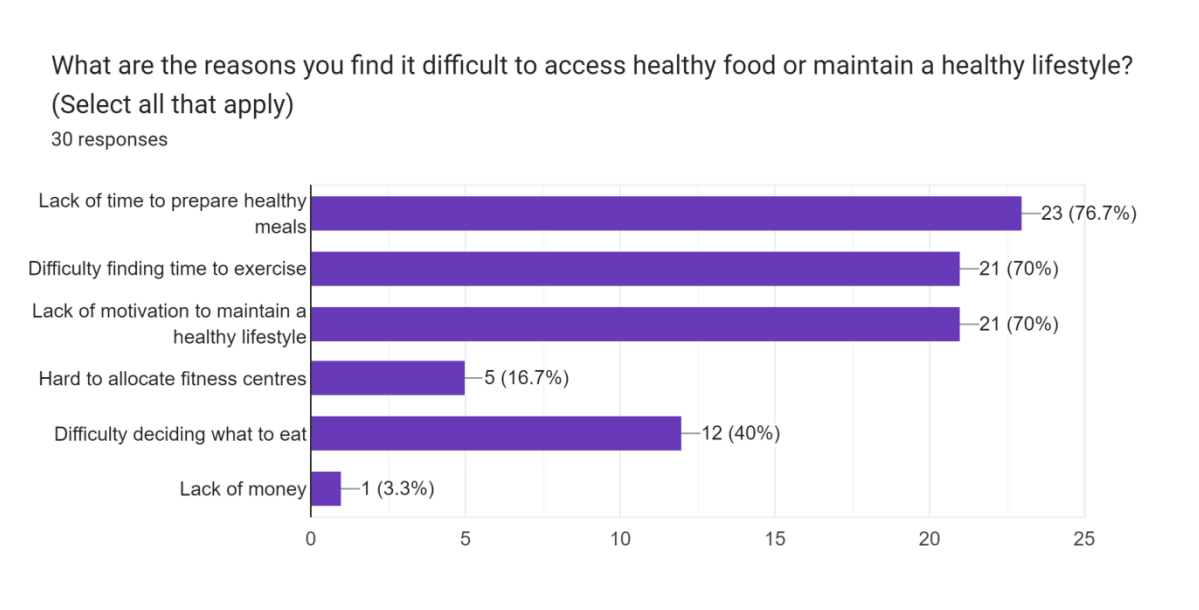


Figure 3.4: Bar chart of respondents' reason for finding it difficult to access healthy food or maintain a healthy lifestyle

The survey identifies several challenges students face in maintaining a healthy lifestyle. The primary reason is the lack of time to prepare healthy meals, cited by 76.7% of respondents, followed by difficulty finding time to exercise (70%) and a lack of motivation to maintain a healthy lifestyle (70%). Additionally, 40% struggle with deciding what to eat, while 16.7% find it hard to allocate fitness centers, and 3.3% mention financial constraints as a barrier.

For UNIMAS students, FitFusion could address these issues by offering meal planning features, quick workout routines, motivational tools, and guidance on healthy eating. By catering to these needs, FitFusion can provide practical solutions to help students overcome these barriers and achieve a healthier lifestyle despite their busy academic schedules.

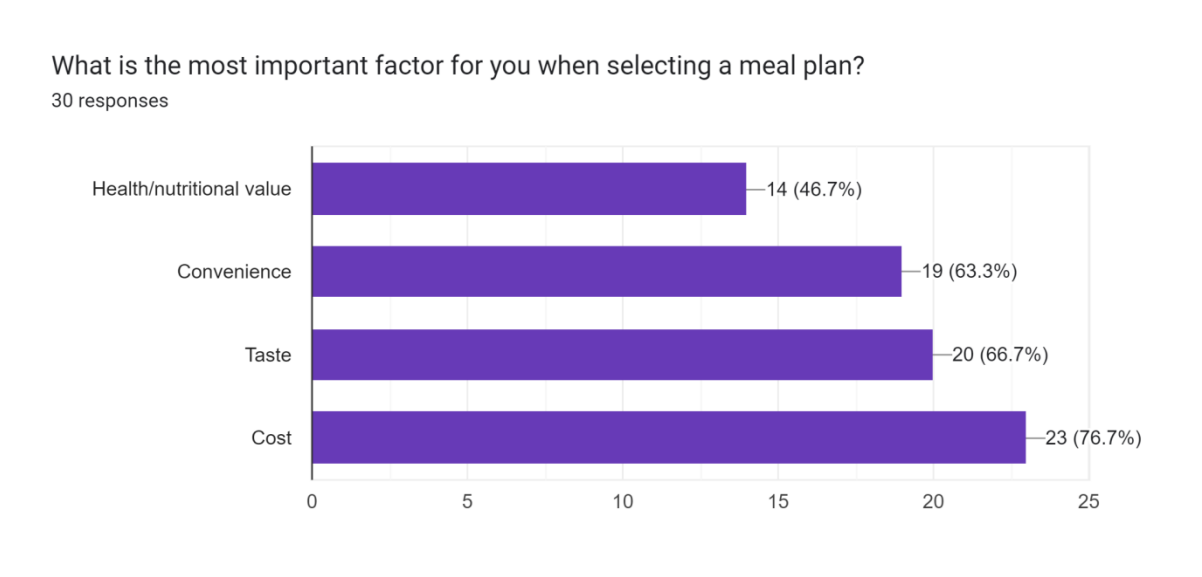


Figure 3.5: Bar chart of respondents' most important factor when selecting a meal plan

The survey results highlight the most important factors students consider when selecting a meal plan. Cost is the top priority, with 76.7% of respondents emphasizing its importance, followed by taste (66.7%) and convenience (63.3%). Health and nutritional value are also significant, with 46.7% considering it as a key factor. FitFusion can play a crucial role by providing affordable meal plans that balance taste, convenience, and nutritional value. By addressing these preferences, the platform can help students make healthier food choices without compromising on cost or convenience, ensuring accessibility and practicality in their daily lives.

Would you use an AI-powered system to recommend personalized meal plans? eg: This system could consider your dietary needs, health goals, and food preferences to provide tailored suggestions
30 responses

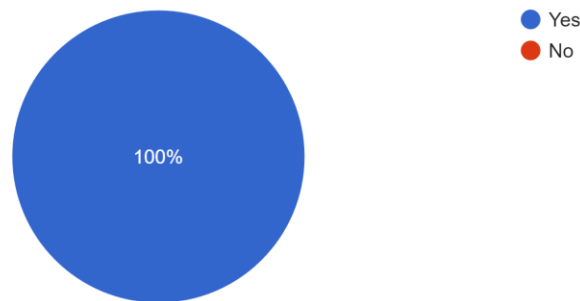


Figure 3.6: Pie chart of respondents' willingness to use an AI-powered system for personalized meal plans

The survey indicates all of the respondents expressing willingness to use an AI-powered system for personalized meal plan recommendations. Such a system would consider dietary needs, health goals, and food preferences to provide tailored suggestions. This highlights a strong demand for innovative solutions like FitFusion. By integrating AI-powered recommendations, the platform can offer a unique and practical tool to support healthier lifestyles, making it highly relevant and appealing to the student population.



Figure 3.7: Bar chart of respondents' priorities in a health and fitness app

The survey highlights key feature priorities for a health and fitness app among respondents. Personalized meal recommendations received the highest importance, aligning with the interest in AI-powered systems for tailored meal planning. Goal tracking and community support also emerged as significant preferences, indicating a demand for features that motivate and connect users. Exercise plans were moderately prioritized, showing a balanced interest in fitness guidance alongside nutrition. These insights underscore the relevance of incorporating these features into FitFusion, addressing the holistic health and fitness needs of UNIMAS students. By integrating these priorities, the platform can enhance user engagement and foster healthier lifestyles.

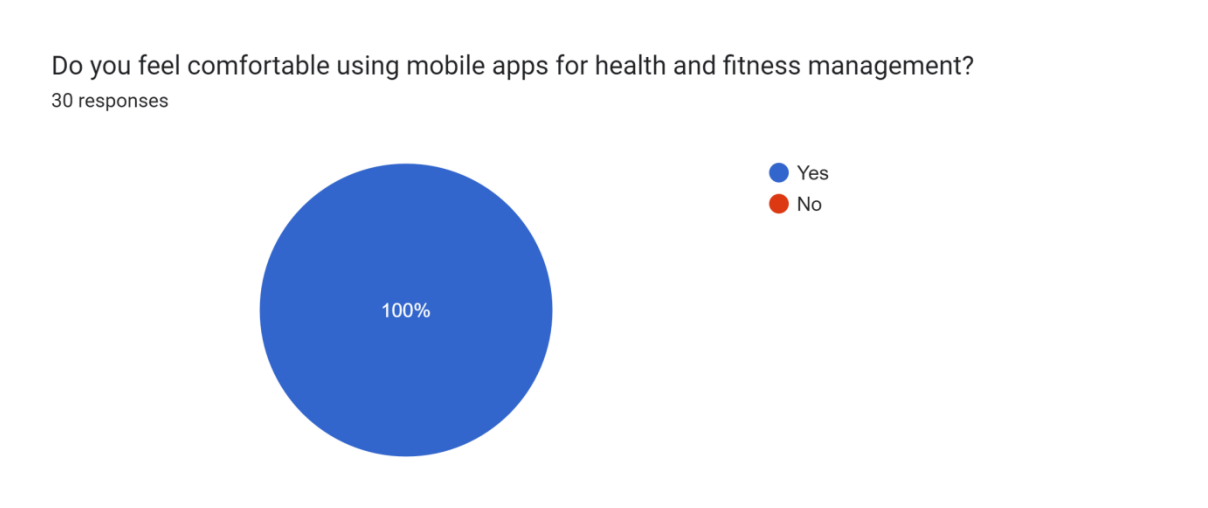


Figure 3.8: Pie chart of respondents' preferences in using mobile apps for health and fitness management

The survey reveals that all respondents (100%) feel comfortable using mobile apps for health and fitness management. This unanimous acceptance emphasizes the readiness of the target audience to adopt digital tools for improving their health and lifestyle. It reinforces the potential of FitFusion as a valuable solution for UNIMAS students, leveraging mobile technology to deliver personalized fitness and nutrition support effectively.

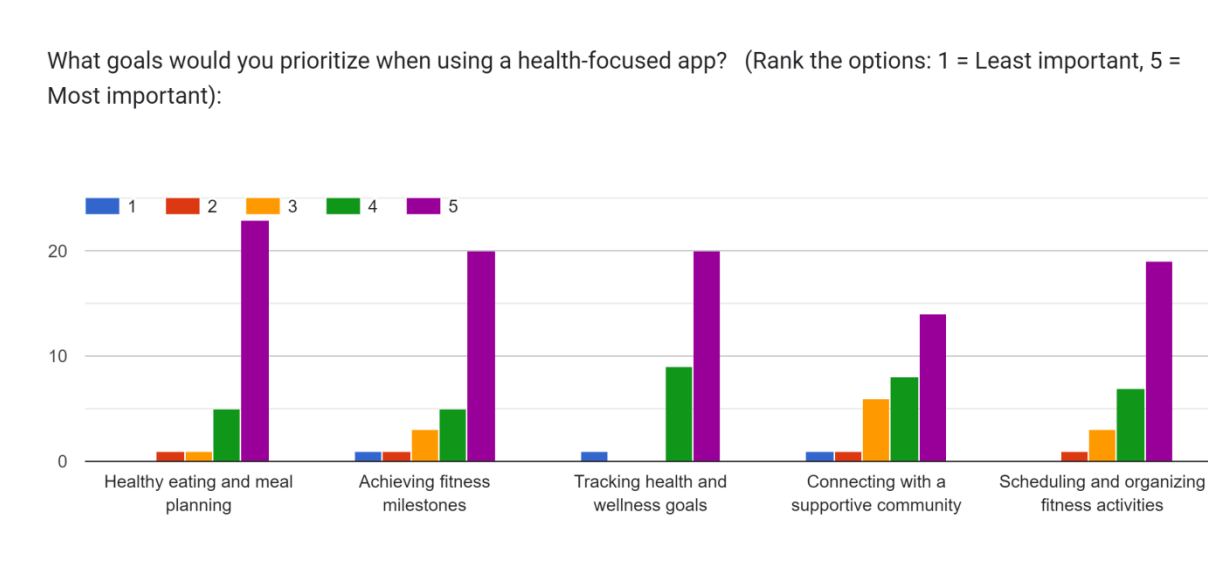


Figure 3.9 Bar chart of respondents' prioritized goals when using a health-focused app

The chart highlights the key priorities when using a health-focused app, with most individuals valuing healthy eating and meal planning, tracking health and wellness goals, and achieving

fitness milestones. Scheduling fitness activities and connecting with a supportive community are also important. For UNIMAS students, these priorities align with FitFusion's features, such as personalized meal plans, fitness tracking, and community engagement, making it highly relevant to their needs and promoting a healthier lifestyle.

The findings from this questionnaire form the basis of the system's functional and non-functional requirements. A detailed description of these requirements, along with a use case diagram, is provided to guide the design and development process of the FitFusion application.

3.2.1 Use Case Diagram

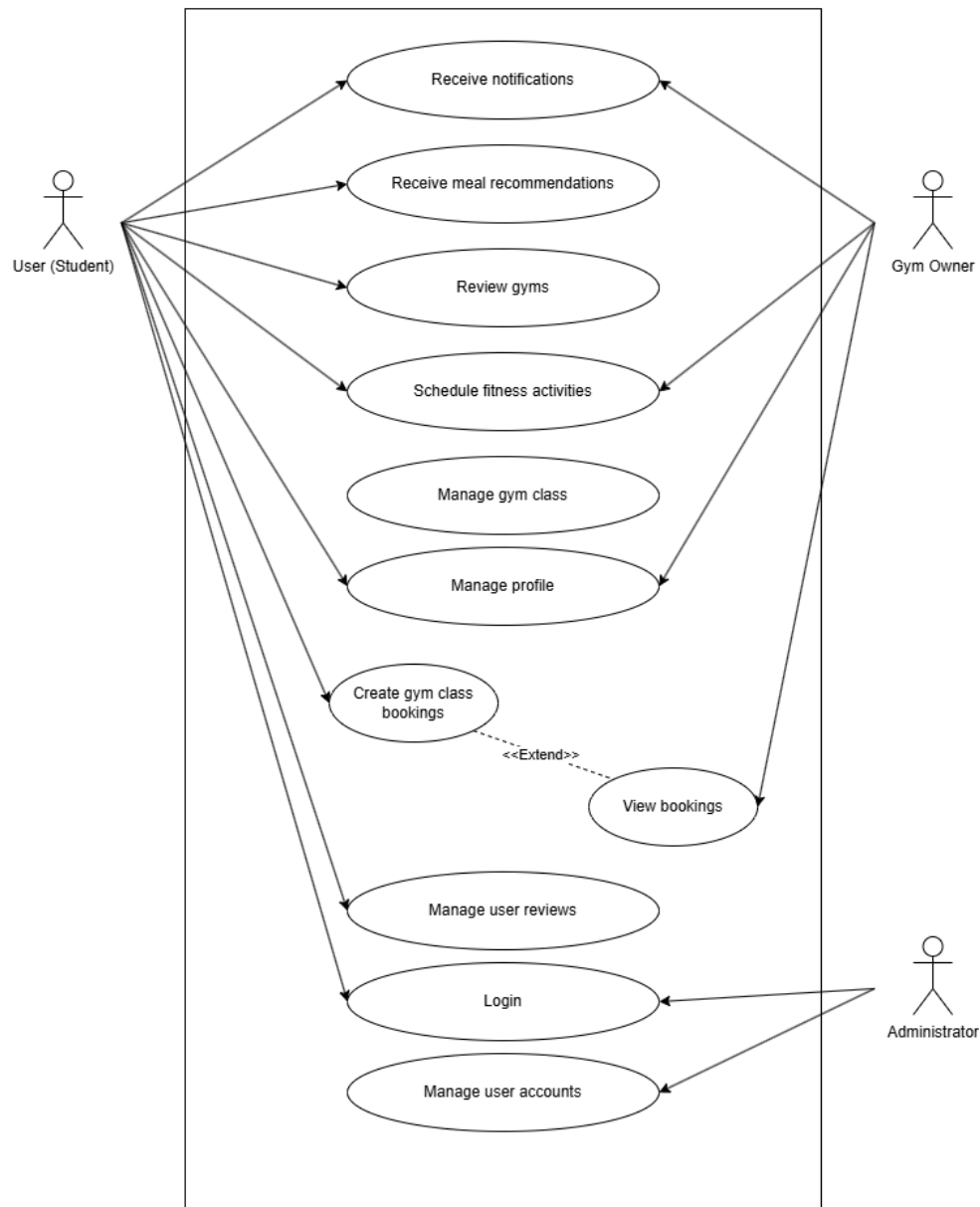


Figure 3.10 Use case diagram for FitFusion

3.2.2 Use Case Description

This section provides a breakdown of the key functionalities and interactions within the FitFusion system through use case descriptions. Each use case represents a specific scenario of how users, administrators, and gym owners interact with the system to achieve their goals. The

tables included in this section outline these use cases in a structured format, highlighting the actors involved, the objectives of each use case, the preconditions that must be met, and the expected outcomes. Additionally, the tables include the main flow of activities and any alternative flows, ensuring a better understanding of the system's functionality.

Table 3.1 Login use case description

Use Case Name	Login
Actors	User (Student), Gym Owner, Administrator
Description	Allows users to log into the FitFusion system using valid credentials.
Preconditions	Users must be registered in the system.
Main Flow	1. User enters username and password. 2. System verifies credentials. 3. User is granted access to their dashboard.
Alternative Flow	Invalid credentials result in an error message prompting re-entry.
Postconditions	User is logged into the system and has access to their respective features.

Table 3.2 Receive notifications use case description

Use Case Name	Receive Notifications
Actors	User (Student), Gym Owner
Description	Sends important notifications related to bookings, schedules, and updates to users.
Preconditions	The user must be logged into the system.
Main Flow	1. System identifies relevant notifications. 2. Notifications are displayed on the user's dashboard.
Alternative Flow	Notifications may also be sent via email if users are offline.
Postconditions	Notifications are received and acknowledged by users.

Table 3.3 Receive meal recommendations use case description

Use Case Name	Receive Meal Recommendations
Actors	User (Student)
Description	Provides personalized meal recommendations based on user preferences or fitness goals.
Preconditions	The user must have completed their meal preference setup.
Main Flow	1. User requests meal recommendations. 2. System analyzes user data. 3. Relevant meal plans are displayed.
Alternative Flow	None.
Postconditions	The user receives meal recommendations.

Table 3.4 Schedule fitness activities use case description

Use Case Name	Schedule Fitness Activities
Actors	User (Student), Gym Owner
Description	Enables users to schedule fitness activities or classes.
Preconditions	The user must have an active account.
Main Flow	1. User browses available activities. 2. User selects a desired schedule. 3. System confirms the booking.
Alternative Flow	If the schedule is full, the user is prompted to choose another slot.
Postconditions	The fitness activity is added to the user's calendar.

Table 3.5 Create bookings use case description

Use Case Name	Create Bookings
Actors	User (Student)
Description	Allows users to book gym facilities or services.
Preconditions	The user must have an active account.
Main Flow	1. User searches for a gym. 2. User selects a service and time slot. 3. System confirms the booking.
Alternative Flow	None.
Postconditions	The booking is recorded in the system.

Table 3.6 View bookings use case description

Use Case Name	View Bookings
Actors	User (Student), Gym Owner
Description	Allows users to view their current and past bookings.
Preconditions	The user must have made at least one booking.
Main Flow	1. User navigates to the bookings section. 2. System displays booking history.
Alternative Flow	None.
Postconditions	The user views booking information.

Table 3.7 Manage profile use case description

Use Case Name	Manage Profile
Actors	User (Student), Gym Owner
Description	Enables users to update their profile information.
Preconditions	The user must be logged in.
Main Flow	1. User accesses the profile section. 2. User updates relevant details. 3. System saves the changes.
Alternative Flow	None.
Postconditions	Profile information is updated.

Table 3.8 Manage fitness class schedules use case description

Use Case Name	Manage Fitness Class Schedules
Actors	Gym Owner

Description	Allows gym owners to manage class schedules by adding or deleting classes.
Preconditions	The gym owner must be logged in.
Main Flow	1. Gym owner navigates to class schedules. 2. Gym owner modifies schedules as needed. 3. System saves the updates.
Alternative Flow	None.
Postconditions	Class schedules are updated in the system.

Table 3.9 Manage user reviews use case description

Use Case Name	Manage User Reviews
Actors	Gym Owner
Description	Allows gym owners to monitor and respond to user reviews.
Preconditions	The gym owner must be logged in.
Main Flow	1. Gym owner views user reviews. 2. Gym owner responds to reviews. 3. Responses are saved in the system.
Alternative Flow	None.
Postconditions	Review responses are visible to users.

Table 3.10 Manage user accounts use case description

Use Case Name	Manage User Accounts
Actors	Administrator
Description	Enables administrators to manage user accounts by creating, updating, or deleting them.
Preconditions	The administrator must be logged in.
Main Flow	1. Administrator accesses user management. 2. Administrator modifies account details. 3. System saves the changes.
Alternative Flow	None.
Postconditions	User accounts are updated.

3.2.3 Functional Requirement Analysis

This section lists all functional requirements of the proposed FitFusion application based on the findings from the questionnaire distributed to UNIMAS students. The proposed system includes features designed to support students in managing their health and fitness effectively.

The functional requirements for the proposed system are as follows:

Table 3.11 Functional requirement analysis of FitFusion

Category	Feature	Details
----------	---------	---------

User functions	Personalized health profiles	Users can create and update health and fitness profiles.
	Meal Recommendations	AI-generated meal plans based on dietary preferences and fitness goals.
	Fitness Activity Scheduling	Schedule fitness activities.
	Appointment Booking	Book appointments for gym classes.
	Notifications	Receive notifications for scheduled activities.
Gym owner functions	Class Scheduling	Schedule fitness classes and set maximum participant limits.
Administrator Functions	Moderation	Review and manage submitted user content and profiles.

3.3 Non-functional Requirement Analysis

The non-functional requirements define the quality attributes of the system and constraints on its design. A list of non-functional requirements for this proposed system is as follows:

- a) The system shall have a user-friendly interface, ensuring simple navigation and accessibility for students.
- b) The system shall respond to user interactions within 2 seconds to ensure a seamless experience.
- c) The system shall protect user data through secure login mechanisms.
- d) The mobile application shall operate on Android platforms to ensure compatibility with common devices.

3.4 System Design

This section provides an overview of the design of the proposed system, covering four key aspects which are the system module design, architecture design, database design, and user interface (UI) design. The system module design focuses on breaking the system into smaller,

functional modules, illustrating their relationships and interactions through class diagrams. The architecture design presents a high-level view of the system's physical structure, showing how components are organized and how data flows across various layers. The database design defines the structure of the system's data storage, including tables, attributes, relationships, and constraints, ensuring efficient data management and retrieval. Finally, the user interface design drafts the visual and interactive elements of the system, using wireframes to outline an intuitive and user-friendly interface.

3.4.1 Module Design

In this section, class diagrams and sequence diagrams are produced to demonstrate the module design of this proposed system.

3.4.1.1 Class Diagram

The class diagram represents the structural design of the system, highlighting its main components such as User, Admin, Gym Owner, and their associated functionalities. It illustrates the relationships between classes, including Fitness Schedule, Appointment, Profile, Notifications, and Feedback. Each class specifies its attributes and methods, providing a clear blueprint for the system's database design and software implementation, ensuring seamless interaction between users, gym owners, and administrators.

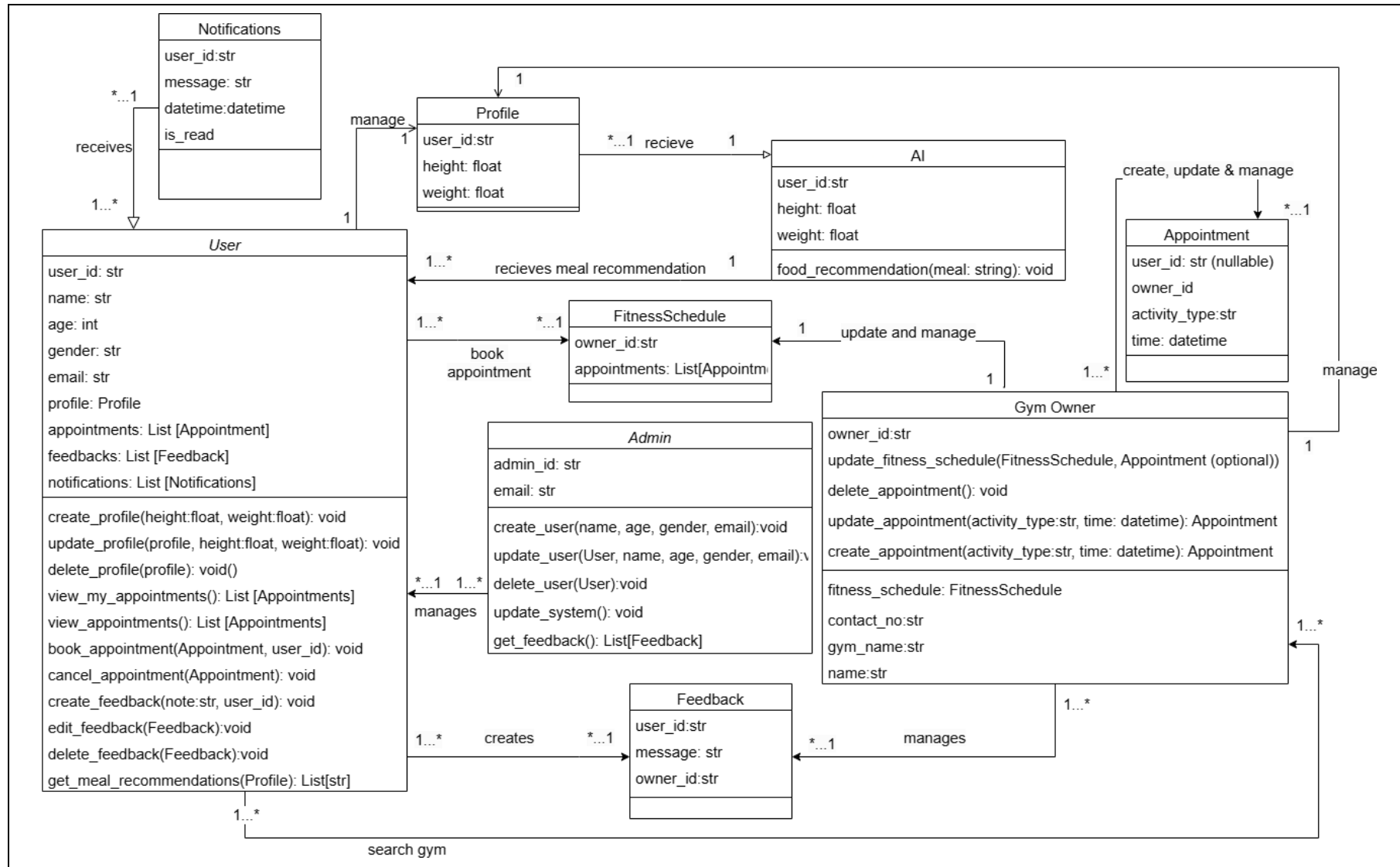


Figure 3.11 Class diagram for FitFusion

3.4.1.2 Sequence Diagram

The sequence diagram of the FitFusion system illustrates the interactions between various components, including users, the database, fitness schedules, gym owners, notifications and administrators.

In the FitFusion login process, a user initiates a login request to the authentication system. The system validates the user credentials by verifying them with the database. If the credentials are valid, the login is successful, and the user gains access. If the credentials are invalid, the login fails, prompting the user to ensure the correct username and password.

