

# **CogniCare Mobile Application Development**

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## **Chapter 1: Introduction**

### **1.1 Background**

In elderly adults, Alzheimer's disease (AD) is the most prevalent type of dementia. The primary clinical manifestations of dementia, also referred to as neuropsychiatric or behavioral and psychological symptoms of dementia (BPSD), include cognitive decline and a number of other symptoms involving perception, mood, personality, and basic functioning (Bruno et al., 2023). Due to an ageing population, dementia rates are rising globally. 70% of the 270,000 dementia sufferers in the Netherlands prefer to receive their care at home. Over time, they become more reliant on their social network, and while nursing home care may eventually be required, the aim is to keep them at home as long as possible, in line with the policy in many Western nations. Despite, the aspirations of the elderly and regulations promoting ageing in place, living at home can be exceedingly challenging for person with dementia (PwD) (Thoma-Lürken et al., 2018).

Effective support measures are needed due to the rising number of people with dementia. Access to mobile devices more easily can help with the monitoring and follow-up of dementia sufferers (de Oliveira Cruz et al., 2023). Unfortunately, a recent research of PwD living at home discovered two critical themes with considerable practical issues. Reduced self-reliance and informal care/network challenges are included in these categories (Thoma-Lürken et al., 2018). In addition, another major problem is the source of stress among the aging population (Mikula et al., 2022). Therefore, to address the aforementioned issues, an application named CogniCare will be developed that will track dementia patients and lower the risk of Alzheimer's disease.

### **1.2 List of problems**

#### **1. Reduce self-reliance for people with dementia**

Dementia patients will be unable to perform ADLs (Thoma-Lürken et al., 2018).

#### **2. Informal care/network challenges for people with dementia**

Informal carers may face a significant load, absence of or a heavy load of care duty for dementia patients (Thoma-Lürken et al., 2018).

#### **3. Source of stress among the aging population**

An important source of anxiety in aging population is concerns about memory problems and possible loss of independence (Mikula et al., 2022).

### **1.3 Problem statement**

There is a problem in the care of individuals with dementia. Despite attempts to promote independence, a reduction in self-reliance among dementia patients is occurring. This issue is supported by research suggesting that dementia patients become progressively unable to execute Activities of Daily Living (ADLs), etc. This problem has negatively affected both patients and carers because it leads to a loss of autonomy, increased caregiving load, etc. (Thoma-Lürken et al., 2018). A possible cause of this problem is the gradual nature of dementia, which weakens cognitive and functional capacities over time. Perhaps a study which investigates effective interventions and strategies to sustain self-reliance in dementia patients by using a holistic care paradigm and evidence-based approaches could help address this dilemma. Such a study has the potential to improve the quality of life for people with dementia while also easing the burden on carers.

### **1.4 Problem solution**

To address the multiple issues faced by people with dementia, notably Alzheimer's disease, the creation of "CogniCare", a smartphone application is proposed. This unique program will provide cognitive training exercises, cognitive progress tracking, etc., allowing dementia patients to regain and preserve their independence. CogniCare will be subjected to rigorous research to ensure its effectiveness, led by holistic care paradigms and evidence-based methodologies. This method has the potential to greatly improve the quality of life for those living with dementia while also reducing the strain on carers.

### **1.5 Project Objectives**

1. To investigate the existing techniques and systems to stimulate brain for individuals with dementia.
2. To design and develop the CogniCare mobile application, which aims to enhance the self-reliance of dementia patients living at home.
3. To validate the effectiveness of the CogniCare application in improving the quality of life for individuals with dementia.

## 1.6 Project Questions

1. What are the existing techniques and systems that could stimulate brain for individuals with dementia?
2. How to design and develop the CogniCare mobile application, which could enhance the self-reliance of dementia patients living at home?
3. Can CogniCare effectively address the issue of improving the quality of life for individuals with dementia?

## 1.7 Project Scope

*Table 0-1.0 - System project scope*

Level	Basic	Description
Basic	The system shall be able to provide games that stimulate the brain	The system shall allow the user to play games that are designed to challenge the four core cognitive areas: Problem-solving, Speed, Memory, and Attention
	The system shall be able to provide exercise programs	The system shall allow the user to access list of daily workout routines to stay physically fit
	The system shall be able to provide nutrition tips	The system shall allow the user to view different nutrition tips
Intermediate	The system shall be able to provide a variety of food recipes	The system shall allow the user to view different types of real-time recipes
	The system shall be able to provide news for the user to read	The system shall allow the user to view different real-time news
Advance	The system shall be able to keep track and assess cognitive over time	The system shall allow the user to view a progress report based on their baseline, which is measured when they join by receiving an assessment

## 1.8 Conceptual Framework

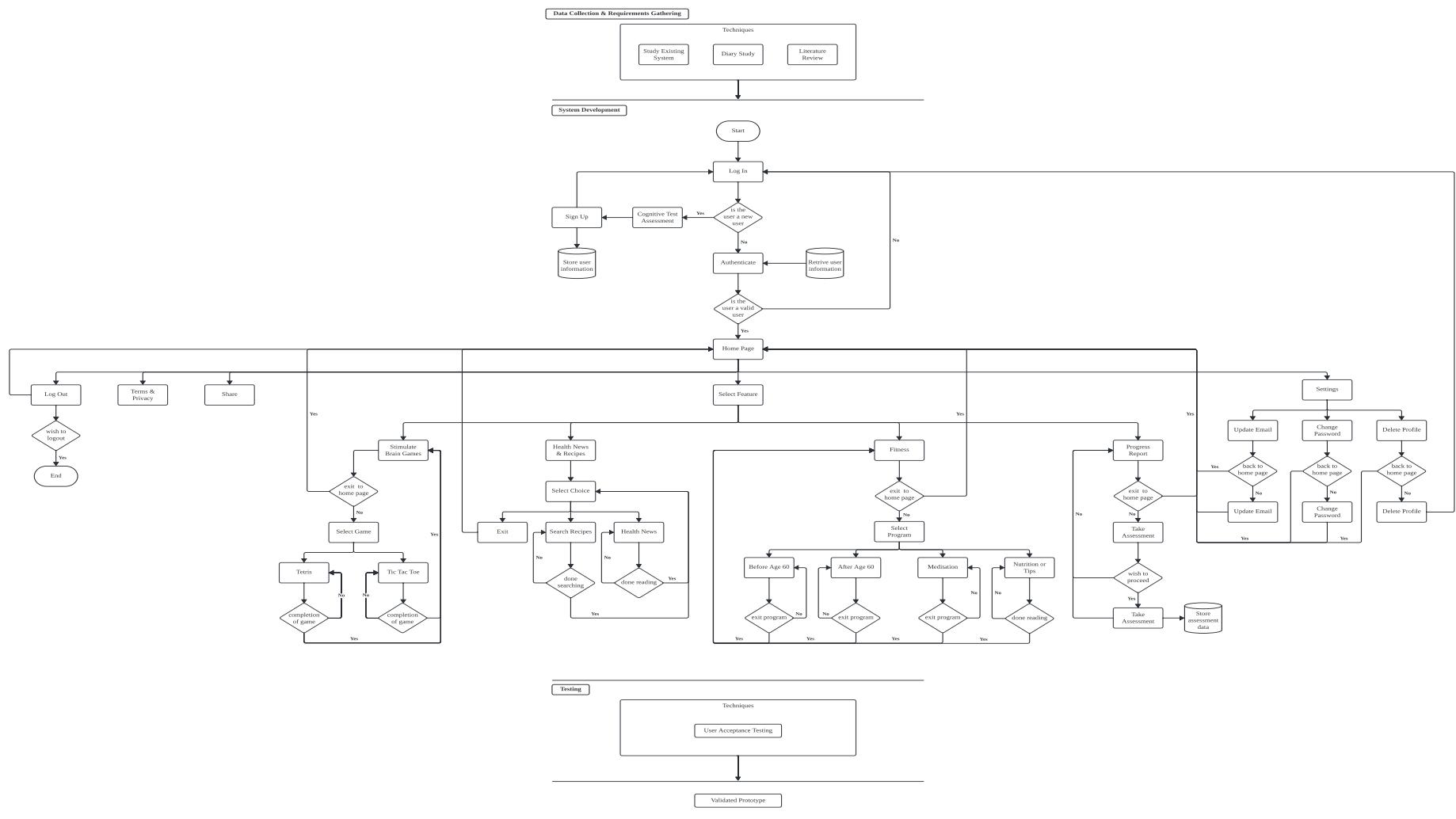


Figure 1.0 - Conceptual Framework

## **1.9 Significance of project**

The following areas may benefit from this project:

### **1. Elevating dementia care through empowerment and independence**

CogniCare, a mobile programme that provides cognitive training, daily activity planning, and real-time safety monitoring, etc, greatly enhances dementia care. It empowers dementia patients by increasing independence and well-being in the home. This is consistent with the global-aging-in-place trend, and it addresses critical demands of the ageing population.

### **2. Pioneering industry 4.0 innovations in dementia care**

CogniCare is a significant Industry 4.0 advancement that combines digital technology with healthcare. It highlights Industry 4.0's potential for more efficient caregiving by leveraging mobile, wearables, and data. The software pioneers digital integration in caregiving by aligning with essential Industry 4.0 principles such as IoT innovation.

### **3. Empowering society 5.0 through human-centric dementia support**

CogniCare is a critical step towards achieving Society 5.0, a human-centered, technology-driven vision. It emphasizes inclusivity, well-being, and sustainability by addressing the requirements of dementia patients and carers. CogniCare improves the quality of life for vulnerable people by seamlessly integrating digital technology, aligning with Society 5.0's basic values.

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## Chapter 2: Literature Review

In this literature review, major topics that's related in the development of this project will be discussed.

### 2.1 Study Existing System

Table 0-1.0 - Mobile Apps for Dementia Patients

Application	Feature	Description
Witty words	<ul style="list-style-type: none"><li>Mental challenges and rewards</li></ul>	<ul style="list-style-type: none"><li>Gain rewards by playing<ul style="list-style-type: none"><li>Amusing vocabulary</li><li>Word connections</li><li>Daily crossword</li></ul></li></ul>
	<ul style="list-style-type: none"><li>Progressive difficulty</li></ul>	<ul style="list-style-type: none"><li>The game starts easy and gets harder, with available assistance</li></ul>
	<ul style="list-style-type: none"><li>Scenic learning</li></ul>	<ul style="list-style-type: none"><li>Offers beautiful themes and teaches new phrases</li></ul>
Lumosity	<ul style="list-style-type: none"><li>Dementia-optimized</li></ul>	<ul style="list-style-type: none"><li>It's rooted in cognitive psychology, tailors challenges to individuals for ongoing mental stimulation</li></ul>
Word Search Colourful	<ul style="list-style-type: none"><li>Google play game</li></ul>	<ul style="list-style-type: none"><li>It have<ul style="list-style-type: none"><li>8 game modes</li><li>50+ word groups</li><li>Hundreds of puzzles</li></ul></li></ul>

Note: Adapted from (Dhanyamraju, 2023)

Based on the features listed above, Table 2.0, these existing applications offer a range of activities and resources to help people with dementia. They provide features such as mental challenges and rewards, progressive difficulty, scenic learning, dementia-optimized, comprehensive cognitive testing, and google play game. For final year project related to developing this proposed system based on the project scope as shown in Table 1.0, these existing applications can serve as useful references for identifying key features and functionalities to include in my proposed system aligning with the principles of cognitive and exercise training as illustrated in Figure 2.0. By examining the strengths and limitations of these existing systems, I can determine what features are most important to users and how to improve upon existing designs.

## 2.2 Background Knowledge

### 2.2.1 What is dementia

Ageing is connected with considerable changes in physical, cognitive, and emotional functioning, predisposing older persons to multimorbidity and functional reliance, necessitating ADL support and medical care from carers.

According to a recent study by (Theng et al., 2023), the burden of dementia is increasing, and there is a greater need for effective interventions to improve the quality of life for affected persons and their families. The study highlighted smartphone app has the ability to effectively reduce stress for carers by providing help at any time and in any location.

The development of this dementia application is guided by the growing body of research in dementia care and will incorporate best practices and recommendations from leading medical journals, such as the study by (Bherer et al., 2023). Figure 2.0 depicts the impacts of cardiovascular risk factors and diseases on cognitive health, and potential benefits of exercise and cognitive training interventions.

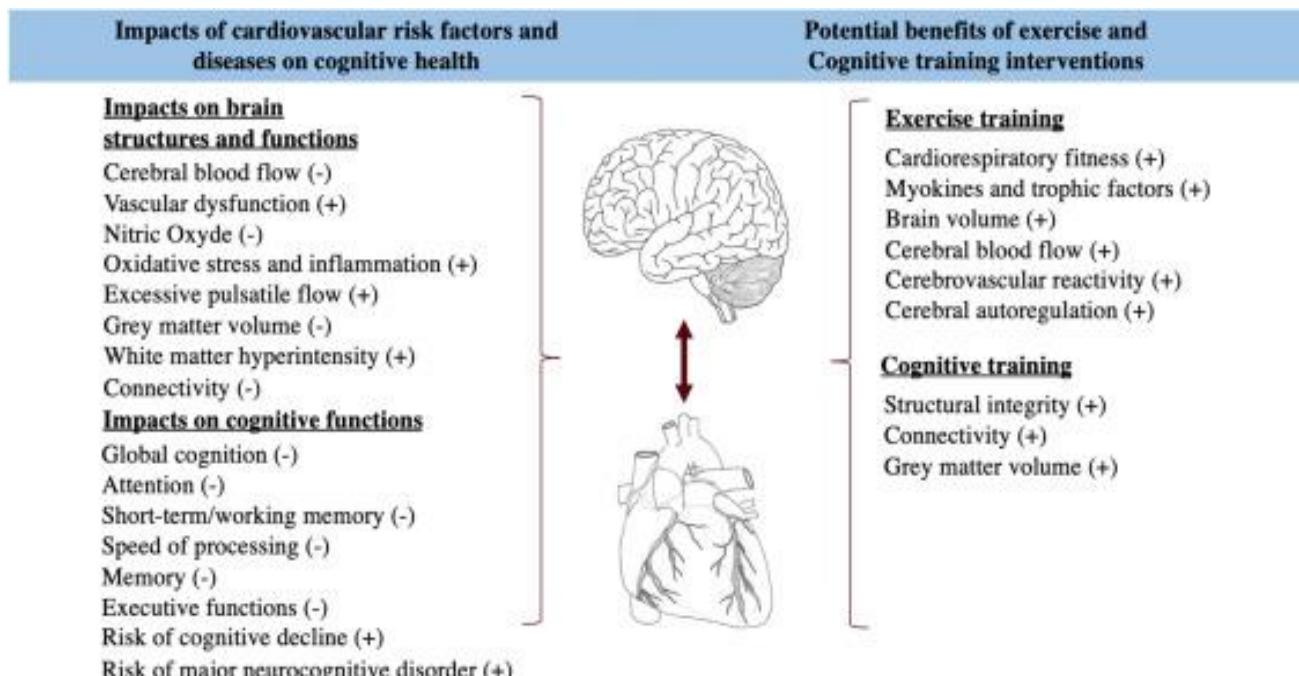


Figure 2.0 - Neurocognitive Effects of CVRF and CVD

Note: CVRF = Cardiovascular Risk Factors

CVD = Cardiovascular Disease

Hence, the “CogniCare” dementia application project aims to contribute to this endeavor by using technology to provide comprehensive and personalized support for dementia patients, allowing them to live with dignity and comfort while relieving the strain on their carers.

### **2.2.2 The significance of CogniCare application**

As mentioned in section 2.2.1, dementia poses a number of difficulties that necessitate a comprehensive strategy to manage the affected people’s physical, emotional, and social well-being. In order to meet each patient’s specific needs and features to suit their cognitive and functional abilities, this application will be designed in accordance with Figure 2.0’s Potential Benefits of Exercise and Cognitive Training Interventions. Additionally, it will provide support to carer so they can handle the stress and responsibilities that come with caring for a patient.

## **2.3 CogniCare application purpose**

Outlining the main features and capabilities that will be added into the “CogniCare” dementia application is crucial as it moves forward, since it will meet the particular issues that dementia patients and their carers experience. This section outlines the essential components that will turn the application into a useful tool for enhancing the quality of life for dementia patients.

### **2.3.1 Cognitive enhancement and support**

#### **2.3.1.1 Cognitive training**

Cognitive training exercises is one of the main goals of the “CogniCare” application. The cognitive demands and abilities of each patient are taken into consideration when designing these activities. The application seeks to improve cognitive abilities and halt the advancement of cognitive deterioration by utilising cognitive exercise to individual profiles.

#### **2.3.1.2 Memory enhancement**

A major focus is on memory-related issues. Memory enhancement tools, such as memory games (games that stimulate the brain), will be included in the application to assist users retain critical information and preserve a sense of independence.

## **2.3.2 Physical and Mental well-being, and exercise programs**

### **2.3.2.1 Daily workout routines**

The application “CogniCare” recognizes the significance of physical fitness in dementia care. In addition, according to (Willis et al., 2024), the researchers noted that the older adults population is quickly expanding, and there is significant evidence that physical activity promotes good ageing. Furthermore, the OA Compendium offers the energy costs of 99 Specific Activities in individuals over the age of 60. As a result, two set of users – those under 60 and over 60 – will have access to a choice of daily workout programs. These practices are designed to increase physical well-being, mobility, and overall health.

### **2.3.2.2 Food recipes**

The application will offer nutritional guidance as well as multiple choices of real-time recipes. Nutritional support is essential for physical health and overall well-being.

### **2.3.2.3 Health news**

According to (Mikula et al., 2022), prioritising the mental health of people with dementia is essential because carers of older folks with dementia endure a great deal of stress. The establishment of social connectedness and the encouragement of leisure and activity have been found to be crucial components in improving their quality of life. Hence, the application will include real-time news so that it can be a great way to encourage interesting activities, foster social connections, and keep them up to date on current events.

## **2.4 Types of games that stimulate the brain**

In Figure 2.0, the segment on cognitive training provides the principles of cognitive training. Here’s some of the key concepts associated with the principles of cognitive training segment:

### **1. Structural integrity**

As stated by (Delgorio et al., 2023), the soundness, health, and functionality of brain tissue are referred to as structural integrity, with an emphasis on the microstructural characteristics and organisation of the tissue.

### **2. Connectivity**

As stated by (Clayden et al., 2023), the intensity and effectiveness of the connections or pathways that connect various brain regions is referred to as connectivity.

### **3. Grey matter volume**

As stated by (Bolton et al., 2023), grey matter volume is used to describe the volume or quantity of grey matter in the brain. Information processing in the brain is carried out by grey matter, a significant part of the central nervous system.

Hence, this section will go over the list of games that fall under the "Cognitive training" segment, as seen in Figure 2.0. Cognitive training games are intended to stimulate and improve various cognitive functions. The games detailed below will challenge and exercise the brain, boosting mental agility and overall cognitive well-being.

#### **2.4.1 Tic Tac Toe**

Two players alternately draw a “O” or a “X” on one square of a grid of nine squares to play the game tic tac toe. The first player to get three consecutive identical symbols wins.

According to (An et al., 2018), the researchers stated Tic Tac Toe-based content could help dementia patients improve their cognitive function, communication ability, and daily life function (ADL).

#### **2.4.2 Tetris**

In Tetris, players complete lines by moving different-shaped pieces (tetrominoes) that fall into the playing field. The finished lines vanish, awarding the player points, and the player can now fill the empty areas. The game concludes when the uncleared lines reach the top of the playing field. The longer the player can postpone this conclusion, the better their score will be.

According to (Kim & Kim, 2016), the researchers stated Tetris is a well-known video game that is used to train the brain in order to avoid memory loss and dementia. It allows users to plan out how to slot blocks together, avoiding incomplete rows. The game also tests the user's cognitive speed and accuracy, including their ability to react quickly to falling blocks.

## **2.5 Types of exercise programs for body and soul**

In Figure 2.0, the segment on exercise training provides the principles of exercise training. Here's some of the key concepts associated with the principles of exercise training segment:

### **1. Cardiorespiratory fitness**

As stated by (Won et al., 2023), the ability of a person's circulatory and respiratory systems to provide oxygen to their muscles during physical activity is known as cardiorespiratory fitness.

### **2. Myokines and trophic factors**

As stated by (Vints et al., 2023), myokines are neurotrophic and anti-inflammatory chemicals released during muscle contraction. Additionally, the researchers stated that physical exercise could be implemented as a therapeutic approach to decrease systemic inflammation and increase the levels of neurotrophic factors in persons with SCI.

### **3. Brain volume**

As stated by (Melo Neves et al., 2022), the volume or area that various brain areas and structures occupy is referred to as "brain volume." Furthermore, the researchers stated that achieving the necessary levels of physical activity can have a broad impact on maintaining the volume of over thirty different brain regions and structures, which is linked to improved cognitive health in older people.

### **4. Cerebral blood flow**

As stated by (Lin et al., 2023), cerebral blood flow refer to the blood flow within the brain's blood vessels, which is an essential component of brain function. Additionally, the researchers stated that frequent exercise may help enhance cerebral blood flow in older persons with cognitive fragility by improving blood circulation throughout the brain, according to the study.

### **5. Cerebrovascular reactivity**

As stated by (Wang et al., 2023), cerebrovascular reactivity (CVR) is the ability of the blood arteries in the brain to regulate and adapt to changes in blood flow and other vascular variables, and it is critical for maintaining good brain function.

## **6. Cerebral autoregulation**

As stated by (Moris et al., 2023), the ability of the brain to maintain constant cerebral blood flow (CBF) is referred to as cerebral autoregulation (CA). Furthermore, the researchers stated that exercise and the choice of breathing pattern during exercise may influence cerebral blood flow (CBF) and, hence, cerebral autoregulation (CA).

Hence, this section will go over the list of exercise programs that fall under the "Exercise training" segment, as seen in Figure 2.0. Exercise training programs are designed to promote physical health and well-being. The exercises detailed below can enhance cardiorespiratory fitness, muscular strength, flexibility, and overall physical wellness which will be accessible in video format for easy learning and practice.

### **2.5.1 Standing exercises**

Standing exercises are physical movements done while standing on your feet, working on balance, strength, and flexibility. These exercises encompass various types, including Strength Workouts, Strong Legs Workout, and the list goes on.

According to (Arciero et al., 2023), the researchers stated that physical exercise remains a promising strategy to preserve cognitive function in individuals with Alzheimer's and related dementias (ADRD). This is because exercise can improve cognition and brain health, prevent hippocampal volume loss, and preserve cognitive function. These benefits are all in line with the principles of exercise training, such as cardiorespiratory fitness, myokines and trophic factors, etc.

### **2.5.2 Meditation**

Meditation is a mental practise that entails focusing one's attention and removing distracting ideas in order to gain mental clarity, calm, and heightened awareness.

According to (Sleimen-Malkoun et al., 2023), the researchers stated that mindfulness meditation (MM) can have immediate impacts on cognitive processes such as attention, inhibition, and cognitive flexibility. It demonstrates how a single 10-minute MM session can improve key cognitive abilities. As a result, meditation can aid improve cognitive performance.

## **2.6 Types of food and recipes**

### **2.6.1 Recipes**

Various meal recipes will be supplied by drawing inspiration from (Shannon et al., 2023), in which the researchers determined that a higher Mediterranean Diet (MedDiet) has been advocated to minimise dementia risk. MedDiet is defined as a typical Mediterranean diet. It is based on the intake of plant-based items such as fruits, vegetables, whole grains, legumes, nuts, and olive oil, as well as moderate consumption of fish and seafood and minimal consumption of red meat (Karlik et al., 2023).

According to (Maggi et al., 2023), the researchers stated that nutrition plays a key role in brain health and cognition. Additionally, it also emphasises that nutrition has interconnected benefits on numerous organ systems, metabolic processes, and health states, which can help to reduce the risk of dementia.

### **2.6.2 Nutrition tips**

Several nutrition tips will be supplied such as “Drink less alcohol” since it educates users on how their intake can affect cognitive health, prevent nutritional deficiencies, and improve their overall quality of life.

## **2.7 Game algorithms in CogniCare application**

The researchers have stated the concept of developing games on applications using multiple algorithms, which is depicted in Table 2.1.

*Table 2.1 - Concepts of creating games on applications with various algorithms*

<b>Algorithm</b>	<b>Description</b>
Memory Matching Algorithm	Memory matching games, in which players must match pairs of cards or objects, are useful for stimulating memory. These games' algorithms often entail shuffling a set of things and randomly assigning them to the playing board. As the player makes selections, the algorithm searches for matches and updates the game state accordingly.
Randomization Algorithm	Incorporating randomization into gaming mechanisms can offer a sense of surprise and enjoyment. Randomization algorithms can be used to provide surprising game aspects. This helps to keep the game interesting and avoids boredom.

Pattern Recognition Algorithm	Memory stimulation can also be aided by games that encourage players to discover and recognise patterns. In such games, the algorithm develops and presents various patterns to the player, which they must identify or recreate. As the player develops, the algorithm can be built to gradually increase the intricacy of the patterns.
Adaptive Difficulty Algorithm	An adjustable difficulty algorithm can be devised to ensure that games stay interesting for senior players. This algorithm monitors the player's performance and modifies the difficulty level as needed. It seeks to create a right amount of challenge in order to keep the player engaged without overpowering them.
Reinforcement Learning Algorithm	Reinforcement learning algorithms can be used in more advanced game applications to personalise the gaming experience for individual players. Based on the player's actions and preferences, these algorithms can learn and adapt, customising game content and challenges to their abilities and interests.

*Note:* Adapted from (Siricharoen, 2023)

As a result, the creation of the CogniCare application will closely adhere to the algorithms given in Table 2.1, which illustrates the concepts of developing games on applications with various algorithms.

## 2.8 Technical domain

### 2.8.1 Tools, frameworks, and technologies

#### 2.8.1.1 Android studio

Android Studio is an integrated development environment (IDE) that allows you to create Android apps. It is the official Android development tool, with tools and functionality for creating, testing, and delivering Android apps. A code editor, a visual layout editor, a debugger, and tools for managing dependencies and creating APKs are all included with Android Studio. It also includes a variety of libraries and templates to assist developers in swiftly creating high-quality Android apps. Android Studio is available in a variety of languages and platforms, and it is continuously updated with new features and improvements.

#### **2.8.1.2 React Native**

React Native is another prominent open-source mobile app development framework created by Facebook. It employs JavaScript and enables developers to create high-quality mobile apps for both the iOS and Android platforms using a single codebase. React Native includes a set of pre-built UI components that may be used to develop quick and responsive mobile apps. One of the main advantages of React Native is that it supports hot reloading, which makes the development process faster and more efficient. It also has a large and active community, which means there are plenty of resources and assistance available for creators.

#### **2.8.1.3 Flutter**

Flutter, an open-source mobile app development framework created by Google, utilizes the Dart programming language and offers an extensive array of pre-designed widgets, tools, and libraries for crafting visually captivating, swift, and high-performing mobile applications. It empowers developers to construct iOS and Android apps with a singular codebase, streamlining development and reducing its intricacy. An essential advantage of Flutter is its capacity to generate top-notch, personalized UI designs, rendering it a favored option for constructing visually impressive mobile apps. Additionally, Flutter enjoys a burgeoning community and comprehensive documentation, facilitating a straightforward learning curve and ease of initiation.

#### **2.8.1.4 XCode**

XCode is Apple's official IDE for iOS and macOS app development. It offers a robust set of tools, including a code editor, visual interface builder, debugger, and various resources to create high-quality apps. It supports Swift and Objective-C and receives regular updates with new features.

### **2.8.1.5 Kotlin**

Kotlin, a programming language crafted by JetBrains, the creators of the widely-used IntelliJ IDEA integrated development environment (IDE), is engineered to serve as a more succinct and expressive substitute for Java. It seamlessly integrates with existing Java code, enabling developers to readily incorporate Kotlin into their Android applications. Kotlin holds the status of an official programming language for Android app development and is on the rise in popularity, thanks to its contemporary features, user-friendliness, and enhanced developer efficiency.

### **2.8.1.6 Dart**

Dart, a programming language originated by Google, was designed to rectify the deficiencies of JavaScript and offer a more organized and typed alternative for web and mobile app development. Dart serves as the principal programming language employed in the development of applications using the widely adopted cross-platform mobile app development framework, Flutter.

### **2.8.1.7 Java**

Java is a widely-used, object-oriented programming language suitable for creating diverse applications, such as web, mobile, and desktop software. Initially introduced in 1995, it has evolved into one of the world's most popular programming languages. Java is esteemed for its simplicity, readability, and ability to function across various platforms, thanks to the Java Virtual Machine (JVM). The JVM enables Java code to run on any platform with JVM support. Java boasts an extensive collection of libraries and frameworks that simplify the development of complex applications, and it consistently receives updates to introduce new features and improvements.

### **2.8.1.8 Firebase**

Firebase represents a mobile and web app development platform, offering an assortment of tools and services for the construction of scalable, top-tier applications. Google acquired Firebase in 2014, and it has since gained popularity among developers for its user-friendliness and adaptability. Firebase delivers a wide array of functionalities, including authentication, real-time databases, cloud storage, hosting, analytics, and more. These functionalities can be employed individually or in combination to establish a comprehensive backend system for both mobile and web applications. Firebase is also renowned for its real-time capabilities, enabling developers to create applications that update in real-time without the need for manual page refreshing.

### **2.8.1.9 SQLite**

SQLite is a mobile-friendly, lightweight relational database system that integrates smoothly with software applications. It operates without a separate server, making it popular in mobile app development. SQLite is self-contained, quick, and well-suited for managing small to medium-sized databases. It's cross-platform, compatible with iOS, Android, and Windows, and open-source for customization.

### **2.8.1.10 MySQL**

MySQL is a versatile, open-source relational database system suitable for various software applications. It's widely used for web and mobile development, offering robust features and scalability. MySQL is a popular choice for data storage in applications, supporting a wide range of platforms and easily integrated into development projects.

The technical review offers an examination of the tools, frameworks, and technologies available for mobile app development, including Android Studio, React Native, Flutter, Xcode, Kotlin, Dart, Java, Firebase, SQLite, and MySQL. Firstly, for this project, Android Studio is selected as the software for developing the proposed system due to its status as the official Android development tool, offering an extensive array of features and tools for app creation, testing, and deployment. Secondly, Java is the preferred programming language for this project, given its widespread use and popularity in building numerous mobile applications. Lastly, the selection of Firebase for database storage since it is driven by its real-time capabilities, ensuring rapid and efficient data storage and retrieval.

## **2.8.2 Application Programming Interface (API)**

Various APIs are accessible for mobile application development, specifically tailored for real-time integration of recipes and news.

### **2.8.2.1 News API**

News API is a basic REST API that returns JSON search results for current and archived news stories from more than 80,000 global sources. Furthermore, three primary selling features are Worldwide scale, where it can explore vast databases containing hundreds of millions of articles in 14 languages and 55 countries, Easy integration, where it can obtain JSON results with simple HTTP GET queries, or utilise one of the available SDKs in your preferred programming language, and lastly, Free for Development, where if you are still in the development phase, you may begin your trial without using a credit card.

### **2.8.2.2 The News API**

The News API includes RESTful API endpoints that return news data including top stories, real-time news feeds, and historical news data. These allow you to acquire access to news data for your own apps or initiatives. In addition, it gets news from more than 50 countries around the world, over thirty languages are presently supported, and lastly they index approximately a million new articles each week.

### **2.8.2.3 NewsData.io API**

NewsData.io API may get the current breaking news or search historical news data from 47209+ sources dating back 6 years (since January 2018). In addition, this API has various selling factors, like ease of integration, 47209 news sources, support for 82 languages, free development, and so on.

### **2.8.2.4 Spoonacular API**

Spoonacular API allows you to create sample requests for each endpoint, download SDKs, and execute examples in Postman. Additionally, it searches through thousands of recipes using powerful filtering and ranking.

### **2.8.2.5 Edamam's Recipe Search API**

Edamam's Recipe Search API allows you to include a recipe database and faceted recipe search in your websites or mobile apps.

### 2.8.2.6 Review of APIs

*Table 2.2 - Review of APIs for real-time news*

	<b>News API</b>	<b>The News API</b>	<b>NewsData.io API</b>
API Request (Daily)	100	100	20
Real time data	Yes	Yes	Yes
Live Top Headlines	Yes	No	Yes
Languages Offered	14	30+	82
Countries Available	55	50+	196
Price For Developer	Free	Free	Free

*Table 2.3 - Review of APIs for real-time recipes*

	<b>Spoonacular API</b>	<b>Edamam's Recipe Search API</b>
API Request (Daily)	150	Not Stated
Real time data	Yes	Yes
Recipe Caching	Recipe ID, Recipe Name, etc	Recipe ID and Recipe Name
Number of filters	120+	30+
Price For Developer	Free	Free

As shown in Table 2.2 and 2.3, given the desire to produce real-time news and recipes, News API is an excellent candidate because it receives 100 API requests per day and also delivers live top headlines, whereas newsdata.io API is good overall but receives just 20 API requests per day. Furthermore, Spoonacular API is an ideal possibility because it has over 120 filters, giving the user more options for making requests, such as searching for recipes, searching for recipes by nutrients, and so on. In addition, it has greater recipe caching than Edamam's Recipe Search API. As a result, News API and Spoonacular API will be used to deliver real-time news and recipes.

