SeniorCare: An Elderly Assistance Mobile Application

By

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A REPORT

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To all named and unnamed, who have been part of this journey: Thank you!

ABSTRACT

As Malaysia's population continues to age, there is a growing need for new solutions to aid and assist elderly individuals in their safety, health, and well-being. Existing assistance applications available in the mobile application space, such as Medisafe and Family360, center around an isolation feature and do not deliver a consolidated system addressing the multiple challenges present among the elderly population at large. Thus, this project proposes the creation of a one-stop mobile application specifically targeting elderly individuals to aid and assist in many of its aspects. It would integrate various features, including reminders of medications and appointments, mental stimulation through mini games, an emergency alert system, use of the Global Positioning System (GPS) for location tracking, task assistance services, and remote monitoring and control by family members. The proposed solution aims at promoting the independence of senior citizens and, at the same time, gives peace of mind to their families wherever they may be around the world. The proposed application is developed using Android Studio, Flutter, and the Dart language. The primary application features include the medications and appointment reminder system, the emergency alert system, and the family locator system. The medication and appointment management system helps to keep scheduling, tracking, and getting reminders of medications and appointments at the right time. Thus, they will never miss critical treatments. An emergency alert system allows elderly individuals to quickly deliver emergency signals via diverse methods such as an inactivity timer, hand gesture, or verbal command. Messages will be sent instantly to emergency contacts to allow a quick response in cases of emergency. A family locator system provides position tracking, allowing family members to track the position of their elderly relatives. It also allows geofencing, where alarms will be raised if an individual goes outside or enters a predefined area. The mini game feature allows senior citizens to remain mentally active and moods elevated.

Area of Study: Mobile Application Development

Keywords: Elderly Assistance Application, Mobile Application, User-friendly Application, Monitoring Application, Gerontology

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LIST OF ABBREVIATIONS

GPS	Global Positioning System
AI	Artificial Intelligence
QR	Quick Response
SMS	Short Message Service
SOS	Save Our Ship
SDM	System Development Methodology
SDLC	Software Development Life Cycle
LCD	Liquid Crystal Display
UI	User Interface
BaaS	Backend-as-a-Service
GUI	Graphical User Interface
API	Application Programming Interface
OTP	One-Time Password

CHAPTER 1: Introduction

1.1 Problem Statement and Motivation

The increasing number and proportion of people aged 60 years and above, followed by the decreasing population under 15, causes population aging [1]. The studies indicate that the global population of 65 years old and above is growing faster than the population below that age [2]. While developing nations, including Malaysia, will gain more momentum in the coming years [3]. According to [4], the proportion of the elderly population of 65 years and above in Malaysia increased from 7.2% in 2022 to 7.4% in 2023, encompassing 2.5 million people. In 2024, Malaysia will have a nearly equal share of the young (18.6%) and older population (14.5%) [5]. These indicate that the elderly population of Malaysia is growing.

Unfortunately, aging is associated with challenges in various aspects, such as family dynamics, support, and care system, and deterioration of physical and mental health quality. As more elderly individuals live alone, it causes changes in family structure and obstacles for family members to provide adequate support and care to elderly individuals. Furthermore, low vision, hearing impairment, decreased physical endurance, and memory loss are the most typical problems faced by seniors [6], [7]. These may cause difficulties for seniors to manage their daily routines and health by themselves [7]. Medication and appointment management will become challenging, while missing them may lead to consequences. As known, senior citizens are at a higher risk of medical emergencies and incidents due to their higher age and weaker physical condition. Besides, the mental health of elderly individuals may be affected by loneliness and isolation, especially those who live alone [8], [9]. Therefore, the elderly individuals require special care and attention from their family members. Although family members wish to help, they may find it hard to manage their lives and care for the aged individuals.

There is a need for innovative solutions for enhancing the quality of life, safety, and health of elderly individuals. Many related assistance applications have been designed and developed to support and help senior citizens. For example, applications such as Medisafe [10], [11] aim to empower users to manage medication for themselves

or their family members. Aside from that, the application Family360 [12], [13] provides Global Positioning System (GPS) tracking services and emergency alert functions.

However, current assistance applications in the mobile application market only address these issues in isolation. Also, they are not developed specifically to support elderly individuals. For instance, the application Medisafe [10], [11] only helps in medication and appointment management and reminding. Its interface is too complex and may cause difficulties for senior citizens with low technical skills. On the other hand, the application Family360 [12], [13] only provides GPS tracking and emergency alert functionalities. Although the Private Elderly Care [14] application is a caregiver-seeking platform that allows elderly individuals or family members to get task assistance, the availability of qualified caregivers is limited. Though offering several features, the application AgeWiser [15], [16], [17], [18] is insufficient to tackle the problem as some important features are not included. Furthermore, most of the applications do not support multiple languages, as Malaysians who speak several languages require. Hence, the comprehensive solution covering all aspects is lacking.

The motivation for developing the proposed integrated elderly assistance mobile application is to cater to the diverse needs of senior citizens and provide their families peace of mind in Malaysia. The medication and appointment reminder functionality assists elderly individuals in taking medication and making medical visits without missing any. In addition, the mini-games promote mental stimulation and entertainment to elderly individuals. With these features, the proposed application aims to promote physical and mental health for elderly individuals. Furthermore, the proposed application intends to enhance the safety and security of senior citizens by utilizing the quick access emergency alert system and GPS tracking. Besides, senior citizens and families can request help from service providers or volunteers who meet their requirements to assist with duties. The convenience provided is one of the motivations of the proposed application. Additionally, involvement of families in monitoring and remote control keeps families up-to-date and enables them to provide assistance for their elderly members even though they might reside at a distance. By developing simplified and integral solutions, the approach boosts the quality of life of elderly individuals and reinforces family ties.

1.2 Objectives

The objectives of this work are to implement an elderly assistance system through mobile software, with different functionalities integrated inside the application:

- To provide health and well-being support:
  - Provides reminders of medicines and appointments to reduce the likelihood of missed dosages and healthcare visits.
  - Promotes entertainment and mental exercise so the mind remains active through mini games.
- To provide safety and security:
  - Allow quick access to emergency contacts to enhance safety in urgent situations.
  - Utilize GPS tracking to monitor the location of senior relatives to provide peace of mind.
- To support and maintain family connections:
  - Allow seeking assistance from a caregiver to help with tasks, providing support and convenience.
  - Allow family members to track activities and locations.

1.3 Project Scope and Direction

The proposed elderly assistance mobile application is categorized as a utility mobile application. It aims to help the elderly manage their daily lives, health, and well-being, and keep their families in touch. Features offered by this application include medicine and appointment reminders, mini-games, emergency alarms, GPS tracking, task assistance, and family control and tracking. The main goal of this application is to enhance the quality of seniors and provide peace of mind to their families.

This proposed application will be available in Android to support users in Malaysia. Smartphones and tablets can run this application. The end-users involve senior citizens who need help and support, families of the senior citizens, and service providers or volunteers who provide task assistance services.

The proposed application is integrated with an existing or built-in calendar app for medication and appointment reminders. Aside from this, there are reliable GPS and

map services to be utilized for location tracking. Since the application stores and shares health and location data, the application will have to comply with data protection regulations so that safety and security can be ensured. Additionally, considering the seniors with differing levels of skills in technologies, the application interface will have to be straightforward and easy to use.

1.4 Contributions

The main contribution of this work is to provide a one-stop solution by implementing an assistance mobile application, mainly for elderly individuals and their family members. It is expected that senior citizens can manage their medication and appointments easily and get notified on time. They are also expected to stay mentally active and be entertained by playing the mini games. Moreover, seniors are expected to send out emergency messages and alert emergency contacts quickly with simple action. Seniors and family members are expected to know the locations of each other through the location tracking services. Family members are expected to have the feature to remotely control some features to help elderly individuals with limited technical skills. Furthermore, elderly individuals and their families are expected to get task assistance from caregivers or volunteers. Additionally, the elderly and their families will be provided with task support by task helpers. The proposed application will assist in improving the quality of life, enhancing their safety, health, and independence, and reassuring their families.

1.5 Report Organization

The details of this development are shown in the following chapters. In Chapter 2, some existing applications were studied and reviewed to identify user needs and improve the functionality of the proposed application. Critical analysis will be conducted to compare the strengths and weaknesses of applications. The system methodology, system requirements, and system design diagram are discussed in Chapter 3. Chapter 4 will discuss the system design of the application. In Chapter 5, the system implementation and development will be discussed. Evaluation of the system

and discussion will be discussed in Chapter 6. Finally, this report will conclude with recommendations in Chapter 7.

CHAPTER 2: Literature Reviews

2.1 Evaluation of Existing Similar System

2.1.1 AgeWiser

AgeWiser is a comprehensive care solution application that enhances the quality of life of elderly individuals by providing a wide range of features [16]. This application aims to promote independence, optimize health, and maintain social connections among seniors to ensure their happiness and health. To achieve its objectives, AgeWiser is created with four key aspects: mobility, mind, medication, and social [17].

Figure 2.1 Main page of AgeWiser

According to Figure 2.1, AgeWiser provides several features to assist senior citizens in different ways. These features include “Mobility”, “Vitals”, “Brain games”, “Jen”, “Social”, “Journal”, “Weather”, “Pill management”, and “SOS”.

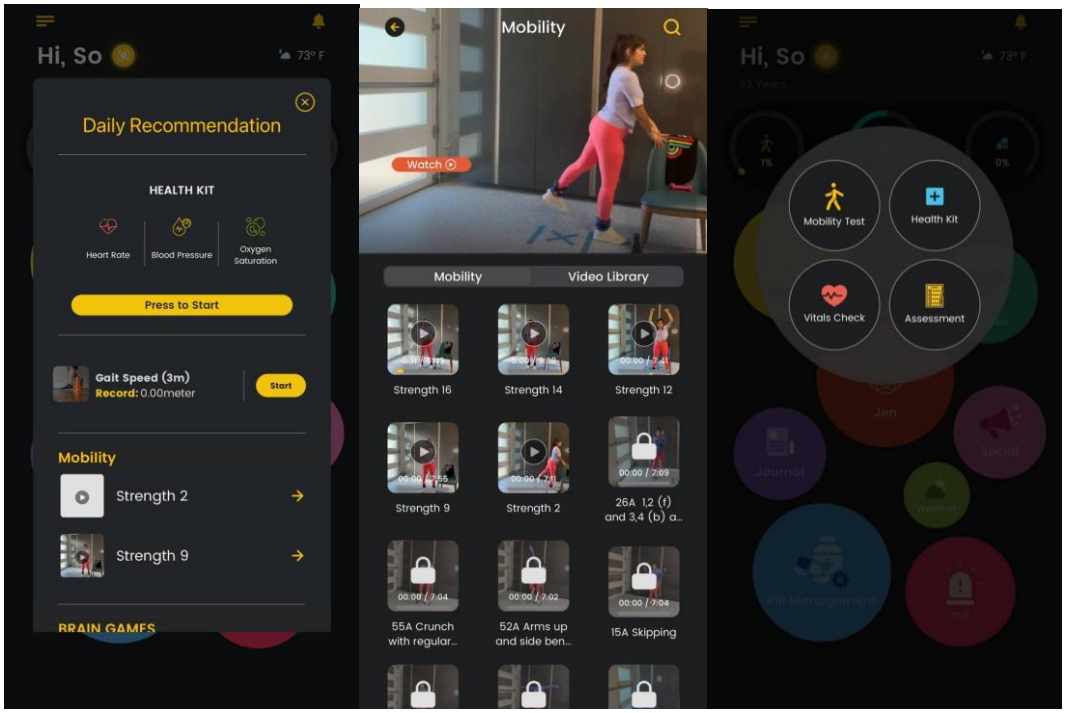


Figure 2.2 Daily recommendation, mobility, and sub-features in vitals

As shown in Figure 2.2, when the users enter the application, a daily recommendation window will pop up to suggest activities for the users. In the feature "Mobility", a healthy and active lifestyle of users is ensured. Four sub-features in vitals focus on well-being. Users can check their mobility with guided exercise videos, track health data, perform vital checks to obtain personalized insights and monitor cognitive well-being after the completion of assessments. In addition, "Jen" is a powerful artificial intelligence (AI) companion system in which the users can chat with the created AI avatar that has the cloned voice of their loved one. This feature aims to combat the loneliness of users.

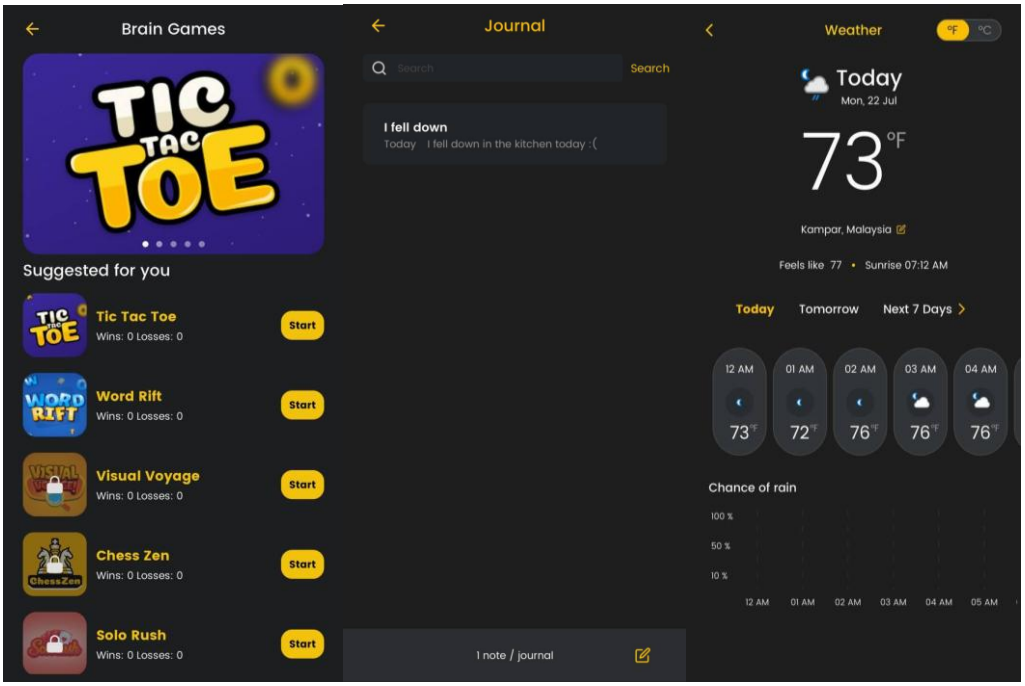


Figure 2.3 Brain games, Journal, Weather

According to Figure 2.3, users are engaging in stimulating cognitive games that keep their minds active and sharp. They have their hours of entertainment and improve cognitive function through the games. Next, users can express themselves and capture memories with the journaling functionality. There is also a built-in weather feature that displays weather forecast information. Based on Figure 2.4 below, users can also get pill reminders, manage medications, and detect conflicts with the pill management system.

Based on Figure 2.4 below, users can also get pill reminders, manage medications, and detect conflicts with the pill management system.

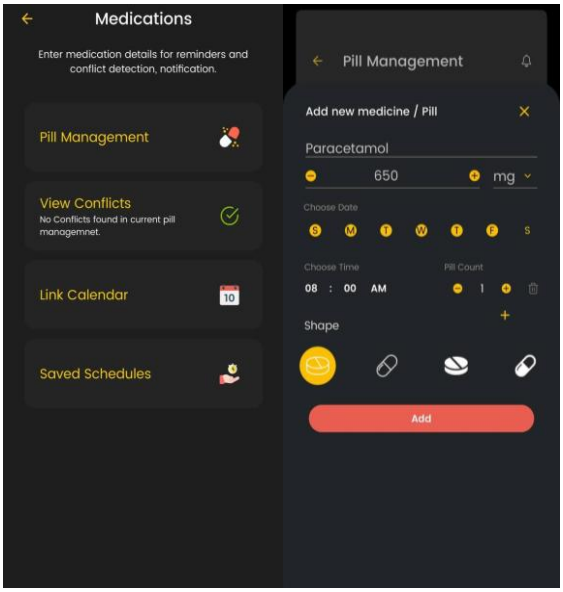


Figure 2.4 Pill management

Social Matter is another functionality that combats loneliness by allowing users to find and connect with friends and family. Users can also create posts and share updates, similar to other social media platforms. Furthermore, this application also helps to prevent falls with AI-powered anomaly detection. The "SOS" feature allows users to make emergency calls with just one click [15], [17], [18].