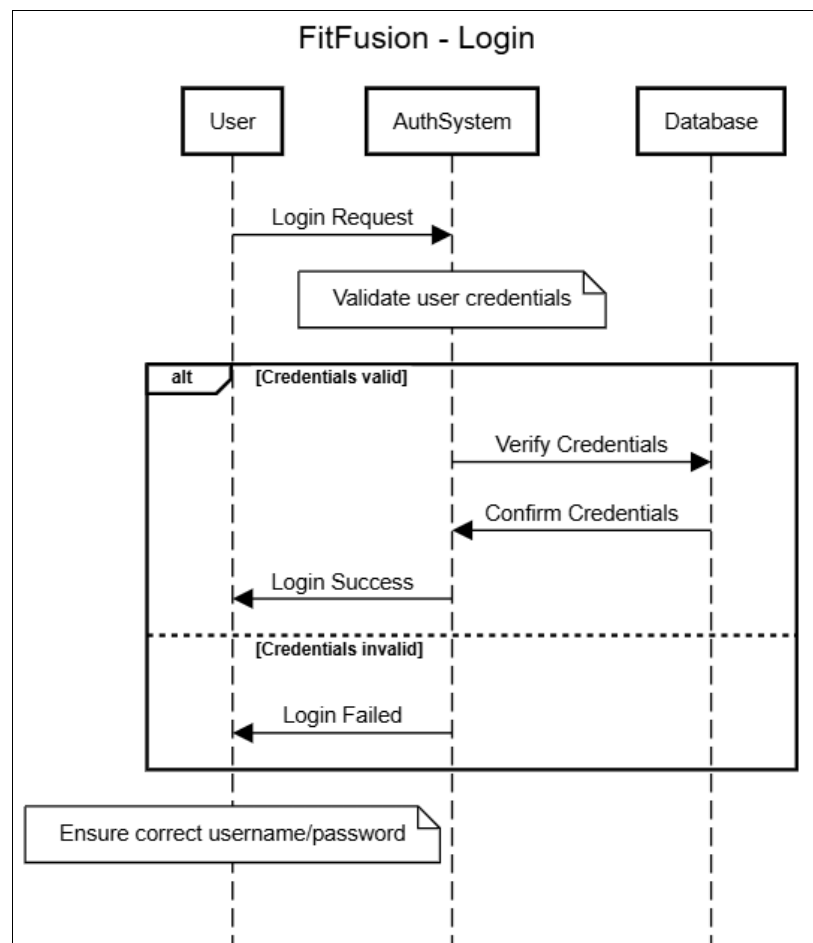


Figure 3.12 Sequence diagram for login

The figure below shows the FitFusion booking process. A user initiates a booking request by

selecting an activity. The system validates the booking details and checks the availability of the selected time slot. If the slot is available, the booking details are saved in the database, a confirmation is sent to the user, and the gym owner is notified of the new booking. If the slot is unavailable, the user is informed and prompted to select a different time slot.

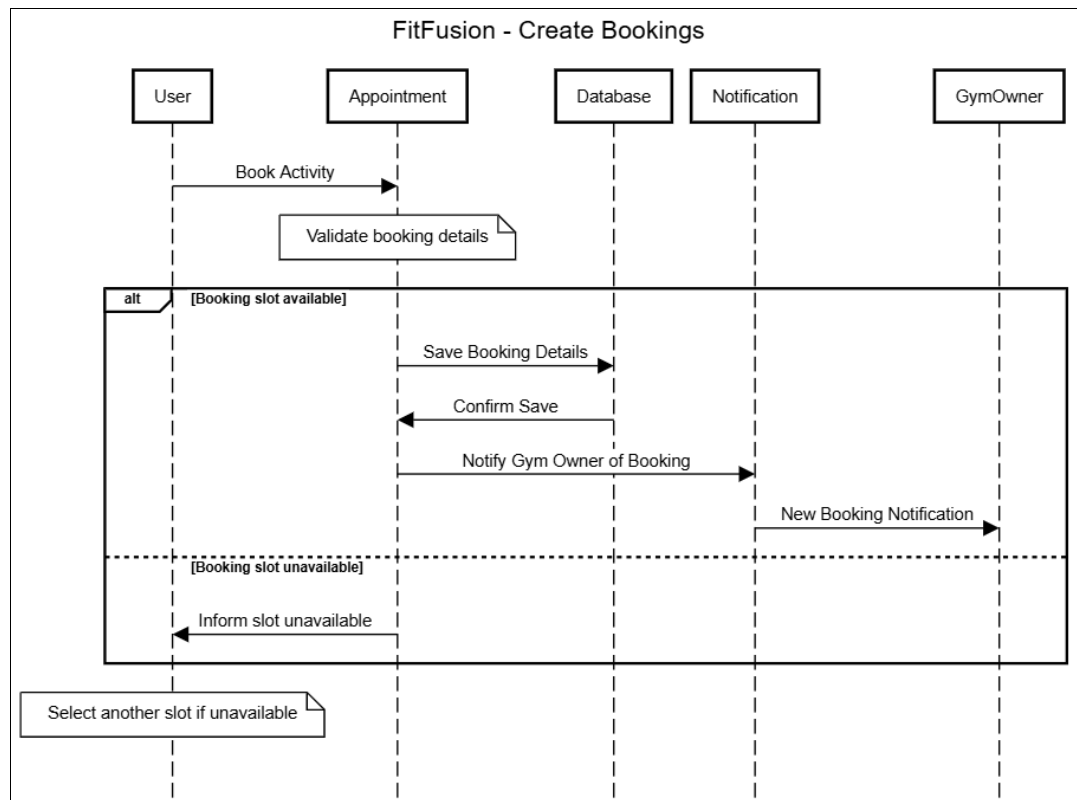


Figure 3.13 Sequence diagram for create bookings

The figure below shows the process of managing fitness class schedule where, a gym owner

initiates a request to manage fitness class schedules. The system fetches existing schedules from the database. If schedules are available, the system retrieves and returns the schedule details, displaying them for editing. If no schedules are found, the system notifies the gym owner, prompting them to add new schedules.

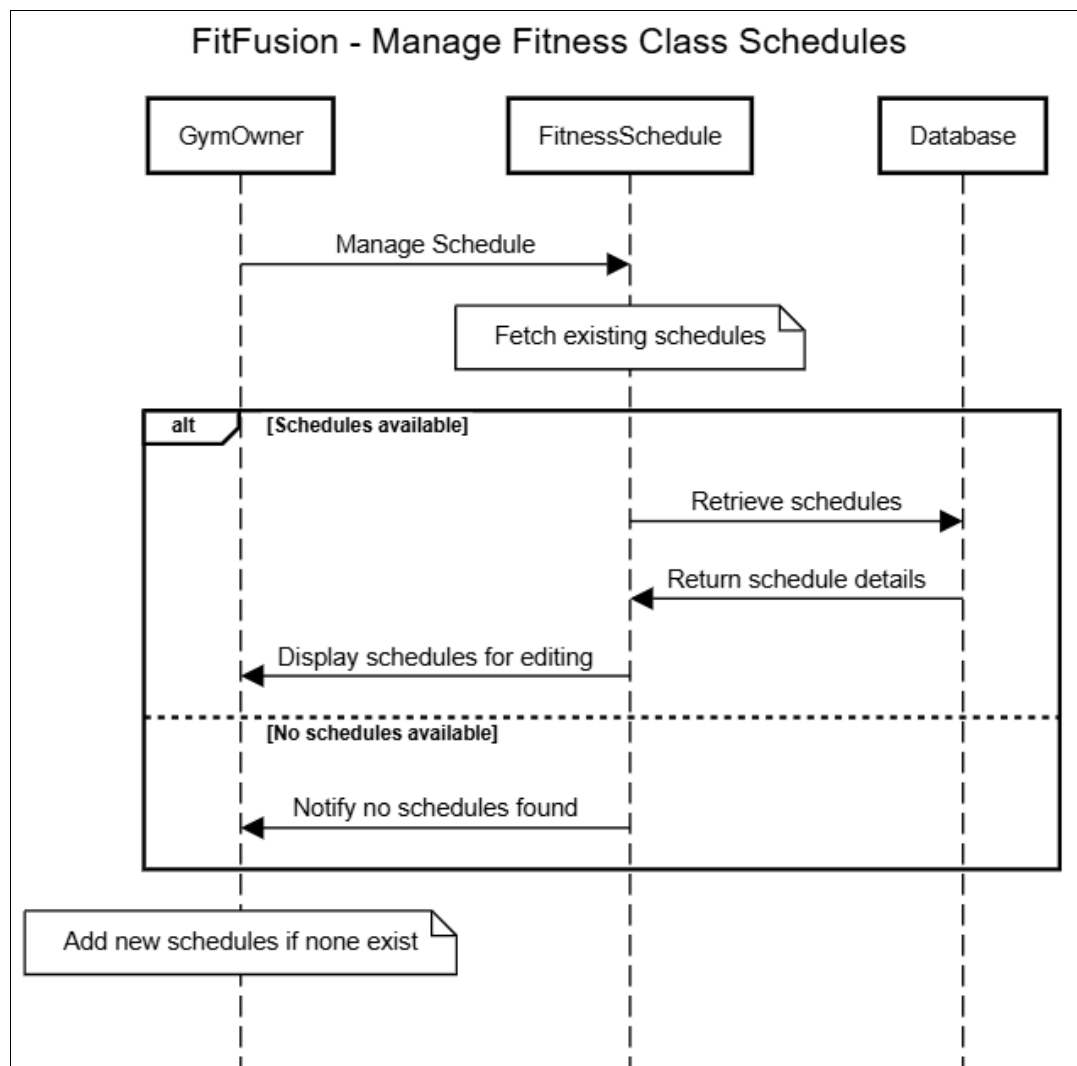


Figure 3.14 Sequence diagram for managing fitness class schedules

In the FitFusion booking view process, a user initiates a request to view their bookings. The

system fetches booking details from the database. If bookings are available, the system retrieves the booking details and displays them to the user. If no bookings are found, the system notifies the user, prompting them to create a new booking if needed.

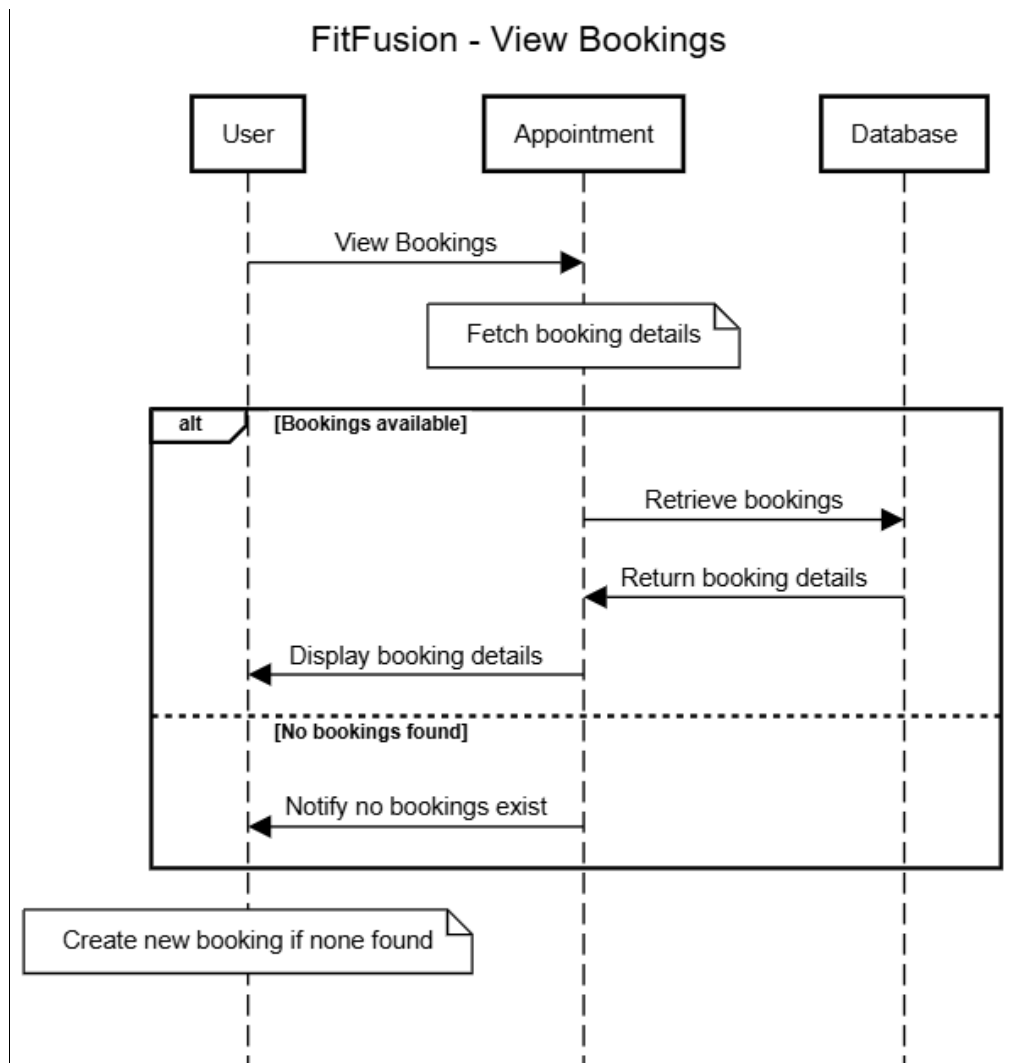


Figure 3.15 Sequence diagram for view bookings

In the FitFusion application, the Receive Meal Recommendations process begins when a user initiates a request for personalized meal suggestions. Upon receiving the request, the Meal

Recommendation System retrieves the user's dietary preferences and fitness goals from the database. These preferences are then used to formulate a structured prompt, which is sent to the OpenAI API. The API processes the input and generates a set of meal recommendations tailored to the user's profile.

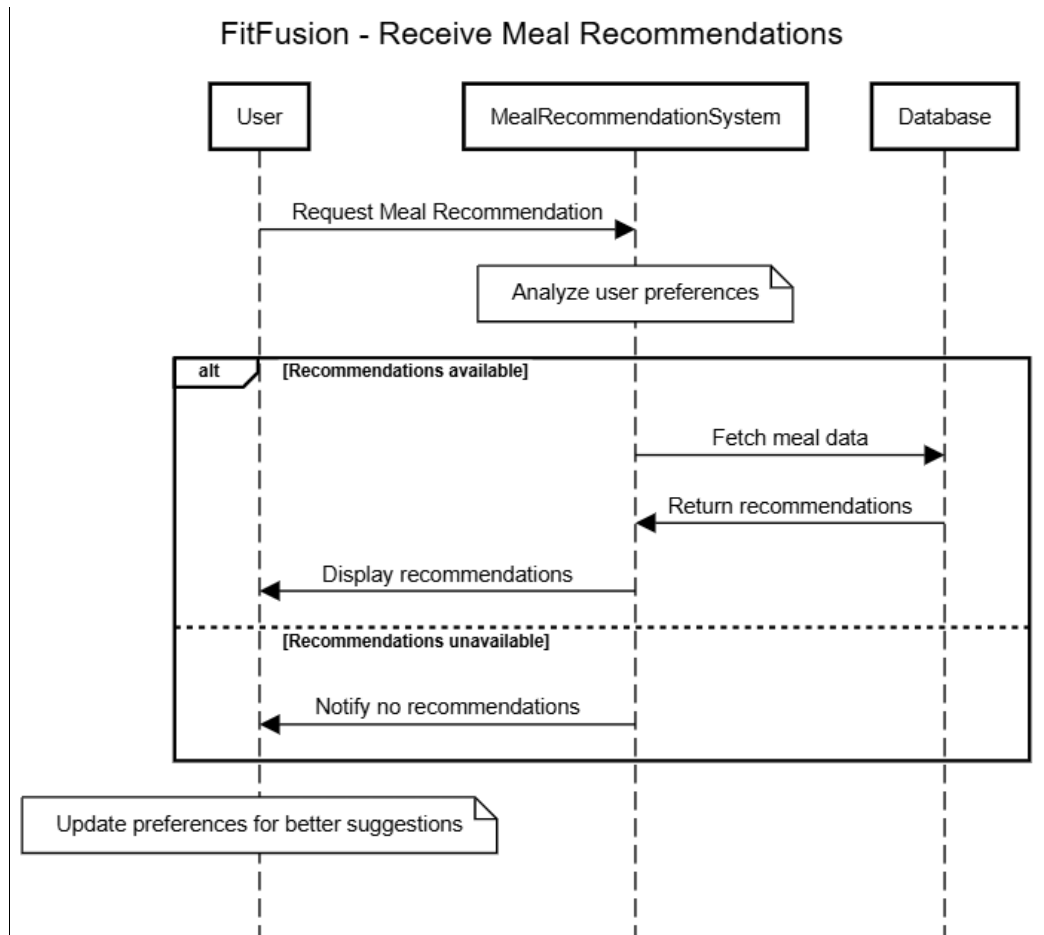


Figure 3.16 Sequence diagram for receive meal recommendations

In the FitFusion Receive Notifications process, a notification is sent to the user. If the notification is successfully received, the user can view the notification details. However, if the notification is not received, the system either retries sending it or notifies the user of an error.

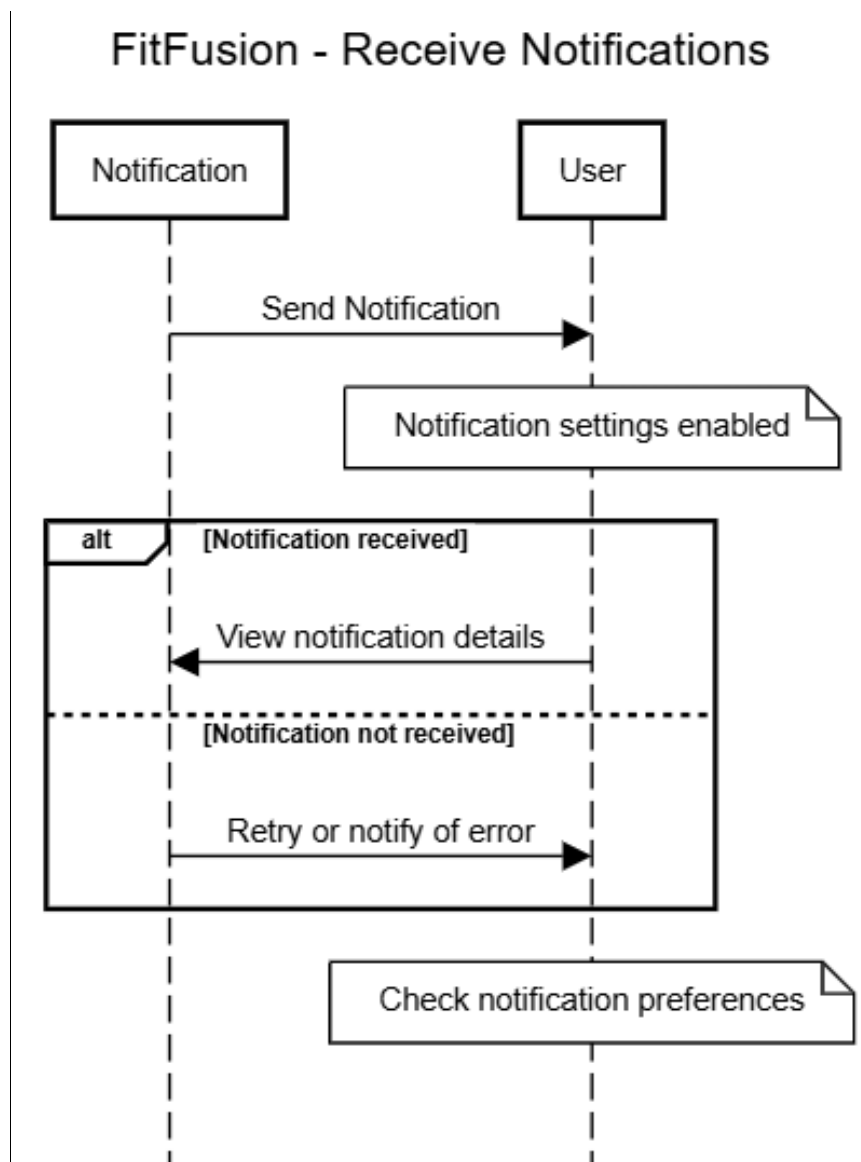


Figure 3.17 Sequence diagram for receive notifications

In manage profile, users can create or update their profiles, with the details being saved to the database. A confirmation is sent back to the user to acknowledge the successful update. For scheduling fitness activities, the user initiates the scheduling process, which updates the fitness schedule. Notifications are sent to the gym owner for confirmation, after which the activity

confirmation is displayed to the user.

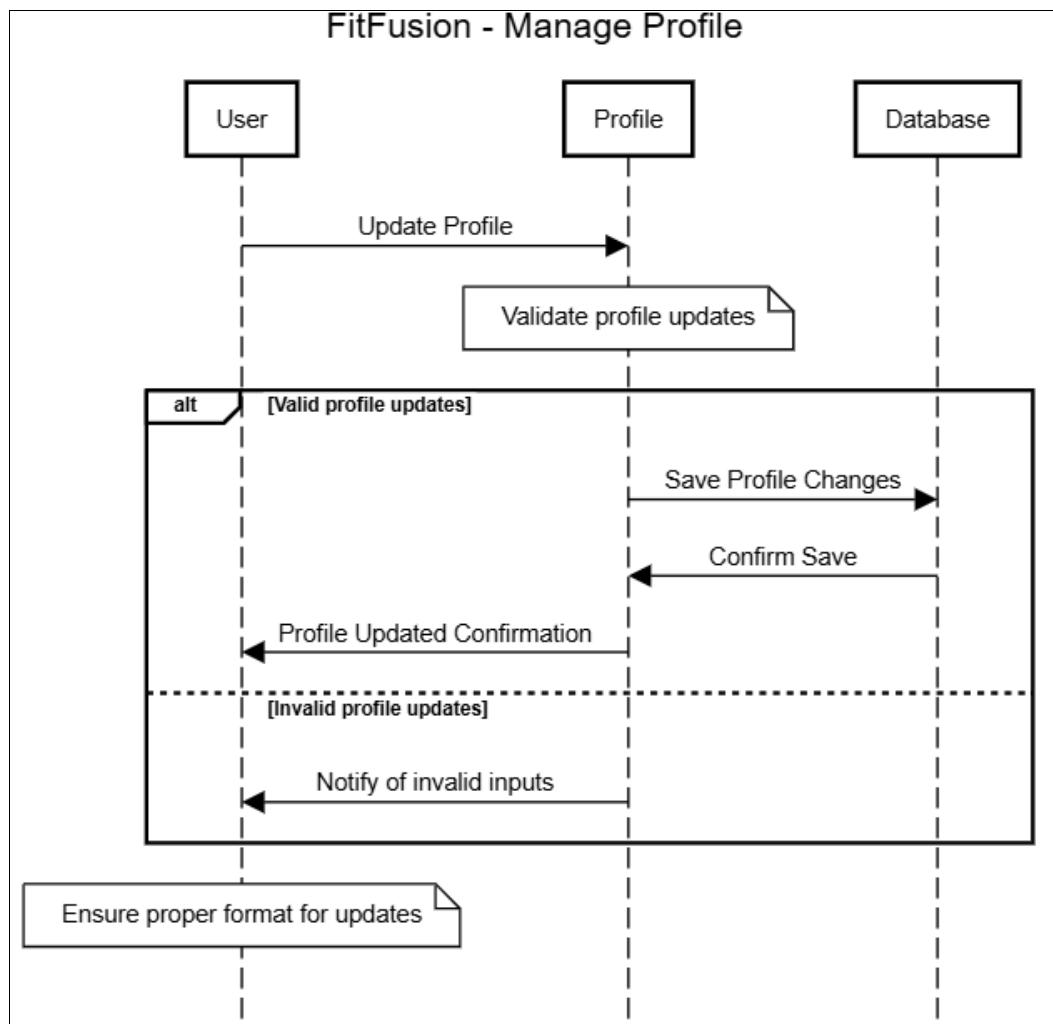


Figure 3.18 Sequence diagram for manage profile

Figure 3.19 shows the sequence diagram for reviewing gyms. The system supports feedback submission, where users can provide their input on the platform or services. The feedback is stored in the feedback system and confirmed to the user. Administrators are notified of new feedback and can respond to it. The user's feedback response is then displayed, completing the

feedback loop.

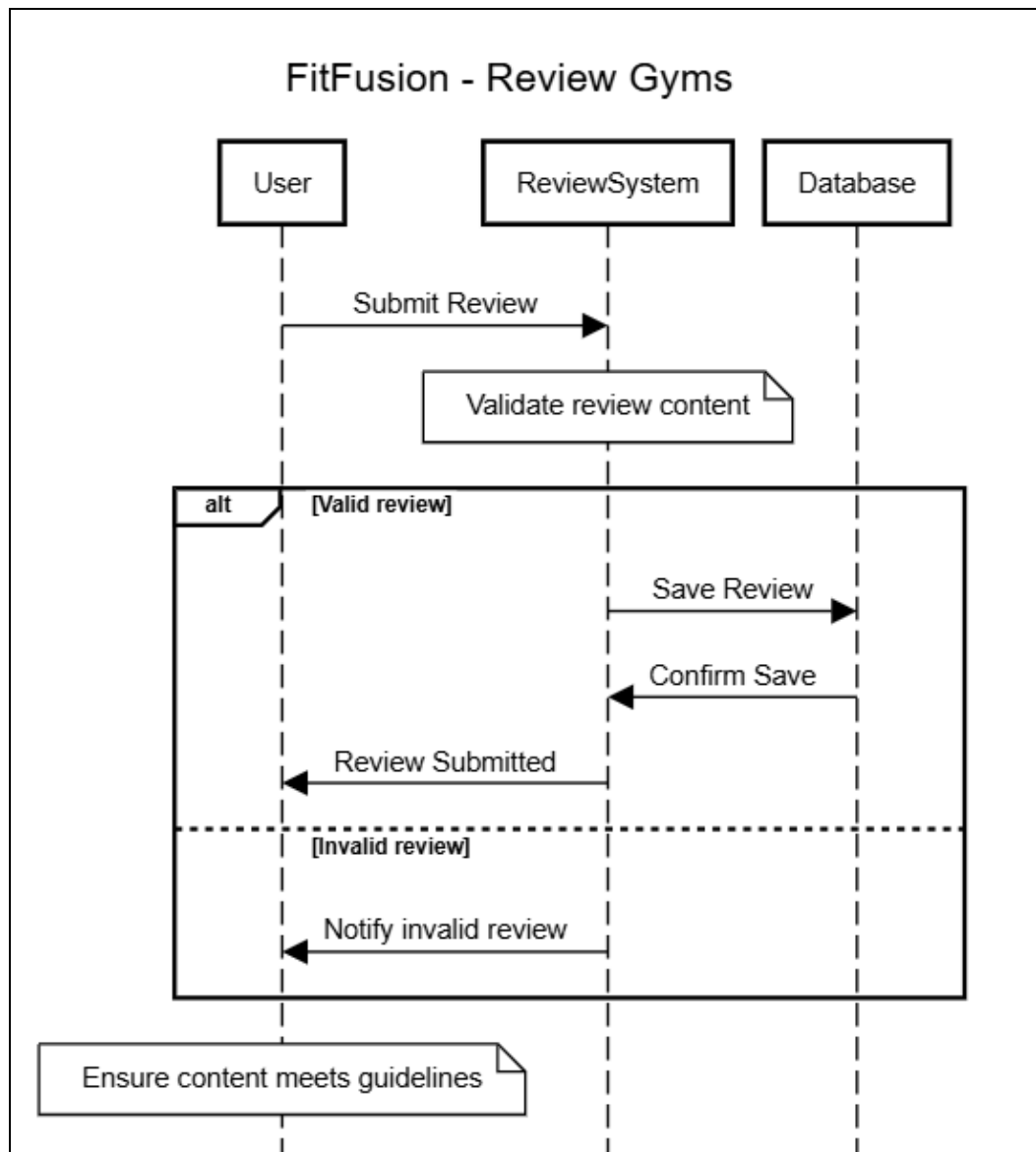


Figure 3.19 Sequence diagram for review gyms

The figure below shows the sequence diagram for scheduling fitness activities in the FitFusion platform. It shows the interaction between the Gym Owner, FitnessSchedule system, and Database to create or update fitness schedules, ensuring the process is completed and confirmed seamlessly. The Gym Owner initiates the process by creating or updating a fitness activity. This request is sent to the FitnessSchedule system, which then communicates with the Database

to save or update the schedule details. Once the database successfully processes the request, a confirmation is sent back to the FitnessSchedule system, which then notifies the Gym Owner that the schedule has been saved or updated.