### 2.9 Application development tools

Android Studio was chosen as the software for constructing the proposed system, Java as the preferable programming language, Firebase for database storage, News API for creating real-time news, and Spoonacular API for creating real-time recipes.

## 2.10 Software development methodologies

### 2.10.1 Agile model

Agile model is a system development approach that works effectively for software projects that need to be delivered quickly and with frequent adjustments (Hayat et al., 2019). In Agile development process, tasks are organized into time-bound segments known as sprints, which are recurring cycles. Work is divided into smaller components that progressively build upon one another. These components often encompass stages such as plan, design, develop, test, deploy, review, and launch as illustrated in Figure 2.1 with each sprint focusing on enhancing and expanding the software based on the outcomes of the previous stages.

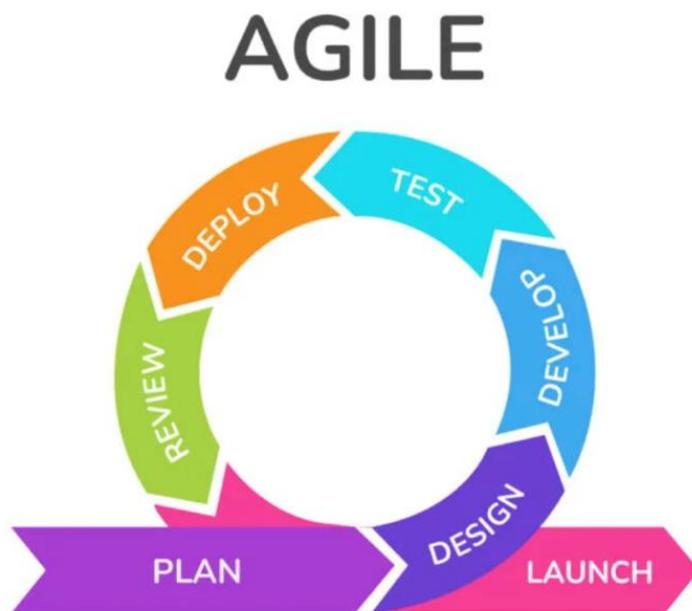


Figure 2.1 - Agile Model

#### Advantages of Agile Model:

- High project flexibility and the capacity to make rapid adjustments
- Constant stakeholder interaction that fosters creativity and improves outcomes
- Continuous quality assurance and attention to detail

#### Disadvantages of Agile Model:

- Coordination issues with the workflow
- Early planning is challenging
- Lack of long-term planning

## 2.10.2 Waterfall model

The waterfall model divides a project into linear sequential tasks with deliverables used in the following phase (Leong et al., 2023). The steps of the waterfall model involve requirements analysis, system design, implementation, testing, deployment, and maintenance as illustrated in Figure 2.2.

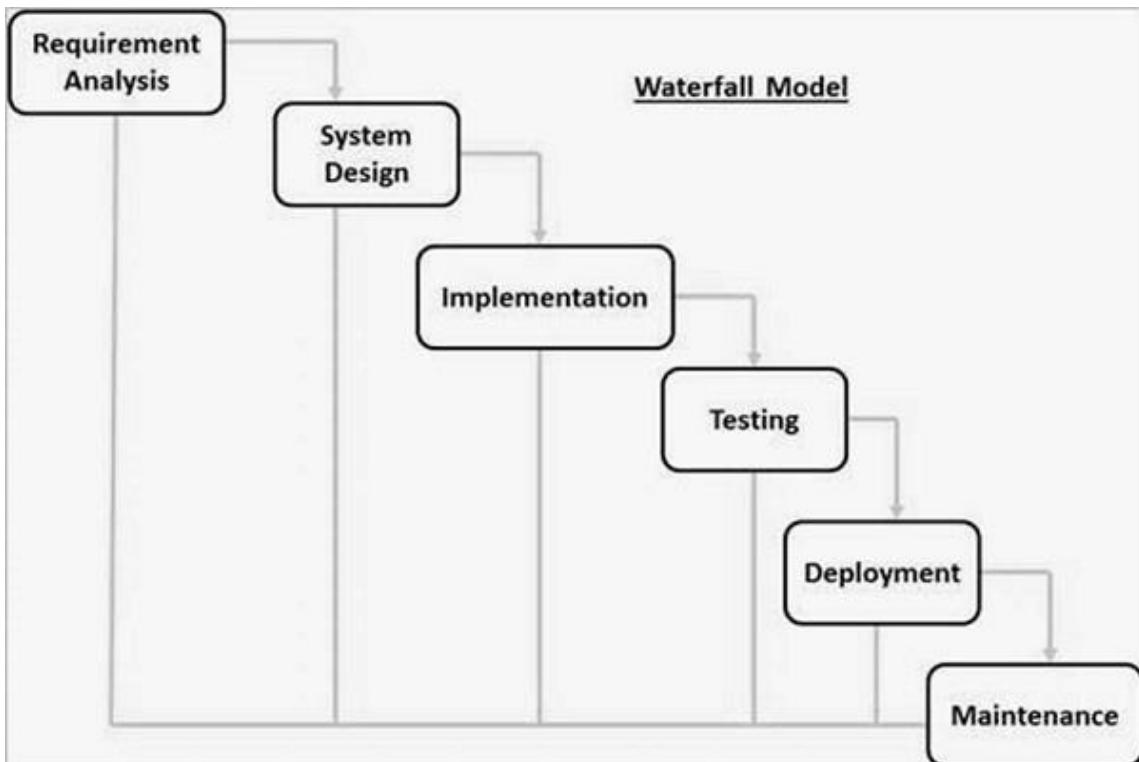


Figure 2.2 - Waterfall Model

Advantages of Waterfall Model:

- Simple and easy to understand and use
- Have clearly defined stages
- Process and results are well documented

Disadvantages of Waterfall Model:

- High amounts of risk and uncertainty
- It is difficult to measure progress within stages
- Cannot accommodate changing requirements

### 2.10.3 Spiral model

As illustrated in Figure 2.3, the spiral model is a hybrid of several models, such as the waterfall model, evolutionary models, and prototyping models. The model is made up of multiple loops or phases that include objectives determination and identify alternative solutions, identify and resolve risks, develop next version of the product, and review and plan for the next phase. The number of loops may vary depending on the project's needs and risk factors.

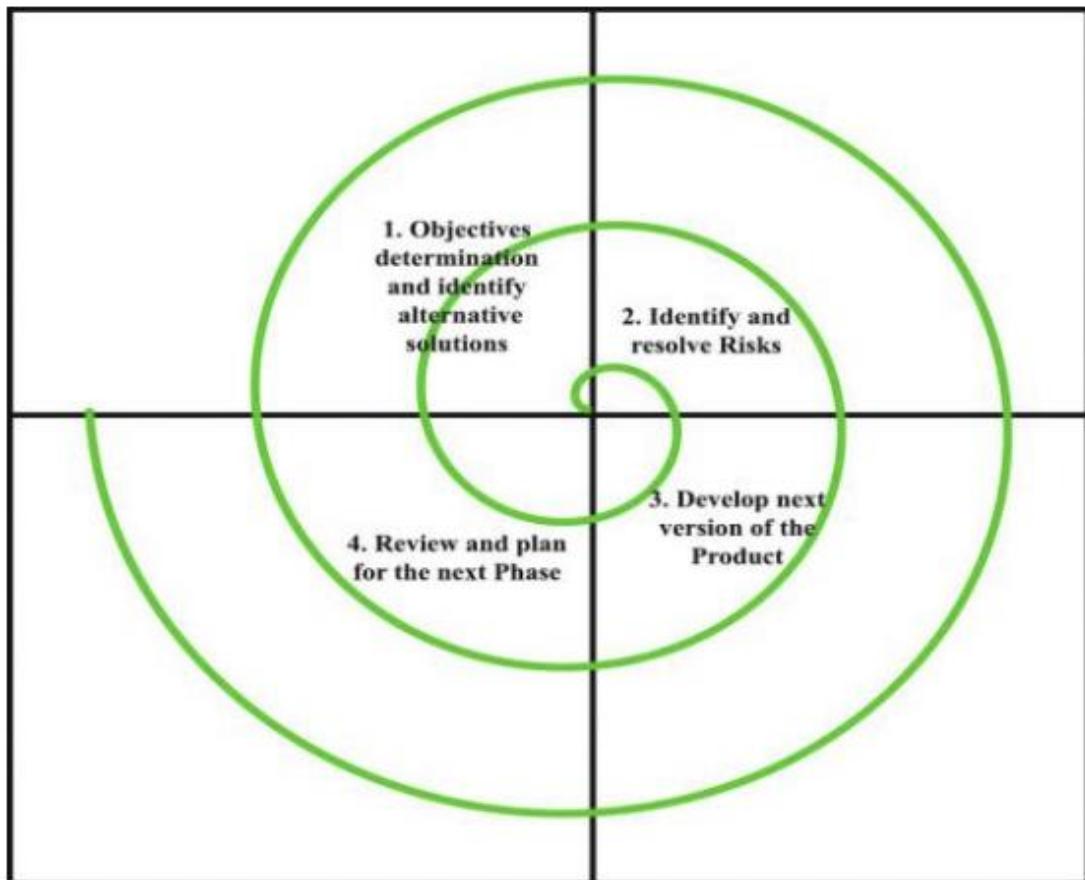


Figure 2.3 - Spiral Model

Advantages of Spiral Model:

- Risk management
- Ideal for large projects
- Requirements adaptability

Disadvantages of Spiral Model:

- Complex
- Difficulty in time management
- It may go on indefinitely

#### 2.10.4 Prototype model

The prototype model is a software development life cycle model that involves creating a working replica of a product or system, which serves as a small-scale version of the final product. This model involves six key phases, Requirements, Quick design, Build prototype, User evaluation, Refining prototype, Implement and Maintain as illustrated in Figure 2.4. In addition, this approach is used when project requirements are not fully known in advance. It entails building, testing, and refining an initial product prototype based on user feedback until a satisfactory prototype is achieved, serving as the basis for the full system development. The prototype model requires close collaboration between developers and users, involving a trial-and-error process to reach the desired outcome.

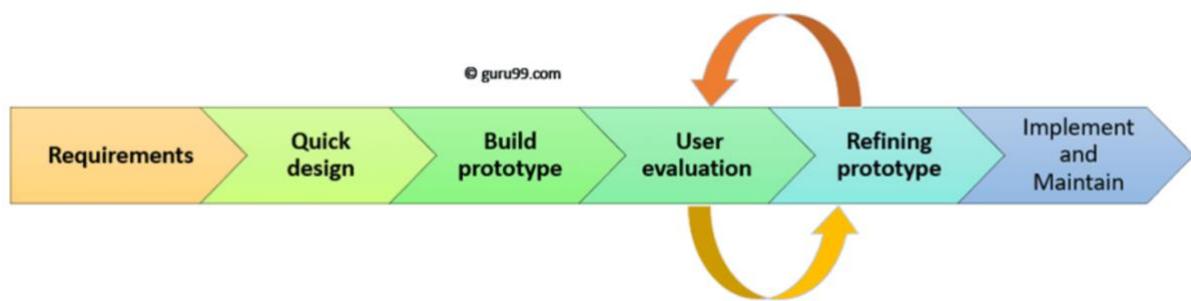


Figure 2.4 - Prototype Model

Advantages of Prototype Model:

- Design adaptability
- The produced prototype can be reused by the developer in the future for more complex applications
- New requirements are easily fulfilled because there is room for improvement

Disadvantages of Prototype Model:

- Costly in terms of both time and money
- Poor documentation as a result of constantly changing customer needs
- It is quite tough for developers to accommodate all of the changes requested by the client.

## 2.10.5 V-shaped model

As illustrated in Figure 2.5, the V-shaped model, also known as the Verification and Validation model, is an SDLC approach that aligns each development stage with an associated testing phase. Advancement to the next stage requires the successful verification and validation of the current stage. This model follows a sequential V-shaped process.

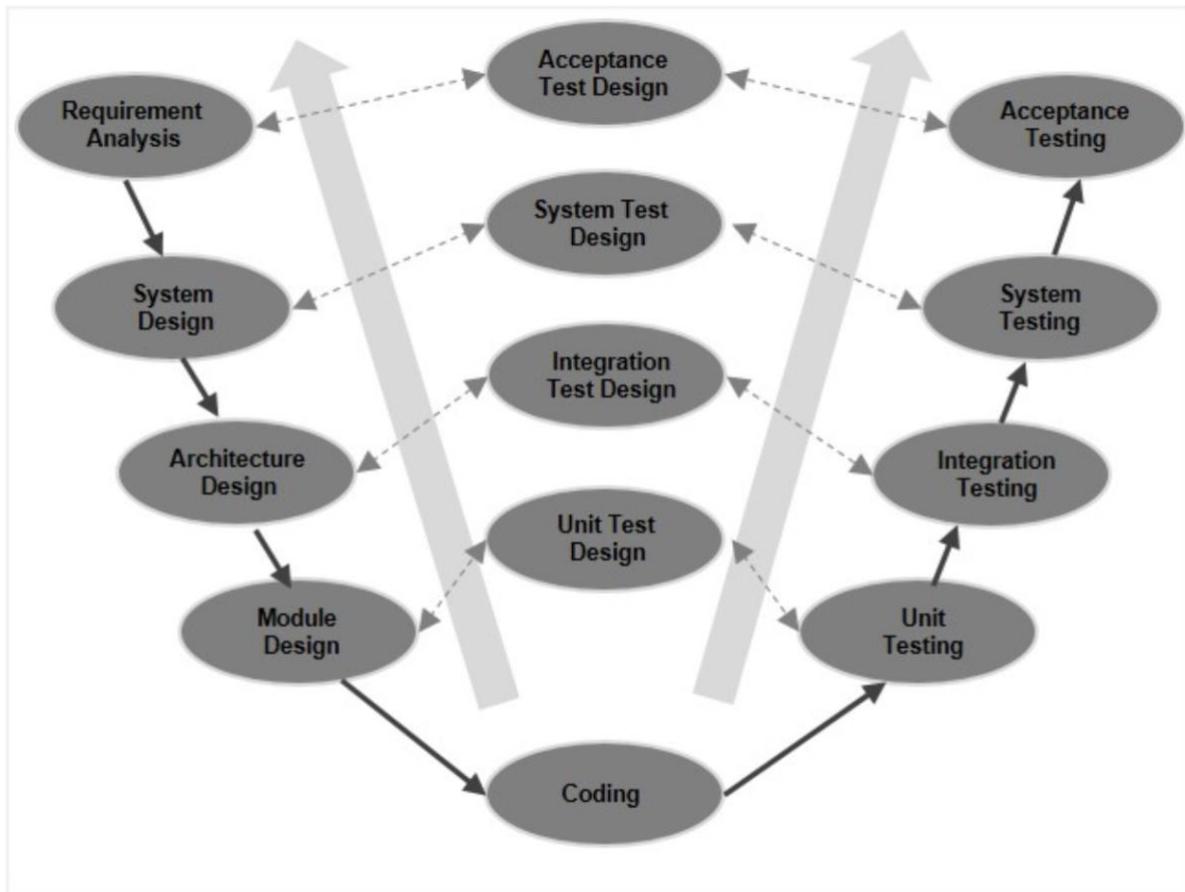


Figure 2.5 - V-shaped Model

### Advantages of V-shaped Model:

- Works effectively for smaller projects with well-defined needs
- Simple to grasp and apply
- It is simple to manage because of the model's rigidity

### Disadvantages of V-shaped Model:

- High risk and uncertainty
- Not suitable for complex and object-oriented projects
- Poor model for long-term projects

## 2.10.6 RAD model

As illustrated in Figure 2.6, RAD (Rapid Application Development) methodology is known for its quick project completion compared to other SDLC methodologies. It places a high emphasis on rapid prototyping and minimizes extensive planning (Fauzi et al., 2023) while adopting certain aspects of the waterfall model, which is a more traditional and sequential SDLC approach. This blend of approaches allows for rapid development while ensuring that project stages are well-defined and validated.

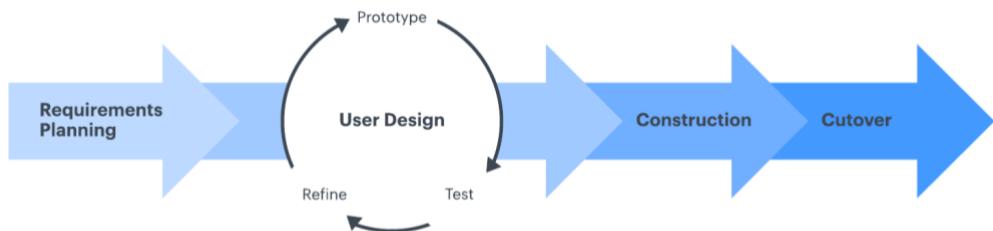


Figure 2.6 - RAD Model

Advantages of RAD Model:

- Suitable for large-scale projects
- Costs are lower since fewer developers are required
- The use of reusable components helps to reduce project cycle time.

Disadvantages of RAD Model:

- Skilled experts are needed for powerful tools
- Lack of reusable components can lead to project failure
- Team leader collaboration with developers and clients is crucial for timely project completion

## 2.11 Research design

Research design involves using real-world data to address your research question. There are three categories of research approaches: Quantitative Research, Qualitative Research, and Mixed-Method Research.

### 2.11.1 Quantitative research

Quantitative research is a method that employs structured techniques for data collection and analysis, using numerical values derived from observations to explain and describe various phenomena. It focuses on addressing specific research questions by considering relevant variables, aiming to provide explanations and predictions that can be applied to broader populations, events, and contexts. This process begins with defining the research problem and formulating specific hypotheses. Data collection involves using structured instruments as illustrated in Figure 2.7, such as surveys and experiments, designed for gathering quantitative data. These instruments are meticulously structured and validated to ensure precise and reliable measurements. In essence, quantitative research seeks to derive generalizable insights through a numerical and systematic approach, employing mathematical methods and statistics for data analysis (Taherdoost,2022).

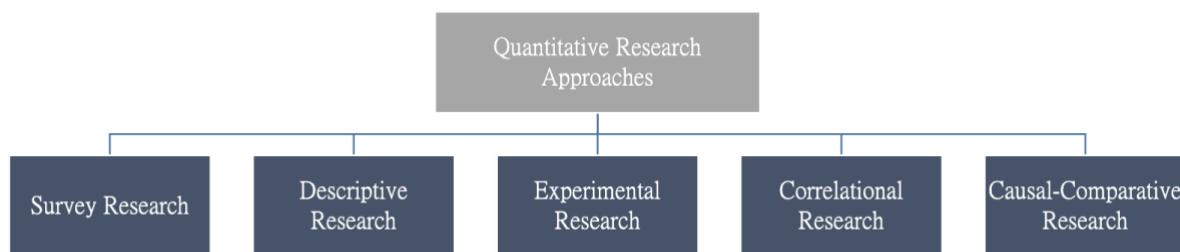


Figure 2.7 - Quantitative Approaches

### 2.11.2 Qualitative research

Qualitative research encompasses various approaches aimed at addressing scientific and practical societal issues. It involves naturalistic and interpretative methods, utilizing empirical materials like life stories and case studies to delve into the profound meaning and motivations that can't be quantified. Qualitative research centers on the "how" and "why" of tasks, emphasizing a deep understanding of the subject matter. It collects and analyzes primary textual data using specific interpretive techniques, making it particularly valuable for exploring phenomena with limited available information. This approach is process-oriented and employs various data collection methods as illustrated in Figure 2.8, such as observations and interviews,

to investigate specific research problems. Sampling techniques and data recording protocols are used to uncover insights and generate new theories within specific contexts, without necessarily seeking broad generalizations beyond those contexts (Taherdoost, 2022).

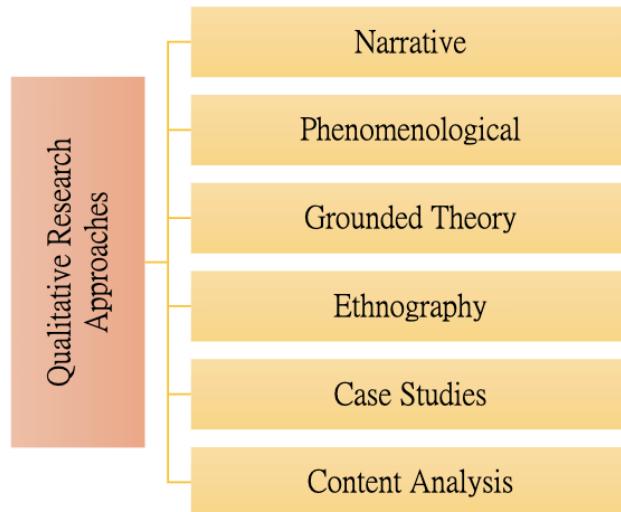


Figure 2.8 - Qualitative Approaches

### 2.11.3 Mixed-method research

Mixed-method research is an approach that combines both qualitative and quantitative research methods to gain a more comprehensive understanding of a subject. The choice of methods and their balance depends on the research question and purpose. Mixed-method research can be used to address complex research situations in various fields, such as social and health research. Mixed methods offer the advantages of both qualitative and quantitative methods, making them useful when one approach alone may be insufficient. This approach is commonly used in interdisciplinary research, where researchers with different methodological preferences collaborate. While mixed-method research is applied in various fields, it doesn't necessarily have to be explicitly labeled as such and can remain unrecognized. Researchers can maximize the benefits of mixed methods by using them extensively, and different design options for mixed-method research are discussed in detail (Taherdoost, 2022).

## **2.12 Research instrument**

### **2.12.1 Questionnaires**

Questionnaires are commonly used as an efficient and cost-effective research tool to collect data from a large population of respondents (Yusoff et al., 2021). Questionnaires typically contain two types of questions: closed-ended and open-ended. Closed-ended questions, including multiple-choice and scaling questions like Likert scale questions, are useful when researchers aim to obtain specific information, such as demographics or attitudes. On the other hand, open-ended questions in questionnaires allow participants to provide more detailed responses, making them valuable when researchers seek in-depth information, such as personal experiences or opinions. Questionnaires find applications in various fields, such as psychology, sociology, market research, and healthcare, and can be administered through different methods, including paper and pencil, online platforms, or interviews. There are several types of questionnaires such as structured questionnaires where questions are predetermined with closed-ended responses, unstructured questionnaires where questions are open-ended, and lastly semi-structured questionnaires where it combine structured and unstructured questions.

### **2.12.2 Observation**

Observation is a versatile research method used in various fields, such as social sciences, psychology, education, and anthropology. It involves systematically observing and recording the behavior, actions, or events of people or objects in their natural setting. There are several types of observations, including naturalistic observation, participant observation, structured observation, and unstructured observation. These methods allow researchers to collect data without manipulation or intervention, actively participate in the setting being observed, use specific protocols for recording behavior, or generate hypotheses in exploratory research. Observation can be conducted using techniques like direct observation, indirect observation, and systematic sampling, each offering unique advantages for studying complex social interactions and behaviors in natural settings. However, observation may be subject to potential observer bias, challenges in establishing causality, and ethical concerns related to privacy invasion.

### **2.12.3 Interview**

Interviews is a research method for collecting data through a series of questions related to the research topic, offer various approaches. These include structured interviews, which adhere to a strict interview protocol; semi-structured interviews, allowing for exploration of relevant ideas while focusing on the main topic; and unstructured interviews, resembling natural conversations (Adeoye-Olatunde & Olenik, 2021). Interviews, conducted in diverse ways such as face-to-face, phone, or video conferencing, find application in psychology, sociology, market research, and journalism. Structured interviews use predetermined questions for standardized data collection, unstructured interviews offer flexibility and depth in exploring experiences and opinions, while semi-structured interviews strike a balance between specificity and detailed responses. Group interviews, known as focus groups, involve small participant groups discussing specific topics and provide insights into group dynamics and interactions. Interviews enable real-time data collection and in-depth exploration of experiences and attitudes. However, they may be subject to potential biases, including interviewer influence and response biases.

### **2.12.4 Survey**

A survey is a research technique that involves posing a series of questions to a selected group of individuals to gather data. Surveys can be conducted through different means, such as online, phone, mail, or in person, and are applicable in various fields, including psychology, sociology, market research, and healthcare. They typically include a set of questions aimed at collecting information on specific topics and can encompass both open-ended and closed-ended questions in various formats like multiple-choice, ranking, or rating scales. Surveys offer numerous benefits in research, as they efficiently gather data from a large number of participants, are easy to standardize to ensure consistency, and provide valuable insights into attitudes, opinions, and changes over time. Nevertheless, surveys come with their limitations, including the possibility of response biases, sampling biases, and constraints in obtaining detailed information about participants' experiences and opinions.

### **2.12.5 Focus group discussion**

Focus group discussion involves interviewing a group of prospective participants. One advantage of using focus groups is that participants may feel more comfortable declining to respond to a specific question or sharing a particular viewpoint in comparison to one-on-one

interviews. Nevertheless, it's essential to note that the drawback of focus groups lies in the potential harm that could result from discussing sensitive topics if the information becomes public (Sim & Waterfield, 2019).

### **2.12.6 Experiment**

Experimental research involves a comparative analysis where two or more variables are studied, and groups are observed under specific or varying conditions. By analyzing the outcomes of such studies, researchers can identify correlations between the applied variables and their impacts on each group. This approach utilizes the scientific method to discover optimal ways of accomplishing tasks or delivering services. Experimentation is a research method used to investigate cause-and-effect relationships between variables. In an experiment, the researcher manipulates independent variables and observes the effects on dependent variables while controlling for other influencing factors. Various types of experiments, including laboratory, field, and natural experiments, offer differing levels of ecological validity and control over extraneous variables. Experiments provide strong evidence for establishing cause-and-effect relationships, but they also have limitations such as ethical concerns and challenges in generalizing results to real-world settings.

### **2.12.7 Diary study**

A diary study is a research method used to collect qualitative data about user behaviors, activities, and experiences over an extended period of time, ranging from a few days to a month or longer. Participants in the study self-report their activities and experiences by keeping a diary and logging specific information related to the research topic. To aid participant compliance, reminders may be used. Diary studies differ from other user research methods like surveys and usability tests in that they gather data in the context and time frame of the user's real-life experiences, making them a less detailed but more practical alternative to field studies.

## **2.13 Future improvement**

Future improvements for CogniCare dementia application should focus on personalization based on the individual's dementia progression. This includes customizing cognitive games, nutrition advice, and workout routines to suit their cognitive status.

## **Chapter 3: Preliminary studies**

### **3.1 Review of research method**

The research approach selected for this study is qualitative method, aiming to comprehend and elucidate phenomena through non-numeric information, such as language, narratives, and observations. Qualitative methodology was employed in this research due to the use of diary studies as data collection techniques.

### **3.2 Research design**

#### **3.2.1 Design science research methodology (DSRM)**

*Table 3.0 - Design science research methodology*

<b>Phase</b>	<b>Details of activities</b>
<b>Phase 1</b>	<b>Problem identification and motivation</b> <ul style="list-style-type: none"><li>• According to several articles, it was stated that individuals with dementia have a problem with losing self-reliance and independence.</li><li>• A literature review was conducted to ensure the efficiency of designing the CogniCare application in addressing the existent issues described above.</li><li>• Based on the preliminary study conducted, we can investigate whether the adoption of the CogniCare application may be able to resolve the existing issues.</li></ul>
<b>Phase 2</b>	<b>Define objectives of a solution</b> <ul style="list-style-type: none"><li>• According to researches, the current concern encountered is the enhancement of the quality of life for dementia patients and recommended potential methods to improve the quality of life for dementia patients.</li><li>• Elements and functional components of CogniCare application were discovered and translated into a conceptual model as a reference for the design phase.</li></ul>

<b>Phase 3</b>	<b>Design and development</b> <ul style="list-style-type: none"> <li>The system's design, including its functions and algorithms, will be established based on insights gained from a review of relevant literature.</li> <li>During the development phase, the system will be constructed utilizing Android Studio, Java, Firebase, News API and Spoonacular API, with preliminary testing to verify its functionality aligns with the intended design.</li> </ul>
<b>Phase 4</b>	<b>Demonstration</b> <ul style="list-style-type: none"> <li>A set of assessment criteria is established to verify the quality of the artifact.</li> <li>To gather user input regarding the artifact.</li> </ul>
<b>Phase 5</b>	<b>Evaluation</b> <ul style="list-style-type: none"> <li>User Acceptance Testing will be executed with users to ensure the system's performance.</li> <li>The performance evaluation will encompass measures of learning effectiveness.</li> </ul>
<b>Phase 6</b>	<b>Communication</b> <ul style="list-style-type: none"> <li>The findings and results are compiled into a full comprehensive report, which includes a description of the system and a user manual.</li> </ul>

### 3.2.2 Research design table (RDT)

Table 3.1 - Research design table

No.	Research Questions(s)	Research Objectives(s)	Methods	Expected Outcome
1	What are the existing techniques and systems that could stimulate brain for individuals with dementia?	To investigate the existing techniques and systems to stimulate brain for individuals with dementia.	1. Literature review 2. Studying existing system	List of requirements of the current system pertaining to brain stimulation.

<b>2</b>	How to design and develop the CogniCare mobile application, which could enhance the self-reliance and independence of dementia patients living at home?	To design and develop the CogniCare mobile application, which aims to enhance the self-reliance and independence of dementia patients living at home.	1. Diary study	Develop a working prototype of the system
<b>3</b>	Can CogniCare effectively address the issue of improving the quality of life for individuals with dementia?	To validate the effectiveness of the CogniCare application in improving the quality of life for individuals with dementia.	1. Conduct User Acceptance Testing	Validated prototype

### 3.2.3 Overall research design

*Table 3.2 - Overall research design*

Phase	Input	Main Task	Output
Phase 1	- Issues - Problem identification	- Issues validation - Analysis on the problem	- Proposed solutions
Phase 2	- Proposed solutions	- Further research - Refinement on the solutions	- Conceptual framework
Phase 3	- Conceptual framework	- Artefact design and development	- Artefact design
Phase 4	- Artefact design	- Artefact demonstration	- Validated conceptual framework

Phase 5	- Validated conceptual framework	- Accuracy and reliability measurement	- Validated artefact
Phase 6	- Validated artefact	- Compilation of findings and results - Documentation	- Final Year Project Report

### 3.2.4 Evaluation table

Table 3.3 - Evaluation table

CogniCare Mobile Application	
Participant	Users with dementia
Task	<ol style="list-style-type: none"> <li>1. Cognitive test assessment</li> <li>2. Registration</li> <li>3. Log In</li> <li>4. Exercise Programs and nutrition tips</li> <li>5. Brain stimulation games</li> <li>6. Food recipes</li> <li>7. Health News</li> <li>8. Progress report</li> <li>9. Log out</li> </ol>
Technique	Study existing system, Game algorithms, Diary study, User Acceptance Testing
Measurement	<ol style="list-style-type: none"> <li>1. Attempts taken for user to complete cognitive test assessment during sign up phase</li> <li>2. Attempts for user to complete cognitive test assessment over time</li> </ol>
Outline	<ul style="list-style-type: none"> <li>• Explain the goal and objective of diary study to the participant</li> <li>• Give a demonstration of the system to the participants</li> <li>• Provide diary study to participant for their views to analyze the system further</li> <li>• Transcribe diary study data into a summarized table</li> <li>• Analyze the diary study data</li> </ul>

### 3.3 Research Operational Framework

Table 3.4 - Research operational framework

Item	Phases	Activity Description	Output	Expected Contribution
Idea Generation	Phase 1: Problem identification & motivation	<ul style="list-style-type: none"> <li>Conduct literature search and review study</li> <li>Study existing system</li> </ul>	<ul style="list-style-type: none"> <li>Proposed Solutions</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge</li> </ul>
Conceptual Model	Phase 2: Suggestion of solutions	<ul style="list-style-type: none"> <li>Literature review</li> <li>In-depth diary study</li> </ul>	<ul style="list-style-type: none"> <li>Refined Conceptual Framework</li> </ul>	<ul style="list-style-type: none"> <li>Artefact – Prototype of CogniCare application</li> <li>Technique to detect/capture the user activity</li> <li>Mechanisms to provide punctual prompts of user activity</li> </ul>
Working Prototype	Phase 3: Artefact design & development		<ul style="list-style-type: none"> <li>Artefact Design</li> </ul>	
Artefact	Phase 4: Artefact evaluation	<ul style="list-style-type: none"> <li>Develop performance measures assessment</li> <li>Users use the artefact and give performance measures</li> </ul>	<ul style="list-style-type: none"> <li>Identified Performance Measure</li> </ul>	
	Phase 5: Model validation	<ul style="list-style-type: none"> <li>To conduct User Acceptance Testing with working prototype</li> </ul>	<ul style="list-style-type: none"> <li>Validated Model</li> </ul>	<ul style="list-style-type: none"> <li>Final Model of CogniCare application</li> </ul>
	Phase 6: Documentation	<ul style="list-style-type: none"> <li>To combine all results from literature review, artefact design, artefact evaluation report, framework validation report into a complete report</li> </ul>	<ul style="list-style-type: none"> <li>Final thesis report</li> </ul>	

### **3.4 Review of research instruments**

In this study, a diary study were utilized as the research instruments for data collection and gathering. The diary study involved participants, such as individuals living with dementia and their caregivers, regularly documenting their experiences and interactions with the dementia mobile application. Participants were instructed to maintain diaries over a specified period, recording their daily experiences, challenges, and any insights related to the use of the mobile application.