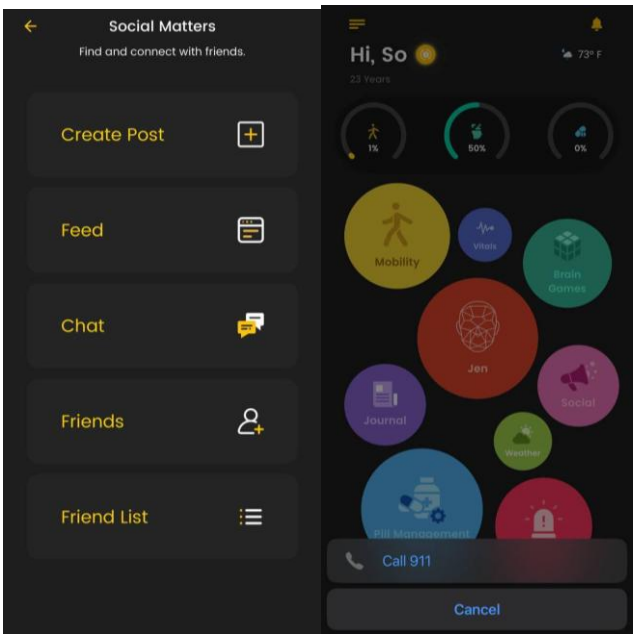


Figure 2.5 Social Matters, and SOS

2.1.2 Medisafe

Medisafe [10], [11] is a medication engagement software that empowers users to manage medication and treatment for themselves or their family members. It is an award-winning application that not only organizes pills but also provides health tracking services.

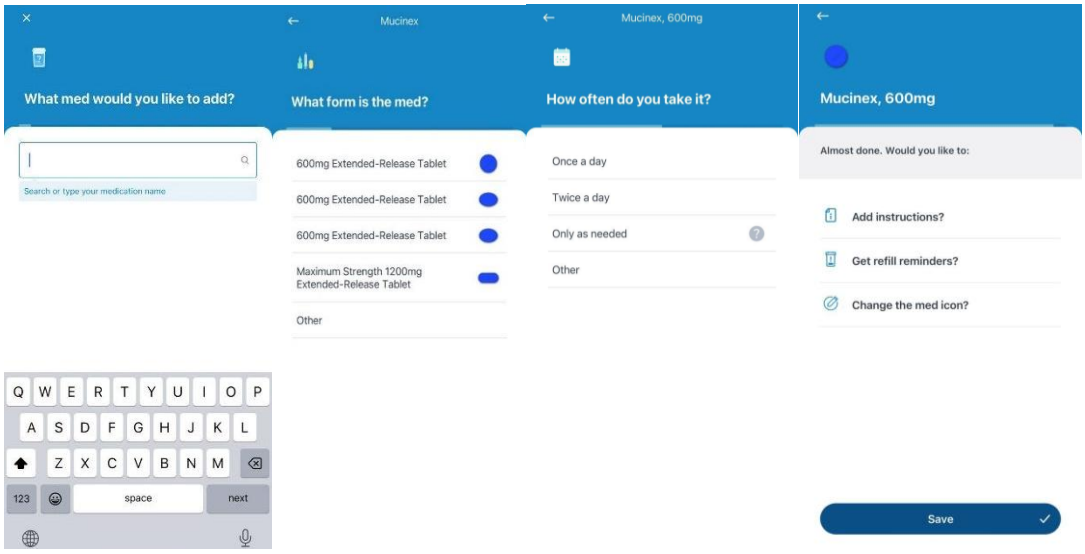


Figure 2.6 Add medicine

First and foremost, as shown in Figure 2.6, the application allows users to key in their medication information, such as medication name, time between medications, medication reminders, instructions, as well as pill numbers. Users will receive a notification at the preset time to remind them to take their pills. Other than that, there is a critical alert that will send a notification to users if they have not marked the pill as taken within half an hour. This application provides a "Invite Medfriend" feature, which allow easy tracking of family's medication doses and schedules. The added users will be notified when the hosts miss a dose so that they can text message or call their hosts to remind them. Besides medication, users can manage their medical appointments and get reminders. The appointment can be added and synchronized to the default calendar on the phone.

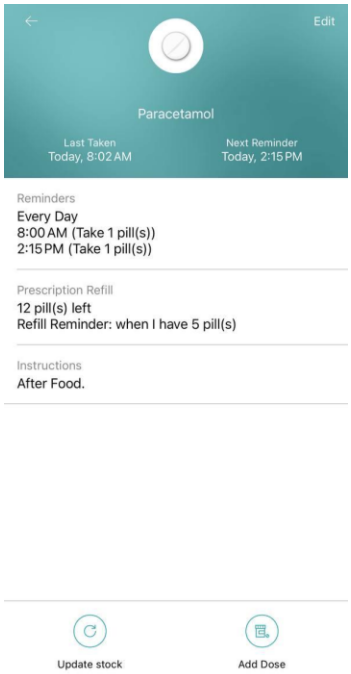


Figure 2.7 Pill refill

Figure 2.7 shows one of the most useful features is the pill refill reminder, which allows users to refill the pills, thus allowing them to take the medication consistently. After users mark the pill reminder as taken, the pill numbers will decrease by the number of pills taken. When the remaining pill numbers match the specific number, the system will prompt a notification to users. Users can easily update the pill stock after they refill it. Furthermore, Medisafe provides health tracking and measurement functionality, and users can download and share the status reports. Also, this application offers personalized health information and resources according to users' medication and circumstances. Users can record their health status by writing in the built-in diary.

2.1.3 Family360

Family360 [12], [13] is a family locator application that provides functionalities related to GPS tracking.

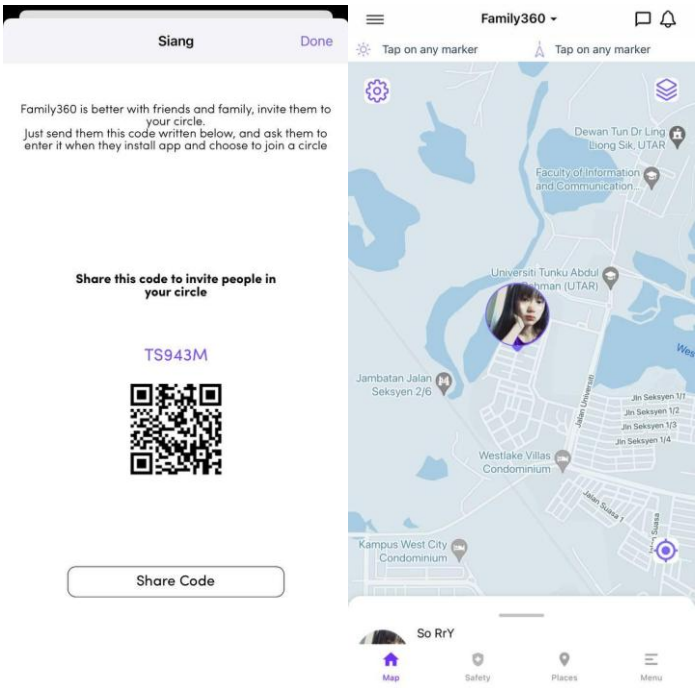


Figure 2.8 Circle member invitation, and location sharing map

According to Figure 2.8, after creating an account in the application, users can add their family members to their group using a Quick Response (QR) code or text code. Through this application, all the members in the same group can see the real-time location and location history of all members.

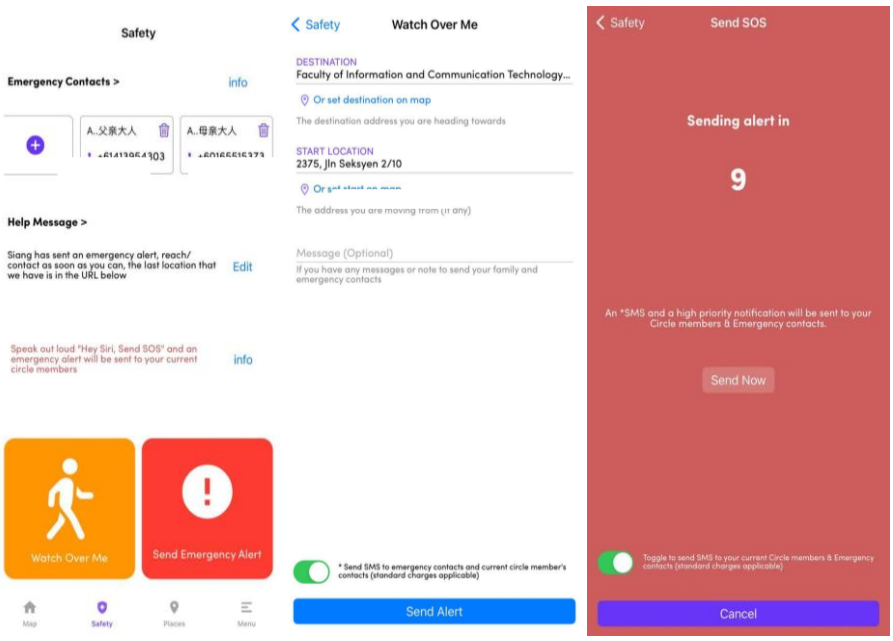


Figure 2.9 Safety, Watch over me, Send emergency alert

Under the second main function, safety, as shown in Figure 2.9, users can add emergency contacts to the application easily by accessing the data from contacts. Also, users can set the help message that will be sent after the emergency alert function is triggered. By clicking the orange “Watch Over Me” button, the address of the start location and destination and a short message service (SMS) will be sent to group members and emergency contacts. An SMS and a high-priority notification will be sent to group members and emergency contacts by clicking the red “Send Emergency Alert” button. Moreover, the powerful feature of this application is speaking voice commands or shaking to send a save our ship (SOS), where the emergency alert is triggered by speaking out the specific command and shaking the phone. Users can add places they and their family stay or visit frequently.

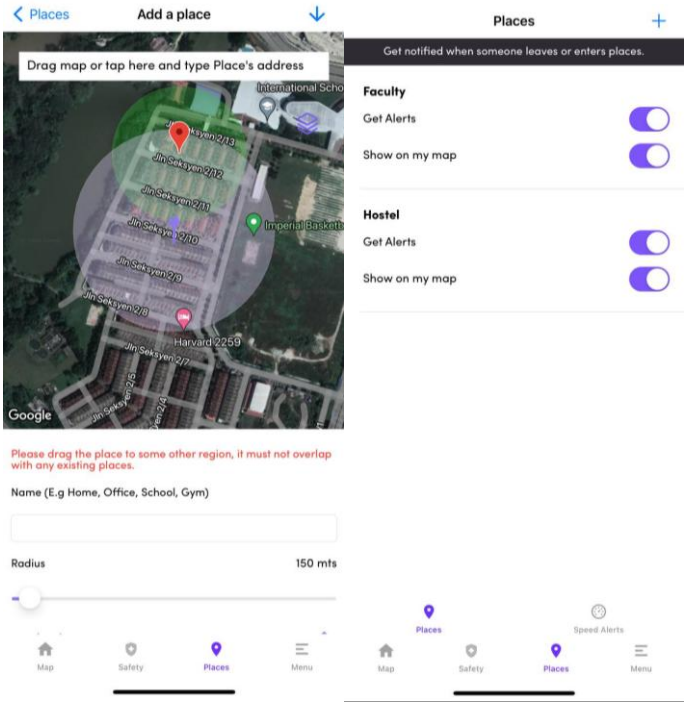


Figure 2.10 Geofencing functionality

Based on Figure 2.10, this application provides a geofencing feature. Users can customize the setting, such as adding places and setting the radius around them. They can view the added places on a map or get notifications when group members leave or enter them.

2.1.4 Private Elderly Care

Private Elderly Care [14] is a platform that provides the best means of senior care, where caregivers and care seekers can interact for employment. Users can log in or sign up as a caregiver or care seeker. The caregivers can key in their details such as basic personal information, services provided, hourly rate, and location. While the care seekers can key in the requirements or service needed, location, date, and hourly rate. According to Figure 2.11 below, both caregivers and care seekers can search by applying filters to find the right match. Additionally, care seekers can view the basic information, qualifications, and reviews of caregivers.

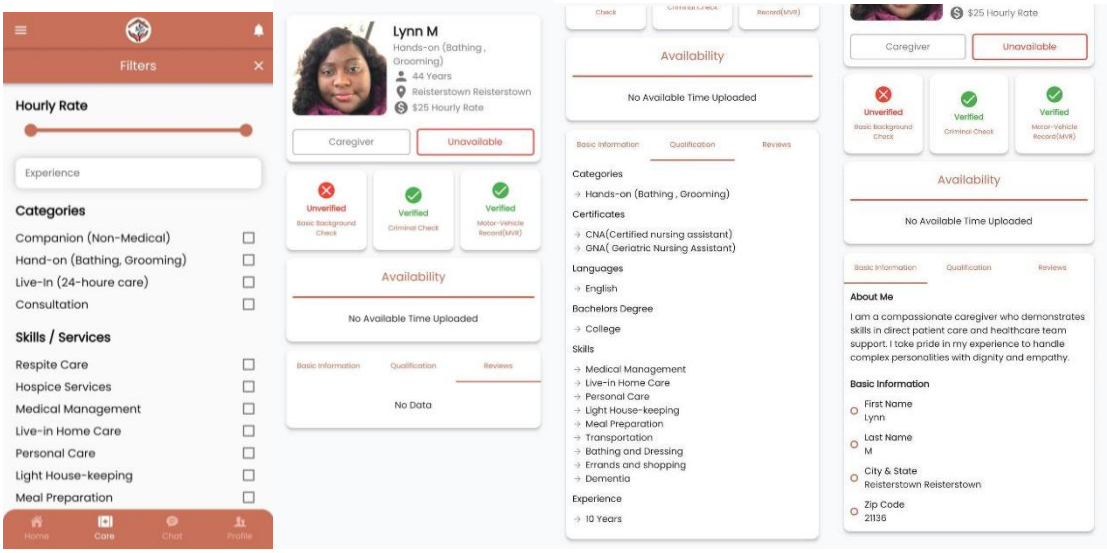


Figure 2.11 Filters on searching, Caregivers profile

2.2 Critical Analysis

This section discusses the critical analysis of applications with similar features, namely AgeWiser [15], [16], [17], [18] , Medisafe [10], [11], Family360 [12], [13], and Private Elderly Care [14], which are reviewed in Section 2.1.

2.2.1 AgeWiser

To highlight, AgeWiser offers a variety of functionalities to assist users in different areas, including mobility, mentation, medication, and social. The emergency alert feature, which helps users in critical situations, enhances users' safety. Besides,

the social feature, which allows users to stay connected with family and friends, promotes social connectivity. Moreover, continuous health monitoring helps in maintaining overall well-being.

However, the main drawback of this application is the interface may be too complex for some elderly users with low technical skill levels. Besides, the emergency alert system could be more robust as it requires users to click multiple times, and only make a call to emergency services but not including emergency contacts. Although it integrates a few useful features into one application, some important features are still left out. For example, GPS tracking features, task assistance services, and family monitoring and control features. Moreover, multi-language is not supported and may bring difficulty to users who only understand a specific language.

Table 2.1 Advantages and Disadvantages of AgeWiser

Advantages	Disadvantages
• Include variety functionalities • Improved safety • Promote social connectivity • Health management	• Complex interface • Limited emergency alert features • Some important features are not provided • Multi-language is not supported

2.2.2 Medisafe

In a word, Medisafe provides medication management and health tracking features. It provides the tracking function of sending notifications to family members or friends who have been added as “medfriends” so that they can alert users to take the forgotten pills. Multi-language is available in this application to support users who only know certain languages.

However, the interface may be too complicated for some users as it could be more intuitive. Besides, this single-function application only helps with medication and appointment managing and reminding. It does not integrate other features such as mini games, GPS tracking, task assistance services, and family monitoring and control.

Table 2.2 Advantages and Disadvantages of Medisafe

Advantages	Disadvantages
• Family members or friends as second reminder • Multi-language is supported	• Complex interface • Single-function application

2.2.3 Family360

Family360 has the advantage of enhancing safety through real-time location sharing and SOS alerts that enable an easy and quick alert system that is powerful during an emergency. Moreover, users will be notified when family members leave or reach a place. It is powerful to ensure the safety, especially of children and seniors. This application also has an interface that is easy to use.

The main drawback of this application is that it does not provide other features such as medication and appointment reminders, mini-games, GPS tracking, task assistance services, and family monitoring and control. Continuous tracking may raise privacy issues and cause frequent alerts and notifications. Moreover, multi-language functionality is not available for users to choose their preferred language.

Table 2.3 Advantages and Disadvantages of Family360

Advantages	Disadvantages
• Enhanced safety • Geofencing alerts • User friendly interface	• Single-function application • Privacy concerns • Multi-language is not supported

2.2.4 Private Elderly Care

Private Elderly Care offers an online platform that allows caregivers and care seekers to find suitable jobs and services. In addition to the application, it also provides the same services on the website. Thus, users can use both of them. The filtering tools

allow users to narrow down the finding scope so that a suitable job or service can be found. Furthermore, the user interface is easy to use.

On the contrary, one of the drawbacks of this application is it only provides single features. Other useful functionalities such as mini-games, GPS tracking, task assistance services, and family monitoring and control are not included. Besides, there are concerns about personal data and privacy as both caregivers and care seekers need to enter their details. Furthermore, qualified caregivers are readily available in some areas. The multi-language feature is not available either.