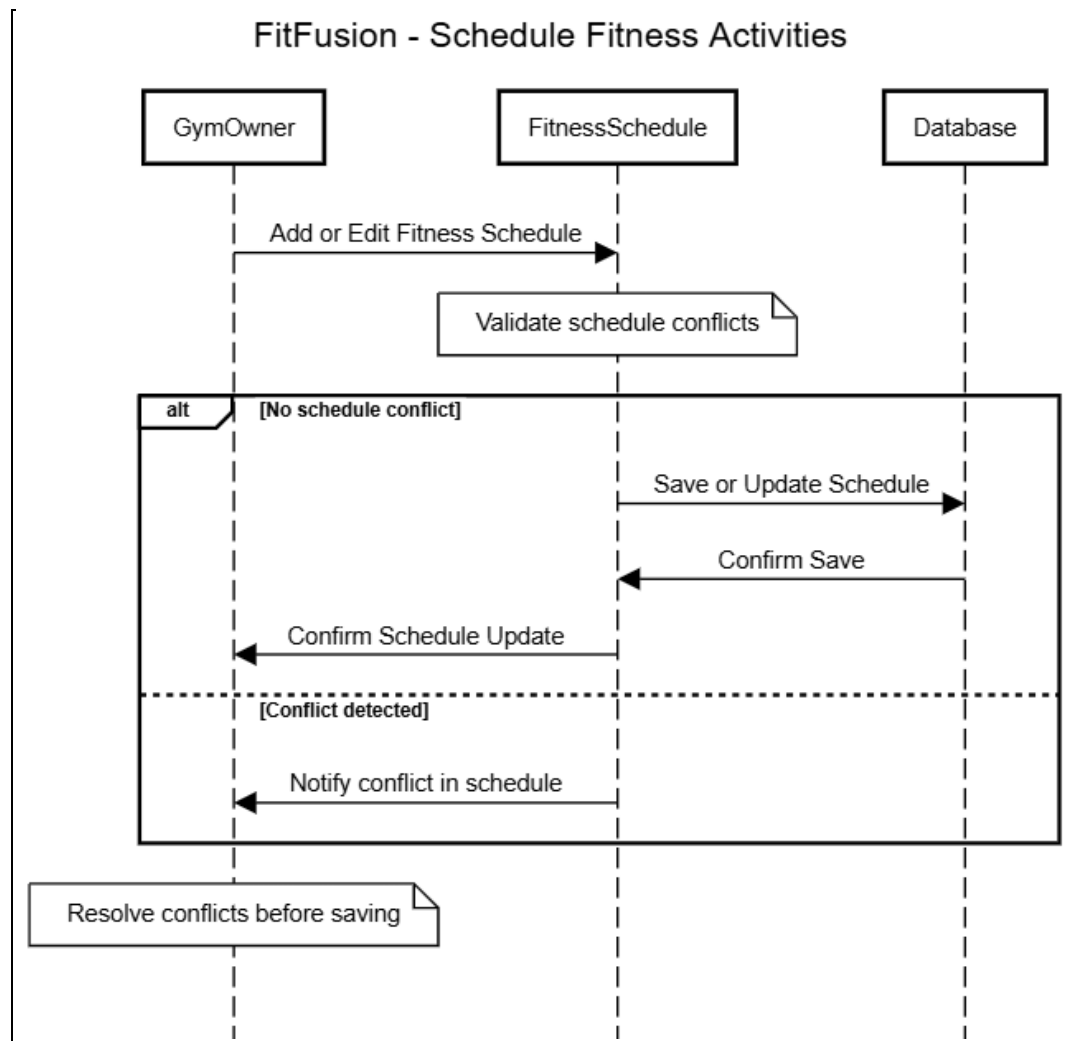


Figure 3.20 Sequence diagram for schedule fitness activities

In FitFusion, gym owners are responsible for managing gym class schedules through the platform's scheduling interface. Admins in FitFusion play a higher-level role by managing user accounts, and moderating content. They have the authority to delete gym classes and fitness activities when necessary. These administrative actions are logged and confirmed through the system to ensure the accuracy and integrity of the scheduling data stored in the database.

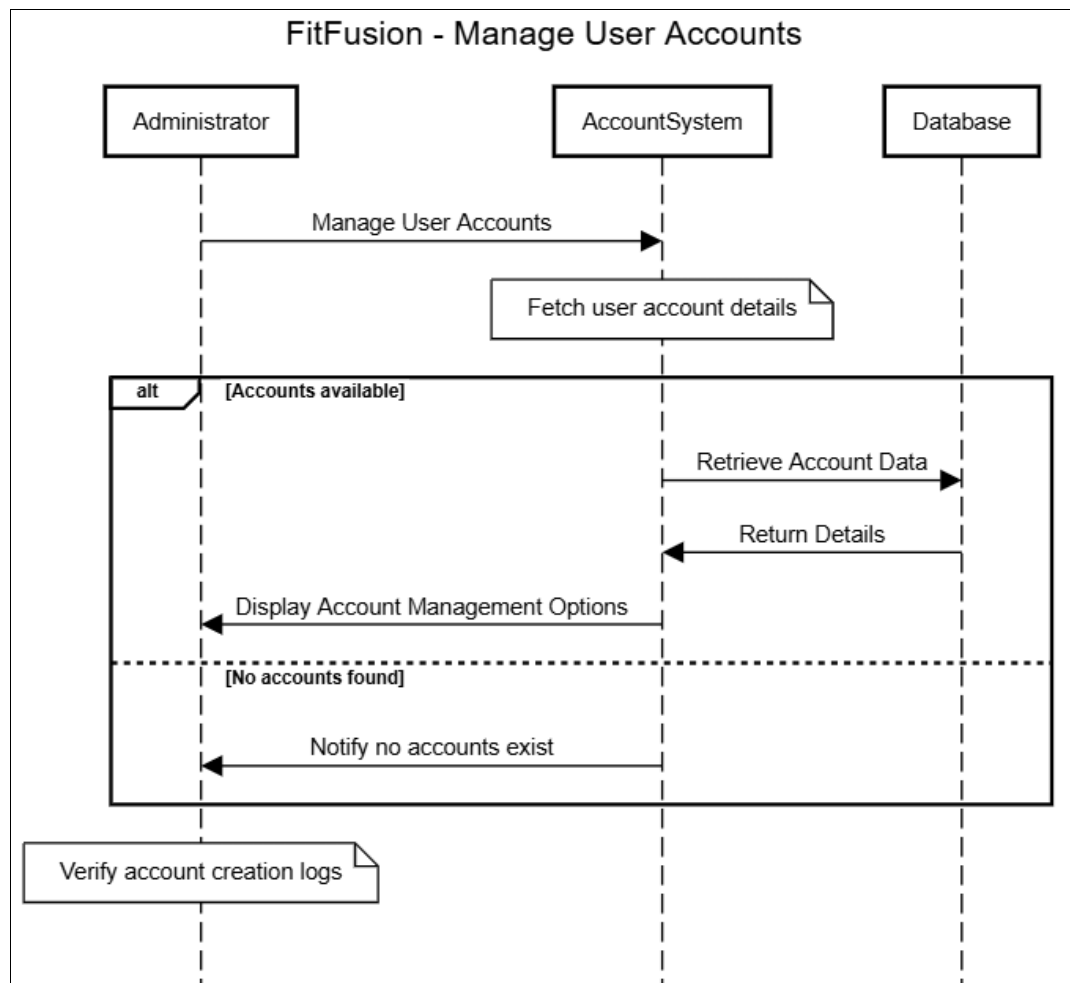


Figure 3.21 Sequence diagram for manage user accounts

3.4.2 Database design

The figure below shows the database design for FitFusion which outlines the key entities, attributes, and their relationships. At the core of the design is the User entity, which connects to other entities such as Profile, Fitness Schedule, Appointment, Notifications, and Feedback. Users can create or update their profiles, book fitness activities through appointments, receive notifications about their activities, and submit feedback to enhance the system.

The Profile entity captures user details and preferences, while the Fitness Schedule represents the available fitness classes or activities. Appointments are linked to the schedule and managed by gym owners, ensuring proper coordination of activities. Notifications serve as system-generated alerts sent to users, keeping them informed about updates or confirmations. Feedback allows users to share their experiences, which are then managed and addressed by admins.

The design also highlights the responsibilities of Admin and Gym Owner roles. Admins oversee the fitness schedule, manage user accounts, and handle feedback to ensure seamless operations and quality service. Gym owners manage appointments, confirming bookings and coordinating schedules effectively. This relational structure ensures data integrity, minimizes redundancy, and supports the platform's functionality, providing a robust framework for user interactions and system workflows.

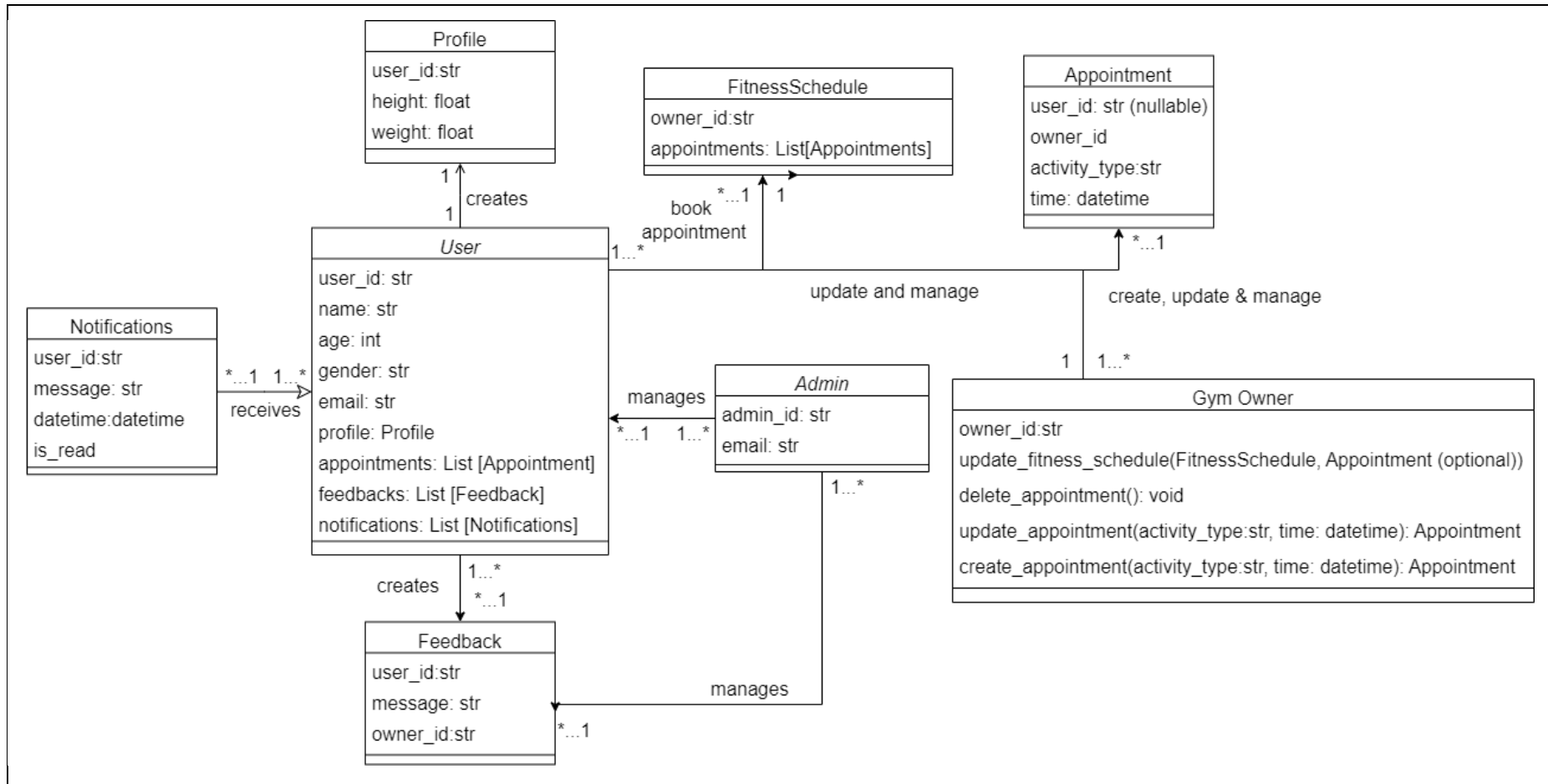


Figure 3.22 Database design for FitFusion

The data dictionary provides detailed metadata for the attributes used in the FitFusion application's database. It outlines critical information such as field names, data types, element lengths, and concise descriptions for each attribute across various data entities. Serving as a foundational

component of the database design, the data dictionary ensures clarity, uniformity, and ease of reference when managing and interacting with the application's data structures. **Table 3.12** presents the data dictionary, which documents the attributes for key entities in the FitFusion system, including Users, Gyms, Booked Gym Classes, Exercises, Notifications, Admins, and Gym Owners.

Table 3.12 Data dictionary

Data Store ID	Data Store Name	Data Store Description	Name	Description	Element Length	Type of Data	Example Format
D1	User	Store all user information	user_id	ID for user	15	String	U123
			name	Name of the user	100	Varchar	John Doe
			age	Age of the user	3	Integer	25
			gender	Gender of the user	10	Varchar	Male
			email	Email address of the user	50	Varchar	john.doe@example.com
D2	Profile	Store height and weight information for the user	user_id	ID for user (linked to User)	15	String	U123
			height	Height of the user	5	Float	175.5
			weight	Weight of the user	5	Float	70.0
D3	Fitness Schedule	Store fitness schedule information	owner_id	ID of the gym owner	15	String	GYM001
			appointments	List of appointments	-	List	[Appointment1, ...]
D4	Appointment	Store appointment details	user_id	ID of user (nullable)	15	String	U123
			owner_id	ID of the gym owner	15	String	GYM001
			activity_type	Type of activity	50	Varchar	Yoga
			time	Scheduled time	-	Datetime	2025-01-17 10:00:00
D5	Notifications	Store notification messages	user_id	ID of user receiving notification	15	String	U123
			message	Notification message content	255	Varchar	"Your session is booked"
			datetime	Notification sent date and time	-	Datetime	2025-01-17 09:00:00

			is_read	Whether the notification is read	1	Boolean	true
D6	Feedback	Store feedback information	user_id	ID of the user	15	String	U123
			message	Feedback message content	255	Varchar	"Great session!"
			owner_id	ID of the gym owner	15	String	GYM001
D7	Gym Owner	Store gym owner details and operations	owner_id	ID of the gym owner	15	String	GYM001
			update_fitness_schedule	Updates the fitness schedule	-	Function	-
			delete_appointment	Deletes an appointment	-	Function	-
			update_appointment	Updates an appointment	-	Function	-
			create_appointment	Creates a new appointment	-	Function	-
D8	Admin	Store admin information	admin_id	ID of the administrator	15	String	A001
			email	Email of the administrator	50	Varchar	admin@example.com

3.4.2.1 Architecture design

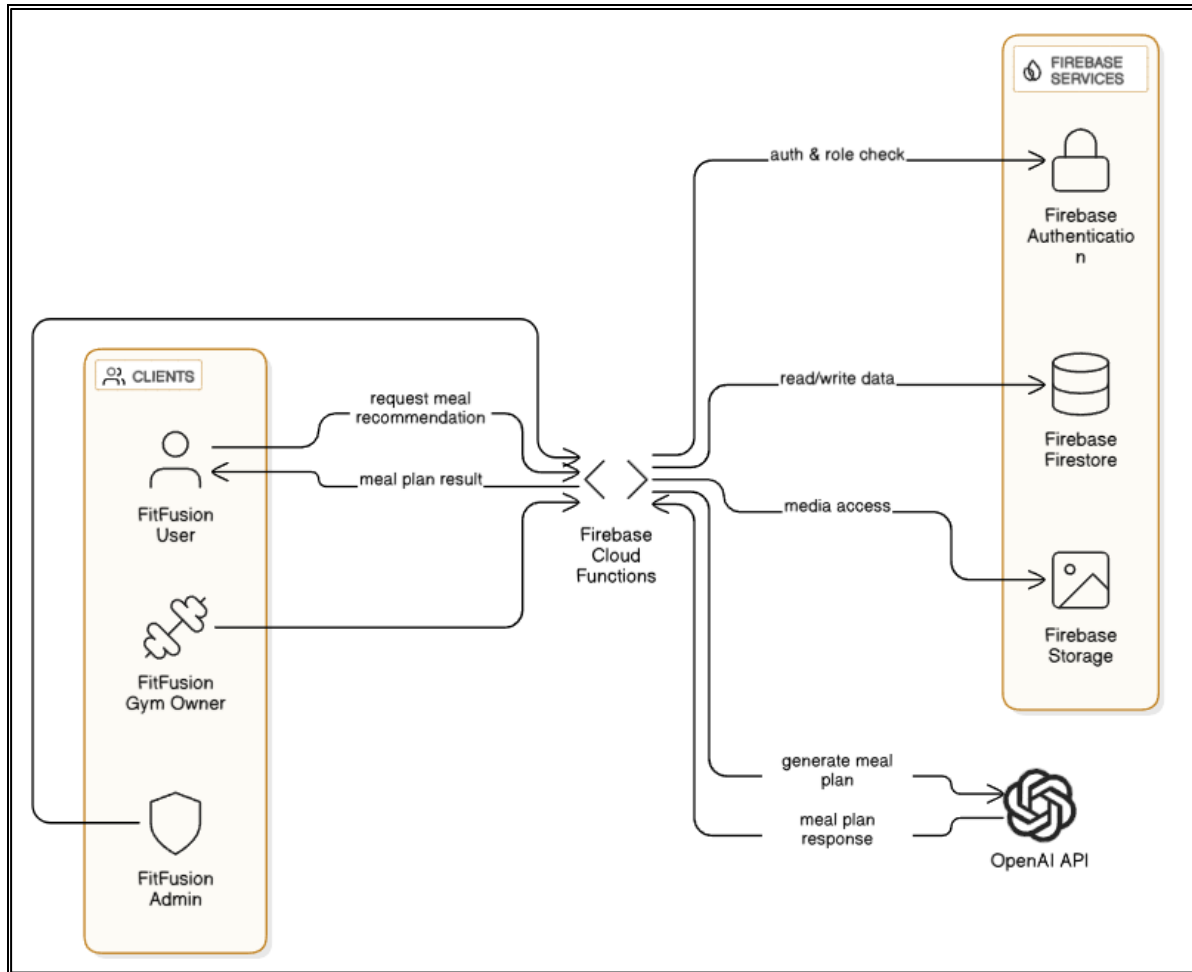


Figure 3.23 Architecture design for FitFusion

The FitFusion architecture is a cloud-native system built for intelligent automation and real-time responsiveness. Users, gym owners, and administrators interact with the platform through dedicated interfaces that connect to Firebase Cloud Functions, which serves as the backend engine orchestrating all core logic. Firebase Authentication manages secure access and role-based permissions, while Firestore acts as the real-time database for user data, gym activities, and class schedules. Media content such as images are handled via Firebase Storage. For personalized health experiences, FitFusion integrates with the OpenAI API to generate meal recommendations based on user preferences, processed through Cloud Functions. This architecture ensures a seamless and secure flow of data between users and services, delivering a personalized and efficient fitness platform experience.

3.4.3 User Interface Design

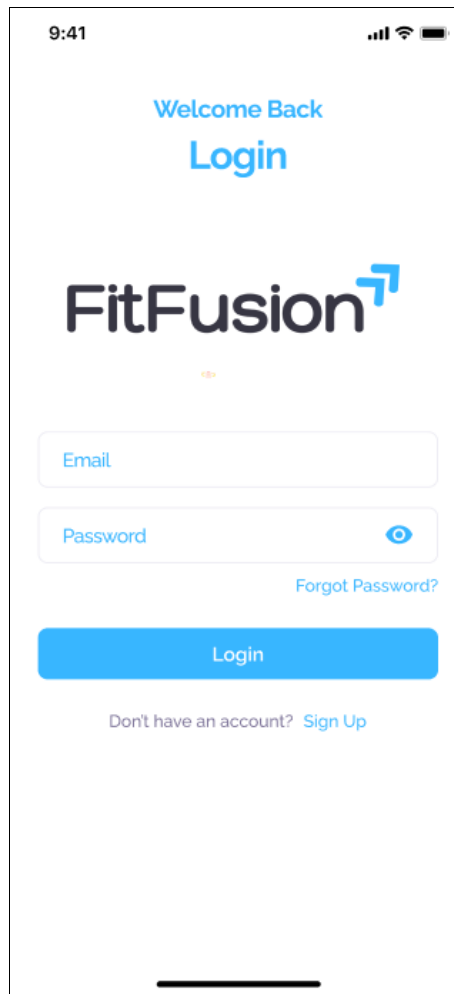


Figure 3.24 FitFusion login page

The login interface includes fields for email and password entry, with an option to reset the password if forgotten. A "Sign Up" link is available for new users, ensuring ease of access and usability.

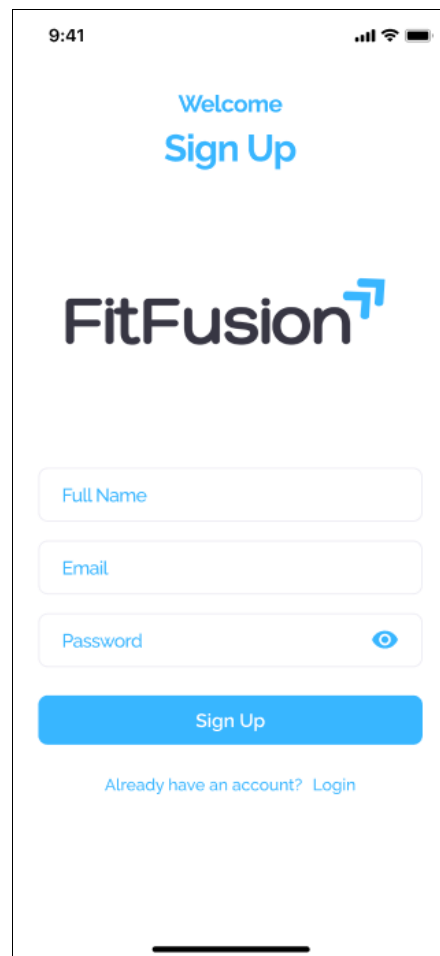
A mobile app sign-up screen for FitFusion. The screen has a white background. At the top, the status bar shows the time 9:41, signal strength, and battery level. Below the status bar, the text "Welcome" is in a small blue font, followed by "Sign Up" in a larger blue font. The FitFusion logo, consisting of the word "FitFusion" in black and a blue stylized "F" icon, is centered below the text. There are three input fields: "Full Name", "Email", and "Password". The "Password" field has a blue eye icon to its right. Below the input fields is a prominent blue button with the text "Sign Up" in white. At the bottom, there is a link that says "Already have an account? Login" in a small blue font. A black horizontal bar is visible at the very bottom of the screen, likely representing the home indicator on an iPhone.

Figure 3.25 FitFusion sign up page

The registration page allows new users to create an account by entering their full name, email, and password. The form is simple and well-organized, featuring a prominent "Sign Up" button and a link to log in for existing users, ensuring a seamless user experience.

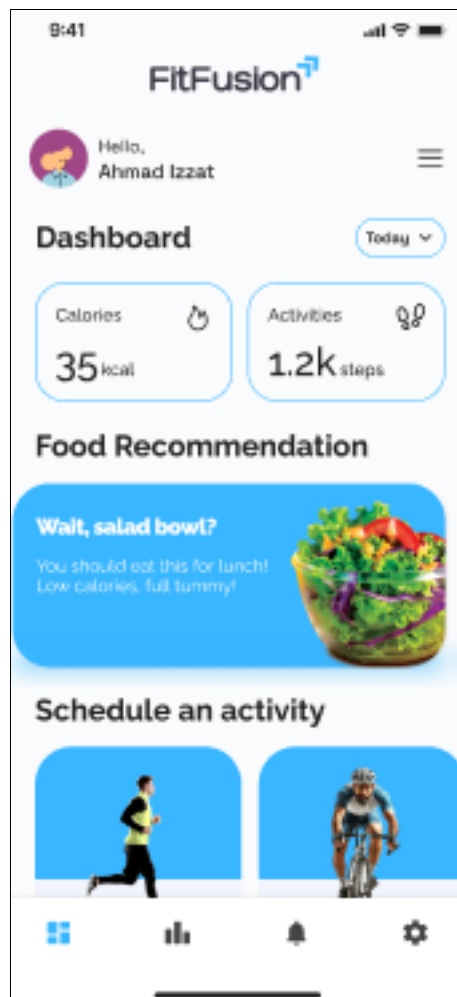


Figure 3.26 FitFusion home page

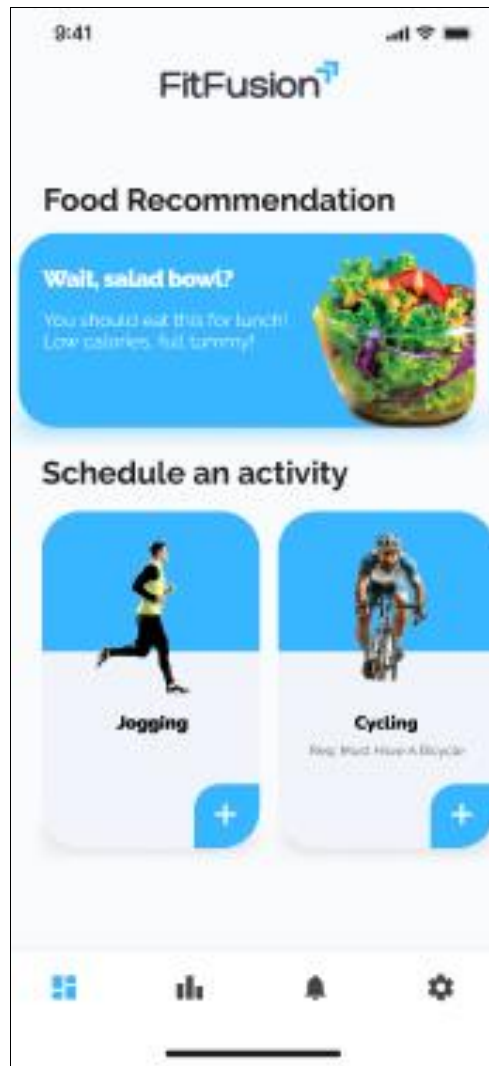


Figure 3.27 FitFusion home page (scrolled down)

The dashboard provides an overview of the user's health and fitness data, including calorie intake and daily activity steps. It features personalized food recommendations, such as meal suggestions, to promote healthy eating habits. Users can also schedule activities directly from the interface, ensuring convenient access to fitness management tools. The design is user-friendly, with intuitive navigation options and visually appealing graphics.