The user acceptance testing, on the other hand, was designed to evaluate the effectiveness of the dementia mobile application. Participants, including those living with dementia and caregivers, were actively engaged in using the application, performing tasks, and providing feedback on their experiences. Key aspects of the User Acceptance Testing included assessing the application's user-friendliness, its impact on cognitive and emotional well-being, and its overall effectiveness in addressing the needs of individuals with dementia.

#### **3.4.1 Population and sample**

The research focuses on individuals with dementia in the age range of 50 to 90 years. The diary study specifically targets individuals who have dementia. Data will be collected through personal connections, such as friends' grandparents who are affected by dementia. The diary study will be distributed to the intended population through face-to-face interactions.

*Table 3.5 - Population and sample*

1. Participants	Individuals with dementia
2. Technique	Diary study, User Acceptance Testing
3. Representative tasks	Displaying the application's features
4. Measurements	Effectiveness of system and ease of use
5. Outline plan	Collect data from diary studies and allow users to put the system through its paces

### **3.5 Software development life cycle (SDLC)**

For this research, the selected approach in software development is the agile methodology. Agile methodology is founded on four fundamental principles, prioritizing individual and interpersonal interactions over strict adherence to processes and tools, emphasizing the delivery of functional software over extensive documentation, promoting customer engagement over rigid contract negotiations, and valuing adaptability and responsiveness over rigidly adhering to a pre-established plan (Petrescu & Sterca, 2022).

Therefore, it is well-suited for developing software projects that demand frequent modifications and swift delivery. Additionally, agile methodology places significant emphasis on fostering a strong relationship between users and developers, ensuring that the software's requirements and development remain aligned. Its adaptability enables it to accommodate future changes in requirements based on customer needs. Consequently, the selection of agile methodology for this research project is justified because it can reliably deliver a high-quality product within the specified time frame (Hayat et al., 2019).

### 3.5.1 Proposed agile model

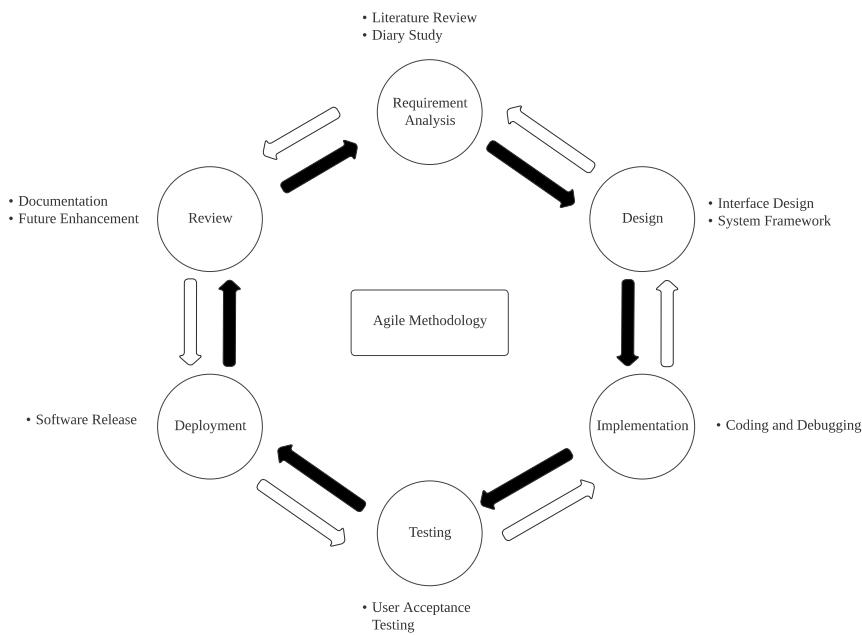


Figure 3.0 - Proposed Agile Model

### 3.6 Hardware and Software Specification

Table 3.6 - Hardware and software specification

	Justification
<b>Hardware</b>	
Android Phone	Given that Android Studio was selected as the development tool, it's important to note that it exclusively caters to Android app development.
<b>Software</b>	
Android Studio	It is the software that can develop CogniCare application.

## **Chapter 4: Analysis**

### **4.1 Introduction**

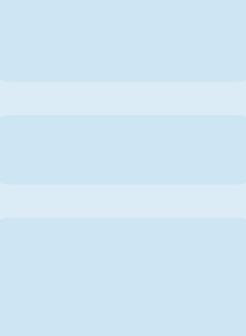
A diary study was conducted with one elderly adult, refer to section 4.2 for the persona, with the goal of gathering significant data and insights into his thoughts on utilizing the Witty Words application for cognitive training exercises. This study adopts a diary format, allowing the elderly adult to share his thoughts in a more spontaneous and unstructured manner.

In this diary study, I have opted for a paper format to allow for a more personalized and hands-on approach to gathering information from the elderly adult. A designated carer has been assigned to actively engage with him and ask specific questions about his experiences with Witty Words application. The carer will act as a conduit for recording his ideas, opinions, and any obstacles experienced while using the tool.

This strategy ensures a smooth and pleasant relationship for the elderly adult, allowing him to express himself verbally while the carer meticulously records his comments. The caregiver's role is critical in ensuring a seamless flow of communication by gathering nuanced information on usability and accessibility, overall experience, and suggestions for improvement.

The paper-based format streamlines the procedure for the elderly adult while still accommodating any technological issues he may encounter. This strategy prioritises the collecting of authentic and thorough thoughts, with the carer available to provide extra context and clarity as needed.

## 4.2 Persona

NAME	<p>Foo Suan Teng</p>	
DESCRIPTOR	<p>My grandfather and he live in Kuantan, Pahang</p>	
QUOTE	<p>While no one can change the outcome of dementia or Alzheimer's, with the right support you can change the journey.</p>	
WHO IS IT ?	<p>My grandfather, Foo Suan Teng, who is 86 years old, is experiencing memory problems associated with dementia, leading to frequent forgetfulness.</p>	
WHAT GOALS?	<p>Designing an application that tackle cognitive issues.</p>	
WHAT ATTITUDE?	<p>Having a good utility, Easy to Learn, and Efficient to Use will prompt to every desirable aspects of user experience such as enjoyable, satisfied, and the rundown goes on.</p>	
WHICH BEHAVIOUR?	<p>Foo Suan Teng, amidst grappling with dementia, which is seeking to regain and preserve his independence. He seeks an that could greatly improve the quality of life for those living with dementia.</p>	
ACTUAL	<p> </p> <p> </p> <p> </p>	

THE PERSONA CORE POSTER by CREATIVE COMPANION 

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Figure 4.0 - Persona

### 4.3 Diary study questions

Figure 4.1 depict the set of questions asked from the diary study between the elderly adult and I conducted. The questions were on the mobile application he was using, its usability and accessibility, their overall experience, and suggestions for improvement. These figures serve as a thorough framework for gathering insightful information from the elderly adult during the diary study throughout one week, in which the elderly adult and the carer must actively engage with the following set of questions every day. It covers usability, satisfaction, and constructive feedback on how to improve their app experience.

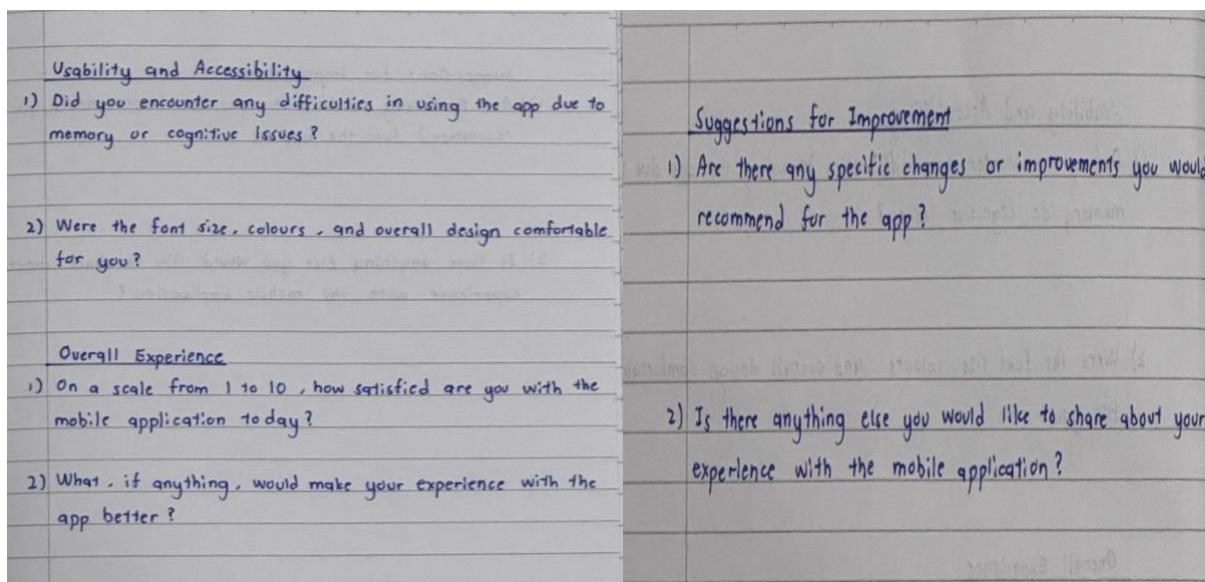


Figure 4.1 - Questions Set For Diary Study

#### Objective 1

To comprehend the target audience's perspective on the usability and accessibility of the Witty Words application, which functions as a cognitive training application for seniors

#### Questions

1. Did you encounter any difficulties in using the app due to memory or cognitive issues?
2. Were the font size, colors, and overall design comfortable for you?

#### Objective 2

To comprehend the target audience's perspective on the overall experience of the Witty Words application, which functions as a cognitive training application for seniors

#### Questions

1. On a scale from 1 to 10, how satisfied are you with the mobile application today?
2. What, if anything, would make your experience with the app better?

### Objective 3

To comprehend the target audience's perspective on the suggestions for improvement of the Witty Words application, which functions as a cognitive training application for seniors

### Questions

1. Are there any specific changes or improvements you would recommend for the app?
2. Is there anything else you would like to share about your experience with the app?

The following section will display the data collected between day 1 and day 7.

DAY 1	
Usability and Accessibility	
1.	Yes, it is difficult for me to finish the daily puzzles because there are so many words to solve
2.	Yes
Overall Experience	
1.	7
2.	If the app have more features to its, it will be more intriguing because it now just has one, which is crossword puzzle game
Suggestions for Improvement	
1.	No
2.	No

Figure 4.2 - Day 1 Data Collected

As illustrated in Figure 4.2, the user reported difficulties in solving the daily puzzles due to the abundance of words. He also noted that adding more features to the app will boost its attractiveness. In addition, he expressed happiness with the overall design, text size, and colour palette. Notably, no suggestions for improvement were given on day one.

DAY 2	
Usability and Accessibility	
1.	Yes, I found it challenging to solve this crossword puzzle game, and I keep forgetting what the word to it.
2.	Yes
Overall Experience	
1.	6
2.	Adding a range of different games besides crosswords would improve the overall user experience.
Suggestions for Improvement	
1.	Not at the moment.
2.	Everything seems well-designed, and I enjoyed the app's simplicity

Figure 4.3 - Day 2 Data Collected

As illustrated in Figure 4.3, the user reported problems in solving the puzzles, which is consistent with his response on day 1. He also mentioned that including a variety of games other than crosswords will enhance the whole experience. In addition, he expressed satisfaction with the overall design, font size, and colour palette. Notably, he remarked that he loved the app's simplicity, which made it easier for him to use.

<b>DAY 3</b>
<b>Usability and Accessibility</b>
1. No, I did not face any challenges related to memory or cognitive issues while using the app
2. Yes, the font size, colours, and overall design were pleasing and easy to interact with
<b>Overall Experience</b>
1. 7
2. Adding a range of different games besides crosswords would improve the overall user experience.
<b>Suggestions for Improvement</b>
1. Perhaps adding things like food recipes could benefit me as well, as I occasionally forget what the recipe is for a given meal
2. The app is quite enjoyable as it is, and I appreciate the straightforward approach.

Figure 4.4 - Day 3 Data Collected

As illustrated in Figure 4.4, the user reported no difficulty with the app owing to memory or cognitive disorders. He also said that incorporating games other than crosswords will enhance the entire user experience. In addition, he emphasised his happiness with the overall design, font size, and colour palette. Notably, he stated that adding elements such as food recipes will benefit him because he frequently forgets what the recipe is for a given meal.

<b>DAY 4</b>
<b>Usability and Accessibility</b>
1. Yes
2. No, I discovered that the music is pretty irritating, which makes me annoyed.
<b>Overall Experience</b>
1. 7
2. Incorporating a social feature where users can challenge friends or compete with others would be an interesting addition.
<b>Suggestions for Improvement</b>
1. No
2. No

Figure 4.5 - Day 4 Data Collected

As illustrated in Figure 4.5, the user reported difficulties in using the app due to memory or cognitive issues which is the same respond as Day 1 and 2. He also suggested that a social function allowing users to challenge friends or compete with others would be a good addition.

In addition, he expressed his satisfaction with the overall design, font size, and colour palette. Notably, he mentioned that if music is incorporated, it is bothersome for him.

DAY 5
Usability and Accessibility
1. No
2. Yes, it's pretty clean and simple
Overall Experience
1. 8
2. Nothing
Suggestions for Improvement
1. Yes, I would propose the app to add other games because it's really dull to play only crossword puzzles.
2. No.

Figure 4.6 - Day 5 Data Collected

As illustrated in Figure 4.6, the user reported no difficulty with the app owing to memory or cognitive disorders. He also suggested that the app should add other games because it's really dull to play only crossword puzzles. In addition, he expressed his satisfaction with the overall design, font size, and colour palette. Notably, he remarked that he loved the app's simplicity.

DAY 6
Usability and Accessibility
1. No, I discovered that it is pretty easy for me to solve simple crossword puzzles.
2. Yes
Overall Experience
1. 7
2. So far, I'm delighted with this application.
Suggestions for Improvement
1. No specific changes at this time
2. The app is simple and effective, providing a satisfying experience.

Figure 4.7 - Day 6 Data Collected

As illustrated in Figure 4.7, the user reported no difficulty in using the app and he mentioned that it's pretty easy for him to solve simple crossword puzzle. In addition, he emphasised his happiness with the overall design, font size, and colour palette. Notably, he stated that the app is simple and effective which provide a satisfying experience for him.

DAY 7	
<u>Usability and Accessibility</u>	
1.	Yes, the daily puzzles I couldn't solve majority of it because they were too complex
2.	Yes
<u>Overall Experience</u>	
1.	6
2.	No
<u>Suggestions for Improvement</u>	
1.	No
2.	Not at the moment

*Figure 4.8 - Day 7 Data Collected*

As illustrated in Figure 4.8, the user reported difficulties in using the app due to the crossword puzzles were too complex for him. In addition, he emphasised his happiness with the overall design, font size, and colour palette. Notably, no suggestions for improvement were given on day seven.

#### **4.4 Summary of the overall findings**

In this section, a synopsis will be provided which include an overview of the data obtained over the period of seven days. After analyzing the data gathered, he gave Witty Words application and average grade of 7. Furthermore, he prefers simple game designs or user interfaces because he has difficulty in solving highly complex puzzles or understanding elaborate interfaces. He also feels that adding features like food recipes, multiplayer mode, and a varied selection of games will improve the app interaction. Therefore, the CogniCare application's development will follow closely to the acquired data, ensuring that it meets the needs of the users.

## 4.5 Product Features

The following table (Table 4.0) contains the list of features to be implemented in CogniCare Application.

*Table 4.0 - Product Features*

Feature ID	Feature	Description	Accessible Role
F001	Register	To allow users to register an account to use the application	User
F002	Login	To allow users to login to their accounts to use the application	User
F003	Overflow Menu	To allow users to choose different features including Settings, Share, Terms & Privacy, and Log Out	User
F004	Settings	To allow users to choose different features including Update Email, Change Password, and Delete Profile	User
F005	Forgot Password	To allow users to reset their password during login phase	User
F006	Brain Stimulation Games	To allow users to access many sorts of games, including Tetris and Tic Tac Toe	User
F007	Tetris	To allow users to play the game designed	User
F008	Tic Tac Toe	To allow users to play the game designed	User
F009	Health News & Recipes	To allow users to access different features, including Search Recipes, Health News and Exit	User
F010	Fitness	To allow users to access different program such as Before Age 60, After Age 60, Meditation, and Nutrition or Tips	User
F011	Progress Report	To allow users to take the test assessment to track their progress and view the report generated regarding their progress over time	User

## 4.6 Requirements

### 4.6.1 Use Case Diagram



Figure 4.9 - Use Case Diagram

Figure 4.9 displays the Use Case Diagram, which has several aspects. To start off with, a new user must first complete a test assessment before registering and logging in. On the other hand, existing users, can move directly to the login page, which have the option to choose Forgot Password or Register. Upon successful login, the user will be brought to the home page, which includes a variety of options. Firstly, the overflow menu. The user will have the option to choose settings, log out, share, and terms & privacy. A drop-down menu in the settings allows users to choose different function such as update email, change passwords, or delete profile. To conduct any of these tasks, users must first authenticate themselves before continue with the desired action, such as updating their email. Next, there are brain stimulation games available. This page allows the user to choose between two games options: Tetris or Tic Tac Toe. Users can choose whether to start the Tetris game or exit. In Tic Tac Toe, users can start the game in one of three modes: single player, multiplayer, or local mode, or they can exit from the game. Moving on to the health news and recipes page, there are three options available for the user to choose: search recipes, health news, or exit. Users can utilise the search recipes function to find specific recipes, such as Turkey Pot Pie, or browse recipes organised by main course, side dish, dessert, appetiser, salad, bread, breakfast, soup, beverage, sauce, marinade, finger foods, and drinks. Additionally, when browsing the selected recipe, the user will be presented with instructions, similar recipes, and ingredient information. Furthermore, readers in the health news section can get up-to-the-minute news updates, as well as search for specialised news, such as news in the Sports category. Then for fitness page has four features for the user to choose: before age 60, after age 60, meditation, and nutrition or tips. The only variation between the before and after age 60 features was the exercise time, which was 30 minutes before 60 and 45 minutes after 60. Furthermore, the nutrition or tips section allows the user to examine various tips, such as staying physically active with Alzheimer. Finally, the progress report page allows users to view the progress report, such as gender and date of birth, as well as their test completion attempts from the initial test assessment completed during the sign-up step. Additionally, individuals have the option to retake the test to track their dementia progression over time. When retaking the test, users can compare the number of attempts between the initial and subsequent tests to see if there are any improvements or not.

## 4.6.2 Use Case Description

The following Use Case Table (Table 4.1) shows the details of this feature.

*Table 4.1 - Use Case Table (Register)*

<b>Use Case ID</b>	UC001	<b>Version</b>	1.0
<b>Feature</b>	F001 Register		
<b>Purpose</b>	To allow users to register an account to use the system		
<b>Actor</b>	User		
<b>Trigger</b>	User will click on the “Get Started” option from the login page		
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the login page provided with the “Get Started” option</li> <li>• User is not successfully logged in</li> </ul>		
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>	
<b>Main Flow</b>	1	System will display sign up page to the user	
	2	User will enter their information such as Full Name, Email, and so forth	
	3	System will retrieve user credentials	
	4	Credentials retrieved will be validated	
	5	Credentials authenticated	
	6	The test assessment page will then display options for user to choose	
<b>Alternate Flow – Email already registered</b>	4.1	Credentials not authenticated and unsuccessful register	
	4.2	System shall display an error message showing that email has been registered	
	4.3	User re-enter credentials and repeat step 3	
<b>Alternate Flow – Password is too weak</b>	4.1	Credentials not authenticated and unsuccessful register	
	4.2	System shall display an error message showing that password is too weak	
	4.3	User re-enter credentials and repeat step 3	
<b>Alternate Flow – Continue chosen</b>	6.1	The user will be taking the test assessment	
	6.2	The system will then display options for user to choose after finishing the test assessment	

<b>Alternate Flow – Finish chosen</b>	6.2.1	The system will register the user and save the credentials into the database
	6.2.2	The system will then display the home page
<b>Alternate Flow – Exit chosen</b>	6.2.1	The system will then display the main page
<b>Alternate Flow – Exit chosen</b>	6.1	The system will then display the main page
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Email used to register must be valid</li> <li>• Email should not be registered</li> <li>• Password length must be at least 8 digits</li> <li>• Terms &amp; Privacy must be agreed</li> </ul>	
<b>Author</b>	Foo Fang Khai	

The following Use Case Table (Table 4.2) shows the details of this feature.

Table 4.2 - Use Case Table (Login)

<b>Use Case ID</b>	UC002	<b>Version</b>	1.0
<b>Feature</b>	F002 Login		
<b>Purpose</b>	To allow users to login to their accounts to use the application		
<b>Actor</b>	User		
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on the “Sign in with Google” option from the login page</li> <li>• User will click on the “Sign in with Phone” option from the login page</li> <li>• User will click on the “Sign in with Email” option from the login page</li> </ul>		
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the login page</li> <li>• User is not logged in</li> </ul>		
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>	
<b>Main Flow</b>	1	System will display main page with different login options including “Sign in with Google”, “Sign in with Phone”, or “Sign in with Email” then user will have to choose a login method	

<b>Alternate Flow – Sign in with Email chosen</b>	1.1	The “Sign in with Email” page, it also offers to reset password or register new accounts, allowing users to choose their preferred actions
	1.2	User will enter credentials
	1.3	System will retrieve user credentials
	1.4	Credentials retrieved will be validated
	1.5	System will return the validation result
	1.6	Credentials authenticated
	1.7	System will display home Page
<b>Alternate Flow – Forgot password chosen</b>	1.1.1	System will display the forgot password page
<b>Alternate Flow – Register chosen</b>	1.1.1	System will display the sign up page
<b>Alternate Flow – Email entered is incorrect</b>	1.5.1	Credentials not authenticated and cannot perform action
	1.5.2	System shall display an error message showing that what is invalid
	1.5.3	User re-enter credentials and repeat step 1.3
<b>Alternate Flow – Password entered is incorrect</b>	1.5.1	Credentials not authenticated and cannot perform action
	1.5.2	System shall display an error message showing that what is invalid
	1.5.3	User re-enter credentials and repeat step 1.3
<b>Alternate Flow – Sign in with Google chosen</b>	1.1	User will have to choose which google account to login with
	1.2	System will retrieve user credentials
	1.3	Credentials retrieved will be validated
	1.4	System will return the validation result
	1.5	System will display the home page

<b>Alternate Flow – Sign in with Phone Number chosen</b>	1.1	User will enter credentials
	1.2	System will retrieve user credentials
	1.3	Credentials retrieved will be validated
	1.4	System will return the validation result
	1.5	Credentials authenticated
	1.6	System will send an OTP to the user phone number
	1.7	User will enter the OTP received
	1.8	System will retrieve user credentials
	1.9	Credentials retrieved will be validated
	1.10	Credentials authenticated
	1.11	System will display home page
<b>Alternate Flow – Phone Number is invalid</b>	1.4.1	Credentials not authenticated and cannot perform action
	1.4.2	System shall display an error message showing that what is invalid and repeat step 1.1
<b>Alternate Flow – OTP is invalid</b>	1.9.1	Credentials not authenticated and cannot perform action
	1.9.2	System shall display an error message showing that what is invalid and repeat step 1.7
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Login credentials should be correct</li> </ul>	
<b>Author</b>	Foo Fang Khai	

The following Use Case Table (Table 4.3) shows the details of this feature.

*Table 4.3 - Use Case Table (Overflow Menu)*

<b>Use Case ID</b>	UC003	<b>Version</b>	1.0		
<b>Feature</b>	F003 Overflow Menu				
<b>Purpose</b>	To allow users to choose different features including Settings, Share, Terms & Privacy, and Log Out				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on the overflow menu in the home page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System shall display and allow the user to choose which feature they wanted to use			
<b>Alternate Flow – Share function is chosen</b>	1.1	System will display share page			
	1.2	Users share the application			
<b>Alternate Flow – Terms &amp; Privacy function is chosen</b>	1.1	System will display terms & privacy page			
<b>Alternate Flow – Logout function is chosen</b>	1.1	System will display the main page and log out the user account			
<b>Alternate Flow – Settings function is chosen</b>	1.1	System will display the settings page			
<b>Rules</b>	-				
<b>Author</b>	Foo Fang Khai				

The following Use Case Table (Table 4.4) shows the details of this feature.

*Table 4.4 - Use Case Table (Settings)*

<b>Use Case ID</b>	UC004	<b>Version</b>	1.0
<b>Feature</b>	F004 Settings		
<b>Purpose</b>	To allow users to choose different features including Update Email, Change Password, and Delete Profile		
<b>Actor</b>	User		
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Settings” provided in the overflow menu</li> </ul>		
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>		
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>	
<b>Main Flow</b>	1	System will display a drop down menu which include Update Email, Change Password, and Delete Profile for the user to choose	
<b>Alternate Flow – Update email function chosen</b>	1.1	System will display update email page	
	1.2	User will enter credentials	
	1.3	System will retrieve user credentials	
	1.4	Credentials retrieved will be validated	
	1.5	System will return the validation result	
	1.6	Credentials authenticated	
	1.7	User will enter new email and click the update email button	
	1.8	System will retrieve user credentials	
	1.9	Updated credentials will be stored in the database	
	1.10	Details will be updated in the database	
	1.11	System will display home page	
<b>Alternate Flow – Credentials entered incorrect</b>	1.5.1	Credentials not authenticated and cannot perform action	
	1.5.2	System shall display an error message showing that what is invalid	
	1.5.3	User re-enter credentials and repeat step 1.3	

<b>Alternate Flow – Change password function chosen</b>	1.1	System will display change password page
	1.2	User will enter credentials
	1.3	System will retrieve user credentials
	1.4	Credentials retrieved will be validated
	1.5	System will return the validation result
	1.6	Credentials authenticated
	1.7	User will enter new password and click the change password button
	1.8	System will retrieve user credentials
	1.9	Credentials retrieved will be validated
	1.10	System will return the validation result
	1.11	Credentials authenticated
	1.12	Updated credentials will be stored in the database
	1.13	Details will be updated in the database
	1.14	System will display home page
<b>Alternate Flow – Credentials entered incorrect</b>	1.5.1	Credentials not authenticated and cannot perform action
	1.5.2	System shall display an error message showing that what is invalid
	1.5.3	User re-enter credentials and repeat step 1.3
<b>Alternate Flow – Password entered not the same</b>	1.10.1	Credentials not authenticated and cannot perform action
	1.10.2	System shall display an error message showing that what is invalid
	1.10.3	User re-enter credentials and repeat step 1.8
<b>Alternate Flow – Delete profile function chosen</b>	1.1	System will display delete password page
	1.2	User will enter credentials
	1.3	System will retrieve user credentials
	1.4	Credentials retrieved will be validated
	1.5	System will return the validation result
	1.6	Credentials authenticated

	1.7	User will click on the Delete profile button
	1.8	System will display Continue or Exit option for the user to choose
<b>Alternate Flow – Credentials entered incorrect</b>	1.5.1	Credentials not authenticated and cannot perform action
	1.5.2	System shall display an error message showing that what is invalid
	1.5.3	User re-enter credentials and repeat step 1.3
<b>Alternate Flow – Continue chosen</b>	1.8.1	System will retrieve user credentials
	1.8.2	User credentials will be deleted in the database
	1.8.3	Details will be deleted in the database
	1.8.4	System will display home page
<b>Alternate Flow – Cancel chosen</b>	1.8.1	System will display delete profile page
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Credentials entered should be correct</li> <li>• New email entered should not be the same as the old one</li> <li>• Password entered should not be the same as the old one</li> <li>• New Password and Confirm Password entered should be the same</li> </ul>	
<b>Author</b>	Foo Fang Khai	

The following Use Case Table (Table 4.5) shows the details of this feature.

*Table 4.5 - Use Case Table (Forgot Password)*

<b>Use Case ID</b>	UC005	<b>Version</b>	1.0		
<b>Feature</b>	F005 Forgot Password				
<b>Purpose</b>	To allow users to reset their password during login phase				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Click here to reset” provided in the Sign in with Email page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the Sign in with Email page</li> <li>• User is not logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System will display forgot password page			
	2	User will enter credentials			
	3	System will retrieve user credentials			
	4	Credentials retrieved will be validated			
	5	System will return the validation result			
	6	Credentials authenticated			
	7	System will display main page			
	8	System will send a password reset link to the user’s email			
<b>Alternate Flow –</b> <b>Email entered invalid</b>	5.1	Credentials not authenticated and cannot perform action			
	5.2	System shall display an error message showing that what is invalid			
	5.3	User re-enter credentials and repeat step 3			
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Email entered should be valid</li> </ul>				
<b>Author</b>	Foo Fang Khai				

The following Use Case Table (Table 4.6) shows the details of this feature.

*Table 4.6 - Use Case Table (Brain Stimulation Games)*

<b>Use Case ID</b>	UC006	<b>Version</b>	1.0		
<b>Feature</b>	F006 Brain Stimulation Games				
<b>Purpose</b>	To allow users to access many sorts of games, including Tetris and Tic Tac Toe				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Brain Stimulation Games” provided in the home page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System will display home page			
	2	User will choose the brain stimulation games function			
	3	System will display brain stimulation games page with various game for the user to choose			
<b>Alternate Flow – Return button clicked</b>	3.1	System will display home page			
<b>Alternate Flow – Tic Tac Toe chosen</b>	3.1	System will display tic tac toe page			
<b>Alternate Flow – Tetris chosen</b>	3.1	System will display tetris page			
<b>Rules</b>	-				
<b>Author</b>	Foo Fang Khai				

The following Use Case Table (Table 4.7) shows the details of this feature.

*Table 4.7 - Use Case Table (Tetris)*

<b>Use Case ID</b>	UC007	<b>Version</b>	1.0		
<b>Feature</b>	F007 Tetris				
<b>Purpose</b>	To allow users to play the game designed				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Tetris” provided in the Brain Stimulation Games page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the Brain Stimulation Games page</li> <li>• User is logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System will display Tetris page and with Start Game or Exit option for the user to choose			
<b>Alternate Flow – Start Game chose</b>	1.1	System will display Tetris game page and with Start or Exit option for the user to choose			
<b>Alternate Flow – Start chose</b>	1.1.1	System will initiate the game			
	1.1.2	User will play the game initiated			
<b>Alternate Flow – Exit chose</b>	1.1.1	System will display Tetris page			
<b>Alternate Flow – Exit chose</b>	1.1	System will display brain stimulation games page			
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Option between Start Game and Exit must be choose</li> </ul>				
<b>Author</b>	Foo Fang Khai				

The following Use Case Table (Table 4.8) shows the details of this feature.

*Table 4.8 - Use Case Table (Tic Tac Toe)*

<b>Use Case ID</b>	UC008	<b>Version</b>	1.0
<b>Feature</b>	F008 Tic Tac Toe		
<b>Purpose</b>	To allow users to play the game designed		
<b>Actor</b>	User		
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Tic Tac Toe” provided in the Brain Stimulation Games page</li> </ul>		
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the Brain Stimulation Games page</li> <li>• User is logged in</li> </ul>		
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>	
<b>Main Flow</b>	1	System will display Tic Tac Toe game page and user can choose to play different modes	
<b>Alternate Flow – Single Player chose</b>	1.1	System will display single player page	
	1.2	System will launch the game for single player mode	
	1.3	User will play the game	
	1.4	System will display options for the user to choose either start a new match or exit from the game after the game finished	
	1.5	User will then choose to start a new match or exit	
<b>Alternate Flow – Start New Match chose</b>	1.5.1	Repeat step 1.2	
<b>Alternate Flow – Exit chose</b>	1.5.1	System will display Tic Tac Toe game page	
<b>Alternate Flow – Local Mode chose</b>	1.1	System will display local mode page	
	1.2	System will launch the game for local mode	
	1.3	User will play the game	
	1.4	System will display options for the user to choose either start a new match or exit from the game after the game finished	

	1.5	User will then choose to start a new match or exit
<b>Alternate Flow – Start New Match chose</b>	1.5.1	Repeat step 1.2
<b>Alternate Flow – Exit chose</b>	1.5.1	System will display Tic Tac Toe game page
<b>Alternate Flow – Multiplayer Mode chose</b>	1.1	System will display multiplayer mode page
	1.2	User will enter their player name and given the option to Continue or Exit from the game
<b>Alternate Flow – Continue chose</b>	1.2.1	System will launch the game for multiplayer mode
	1.2.2	User will play the game
	1.2.3	After game finished, the system will redirect the user back to the multiplayer mode page and repeat step 1.2
<b>Alternate Flow – Exit chose</b>	1.2.1	System will display Tic Tac Toe game page
<b>Alternate Flow – Exit chose</b>	1.1	System will display brain stimulation games page
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Option between Start New Match and Exit must be choose</li> <li>• Option between Continue and Exit must be choose</li> </ul>	
<b>Author</b>	Foo Fang Khai	

The following Use Case Table (Table 4.9) shows the details of this feature.