Table 2.4 Advantages and Disadvantages of Private Elderly Care

Advantages	Disadvantages
• Application and website are available • Useful filtering tools • User friendly interface	• Single-function application • Privacy concerns • Limited availability • Multi-language is not supported

CHAPTER 3: System Method/Approach

3.1 Proposed Method/Approach

As stated in [19], system development methodology (SDM) is a standard process followed in an organization to conduct all the steps necessary to analyze, design, implement, and maintain information systems. Implementation of methodology is beneficial as it helps in better planning and control of the development process. There are different methodologies with different life cycles, for example, traditional waterfall methodology, prototype methodology, and agile methodology. The selection of the methodology depends on a few factors, such as project size and the likelihood of requirements changing.

The agile methodology [19] is selected to develop the proposed senior assistance mobile application.

Figure 3.1 Agile Methodology in System Development [19]

In agile methodology, the project increments undergo continuous iterations and testing during the entire Software Development Life Cycle (SDLC). It contains three core principles: (1) focus on adaptive rather than predictive, (2) focus on people rather than roles, and (3) focus on self-adaptive [19]. According to [19] and [20], this methodology is recommended to be used for projects that have changing or uncertain requirements, require flexibility to adapt to changing needs, need a rapid delivery of working software, and highly involve clients or stakeholders.

The agile methodology, as shown in Figure 3.1, involves a few stages of the SDLC. During the requirement stage, the project's scope, objectives, and potential challenges are identified, and user requirements are collected and analyzed. Once the project is defined, the developers will create system blueprints, such as architecture, modules, and data structure. Moving on to the development stage, developers will build a working system with basic functionality and end the iteration. The stakeholders will review the increment and provide their feedback. Then, a new iteration will start. Additional features and improvements are added in every new iteration. Next, various types of testing will be conducted to check the performance of the software. For instance, unit testing, integration testing, system testing, and acceptance testing. After that, the software will be deployed into the real world. Training and support will be provided for end-users. The issues that may arise after deployment will be detected and resolved, and updates and patches will be released to enhance the software.

Since the proposed application involves a wide range of features that require continuous user feedback and changing requirements, the agile methodology with high adaptability and flexibility is most suitable. It allows the developer to adapt to changing user requirements, ensuring the application meets the requirements and is enhanced accordingly. Besides, agile methodology promotes incremental development. The application is divided into small, manageable sprints, which allow the developer to build, test, and improve the features individually before integrating them into a complete system. Moreover, the iterative cycles of agile methodology provide frequent opportunities for the developer to test the application and identify potential risks of critical features like emergency alert systems. Thus, the developer can address the risks in real-world scenarios before the application deployment to minimize the failure of the final system. Agile methodology also leads to a reliable, robust, and user-friendly application. This is because the review and feedback collection after each iteration allows the developer to refine and enhance the application continuously.

3.2 System Requirement

3.2.1 Hardware Requirements

Table 3.1 Specifications of Laptop

Hardware Component	Specification
Model	Lenovo Yoga Slim 7 Carbon
Processor	11th Gen Intel Core i7-1165G7 @ 2.80GHz
Operating System	Windows 11 Home (64-bit)
Graphic	Intel Iris Xe
Memory	16GB LPDDR4x-4266
Storage	1TB M.2 2280 SSD

Table 3.2 Specifications of Smartphone

Hardware Component	Specification
Model	OPPO A15
Processor	MediaTek Helio P35
Operating System	Android 10
Display	Liquid crystal display (LCD)
Capacity	32GB

3.2.2 Software Requirements

Table 3.3 Specifications of Software

Hardware component	**Specification**
Operating system	Windows 11 Home (64-bit)
Development tools	Visual Studio Code Flutter Dart
Development platform	Google Firebase

3.2.2.1 Development Tool

3.2.2.1.1 Visual Studio Code

Visual Studio Code is a free and open-source code editor developed by Microsoft. It supports a wide range of programming languages and frameworks and supports extensive plugins. It is lightweight and available for Windows, macOS and Linux.

3.2.2.1.2 Flutter

Flutter is a User Interface (UI) toolkit developed by Google. It is used to build cross-platform applications, including mobile, web, and desktop applications, using Dart programming language.

3.2.2.1.3 Dart

Dart is a free and open-source object-oriented programming language developed by Google. It is mainly used to develop cross-platform applications, such as mobile and web development.

3.2.2.1.4 Google Firebase

Google Firebase is a Backend-as-a-Service (BaaS) platform developed by Google. It offers various tools and services to developers, such as authentication, real-time database, cloud storage, and cloud messaging.

3.3 Timeline

3.3.1 Timeline of FYP1

Table 3.4 Timeline of FYP1

Weeks / Progress	1	2	3	4	5	6	7	8	9	10	11	12	13
Complete Figma prototype and interface design													
Set up Google Firebase Firestore database													
Set up Flutter environment													
Develop user authentication between application and Firebase													
Develop family locator interface													
Develop geofencing and add family member functionalities													
Develop task assistance interface													
Develop task assistance functionality													
System testing and debugging													
Write report													

Complete and submit the final report													
Presentation													

The first task planned in the FYP1 timelines is designing the interface and prototype of the application in Figma. The next task is setting up the Google Firebase Firestore for data storage and fetching, and the Flutter development environment. Next, the Firebase authentication in the application and the related user interface are done. It is expected to take four weeks to develop the family locator interface and functionalities, including adding family members and geofencing. Besides, the development of the task assistance interface and functionalities takes four weeks to complete. It is followed by system testing, debugging, and FYP1 report writing. Finally, the presentation and demonstration of the proposed application are conducted in Week 13.

3.3.2 Timeline of FYP2

Table 3.5 Timeline of FYP2

Weeks / Progress	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Complete remaining development of FYP1														
Develop UI for all remaining features														
Develop emergency alert system functionality														

Develop mini games functionality														
Develop multi-language functionality														
Develop medication and appointment reminder functionality														
System testing and debugging														
Write report														
Complete and submit the final report														
Presentation														

The main tasks to be completed at the beginning of FYP2, as shown in Table 3.5, include the completion of the development of the remaining parts of FYP1 and the development of the UI for all remaining features. Then, it is expected to take a total of six weeks to complete the features of the emergency alert system. Subsequently, a one-week period is anticipated for developing the mini-game features and the multi-language features. Following this, a four-week interval will be dedicated to developing the medication and appointment reminder functionality. From Week 13, the application can be deployed for system testing, followed by FYP2 report writing. Finally, the FYP2 presentation and demonstration will be conducted in Week 14.

CHAPTER 4: System Design

4.1 System Architecture

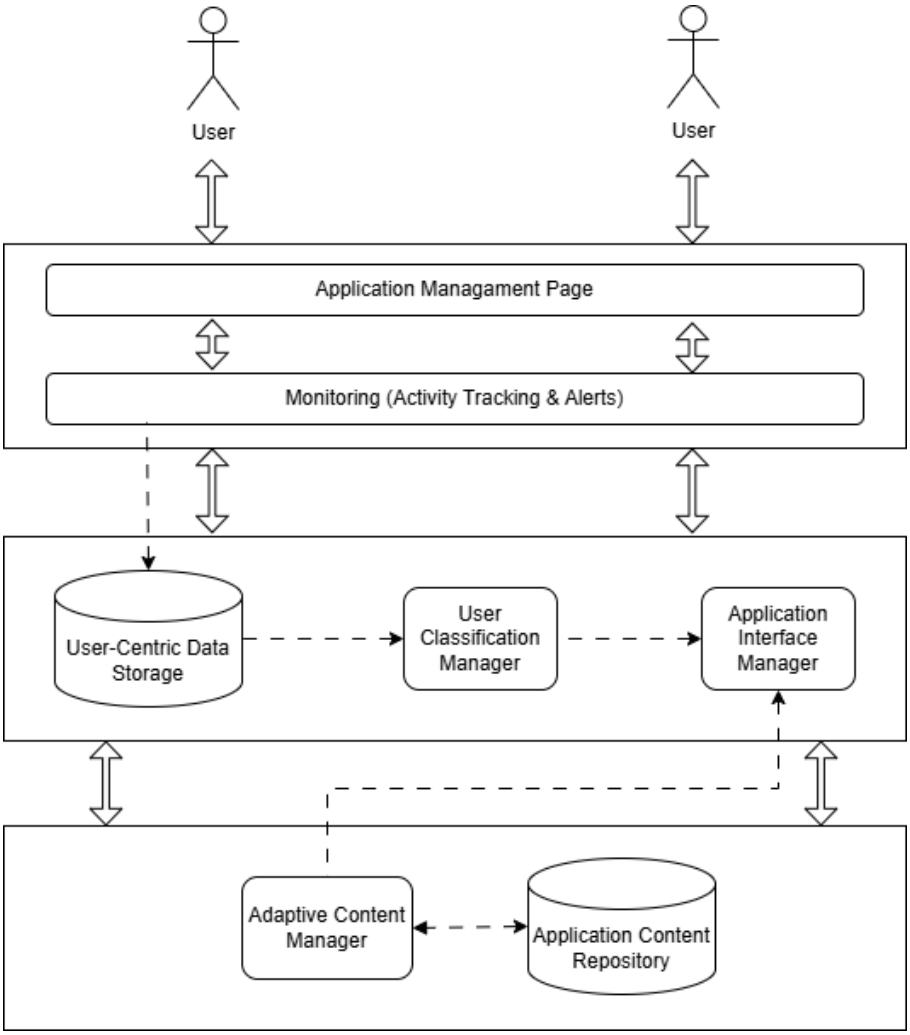


Figure 4.1 System architecture of the proposed elderly assistance application

The system architecture in Figure 4.1 is structured into several interconnected layers. Begin with the top level, users will access the application management page. This presentation layer provides the user with access to all the features of the application required, including medicine and appointment reminders, task assistance, family locator, the emergency alert system, and mini games.

When users join the application, the first step they take is to log in to an existing account or sign up for a new account. This linking of accounts ensures all user data,

whether medications or appointments, game data, or family connections, are properly linked and saved for subsequent use. The frontend of the application is developed specifically for the elderly, as big text, simple navigation, and ease-of-use interfaces are utilized. All data generated flows down to the bottom application logic layer and then into the database.

Health and activity data collection is conducted frequently within the application through various functionalities. The medication and appointment reminder functionality is significant for users, especially newly enrolled senior citizens. Through this feature, they can establish baseline medication and appointment schedules prior to the use of advanced functionalities. The family locator service is also a significant feature that allows the sharing and tracking of locations among family members.

Continuing to the application logic layer, user-centric data storage and the application business rule are beneath the previous layer, since there is a repository linked to every particular user account. Google Firebase serves to store the data of users in a database collection. All the personal information of users is enrolled and stored in the user database. All data obtained from application functionalities is stored under each user's account-specific collection. By this approach, data segregation is maintained, in which the confidential data of the users will not be confused among different users or family groups.

The application interface component manager is responsible for all backend services within the application. It consists of standalone modules and modular code that performs specific functions. These components participate in Firebase Database interaction for authenticating users, secure data processing, data storing, and interaction through external services. They are parts through which users communicate with the graphical user interface (GUI) and application programming interface (API) in direct ways. The component manager ensures the coordination and optimization of real-time interactions between system components and interfaces for reliability.

Finally, the database and content management layer constitute the center of the system architecture. The content manager delivers personalized content for users based on their own profiles. Furthermore, it dynamically adjusts the delivery of content since part of the information, for instance, the medicine and appointment schedules, and location changes over time.

4.2 Use Case Diagram

Figure 4.2 Use case diagram of the proposed elderly assistance application

Figure 4.2 is the use case diagram describing the interactions between users and the elderly assistance application. It shows the key functionalities implemented in the system. It includes the support of health management through reminding the elderly individuals of their medicine or appointments. It includes viewing of stored data, timely notification receiving, editing and deleting the medicine or appointment information. Safety functionalities are represented by the use cases of adding emergency contacts, defining custom alert messages, and configuring trigger methods for enabling the emergency alert system and notifying the emergency contacts. There is further inclusion of the use of location services, enabling users to share locations, add geofencing, and automatically receive notifications on entering or exiting defined places. Before receiving notifications related to members within the same family group, users will need to create or join a family group. Besides, it provides the capability to request task assistance from caregivers or task helpers. For mind stimulation, users can take part in mini games of different levels of difficulty and keep track of the play's time length. Personalization and accessibility might be included through profile management, such as editing of names and the capability to change the language application. The use case descriptions for each task are discussed in the following section, Section 4.3.

4.3 Use Case Description

Table 4.1 Use Case Description for "Add Medication and Appointment Reminder" Use Case

Use Case ID	**UC001**	**Use Case Name**	Add Medication and Appointment Reminder
Primary Actor	User		
Brief Description	Users can access the Medication and Appointment Reminder Page to view their added medicine and appointment with a different view of the calendar, including daily, weekly, and monthly. This page also allows users to add, edit, or delete medicines and appointments.		
Trigger	User clicks on the "Add Medication" or "Add Appointment" button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Medication and Appointment Reminder Page.	
	2	System displays the daily, weekly, and monthly calendar with added medication and appointment, and buttons to add new medicine and appointment.	
	3	User clicks the "Add Medicine" or "Add Appointment" button.	
	4	User key in the information needed.	
	5	System displays a successful page after successfully adding medicine or an appointment, and directs the user back to the Medication and Appointment Reminder Page.	
Sub Flow – Edit or Delete the Added Medicine or Appointment	2a.1	User clicks on the added medication or appointment on the calendar.	
	2a.2	System displays details of the selected medication or appointment.	

	2a.3	User clicks on the Edit icon or Delete icon to edit or delete the selected medication or appointment.

Table 4.2 Use Case Description for "Create or Join Family Group" Use Case

Use Case ID	**UC002**	**Use Case Name**	Create or Join Family Group
Primary Actor	User		
Brief Description	Users can access the Edit Family Group Page through the Profile Page and Emergency Alert Page. This page allows users to create a family group, view family members in the same family group, and add or remove family members. Users can only receive notifications related to family members after joining a family group.		
Trigger	User clicks on the "Create Family Group" or "Join Family Group" button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Edit Family Group Page.	
	2	System displays the family members in a family group, "Create a Family Group" and "Join Family Group" buttons.	
	3	User clicks the "Create a Family Group" or "Join Family Group" button.	
	4	User key in the information needed and follow the steps to create or join a family group.	
	5	System displays a successful page after successfully creating or joining a family group, and directs the user back to the Edit Family Group Page.	
Sub Flow –Add Family Member into Family Group	2a.1	User clicks on the "Add Family Member" button.	
	2a.2	System displays a QR code to be shared for other users to join the family group.	
Sub Flow – Remove Family	2b.1	User clicks on a family member.	
	2b.2	System displays details of the family member.	

Member in Family Group	2b.3	User clicks on the Remove icon to remove the selected family member from the family group.

Table 4.3 Use Case Description for “Share Location with Family Members” Use Case

Use Case ID	**UC003**	**Use Case Name**	Share Location with Family Members
Primary Actor	User		
Brief Description	Users can access the Family Locator Page to share location with family group members, add geofences, and receive notifications on entering or exiting the geofences.		
Trigger	User switches on the “Share Location With Family Group” toggle button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Family Locator Page.	
	2	System displays a map, the “Share Location With Family Group” toggle button, and the “Geofencing” button.	
	3	User switches on the “Share Location With Family Group” toggle button.	
	4	System displays the locations of the user, family members, and geofences.	
Sub Flow – Add Geofencing Location	2a.1	User clicks on the “Geofencing” button.	
	2a.2	User accesses the Geofencing Page.	
	2a.3	System displays a list of added geofences and the “Add A Place” button.	
	2a.4	User clicks the “Add A Place” button.	
	2a.5	User key in the information needed.	
	2a.6	System displays a successful page after successfully adding a geofence location, and directs the user back to the Geofencing Page.	
Sub Flow – Receive Notifications on Entering and	4a.1	Family members enter or leave the geofence locations defined by the user.	
	4a.2	User receives push notification.	

Leaving Geofences		

Table 4.4 Use Case Description for “Ask for Task Assistance” Use Case

Use Case ID	**UC004**	**Use Case Name**	Ask for Task Assistance
Primary Actor	User		
Brief Description	Users can access the Task Assistance Page to search for task helpers, view the details of task helpers, and ask for task assistance from task helpers.		
Trigger	User clicks on the “Contact” button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses to the Task Assistance Page.	
	2	System displays a list of suggested task helpers, a search bar, and a floating chat button.	
	3	User clicks on a task helper.	
	4	System displays the information about the selected task helpers, and the “Contact” button.	
	5	User clicks on the “Contact” button.	
	6	User chat with the task helpers to ask for assistance.	
Sub Flow – Search for Task Helpers	2a.1	User clicks on the search bar and type the searching term.	
	2a.2	System displays the matching results.	
Sub Flow – View Chat History with Task Helpers	2b.1	User clicks on the floating chat button.	
	2b.2	System displays the chat histories with task helpers.	