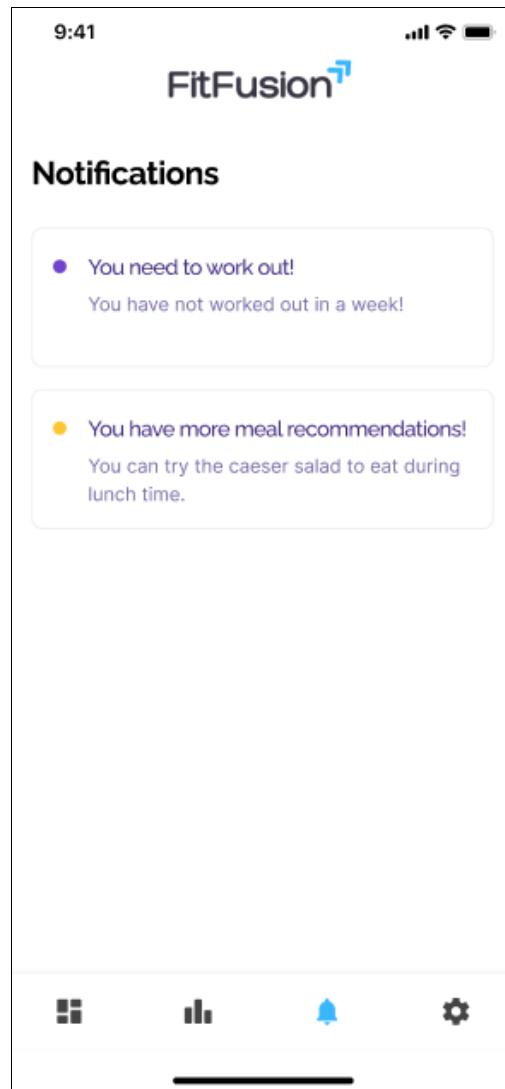


Figure 3.28 FitFusion notification page

The notifications page keeps users informed with reminders and updates, such as prompts to stay active and personalized meal suggestions. Each notification is clearly displayed with concise messages, ensuring users remain engaged and motivated. The design emphasizes readability and quick access to important information.

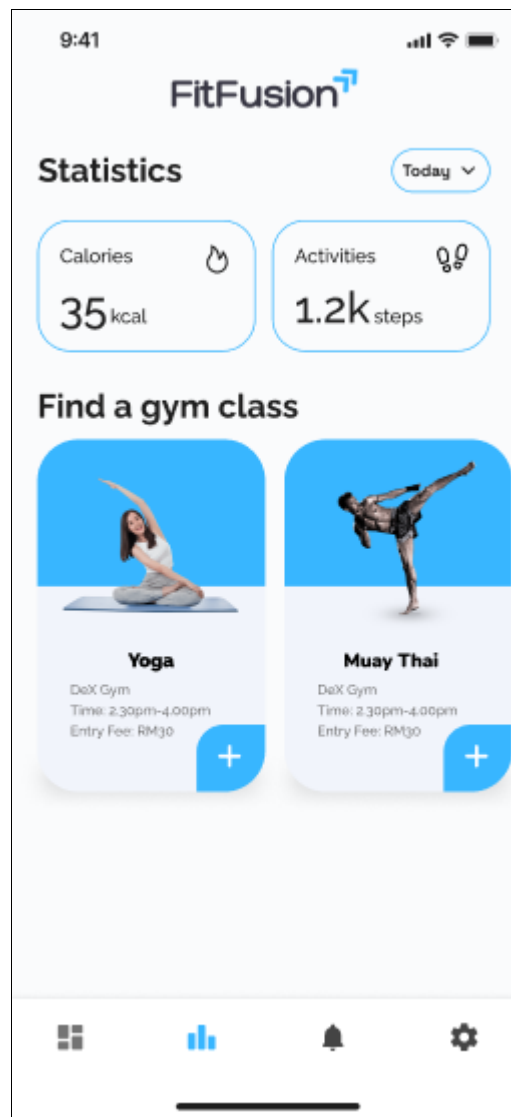


Figure 3.29 FitFusion statistics page

The statistics page provides an overview of daily calories burned and activities, helping users track their progress. Below, a "Find a Gym Class" section features options like Yoga and Muay Thai, including details such as time, location, and fees. The design is clean and user-friendly, making it easy to join fitness classes with a simple "+" button.

3.4 Summary

Chapter 3 discusses the requirement analysis and design of the proposed FitFusion system. User requirements were gathered through a questionnaire distributed to students at UNIMAS and analyzed to ensure the proposed system meets user needs. The functional and non-functional requirements were outlined to aid in designing the system's functionalities and interface. UML diagrams were created to provide a clearer understanding of the proposed system, including the use case diagram, sequence diagrams, module design, database design, and architecture design. This chapter also includes wireframes that were drafted to help visualize the system in a simple and comprehensible manner.

CHAPTER 4: IMPLEMENTATION

4.1 Introduction

This chapter presents the implementation phase of the FitFusion mobile application, detailing the transition from design to functional deployment. FitFusion is a personalized mobile health and wellness platform developed to assist users particularly young adults and university students in managing their fitness routines, dietary choices, and overall lifestyle habits. The app integrates AI-driven features to provide personalized meals and activity recommendations, along with two core fitness engagement features which are joining fitness activities and booking gym classes. These features serve different purposes in which joining fitness activities allows users to explore and participate in group workouts, while booking gym classes enables users to reserve slots for structured, scheduled sessions at nearby fitness centers. Both features were implemented to enhance user accessibility to physical activities and promote healthier, more active lifestyles.

Development followed the Agile methodology using Scrum principles, promoting iterative progress, adaptability, and user-focused enhancements. Each sprint focused on implementing and refining essential components such as secure login, AI recommendation logic, fitness class booking, and weekly progress tracking.

FitFusion's user interface was developed using Flutter, targeting Android platforms during the initial phase. The backend infrastructure leveraged Firebase, which provided user authentication, real-time database access, cloud storage, and notification services. To generate intelligent and context-aware meal suggestions, the application integrated the OpenAI API, which powered the AI recommendation module. This allowed the app to analyze user health data and preferences to return more human-like and relevant dietary advice, enhancing the system's personalization and responsiveness.

This implementation phase also prioritized modular code structure, clean UI/UX, and secure

data handling to ensure scalability and long-term maintenance. The sections that follow will describe the step-by-step development of FitFusion's major features, the technologies utilized, and the strategies adopted to transform the initial design concept into a working mobile solution.

4.2 Environment Setup

4.2.1 Figma

Figma was utilized in the FitFusion project to design clean, intuitive, and responsive user interfaces for the mobile application. Wireframes and high-fidelity mockups were created to map out the flow for essential features such as the homepage, meal recommendation screen, fitness activity booking, and progress tracking. Icons, color themes, and layouts designed in Figma were directly referenced and implemented in the Flutter frontend to ensure design consistency and enhanced user experience.

4.2.2 Flutter

Flutter was selected as the primary framework for developing the FitFusion mobile application. As a cross-platform UI toolkit developed by Google, Flutter allowed for a streamlined development process with a single codebase targeting Android. Its rich widget library enabled the creation of a modern, responsive interface that aligned with the Figma design mockups. Integration with Firebase was also simplified using prebuilt Flutter packages.

4.2.3 Firebase

Firebase served as the backend solution for FitFusion, providing authentication, cloud storage, Firestore database, and notification services. Firebase Authentication was used for secure user login and registration, while Firestore handled real-time data synchronization for meal tracking, user profiles, and booking information. Firebase Cloud Messaging (FCM) was implemented to send timely reminders and updates to users, supporting the app's goal of improving health habit consistency.

4.2.4 Android Studio

Android Studio was the sole integrated development environment (IDE) used during the implementation of FitFusion. It offered comprehensive tools for building and testing the application, including full support for Flutter and Dart. Android Studio was chosen for its compatibility with the Flutter SDK and its robust suite of debugging and layout inspection tools, which were essential in resolving interface and logic issues during development. The Android Virtual Device (AVD) feature was used extensively to emulate various Android devices and screen sizes, enabling real-time testing of the application's UI responsiveness, functionality, and compatibility across multiple environments.

4.3 System Module Implementation

The implementation of FitFusion's system modules was structured around three distinct user roles: students, gym owners, and administrators, each granted access to specific features based on their role. This role-based approach ensures that users interact only with functionalities relevant to their objectives. For example, students can receive AI-generated meal recommendations tailored to their dietary needs and health preferences and fitness activity recommendations based on their preferred body goals. These recommendations are powered by the OpenAI API, which processes user-input data such as fitness goals or dietary restrictions using natural language processing to return personalized, context-aware suggestions, especially for managing non-communicable diseases (NCDs).

Gym owners can create, update, and manage fitness class schedules, while also viewing participant data and responding to user reviews. Administrators are equipped with tools to manage user accounts, oversee system activities, and ensure content compliance. The system's backend logic leverages Firebase for authentication, data storage, and real-time synchronization, while logic for data processing and communication with AI services is handled through integrated cloud functions. All outputs shown to users are dynamically generated and reflect the most recent interactions and updates across the platform.

4.4 User Interface Design

The user interface (UI) for FitFusion was designed to be clean, intuitive, and accessible, ensuring that users of all backgrounds can easily navigate the application and interact with its core health and wellness features. The design prioritizes simplicity, clarity, and responsiveness across various screen sizes to provide smooth and efficient user experience.

4.4.1 Login

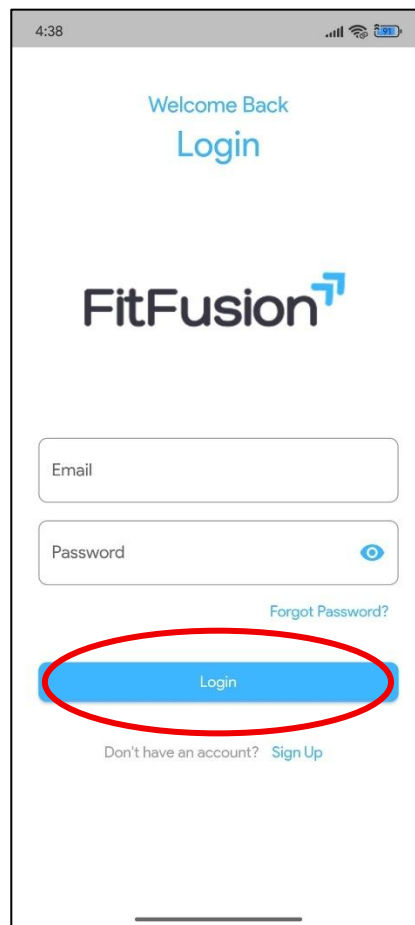


Figure 4.1 FitFusion login page

Login page of the FitFusion app that requires users to enter their email and password to sign in. Options for password recovery and new user registration are also available.

4.4.2 Register

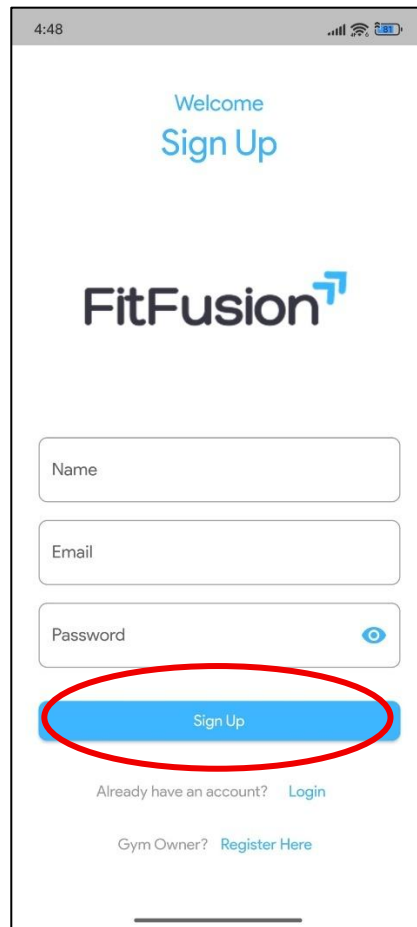


Figure 4.2 FitFusion sign up page

Registration page of the FitFusion app that requires users to enter their full name, email, and password to create a new account. The interface is clean and minimal, designed to guide new users through the sign-up process easily. A password visibility toggle is provided to ensure accuracy while entering the password. At the bottom of the screen, there is a prompt for users who already have an account, with a link that redirects them to the login page.

4.4.3 Homepage/Dashboard

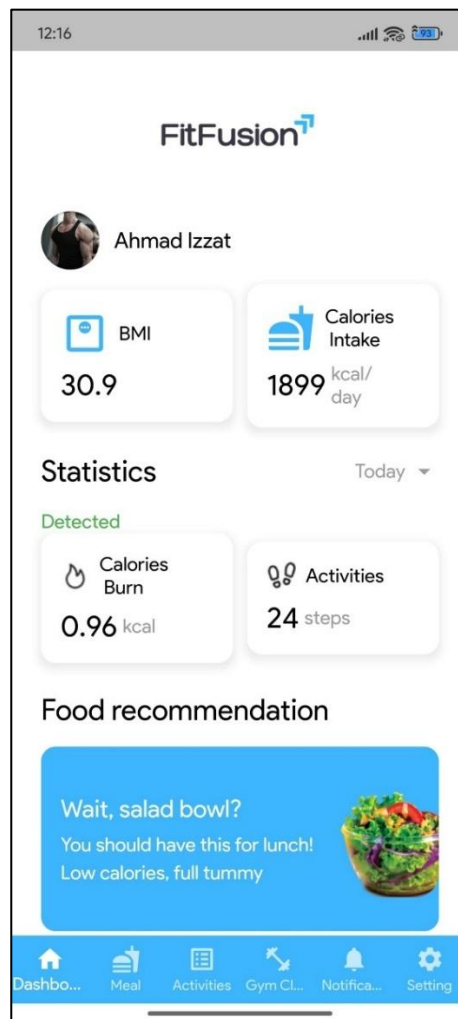


Figure 4.3 FitFusion homepage/dasboard

Homepage of the FitFusion app that provides users with a personalized fitness dashboard. It displays the user's name, profile picture, Body Mass Index (BMI), and total calories burned for the day. The “Statistics” section offers real-time tracking of calories burned and steps taken. Below that, users receive tailored food recommendations based on their activity levels and dietary goals, such as a prompt to have a salad for lunch. The clean layout and organized sections make it easy for users to monitor their health and fitness progress at a glance.

4.4.4 AI Meal Recommendations

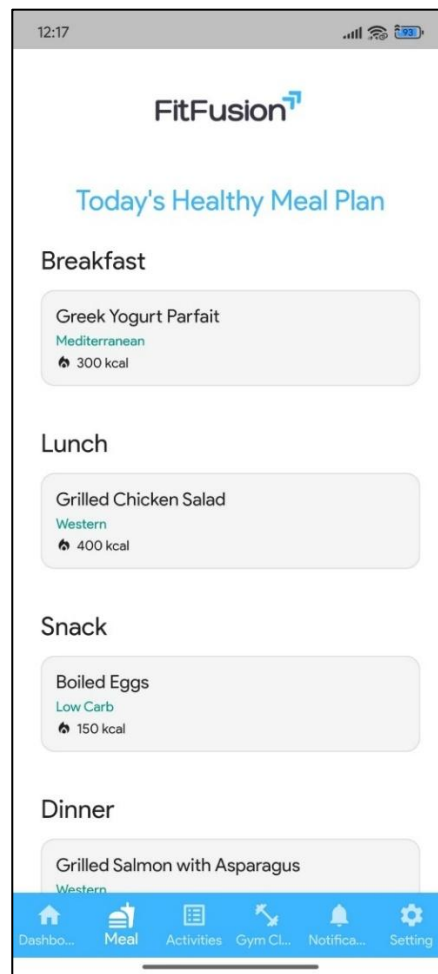


Figure 4.4 FitFusion AI meal recommendations page

The AI Meal Recommendations page of the FitFusion app delivers personalized meal suggestions based on each user's fitness goals and dietary preferences. These preferences are initially gathered through a questionnaire completed by users during the registration process, which captures information such as dietary restrictions, fitness objectives, and eating habits. The interface categorizes meals by time of day (e.g., Breakfast, Lunch, Dinner), helping users easily plan a balanced diet. Each recommendation includes a high-quality image, meal name, nutritional tags (such as "High Protein, Low Carb" or "Vegetarian, High Fiber"), and a total calorie count, enabling users to make informed dietary choices quickly and effectively.

The system sends the collected data to the AI model via Firebase Cloud Functions, which interprets the input and returns contextual, human-like meal suggestions. This implementation supports intelligent, real-time generation of meal plans aligned with health goals, particularly in managing non-communicable disease (NCD) risk factors.

4.4.5 Book Gym Classes

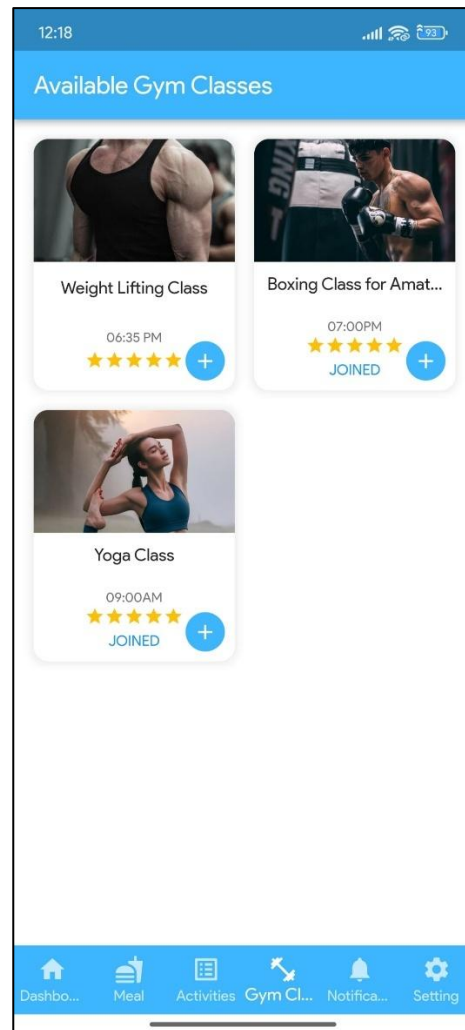


Figure 4.5 FitFusion gym class booking page

Book Gym Classes page of the FitFusion app allows users to browse and reserve available gym sessions. Each class card displays essential information such as the gym class name, time, and location. A plus icon on each card allows users to book a spot in their desired class with a single tap while displaying all the information regarding the gym class. The visually rich layout with

accompanying class images helps users make quick and informed decisions, enhancing the convenience of planning their workout schedules.

4.4.6 Join Fitness Activities/AI Fitness Activity Recommendations

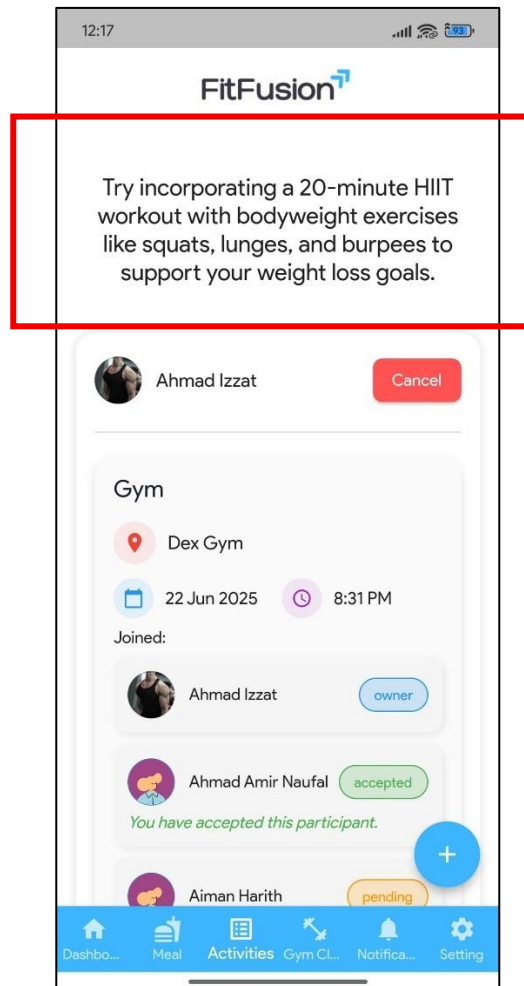


Figure 4.6 FitFusion activities page

The Join Fitness Activities page of the FitFusion app allows users to view and participate in scheduled exercise sessions organized by others. Each activity card displays the type of exercise (e.g., jogging), location, date, and time. Users can also see who created the session and who has already joined. A “Join” button is provided for users to request participation in open activities, with their status marked as pending until approved or rejected by the activity creator. A floating action button at the bottom right enables users to create and share new exercise sessions.

At the top of the page in Figure 4.6, a highlighted AI-powered recommendation section presents suggested fitness activities tailored to each user. These suggestions are based on data collected during registration, including body mass index (BMI), types of non-communicable diseases (NCDs) the user may be managing (e.g., diabetes, hypertension), and individual fitness goals. The AI feature utilizes the OpenAI API to recommend fitness activities that align with the user's BMI and desired body goals.

By analyzing this specific data provided during registration, the system generates personalized workout suggestions such as strength training for muscle gain or cardio sessions for fat loss. These intelligent recommendations help users discover more relevant exercises that suit their objectives, making it easier to stay motivated and committed to their fitness journey.

Below the AI recommendation, users can explore community-organized workout sessions. Each activity card displays essential details such as the type of exercise (e.g., jogging), location, date, and time. It also shows who created the session and the list of current participants. Users can tap the "Join" button to request participation, with their status shown as pending until the activity creator approves or rejects the request. Additionally, a floating action button at the bottom right corner allows users to create and share their own fitness sessions with the community.

4.4.7 Settings

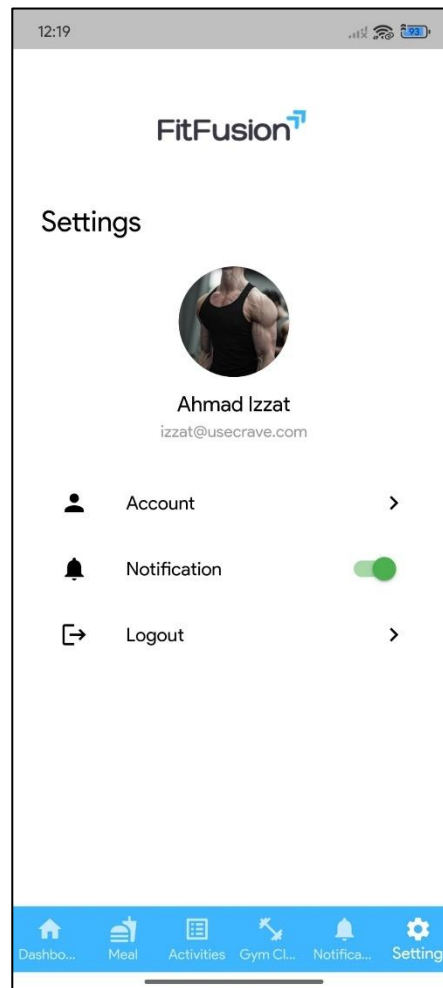


Figure 4.7 FitFusion settings page

Settings page of the FitFusion app provides users with access to their personal and app-related preferences. The page displays the user's profile picture, name, and email, along with an option to edit their profile photo. Users can manage their account settings, adjust notification preferences, and view a list of gyms they've joined. Additionally, a logout option is provided for secure sign-out. The layout is clean and user-friendly, offering easy navigation through key personalization and account management features.

4.4.8 Gym Owner Dashboard

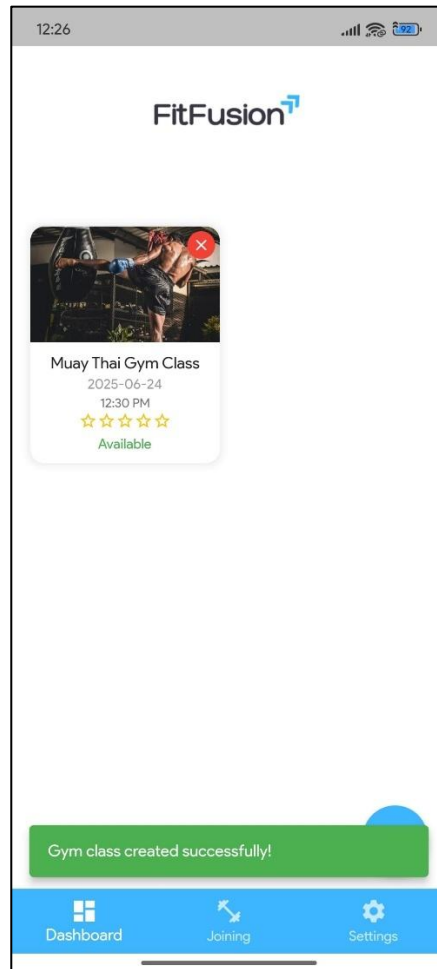
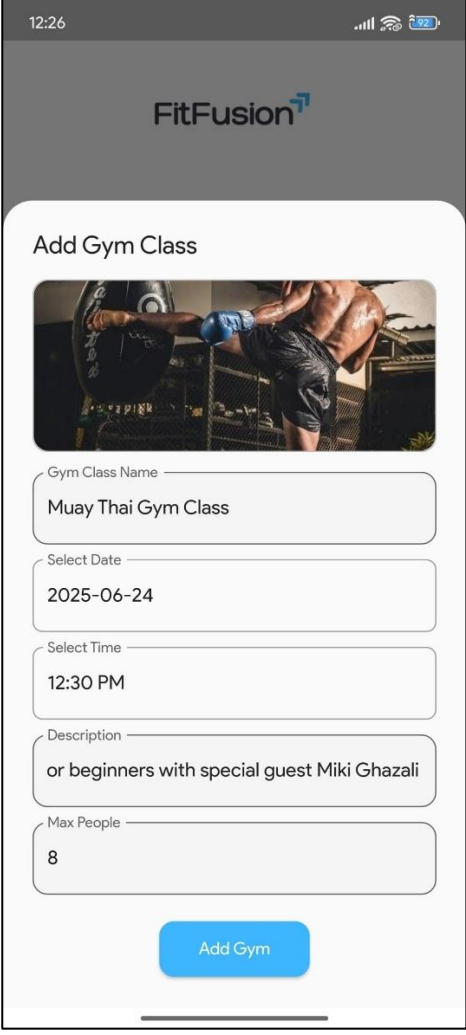


Figure 4.8 FitFusion gym owner dashboard

Gym Owner Dashboard of the FitFusion app enables gym owners to manage their scheduled classes efficiently. Each class card displays the name, time, and location of the session, accompanied by a background image that reflects the class type. Owners can delete a class instantly using the red “X” button located on the top-right corner of each card. A floating plus icon allows owners to add new classes. The bottom navigation bar provides quick access to the dashboard, join requests, and logout options, offering a seamless experience for gym owners to monitor and organize their offerings.

4.4.9 Add Gym Classes



The screenshot shows the 'Add Gym Class' form in the FitFusion app. At the top, the status bar displays the time 12:26, signal strength, Wi-Fi, and battery level at 92%. The app's logo, 'FitFusion', is centered at the top of the form. Below the title, there is a placeholder image of a person in a boxing stance. The form contains several input fields: 'Gym Class Name' with the text 'Muay Thai Gym Class', 'Select Date' with the date '2025-06-24', 'Select Time' with the time '12:30 PM', 'Description' with the text 'or beginners with special guest Miki Ghazali', and 'Max People' with the number '8'. A blue 'Add Gym' button is located at the bottom of the form.

Figure 4.9 FitFusion add gym classes page

Add Gym Classes page of the FitFusion app allows gym owners to create and publish new gym sessions. The form requires key details such as the gym class name, scheduled time, and address. An image upload option is also available, enabling owners to include a representative photo for the class. Once all fields are completed, the owner can tap the “Add Gym” button to make the class available for booking. This intuitive interface ensures a smooth and efficient process for adding new fitness offerings to the platform.