*Table 4.9 - Use Case Table (Health News & Recipes)*

<b>Use Case ID</b>	UC009	<b>Version</b>	1.0		
<b>Feature</b>	F009 Health News & Recipes				
<b>Purpose</b>	To allow users to access different features, including Search Recipes, Health News, and Exit				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Health Tips” provided in the home page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System will display health tips page and with options of Search Recipe, Health News, or Exit for the user to choose			
<b>Alternate Flow – Search recipe function chose</b>	1.1	System will display search recipes page			
	1.2	User searches for a recipe			
	1.3	System will display the recipe details searched			
<b>Alternate Flow – Done viewing</b>	1.3.1	User clicks on the return button			
	1.3.2	System will display health tips page			
<b>Alternate Flow – Health news function chose</b>	1.1	System will display health news page			
	1.2	User searches for news			
	1.3	System will display the news details searched			
<b>Alternate Flow – Done viewing</b>	1.3.1	User clicks on the return button			
	1.3.2	System will display health tips page			
<b>Alternate Flow – Exit function chose</b>	1.1	System will display home page			
<b>Rules</b>	-				
<b>Author</b>	Foo Fang Khai				

The following Use Case Table (Table 4.10) shows the details of this feature.

*Table 4.10 - Use Case Table (Fitness)*

<b>Use Case ID</b>	UC010	<b>Version</b>	1.0
<b>Feature</b>	F010 Fitness		
<b>Purpose</b>	To allow users to access different program such as Before Age 60, After Age 60, Meditation, and Nutrition or Tips		
<b>Actor</b>	User		
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Fitness” provided in the home page</li> </ul>		
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>		
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>	
<b>Main Flow</b>	1	System will display fitness page and with options of Before Age 60, After Age 60, Meditation, and Nutrition or Tips for the user to choose	
<b>Alternate Flow – Before age 60 function chosen</b>	1.1	System will display before age 60 activity page	
	1.2	User selects an exercise	
	1.3	System will display the chosen exercise details which includes Read button where it will read out the instructions on how to perform the exercise to the user, and Find Out More button which will guide the user with one video assigned on how to complete the exercise. Then the user can choose to Start or Exit the exercise	
<b>Alternate Flow – Start chosen</b>	1.3.1	The system will start the timer	
<b>Alternate Flow – If timer pause</b>	1.3.1.1	The system will pause the timer	
<b>Alternate Flow – If timer didn't pause</b>	1.3.1.1	The system will display the chosen exercise details	
<b>Alternate Flow – Exit chosen</b>	1.3.1	System will display before age 60 activity page	

<b>Alternate Flow – After age 60 function chosen</b>	1.1 1.2 1.3	System will display after age 60 activity page User selects an exercise System will display the chosen exercise details which includes Read button where it will read out the instructions on how to perform the exercise to the user, and Find Out More button which will guide the user with one video assigned on how to complete the exercise. Then the user can choose to Start or Exit the exercise
<b>Alternate Flow – Start chosen</b>	1.3.1	The system will start the timer
<b>Alternate Flow – If timer pause</b>	1.3.1.1	The system will pause the timer
<b>Alternate Flow – If timer didn't pause</b>	1.3.1.1	The system will display the chosen exercise details
<b>Alternate Flow – Exit chosen</b>	1.3.1	System will display before age 60 activity page
<b>Alternate Flow – Meditation function chosen</b>	1.1	System will display meditation page
<b>Alternate Flow – Nutrition or tips function chosen</b>	1.1	System will display nutrition or tips page
	1.2	System will display tips & diet information
	1.3	User can view the information
<b>Alternate Flow – Done viewing</b>	1.3.1	User clicks on the return button
	1.3.2	System display fitness page
<b>Rules</b>	-	
<b>Author</b>	Foo Fang Khai	

The following Use Case Table (Table 4.11) shows the details of this feature.

*Table 4.11 - Use Case Table (Progress Report)*

<b>Use Case ID</b>	UC011	<b>Version</b>	1.0		
<b>Feature</b>	F011 Progress Report				
<b>Purpose</b>	To allow users to take the test assessment to track their progress and view the report generated regarding their progress over time				
<b>Actor</b>	User				
<b>Trigger</b>	<ul style="list-style-type: none"> <li>• User will click on option “Progress Report” provided in the home page</li> </ul>				
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• User is on the home page</li> <li>• User is logged in</li> </ul>				
<b>Scenario Name</b>	<b>Step</b>	<b>Action</b>			
<b>Main Flow</b>	1	System will display progress report page and with options of Continue or Exit for the user to choose			
<b>Alternate Flow – Option Continue chose</b>	1.1	System will display progress report page where the user has the option to take the test assessment or exit from this page			
	1.2	System will get the user id			
	1.3	System will retrieve user credentials			
	1.4	System will return the retrieved credentials			
	1.5	System will display the user details retrieved to the user			
<b>Alternate Flow – Take test assessment</b>	1.1.1	System will display the test assessment page			
<b>Alternate Flow – Done viewing</b>	1.1.1	User clicks on the return button			
	1.1.2	System will display home page			
<b>Alternate Flow – Option Exit chose</b>	1.1	System will display home page			
<b>Rules</b>	<ul style="list-style-type: none"> <li>• Option between Exit and Continue must be choose</li> </ul>				
<b>Author</b>	Foo Fang Khai				

## 4.7 Functional Requirements

<b>Requirement ID</b>	REQ_F001	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to register new users and issue an email verification link for confirmation purpose		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F002	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to authenticate users with login credentials		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F003	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display different features to the user including Settings, Share, Terms & Privacy, and Log Out		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F004	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display different features to the user including Update Email, Change Password, and Delete Profile		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F005	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to allow the user to reset their password by sending an email to their registered email for reset purpose		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F006	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display and allow the user to select the type of game they want to play including Tetris and Tic Tac Toe		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F007	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to allow the user to play Tetris game		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F008	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to allow the user to play Tic Tac Toe game		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F009	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display and allow the user to select the feature they wanted to use including Search Recipes, Health News and Exit		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F010	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display and allow the user to select which program they wanted to access including Before Age 60, After Age 60, Meditation, and Nutrition or Tips		
<b>Author</b>	Foo Fang Khai		

<b>Requirement ID</b>	REQ_F011	<b>Version</b>	1.0
<b>Description</b>	The system shall be able to display the user details, progress report, and allow the user to take the test assessment for progress tracking purposes		
<b>Author</b>	Foo Fang Khai		

## **4.8 Non-Functional Requirements**

### **4.8.1 Functionality Application Requirements**

<b>ID</b>	<b>Version</b>	<b>Description</b>	<b>Priority (1-5)</b>
001-001	1.0	Security	
001-001-001	1.0	The application shall ensure that only authorized users may conduct tasks such as updating email	5
001-001-002	1.0	The application shall be able to authenticate users login credentials	5
001-001-003	1.0	The application shall allow users to perform an One Time Password as affirmation for phone login	5
001-001-004	1.0	The application shall allow users to delete their profile once it's no longer needed	4

### **4.8.2 Reliability Application Requirements**

<b>ID</b>	<b>Version</b>	<b>Description</b>	<b>Priority (1-5)</b>
002-001	1.0	Recoverability	
002-001-001	1.0	The application shall allow users to reset password when they forgot their password	4
002-002	1.0	Reliability	
002-002-001	1.0	The application shall allow users to access their account after login credentials being validated without any failure or delay	4
002-002-002	1.0	The application shall be available for users 99.9% of the time without crashing	4

#### 4.8.3 Usability Application Requirements

ID	Version	Description	Priority (1-5)
003-001	1.0	Usability	
003-001-001	1.0	The application shall have appropriate interface to allow elderly users to utilize the application without any prior training even first time accessing	5
003-002	1.0	Attractiveness	
003-002-001	1.0	The application shall have a design with suitable colors for elderly users	3

#### 4.8.4 Efficiency Application Requirements

ID	Version	Description	Priority (1-5)
004-001	1.0	Performance	
004-001-001	1.0	The application shall make some heap memories of not over 2 second while users start the application	5
004-001-002	1.0	The application shall direct users to functions when those functions was chose by the users within 2 second	4
004-001-003	1.0	The application shall display the progress report within 3 seconds after retrieving details	5
004-001-004	1.0	The application shall ensure that users receive the latest news with a maximum delay of 24 hours for updates	4

## Chapter 5: Design

### 5.1 Introduction

Technical drawings, the project's system architecture, and design principles will all be included in this chapter.

### 5.2 Technical Drawings

#### 5.2.1 Entity Relationship Diagram

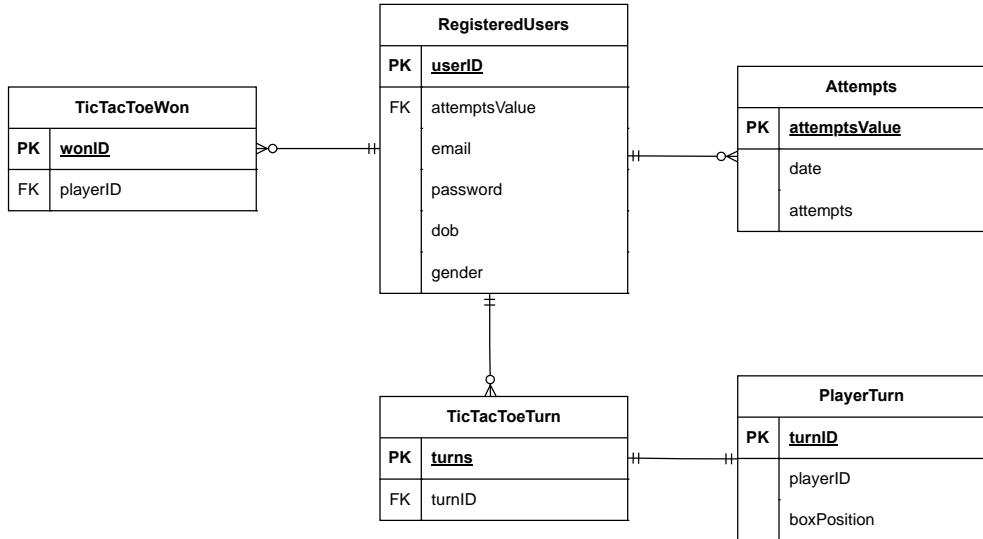


Figure 5.0 - Entity Relationship Diagram

The main entities include Registered users, Attempts, Tic-tac-toe turn, Player turn, and Tic-tac-toe won. First off, there are several properties associated with the Registered users entity: userID, attemptsValue, email, password, dob, and gender. Second, there are other attributes associated with the Attempts entity, such as attemptsValue, date, and attempts. Thirdly, the Tic-tac-toe won entity has several attributes, such as playerID and wonID. Fourth, turns and turnID are two of the attributes that make up the Tic-Tac-Toe turn entity. Last but not least, the Player turn entity features turnID, playerID, and boxPosition.

A one-to-many relationship between registered users and attempts is established by the multiple attempts values that each registered user may have where these values are utilised for cognitive test assessments. Comparably, a one-to-many relationship between registered users and Tic Tac Toe won may be seen in the several wins that a registered user may have in a game. Similar to this, a registered player may have many turns in Tic Tac Toe games, suggesting yet another one-to-many relationship. Lastly, every Tic Tac Toe turn consists of a single player

turn that stores box position and player ID information which suggests an one-to-one relationship.

### 5.2.2 Activity Diagram

#### 5.2.2.1 Main Activity Diagram

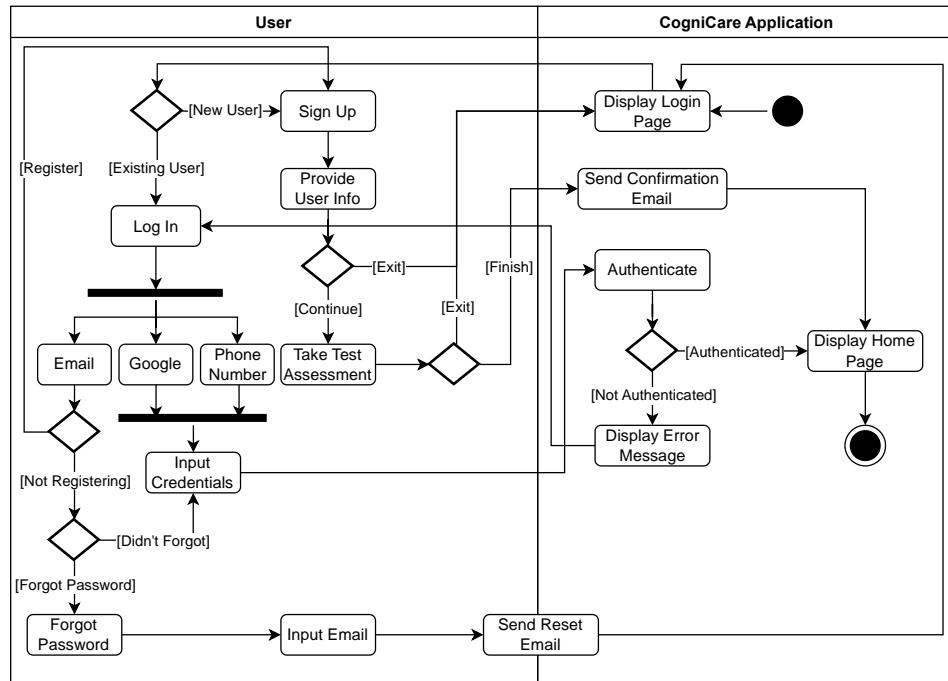


Figure 5.1 Main Activity Diagram

The CogniCare Application's main activity process is shown in Figure 5.1. The user will first be presented with the login page, from which they must select whether to sign up or log in. If the option to sign up was selected, the user will be prompted to provide the information needed before selecting whether or not to take the test. The user will be returned to the login page if they choose Exit. The user will be able to take the test if they choose Continue, otherwise. The user will have the option to either Finish or Exit the completed test. The user will be redirected to the login page if Exit was selected. Else, the user will be getting a confirmation email from the CogniCare Application asking them to confirm their email address and be taken to the home page. The user won't be authenticated by the system upon their subsequent login if the email isn't verified. In the event that the user selects Log In, they will be presented with three options: phone number, Google account, and email which consists of two other functions, Register and Forgot Password; if Register is chosen, the user will be led to the Sign Up page; if Forgot Password is chosen, the user will be led to the Forgot Password page and input their email to receive the reset email. The system will authenticate once the user selects a method and entered their credentials. The user will be taken to the home page if their

credentials are verified. Otherwise, the system will display an error message and direct the user back to the login page if the credentials are not authenticated.

### 5.2.2.2 Overflow Menu Activity Diagram

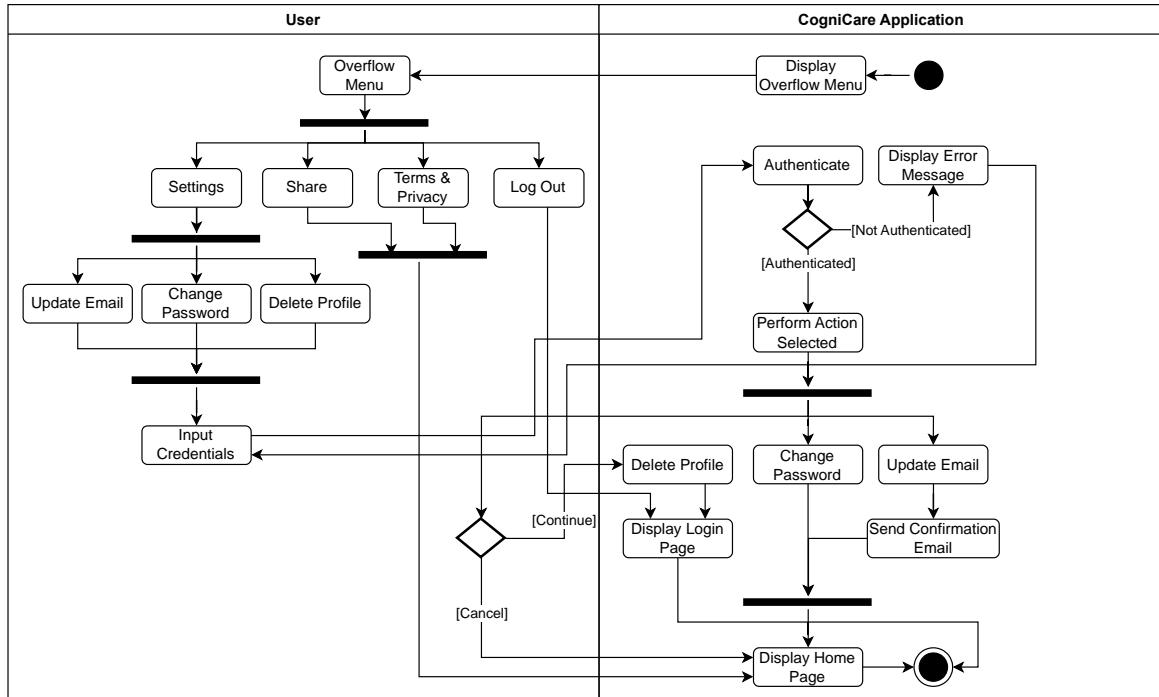


Figure 5.2 - Overflow Menu Activity Diagram

The CogniCare Application's overflow menu process is shown in Figure 5.2. The user will first be presented with the overflow menu page which has four functions, Settings, Share, Terms & Privacy, and Log Out. In the event that the user selects Log Out, they will be taken to the login page. If they select Share or Terms & Privacy, after completing the action, they will be taken back to the home page. If Settings is chosen, it encompasses three functions which include Update Email, Change Password, and Delete Profile. Furthermore, if the user choose to perform any of the functions, the selected function will be executed by the system after an authentication process. For instance, when the user chooses to Delete Profile, they have to enter their credentials, like the password, in order to complete the action. The system verifies the credentials they entered. An error message will be displayed and the user is prompted to provide the correct credentials if the credentials entered are invalid. On the other hand, the system performs the chosen action – in this case, Delete Profile – if the credentials are verified. Next, the user will be presented with the choice of Continue or Cancel to perform the delete profile action. If the user selects Continue, the system will delete the user's profile and display the login page. Otherwise, if Cancel is selected, the system will display the home page. Therefore, the process for altering a password and updating email will be comparable. After authentication, for updating email, a confirmation email is sent to verify the new email address entered, and

then the home page is displayed. Lastly, the home page is shown when the function to change password is invoked immediately upon authentication.

### 5.2.2.3 Brain Stimulation Games Activity Diagram

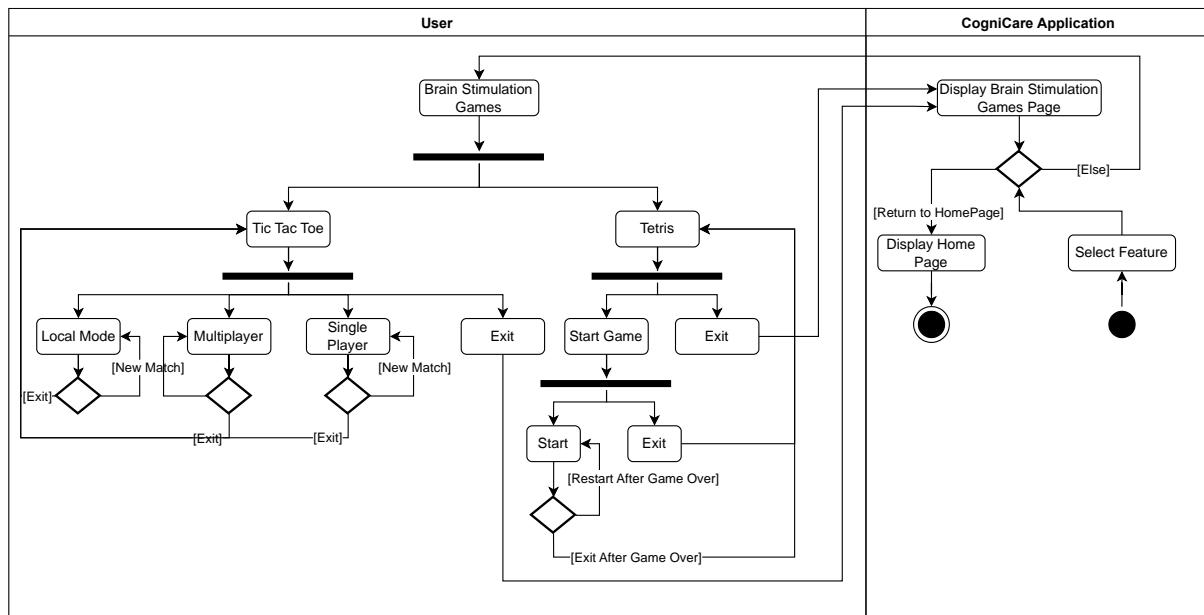


Figure 5.3 - Brain Stimulation Games Activity Diagram

The CogniCare Application's brain stimulation games process is shown in Figure 5.3. Initially, the feature Brain Stimulation Games will be selected by the user. Once chosen, the user had the option to go back to the home page. Else, the user will select one of the games from the brain stimulation games. There are two different kinds of games available: Tic Tac Toe and Tetris. To start off with, when the user chooses Tic Tac Toe, they have four options to choose from: Local Mode, Multiplayer, Single Player, and Exit. If Exit is selected, the screen for brain stimulation games will appear on the user's screen. If Local Mode, Multiplayer, or Single Player are selected, the user will be prompted to either start a new match or exit after each match. The user will play in the same game mode again if they choose to start a new match. The user will be brought back to the Tic Tac Toe game page if exit is chosen. Tetris comes next. There are two features in Tetris game: Start Game and Exit. The brain stimulation games page will be displayed by the system if Exit is chosen. The user will be able to pick whether to Start or Exit the Tetris game if Start Game is selected. The user will be brought back to the Tetris game page if they choose to Exit. In the event that Start is chosen, the user will have the option to restart the game or exit the game once it's game over.

#### 5.2.2.4 Health Tips Activity Diagram

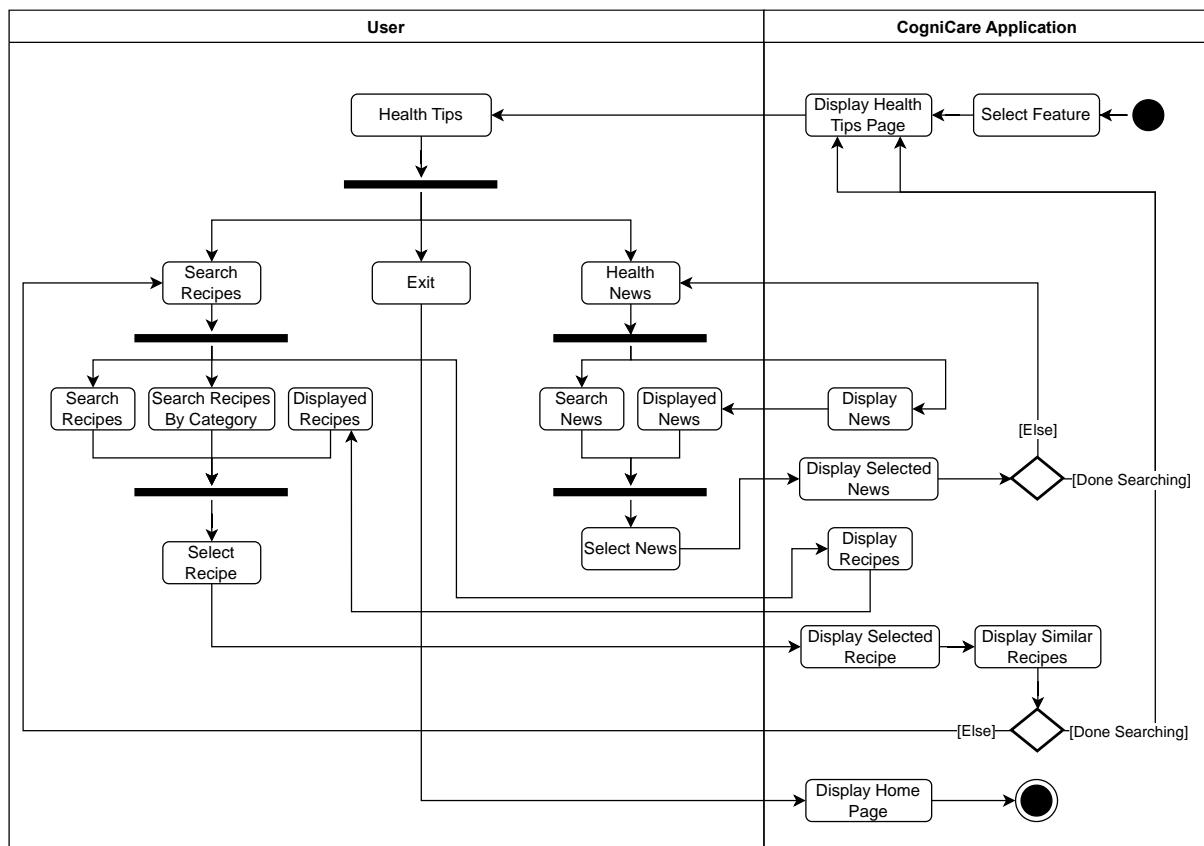


Figure 5.4 - Health Tips Activity Diagram

The CogniCare Application's health tips process is shown in Figure 5.4. First, the user will choose the Health Tips feature that is provided in the homepage. The three functions on the health tips page – Search Recipes, Exit, and Health News – will be displayed by the system once it has been selected. In the event that Exit is selected, the user will be returned to the homepage. If the user selects the Search Recipes function, they will be able to perform three tasks including Search Recipes, Search Recipes by Category, and view the system-displayed recipes. The user will then select which recipe they wish to view then the chosen recipe and similar recipes will be shown to the user by the system. After then, the user will decide whether to either stop searching or continue. They will return to the Search Recipes function if they want to continue searching. Else, the user will be returned to the health tips page. If Health News function was chosen by the user, the user will be able to Search News and view the system-displayed news. The user will then pick the news they wish to view and the chosen news will be shown to the user by the system. After then, the user will decide whether to either stop searching or continue. They will return to the Health News function if they want to continue searching. Else, the user will be returned to the health tips page.

### 5.2.2.5 Fitness Activity Diagram

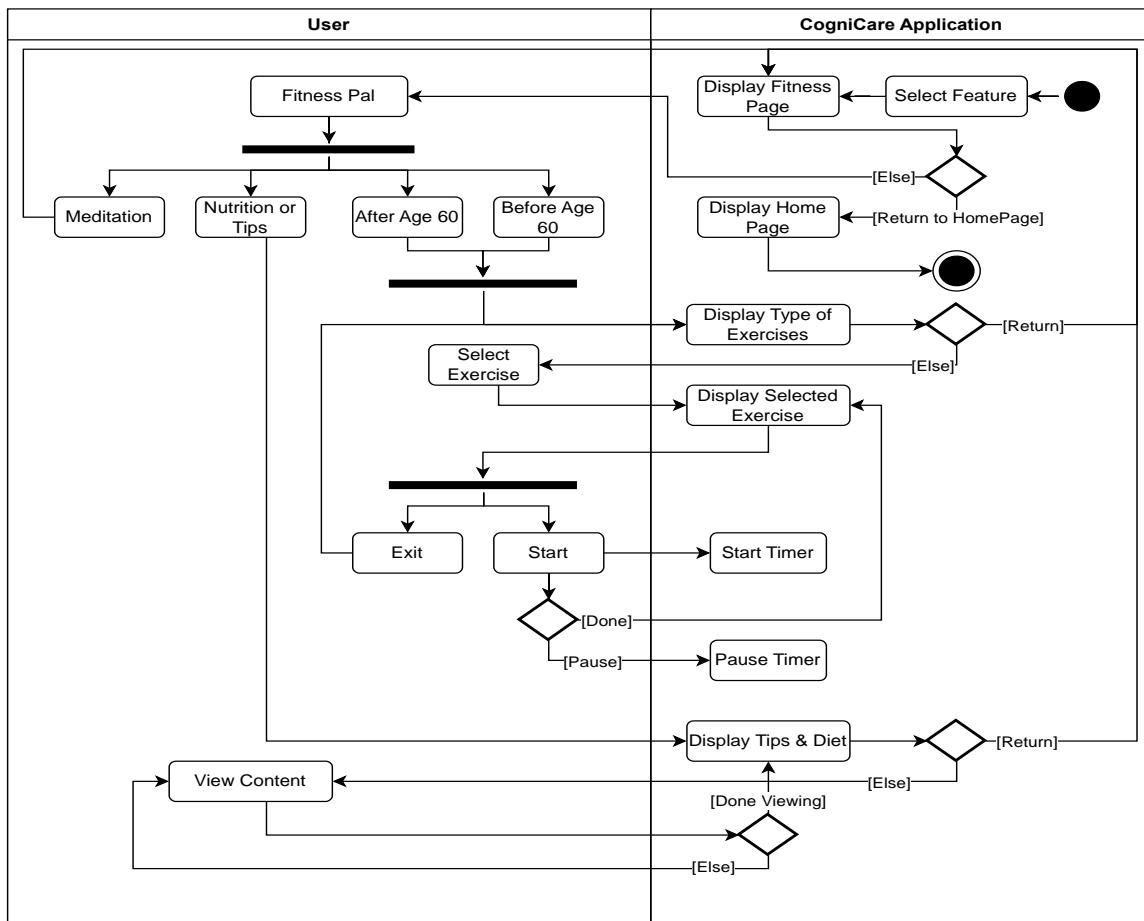


Figure 5.5 - Fitness Activity Diagram

The CogniCare Application's fitness process is shown in Figure 5.5. The system will first display the fitness page with four functions – Meditation, Nutrition or Tips, After Age 60, and Before Age 60 – after the user selects the Fitness option from the home page. The user will be presented with a list of workout options if they choose to select after or before the age of 60, and they will be given the option to either choose the exercises displayed or return to the fitness page. If the user decide to go back, they will be redirected to the fitness page. If not, the user will see the exercise they have picked on the screen, where they can choose to Start (which initiates the timer) or Exit (which ends the exercise). The system will return the user to the exercises page's display type if Exit is selected. If the option for start is selected, the timer will begin automatically and allow the user to pause it. If the timer finished counting, the system will redirect the user back to the exercise page they initially chose. In the event that the user selects nutrition or tips, the system will show them the diet & tips. They will then have the option to either continue viewing the information or go back to the fitness page. If the user chooses to meditate, the system will take them to a YouTube link, from which it will return to the fitness page.

### 5.2.2.6 Progress Report Activity Diagram

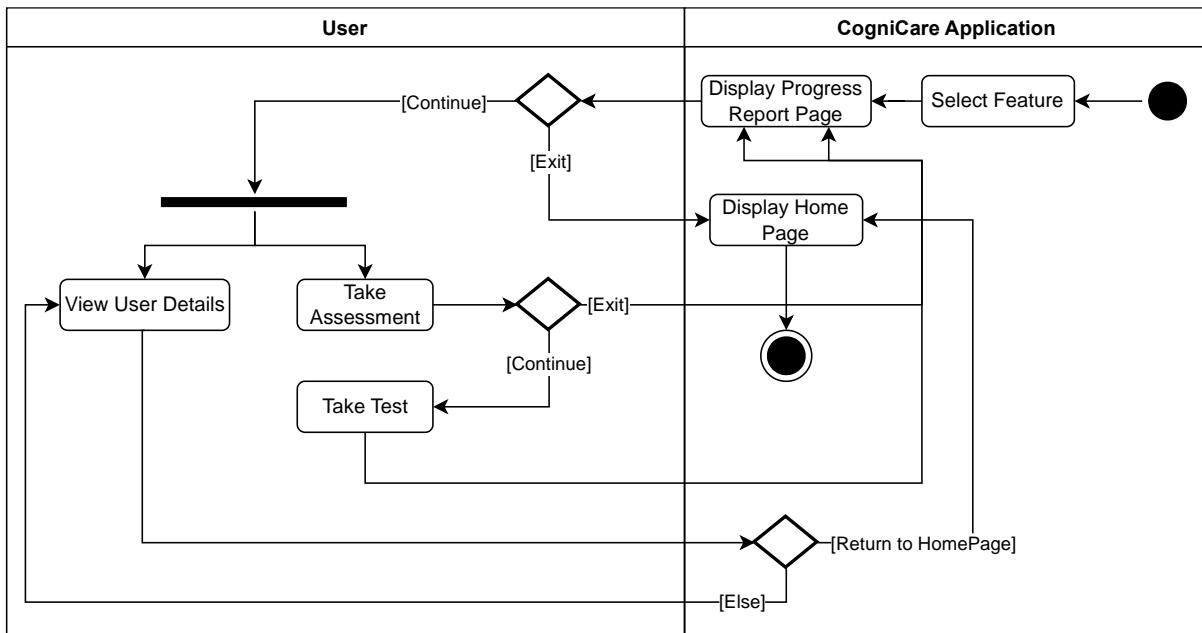


Figure 5.6 - Progress Report Activity Diagram

The CogniCare Application's progress report process is shown in Figure 5.6. The progress report page will appear on the screen after the user selects the progress report function. The user will then be given the option to either Continue or Exit. The user will be taken back to the home page if they selected the exit option. If the option to continue was selected, the user has the option to read their personal information or take the test. The user will have the choice to either continue viewing or return to the home page if they choose to view their personal details. After selecting to take the assessment, the user will be given the option to either continue with the test or exit it. The user will return to the progress report page if they select Exit. IF the option to Continue was selected, the user will take the test and be returned to the progress report page after it is finished.