Table 4.5 Use Case Description for “Add Emergency Alert Contact” Use Case

Use Case ID	**UC005**	**Use Case Name**	Add Emergency Alert Contact
Primary Actor	User		
Brief Description	Users can access the Emergency Alert Page to add emergency contacts, edit the help message, and set the system trigger method.		
Trigger	User clicks on the “Add” icon button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accessed the Emergency Alert Page.	
	2	System displays the added emergency contacts, help message, and system trigger method.	
	3	User clicks on the “Add” icon button.	
	4	User selects family member to be added as emergency contact.	
Sub Flow – Edit Help Message	2a.1	User clicks on the “Edit” text button.	
	2a.2	User keys in the help message.	
	2a.3	User clicks on the “Done” button.	
	2a.4	System displays the updated help message.	
Sub Flow – Set System Trigger Method	2b.1	User clicks on the “Edit” text button.	
	2b.2	User selects preferred trigger method in the drop-down menu.	
	2b.3	User sets up the settings for the selected trigger method.	
	2b.4	User clicks on the “Done” button.	
	2.b.5	System displays the updated trigger method.	

Table 4.6 Use Case Description for “Play Mini Games” Use Case

Use Case ID	**UC006**	**Use Case Name**	Play Mini Games
Primary Actor	User		
Brief Description	Users can access the Mini Games Page to select games, select a difficulty level, play the games, and view the last played date.		
Trigger	User clicks on the games.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Mini Games Page.	
	2	System displays available games and the last played date of each game.	
	3	User selects the preferred game.	
	4	User selects the preferred game difficulty level.	
	5	User plays the game.	
	6	System displays playing duration when user completes the game, and directs user back to the Mini Games Page.	

Table 4.7 Use Case Description for "Edit User Profile" Use Case

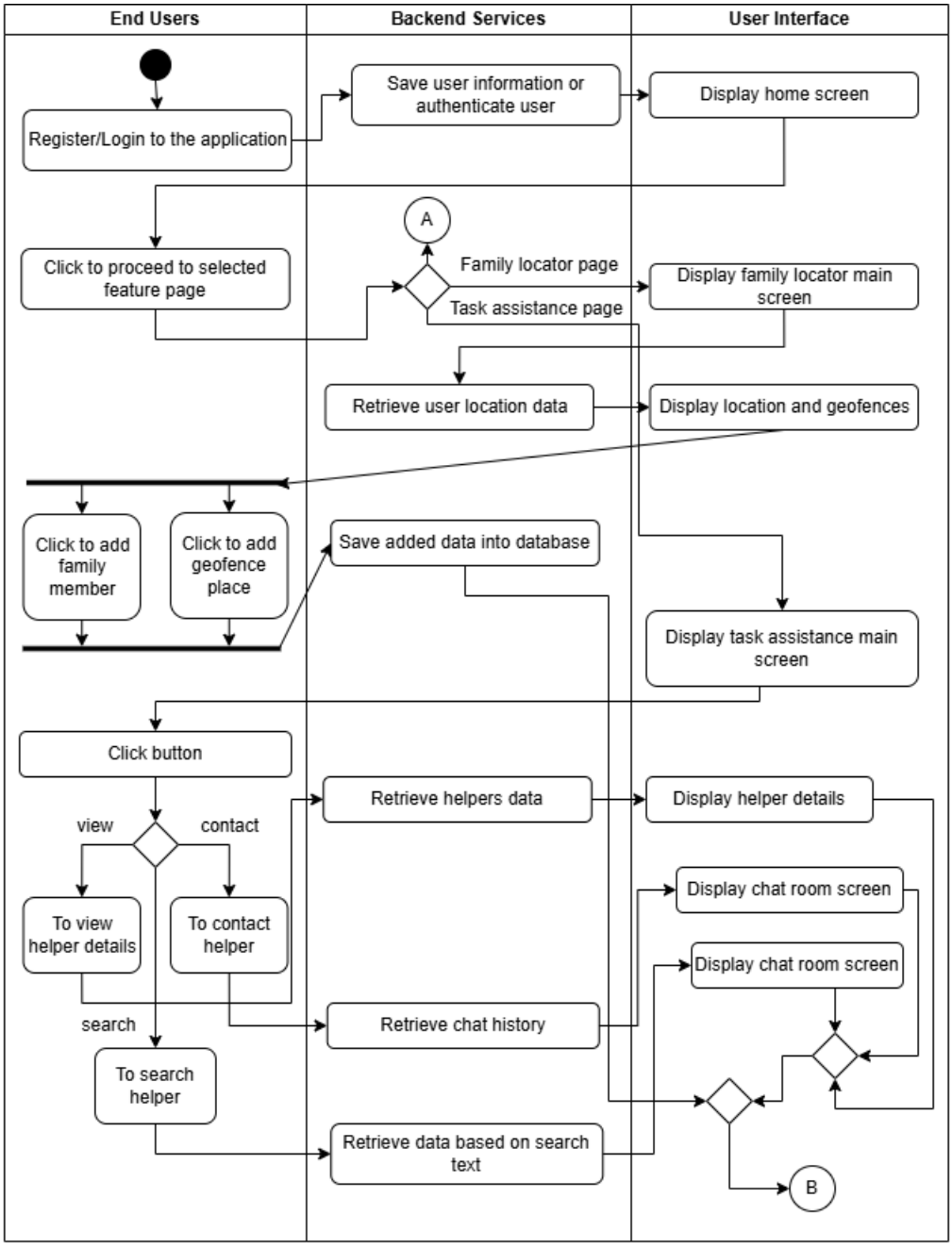
Use Case ID	**UC007**	**Use Case Name**	Edit User Profile
Primary Actor	User		
Brief Description	Users can access the Profile Page to edit family group, edit profile, change phone number, change settings, delete account, read support notes, and log out from the application.		
Trigger	User clicks on the "Edit Profile" text button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Profile Page.	
	2	System displays the "Edit Family Group", "Edit Profile", "Change Phone Number", "Settings", "About Us", "Contact Us", "FAQ", "Delete Account", and "Logout" text buttons.	
	3	User clicks on the "Edit Profile" or "Change Phone Number" text button.	
	4	User edits the information.	
	5	User clicks on the "Save Changes" button.	
	6	System displays a successful page after successfully editing the information, and directs the user back to the Profile Page.	
Sub Flow – Change Settings	2a.1	User clicks on the "Settings" text button.	
	2a.2	User switches on or off the "Push Notification" toggle button to enable or disable notification from the application.	
	2a.3	User clicks on the preferred language.	
	2.a.4	System displays in the selected language.	
Sub Flow – Read Support Notes	2.b.1	User clicks on the "About Us", "Contact Us", or "FAQ" text button.	
	2b.2	System displays the support notes.	
	2c.1	User clicks on the "Delete Account" text button.	

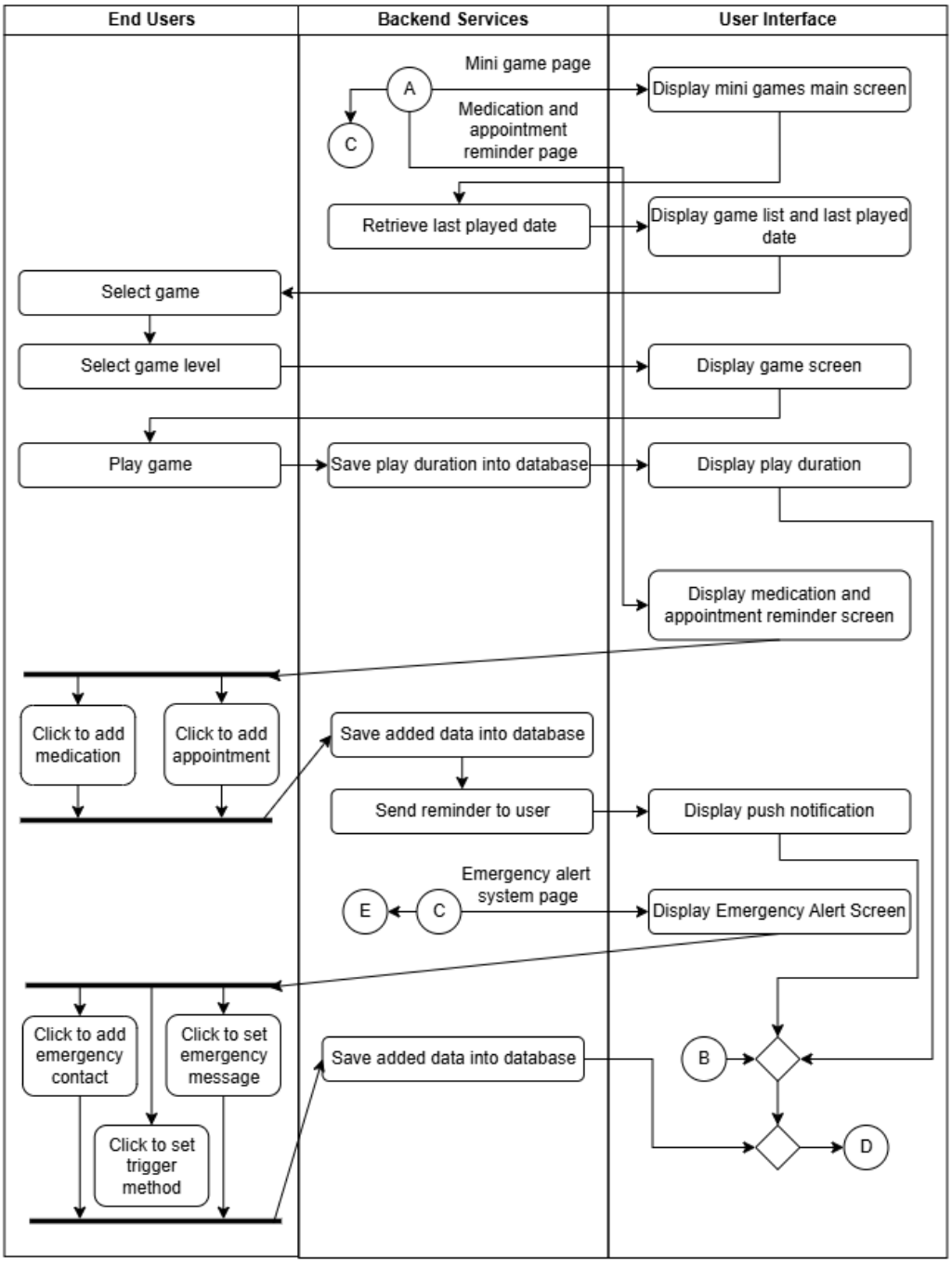
Sub Flow – Delete Account	2c.2	System displays a pop-up window to ask for confirmation.
	2c.3	User clicks on the “Delete” button.
	2c.4	System deletes the user account and directs the user to the login page.
Sub Flow – Logout	2d.1	User clicks on the “Logout” text button.
	2d.2	System displays a pop-up window to ask for confirmation.
	2d.3	User clicks on the “Log Out” button.
	2d.4	System logs out the user and directs the user to the login page.

Table 4.8 Use Case Description for “Change Application Language” Use Case

Use Case ID	**UC008**	**Use Case Name**	Change Application Language
Primary Actor	User		
Brief Description	Users can access the Profile Page to edit family group, edit profile, change phone number, change settings, delete account, read support notes, and log out from the application.		
Trigger	User clicks on the “Settings” text button.		
Precondition	User has accessed the application home page.		
Scenario Name	**Step**	**Action**	
Main Flow	1	User accesses the Profile Page.	
	2	User clicks on the “Settings” text button.	
	3	User clicks on the preferred language.	
	4	System displays in the selected language.	

4.4 Activity Diagram




End Users
Backend Services
User Interface
Mini game page
A
C
Display mini games main screen
Medication and appointment reminder page
Retrieve last played date
Display game list and last played date
Select game
Select game level
Display game screen
Play game
Save play duration into database
Display play duration
Display medication and appointment reminder screen
Click to add medication
Click to add appointment
Save added data into database
Send reminder to user
Display push notification
Emergency alert system page
E
C
Display Emergency Alert Screen
Click to add emergency contact
Click to set emergency message
Click to set trigger method
Save added data into database
B
D

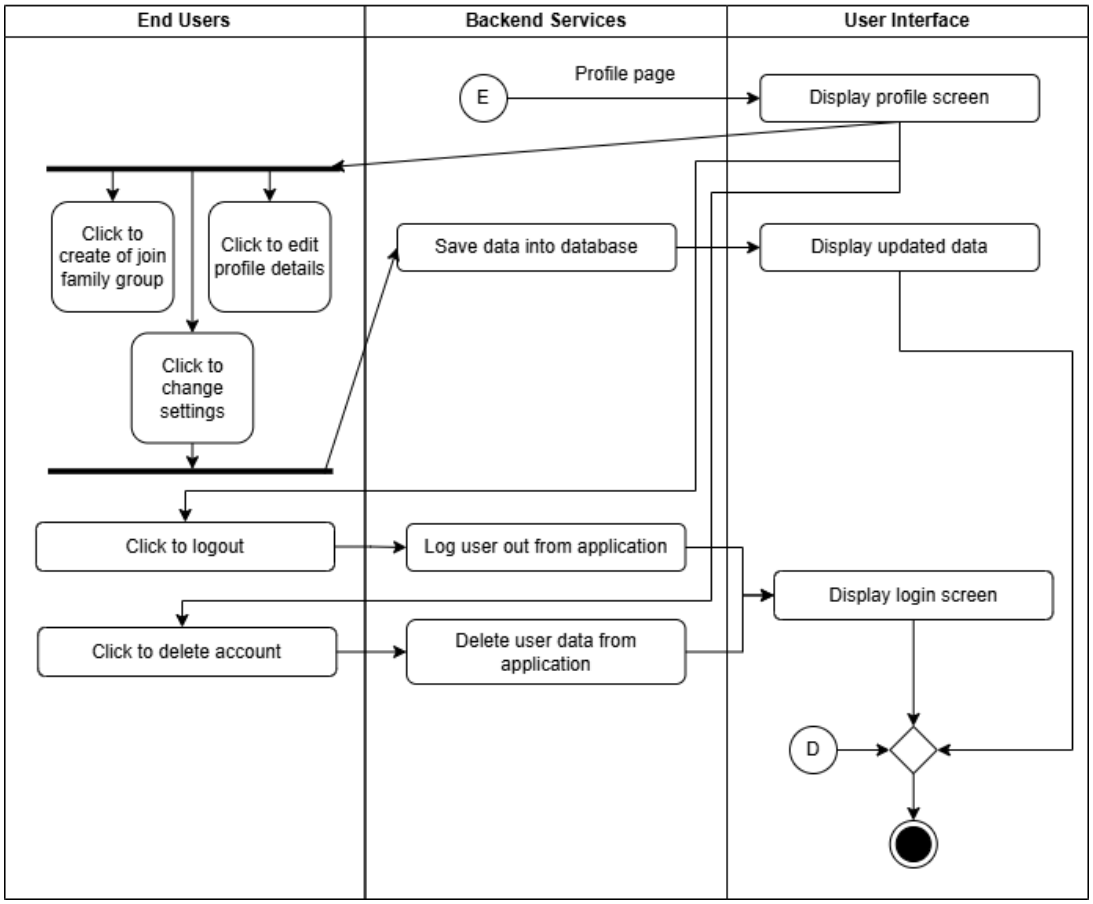


Figure 4.3 Activity diagram for proposed elderly assistance application

Figure 4.3 shows the application flow involving the end users, backend services, and user interface. When a new user has completed the registration or an existing user has logged into the application, their information will be stored and authenticated by backend services. Then, they will be directed to the home page that displays the available features.

If the users select the family locator feature, they will be directed to the family locator main page, and their current position will be fetched by backend services and displayed on the map. Users can add geofencing locations so that they will be alerted if someone is entering or leaving the geofencing locations. Besides, users can share their positions with family members by adding family members to the family group.

If the users select the task assistance feature, they will be directed to the task assistance main page, and a list of helpers will be fetched by backend services and displayed to users. Users can click on each helper to view their details and chat with

them. By clicking the chat floating button, users can view their chat histories. Users can also enter the search terms in the search bar to search for task helpers that match their requirements.

If the users select the mini game features, they will be directed to the mini game main page. A list of available games and the last played date of each game will be retrieved by backend services and displayed to users. Users can first select the game they want to play, and then select the difficulty level they prefer. Then, users can play the selected game. The play duration will be displayed to users and saved to the database.

If the users select medication and appointment reminder features, they will be directed to the medication and appointment reminder main page. The daily, weekly, and monthly calendars will be displayed with added medication and appointments fetched by backend services. Users can click to add medication and an appointment, enter the details needed, and the data will be stored in the database. Reminders will be sent to the user in push notifications.

If the users select emergency alert features, they will be directed to the emergency alert main page. Users can add emergency contacts, set the emergency message, and set the system trigger method. The data will be stored in the database.

If the users select the profile page, they will be directed to the profile main page. Users can create or join a family group and edit profile details. Besides, they can change the system settings such as push notification receiving preference and application language. Users can also log out and delete their account from this application, and they will be directed to the login page.

CHAPTER 5: System Implementation

5.1 Integration of Google Firebase Services

Firstly, a Firebase project is being created as shown in Figure 5.1.