4.4.10 Admin Manage User

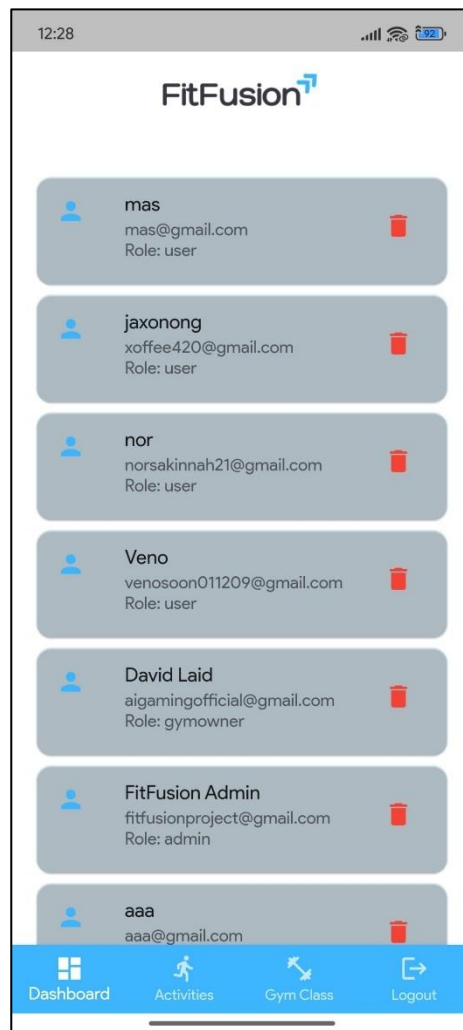


Figure 4.10 FitFusion admin dashboard

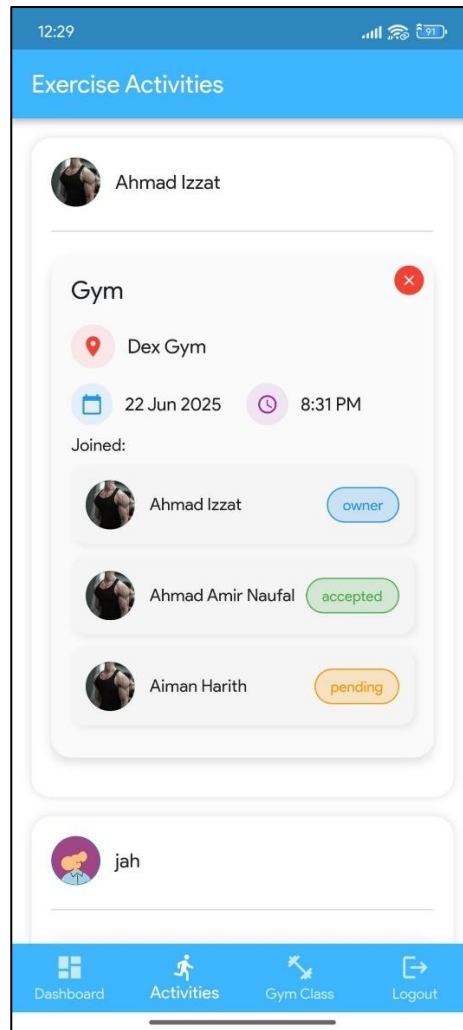


Figure 4.11 FitFusion admin manage activites page

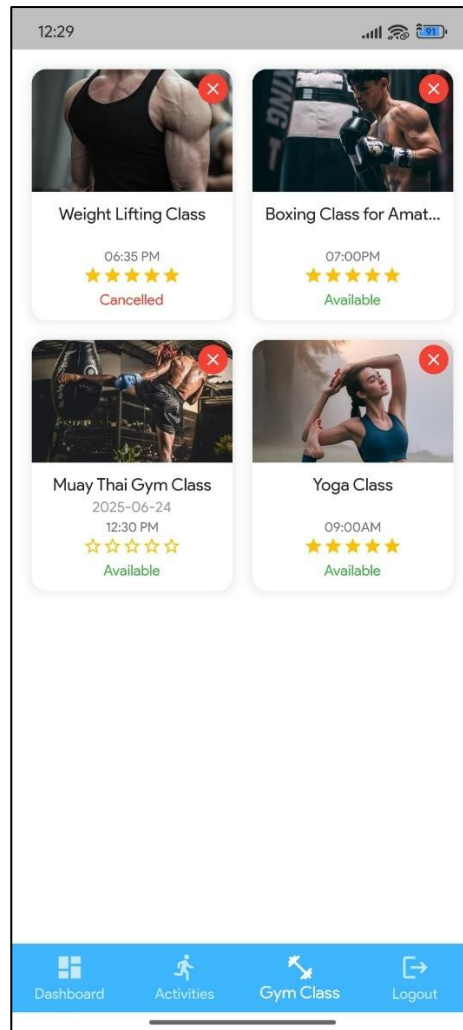


Figure 4.12 FitFusion admin manage gym class page

Admin Manage User page of the FitFusion app provides administrative users with the ability to oversee and manage all registered accounts. Each entry in the list displays the user's name, email, and assigned role. A red trash bin icon next to each user allows admins to remove accounts when necessary. The streamlined interface ensures easy monitoring and quick action for account management. Navigation tabs at the bottom of the screen offer access to the admin dashboard, user management panel, and logout option, supporting efficient administrative control within the app.

4.5 Summary

The implementation phase successfully translated the FitFusion mobile application from concept to a working prototype by focusing on the development of three key modules: the AI-powered meal recommendation system, the fitness activity participation feature, and the gym class booking functionality.

The AI meal recommendation engine was implemented using a content-based filtering approach to generate personalized meal suggestions based on users' health profiles, dietary preferences, and fitness goals. This core feature enables users to make informed nutritional decisions tailored to their needs, reinforcing the app's focus on preventive health.

The fitness activity suggestion module was developed to provide users with appropriate workout options, filtered by intensity level, activity type, and personal health conditions. It enhances user engagement by promoting regular physical activity that aligns with their lifestyle and wellness objectives.

Additionally, the gym class booking system was integrated to allow users to search for fitness facilities and reserve available sessions in just a few taps. This functionality improves convenience and accessibility, removing common barriers to exercise participation.

By leveraging Flutter and Firebase, the implementation ensured seamless performance, real-time data handling, and a responsive mobile interface. These modules collectively form the core of FitFusion, setting a strong foundation for further testing, refinement, and real-world application.

CHAPTER 5: TESTING

5.1 Introduction

This chapter presents a detailed evaluation of the FitFusion mobile application, emphasizing the testing and validation of its core functionalities: AI-driven meal recommendations, fitness activity engagement, and gym class booking. The testing process was structured into several phases to ensure the system's reliability, responsiveness, and usability.

The first phase involved functional testing, which aimed to confirm the accuracy and consistency of the AI meal recommendation engine based on user input such as dietary goals and health preferences. Additionally, the workflows for discovering and joining fitness activities, as well as booking sessions at gyms, were thoroughly tested to ensure seamless navigation and feature integration.

User acceptance testing (UAT) was carried out with a sample of university students to assess the practical usability of the app in supporting daily health routines. Test participants evaluated how effectively the app assisted them in choosing meals, participating in fitness activities, and booking exercise sessions. Feedback from this phase was used to refine the user interface and improve feature clarity.

The results from all testing phases confirm FitFusion's value as a user-centric wellness tool. The successful implementation of these key features positions the app as a promising platform for encouraging healthier lifestyles among students and young adults.

5.2 Functional testing

Functional testing was conducted to verify that each module of the FitFusion system operates as expected. The following tables outline the test cases executed for each module to ensure that all features function correctly and meet the intended requirements.

Table 5.1 Functional testing results for the Login module.

Module: Login Test objective: To ensure that registered users can securely access the system using valid login credentials, and that appropriate error messages are displayed for invalid attempts.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_LOGIN_001	Verify login functionality	Enter valid Email and valid Password	User must have a registered account	1. Enter Email 2. Enter Password 3. Click 'Login'	1. Email: izzat@usecra ve.com 2. Password: Bigboldhead 02	User is logged in successfully	Homepage is displayed	As expected	Pass
TC_LOGIN_002		Enter valid Email and invalid Password	User must have a registered account	1. Enter Email 2. Enter Password 3. Click 'Login'	1. Email: izzat@usecra ve.com 2. Password: 111111	Error message is displayed	User stays on login page	As expected	Pass
TC_LOGIN_003		Enter invalid Email and valid Password	User must not be registered in system	1. Enter Email 2. Enter Password 3. Click 'Login'	1. Email: fitfusion1234 2. Password: Bigboldhead 02	Error message is displayed	User stays on login page	As expected	Pass

				3. Click 'Login'					
TC_LOGIN_004		Enter invalid Email and invalid Password	User must not be registered in system	1. Enter Email 2. Enter Password 3. Click 'Login'	1. Email: fitfusion1234 2. Password: 111111	Error message is displayed	User stays on login page	As expected	Pass

Table 5.2 Functional testing results for the Registration module.

Module: Registration Test objective: To validate that new users can successfully create accounts by providing the required information, and that all input fields are properly validated for completeness and format.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_SIGNUP_001	Verify user registration	Enter name, email, and valid password	User is not registered	1. Enter Name 2. Enter Email 3. Enter Password 4. Click 'Sign Up'	1. Name: Ahmad Izzat 2. Email: ahmadizzat1441@gmail.com 3. Password: Bigboldhead02	Account is created	Redirected to login page	As expected	Pass
TC_SIGNUP_002	Verify validation	Leave all fields empty	None	1. Leave all fields empty	Empty inputs	Error messages	Still on sign-up page	As expected	Pass

				2. Click 'Sign Up'		displayed			
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Table 5.3 Functional testing results for the AI Meal Recommendation module.

Module: AI Meal Recommendations Test objective: To validate that the system generates personalized meal suggestions based on the user's activity data (e.g., calories burned, BMI), and that recommendations are clear, accurate, and relevant to the user's health goals.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_MEAL_001	Verify meal recommendation generation	Request personalized meals after activity	User has valid profile and activity data	1. Open Meal Recommendations page from navigation bar	User BMI : 22.5	Recommended meals are shown for each time of the day (eg. Breakfast, Lunch and Dinner)	Meal suggestion is visible on the Meal Recommendations page	As expected	Pass

Table 5.4 Functional testing results for the Book Gym Class module.

Module: Book Gym Class Test objective: To confirm that users can browse available gym classes and successfully book sessions, and that the booking status and class details are accurately reflected.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_BOOK_001	Verify booking functionality	Book an available gym class	User is logged in	1. Navigate to classes 2. Click '+' on class card	Weightlifting Class 06:35 PM	Class is booked	Confirmation message shown	As expected	Pass
TC_BOOK_002	Check duplicate booking	Attempt to book the same class again	Class is already booked	1. Click '+' on already booked class	Weightlifting Class	Error shown or booking denied	No duplicate entry made	As expected	Pass

Table 5.5 Functional testing results for the Join Fitness Activity module.

Module: Join Fitness Activity Test objective: To verify that users can request to join fitness activities organized by others, and that the request system updates the status correctly based on acceptance or rejection by the activity owner.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_JOIN_001	Request to join an activity	Click 'Join' on an activity	User is logged in	1. Click 'Join' on activity card	Jogging @ UNIMAS	Status: Pending	User request listed under pending	As expected	Pass
TC_JOIN_002	Verify approval	Activity owner accepts the request	Request pending	1. Activity owner reviews request 2. Click 'Accept'	Accept	User status updated to 'Joined'	Request removed from pending	As expected	Pass
TC_JOIN_003	Verify rejection	Activity owner rejects the request	Request pending	1. Activity owner reviews request 2. Click 'Reject'	Reject	User status updated to 'Rejected'	Request removed from pending	As expected	Pass

Table 5.6 Functional testing results for the Settings/Profile module.

Module: Settings/Profile Test objective: To test that users can view and modify their profile information, manage account settings, and ensure changes are correctly saved and reflected throughout the app.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_PROFILE_001	Edit user profile	Change profile picture and name	User is logged in	1. Navigate to settings 2. Select Account 3. Click on the picture 4. Choose profile picture 5. Save changes	New Image	Profile updated	Changes reflected in profile	As expected	Pass
TC_PROFILE_002	Edit username	Change only the username	User is logged in	1. Navigate to settings 2. Select Account 3. Edit name field 4. Save changes	New username	Username is successfully updated	Changes reflected in profile	As expected	Pass
TC_PROFILE_003	Edit user password	Change user password	User is logged in and knows password	1. Navigate to settings 2. Select Account	New Password	Password is successfully changed	Users must use new password on next login	As expected	Pass

				3. Edit the password field 4. Enter new password5. Save changes					
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Table 5.7 Functional testing results for the Admin Manage Users module.

Module: Admin Manage Users Test objective: To ensure that admins can view, manage, and delete user accounts as necessary, with correct role-based access control and user list updates.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_ADMIN_001	Delete a user	Click delete on a listed user	Admin logged in	1. Open Dashboard 2. Click delete icon	Press 'X'	User removed	User no longer in list	As expected	Pass

Table 5.8 Functional testing results for the Gym Owner Add Class module.

Module: Gym Owner Add Class Test objective: To confirm that gym owners can create, manage, and delete gym class listings, and that the classes are correctly displayed to users for booking.									
Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
TC_OWNER_001	Add a new gym class	Fill form and click Add	Owner logged in	1. Fill class name, time, location 2. Upload image 3. Click Add Gym	Yoga Class 09:00 AM Kuching	Class added	Visible in class list	As expected	Pass

5.3 Non-Functional Testing

Non-functional testing was conducted to assess FitFusion in terms of usability, responsiveness, performance, and interface reliability. Key areas tested included button functionality, screen load times, AI response performance, and user satisfaction. Results showed high stability and positive user feedback, with minor delays observed in AI-driven modules, indicating areas for further optimization.

Table 5.9 Non-functional testing results.

Test Case ID	Test Scenario	Test Case	Pre-conditions	Test Steps	Test Data	Expected Results	Post Conditions	Actual Results	Status (Pass/Fail)
NF T-01	Usability: Interface Responsiveness	Verify button and icon functionality across the app	User is logged in to the app	1. Navigate to each module 2. Tap buttons and icons	Tap on: “Book Now”, “Join Activity”, “Get Meal”, “Edit Profile”, “Logout”	Each button/icon responds instantly and performs its action	User navigates smoothly; no broken or unresponsive elements	All UI elements responded as intended	Pass
NF T-02	Performance: General System Responsiveness	Test load time for login and navigation	Fresh app installation	1. Launch FitFusion 2. Log in 3. Switch between tabs	Email: fitfusiontestuser@gmail.com Password: Fitfusiontester123	Login and screen navigation complete within 2 seconds	Dashboard or selected tab loads correctly	Navigation and login within expected time	Pass
NF T-03	Performance: AI Meal Recommendation	Measure load time for AI meal suggestions	User is logged in and meal setup is complete	1. Open Meal Recommendation 2. Tap “Get Recommendation”	Preferences: Low-carb Tap on “Get Meal”	AI response appears within 3 seconds	Meal plan is shown based on input	Load time took ~4s on some devices	Fail
NF T-04	Reliability: Core Feature Stability	Confirm booking and activity modules	User has an active account	1. Book gym class 2. Join activity 3. Check profile	Select “Yoga Class”, “HIIT Group Activity”, open “Profile”	All features execute without crash or error	Data updates correctly (booking saved,	No crashes; all functions operated as expected	Pass

		work reliably					profile loaded)		
NF T-05	Performance: System Freezing	Detect delays or freezing during extended use	App is running on Android 10+	1. Use app for 15 mins 2. Switch rapidly between modules	Tap continuously on: Meal → Profile → Class Booking → Back	No freezing or UI hangs; actions remain smooth	App remains responsive under stress	Minor delay in AI module; other areas stable	Partial Pass
NF T-06	Usability: UI/UX Clarity	Assess navigation and label clarity	New user opens app for the first time	1. Try to book class and view profile without instructions	Inputs: Tap “Book Gym”, “My Profile”, “Join Activity”	User understands interface without confusion	Tasks completed without assistance	UI was generally clear; small improvements suggested	Pass

5.3.1 User Acceptance Testing

The user acceptance testing (UAT) for FitFusion aimed to assess how well the system fulfilled its non-functional requirements. A structured Google Form was used for data collection, designed with both open-ended and close-ended questions to gather user feedback. Several items used a linear scale (1 to 5) to evaluate user satisfaction and perception.

Participants were selected based on their roles, consisting of 10 general users, 5 gym owners, and 1 administrator. They were first asked to experience the FitFusion mobile application by exploring its core features such as registration, login, gym booking, and AI meal recommendations. After using the app, they completed the questionnaire to provide structured feedback.

The evaluation focused on key non-functional aspects such as interface usability, ease of navigation, system responsiveness, and compatibility with Android devices. Respondents rated clarity and simplicity in navigation to assess the system's user-friendliness. System speed was also measured, aiming to meet a benchmark of under 2 seconds for standard actions.

In addition, users shared their views on data security through the login system and provided suggestions for improvement via open-ended responses. This approach enabled a comprehensive review of the system's quality attributes and highlighted potential areas for future refinement.

a) General User

Close-Ended Questions

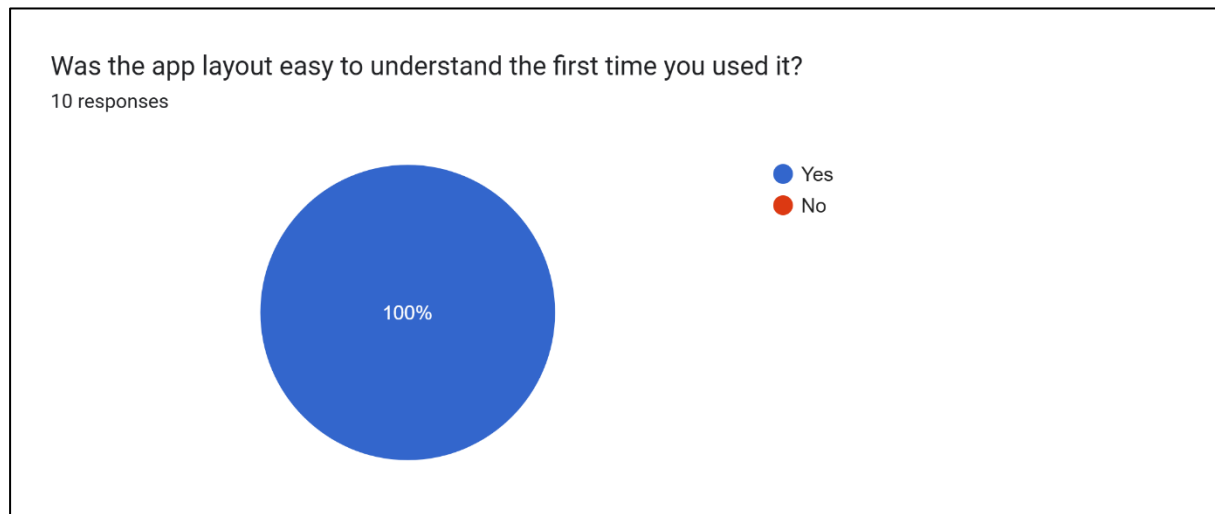


Figure 5.1 Pie chart illustrating user responses regarding the ease of understanding the app layout upon first use.

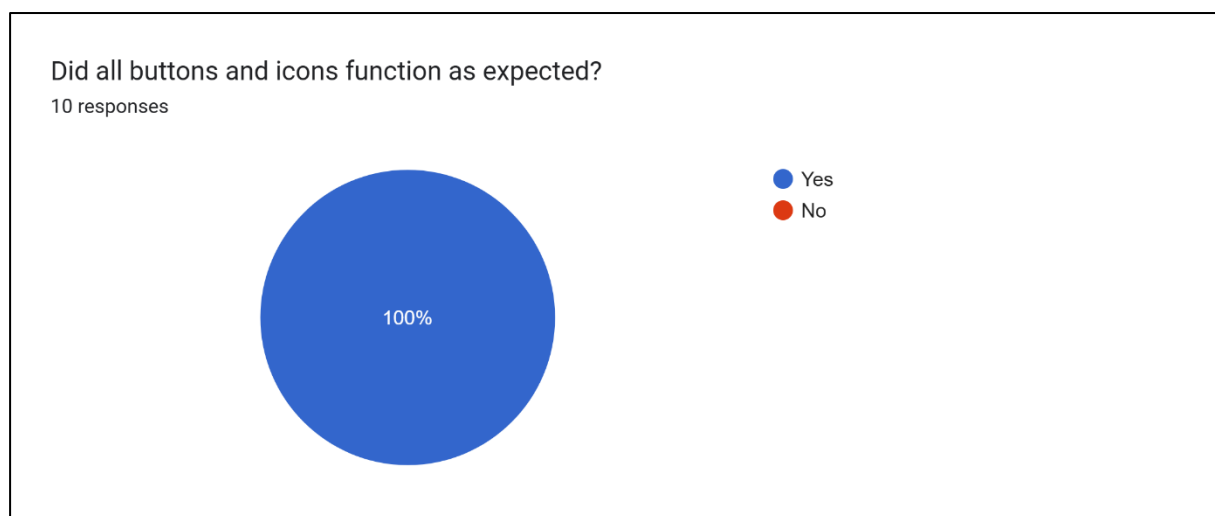


Figure 5.2 Pie chart demonstrating user feedback on whether all buttons and icons functioned as expected.

All users confirmed that the buttons and icons in the system functioned correctly and as expected. This indicates a high level of interface stability and reliability, which aligns with the non-functional requirement that the system must provide a user-friendly and intuitive interface. The result confirms that users experienced no interface-related issues while interacting with the app's controls, contributing to a smooth and error-free experience.



Figure 5.3 Pie chart depicting user responses to the system's responsiveness for actions such as login and navigation, with a focus on load times.

Most users (90%) reported that the system was responsive, completing actions such as login and navigation within the expected 2-second window. However, one user highlighted a slower load time specifically within the AI Meal recommendation and fitness recommendation feature. This suggests that while the system overall meets the non-functional requirement for performance speed, there is room for optimization in areas involving AI-based or data-intensive components. Addressing this lag would help ensure consistency across all modules.

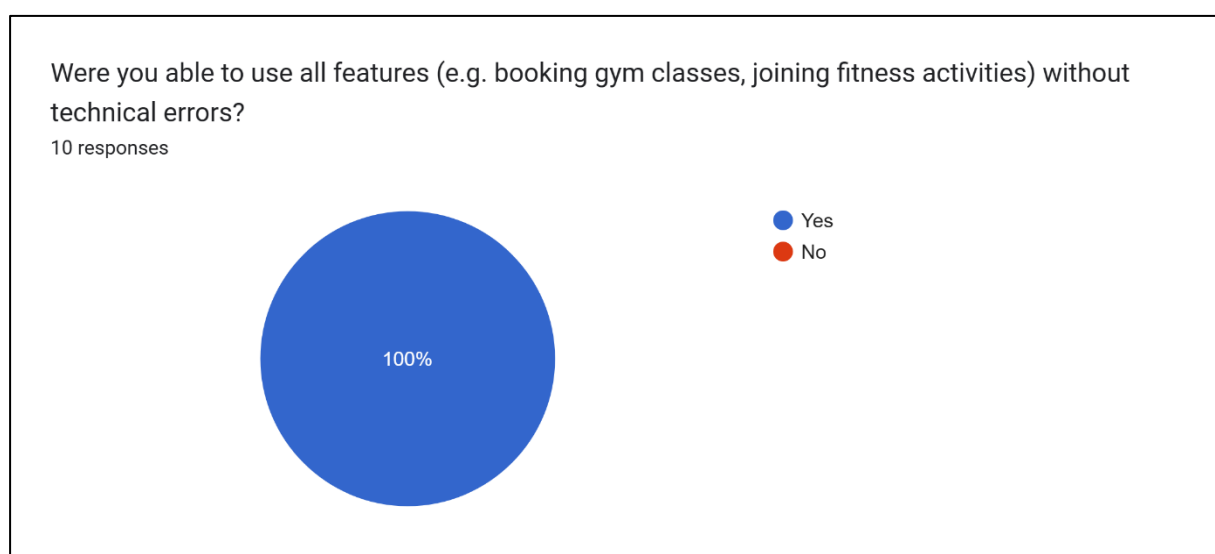


Figure 5.4 Pie chart illustrating user feedback on the ability to use all features (e.g., booking gym classes, joining fitness activities) without encountering technical errors.

All respondents confirmed they were able to access and use key features of the system without encountering technical errors. This result demonstrates strong system stability and functional reliability, aligning with non-functional expectations for seamless feature access and robust error handling. It indicates that the core functionalities such as class booking and fitness activity participation are well-implemented and stable in real-world use.

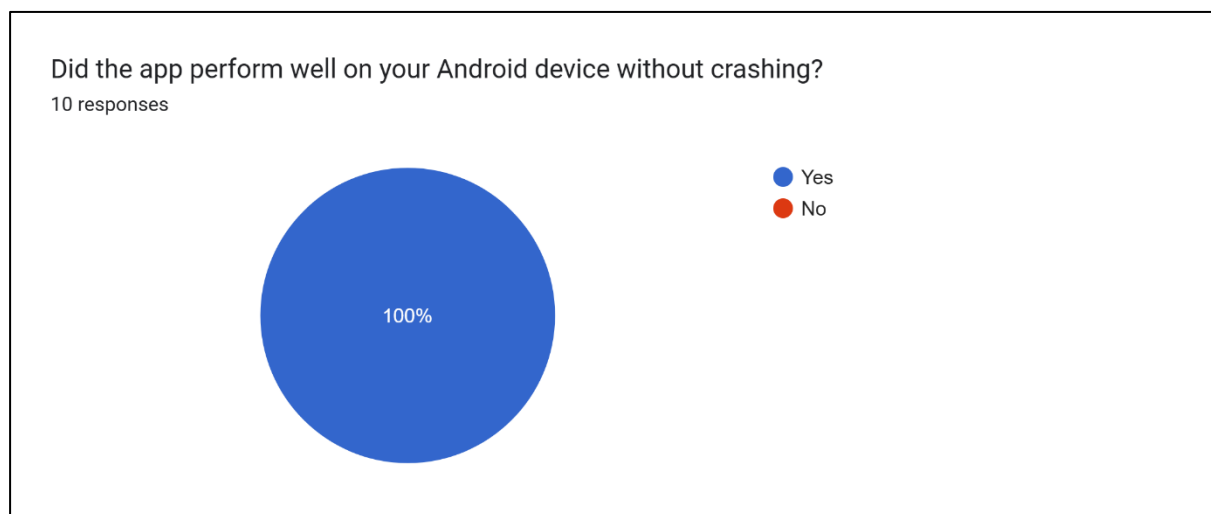


Figure 5.5 Pie chart showing user responses on the app's performance on Android devices, specifically addressing the absence of crashes. All users reported that the app functioned reliably on their Android devices without experiencing any crashes. This result strongly supports the non-functional requirement that the application should be compatible with Android platforms and maintain operational stability during use. The consistent positive feedback confirms that the app delivers a dependable experience across different Android environments, contributing to overall user confidence and satisfaction.