### 5.2.3 Class Diagram

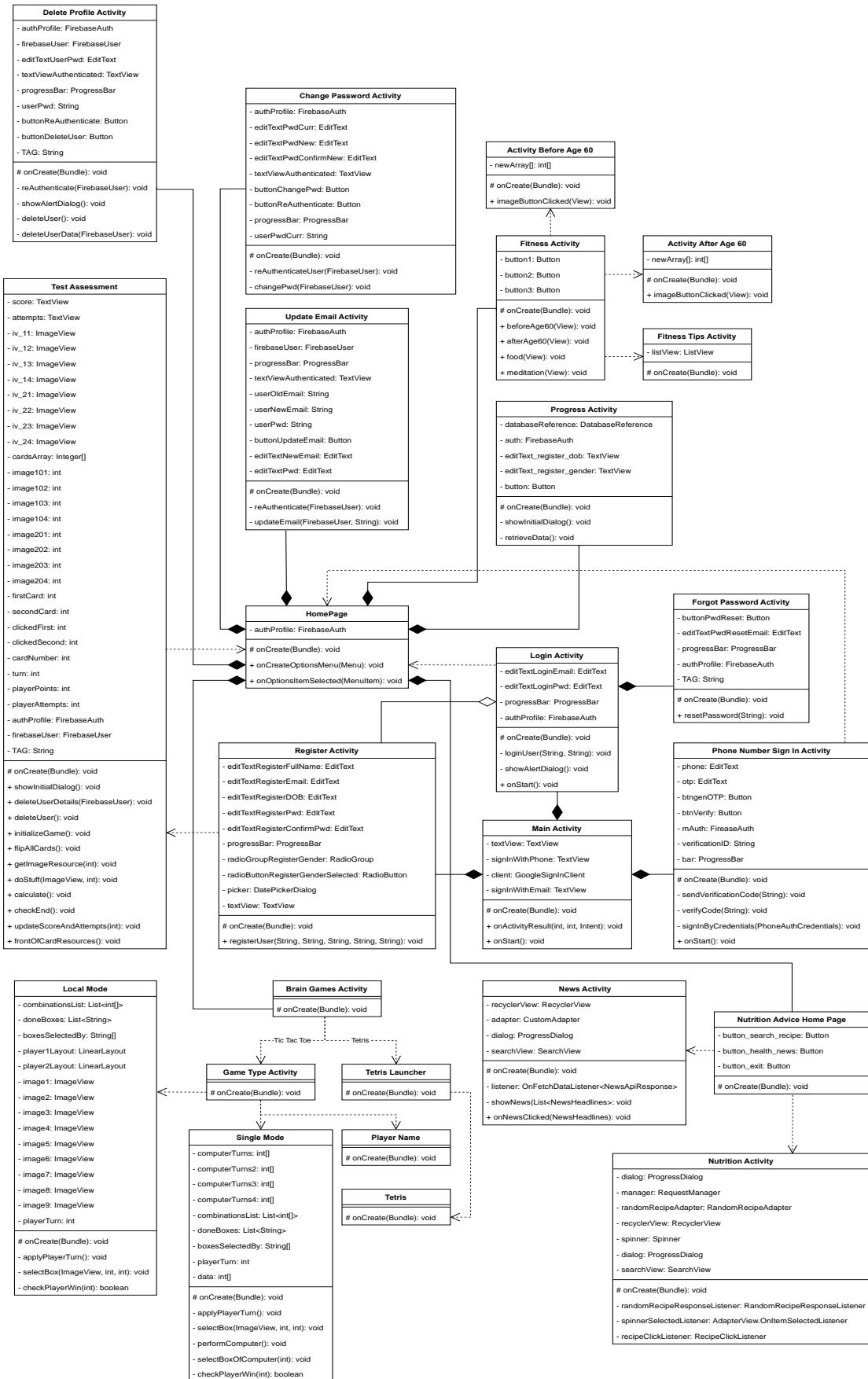


Figure 5.7 - Class Diagram

The application's general structure is shown in Figure 5.7. Let's begin with the Main Activity, where users can register and sign in via Google, phone, or email. It has textView, signInWithPhone, client, and signInWithEmail as fields, and onCreate, onActivityResult, and onStart as methods. There is a composition relationship between the Main Activity and the Login Activity, Register Activity, and Phone Number Sign In Activity classes because those classes stated will not exist if the Main Activity does not.

Login Activity has methods called onCreate, loginUser, showDialog, and onStart, and fields called editTextLoginEmail, editTextLoginPwd, progressBar, and authProfile. Since the Forgot Password Activity is a function that may only be utilised inside the Login Activity, it has a composition relationship with the Login Activity. If the Login Activity is not present, it will not exist. OnCreate and resetPassword are its methods, and buttonPwdReset, editTextPwdResetEmail, progressBar, authProfile, and TAG are its fields.

Phone Number Sign In Activity, there are fields for phone, otp, btngenOTP, btnVerify, mAuth, verificationID, and bar. Additionally, there are methods for onCreate, sendVerificationCode, verifyCode, signInByCredentials, and onStart.

Register Activity comprises the following fields: editTextRegisterFullName, editTextRegisterEmail, editTextRegisterDOB, editTextRegisterPwd, editTextRegisterConfirmPwd, progressBar, radioGroupRegisterGender, radioButtonRegisterGenderSelected, picker, and textView. Additionally, it has methods for onCreate and registerUser. Moreover, it shares an aggregate relationship with Login Activity since, although it permits user registration within Login Activity, Register Activity can still exist in the event that Login Activity is not available because it can be accessed elsewhere. Furthermore, there is a dependency relationship between it and the Test Assessment class because the user will access the latter once they register, and it has fields for score, attempts, iv\_11 to iv\_14, iv\_21 to iv\_24, cards.Array, image101 to image104, image201 to image204, firstCard, secondCard, clickedFirst, clickedSecond, cardNumber, turn, playerPoints, playerAttempts, authProfile, firebaseUser, and TAG. It also has methods for onCreate, showInitialDialog, deleteUserDetails, deleteUser, initializeGame, flipAllCards, getImageResource, doStuff, calculate, checkEnd, updateScoreAndAttempts, and frontOfCardResources.

Home Page comprises onCreate, onCreateOptionsMenu, and onOptionsItemSelected methods and the authProfile field. Furthermore, it has a dependency relationship on the Test Assessment, Login Activity, and Phone Number Sign In Activity classes because they must all be completed before moving on to the Home Page class. Additionally, since none of these classes would exist without the Home Page class, it also has composition relationships with the classes of Update Email Activity, Change Password Activity, Delete Profile Activity, Brain Games Activity, Fitness Activity, Nutrition Advice Home Page, and Progress Activity.

Update Email Activity contains the following fields: authProfile, firebaseUser, progressBar, textViewAuthenticated, userOldEmail, userNewEmail, userPwd, buttonUpdateEmail, editTextNewEmail, and editTextPwd. The methods are onCreate, reAuthenticate, and updateEmail.

Change Password Activity contains the following fields: authProfile, editTextPwdCurr, editTextPwdNew, editTextPwdConfirmNew, textViewAuthenticated, buttonChangePwd, buttonReAuthenticate, progressBar, and userPwdCurr. The methods are onCreate, reAuthenticateUser, and changePwd.

Delete Profile Activity contains the following fields: authProfile, firebaseUser, editTextUserPwd, textViewAuthenticated, progressBar, userPwd, buttonReAuthenticate, buttonDeleteUser, and TAG. The methods are onCreate, reAuthenticate, showAlertDialog, deleteUser, and deleteUserData.

Fitness Activity, there are fields for button1 to button 3. Additionally, there are methods for onCreate, beforeAge60, afterAge60, food, and meditation. Furthermore, as the aforementioned classes may only be accessed by the user when they are present at the Fitness Activity. Hence, there is a dependency relationship between Fitness Activity and the classes of Activity Before Age 60 which consists the field of newArray[] and methods of onCreate and imageButtonClicked, Activity After Age 60 which consists the field of newArray[] and methods of onCreate and imageButtonClicked, and Fitness Tips Activity which consists the field of listView and method of onCreate.

Progress Activity comprises the following field: databaseReference, auth, editText\_register\_dob, editText\_register\_gender, and button. The methods are onCreate, showInitialDialog, and retrieveData.

Brain Games Activity comprises the following method, onCreate. In addition, Game Type Activity and Tetris Launcher can only function when the user is in the Brain Games Activity page. It therefore has a dependency relationship with the above described classes, which include the onCreate method.

Game Type Activity has dependencies relationship on three classes: Local Mode, Single Mode, and Player Name since the user can only select the mode they wish to play when they are on the Game Type Activity page. Firstly, the Local Mode class has the fields of combinationsList, doneBoxes, boxesSelectedBy, player1Layout, player2Layout, image1 to image9, and playerTurn with the methods of onCreate, applyPlayerTurn, selectBox, and checkPlayerWin. Secondly, the Single Mode class has the fields of computerTurns to computerTurns4, combinationsList, doneBoxes, boxesSelectedBy, playerTurn, and data with the methods of onCreate, applyPlayerTurn, selectBox, performComputer, selectBoxOfComputer, and checkPlayerWin. Lastly, the Player Name class has the method of onCreate.

Tetris Launcher has a dependency relationship with the class Tetris which consists of the method onCreate, because the Tetris class is only accessible when the Tetris Launcher class is accessed.

Nutrition Advice Home Page comprises the following fields: button\_search\_recipe, button\_health\_news, and button\_exit and also the method, onCreate. In addition, it has a dependency relationship with the classes News Activity and Nutrition Activity, as two of these classes are only accessible when the user is on the Nutrition Advice Home Page. News Activity has the following fields: recyclerView, adapter, dialog, and searchView with methods of onCreate, listener, showNews, and onNewsClicked. Nutrition Activity has the following fields: dialog, manager, randomReciperAdapter, recyclerView, spinner, dialog, and searchView with methods of onCreate, randomRecipeResponseListener, spinnerSelectedListener, and recipeClickListener.

## 5.2.4 Sequence Diagram

### 5.2.4.1 Sign Up Sequence Diagram

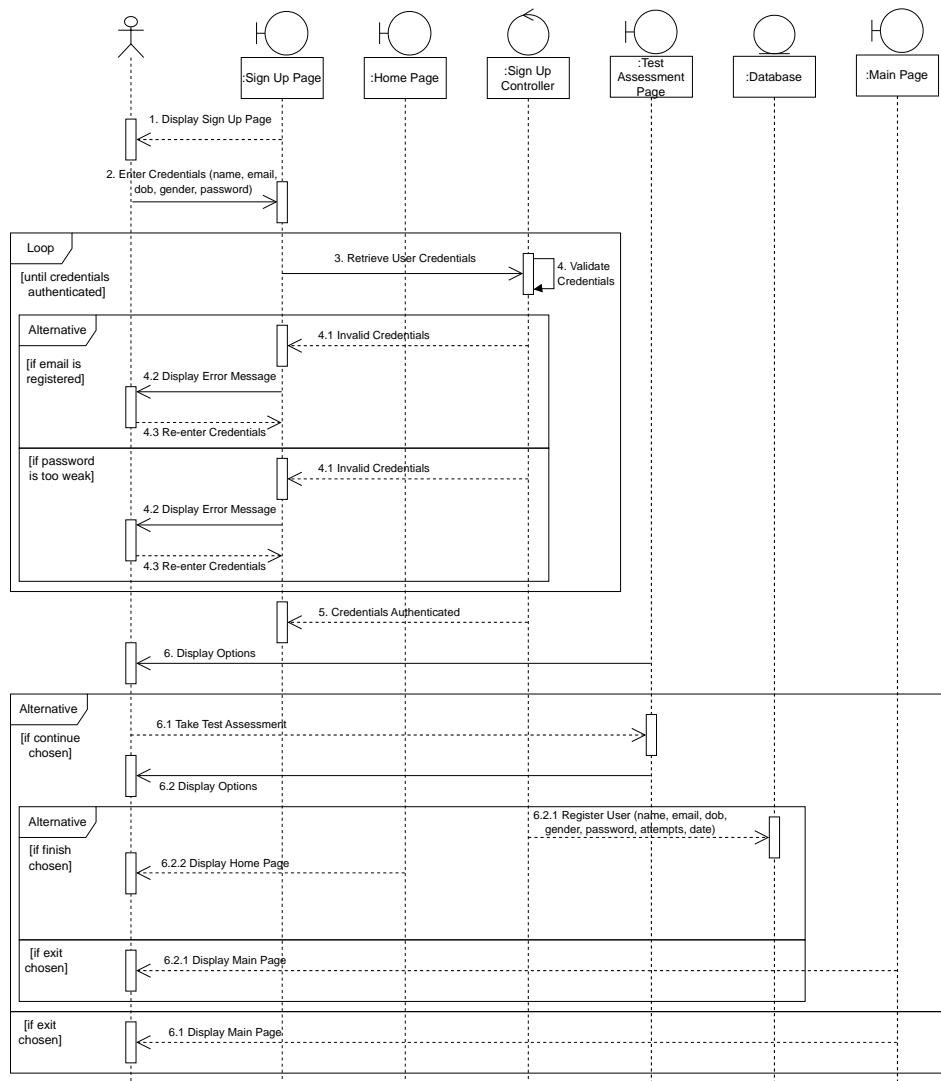


Figure 5.8 - Sign Up Sequence Diagram

Figure 5.8 depicted the sign-up sequence diagram. It will begin by presenting the sign up page for the user, where they will enter their required credentials, after which the sign up controller will obtain and validate the entered credentials. If the password is too weak or an email address is registered, the user will be unable to register and will receive an error message requiring them to re-enter the correct credentials. If the credentials are authenticated, the test assessment page will provide the user the option to “Continue” or “Exit. If Exit is selected, the user will be brought back to the Main Page, which includes the Register and Login functions. If Continue is selected, the user will take the test assessment, and once completed, the user will be given the option of “Finish” or “Exit”. If Finish is selected, the visitor will be taken to the Home Page. If Exit is selected, the user will be taken back to the Main Page.

### 5.2.4.2 Login Sequence Diagram

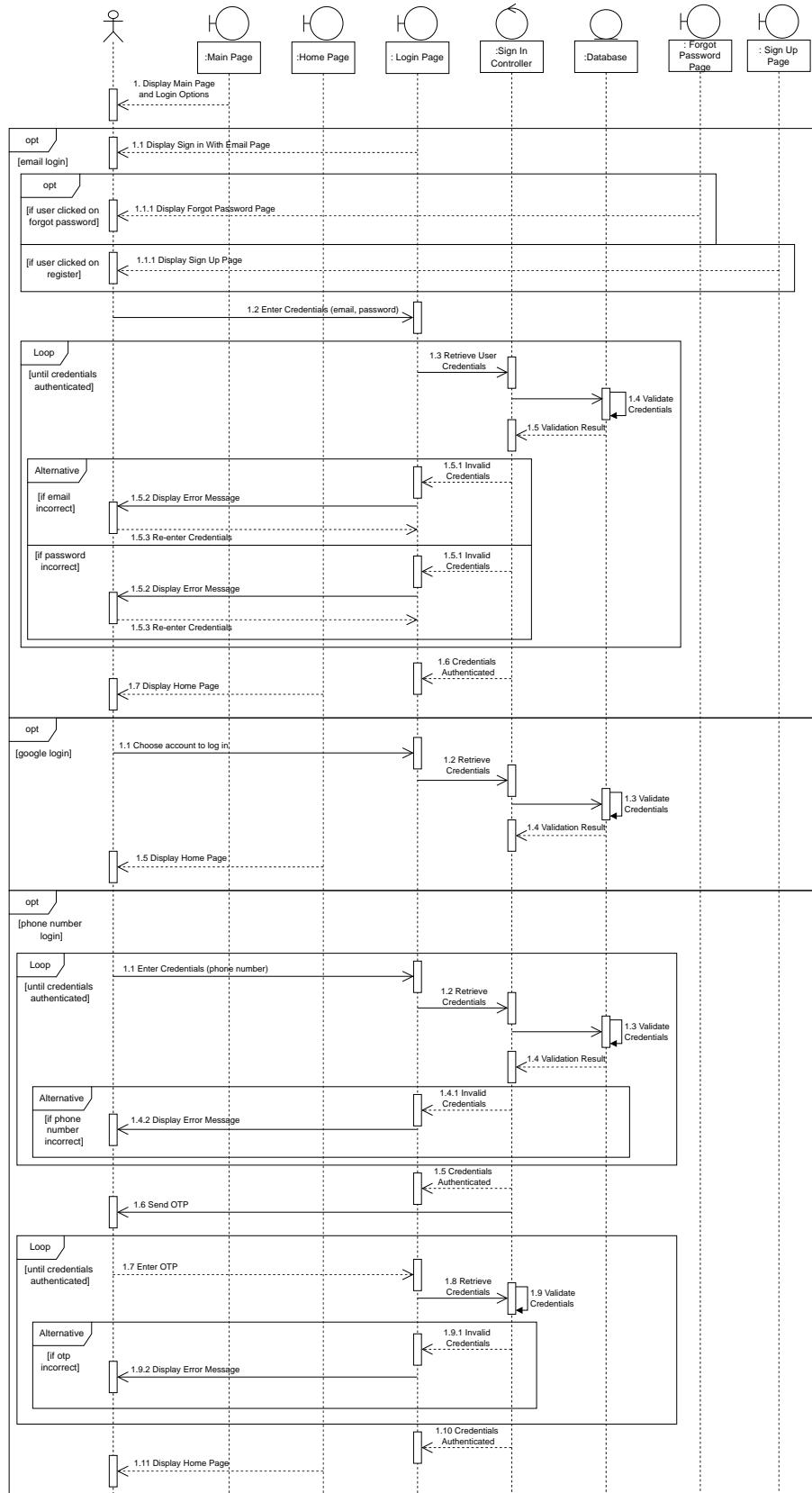


Figure 5.9 - Login Sequence Diagram

Figure 5.9 shows the login sequence diagram. First, the user will see the main page, which contains three login options: email, Google, or phone number. If email was chose, the login with email page includes two extra functions: Register and Forgot Password. If the user chooses to register, the system will display the register page; if the user selects forgot password, the system will display the forgot password page. If the user does not select anything, the system will authenticate the credentials entered using their email and password. If the input is valid, the user will be directed to the home page. If the credentials are invalid, the system will display an error message and prompt the user to re-enter them. If Google was chosen, the user will be prompted to select a Google account to login with. Once selected, the system will authenticate and redirect the user to the home page. If phone number was chosen, the user must enter their phone number, and the system will validate the credentials. If the credentials are validated, OTP will be sent to the user's phone number and the user must enter the OTP received. If the credentials are not validated, the system will display an error message and the user will have to re-enter a valid phone number. Furthermore, if the key in OTP is valid, the system will direct the user to the home page. If the key in OTP is invalid, the system will display an error message and request the user to enter the correct OTP.

#### 5.2.4.3 Forgot Password Sequence Diagram

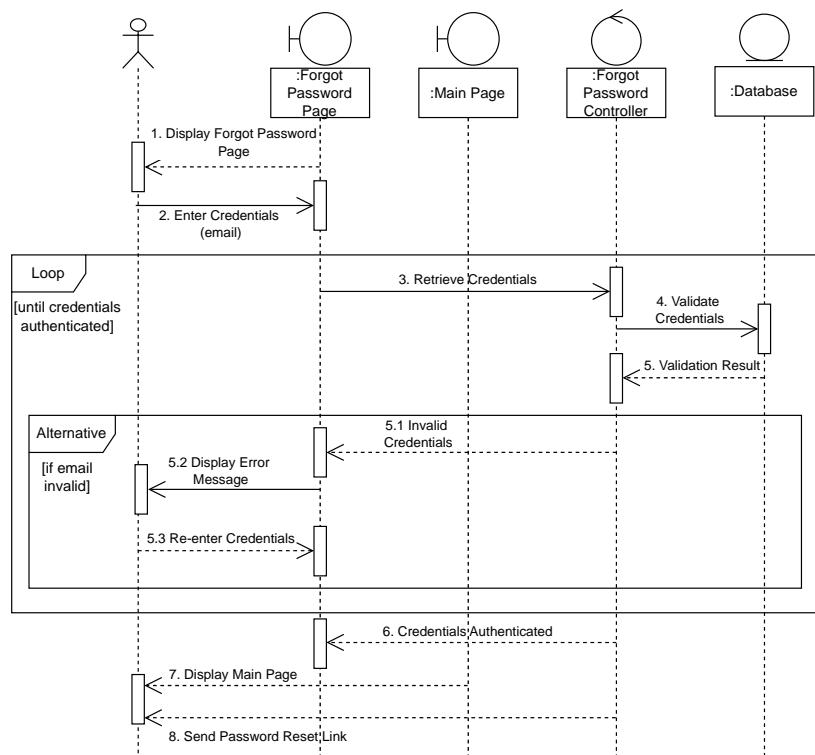


Figure 3.10 - Forgot Password Sequence Diagram

Figure 5.10 depicts the sequence diagram for forgotten password. First, the system will display the forgot password page to the user, prompting them to enter their credentials in order to reset their password. If the credentials entered are invalid, the system will display an error message and require the user to re-enter the proper credentials. Otherwise, if the credentials are validated, the system will display the main page and send a password reset link to the user's email.

#### 5.2.4.4 Brain Stimulation Games Sequence Diagram

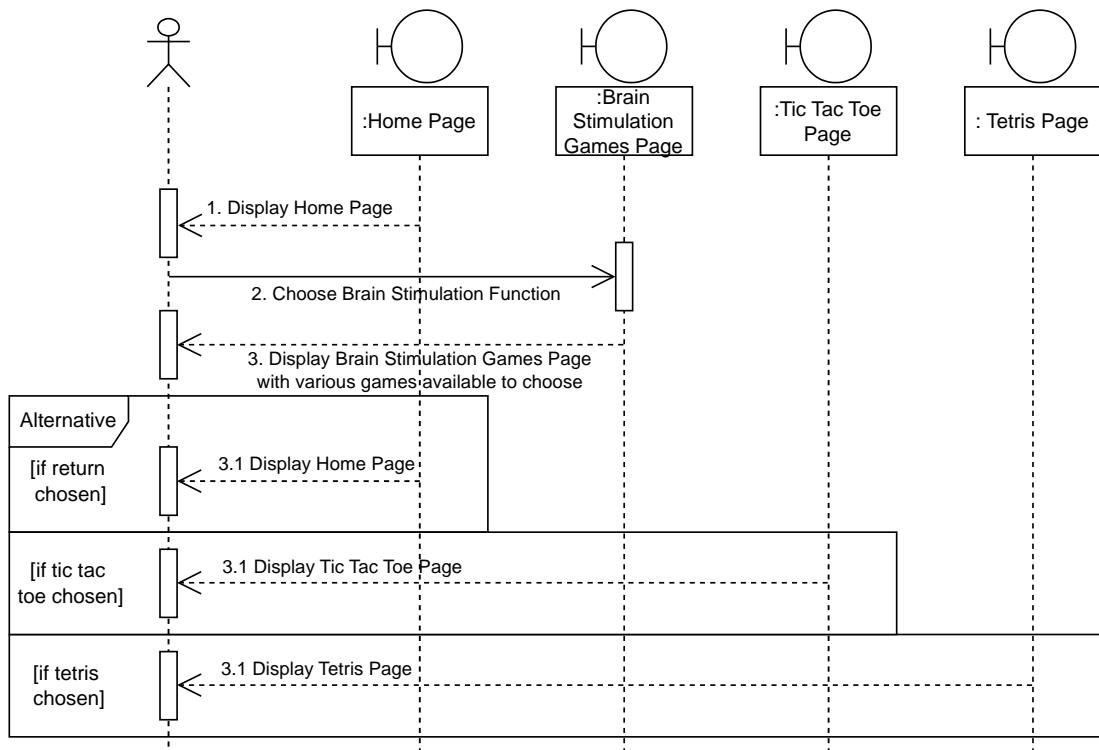


Figure 5.11 - Brain Stimulation Games Sequence Diagram

Figure 5.11 depicts the sequence diagram for brain stimulation game function. First, the system will show the user the home page, and the user will select the brain stimulation function. After selecting, the system will display the brain stimulation games page, and the user will be given the option of returning to the home page, playing tic tac toe or Tetris game. If the user chose return, the system will display the home page. If tic tac toe was selected, the system will display the tic tac toe game page. If Tetris was selected, the system will display the Tetris game page.

### 5.2.4.5 Tic Tac Toe Sequence Diagram

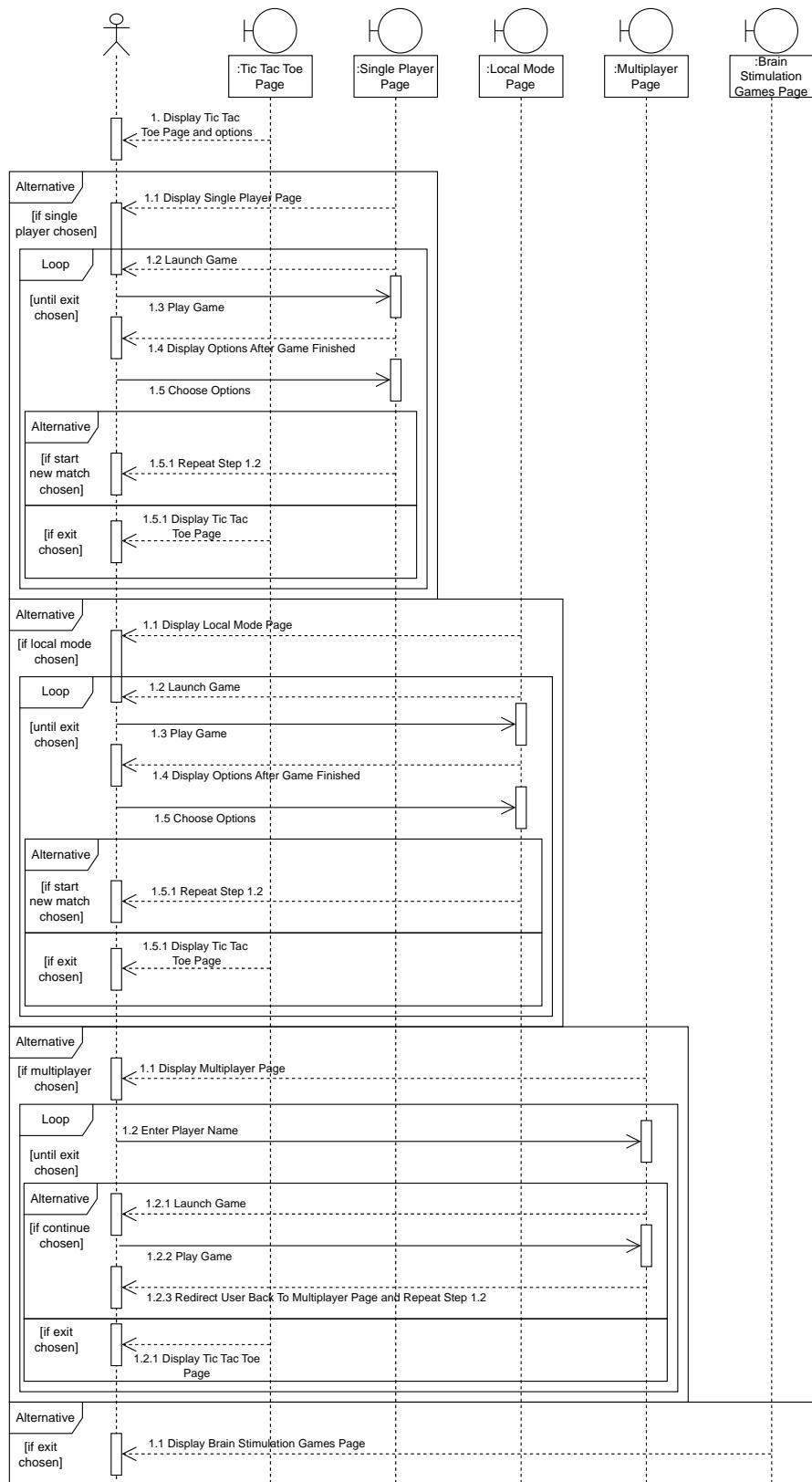


Figure 5.12 - Tic Tac Toe Sequence Diagram

Figure 5.12 depicts a tic tac toe sequence diagram. First, the system will show the user the tic tac toe page, which has four functionalities in total: single player, multiplayer, local mode, and exit. If single player is selected, the system will display the single player page and start the game. When the game is over, the user is presented with two options: start a new match or exit. If the user select Start New Match, a new match will be launched for the player inside the same mode. If the user choose exit, the system will display the tic tac toe page. The sequence for local mode is identical to the single player mode. If multiplayer mode is selected, the system will display the multiplayer page, where the user can input their player name and then continue or exit. If they entered their player name and chose to continue, the system will run the game and then redirect the user back to the multiplayer page once the game is finished. If exit is selected, the system will display the tic tac toe page. Finally, if exit was selected as one of the four functions, the system will display the brain stimulation games page.

#### 5.2.4.6 Tetris Sequence Diagram

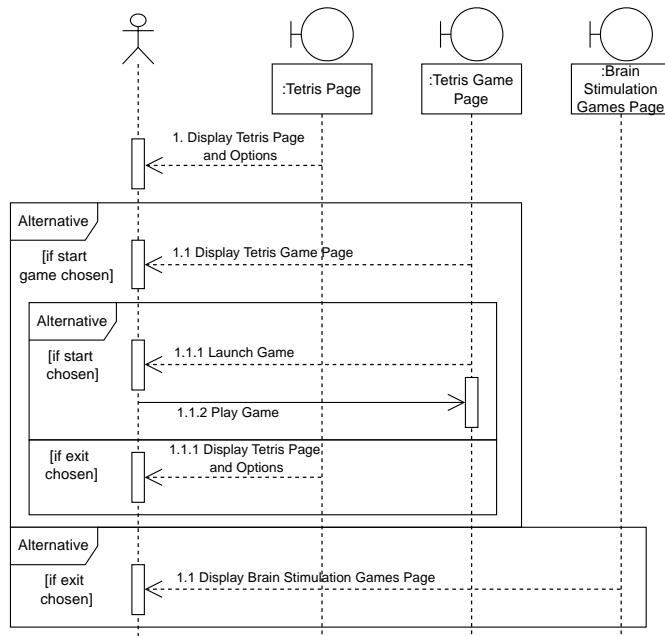


Figure 5.13 - Tetris Sequence Diagram

Figure 5.13 depicts the Tetris sequence diagram. To begin, the system will display the Tetris Page, which offers two options: start the game or exit. If the user select start game, the system will display the Tetris game page with two options: start or exit. If the user select start, the system will launch the game. If exit is selected, the system will display the Tetris page with the two options, start game or exit. If exit is selected from the two alternatives on the Tetris page, then the system will display the brain stimulation games page.