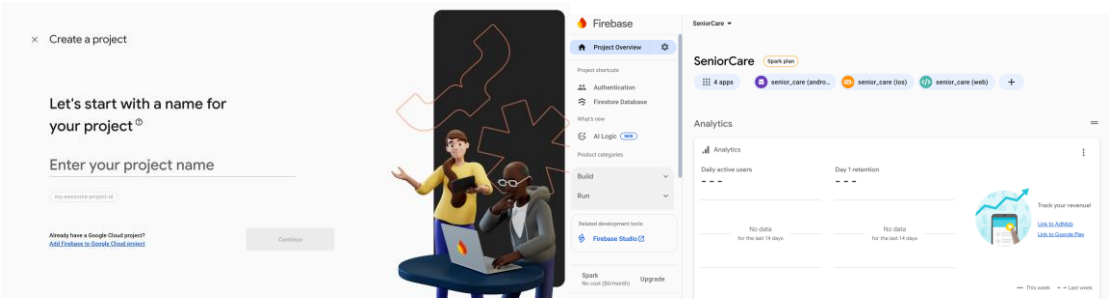


Figure 5.1 Create a Firebase project

Once the project is created, a new project is initiated in Flutter. The project is created with Android Studio and coded in a .dart file. To access Firebase services in a Flutter project, the Firebase CLI needs to be installed as illustrated in Figure 5.2.

```
Command Prompt
Microsoft Windows [Version 10.0.26100.6584]
(c) Microsoft Corporation. All rights reserved.

C:\Users\USER>npm install -g firebase-tools
npm warn deprecated node-domexception@1.0.0: Use your platform's native DOMException instead

added 115 packages, removed 27 packages, and changed 602 packages in 40s

82 packages are looking for funding
  run `npm fund` for details
npm notice
npm notice New major version of npm available! 10.9.2 -> 11.6.0
npm notice Changelog: https://github.com/npm/cli/releases/tag/v11.6.0
npm notice To update run: npm install -g npm@11.6.0
npm notice
```

Figure 5.2 Code to install Firebase CLI

After the installation, authentication must be done by logging into Firebase and listing the Firebase project, as shown in Figure 5.3. FlutterFire CLI also needs to be installed before configuring the application to use Firebase services. A google-services.json file will be added after successful configuration. The steps are shown in Figure 5.4 and Figure 5.5, respectively.

```
C:\Users\USER>firebase login
Already logged in as ruoying23@gmail.com

C:\Users\USER>firebase projects:list
✓ Preparing the list of your Firebase projects
```

Project Display Name	Project ID	Project Number	Resource Location ID
SeniorCare	seniorcare-32801	420135765463	[Not specified]

```
1 project(s) total.
```

Figure 5.3 Log into Firebase and list Firebase project

```
PS C:\Users\User> dart pub global activate flutterfire_cli
Package flutterfire_cli is currently active at version 0.2.7.
Resolving dependencies...
The package flutterfire_cli is already activated at newest available version.
To recompile executables, first run `dart pub global deactivate flutterfire_cli`.
Installed executable flutterfire.
Activated flutterfire_cli 0.2.7.
```

Figure 5.4 Install FlutterFire CLI

google-services.json | med_appt_reminder_page.dart | add_medicine_page.dart

```json
{
  "project_info": {
    "project_number": "420135765463",
    "project_id": "seniorcare-32801",
    "storage_bucket": "seniorcare-32801.firebasestorage.app"
  },
  "client": [
    {
      "client_info": {
        "mobilesdk_app_id": "1:420135765463:android:a4aa998b08f94d1ce03792",
        "android_client_info": {
          "package_name": "com.example.senior_care"
        }
      },
      "oauth_client": [],
      "api_key": [
        {
          "current_key": "AIzaSyBGt2E63EPhahLSMUb-kuB4DoxVYG_a1Wo"
        }
      ],
      "services": {
        "appinvite_service": {
          "other_platform_oauth_client": []
        }
      }
    }
  ],
  "configuration_version": "1"
}
```

Figure 5.5 The google-services.json file

As illustrated in Figure 5.6, the Firebase plugin needs to be imported before using the services and before running the code, Firebase is initialized in the project.

```
# Firebase
firebase_core: ^3.12.1
firebase_auth: ^5.5.1
cloud_firestore: ^5.6.5
firebase_messaging: ^15.2.4
```

```
await Firebase.initializeApp(
  options: DefaultFirebaseOptions.currentPlatform,
);
```

Figure 5.6 Import Firebase plugin and initialize Firebase

The Firebase services that will be used in the proposed application are user authentication and Cloud Firestore, which provides cloud storage. The Firebase plan used in the proposed application is the Spark plan, which is free to use with limits of 50K times of document read and write per day. Figure 5.7 shows the structure of the Cloud Firestore database.

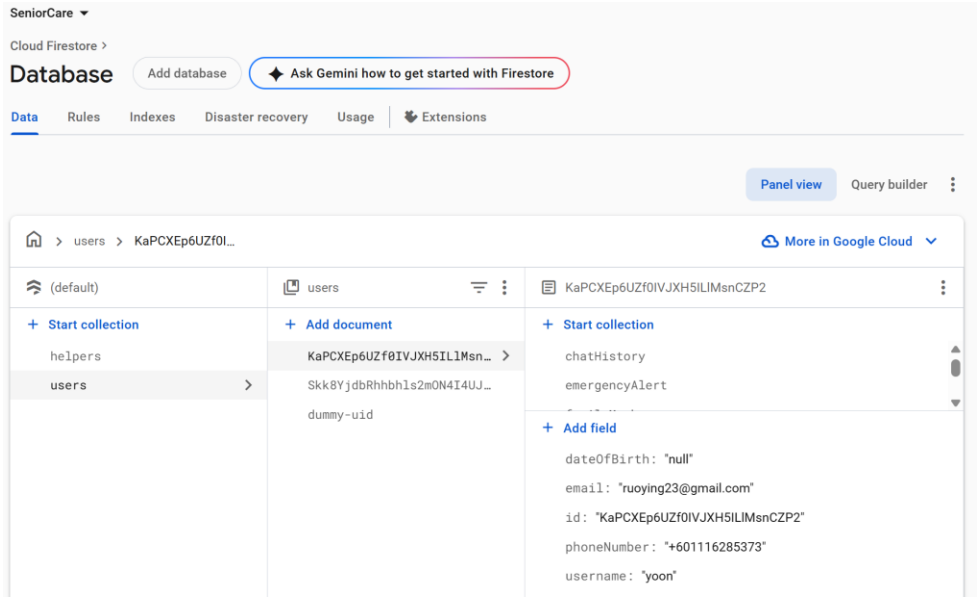


Figure 5.7 Overview of the Cloud Firestore database

Authentication supports multiple sign-in methods, including email/password, phone numbers, and social logins like Google and Facebook [21]. In the proposed application, phone numbers are chosen as the sign-in method, as shown in Figure 5.8.

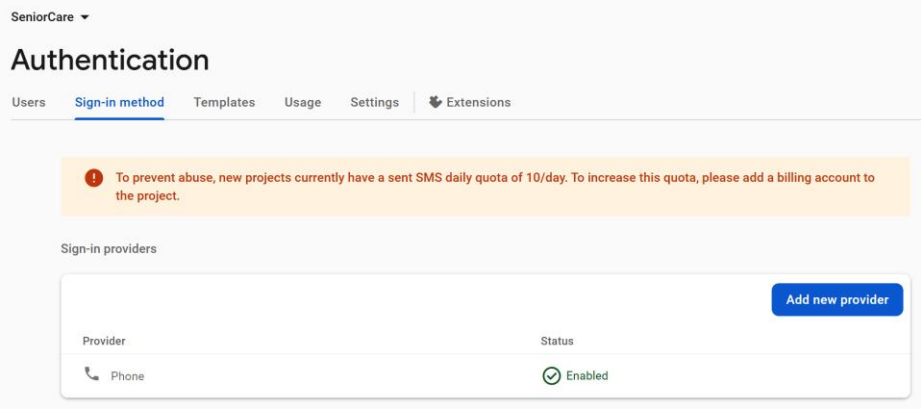


Figure 5.8 Firebase Authentication

5.2 Development of Onboarding Screens

The onboarding screen is a critical component for every mobile application, as it is the first point of interaction between users who launch an app for the first time and the system, as illustrated in Figure 5.9. It welcomes the users, introduces them to the application, and prompts them to get started. In the proposed application, the type of onboarding screen chosen is the value proposition screen. It is used to highlight its benefits and uniqueness [22].

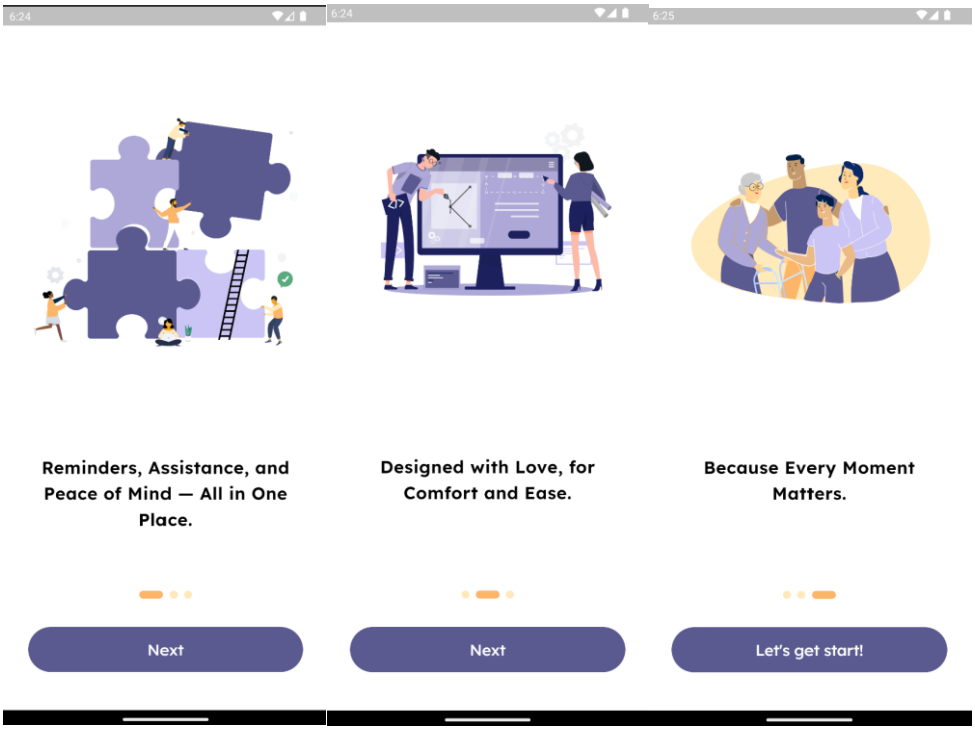


Figure 5.9 Onboarding screen

5.3 Development of Login and Signup Screen

Before login, users need to register for an account on the register page, which will ask for users' information, including username, phone number, email, and password, as shown in Figure 5.10.

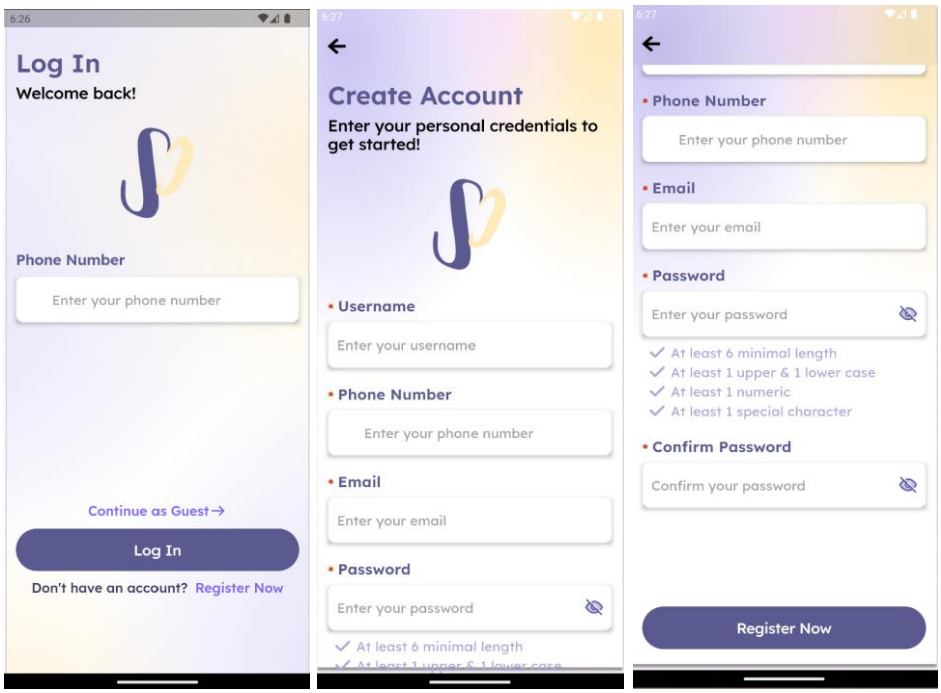


Figure 5.10 Login page (first) and Register page (second and third)

Existing users or users who have already created an account can log in to the application by keying in their phone number and One-Time Password (OTP) code as displayed in Figure 5.11.

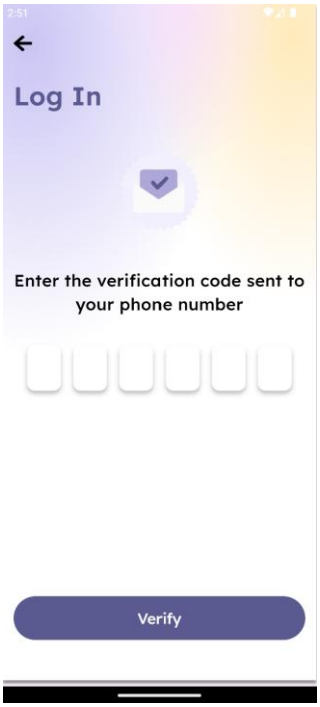


Figure 5.11 Login OTP page

5.4 Development of the Home Page and bottom Navigation Bar

After login, users will be directed to the home page, as illustrated in Figure 5.12, which serves as the central navigation page of the application. It displays the proposed functionalities with clickable rectangles, labels, and icons that represent the function. When users click on any of the items, they will be directed to the specific page related to that function.

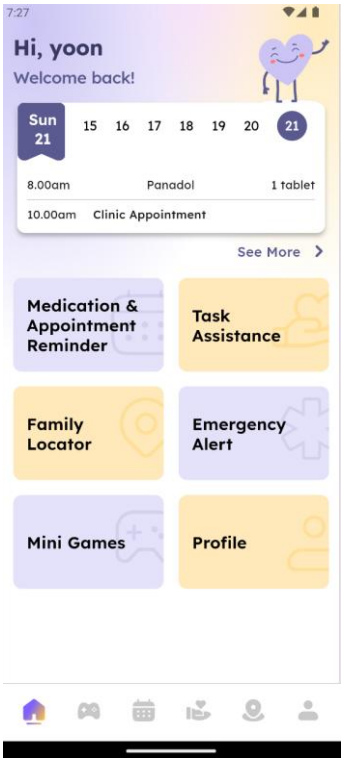


Figure 5.12 Home page

The bottom navigation bar with icons displayed in Figure 5.13 is being implemented for fast switching between main features. The color difference of icons indicates the selection of features. The selected feature will be displayed with a colored icon, while the other unselected features will be displayed with grey icons.

Figure 5.13 Bottom navigation bar

5.5 Development of the Profile Features and Settings

When users click on the Profile button, they will be directed to the profile page. In the profile page, users can edit their family group, edit profile information, change phone number, change application settings, read about support notes, delete account, and log out, as shown in Figure 5.14.

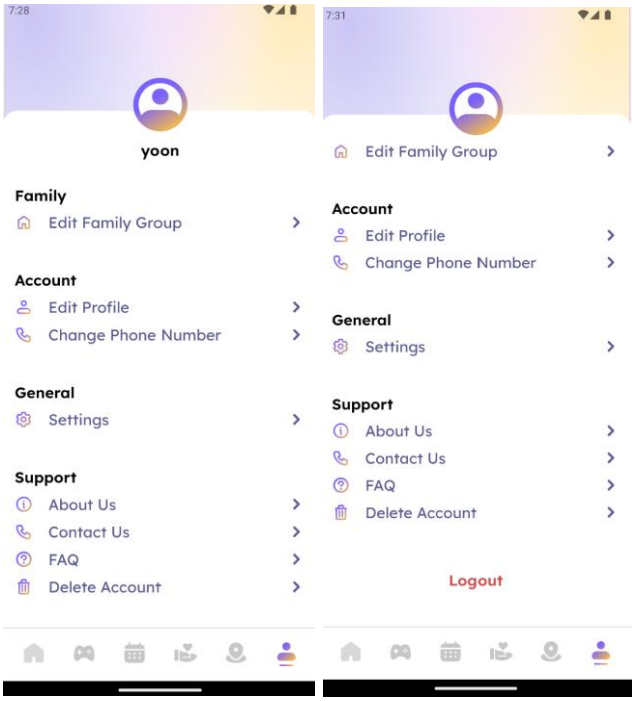


Figure 5.14 Profile page

When users click on the Edit Family Group, they will be directed to the page as illustrated in Figure 5.15, and will be able to view the family members in the same family group.