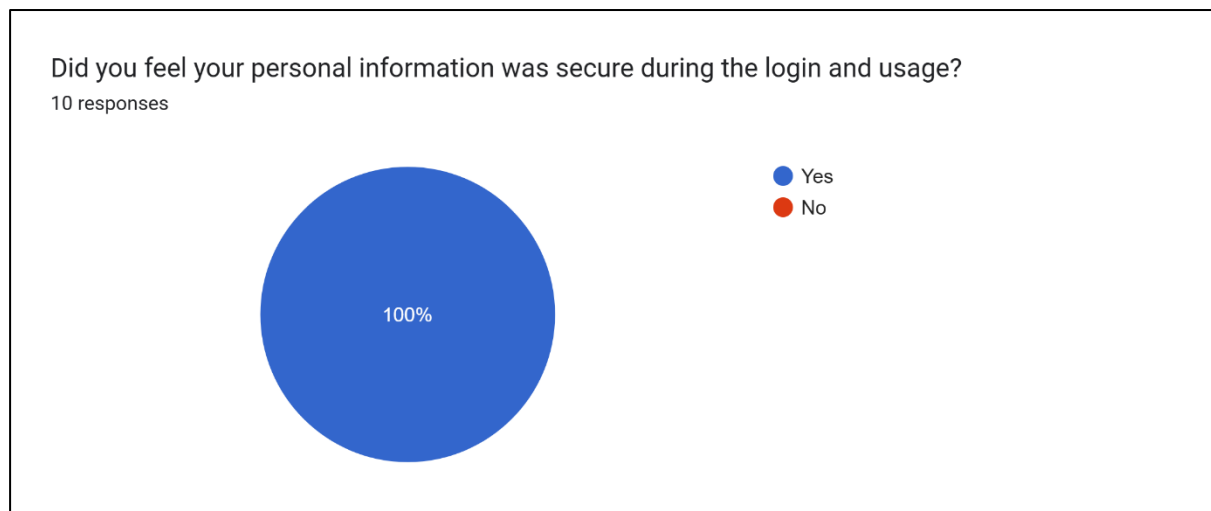


Figure 5.6 Pie chart displaying user perceptions of personal information security during app login and usage.

All respondents reported feeling that their personal information was secure throughout their interaction with the app, particularly during login and general usage. This feedback directly supports the non-functional requirement that the system must protect user data through secure login mechanisms. It also reflects user confidence in how the system manages and safeguards sensitive information, an essential aspect of trust and usability in any digital platform.

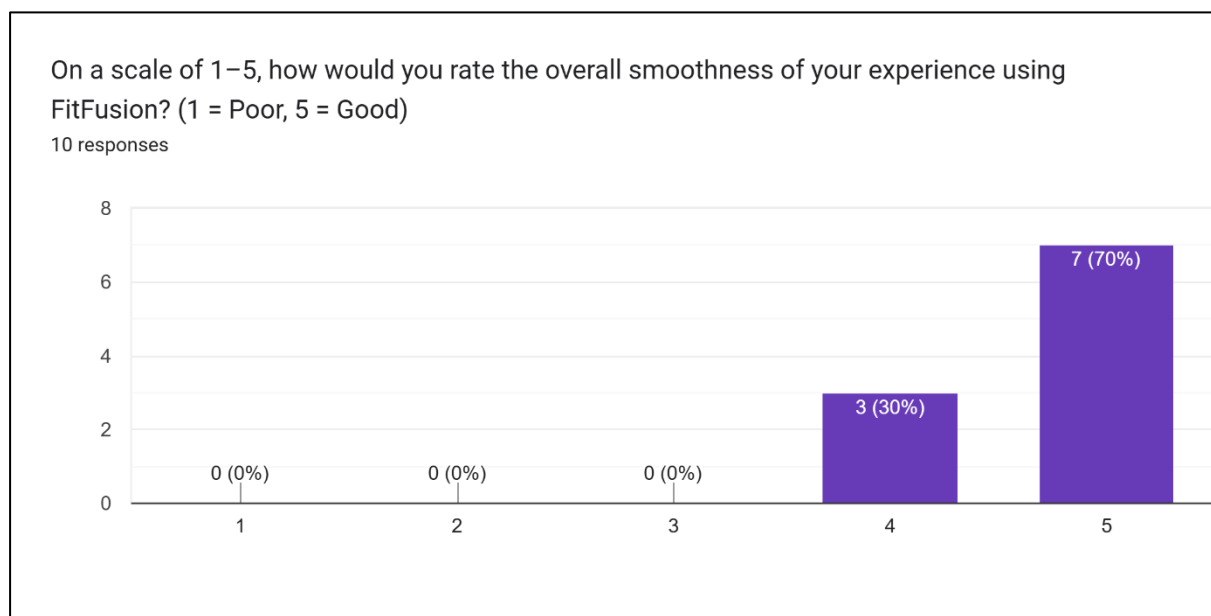


Figure 5.7 Bar chart illustrating user ratings of the overall smoothness of their experience using FitFusion
Most users (70%) rated their overall experience with FitFusion as excellent, while the

remaining 30% rated it as good. No negative ratings were reported. This indicates a high level of satisfaction with how smoothly the system performs, covering aspects such as navigation, responsiveness, and reliability. These results confirm that the system fulfills non-functional requirements related to usability, responsiveness, and general user experience, demonstrating its effectiveness in delivering smooth interactions for users.

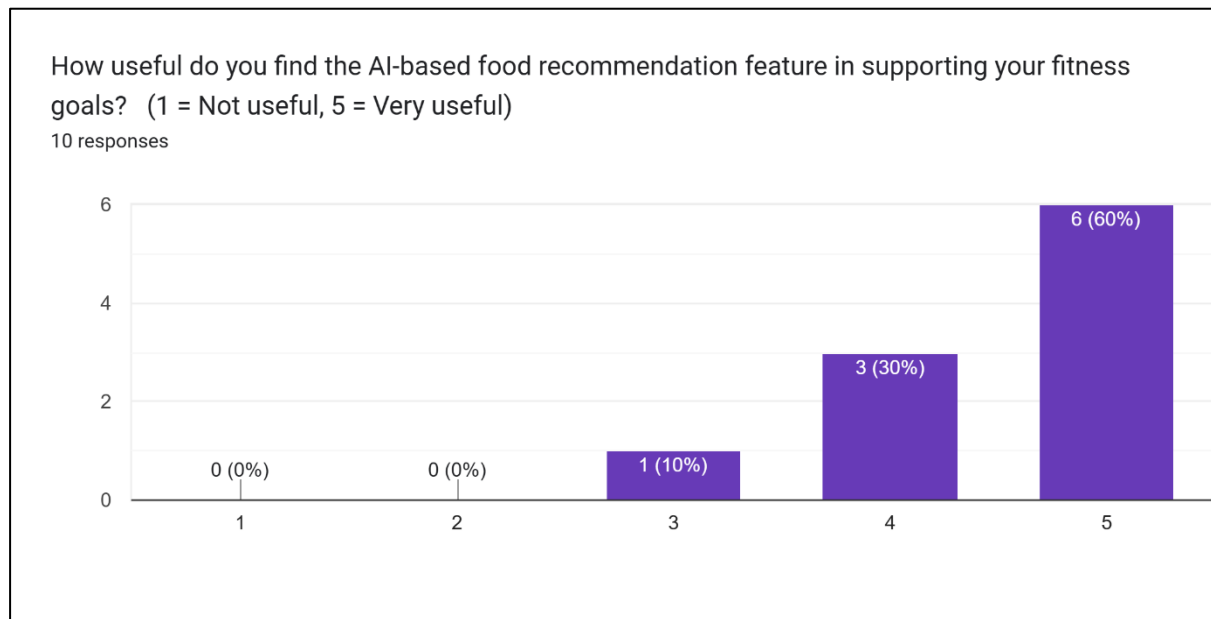


Figure 5.8 Bar chart displaying user ratings of the usefulness of the AI-based food recommendation feature in supporting fitness goals.

Most users (90%) rated the AI-based food recommendation feature as either useful or very useful, indicating strong acceptance and perceived value. This positive reception supports the relevance of the feature in helping users align their dietary choices with fitness goals. The result affirms that the AI integration is well-received and meets user expectations for smart assistance, fulfilling the non-functional requirement of offering intelligent, goal-oriented support in a user-friendly manner.

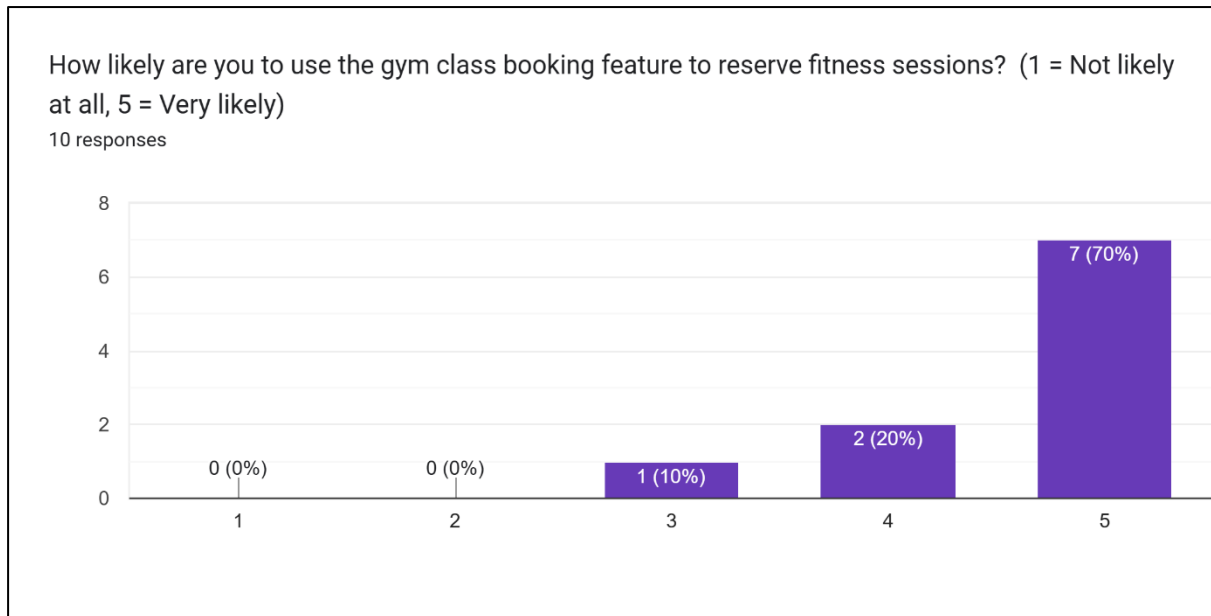


Figure 5.9 Bar chart illustrating user likelihood to use the gym class booking feature to reserve fitness sessions

The results show that most users (90%) are likely or very likely to use the gym class booking feature, with a strong 70% selecting the highest likelihood rating. This demonstrates that the feature resonates with user needs and expectations, supporting the system's objective of simplifying gym participation and class management. The high interest and usability perception validate the design of this feature and aligns with the non-functional requirements regarding usefulness, ease of access, and future user engagement potential.

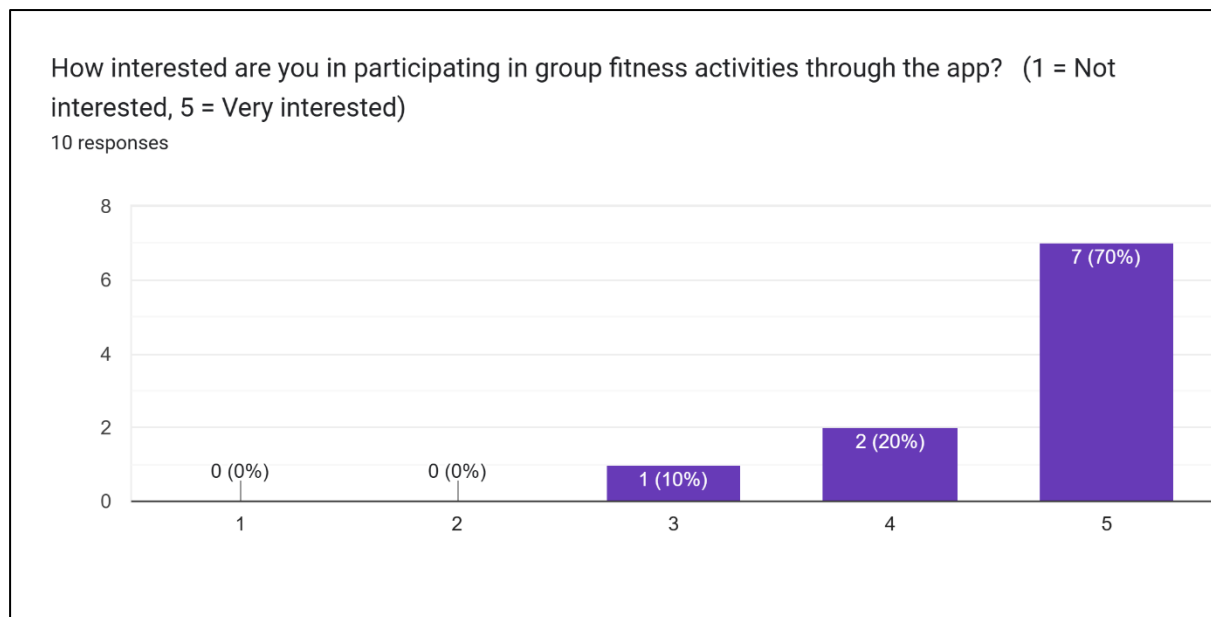


Figure 5.10 Bar chart displaying user interest in participating in group fitness activities through the app

A combined 90% of respondents expressed strong interest in using the app to join group fitness activities, with 70% rating their interest at the highest level. This indicates a clear user demand for socially engaging workout features, reinforcing the value of including group-based functionality in the app. These findings support the non-functional requirement for delivering engaging and community-oriented user experiences and suggest that the group fitness module is well-aligned with user motivations and lifestyle preferences.

Open-Ended Questions

Question 1: What features did you find easiest to use, and why?

What features did you find easiest to use, and why?

10 responses

- Participating in group fitness
- Adding a new activity
- The AI is easy to use in which provides me a good recommendation that I required , it tailors to my need
- tracking steps
-
- participate in group fitness
- tracking the calories and steps
- Participate in fitness activities with other people
- Food recommendations

Figure 5.11 Compilation of user responses to the open-ended question: "What features did you find easiest to use, and why?"

Responses Summary:

Table 5.10 Mentioned features that users found easiest to use, based on open-ended responses.

Feature Mentioned	Frequency
Tracking the calories	2
Participating in group fitness	3
Adding a new activity	1
AI food recommendation	2
Tracking steps	1
- (No input)	1

A variety of features were mentioned, with group fitness participation being the most frequently cited, followed by calorie tracking and the AI food recommendation system. Users appreciated features that were simple, accessible, and tailored to their needs. One user specifically praised

the AI for providing useful, personalized suggestions. This feedback reinforces the system's success in fulfilling non-functional requirements related to usability, simplicity, and intuitive design.

Question 2: Did you encounter any delays or freezing in the app? If so, where?

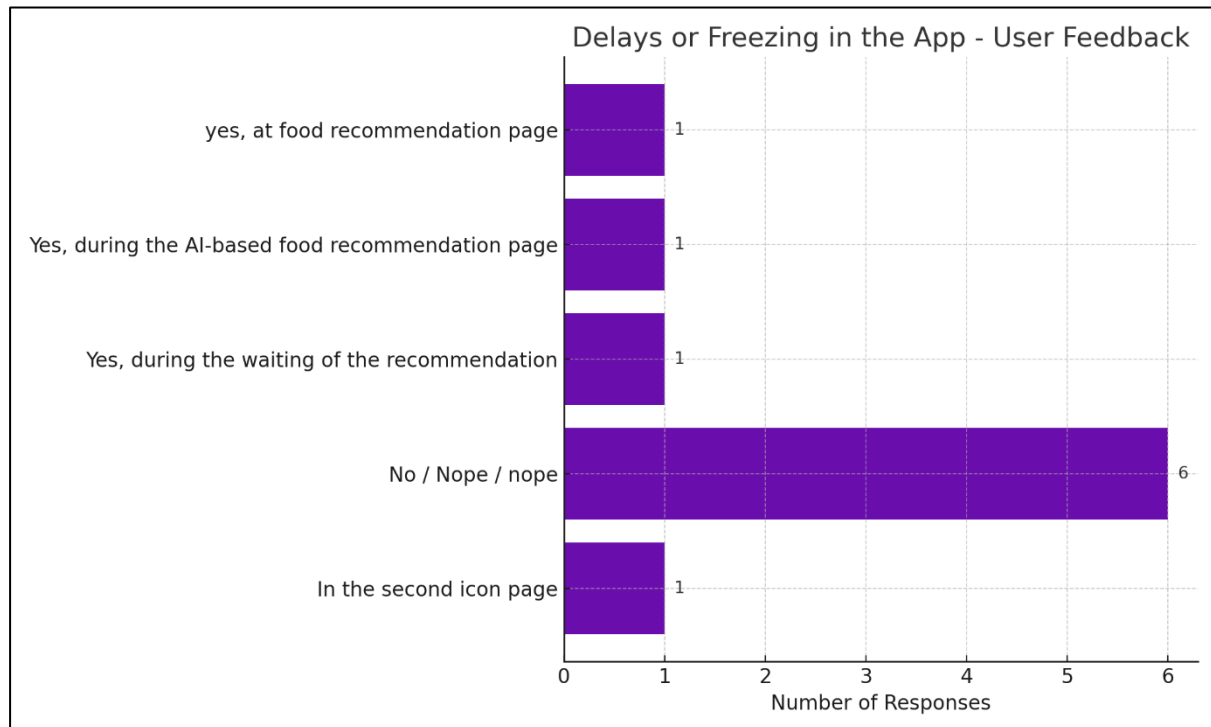


Figure 5.12 Bar chart illustrating user feedback on encountering delays or freezing in the app, specifying locations or instances where such issues occurred.

Out of 10 respondents, half reported experiencing some form of delay or freezing when using the app. The remaining half did not encounter any performance issues. Among those who did report delays, the most commonly affected areas were pages involving the AI-based food recommendation feature. A few also mentioned slow performance on specific pages, such as the second icon page and during the loading of recommendations. These findings suggest that while the overall app performance is acceptable for most users, there are performance concerns specifically related to modules that depend on AI or dynamic content. Optimizing these areas especially in terms of loading speed and responsiveness can help improve user experience and better meet non-functional requirements.

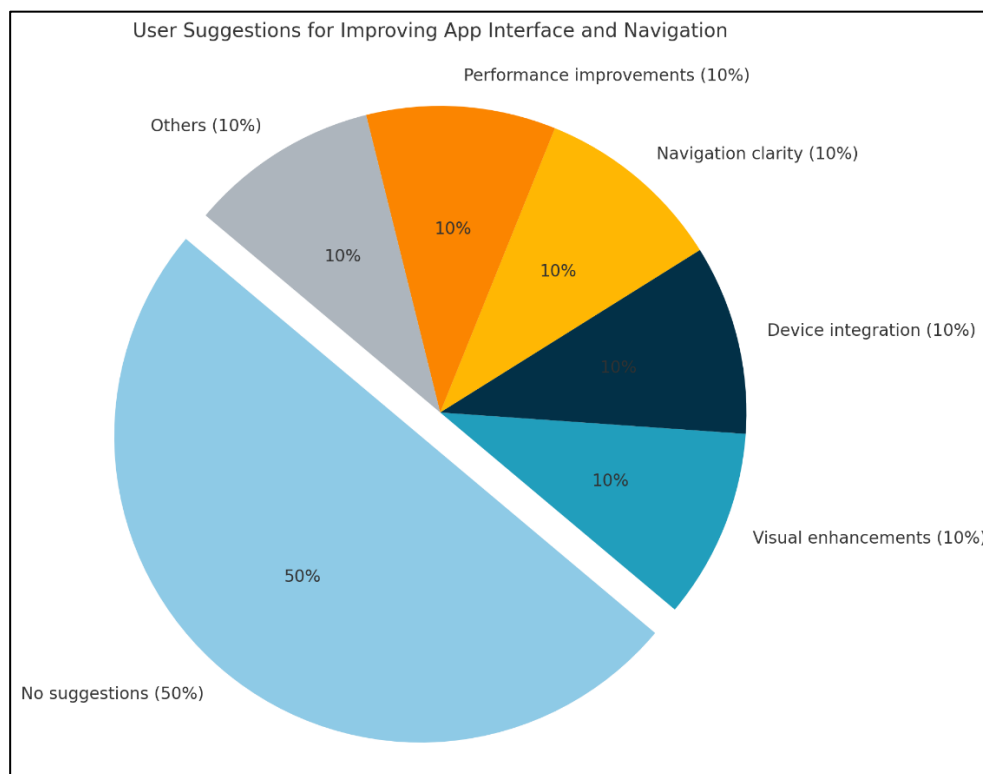
Question 3: What would you suggest to improve the app's interface or navigation?

Figure 5.13 Pie chart summarizing user suggestions for improving the app's interface or navigation.

Half of the respondents did not provide any suggestions, indicating overall satisfaction with the current design and functionality. The remaining feedback was categorized into several areas: visual enhancements, clarity in navigation labels (such as properly naming the taskbar), device integration (e.g., smartwatch compatibility), and performance-related suggestions like improved responsiveness. These categories highlight small but valuable areas for refinement. Overall, the responses indicate that the app meets its usability objectives effectively, while suggesting that minor improvements could further enhance the user experience.

Question 4: Did you feel confident that your personal data (like email or BMI) was protected?

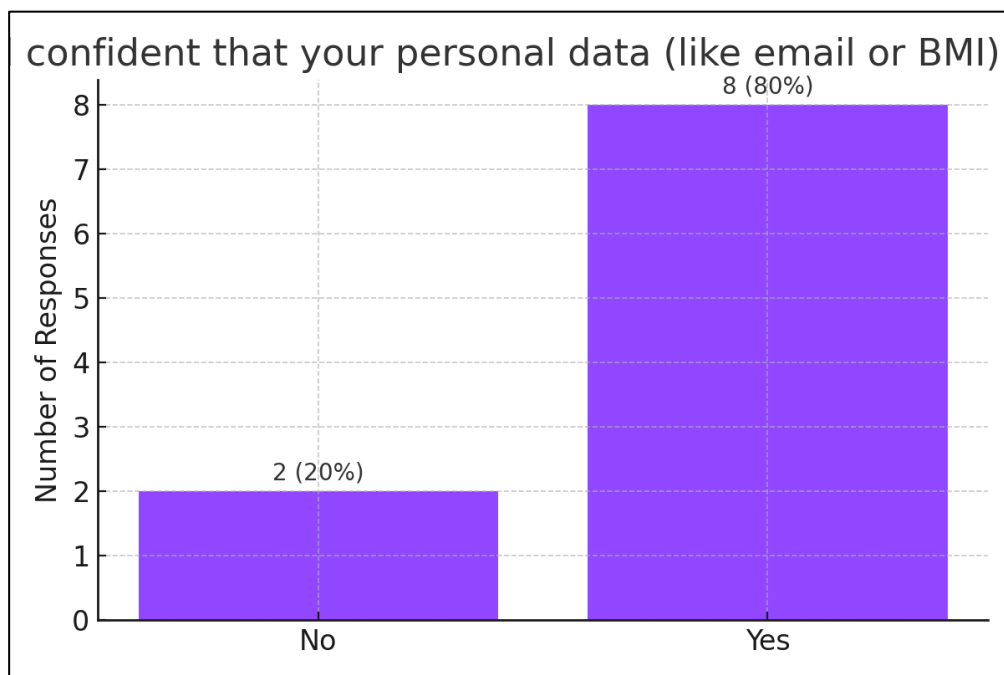


Figure 5.14 Bar chart displaying user confidence levels regarding the protection of their personal data (e.g., email or BMI) within the app.

Out of 10 users, a total of 8 respondents (80%) expressed confidence that their personal data was protected, while 2 users (20%) did not feel confident. This indicates that the majority of users trust the system's data protection measures, fulfilling the non-functional requirement related to secure login and data privacy. However, the presence of 2 users who felt unsure suggests that further reassurance (e.g., visual cues or policy reminders) may help strengthen user confidence across the board.

b) Gym Owner

Close-Ended Questions

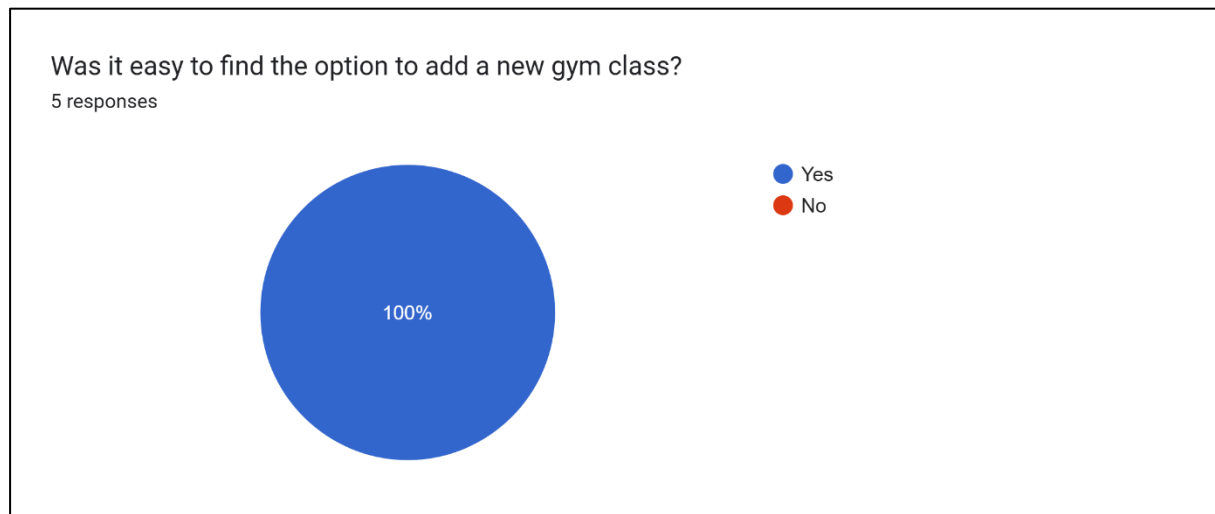


Figure 5.15 Pie chart illustrating user responses regarding the ease of finding the option to add a new gym class.

The 100% positive feedback demonstrates that the app provides a clear, intuitive interface for gym owners, particularly in accessing one of the core features gym class creation. This reflects strong usability design for this user role, minimizing friction in performing key actions.

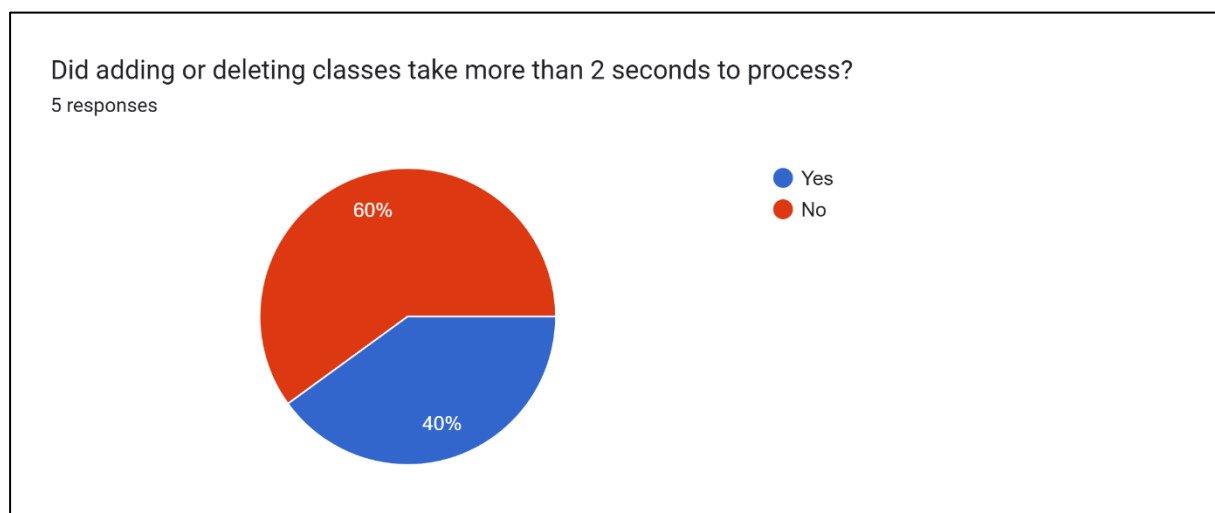


Figure 5.16 Pie chart depicting user responses on whether adding or deleting classes took more than 2 seconds to process.