### 5.2.4.7 Health Tips Sequence Diagram

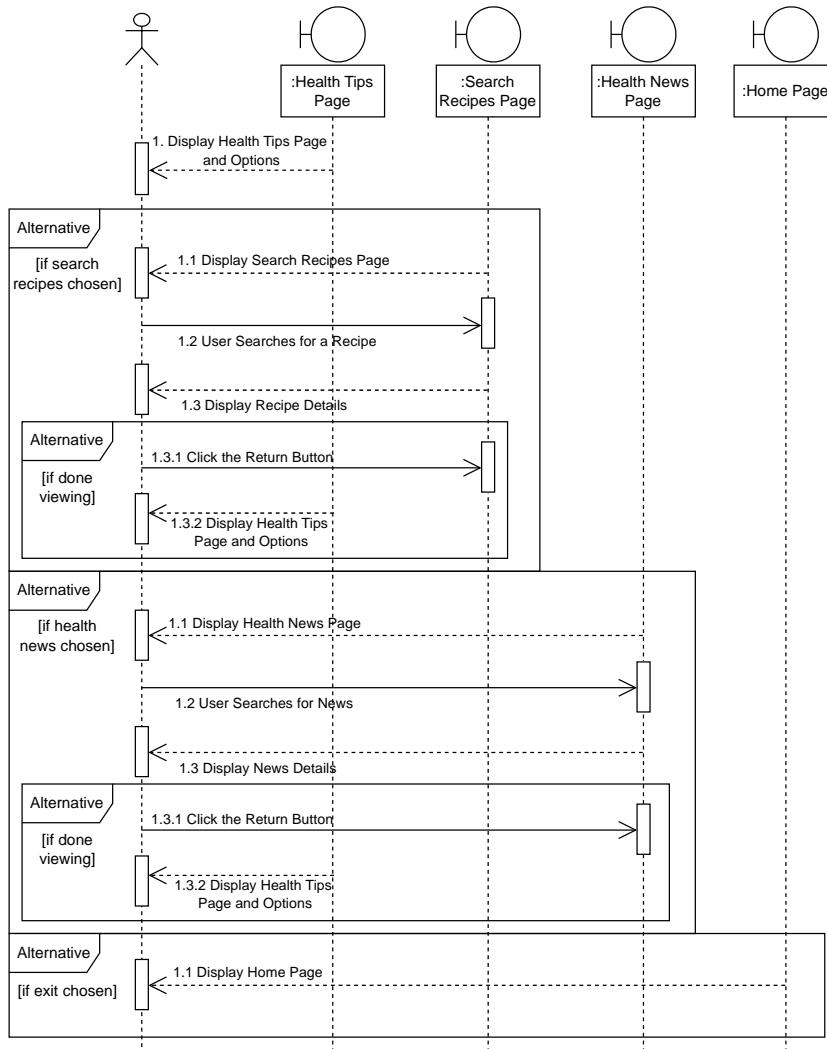


Figure 5.14 - Health Tips Sequence Diagram

Figure 5.14 depicts a sequence diagram for health tips. At first, the system will display the health tips page, which includes three options: search recipes, health news, and exit. If the search recipes option is selected, the system will display the search recipes page where the user can search for a recipe. The system will then display the recipe details based on the recipe sought by the user. If the user is not viewing and want to exit the search recipe feature, they can click the return button, and the system will display the health tips page. The way the system displays health news pages, the user searches for news, and the system displays the news details is the same as how the system displays search recipes sequence. The user can exit this search news feature by clicking the return button, which the system will display the health tips page. Lastly, the system will show the home page if the user selects exit from the three alternatives on the health tips page.

### 5.2.4.8 Fitness Sequence Diagram

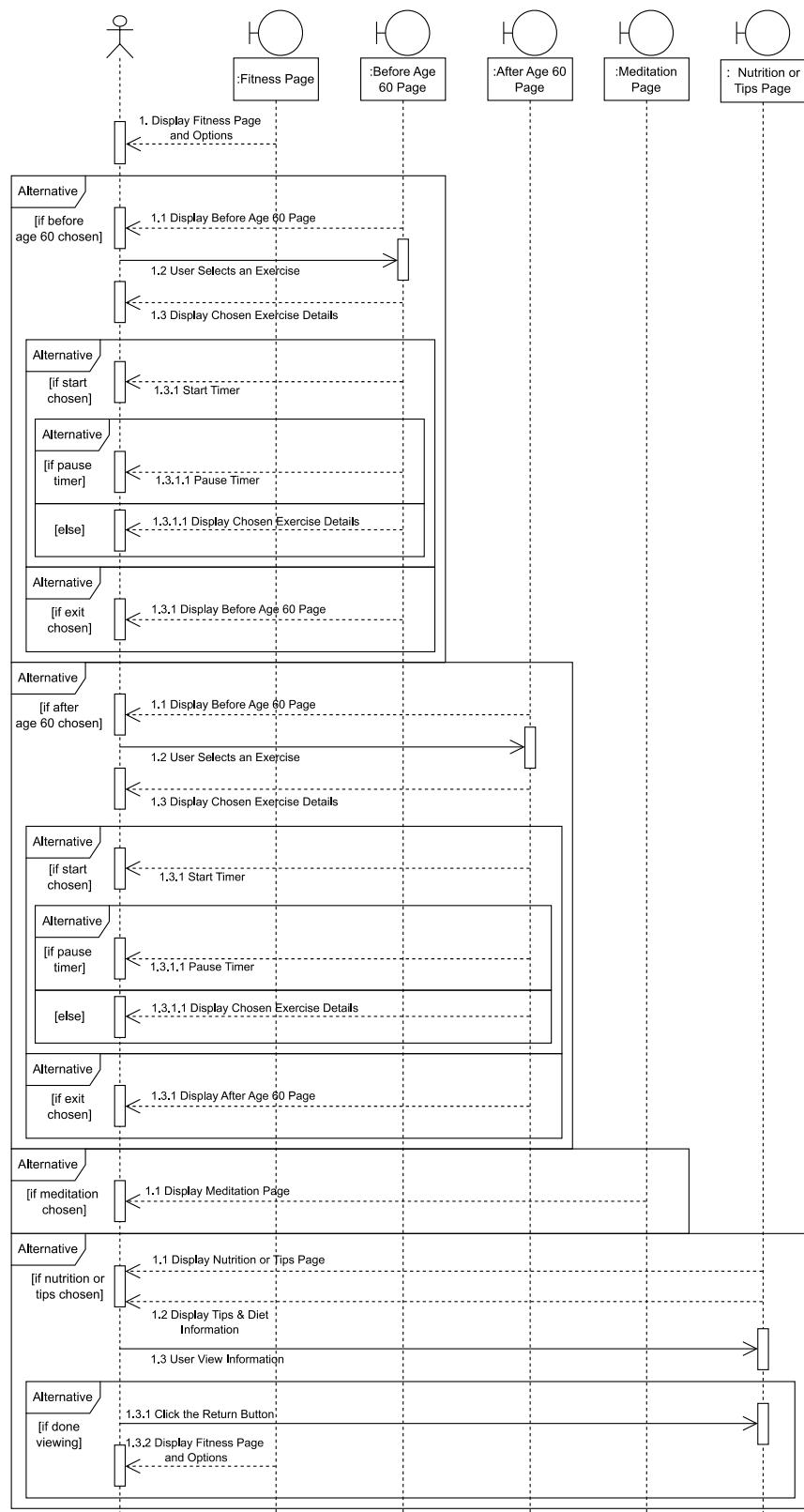


Figure 5.15 - Fitness Sequence Diagram

Figure 5.15 depicts a fitness sequence diagram. First, the system will display the fitness page, with four functions for the user to select: Before Age 60, After Age 60, Meditation, and Nutrition or Tips. If before age 60 chosen, the system will display the before age 60 page with several exercises for the user to select. After the user selects an exercise, the system displays the workout details, which include two options: start or exit. If the user chooses to start, the system will start the timer, and the user can also pause it. The selected workout data will then be displayed by the system if the timer is not paused and it ticks down on its own. The before age 60 page will be displayed by the system if exit is selected. The sequence is the same for those over 60 as it was for those under 60. In addition, the system will show the user the meditation page if they selected to meditate. Finally, the system will provide the tips & diet details along with the nutrition or tips page if the user selected that option. The user can then see those details. When the user clicks the return button after finishing their viewing, the fitness page with their four selections will be displayed by the system.

#### 5.2.4.9 Progress Report Sequence Diagram

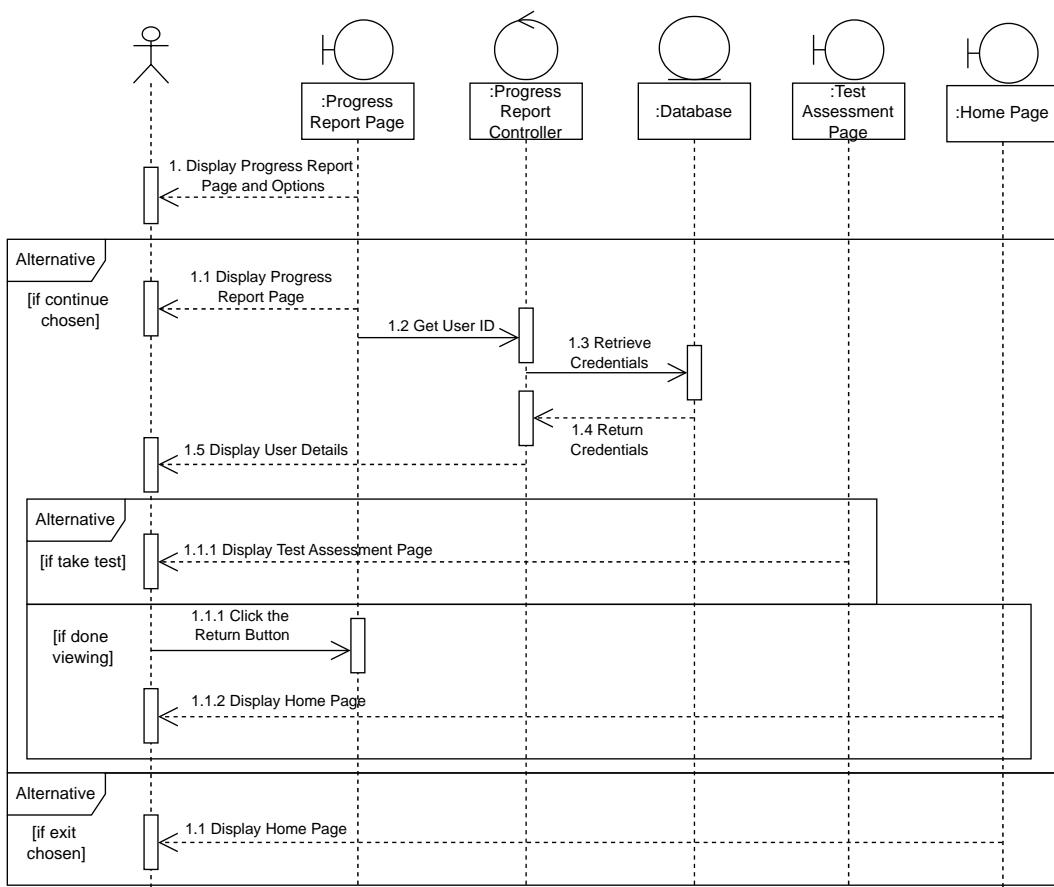


Figure 5.16 - Progress Report Sequence Diagram

Figure 5.16 depicted the sequence diagram for the progress report. First, the system will prompt the user to pick between two options: continue or exit. If the user selects exit, the system will load the home page. If the user selects continue, the system will display the progress report page, obtain the user ID, retrieve the credentials from the database, and present the retrieved credentials (user details) to the user. Furthermore, the user has the option to take the test assessment on the progress report page. If they have finished seeing the progress report, they can click the return button, and the system will display the home page to the user.

#### 5.2.4.10 Overflow Menu Sequence Diagram

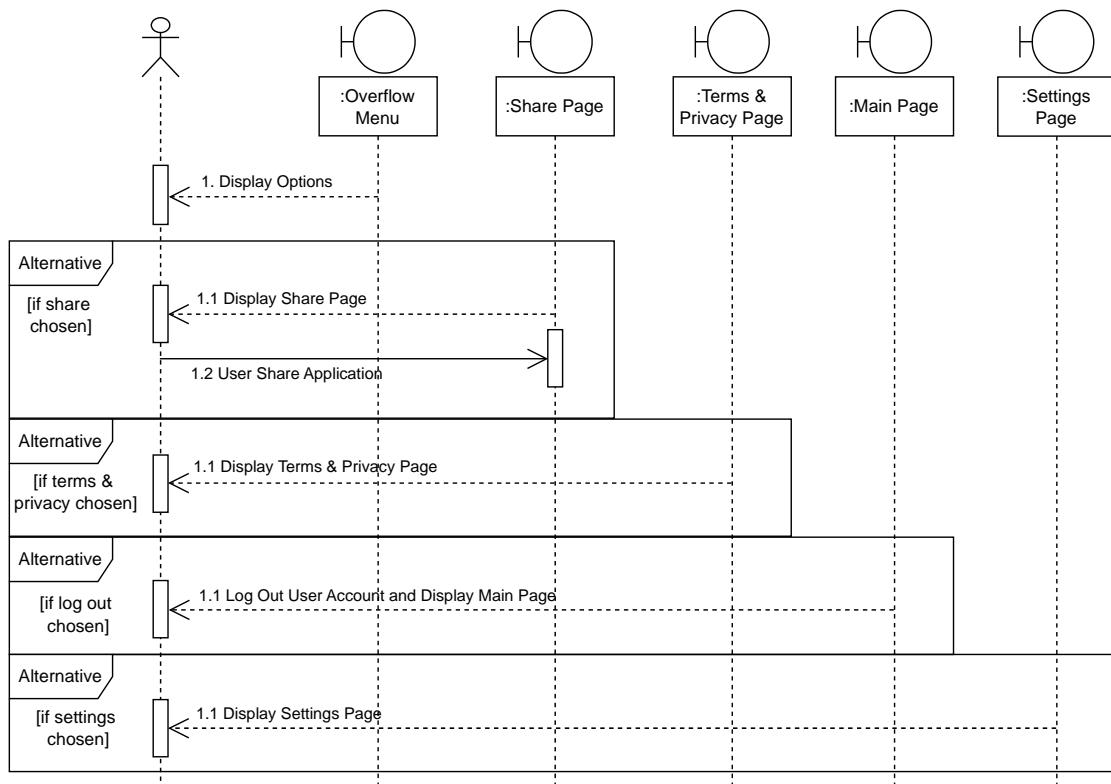


Figure 5.17 - Overflow Menu Sequence Diagram

Figure 5.17 showed the overflow menu's sequence diagram. A number of options, including share, terms & privacy, log out, and settings, will initially be displayed to the user while they are at the overflow menu. Sharing the application is permitted if the user selected the share option, in which case the system will show the share page. If the user selects terms and privacy, the terms and privacy page will be shown by the system. The home screen will appear if logout is selected. Lastly, if the user select settings, the settings page will be displayed by the system.

### 5.2.4.11 Settings Sequence Diagram

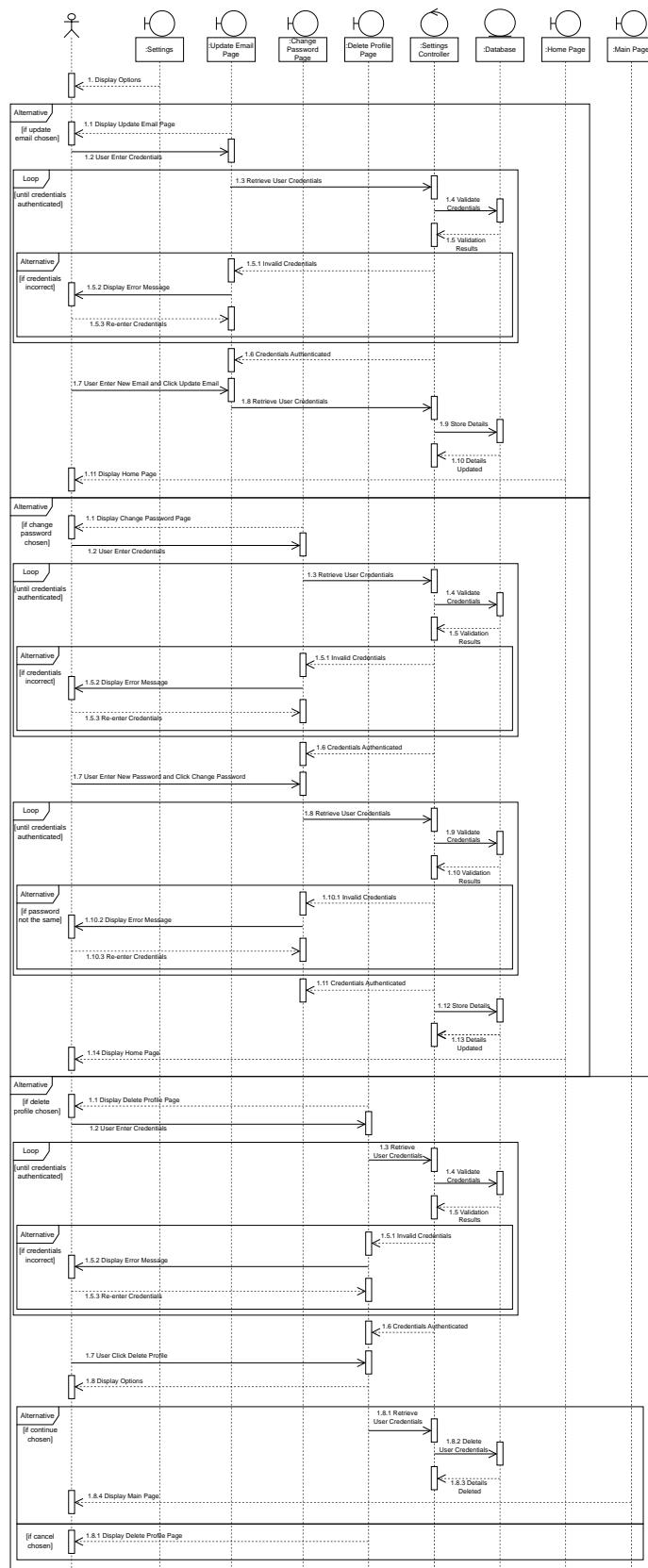


Figure 5.18 Settings Sequence Diagram

Figure 5.18 depicts the settings sequence diagram. When the user enters the settings function, they will be offered with three options: update email, change password, and delete profile. If update email is selected, the system will display the update email page, where the user must enter their credentials before they may update their email. Once the credentials are entered, the system will authenticate them. If the user is not authorised, the system will display an error message and prompt them to input the right credentials. After entering a new email address and clicking update email, if the user is authenticated, the system saves the updated email in the database and sends the user back to the homepage. If the user chooses to change their password, the system will show them the change password page and require them to enter their credentials before they can make the change. The system will authenticate those facts after the credentials are entered. The user will need to input the necessary credentials and an error notice will be displayed by the system if they are not authenticated. The user will need to click change password after entering a new password twice if they are authenticated. The system will then verify once more to see if the new password and the one the user retyped are the same. If they aren't the same, the user will need to enter their password again and an error message will appear on the screen. Should the passwords match, the system will apply the newly entered password to the database and send the user back to the homepage. In the event that delete profile is selected, the user will be prompted to input their credentials before being able to delete their profile. The system will authenticate those facts after the credentials are entered. The user will need to input the necessary credentials and an error notice will be displayed by the system if they are not authenticated. After authenticating, the user must click delete profile. The system will then ask the user to select whether to continue or to exit the session, as this action deletes the user's profile along with any associated data and is not undone. The user profile information will be removed from the database and redirected to the home page if the user chooses to continue. The system will show the user the delete profile page if they select to exit.

### 5.3 System Architecture

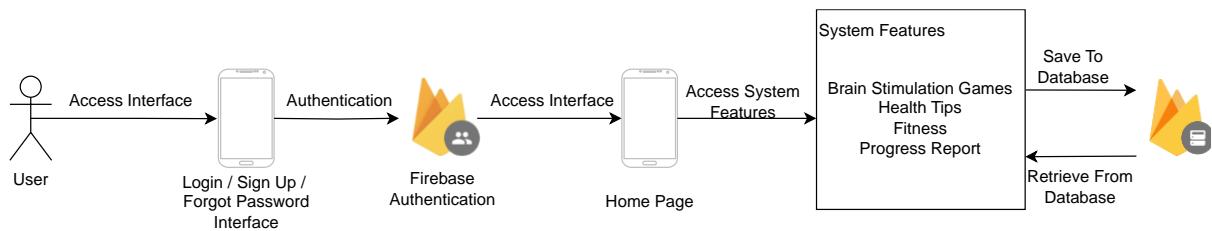


Figure 5.19 - System Architecture

Figure 5.19 depicts the system architecture for the CogniCare Application. Users can initially access the login, sign up, or forget password interface. Then, Firebase will handle authentication to ensure that only valid users may accomplish specific actions, such as logging in. Once authenticated, the user can view the home page, which includes features such as brain stimulation games, health suggestions, fitness, and a progress report. Finally, data from the progress report can be saved and retrieved from the database. The new test assessment that the user took will be saved, along with the number of attempts and the date taken. The gender and date of birth will be retrieved from the database, as well as the test assessment results, which include the total number of tests taken, the number of attempts to finish the test, and the date taken for each test.

### 5.4 Design Principles

The design principles for this application were based on Jakob Nielsen's 10 Usability Heuristics for User Interface Design and Nasrullah Hamidli's Introduction to UI/UX Design. Furthermore, the colour scheme for this application is primarily purple and blue because, according to (M.S, 2020), purple is the colour of royalty, and dementia patients regard purple as sacred, and blue is associated with tranquilly and creativity, making it an aid for both dementia patients and their carers.

### 5.4.1 Visibility

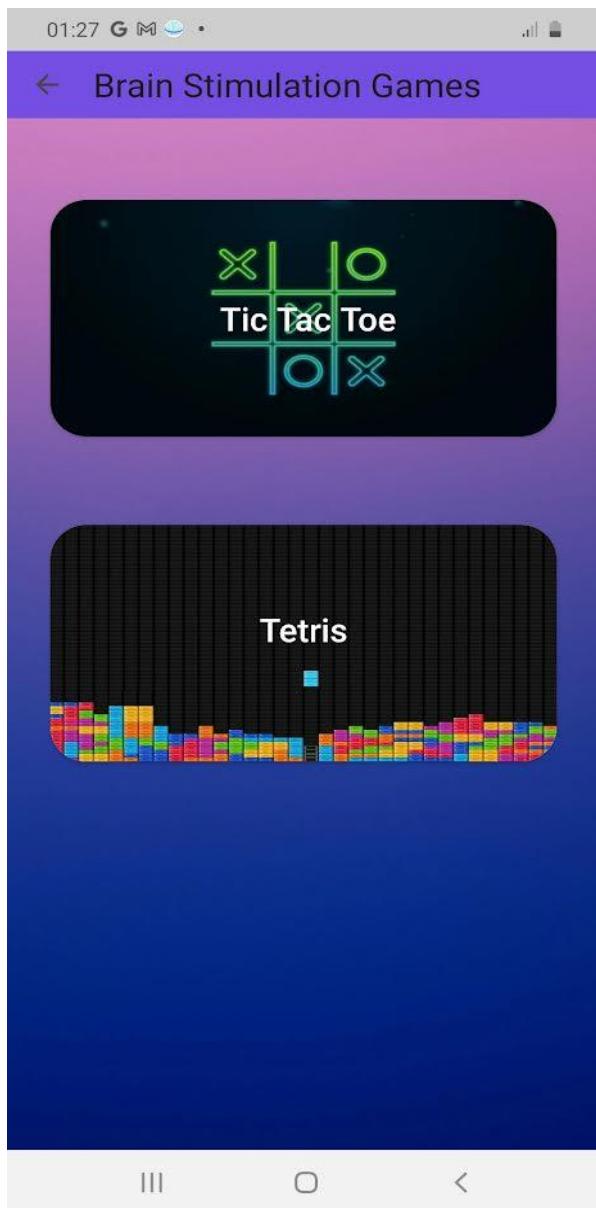


Figure 5.20 - Interface of Brain Stimulation Games

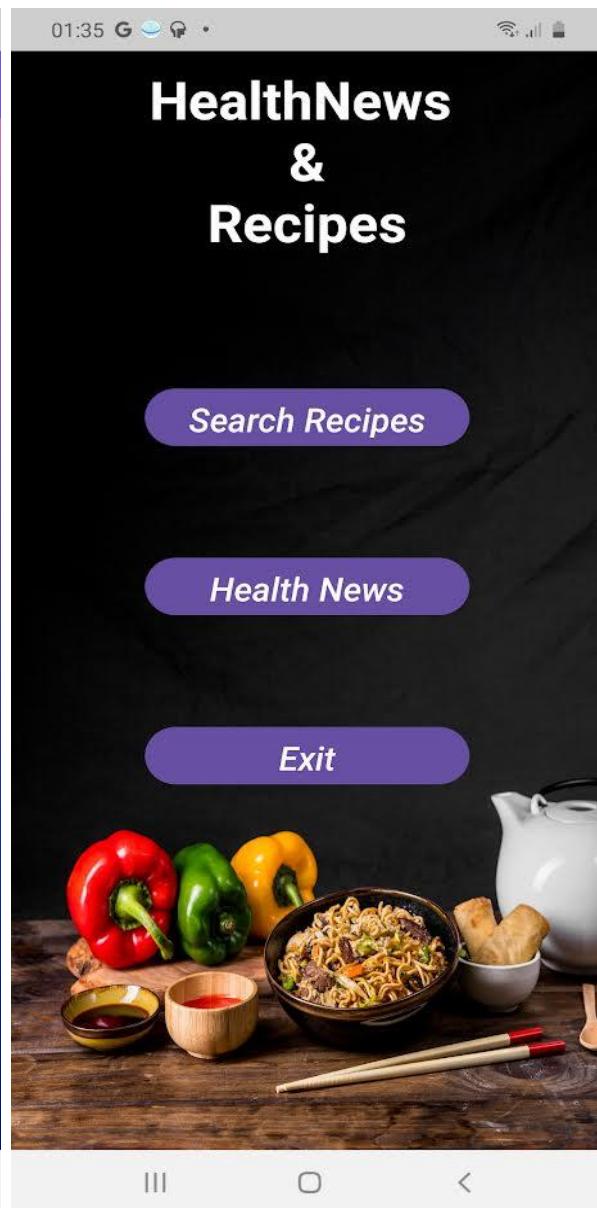


Figure 5.21 - Interface of Health Tips

According to (Hemidli, 2023), visibility is an individual's ability to perceive and comprehend the aspects with which they are currently involved. Interfaces must provide clear and noticeable feedback, usually in the form of text, to ensure that users are aware of the system's current state and the options available. Users may clearly identify the options offered on the Brain Stimulation Games page, as seen in Figure 5.20, which also includes a return button in the top left corner. Similarly, on the Health Tips page, as seen in Figure 5.21, visitors can easily access the text messages offered.

### 5.4.2 Use of Color

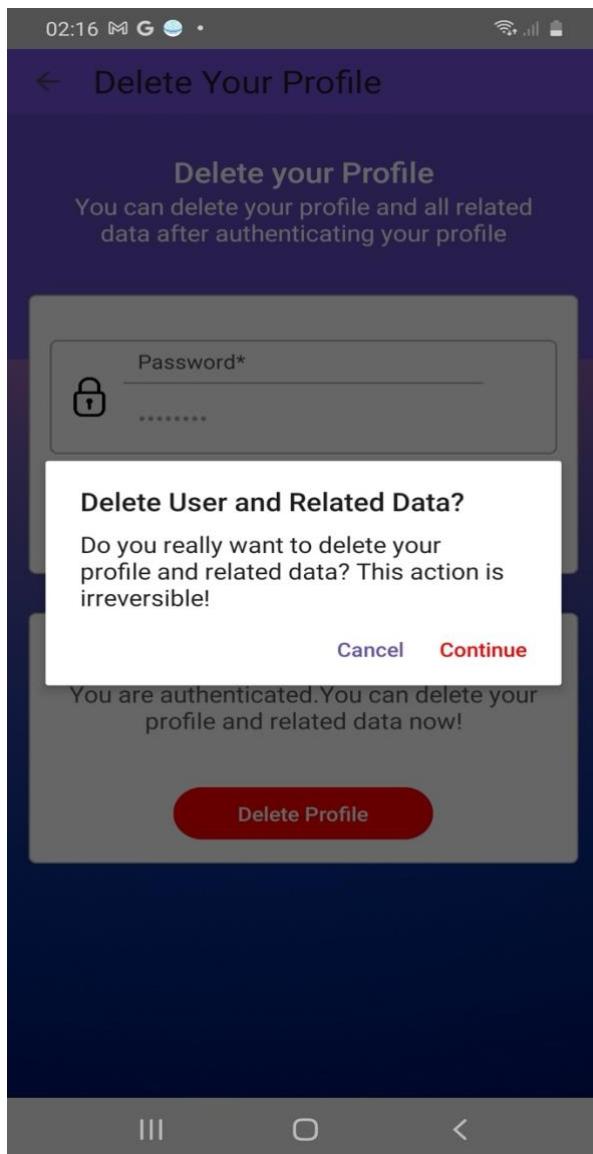


Figure 5.22 - Interface of Delete Profile

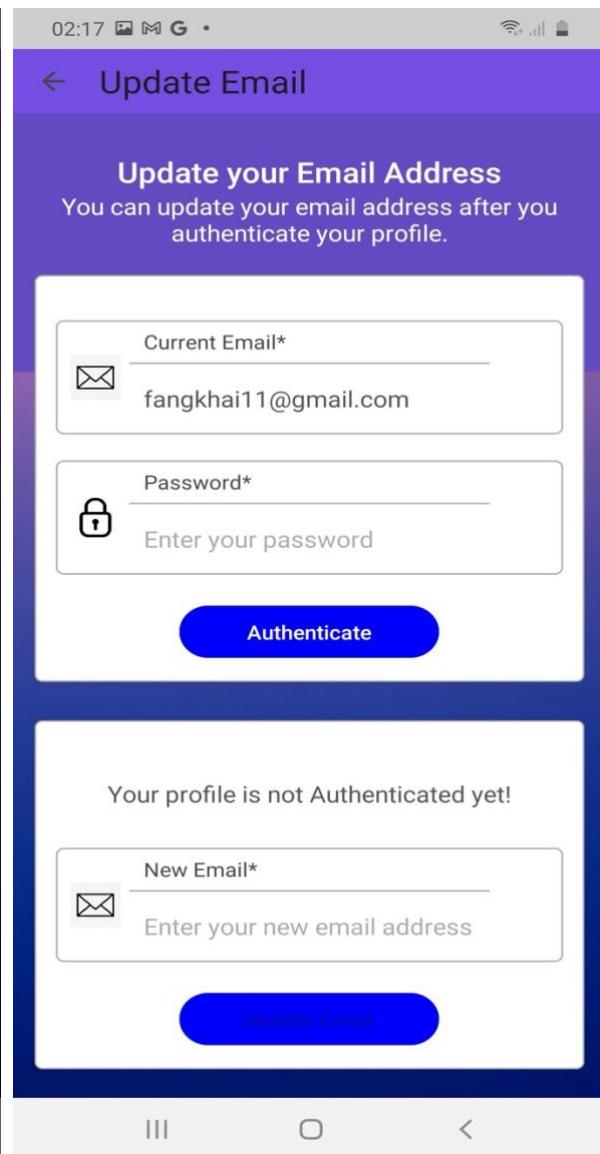


Figure 5.23 - Interface of Update Email

Another important consideration is the use of colour, which has the potential to alter user emotions, moods, and behaviours. Furthermore, colour can help to construct visual hierarchy, highlight key parts, and generate contrast (Hemidli, 2023). For example, as seen in Figure 5.22, the disparity between red for "continue" and blue for "cancel" was intentional, with red often representing alert or cautionary situations. This colour choice encourages users to pause and ponder their activities before moving forward.

Furthermore, as previously said, the major colour scheme of this application is based on blue and purple tones. Furthermore, white was chosen as shown in Figure 5.23 to convey sentiments of purity, calm, and lightness (Muniz et al., 2023). As a result, the researcher chose these colours to give the application a sense of health and tranquillity.

### 5.4.3 User Control and Freedom

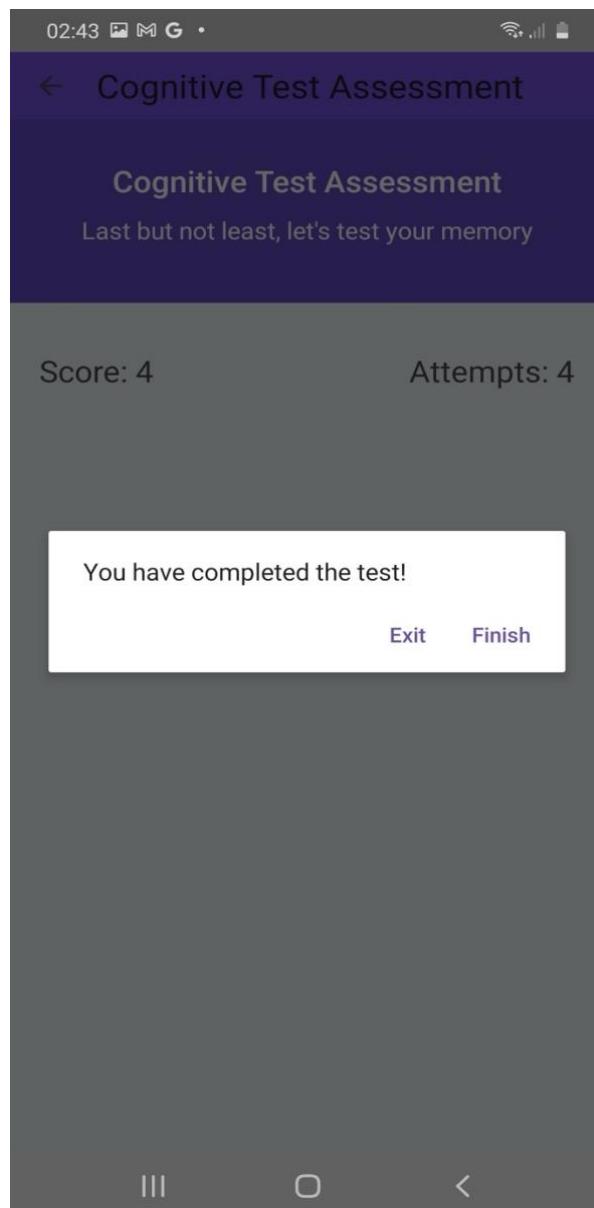


Figure 5.24 - Interface of Test Assessment

Users may mistakenly initiate actions they did not intend to. They demand a clearly labelled "emergency exit" option to quickly leave the unwanted action without going through a lengthy process (Nielsen, 2020). As a result, the user is presented with a clearly indicated exit button as shown in Figure 5.24, allowing them to quickly quit in the event of an error or if they do not want to take the test.