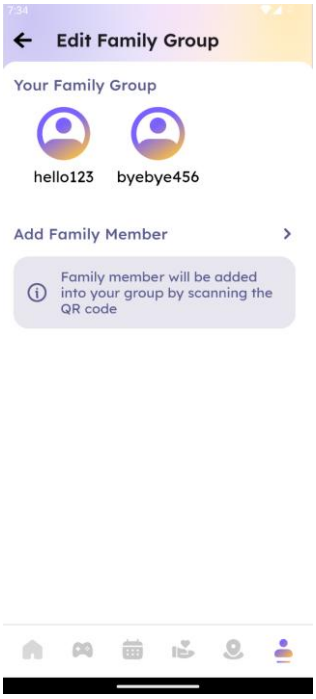


Figure 5.15 Edit family group page

If users have not joined in any family group, they can click on the Create or Join Family Group button. To add family members to join a family group, a shareable QR code displayed in Figure 5.16 will be generated.

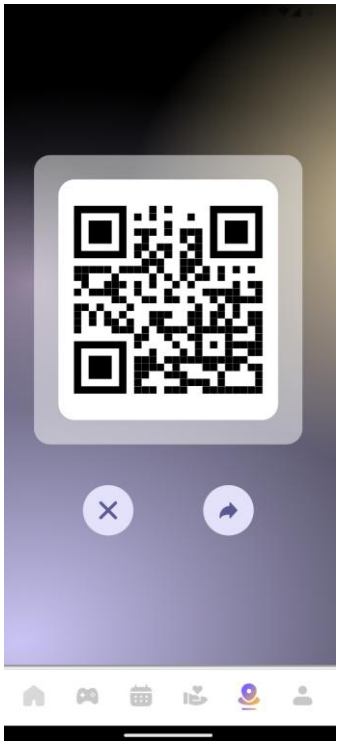


Figure 5.16 Sharable QR code to join a family group

Besides, by clicking on Edit Profile, users can edit their profile information such as profile image and username as shown in Figure 5.17. The information will be stored in the database and updates will reflect quickly.

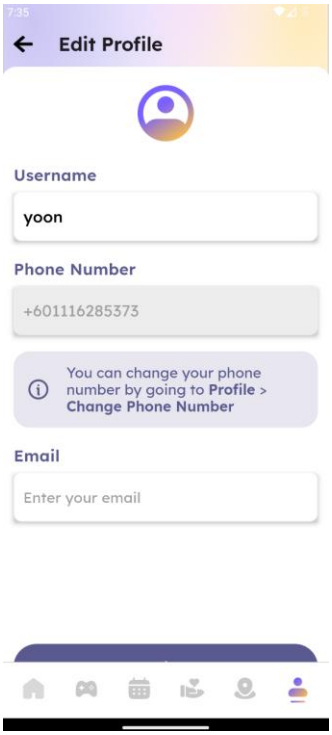


Figure 5.17 Edit profile information

By clicking on the Settings button, users can select one of the three languages that they prefer, and the system will change to the selected language quickly, as shown in Figure 5.18.

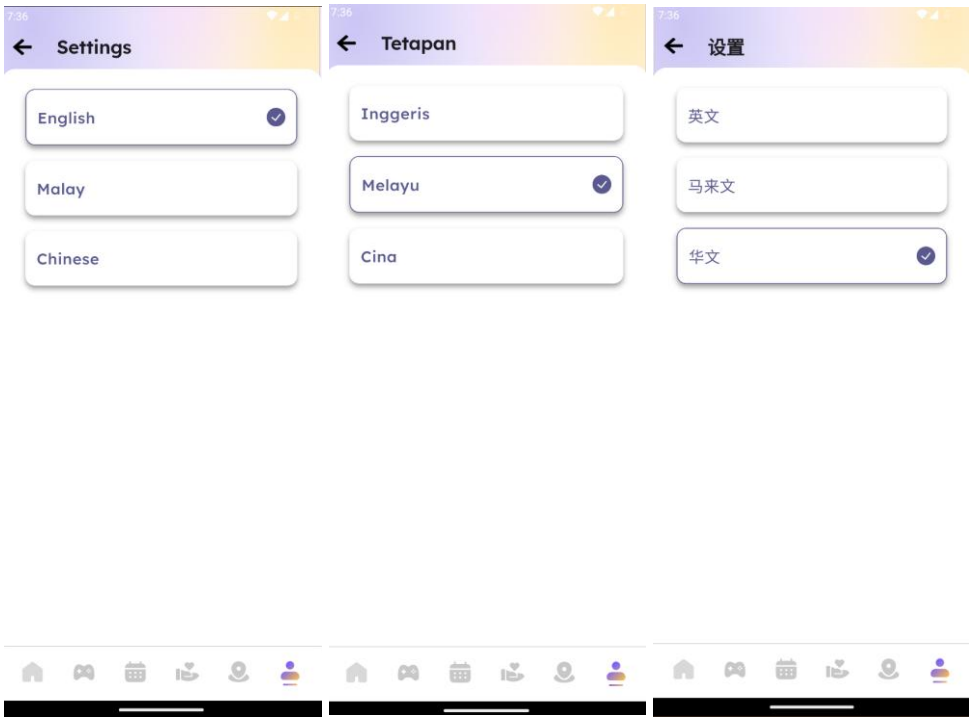


Figure 5.18 Change application language

Under the Support section, users can view the basic information about the application by clicking About Us, Contact Us, and FAQ. Each is displayed in Figure 5.19.

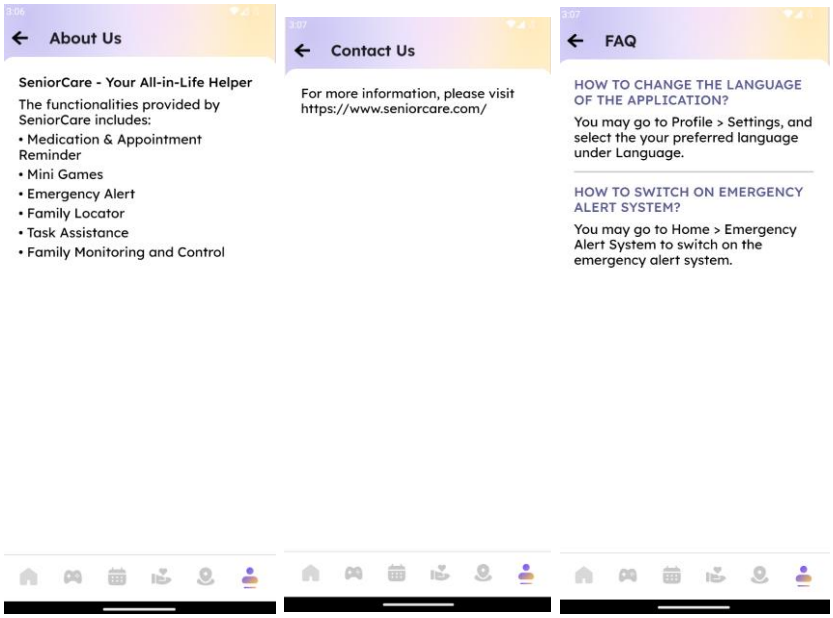


Figure 5.19 About Us, Contact Us, and FAQ

When users click on the Delete Account, a pop-up window, as illustrated in Figure 5.20, will appear to get confirmation from users. To confirm the deletion of the account, users need to click the Delete button, and all the user data will be deleted from the database..

Figure 5.20 Delete account pop-up window

By clicking the Logout text button, a pop-up window, as illustrated in Figure 5.21, will appear to get confirmation from users. To confirm the logout, users need to click the Logout button, and all users will be logged out and directed to the login page.

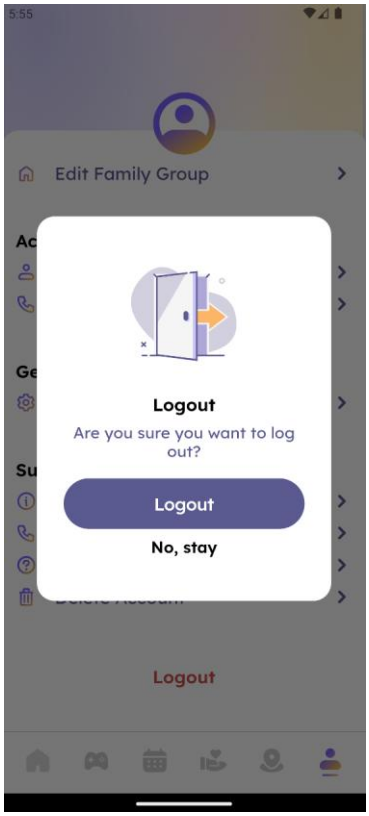


Figure 5.21 Logout pop-up window

5.6 Development of the Family Locator Features

When users enter the family locator main page, the location permission will be checked. For users who have not been granted permission, a permission-asking dialog will be prompted to gain permission, as shown in Figure 5.22.

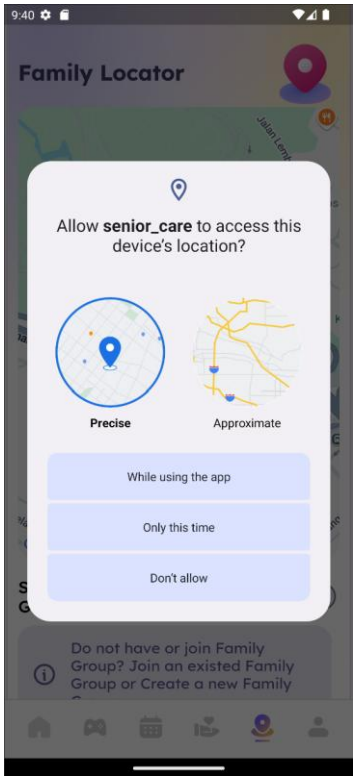


Figure 5.22 Location permission granting dialog

As illustrated in Figure 5.23, the current location of users will be displayed on the map with a purple map pin. If the location sharing with family member switch button is on, users can view the current location of family members in a family group. The current location of family members will be displayed with an orange map pin. To have the location sharing function, users will need to have a family group.

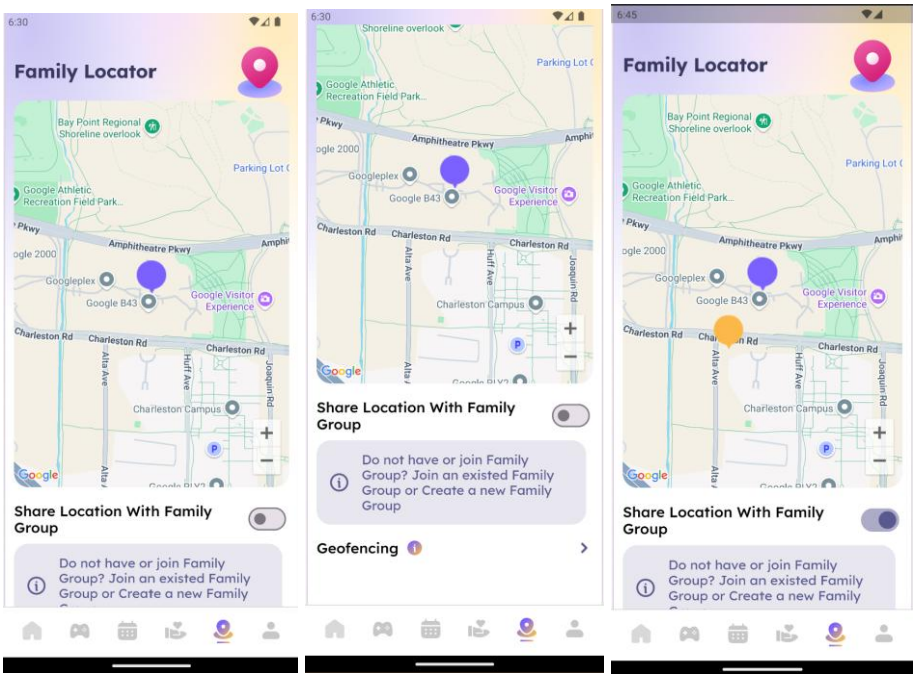


Figure 5.23 Family locator main page and location sharing with family member (third)

Besides, the bottom sheet, as shown in Figure 5.24, will be displayed to explain the geofencing features to users who click on the information icon.

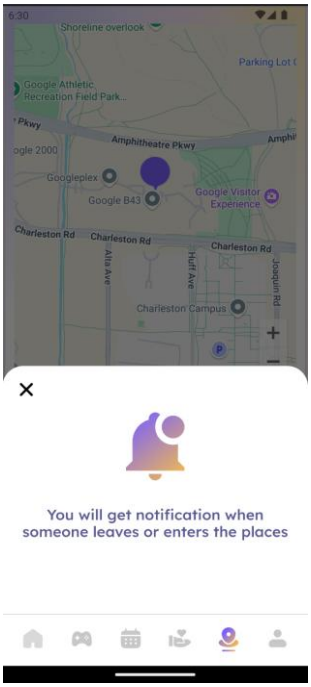


Figure 5.24 Bottom sheet explaining geofencing features

In Figure 5.25, users can add geofencing places by moving the pin to a desired location, and entering the location name and geofencing radius. After adding, the added geofencing location will be displayed on the geofencing page.

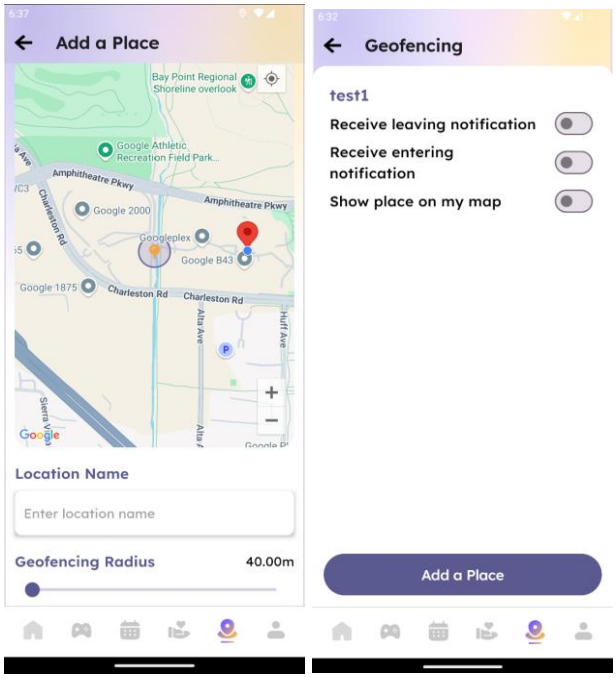


Figure 5.25 Add geofencing place page and geofencing page

When someone enters or leaves the defined geofencing locations, user will receive push notification as shown in Figure 5.26.

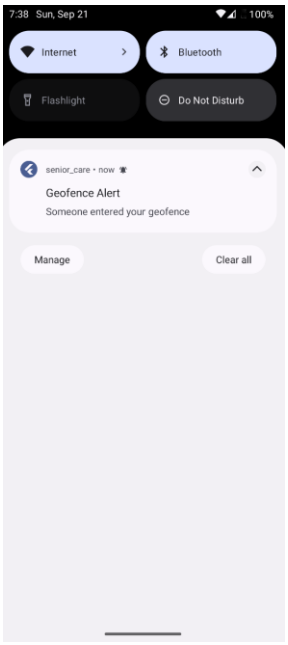


Figure 5.26 Push notification for geofencing locations

5.7 Development of the Task Assistance Features

When users enter the task assistance main page, the information of the task helpers will be fetched from a mock Application Programming Interface (API). The details of the helpers, such as contact number, location, services provided, rating, and comments, will be displayed to users when they click on respective helpers, as shown in Figure 5.27.

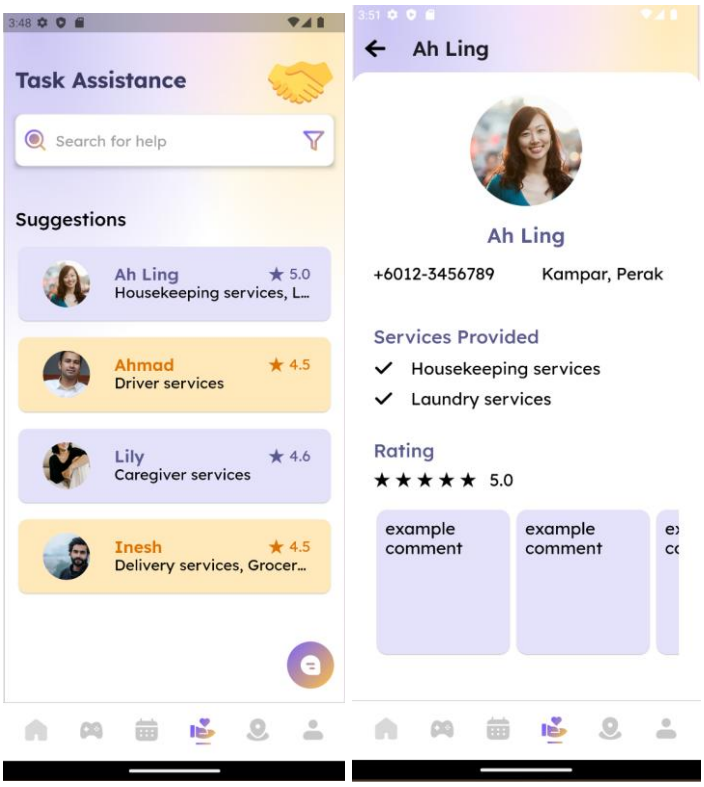


Figure 5.27 Task assistance main page (left) and task helpers detail page (right)

By clicking on the floating chat button, users can view a list of chat history and chat with the task helpers, as displayed in Figure 5.28.