The survey results show that while 60% of gym owners found the system to process class additions or deletions within the expected 2-second response time, 40% experienced delays

beyond this threshold. This mixed feedback suggests that although the system generally meets the performance expectations outlined in the non-functional requirements, there are occasional inconsistencies in responsiveness. These delays may stem from factors such as device performance or internet connectivity. To ensure a consistently smooth experience across all user environments, further optimization of the class management feature may be necessary.

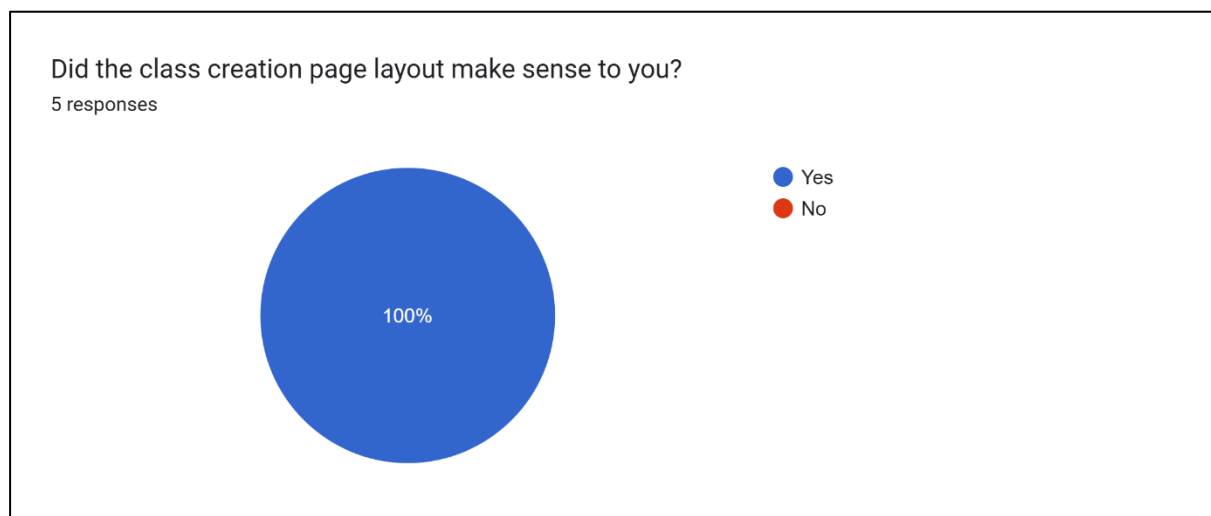


Figure 5.17 Pie chart illustrating user responses regarding whether the class creation page layout made sense to them.

All gym owners agreed that the class creation page layout was clear and understandable. This unanimous positive feedback reflects strong user interface design and supports the non-functional requirement that the system should provide a user-friendly interface with intuitive navigation. It confirms that gym owners can easily understand and use the core functionality without confusion or training.

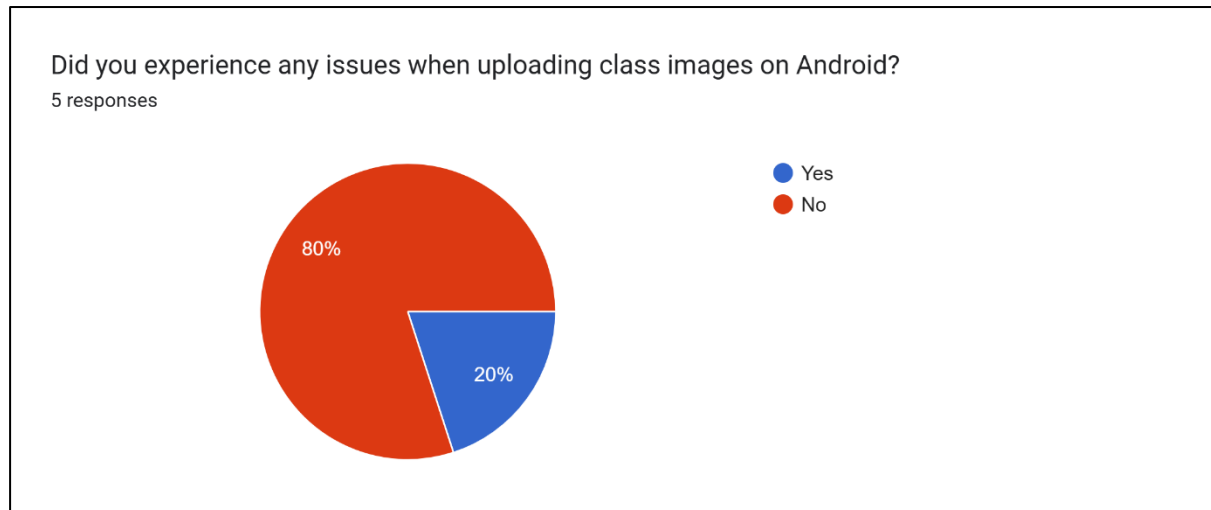


Figure 5.18 Pie chart depicting user experiences with uploading class images on Android devices, specifically identifying any encountered issues.

While most users (80%) reported no problems uploading images, one respondent did encounter an issue. This suggests that the system is generally compatible with Android devices for this feature, but minor inconsistencies or bugs may still exist. This finding partially aligns with the non-functional requirement that the app must operate smoothly on Android platforms and indicates a need to further test and stabilize the image upload functionality across different devices or OS versions.

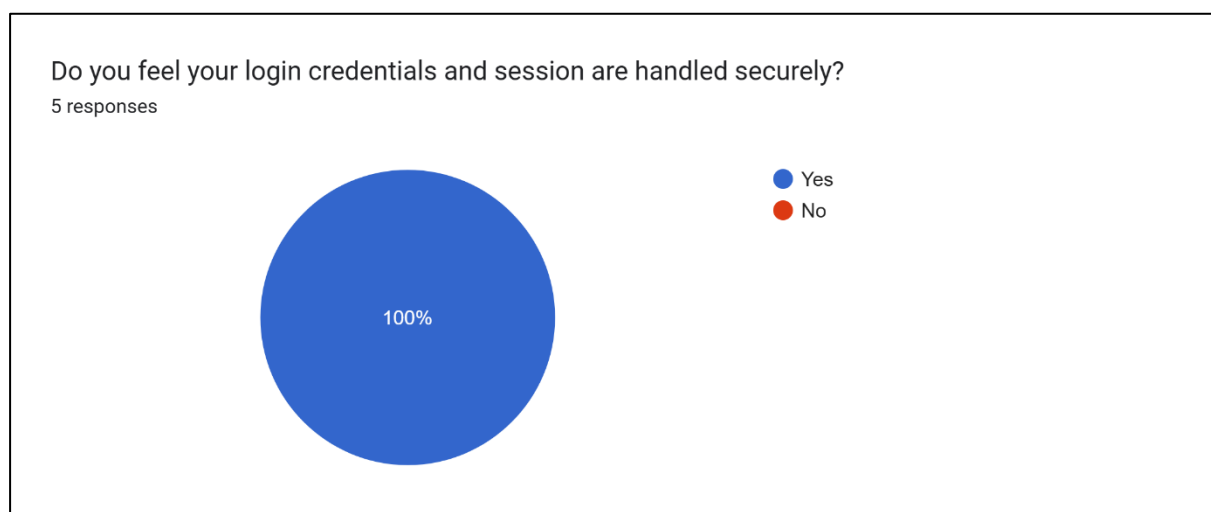


Figure 5.19 Pie chart illustrating user confidence regarding the secure handling of their login credentials and session.

All respondents expressed confidence in the security of their login credentials and session

handling. This fully satisfies the non-functional requirement that the system must protect user data through secure login mechanisms. The result demonstrates that gym owners trust the platform's authentication process and perceive it as secure and reliable.

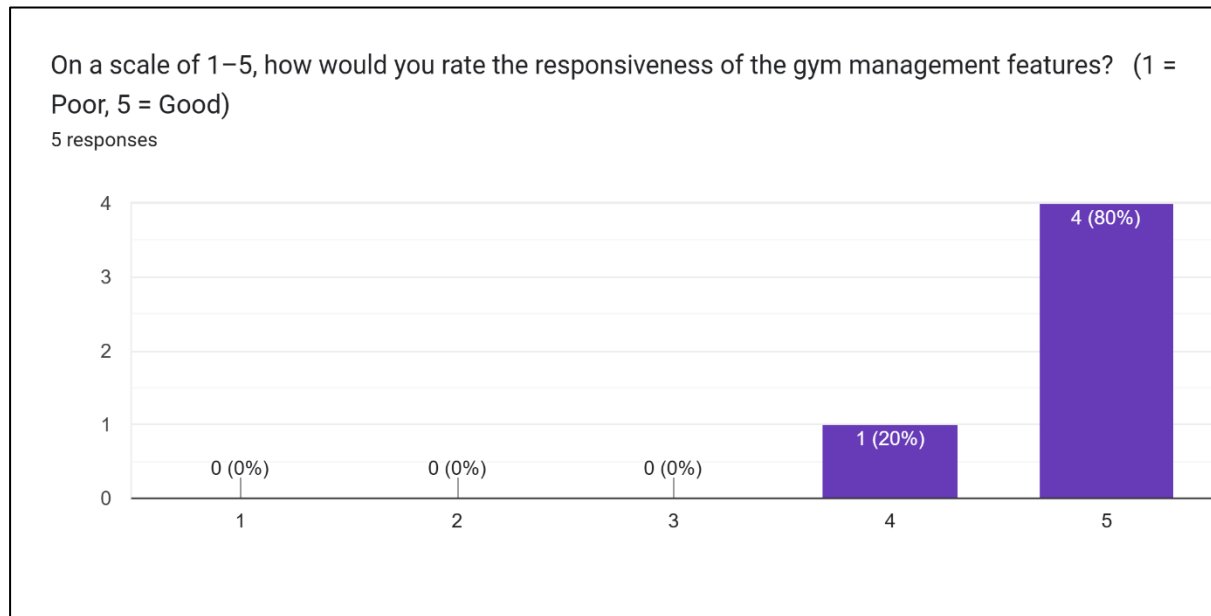


Figure 5.20 Bar chart displaying user ratings of the responsiveness of the gym management features.

Most gym owners rated the responsiveness of the gym management features very highly, with 80% giving the maximum score of 5. This reflects a strong level of satisfaction and confirms that the system is generally responsive when managing tasks such as class creation or updates. This supports the non-functional requirement that the system should respond quickly and reliably to user interactions, particularly in essential workflows. No ratings below 4 further suggest that performance issues are minimal or negligible in real-world use.

Open-Ended Questions

Question 1: Was there any delay or problem when performing frequent tasks like adding/editing classes?

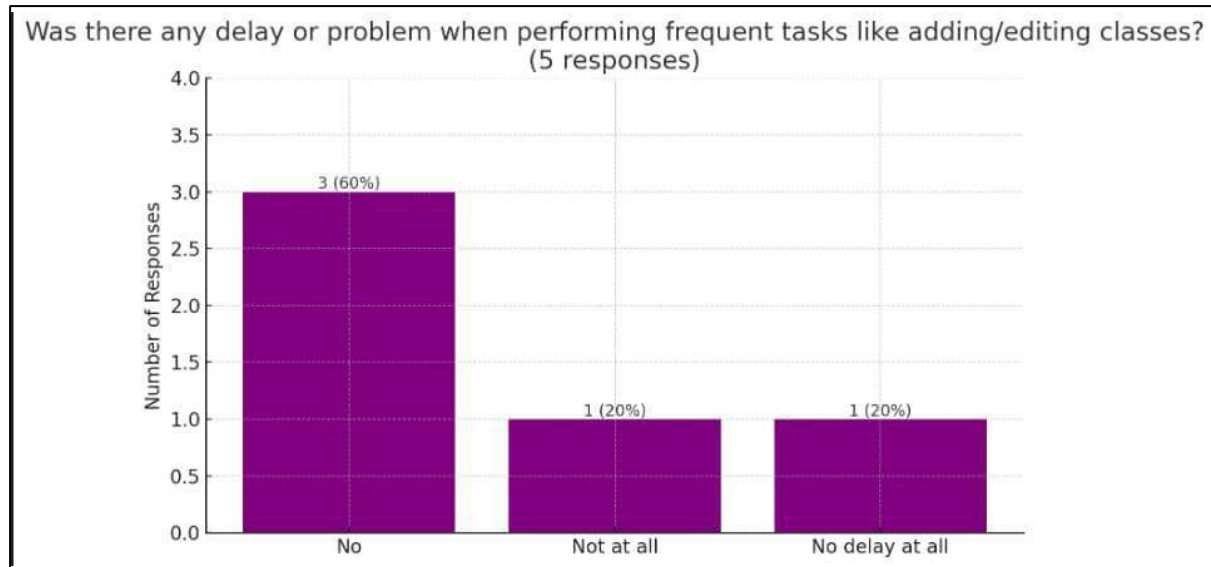


Figure 5.21 Bar chart indicating user experiences regarding delays or problems when performing frequent tasks such as adding or editing classes.

All 5 responses indicate that gym owners did not encounter any delays or problems when carrying out common actions like adding or editing classes. Despite different phrasing, the responses consistently reflect a smooth and efficient experience. This supports the non-functional requirement of ensuring low-latency operations and confirms that task execution times are acceptable under regular use. The consistency of responses across different wordings also implies a user-friendly and reliable experience across the board.

Question 2: Do you feel that the system meets your expectations in terms of speed and usability

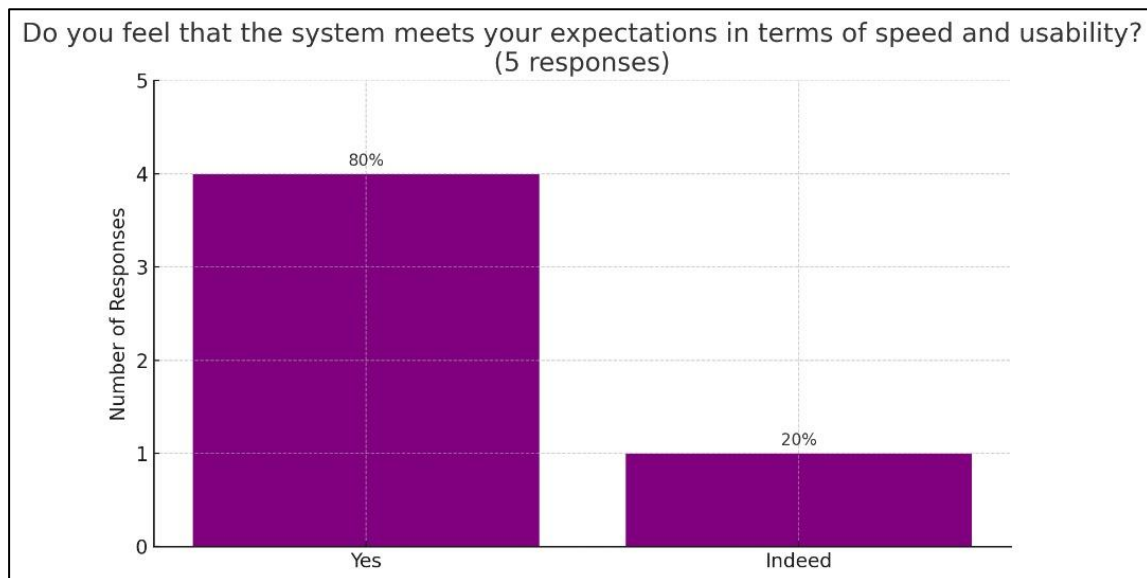
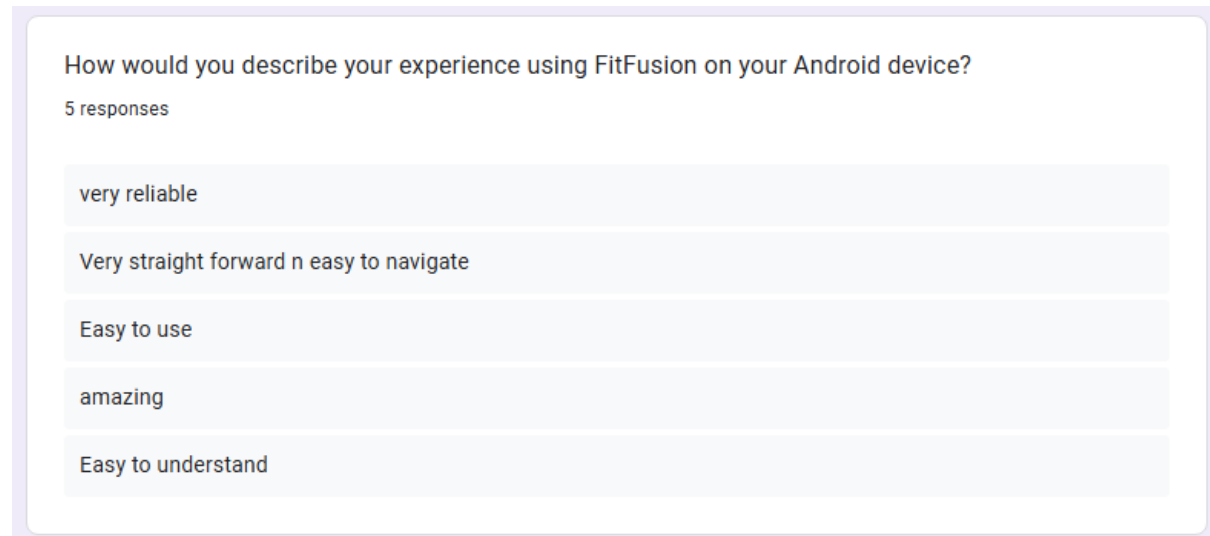


Figure 5.22 Bar chart illustrating user perceptions on whether the system meets their expectations in terms of speed and usability.

All five respondents expressed satisfaction with the system's performance in terms of speed and usability, though phrased slightly differently. Despite variations in capitalization or word choice, all responses reflect a positive sentiment, indicating that the system meets or exceeds expectations in core usability and responsiveness. This strongly supports the non-functional requirement that the application should deliver a smooth, user-friendly, and efficient experience. The consistent approval across all responses confirms that users perceive the platform as reliable and easy to interact with in its current state.

Question 3: How would you describe your experience using FitFusion on your Android device?



How would you describe your experience using FitFusion on your Android device?

5 responses

- very reliable
- Very straight forward n easy to navigate
- Easy to use
- amazing
- Easy to understand

Figure 5.23 Compilation of user responses describing their overall experience using FitFusion on their Android device.

Responses Summary:

Table 5.11 User responses describing their overall experience using FitFusion on an Android device.

Response	Frequency
Very reliable	1
Very straightforward and easy to navigate	1
Easy to use	1
Amazing	1
Easy to understand	1

All 5 respondents indicated a positive user experience, with common themes being *reliability*, *ease of use*, and *simplicity*. This supports the non-functional requirements that the system should provide a user-friendly and accessible interface.

Question 4: What specific improvements would you suggest for the gym class management interface?

What specific improvements would you suggest for the gym class management interface?

5 responses

- good enough
- No
-
- maybe ai features
- All good

Figure 5.24 Compilation of user suggestions for specific improvements to the gym class management interface.

Responses Summary:

Table 5.12 User responses describing their overall experience using FitFusion on an Android device.

Feedback	Frequency
No issues / All good	4
Suggested AI features	1

Most users found the existing interface satisfactory or “good enough,” suggesting that the system meets expectations for ease of use and functional clarity. One user proposed AI integration, indicating interest in future smart features this can be tied to future non-functional requirements expansions or recommendations.

c) Admin

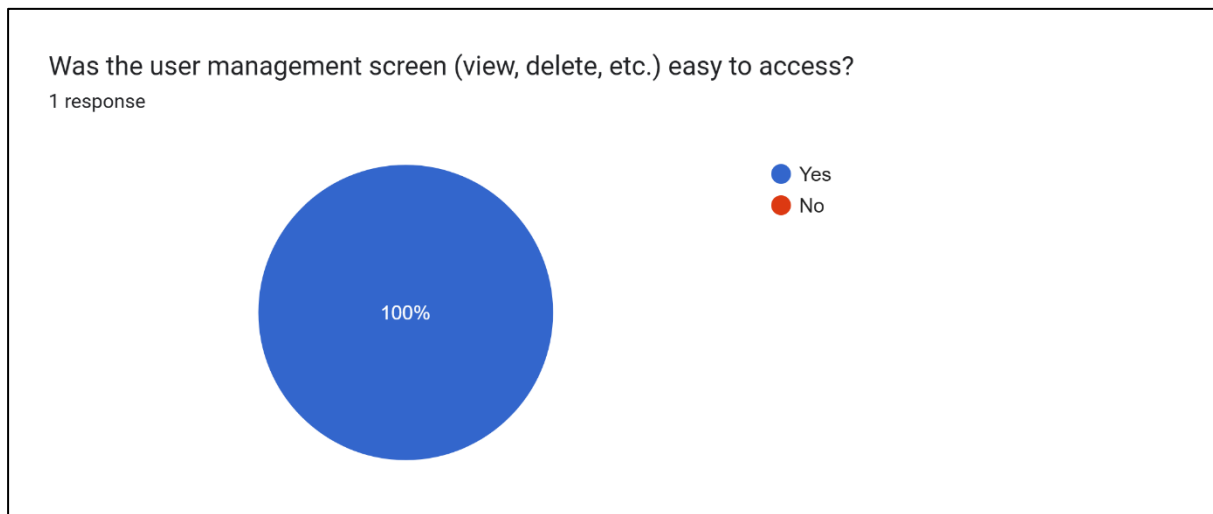


Figure 5.25 Pie chart illustrating the admin's response regarding the ease of access to the user management screen (view, delete, etc.).

The sole admin respondent indicated that the user management screen was easy to access, suggesting that the platform offers a clear and intuitive interface for administrative operations such as viewing and deleting user accounts. This aligns with the non-functional requirement to ensure usability and accessibility for all user roles, including admins. Although the sample size is small, the response demonstrates that the system provides sufficient navigation clarity and supports efficient task execution in the admin module.

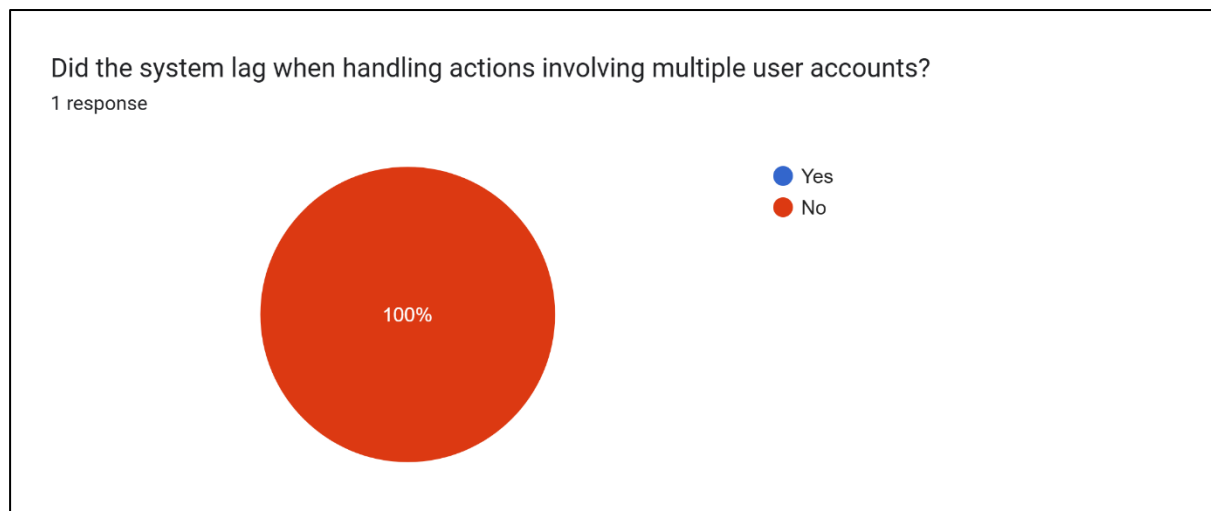


Figure 5.26 Pie chart depicting the admin's response on whether the system lagged when handling actions involving multiple user accounts.

The response indicates that the admin did not experience any lag when performing actions involving multiple user accounts. This suggests that the system handles administrative tasks efficiently even under higher data volume or interaction scenarios. It supports the non-functional requirement that the system should maintain performance stability and responsiveness during intensive operations. While the response sample is small, it still reflects positively on the system's reliability under administrative load.

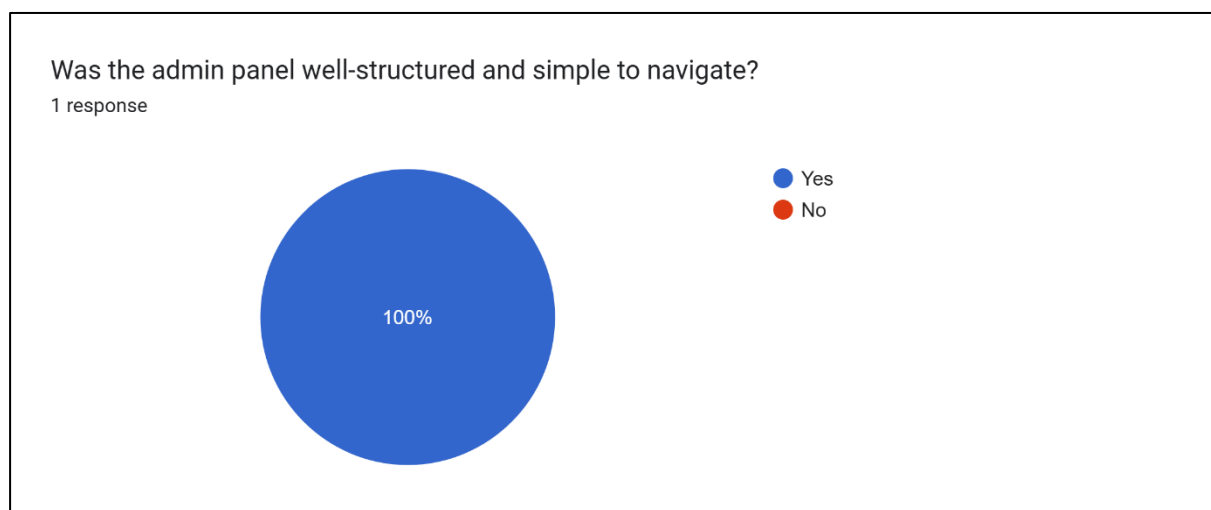


Figure 5.27 Pie chart illustrating the admin's response regarding the structure and navigability of the admin panel.

The single response confirms that the admin found the panel to be well-organized and easy to

use, aligning with the non-functional requirement that the system should offer a user-friendly and accessible interface across all roles. This implies that administrative users can locate features and complete tasks without confusion, promoting effective system use and reducing the learning curve.