#### 5.4.4 Consistency

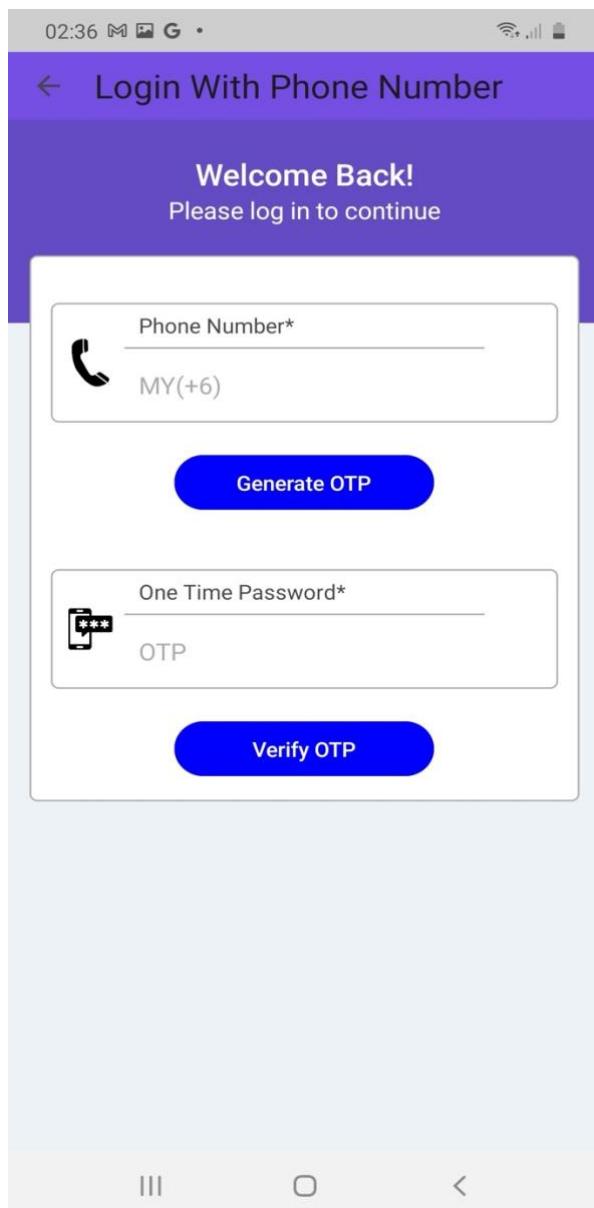


Figure 5.25 - Interface of Phone Number Login

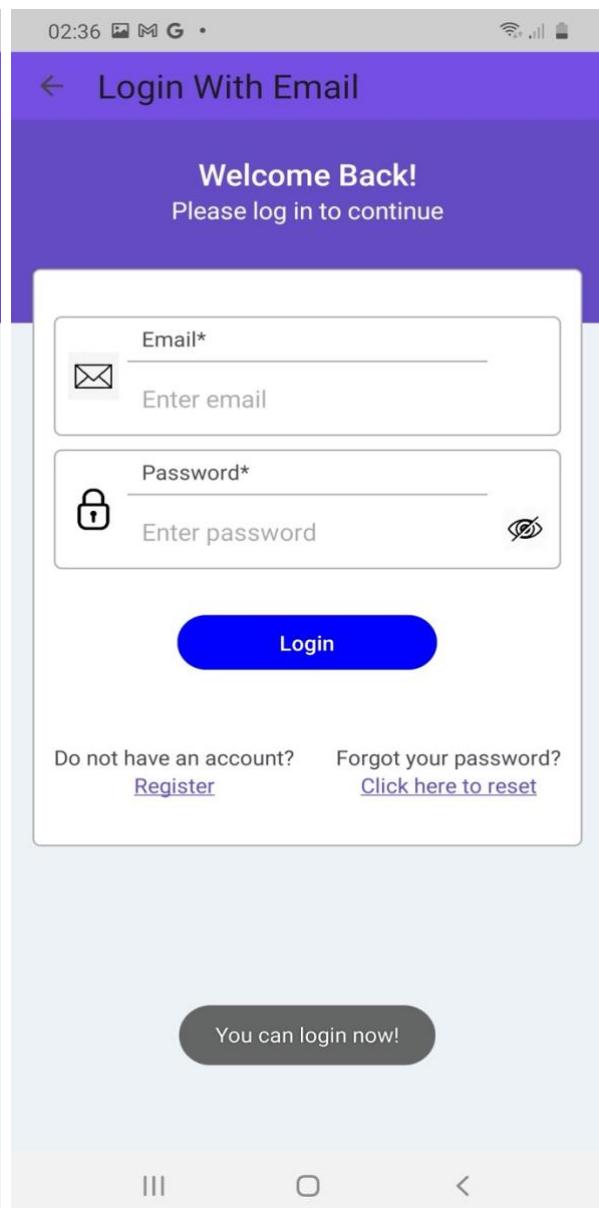


Figure 5.26 - Interface of Email Login

Consistency is important because it gives users a sense of reassurance and predictability. This means that consumers expect to see similar patterns, layouts, fonts, and colours across multiple sites, making it easier for them to understand and navigate (Hemidli, 2023). As shown in Figures 5.25 and 5.26, the Phone Number and Email Login screens are similar. As a result, despite minor changes between the two, visitors may easily understand what steps to take when they encounter these sites.

### 5.4.5 Recognition Rather than Recall

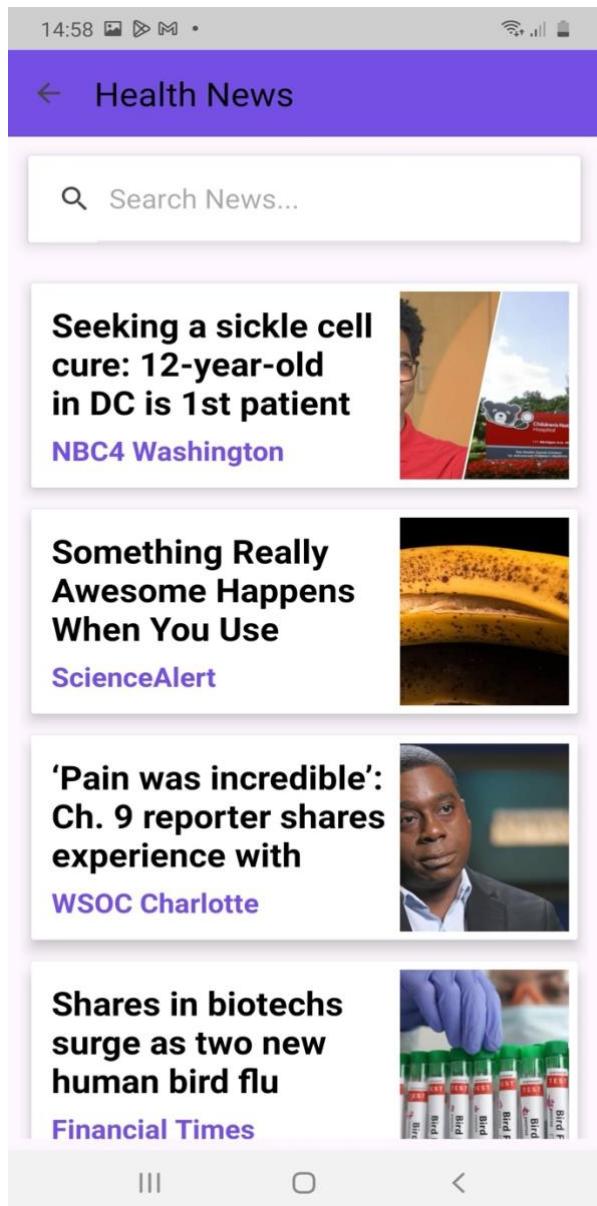


Figure 5.27 - Interface of Health News

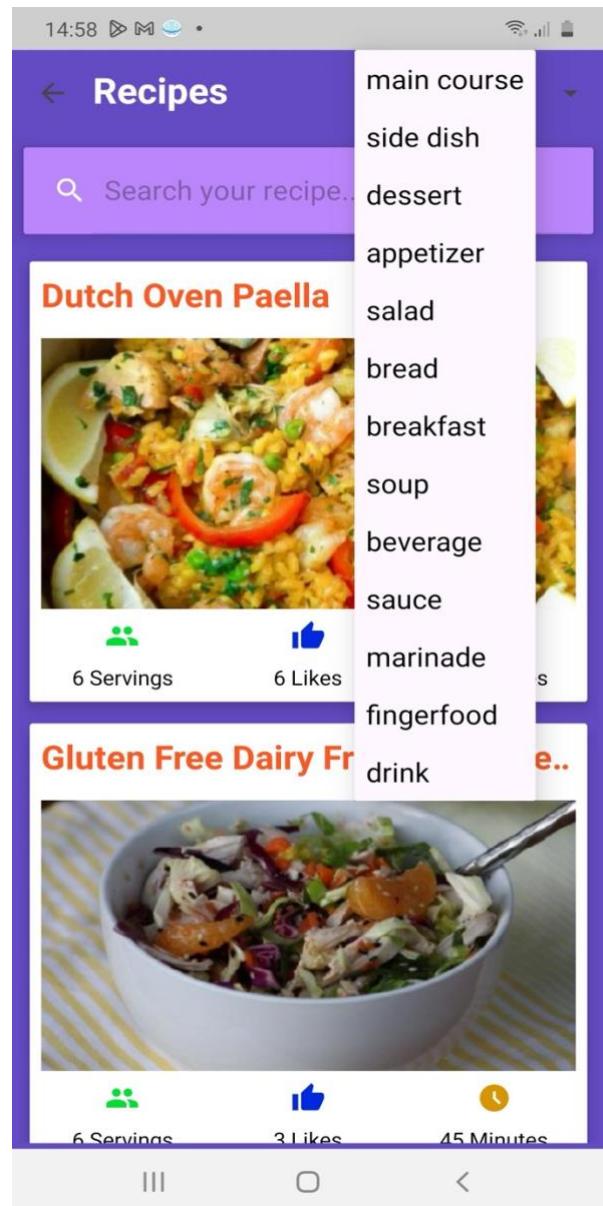


Figure 5.28 - Interface of Search Recipes

Minimise the cognitive load on the user by making sure that elements, actions, and options are easily visible. Information shouldn't have to be remembered as users move from one area of the interface to another. Field labels and menu items—which are crucial for using the design—should be visible or easily retrieved when needed (Nielsen, 2020). As a result, most labels—like the ones for Search News and Search your recipe—are visible, as seen in Figures 5.27 and 5.28. As a result, users won't need to commit the operations of each button to memory because the labels clearly indicate what each one can do.

## 5.4.6 Error

### 5.4.6.1 Error Prevention

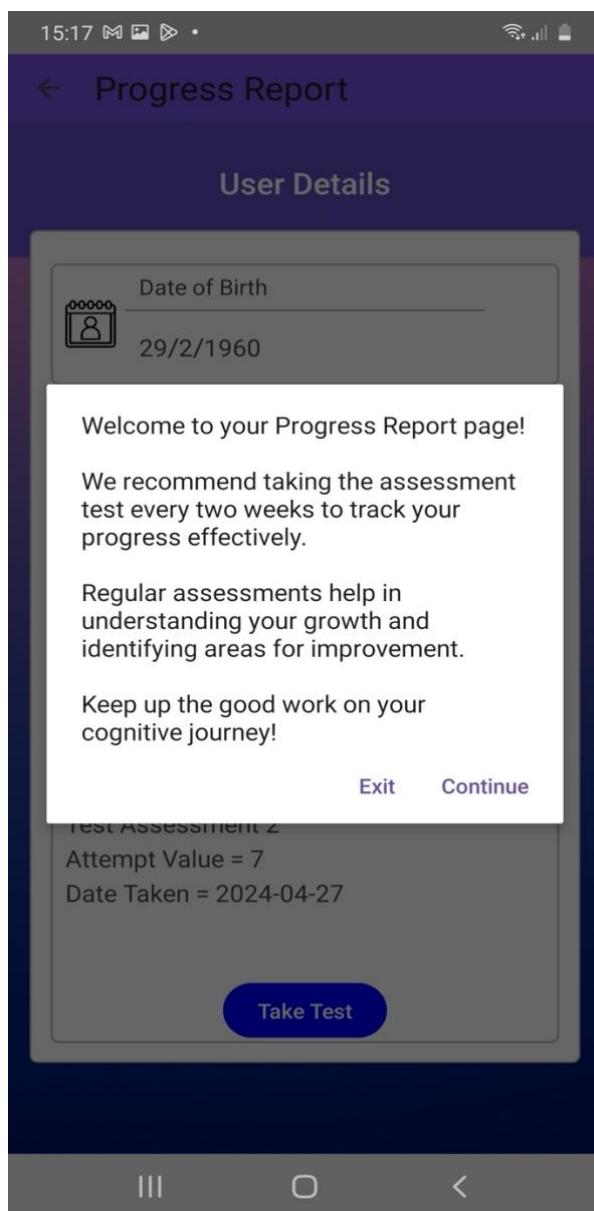


Figure 5.29 - Interface of Progress Report

While appropriate error messages are important, well-designed systems also prevent issues by eliminating risky situations, adding safeguards, and giving users the choice to affirm before taking any further action (Nielsen, 2020). Thus, users are presented with a confirmation choice in Figure 5.29 to affirm that they are sure they want to receive the progress report and take the test assessment. Thus, by offering safeguards such as these, consumers will hesitate before acting.

### 5.4.6.2 Assist User in Recognizing Errors

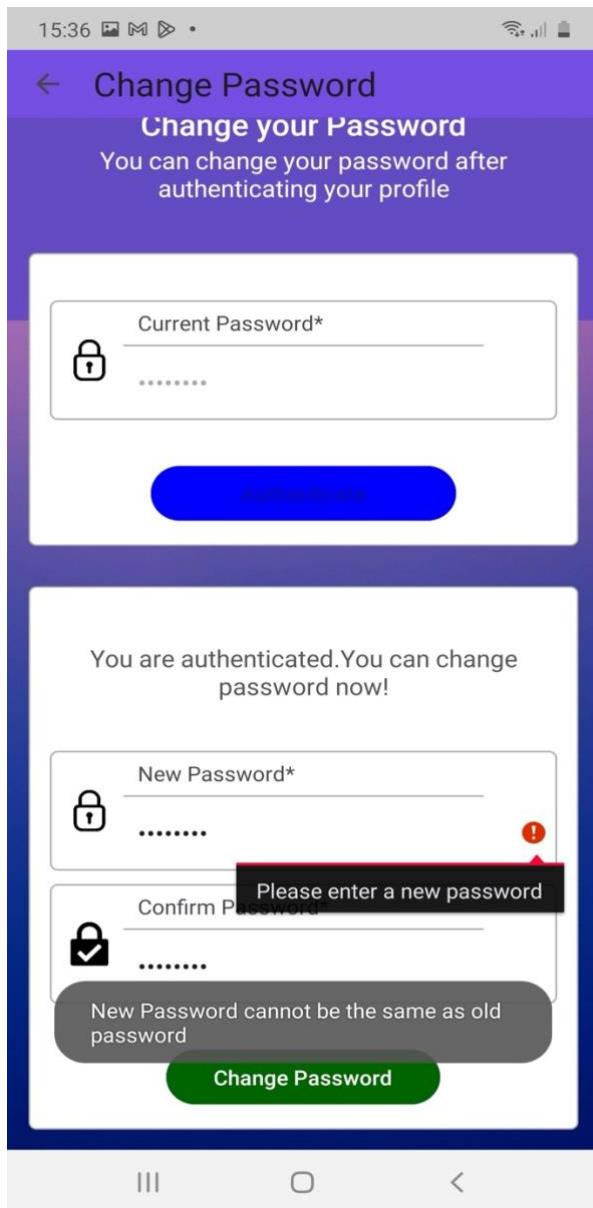


Figure 5.30 - Interface of Change Password

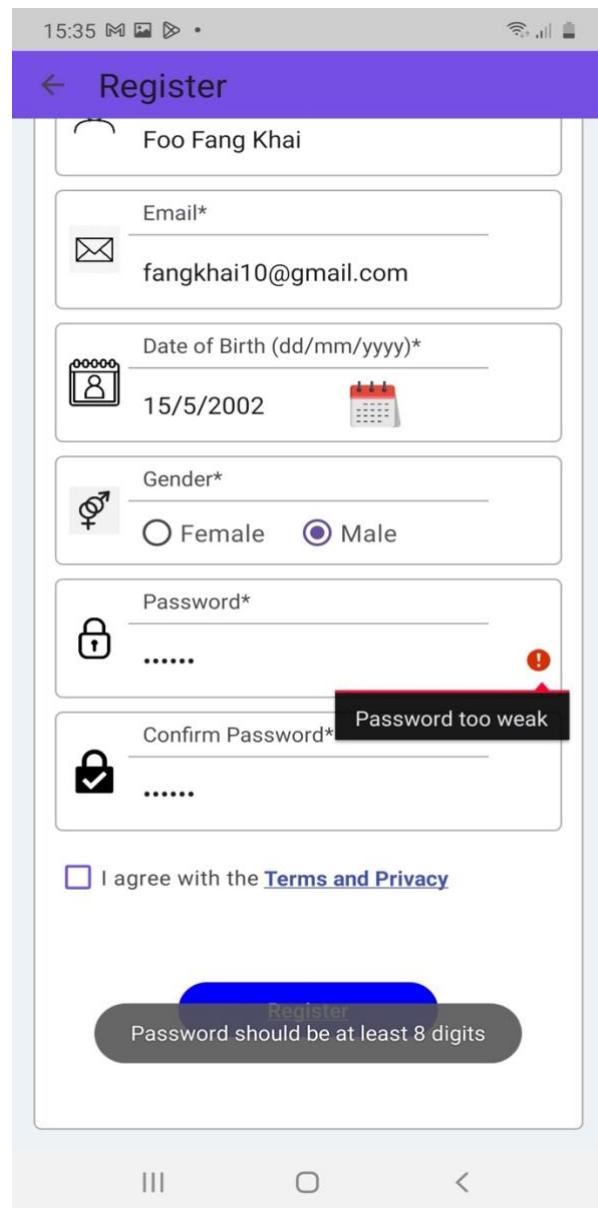


Figure 5.31 - Interface of Sign Up

Instead of using error codes, error notifications should be expressed in plain language. According to Nielsen (2020), they ought to correctly identify the concerns and offer helpful recommendations for resolving them. Users can therefore observe that there is always an error message outlining the problems as well as red outlines indicating the areas where the faults occur in Figures 5.30 and 5.31. Therefore, it is easy for the user to find the faults and make the necessary changes.

## Chapter 6: Implementation

This chapter involves the discussion revolves around the code that have been constructed in Firebase database, along with the functions for Brain Stimulation Games, Health Tips which includes Search Recipes and Health News, Fitness, and Progress Report.

### 6.1 Firebase Structure

Figure 6.0 depicts the database structure. It is clear that each registered user is given a unique ID. Each user's information contains their date of birth (DOB), gender, a counter (denoted as "i") to track the number of tests taken, the date of each test taken, attempt details (attempt 1, attempt 2, etc.), which rise with each subsequent test assessment taken by the user in the progress report function, turns and won which will be used in the Tic Tac Toe game to determine the player turn and which player won the game. Figure 6.1 to Figure 6.4, illustrations demonstrate the implementation of this structure in the coding section.

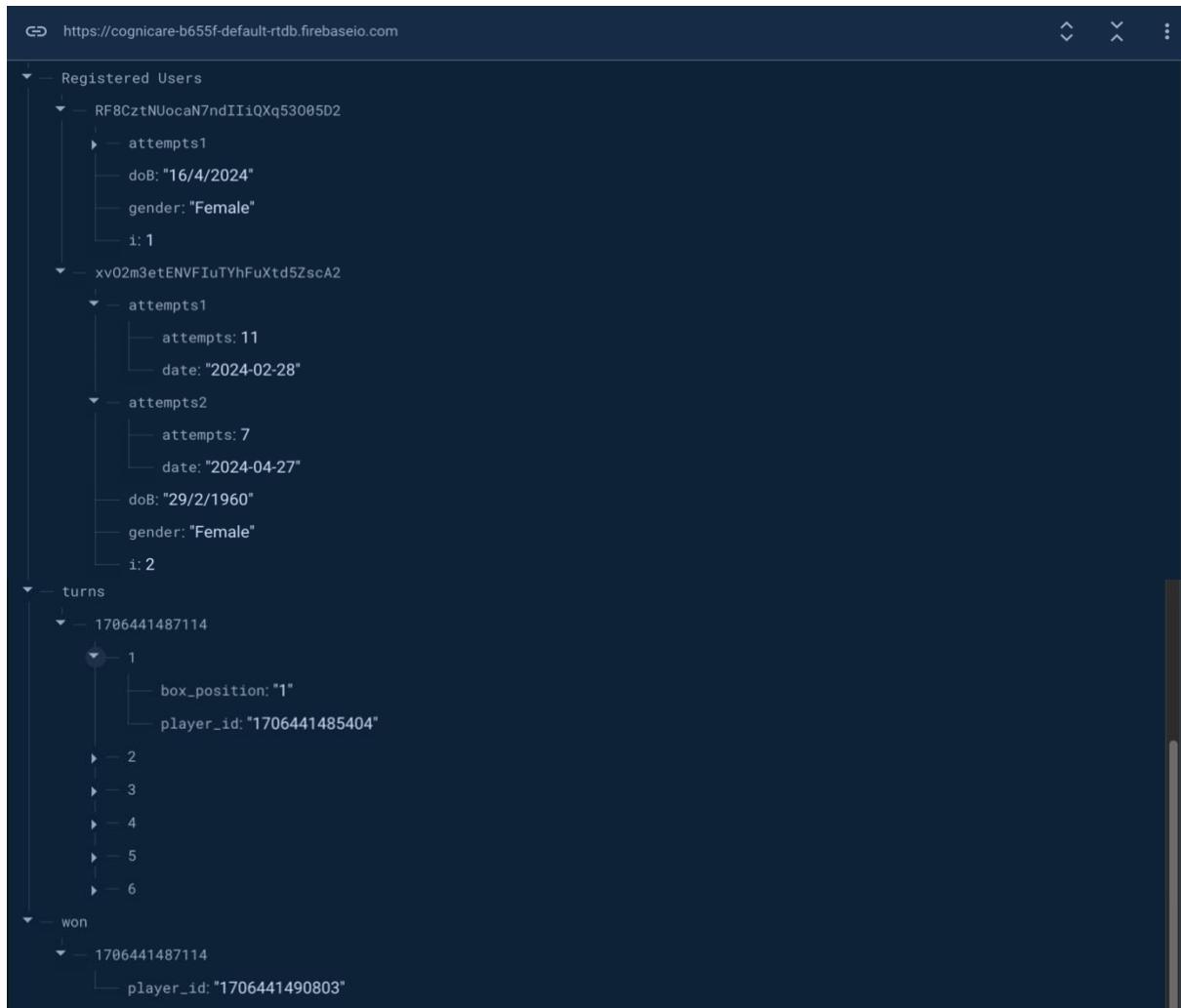


Figure 6.0 - Database Structure

Figure 6.1 depicts the class for ReadWriteUserDetails where it is a public class that is typically used to manage and store user details which includes doB, gender, attempts1, and i. The ReadWriteUserDetails class will be used in the Register java class, as depicted in Figure 6.2.

```

1  package com.example.cognicare;
2
3  8 usages ▲ FooFangKhai *
4  public class ReadWriteUserDetails {
5
6      3 usages
7      public String doB, gender;
8
9      2 usages
10     public int attempts1, i;
11
12
13     2 usages ▲ FooFangKhai
14     public ReadWriteUserDetails(String textDoB, String textGender) {
15         this.doB = textDoB;
16         this.gender = textGender;
17         this.attempts1 = 0;
18         this.i = 1;
19     }
20 }
```

Figure 6.1 - ReadWriteUserDetails Code Snippet

The Register Java class is shown in Figure 6.2. This function produces a node for the doB, gender, i value, and attempt details (attempt 1, attempt 2, etc.) in the database. Information about the test attempts and the date taken for each test is stored under the attempt details node. The user data is stored in lines 189 - 191 using the class ReadWriteUserDetails; it will subsequently be placed in the database, as shown in line 224, where the stored values will be set, creating those nodes in the database.

```

175  private void registerUser(String textFullName, String textEmail, String textDoB, String textGender, String textPwd) {
176
177     FirebaseAuth auth = FirebaseAuth.getInstance();
178     auth.createUserWithEmailAndPassword(textEmail, textPwd)
179         .addOnCompleteListener( activity: RegisterActivity.this, new OnCompleteListener<AuthResult>() {
180             ▲ FooFangKhai *
181             @Override
182             public void onComplete(@NonNull Task<AuthResult> task) {
183                 if(task.isSuccessful()) {
184                     FirebaseUser firebaseUser = auth.getCurrentUser();
185
186                     UserProfileChangeRequest profileChangeRequest = new UserProfileChangeRequest.Builder()
187                         .setDisplayName(textFullName).build();
188                     firebaseUser.updateProfile(profileChangeRequest);
189
190                     ReadWriteUserDetails writeUserDetails = new ReadWriteUserDetails(textDoB, textGender);
191                     writeUserDetails.attempts1 = 0;
192                     writeUserDetails.i = 1;
193
194                     DatabaseReference referenceProfile = FirebaseDatabase.getInstance()
195                         .getReference( path: "Registered Users");
196
197                     if (firebaseUser != null) {
198                         DatabaseReference userProfile = FirebaseDatabase.getInstance().getReference()
199                             .getReference( path: "Registered Users").child(firebaseUser.getUid());
200
201                         ▲ FooFangKhai *
202                         userProfile.child( pathString: "i").addValueEventListener(new ValueEventListener() {
203                             ▲ FooFangKhai *
204                             @Override
205                             public void onDataChange(@NonNull DataSnapshot snapshot) {
206                                 if(snapshot.exists()) {
```

```

285             int currentValue = snapshot.getValue(Integer.class);
286             userProfile.child(pathString + "i").setValue(currentValue);
287
288             String attemptKey = "attempts" + currentValue;
289             DatabaseReference attemptReference = userProfile.child(attemptKey);
290
291             String currentDate = new SimpleDateFormat( pattern: "yyyy-MM-dd", Locale.getDefault())
292                             .format(new Date());
293             attemptReference.child(pathString + "date").setValue(currentDate);
294         }
295     }
296
297     ▲ FooFangKhai
298     @Override
299     public void onCancelled(@NonNull DatabaseError error) {
300
301     });
302 }
303
304 referenceProfile.child(firebaseUser.getUid()).setValue(writeUserDetails)
305     .addOnCompleteListener(new OnCompleteListener<Void>() {
306
307     ▲ FooFangKhai *
308     @Override
309     public void onComplete(@NonNull Task<Void> task) {
310
311         if(task.isSuccessful()) {
312             Intent intent = new Intent(packageContext: RegisterActivity.this, TestAssessment.class);
313             intent.setFlags(Intent.FLAG_ACTIVITY_CLEAR_TOP | Intent.FLAG_ACTIVITY_NEW_TASK |
314                 Intent.FLAG_ACTIVITY_NO_ANIMATION);
315             startActivity(intent);
316             finish();
317         } else {
318             Toast.makeText(context: RegisterActivity.this, text: "User registered failed. Please try again",
319                         Toast.LENGTH_SHORT).show();
320         }
321         progressBar.setVisibility(View.GONE);
322     }
323 }
324
325 });
326

```

Figure 6.2 - Register Java Class Code Snippet

The TestAssessment Java class is shown in Figure 6.3. This function produces a node for test attempts that is stored under the attempt details node.

```

420     □
421     private void updateScoreAndAttempts(int attempts) {
422         FirebaseAuth auth = FirebaseAuth.getInstance();
423         FirebaseUser firebaseUser = auth.getCurrentUser();
424
425         if (firebaseUser != null) {
426             DatabaseReference referenceAttempts = FirebaseDatabase.getInstance().getReference(path: "Registered Users")
427                             .child(firebaseUser.getUid());
428             ▲ FooFangKhai *
429             referenceAttempts.child(pathString: "i").addListenerForSingleValueEvent(new ValueEventListener() {
430
431                 ▲ FooFangKhai *
432                 @Override
433                 public void onDataChange(@NonNull DataSnapshot snapshot) {
434
435                     if(snapshot.exists()) {
436                         int currentValue = snapshot.getValue(Integer.class);
437                         String value = String.valueOf(currentValue);
438                         DatabaseReference referenceProfile = FirebaseDatabase.getInstance()
439                             .getReference(path: "Registered Users");
440                         referenceProfile.child(firebaseUser.getUid()).child(pathString: "attempts"+currentValue)
441                             .child(pathString: "attempts").setValue(attempts);
442
443                     }
444
445                 };
446             });
447         }
448     }
449

```

Figure 6.3 - TestAssessment Java Class Code Snippet

The TicTacToe Java class is shown in Figure 6.4. This function produces a node for the turns and won in the database. Listener for turns and won will be added to the database reference as shown in line 137 and 138. Then, different box positions within the turns node will each be given a distinct player ID, which is derived from lines 338 to 341. Finally, the ID of the person who won in the Tic Tac Toe game will be stored in the won node. This ID is obtained from lines 519 - 524. To conclude, all the stored values will be set, creating those nodes in the database.

```

136     // adding turns listener and won listener to the database reference.
137     databaseReference.child( pathString: "turns").child(connectionId).addValueEventListener(turnsEventListener);
138     databaseReference.child( pathString: "won").child(connectionId).addValueEventListener(wonEventListener);

329     image1.setOnClickListener(new View.OnClickListener() {
330         @FooFangKhai*
331         @Override
332         public void onClick(View v) {
333             // check if the box is not selected before. and current user's player turn
334             if (!doneBoxes.contains("1") && playerTurn.equals(playerUniqueId)) {
335                 ((ImageView) v).setImageResource(R.drawable.cross_icon);
336
337                 // send selected box position and player unique id to Firebase Database
338                 databaseReference.child( pathString: "turns").child(connectionId)
339                     .child(String.valueOf( doneBoxes.size() + 1)).child( pathString: "box_position").setValue("1");
340                 databaseReference.child( pathString: "turns").child(connectionId)
341                     .child(String.valueOf( doneBoxes.size() + 1)).child( pathString: "player_id").setValue(playerUniqueId);
342
343                 // change player turn
344                 playerTurn = opponentUniqueId;
345             }
346         }
347     });

518     // checking wheather player has won the match
519     if (checkPlayerWin(selectedByPlayer)) {
520
521         // sending won player unique id to firebase database so opponent can be notified
522         databaseReference.child( pathString: "won").child(connectionId).child( pathString: "player_id")
523             .setValue(selectedByPlayer);
524     }

```

Figure 6.4 - TicTacToe Java Class Code Snippet

## 6.2 Brain Stimulation Games

The implementation of many games, such as the well-known game Tic Tac Toe, which offers Single Player (Computer AI), Local Mode (play with other players on the same device), and Multiplayer Mode (play with other players remotely), will be covered upon how the game mechanisms work in this part. The popular Tetris game's implementation will also be covered in this section.