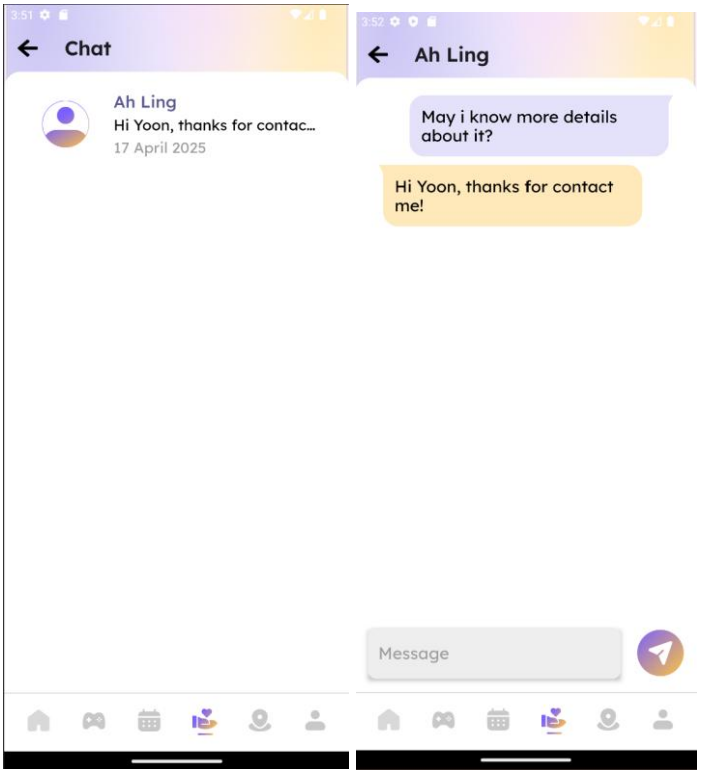


Figure 5.28 Chat listing page (left) and chat room page (right)

Users can narrow down the search by applying filters. By entering specific requirements in the search bar. Matching results will be returned to user as shown in Figure 5.29.

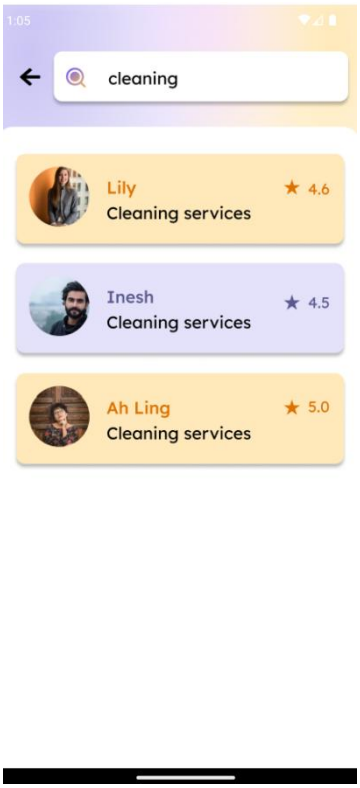


Figure 5.29 Search bar function

5.8 Development of the Emergency Alert System Features

On the main page of the emergency alert system, as illustrated in Figure 5.29, users can add their emergency contacts. Besides, the emergency message that will be sent to the emergency contacts when the system is triggered can be set in Figure 5.30.

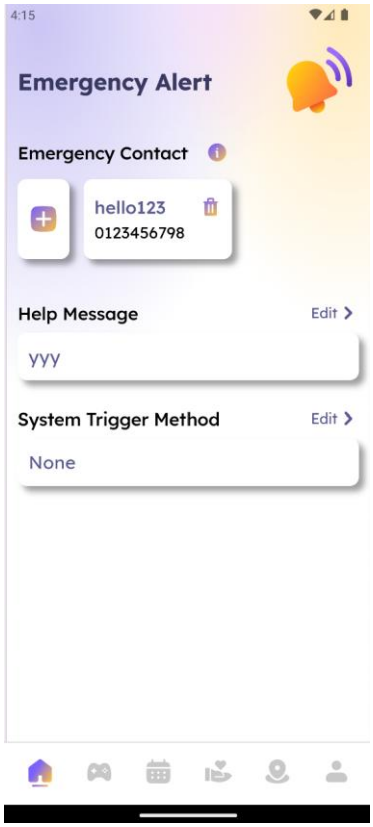


Figure 5.30 Emergency alert system main page

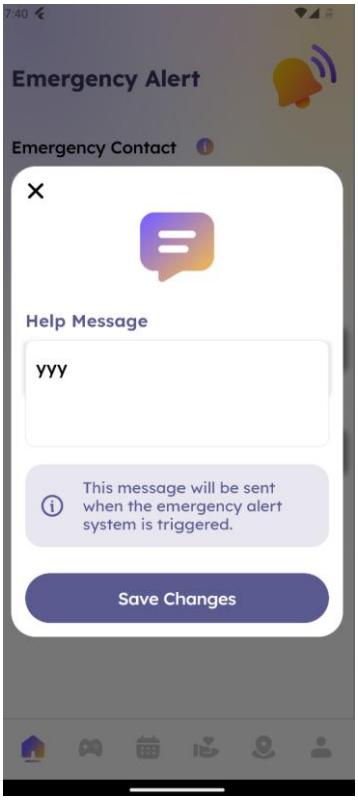


Figure 5.31 Emergency message popup window

There are three trigger methods implemented in this application: hand gesture, voice command, and inactivity timer. Users can choose either one of them from the dropdown menu, as displayed in Figure 5.32.

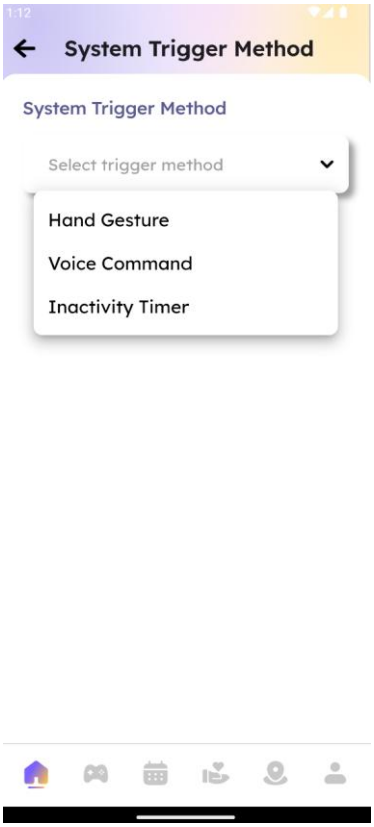


Figure 5.32 Dropdown menu to select system trigger method

For the hand gesture trigger method in Figure 5.33, users will need to draw a pattern to define the hand gesture on the given space. By clicking Done button, the points of the defined hand gesture will be stored in the database. By clicking Clear button, the drawing will be wiped from the given space.

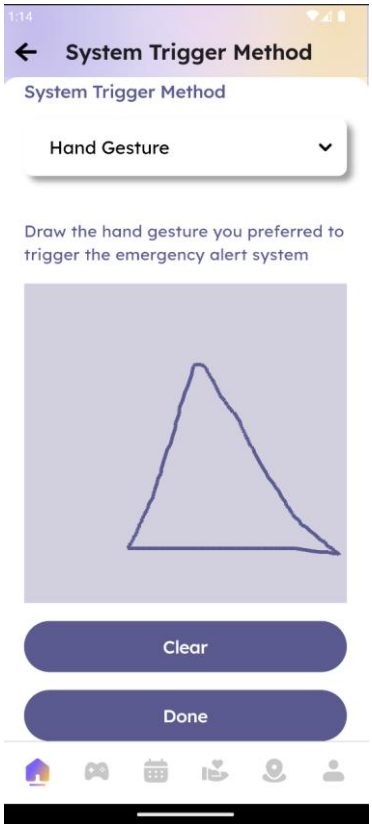


Figure 5.33 Hand gesture

For the voice command trigger method in Figure 5.34, users will need to press on the Microphone icon button while speaking to set the command. The spoken text will be captured and displayed on the screen. If the captured text is captured correctly, users can click the Done button, and the command will be stored in database.

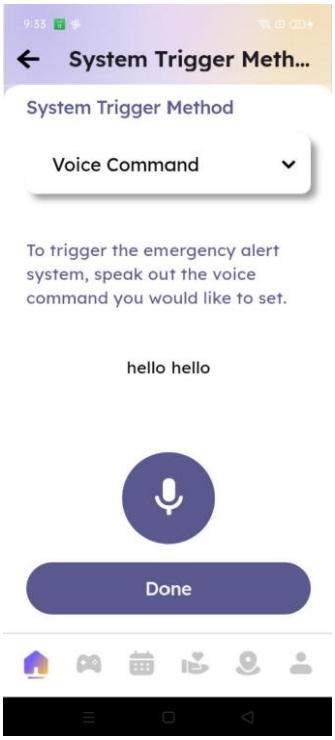


Figure 5.34 Voice command

For the inactivity timer trigger method in Figure 5.35, users will need to set an inactivity timer and a grace timer. When the inactivity timer ends, a push notification will be sent to users to remind them to deactivate the timer. At the same time, the grace timer will start to run. If it is still not deactivated, it will trigger the emergency alert system when it ends.

Figure 5.35 Inactivity timer

As shown in Figure 5.36, push notifications will be sent to notify users to deactivate the inactivity timer and grace timer.

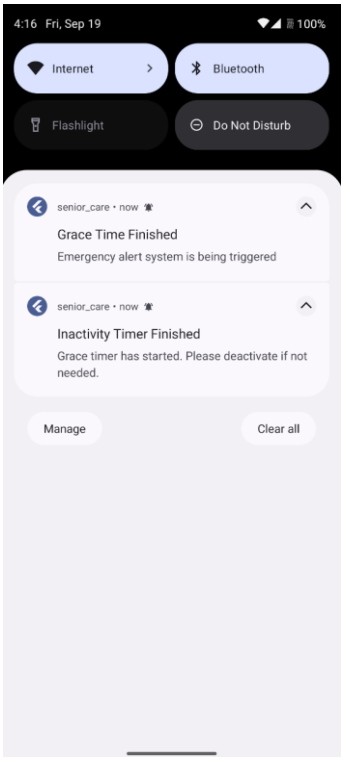


Figure 5.36 Push notification

5.9 Development of the Mini Game Features

A list of available games that are suitable for senior citizens will be displayed on the main page of the mini game functionality, as illustrated in Figure 5.37. Users can select the games they would like to play. Besides, users can also view their last played date.

Figure 5.37 Mini game main page

After selecting the game, users will be directed to the level selection page, as displayed in Figure 5.38, to select the difficulty level. The difficulty selected will be reflected in the gameplay. The differences can be viewed in Figure 5.39.

Figure 5.38 Level selection page

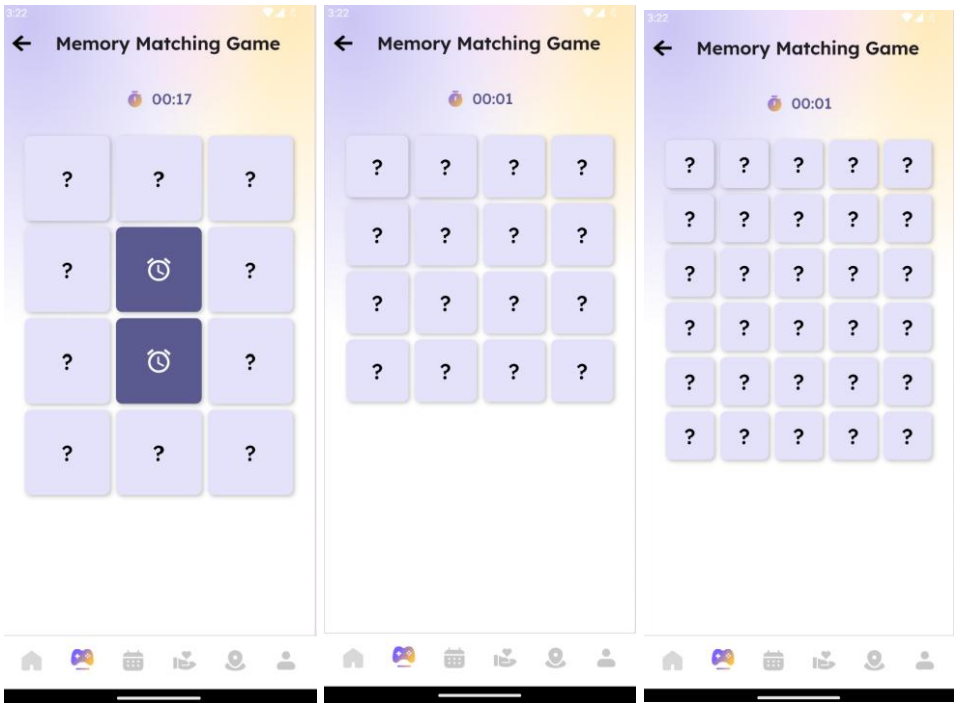


Figure 5.39 Different difficulty of game

After users complete the game, the gameplay time taken by users will be displayed as shown in Figure 5.40.

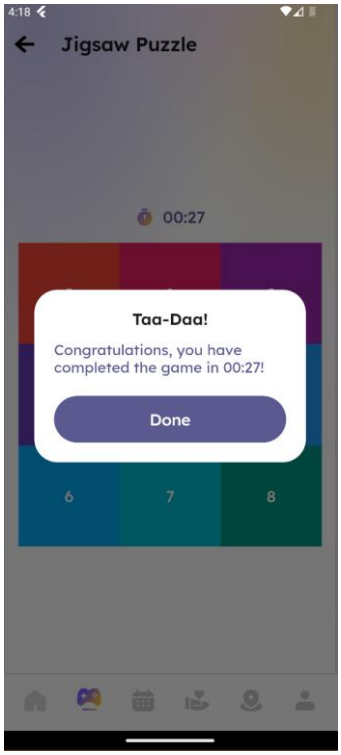


Figure 5.40 Game play time being displayed

5.10 Development of the Medication and Appointment Reminder Features

On the main page of the medication and appointment reminder, there are three calendars for users to view, which include the daily calendar, weekly calendar, and monthly calendar, as illustrated in Figure 5.41. Users can view their added medications and appointment details on the calendars.

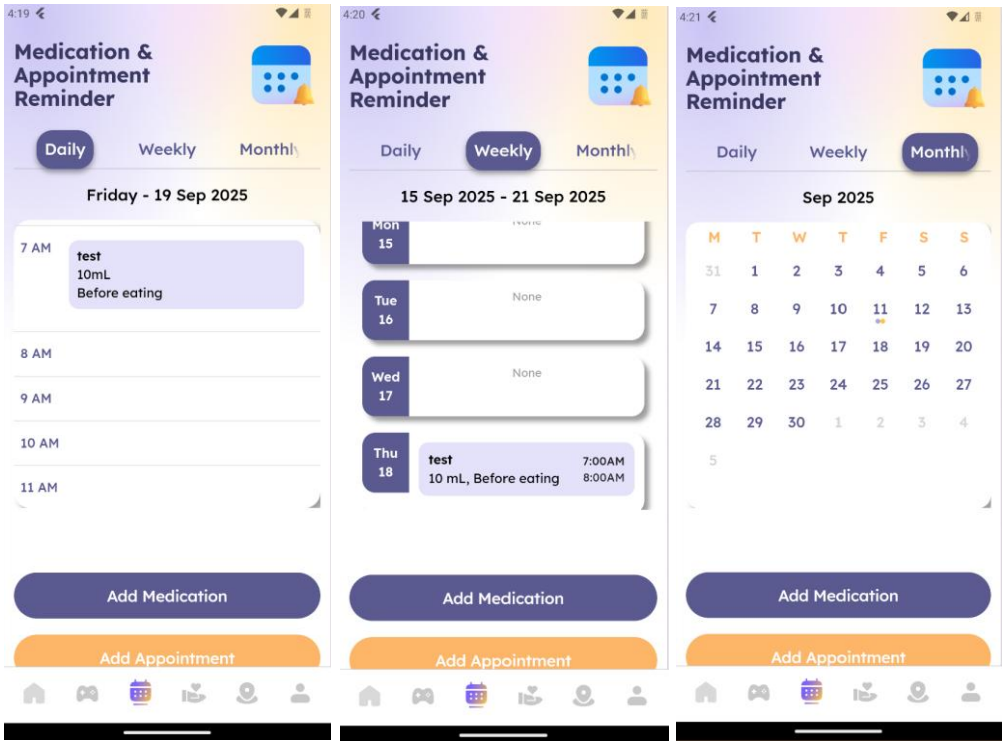


Figure 5.41 Medication and appointment reminder main page

Users can add both medications and appointments by entering the details needed, as shown in Figure 5.42 and Figure 5.43, and push notifications will be sent to users according to the reminder settings they set.