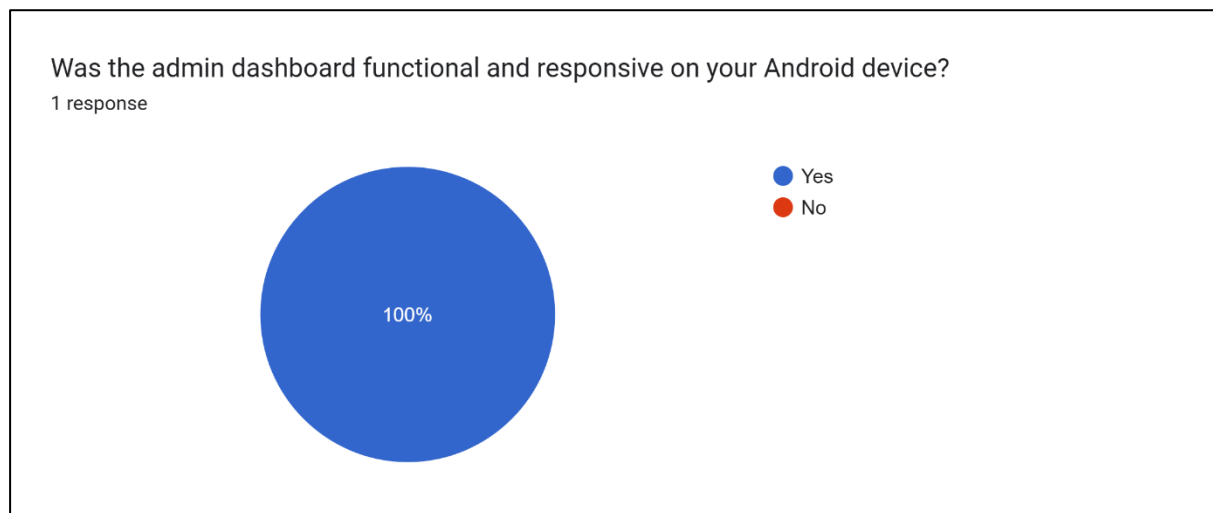


Figure 5.28 Pie chart illustrating the admin's response regarding the functionality and responsiveness of the admin dashboard on an Android device.

The admin respondent indicated that the dashboard was fully functional and responsive on their Android device, suggesting that the system performs well on the intended mobile platform. This supports the non-functional requirements related to both platform compatibility and responsiveness. The positive feedback confirms that administrative tasks can be executed smoothly without performance issues, and the interface behaves reliably on Android. Although based on a single response, it reflects a successful implementation of mobile responsiveness and usability for admin users.

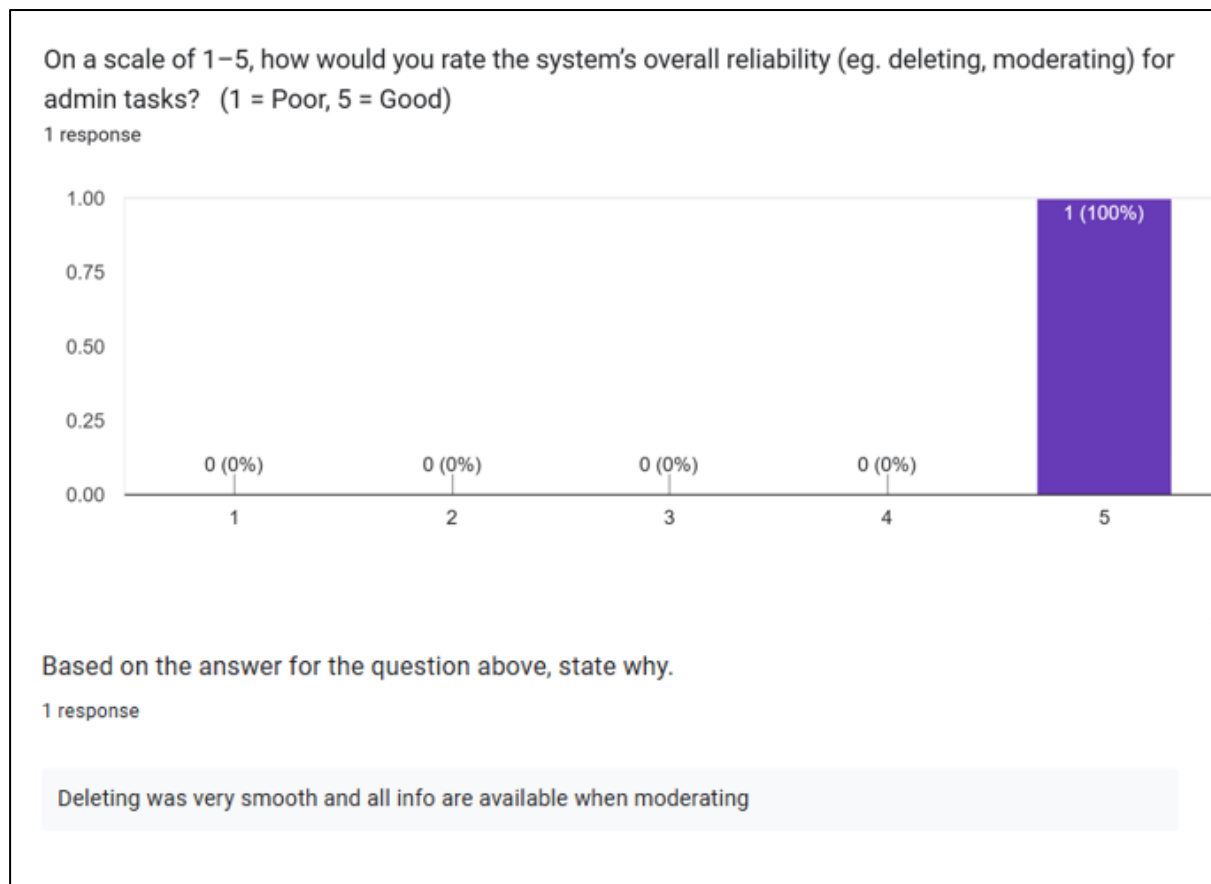


Figure 5.29 Bar chart displaying the admin's rating of the system's overall reliability for admin tasks (e.g., deleting, moderating)

The admin rated the system's overall reliability for performing tasks such as deleting and moderating with a perfect score of 5, describing the experience as "very smooth" and noting that all necessary information was available when moderating. This indicates a high level of confidence in the system's ability to handle administrative operations without issues. The feedback aligns well with the non-functional requirement for system reliability and efficiency, confirming that the admin module is performing as intended and supports accurate, responsive user management tasks.

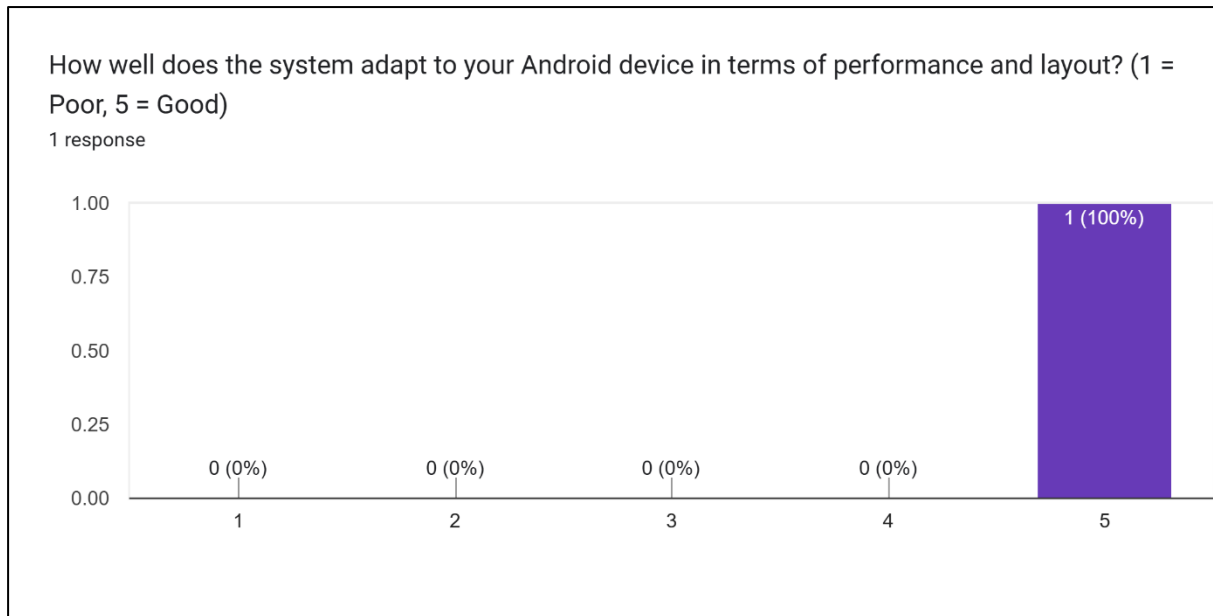


Figure 5.30 Bar chart displaying the admin's rating of how well the system adapts to their Android device in terms of performance and layout

The admin rated the system's adaptation to their Android device a full 5 out of 5, indicating strong satisfaction with both performance and layout. This suggests that the application runs smoothly and displays correctly on Android, the primary target platform. The result supports the non-functional requirement that the mobile application should be fully compatible with Android devices, ensuring usability and responsiveness across screens and features. This positive feedback affirms that the system meets expectations for mobile performance and design consistency on the Android platform.

Open-Ended Question

Question 1: Do you feel the current admin features are sufficient and secure for your needs? Why or why not?

Do you feel the current admin features are sufficient and secure for your needs? Why or why not?

1 response

Yes, the admin features are sufficient and secure because they allow basic user management and require secure login access

Figure 5.31 Admin's response to whether the current admin features are sufficient and secure for their needs, including an explanation.

The response indicates that the current admin tools meet expectations for both functionality (basic user management) and security (secured login). This confirms that the system supports the necessary administrative operations while maintaining a secure environment, thereby fulfilling the relevant non-functional requirements.

5.5 Summary

Comprehensive testing was conducted to evaluate the FitFusion system's functionality, performance, and user experience. Functional testing confirmed that all major modules such as AI-based food recommendations, gym class booking, fitness activity participation, and admin user management operated correctly and as intended. Non-functional testing highlighted the system's strength in performance stability, secure login handling, and smooth responsiveness across Android devices, with only minor delays noted in the AI food recommendation feature. User acceptance testing from general users, gym owners, and administrators revealed overall satisfaction with the app's usability, simplicity, and layout. Feedback particularly praised features like activity tracking and group fitness, while suggesting minor improvements such as enhanced performance during data-intensive tasks. The results validate that FitFusion is ready for deployment and provided actionable insights for enhancing future versions.

CHAPTER 6: CONCLUSION AND FUTURE WORKS

6.1 Introduction

The development and deployment of FitFusion mark a meaningful step forward in enhancing fitness engagement and management within campus and gym environments. This concluding chapter brings together key insights from each phase of the project, evaluating the system's effectiveness in meeting its intended objectives and exploring its broader impact on health-oriented digital ecosystems. FitFusion was designed with a user-centric approach, aiming to streamline fitness-related activities through features such as food recommendations, exercise bookings, and group workout participation delivered via a secure, responsive, and Android-compatible mobile application.

The chapter reviews both technical milestones, including interface design and performance optimization, and practical outcomes derived from real-world testing involving general users, gym owners, and administrators. By integrating user feedback from acceptance testing with the system's alignment to non-functional requirements, the project demonstrates its contribution to promoting healthier lifestyles and operational efficiency. This chapter also considers FitFusion's alignment with Sustainable Development Goal 3 (Good Health and Well-being), underscoring its potential role in encouraging regular physical activity and informed nutrition choices. Finally, the discussion turns to system limitations and outlines potential enhancements for future iterations, providing a forward-looking roadmap to strengthen FitFusion's usability, scalability, and long-term value.

6.2 Project achievement

The project has successfully met its key objectives:

1. **Design a user-friendly mobile application for individuals managing NCDs**
 - The application's UI was kept minimal, clean, and intuitive, ensuring ease of use for all users, including those with limited tech exposure.
 - Health assessments and profile customization ensure the platform caters to personal fitness and dietary needs.
2. **Develop AI-powered features for meal and fitness recommendations**
 - AI-driven content-based filtering was implemented to generate meal suggestions tailored to users' dietary restrictions and preferences.
 - Fitness activity suggestions are customized based on users' health conditions.
3. **Implement a booking system to reserve spots at nearby gyms and fitness classes**
 - A discovery and booking module allows users to find gyms and fitness activities and reserve sessions directly through the app.
 - The system supports gym owner accounts and the scheduling of fitness classes.

6.3 Contribution

The FitFusion project has made several key contributions:

- Promoted healthier lifestyles by providing users with tools to track BMI, calories burned, and physical activity, encouraging consistent fitness habits.
- Simplified fitness engagement through seamless features like gym class booking, group activity participation, and AI-powered food recommendations tailored to user goals.
- Empowered gym owners and admins with structured dashboards to manage users, monitor activity, and handle scheduling efficiently.
- Ensured secure and structured access via role-based login and user management, supporting accountability and data protection.

- Served as a practical platform for applying knowledge in mobile app development, UI/UX design, AI integration, and Android-based performance optimization in a real-world setting.

6.4 Project limitations

6.4.1 Technical Limitations

- The AI recommendation system is based on static rule sets and content filtering rather than dynamic learning from behavioral data.
- No integration with real-time health devices (e.g., smartwatches, fitness bands).
- Limited food and exercise datasets constrained the breadth of recommendations.
- The app is currently supported only on Android and only in English, limiting accessibility for non-English speakers and iOS users.

6.4.2 Operational Challenges

- The gym booking system only supports registered facilities in the database and lacks real-time schedule conflict detection.
- No automated nutrition validation (The AI-generated meal recommendations are not cross-checked with official nutritional guidelines (e.g., Malaysia's RNI, WHO) or expert-reviewed databases).
- Response time delays in AI features (Delays occur during AI meal and fitness recommendations due to external API processing and complex input handling, affecting overall responsiveness).
- User testing was limited to UNIMAS students, which may not reflect the broader Malaysian demographic.
- The system is heavily reliant on user-provided data, which may affect recommendation accuracy due to input errors or inconsistencies.

6.5 Future works

- **Enhance AI Capabilities**
 - Implement collaborative filtering and machine learning algorithms that adapt to user behavior over time.
 - Incorporate NLP to refine recommendation quality based on user feedback and search patterns.
- **Expand Health Ecosystem Integration**
 - Integrate with wearable health tracking devices (e.g., Fitbit, Apple Watch, Google Fit) for real-time activity and biometrics syncing.
 - Enable sync with third-party apps for comprehensive health tracking.
- **Improve Accessibility and Engagement**
 - Launch an iOS version and add multilingual support (e.g., Malay, Mandarin).
 - Introduce community features such as activity leaderboards, user reviews, and social fitness challenges.
- **Sustainability and Long-Term Impact**
 - Incorporate a visual progress dashboard tracking calories, activity goals, and health metrics.
 - Include educational content on NCD prevention and lifestyle management curated by healthcare professionals.
- **Integrate Geolocation Functionality**
 - Add a geolocation system to allow users to discover and navigate to **nearby gyms** based on their current location.
 - Enable location-based gym search filters, map integration, and distance-aware suggestions for fitness activities and classes.

6.6 Conclusion

The FitFusion project has successfully demonstrated how mobile technology and AI-driven personalization can transform health and fitness engagement within a university environment. By addressing the lack of accessible, guided wellness platforms for students, gym owners, and administrators, FitFusion offers a unified, digital solution that promotes healthier lifestyles, structured activity management, and community fitness participation.

The project integrates features such as AI-based food recommendations, join fitness activities, and gym class booking, all within an intuitive Android-based application. The development process emphasized user-centered design, modular architecture, and iterative testing, ensuring the final product aligned with real-world needs and responded effectively to feedback across all user groups. The system also prioritizes security, performance, and ease of use, meeting essential non-functional requirements necessary for long-term engagement.

Feedback collected from functional, non-functional, and user acceptance testing confirmed the system's usability, responsiveness, and potential for widespread adoption. Users expressed satisfaction with the app's simplicity, reliability, and personalized AI support, while also providing helpful suggestions that will guide future enhancements. FitFusion also contributes to Sustainable Development Goal 3 by promoting good health and well-being, especially within academic communities where structured physical activity is often limited.

While some limitations were identified such as occasional delays in AI response time and opportunities for minor interface improvements in which these findings have provided valuable insight for future development. As FitFusion moves toward broader deployment, its scalable design and extensible feature set position it well for growth, including integration with geolocation services, wearable fitness devices, and eventual expansion to iOS platforms.

In conclusion, FitFusion stands as a practical example of how focused technological innovation can empower individuals to take control of their health, foster inclusive fitness communities, and modernize wellness engagement within educational institutions.

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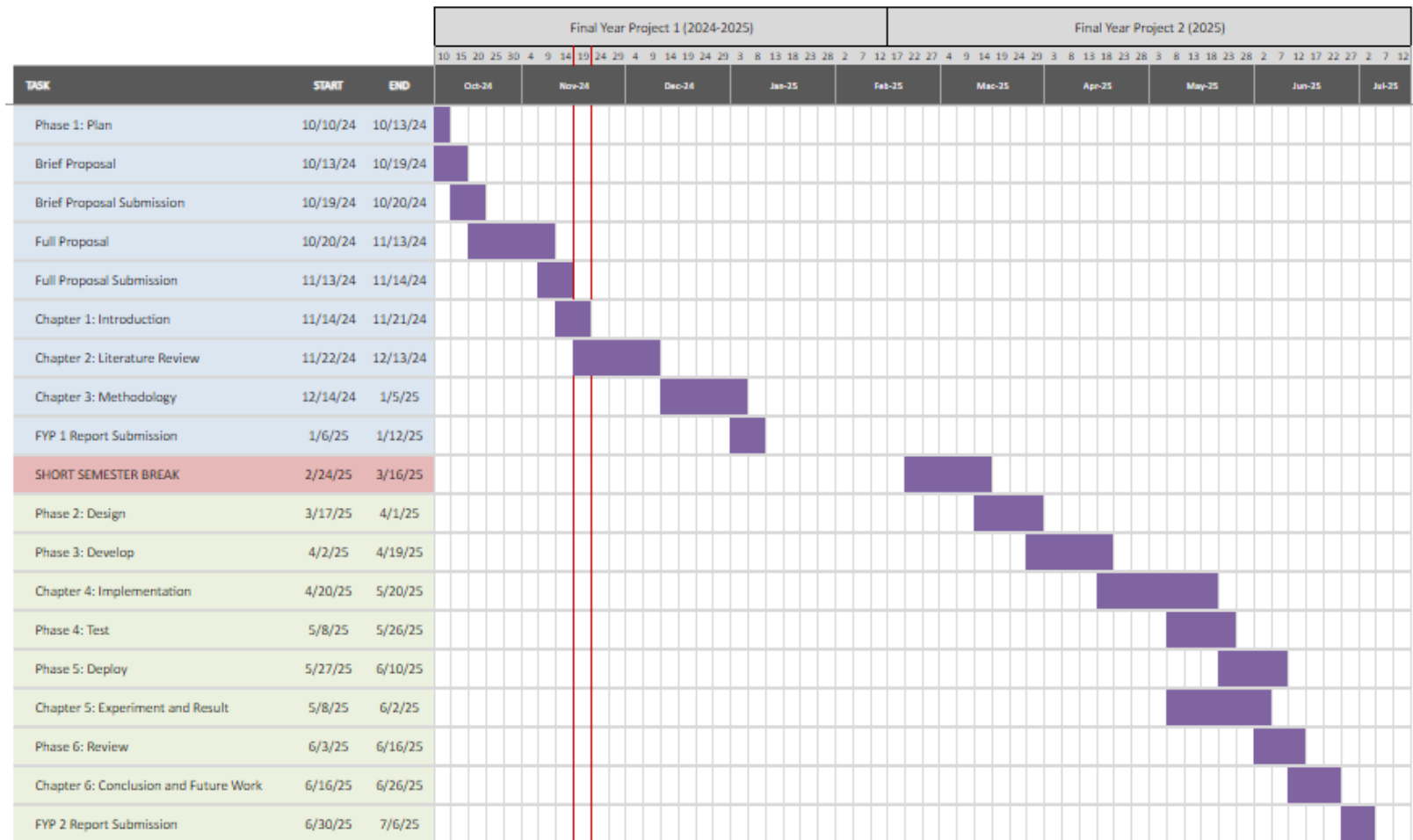
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APPENDICES

Appendix A: Gantt Chart for FYP 1 and FYP 2 Project Schedule



Appendix B: Questionnaire for Requirements

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

🌟 Welcome to the FitFusion Survey! 🌟

Thank you for taking the time to participate in our survey! 📧 I am Ahmad Izzat bin Abdul Taib, and this survey is part of my **Final Year Project (FYP)** at UNIMAS. I am thrilled to introduce **FitFusion**, a mobile app designed to empower individuals to lead healthier lifestyles and manage **Non-Communicable Diseases (NCDs)**, such as diabetes, hypertension, and obesity.

FitFusion leverages advanced **AI technology** to offer personalized meal recommendations, tailored exercise plans, progress tracking, and other features aimed at improving wellness. Whether you're juggling a hectic schedule or striving to maintain a healthier lifestyle, FitFusion is designed to support you every step of the way! 🙌 📱

Your feedback is incredibly valuable to the success of my project 💬 –it will guide the development of FitFusion, ensuring the app is practical, user-friendly, and impactful. 🙏

This survey will only take a few minutes ⌚, and I assure you that all responses will remain completely confidential. 🔒 Your input is greatly appreciated and will play a vital role in shaping the future of FitFusion! 💡 ❤️

If you have any inquiries or suggestions, feel free to contact me at **77755@siswa.unimas.my** or **018-3535681**.

Thank you for helping me on this journey toward creating a healthier, happier future! 🚀

* Indicates required question

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 1: Participant Background

What is your age range? *

- ☐ 18–24
- ☐ 25–34
- ☐ 35–44
- ☐ 45 and above

What is your gender? *

- ☐ Male
- ☐ Female

Do you have any diagnosed Non-Communicable Diseases (NCD)? *

- ☐ Yes
- ☐ No

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 2: Health and Lifestyle Challenges

What are the reasons you find it difficult to access healthy food or maintain a healthy lifestyle? (Select all that apply) *

- ☐ Lack of time to prepare healthy meals
- ☐ Difficulty finding time to exercise
- ☐ Lack of motivation to maintain a healthy lifestyle
- ☐ Hard to allocate fitness centres
- ☐ Difficulty deciding what to eat
- ☐ Other: _____

What is the most important factor for you when selecting a meal plan? *

- ☐ Health/nutritional value
- ☐ Convenience
- ☐ Taste
- ☐ Cost
- ☐ Other: _____

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 3: Technology Adoption

Would you use an AI-powered system to recommend personalized meal plans? *

eg: This system could consider your dietary needs, health goals, and food preferences to provide tailored suggestions

☐ Yes

☐ No

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 3: Technology Adoption

Would you use an AI-powered system to recommend personalized meal plans? *

eg: This system could consider your dietary needs, health goals, and food preferences to provide tailored suggestions

Based on your answer on the previous question, what features would you prioritize in a health and fitness app?

	1	2	3	4	5
Personalized meal recommendations	☐	☐	☐	☐	☐
Exercise plans	☐	☐	☐	☐	☐
Goal tracking	☐	☐	☐	☐	☐
Community support	☐	☐	☐	☐	☐
Appointment scheduling	☐	☐	☐	☐	☐

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 3: Technology Adoption

Would you use an AI-powered system to recommend personalized meal plans? *

eg: This system could consider your dietary needs, health goals, and food preferences to provide tailored suggestions

If no, state why

Your answer

Survey on FitFusion at Universiti Malaysia Sarawak (UNIMAS)

Your email will be recorded when you submit this form

* Indicates required question

Section 3: Technology Adoption

Do you feel comfortable using mobile apps for health and fitness management? *

☐ Yes

☐ No

What goals would you prioritize when using a health-focused app? *

(Rank the options: 1 = Least important, 5 = Most important):

	1	2	3	4	5
Healthy eating and meal planning	☐	☐	☐	☐	☐
Achieving fitness milestones	☐	☐	☐	☐	☐
Tracking health and wellness goals	☐	☐	☐	☐	☐
Connecting with a supportive community	☐	☐	☐	☐	☐
Scheduling and organizing fitness activities	☐	☐	☐	☐	☐

Appendix C: User Acceptance Testing Questionnaire

FitFusion User Acceptance Test – Non-Functional Requirements

Thank you for being a part of FitFusion!

Whether you're using FitFusion to stay on top of your workouts, manage gym sessions, or oversee the platform as an admin, your experience matters to us.

We're continuously working to improve the system's features, performance, and usability for every type of user. We'd love to hear how the platform has worked for you.

Please take a moment to complete our quick, anonymous feedback survey. Your insights will help us shape a better FitFusion experience for everyone.

Together, let's build a stronger, smarter fitness platform.

What is your role in using the FitFusion platform?

- ☐ General User
- ☐ Gym Owner
- ☐ Admin

Section 1: General Users

Was the app layout easy to understand the first time you used it? *

☐ Yes

☐ No

Did all buttons and icons function as expected? *

☐ Yes

☐ No

Did the system respond to your actions (e.g., login, navigation) within 2 seconds? *

☐ Yes

☐ No

☐ Other: _____

Were you able to use all features (e.g. booking gym classes, joining fitness activities) without technical errors? *

☐ Yes

☐ No

Did the app perform well on your Android device without crashing? *

☐ Yes

☐ No

Did you feel your personal information was secure during the login and usage? *

☐ Yes

☐ No

On a scale of 1–5, how would you rate the overall smoothness of your experience *
using FitFusion?
(1 = Poor, 5 = Good)

	1	2	3	4	5	
Poor	☐	☐	☐	☐	☐	Good

How useful do you find the *AI-based food recommendation* feature in supporting *
your fitness goals? (1 = Not useful, 5 = Very useful)

	1	2	3	4	5	
Not useful	☐	☐	☐	☐	☐	Very useful

How likely are you to use the *gym class booking* feature to reserve fitness sessions? (1 = Not likely at all, 5 = Very likely) *

	1	2	3	4	5	
Not likely	☐	☐	☐	☐	☐	Very likely

How interested are you in participating in *group fitness activities* through the app? (1 = Not interested, 5 = Very interested)

	1	2	3	4	5	
Not interested	☐	☐	☐	☐	☐	Very interested

What features did you find easiest to use, and why? *

Your answer _____

Did you encounter any delays or freezing in the app? If so, where? *

Your answer _____

What would you suggest to improve the app's interface or navigation? *

Your answer _____

Did you feel confident that your personal data (like email or BMI) was protected? *

Your answer _____

Section 2: Gym Owners

Was it easy to find the option to add a new gym class? *

☐ Yes

☐ No

Did adding or deleting classes take more than 2 seconds to process? *

☐ Yes

☐ No

Did the class creation page layout make sense to you? *

☐ Yes

☐ No

Did you experience any issues when uploading class images on Android? *

☐ Yes

☐ No

Do you feel your login credentials and session are handled securely? *

☐ Yes

☐ No

On a scale of 1–5, how would you rate the responsiveness of the gym management features? (1 = Poor, 5 = Good) *

	1	2	3	4	5	
Poor	☐	☐	☐	☐	☐	Good

Was there any delay or problem when performing frequent tasks like adding/editing classes? *

Your answer

How would you describe your experience using FitFusion on your Android device? *

Your answer

What specific improvements would you suggest for the gym class management interface? *

Your answer

Do you feel that the system meets your expectations in terms of speed and usability? *

Your answer

Section 3: Admins

Was the user management screen (view, delete, etc.) easy to access? *

☐ Yes

☐ No

Did the system lag when handling actions involving multiple user accounts? *

☐ Yes

☐ No

Was the admin panel well-structured and simple to navigate? *

☐ Yes

☐ No

Was the admin dashboard functional and responsive on your Android device? *

☐ Yes

☐ No

On a scale of 1–5, how would you rate the system's overall reliability (eg. deleting, moderating) for admin tasks? (1 = Poor, 5 = Good) *

	1	2	3	4	5	
Poor	☐	☐	☐	☐	☐	Good

Based on the answer for the question above, state why. *

Your answer

How well does the system adapt to your Android device in terms of performance and layout? (1 = Poor, 5 = Good) *

	1	2	3	4	5	
Poor	☐	☐	☐	☐	☐	Good

Do you feel the current admin features are sufficient and secure for your needs? Why or why not? *

Your answer