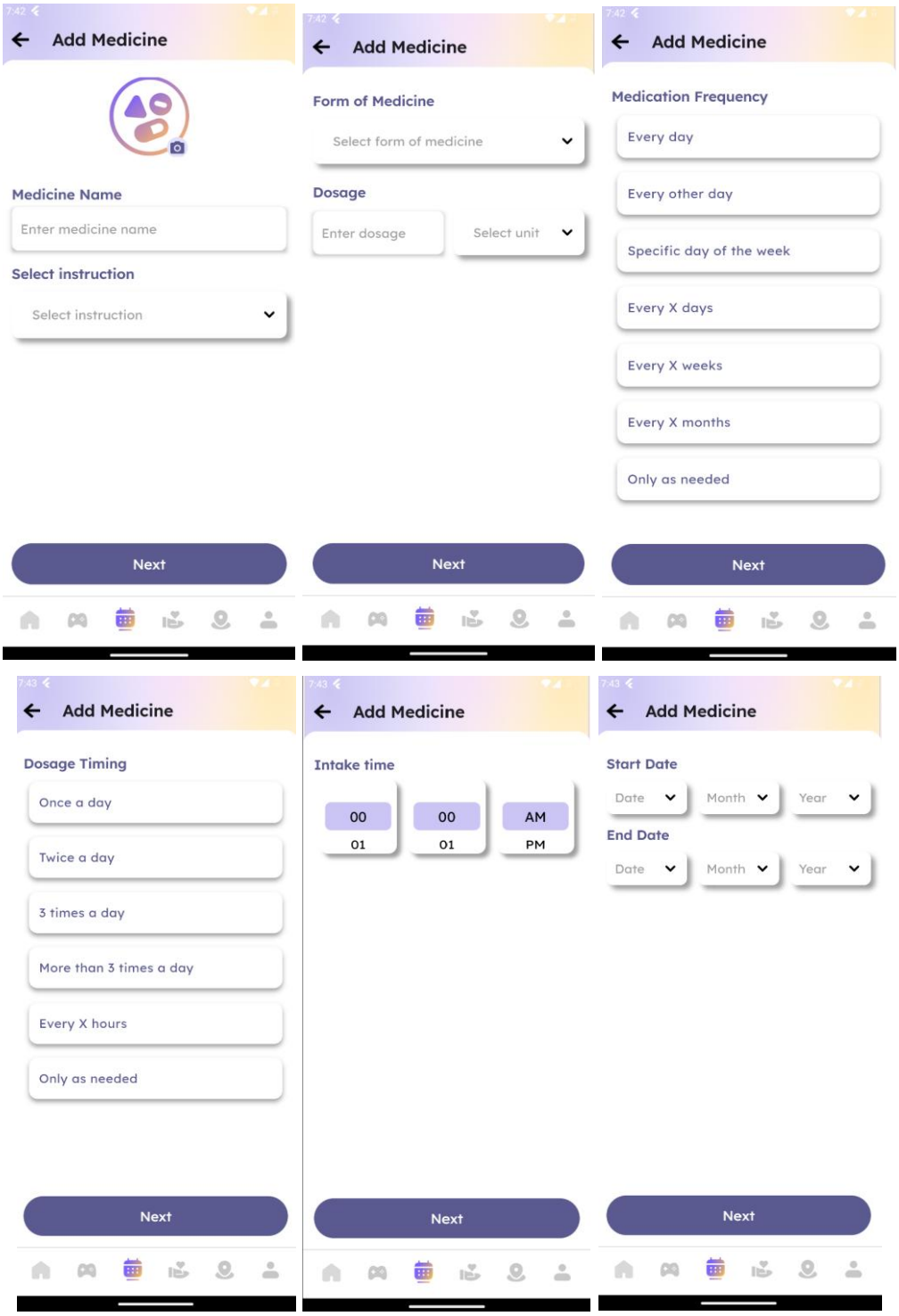


Figure 5.42 Add medicine details pages

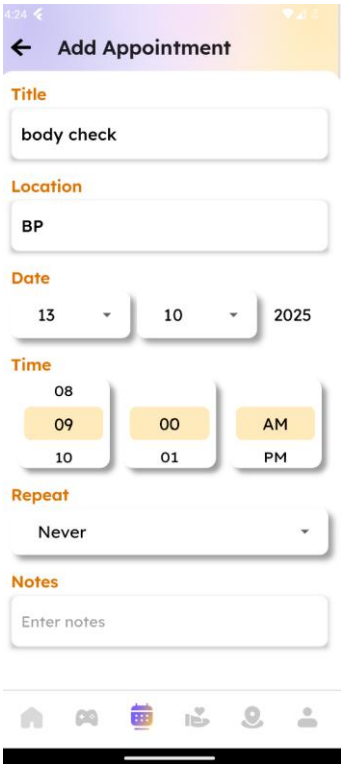


Figure 5.43 Add appointment details page

CHAPTER 6: System Evaluation and Discussion

6.1 Evaluation Methods

The system was evaluated using functional testing, performance testing, and basic usability checks. Functional testing ensured that each feature worked as expected. Performance testing focused on notification delivery time. Usability was evaluated by the interface design, accessibility, and ease of use.

6.2 Evaluation Results

Table 6.1 System evaluation results

Feature Tested	**Expected Result**	**Actual Result**	**Status**
Splash screen display	Users can view the splash screen to know about the application.	Smooth splash screen transition.	Passed
User login	Users can log in to the application.	Authentication is checked correctly before login.	Passed
Account registration	Users can register a new account after entering the needed information.	Data validation is checked for registration.	Passed
Language settings	Users can switch between supported languages.	Text updated immediately.	Passed
Profile management	Users can update profile details.	Updates reflected correctly.	Passed
Mini games	Users can play simple games with different difficulty levels.	Games functioned correctly. Last played date updates correctly.	Passed

Add geofencing locations	Add the selected area as a geofencing location.	Updates reflected correctly.	Passed
Geofencing alert	Notify users when someone enters/leaves the safe zone.	Notifications triggered correctly.	Passed
Share location with family	Users' location shared with family.	Location updated accurately.	Passed
Add appointment reminder	Users can add appointments with details and view updates instantly after being added.	Appointments were saved but displayed in the calendar after a few seconds of waiting.	Functional with delay
Add medication reminder	Users can add medication with details, and view updates instantly after being added.	Medications were saved but displayed in the calendar after a few seconds of waiting.	Functional with delay
Searching function in task assistance feature	Users can get accurate and instant search results.	Results display correctly and instantly after users stop typing.	Passed
Display task helper details	Task helper information is fetched from the mock API and displayed instantly.	Information is displayed after a few seconds of waiting.	Functional with delay
Set emergency message and trigger method	Users can set the message and trigger method.	Updates reflected correctly.	Passed
Get emergency alert notification	Users can receive emergency alert notifications.	Push notification is received.	Passed

6.3 Challenges Faced During Implementation

Many of these challenges were encountered while developing the proposed application and affected both the design approach and the overall implementation. These challenges are elaborated below:

1. Integration with Firestore Database: Managing real-time data synchronization between the application and Firestore was tricky, especially ensuring reminders of medications and appointments are up-to-date across differing calendar views (daily, weekly, and monthly views). Delays in data retrieval and event display required further improvement.
2. Notification Delivery Timing: It was challenging to implement the notification system in a manner so that push notifications would be sent appropriately at the scheduled time points. The device background limitations, the performance of the operating system, and internet accessibility affected the consistency of on-time notification delivery.
3. Complexity of Recurring Events: It proved more difficult than originally intended to implement recurring reminders based on dosings of medications and the schedule of appointments. Designing a flexible frequency logic (daily, weekly, monthly, or custom) required careful handling of time-based data and event conflicts.
4. User Interface Design for Elderly Individuals: Creating an interface that is efficient and usable for elderly users required multiple iterations. Requirements of larger buttons, simple navigation, and natural color schemes had to be balanced against the need to display many features in a limited space on the screen.
5. Testing Across Devices: Making sure of consistent performance across different screen sizes, versions of Android, and hardware was troublesome. Some hardware handled background work and notifications differently, and this affected the consistency during testing.
6. Emergency Alert System Implementation: There was a need for the emergency alert system to be integrated with both contacts and location services. There was a challenge of ensuring the system can initiate alerting immediately, transmit precise location information, and work under conditions of low connectivity.

7. Time Constraints and Scope Management: Due to limited development time, some of the advanced features, such as AI-driven personalization and wearable device integration, were noticed but left for future implementation.

CHAPTER 7: Conclusion and Recommendation

7.1 Conclusion

This project was successful in achieving its development targets that integrate multiple core functionalities, including medicines and appointment reminders, emergency alarms, family locator, mini games, and task assistance. These functionalities aim at enhancing the independence of the senior citizens and providing reassurance to the elderly's families:

1. Medication and Appointment Management: It provides reminders and timely alerts for healthcare visits and medications, and therefore, reduces the likelihood of missed visits and missed medications.
2. Brain-Stimulating Exercises: As a part of aiding cognition, the application provides mini games as entertaining activities, allowing elderly users to remain mentally active and moods elevated.
3. Emergency Alert System: During emergencies, users can immediately invoke the emergency alert system to alert emergency contacts, enabling fast response and safety.
4. GPS Tracking: Elderly individuals can have their current locations monitored, and this can bring reassurance and peace of mind for the elderly users and their relatives.
5. Task Assistance: The application enables senior citizens to request aid from task helpers for activities such as transportation and grocery shopping, making it easy and ensuring their independence.
6. Family Tracking and Control: By forming strong family bonds, family members can track the activities and locations of elder users.

In summary, the application demonstrates strengths in addressing the health, safety, and social needs of the elderly through the combination of healthcare administration and safety and family care under a single platform.

7.2 Recommendation

To enhance the degree of functionality, usability, and overall effectiveness of the elderly assistance application, there are some recommendations for future development:

1. User Experience Improvements: Enhance accessibility through larger icon sizes, high-contrast themes, and voice-controlled navigation to facilitate users with visual disabilities. Also, more languages can be provided to reach a broader population.
2. Integration with Wearable Devices: Integrate the application with smart watches and healthcare monitoring devices to capture vital signs like heart rate, blood pressure, and physical activity, and sync smoothly and regularly with the healthcare tracking system.
3. AI-Driven Personalisation: Apply artificial intelligence technologies to provide personalized health recommendations, activity suggestions, and predictive alerts, such as uncommon health patterns.
4. Offline Features: Make major functionalities like reminders for medicines, reminders for appointments, and viewing of records work without an internet connection, so that assistance continues even in places of low network availability.
5. Data Privacy and Security: Enhance security on the platform through the use of end-to-end encryption and compliance with healthcare data privacy principles to protect confidential data.
6. Community and Social Features: Incorporate social features such as group chat, discussion forums, or community message boards so elderly individuals may communicate with other users, share experiences, and reduce the sense of solitude.

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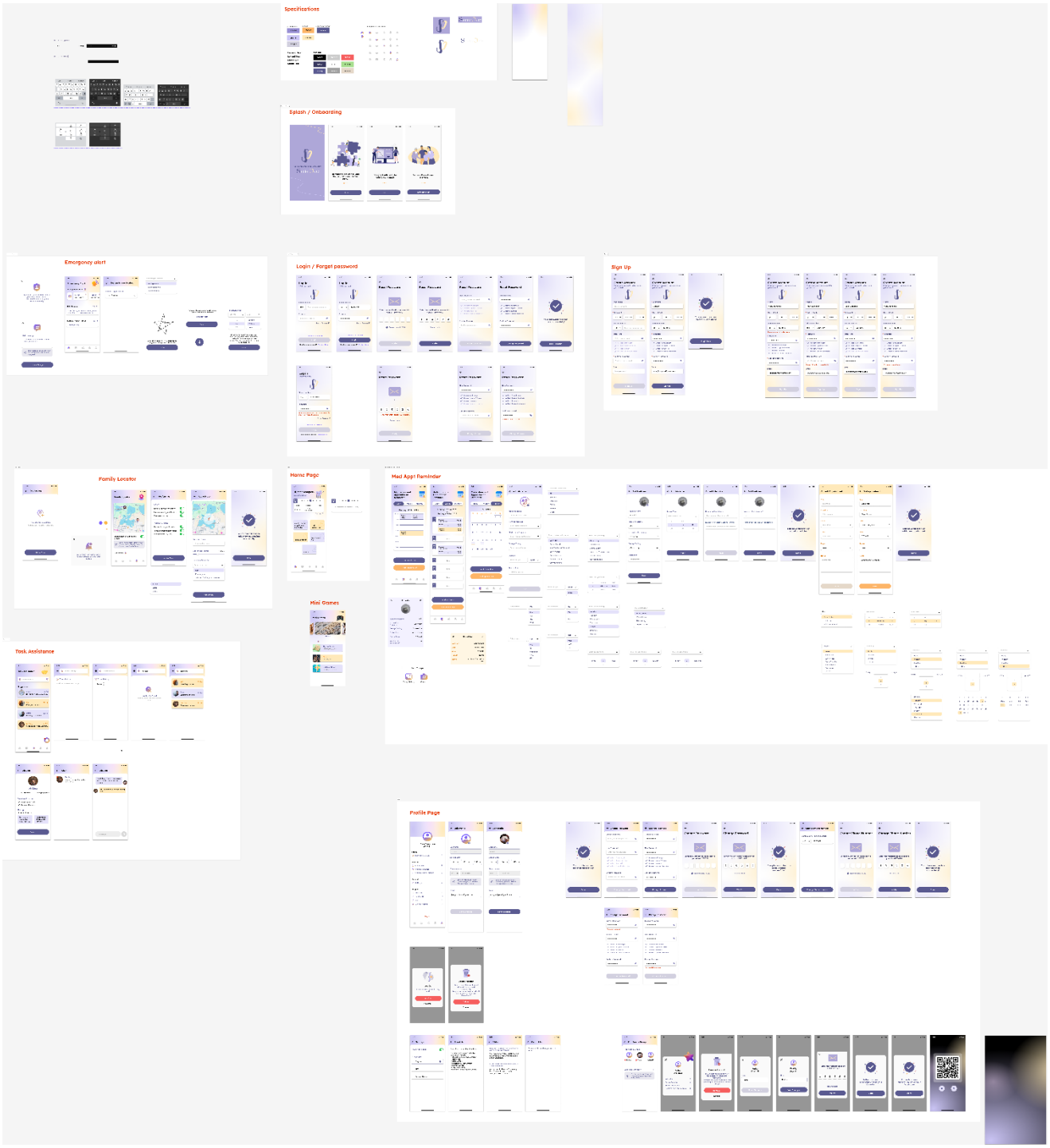
APPENDIX 1

Application Interface Design



Poster


SENIOR CARE
ELDERLY ASSISTANCE MOBILE APP
INTRODUCTION
• CURRENT MOBILE APPS SUPPORT ONLY ISOLATED NEEDS AND ARE NOT DESIGNED SPECIFICALLY FOR SENIORS.
• THIS PROJECT PROPOSED AN ONE-STOP ELDERLY ASSISTANCE MOBILE APPLICATION WITH VARIOUS FEATURES.
• ENHANCE THE INDEPENDENCE OF SENIOR CITIZENS WHILE PROVIDING PEACE OF MIND TO THEIR FAMILIES.
PROJECT OBJECTIVES
• TO PROVIDE HEALTH AND WELL-BEING SUPPORT
• TO SECURE SAFETY AND SECURITY
• TO PROVIDE ASSISTANCE AND FAMILY CONNECTIVITY
METHODS
• DEVELOPED USING FLUTTER, DART, AND AGILE METHODOLOGY.
• WIREFRAME AND UI PROTOTYPING IN FIGMA.
• FIREBASE AUTHENTICATION AND FIRESTORE INTEGRATION
DISCUSSION
• FIREBASE AUTHENTICATION FOR SIGN-IN.
• FIREBASE FIRESTORE FOR NOSQL DATA STORAGE.
• HEALTH AND WELL-BEING SUPPORT: MEDICATION AND APPOINTMENT REMINDER, MINI GAMES
• SAFETY AND SECURITY: FAMILY LOCATOR, EMERGENCY ALERT SYSTEM
• ASSISTANCE AND FAMILY CONNECTIVITY: TASK ASSISTANCE, FAMILY GROUP
RESULTS
Family Locator
Task Assistance
Medication & Appointment Reminder
Emergency Alert
Mini Games
SIANG RUO YING
21ACB04894
BACHELOR IN COMPUTER SCIENCE (HONOURS)
FINAL YEAR PROJECT