## 6.2.1 Tic Tac Toe

### 6.2.1.1 Single Player (Computer AI)

In Figure 6.5, the loop runs through combinationsList, which most likely has every combination that might win the game (for example, [0, 1, 2] for the first row). In addition, it verifies whether the computer has marked any combination of two out of the three boxes (2 being the computer's mark). Furthermore, if the opponent has marked two boxes in a combination and the third box is unmarked, then selectedToWin increases (1 indicates the opponent's mark). Lastly, when two boxes form a winning combination, or when selectedToWin approaches 2, the loop interrupts to give priority to this move.

```
234     // check winning combination of computer
235     for (int i = 0; i < combinationsList.size(); i++) {
236         combination = combinationsList.get(i);
237         selectedToWin = 0;
238
239         // Check if the computer has two boxes in a winning combination
240         if (boxesSelectedBy[combination[0]].equals(String.valueOf(2))) {
241             if (!boxesSelectedBy[combination[1]].equals(String.valueOf(1)) && !boxesSelectedBy[combination[2]]
242                 .equals(String.valueOf(1))) {
243                 selectedToWin++;
244             }
245         }
246
247         // If two boxes are found in the winning combination, break the loop
248         // to prioritize this move
249         if (selectedToWin == 2) {
250             break;
251         }
252     }
```

Figure 6.5 - Check Winning Combination Code Snippet

In Figure 6.6, the computer determines if the opponent is about to win if it believes that it is not about to win (selectedToWin is not 2). In addition, like in the preceding loop, it looks for two boxes in a winning combination for the opponent (1 is the opponent's mark) in each combination. Lastly, the loop is broken to give priority to preventing the opponent's move if selectedToWin approaches 2.

```
267     if(selectedToWin != 2){
268         // prevent opponent from winning
269         for (int i = 0; i < combinationsList.size(); i++) {
270             combination = combinationsList.get(i);
271             selectedToWin = 0;
272
273             // Check if opponent has two boxes in a potential winning combination
274             if (boxesSelectedBy[combination[0]].equals(String.valueOf(1))) {
275                 if (!boxesSelectedBy[combination[1]].equals(String.valueOf(2)) && !boxesSelectedBy[combination[2]]
276                     .equals(String.valueOf(2))) {
277                         selectedToWin++;
278                     }
279             }
280
281             // If opponent has two boxes in a winning combination, break the loop
282             // to prioritize blocking opponent's move
283             if (selectedToWin == 2) {
284                 break;
285             }
286         }
287     }
```

Figure 6.6 - Prevent Opponent from Winning Code Snippet

In Figure 6.7, the computer chooses a box to move if it is not winning (selectedToWin is not 2) or blocking. Most usually, it selects the first box from the unchosen data (doneBoxes) that is available. Furthermore, the computer chooses the subsequent box in the winning combination (combination array) if it is winning or blocking (selectedToWin is 2).

```

298     if (selectedToWin != 2) {
299         // If neither winning nor blocking, select a box to make a move
300         for (int l = 1; l <= data.length; l++) {
301             if (!doneBoxes.contains(String.valueOf(data[l]))) {
302                 selectBoxOfComputer(data[l]);
303                 break;
304             }
305         }
306     } else {
307         // If winning or blocking, select the next box in the winning combination
308         for (int i : combination) {
309             if (!doneBoxes.contains(String.valueOf(combination[i + 1]))) {
310                 selectBoxOfComputer(combination[i + 1]);
311                 break;
312             }
313         }
314     }

```

Figure 6.7 - Make a Move Code Snippet

### 6.2.1.2 Local Mode

In Figure 6.8, by setting backgrounds (round\_black\_dark\_blue\_stroke for the active player and round\_black\_dark\_blue\_20 for the inactive player) on player1Layout and player2Layout, this method visually communicates which player's turn it is.

```

147     private void applyPlayerTurn() {
148         if (playerTurn == 1) {
149             player1Layout.setBackgroundResource(R.drawable.round_black_dark_blue_stroke);
150             player2Layout.setBackgroundResource(R.drawable.round_black_dark_blue_20);
151         } else {
152             player2Layout.setBackgroundResource(R.drawable.round_black_dark_blue_stroke);
153             player1Layout.setBackgroundResource(R.drawable.round_black_dark_blue_20);
154         }
155     }

```

Figure 6.8 - Apply Player Turn (local mode) Code Snippet

In Figure 6.9, it updates playerTurn to switch turns and marks the box with playerTurn's symbol (cross\_icon for Player 1 and zero\_icon for Player 2) as shown in line 159 - 165 and adds the box position that was selected to doneBoxes as shown in line 166. In addition, it calls applyPlayerTurn() to update the UI after a move as shown in line 167. Finally, it determines whether the current player has won (checkPlayerWin(playerTurn)), in which case it shows the relevant win dialogue, and it determines whether all of the boxes are checked (doneBoxes.size() == 9) in which case, if necessary, it shows the draw dialogue.

```

157     private void selectBox(ImageView imageView, int selectedBoxPosition, int playerTurn) {
158         boxesSelectedBy[selectedBoxPosition - 1] = String.valueOf(playerTurn);
159         if (playerTurn == 1) {
160             imageView.setImageResource(R.drawable.cross_icon);
161             this.playerTurn = 0;
162         } else {
163             imageView.setImageResource(R.drawable.zero_icon);
164             this.playerTurn = 1;
165         }
166         doneBoxes.add(String.valueOf(selectedBoxPosition));
167         applyPlayerTurn();
168
169         // checking whether player has won the match
170         if (checkPlayerWin(playerTurn)) {
171             final WinDialog winDialog;
172
173             if (playerTurn == 1) {
174                 // show win dialog
175                 winDialog = new WinDialog(context: LocalMode.this, message: "You won the game");
176             } else {
177                 // show win dialog
178                 winDialog = new WinDialog(context: LocalMode.this, message: "Opponent won the game");
179             }
180             winDialog.setCancelable(false);
181             winDialog.show();
182         }
183         // over the game if there is no box left to be selected
184         if (doneBoxes.size() == 9) {
185             final WinDialog winDialog = new WinDialog(context: LocalMode.this, message: "It is a Draw!");
186             winDialog.setCancelable(false);
187             winDialog.show();
188         }
189     }

```

Figure 6.9 - Select Box (local mode) Code Snippet

In Figure 6.10, it tries different combinationsList to verify if all spots in any winning combination (combination) have been marked by the active player (playerTurn) and returns true in the event that playerTurn finds a winning combination.

```

195     // compare player turns with every winning combination
196     for (int i = 0; i < combinationsList.size(); i++) {
197         final int[] combination = combinationsList.get(i);
198         // checking last three turn of user
199         if (boxesSelectedBy[combination[0]].equals(String.valueOf(playerTurn)) &&
200             boxesSelectedBy[combination[1]].equals(String.valueOf(playerTurn)) &&
201             boxesSelectedBy[combination[2]].equals(String.valueOf(playerTurn))) {
202                 isPlayerWon = true;
203             }
204         }
205     return isPlayerWon;

```

Figure 6.10 - Check Player Win (local mode) Code Snippet

### 6.2.1.3 Multiplayer Mode

In Figure 6.11, on the Firebase Realtime Database, a listener is configured on the connections node on line 83. It listens for changes in the data at that location. Firebase starts monitoring any changes made to the database's connections node as soon as this line runs. The code iterates across the children (snapshot.getChildren()) of the connections node to locate accessible connections and tests if an opponent has been found (!opponentFound) inside the onDataChange function. Additionally, it verifies each connection's player count

(getPlayersCount). The player either waits for an opponent to join or enters an already-existing room, depending on their current position (i.e., whether they are waiting or not). It establishes the game session (playerTurn, UI updates, and event listeners for game events) if the necessary requirements are satisfied (such as exactly two players in a connection). Lastly, a new connection is established if the player is not already waiting (!status.equals("waiting")) and no suitable connection is detected (!opponentFound). In order to do this, the current player must create a unique connection ID (connectionUniqueId), add themselves to it, and indicate that they are waiting for an opponent.

```

83     databaseReference.child( pathString: "connections" ).addValueEventListener( new ValueEventListener() {
84         ...
85         ...
86         @Override
87         // Logic to handle data changes in the connection node
88         public void onDataChange(@NotNull DataSnapshot snapshot) { ... }
89     }
90 }

```

Figure 6.11 - Waiting Mechanism Code Snippet

In Figure 6.12, when there are modifications to the data under turns listener, the onDataChange function is called. After, it goes through every child snapshot (dataSnapshot) that is under the snapshot (which stands for the turns node) and verifies whether a user has chosen a box (the presence of box\_position and player\_id is indicated by getChildrenCount() == 2). Then, it will obtain player\_id and box\_position from Firebase. In addition, if the box hasn't been chosen previously (!doneBoxes.contains()), to mark the box in the user interface, selectBoxByPosition() will be called.

```

245     public void onDataChange(@NotNull DataSnapshot snapshot) {
246         ...
247         ...
248         ...
249         ...
250         ...
251         ...
252         ...
253         ...
254         ...
255         ...
256         ...
257         ...
258         ...
259         ...
260         ...
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263         ...
264         ...
265         ...
266         ...
267         ...
268         ...
269         ...
270         ...
271         ...
272         ...
273         ...
274         ...
275         ...
276         ...
277         ...
278         ...
279         ...
280     }

```

Figure 6.12 - Turn Listener Code Snippet

In Figure 6.13, when there are changes to the data under won listener, the onDataChange function runs. It then determines whether a player has won by looking for a player\_id child in the snapshot. If it does, it retrieves the winning player's ID (getWinPlayerId) and displays a WinDialog1 dialogue box with the winner indicated by getWinPlayerId. Moreover, it makes the dialogue non-cancelable in order to force its presentation. Finally, after the game is over, it deletes both turnsEventListener and wonEventListener to cease receiving game updates.

```

290     public void onDataChange(@NotNull DataSnapshot snapshot) {
291         // check if a user has won the match
292         if (snapshot.hasChild( path: "player_id" )) {
293             String getWinPlayerId = snapshot.child( path: "player_id").getValue(String.class);
294             final WinDialog1 winDialog1;
295             if (getWinPlayerId.equals(playerUniqueId)) {
296                 // show win dialog
297                 winDialog1 = new WinDialog1( context: TicTacToeActivity.this, message: "You won the game");
298             } else {
299                 // show win dialog
300                 winDialog1 = new WinDialog1( context: TicTacToeActivity.this, message: "Opponent won the game");
301             }
302             winDialog1.setCancelable(false);
303             winDialog1.show();
304             // remove listeners from Database
305             databaseReference.child( pathString: "turns").child(connectionId).removeEventListener(turnsEventListener);
306             databaseReference.child( pathString: "won").child(connectionId).removeEventListener(wonEventListener);
307         }
308     }

```

Figure 6.13 - Won Listener Code Snippet

In Figure 6.14, Player1Layout and Player2Layout backgrounds are updated in accordance with the comparison of playerUniqueId2 and playerUniqueId, which indicates whose player's turn it is. Player 1 takes the turn when playerUniqueId2 matches playerUniqueId (player1Layout highlighted). If not, player 2 takes the turn (player2Layout highlighted).

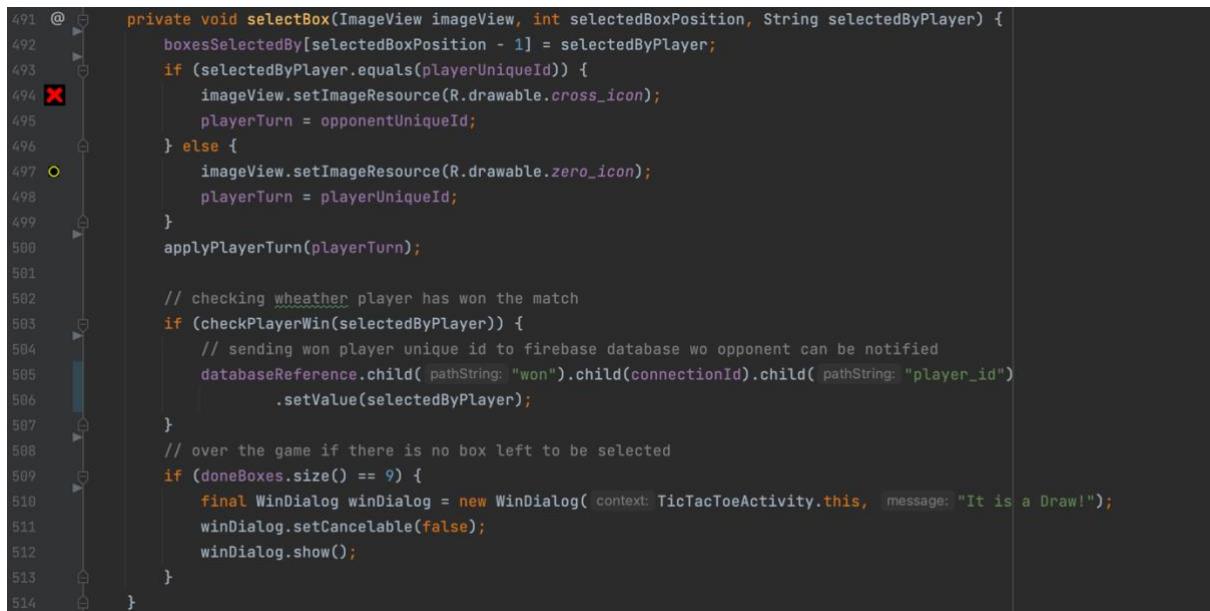
```

481     private void applyPlayerTurn(String playerUniqueId2) {
482         if(playerUniqueId2.equals(playerUniqueId)) {
483             player1Layout.setBackgroundResource(R.drawable.round_black_dark_blue_stroke);
484             player2Layout.setBackgroundResource(R.drawable.round_black_dark_blue_20);
485         } else {
486             player2Layout.setBackgroundResource(R.drawable.round_black_dark_blue_stroke);
487             player1Layout.setBackgroundResource(R.drawable.round_black_dark_blue_20);
488         }
489     }

```

Figure 6.14 - Apply Player Turn (multiplayer mode) Code Snippet

In Figure 6.15, to keep track of which player picked which box, it sets selectedByPlayer in the boxesSelectedBy array. Then, based on selectedByPlayer, it sets imageView to display a cross (cross\_icon) or a zero (zero\_icon). Furthermore, it calls applyPlayerTurn(playerTurn) to update the user interface with the current player's turn and updates playerTurn based on the player who did not simply make a move (opponentUniqueId if the current player is playerUniqueId, and vice versa). Furthermore, it calls checkPlayerWin(selectedByPlayer) to see if selectedByPlayer has prevailed. A dialogue window (WinDialog) indicating a draw will appear if the game ends in a draw with all boxes selected.



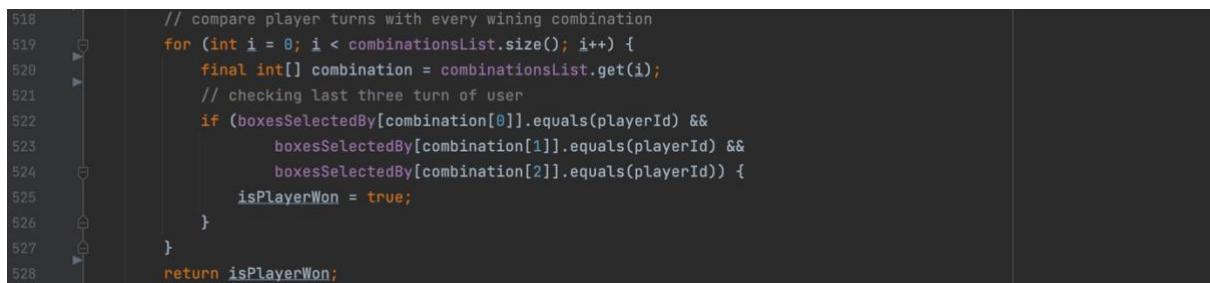
```

491     @
492     private void selectBox(ImageView imageView, int selectedBoxPosition, String selectedByPlayer) {
493         boxesSelectedBy[selectedBoxPosition - 1] = selectedByPlayer;
494         if (selectedByPlayer.equals(playerUniqueId)) {
495             imageView.setImageResource(R.drawable.cross_icon);
496             playerTurn = opponentUniqueId;
497         } else {
498             imageView.setImageResource(R.drawable.zero_icon);
499             playerTurn = playerUniqueId;
500         }
501         applyPlayerTurn(playerTurn);
502
503         // checking whether player has won the match
504         if (checkPlayerWin(selectedByPlayer)) {
505             // sending won player unique id to firebase database so opponent can be notified
506             databaseReference.child(pathString: "won").child(connectionId).child(pathString: "player_id")
507                 .setValue(selectedByPlayer);
508         }
509         // over the game if there is no box left to be selected
510         if (doneBoxes.size() == 9) {
511             final WinDialog winDialog = new WinDialog(context: TicTacToeActivity.this, message: "It is a Draw!");
512             winDialog.setCancelable(false);
513             winDialog.show();
514         }
515     }

```

Figure 6.15 - Select Box (multiplayer mode) Code Snippet

In Figure 6.16, it tries different combinationsList to verify if all spots in any winning combination (combination) have been marked by the active player (playerId) and returns true in the event that playerId finds a winning combination.



```

518     // compare player turns with every winning combination
519     for (int i = 0; i < combinationsList.size(); i++) {
520         final int[] combination = combinationsList.get(i);
521         // checking last three turn of user
522         if (boxesSelectedBy[combination[0]].equals(playerId) &&
523             boxesSelectedBy[combination[1]].equals(playerId) &&
524             boxesSelectedBy[combination[2]].equals(playerId)) {
525             isPlayerWon = true;
526         }
527     }
528     return isPlayerWon;

```

Figure 6.16 - Check Player Win (multiplayer mode) Code Snippet

## 6.2.2 Tetris

In Figure 6.17, It initialises the GameModel and GameView using factories (GameModelFactory and GameViewFactory) and creates an instance of GamePresenter, which serves as the controller for the game logic. The type of game model is specified by GameType.TETRIS as shown in line 31 - 33. Next, it creates click listeners for the directional buttons (up, down, left, right, and fire). When a button is clicked, the game presenter (gamePresenter) performs the associated action (turn), passing a GameTurn enum value (UP, DOWN, LEFT, RIGHT, FIRE) as shown in line 35 - 45. Furthermore, it creates a click listener for gameCtlBtn, which uses gamePresenter to switch between the game's start and pause states as shown in line 47. Finally, to set the game state and begin gameplay, changeStatus() and gamePresenter.init() are called.

```
31     GamePresenter gamePresenter = new GamePresenter();
32     gamePresenter.setGameModel(GameModelFactory.newGameModel(GameType.TETRIS));
33     gamePresenter.setGameView(GameViewFactory.newGameView(gameFrame, gameScoreText, gameStatusText, gameCtlBtn));
34
35     Button upBtn = findViewById(R.id.up_btn);
36     Button downBtn = findViewById(R.id.down_btn);
37     Button leftBtn = findViewById(R.id.left_btn);
38     Button rightBtn = findViewById(R.id.right_btn);
39     Button fireBtn = findViewById(R.id.fire_btn);
40
41     upBtn.setOnClickListener(v -> gamePresenter.turn(GameTurn.UP));
42     downBtn.setOnClickListener(v -> gamePresenter.turn(GameTurn.DOWN));
43     leftBtn.setOnClickListener(v -> gamePresenter.turn(GameTurn.LEFT));
44     rightBtn.setOnClickListener(v -> gamePresenter.turn(GameTurn.RIGHT));
45     fireBtn.setOnClickListener(v -> gamePresenter.turn(GameTurn.FIRE));
46
47     gameCtlBtn.setOnClickListener(v -> gamePresenter.changeStatus());
48
49     gamePresenter.init();
```

Figure 6.17 - Tetris Java Class Code Snippet

## 6.3 Health Tips

The implementation of search recipes and health news function will be covered in this part.

### 6.3.1 Search Recipes

In Figure 6.18, the manager.getRandomRecipes() is handled by the Response Listener (randomRecipeResponseListener) where the didFetch(RandomRecipeApiResponse response, String message) method dismissed the ProgressDialog as shown in line 81 and initialised the RecyclerView (recyclerView) as shown in line 82 - 87. The didError(String message) method shows a toast message if there's an error fetching recipes.

```

78     private final RandomRecipeResponseListener randomRecipeResponseListener = new RandomRecipeResponseListener() {
79         1 usage  ± FooFangKhai *
80     @Override
81         public void didFetch(RandomRecipeApiResponse response, String message) {
82             dialog.dismiss();
83             recyclerView = findViewById(R.id.recycler_random);
84             recyclerView.setHasFixedSize(true);
85             recyclerView.setLayoutManager(new LinearLayoutManager( context: NutritionActivity.this, spanCount: 1));
86             randomRecipeAdapter = new RandomRecipeAdapter( context: NutritionActivity.this, response.recipes,
87                 recipeClickListener);
88             recyclerView.setAdapter(randomRecipeAdapter);
89         }
90
91         2 usages  ± FooFangKhai
92     @Override
93         public void didError(String message) {
94             Toast.makeText( context: NutritionActivity.this, message, Toast.LENGTH_SHORT).show();
95         }
96     };

```

Figure 6.18 - Fetching Random Recipes Code Snippet

In Figure 6.19, this method handles item selection events in the spinner. The onItemSelected(AdapterView view, int i, long l, AdapterView adapterView, View view) method uses manager.getRandomRecipes() to request random recipes, add the desired tag, and clear the tags list as shown in line 99 - 102.

```

96     private final AdapterView.OnItemSelectedListener spinnerSelectedListener = new AdapterView.OnItemSelectedListener() {
97         no usages  ± FooFangKhai
98     @Override
99         public void onItemSelected(AdapterView<?> adapterView, View view, int i, long l) {
100             tags.clear();
101             tags.add(adapterView.getSelectedItem().toString());
102             manager.getRandomRecipes(randomRecipeResponseListener, tags);
103             dialog.show();
104         }
105
106         no usages  ± FooFangKhai *
107     @Override
108         public void onNothingSelected(AdapterView<?> adapterView) {
109             // Handle case where nothing is selected (if needed)
110         }
111     };

```

Figure 6.19 - Spinner Selection Listener Code Snippet

In Figure 6.20, this method handles clicks on recipe items in the RecyclerView where it also starts a new activity to display details of the chosen recipe by passing the recipe ID as an intent extra.

```

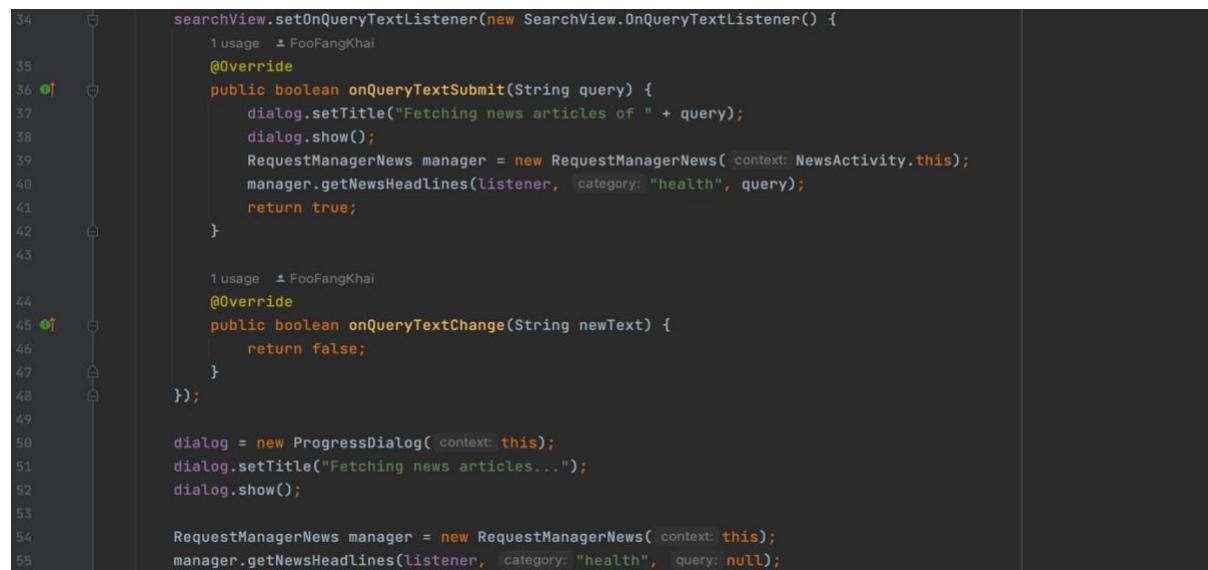
111     private final RecipeClickListener recipeClickListener = new RecipeClickListener() {
112         2 usages  ± FooFangKhai
113     @Override
114         public void onRecipeClick(String id) {
115             startActivity(new Intent( packageContext: NutritionActivity.this, RecipeDetailsActivity.class)
116                 .putExtra( name: "id", id));
117         }
118     };

```

Figure 6.20 - Recipe Click Listener Code Snippet

### 6.3.2 Health News

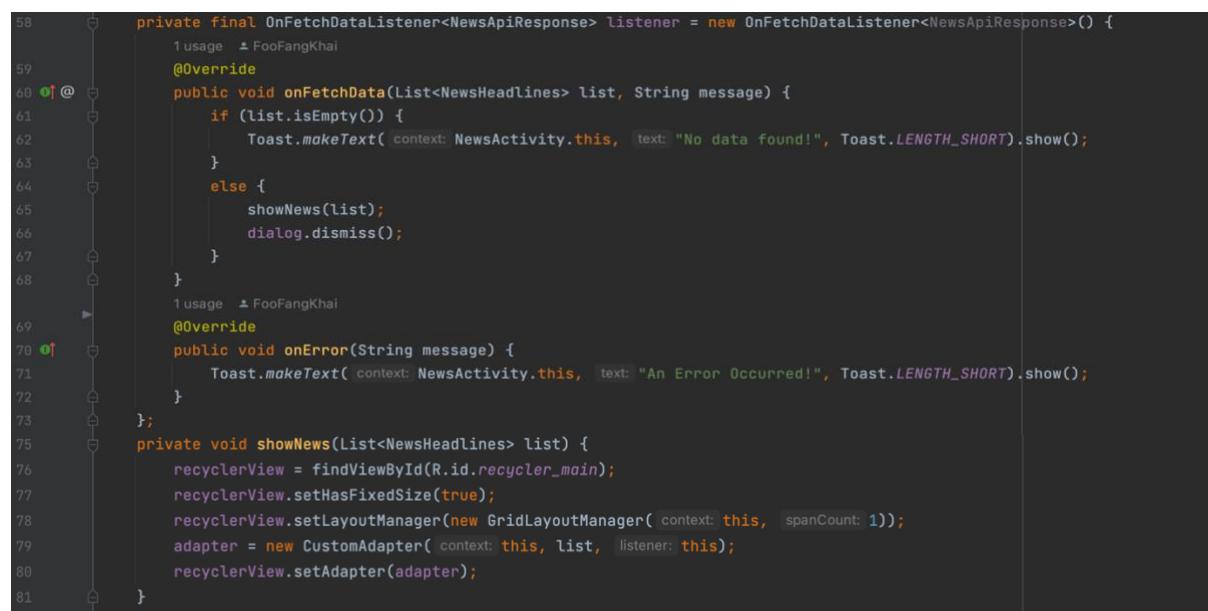
In Figure 6.21, in order to process user input for searching news items, the searchView is configured. RequestManagerNews is used to retrieve news on health-related issues when a query is made (onQueryTextSubmit) as shown in line 34 - 48. In addition, RequestManagerNews is initialised to retrieve health-related news headlines ("health") when the activity is created (onCreate) as shown in line 50 - 55.



```
34     searchView.setOnQueryTextListener(new SearchView.OnQueryTextListener() {
35         @Override
36         public boolean onQueryTextSubmit(String query) {
37             dialog.setTitle("Fetching news articles of " + query);
38             dialog.show();
39             RequestManagerNews manager = new RequestManagerNews(context: NewsActivity.this);
40             manager.getNewsHeadlines(listener, category: "health", query);
41             return true;
42         }
43
44         @Override
45         public boolean onQueryTextChange(String newText) {
46             return false;
47         }
48     );
49
50     dialog = new ProgressDialog(context: this);
51     dialog.setTitle("Fetching news articles...");
52     dialog.show();
53
54     RequestManagerNews manager = new RequestManagerNews(context: this);
55     manager.getNewsHeadlines(listener, category: "health", query: null);
```

Figure 6.21 - News Fetching Code Snippet

In Figure 6.22, this method handles the response from the API. When news items are successfully retrieved (onFetchData), showNews is used to display them as shown in line 75 - 81. An error message appears if an error occurs.



```
58     private final OnFetchDataListener<NewsApiResponse> listener = new OnFetchDataListener<NewsApiResponse>() {
59         @Override
60         public void onFetchData(List<NewsHeadlines> list, String message) {
61             if (list.isEmpty()) {
62                 Toast.makeText(context: NewsActivity.this, text: "No data found!", Toast.LENGTH_SHORT).show();
63             } else {
64                 showNews(list);
65                 dialog.dismiss();
66             }
67         }
68
69         @Override
70         public void onError(String message) {
71             Toast.makeText(context: NewsActivity.this, text: "An Error Occurred!", Toast.LENGTH_SHORT).show();
72         }
73     };
74
75     private void showNews(List<NewsHeadlines> list) {
76         recyclerView = findViewById(R.id.recycler_main);
77         recyclerView.setHasFixedSize(true);
78         recyclerView.setLayoutManager(new GridLayoutManager(context: this, spanCount: 1));
79         adapter = new CustomAdapter(context: this, list, listener: this);
80         recyclerView.setAdapter(adapter);
81     }
```

Figure 6.22 - Handling API Responses and Displaying News Code Snippet

## 6.4 Fitness

### 6.4.1 Activity Before and After Age 60

The implementation of both activities before and after age 60 will be the same, except for the duration of each exercise, as mentioned in section 2.3.2.1, the researchers noted that the older adults population is quickly expanding, and there is significant evidence that physical activity promotes good ageing. Furthermore, the OA Compendium offers the energy costs of 99 Specific Activities in individuals over the age of 60 hence people over age 60 may require increased physical activity to promote health aging. The code shown in Figure 6.23 and 6.24 will be the same code in the implementation for activities before and after the age 60 programme.

In Figure 6.23, an array of image button resource IDs was initialised, which will be used in the Imagebuttonclicked method shown in Figure 6.24.

```
24     newArray = new int[] {  
25         R.id.bow_pose, R.id.bridge_pose, R.id.chair_pose, R.id.child_pose, R.id.cobbler_pose, R.id.cow_pose,  
26         R.id.playji_pose, R.id.pauseji_pose, R.id.plank_pose, R.id.crunches_pose, R.id.situp_pose,  
27         R.id.rotation_pose, R.id.twist_pose, R.id.windmill_pose, R.id.legup_pose  
28     };  
29 }
```

Figure 6.23 - Array Initialisation Code Snippet

In Figure 6.24, it iterates through the newArray to determine which picture button was clicked and retrieves the clicked button's position i and increments it by one to obtain a value. Then, logs this value using 'Log.i' for debugging purposes. Lastly, creates an intent to start the InstructionsActivity class and passes the clicked value as an extra ("value").

```
31     public void Imagebuttonclicked(View view) {  
32         for (int i = 0; i < newArray.Length; i++) {  
33             if (view.getId() == newArray[i]) {  
34                 int value = i + 1;  
35                 Log.i( tag: "FIRST", String .valueOf(value));  
36                 Intent intent = new Intent( packageContext: ActivityBeforeAge60.this, InstructionsActivity.class);  
37                 intent.putExtra( name: "value", String.valueOf(value));  
38                 startActivity(intent);  
39             }  
40         }  
41     }  
42 }
```

Figure 6.24 - Handling Button Clicked Code Snippet

In Figure 6.25, it depicts how the text-to-speech function was implemented in every activity selected by the user. In the `onInit(int i)`, this method checks if initialization is successful(`status != TextToSpeech.ERROR`) as shown in line 43. If successful, it changes the language of the TextToSpeech engine to English as shown in line 44. Furthermore, when the button is selected, it extracts text from an input field (`speech`), as shown in line 52. Then, it determines whether TTS (`t1`) is currently speaking. If yes, the button text will change to Read, and the TTS playback will be stopped as shown in line 53 - 56. Otherwise, the button text will be Pause, which initiates TTS playback as shown in line 57 - 60.

```

40     t1 = new TextToSpeech(context: this, new TextToSpeech.OnInitListener() {
41         ▲ FooFangKhai
42         @Override
43         public void onInit(int i) {
44             if(i != TextToSpeech.ERROR) {
45                 t1.setLanguage(Locale.ENGLISH);
46             }
47         }
48     });
49     speechGenerate.setOnClickListener(new View.OnClickListener() {
50         ▲ FooFangKhai
51         @Override
52         public void onClick(View view) {
53             String text = speech.getText().toString();
54             if(t1.isSpeaking()) {
55                 speechGenerate.setText("Read");
56                 t1.stop();
57             } else {
58                 speechGenerate.setText("Pause");
59                 t1.speak(text, TextToSpeech.QUEUE_FLUSH, params: null);
60             }
61         }
62     });

```

Figure 6.25 - Text to Speech Code Snippet

In Figure 6.26, if the start button is clicked, the `startTimer()` method is executed. Line 110 shows how this method initialises a `CountDownTimer` with the supplied duration (`MTimeLeftinmills`). During each tick (`onTick()` method), the timer display is updated by executing `updateTimer()`, as shown in lines 112 - 115. Finally, when the timer concludes (`onFinish()` method), the logic to start a new activity depending on 'buttonValue' is handled, as demonstrated in lines 117-131.

```

103     private void startTimer() {
104         final CharSequence value1 = mtextview.getText();
105         String num1 = value1.toString();
106         String num2 = num1.substring(0, 2);
107         String num3 = num1.substring(3, 5);
108         final int number = Integer.valueOf(num2) * 60 + Integer.valueOf(num3);
109         MTimeLeftinmills = number * 1000;
110         ▲ FooFangKhai
111         countDownTimer = new CountDownTimer(MTimeLeftinmills, countDownInterval: 1000) {
112             ▲ FooFangKhai
113             @Override
114             public void onTick(long millisUntilFinished) {
115                 MTimeLeftinmills = millisUntilFinished;
116                 updateTimer();
117             }
118         };
119     }

```

```

116
117     @Override
118     public void onFinish() {
119         int newValue = Integer.valueOf(buttonValue) + 1;
120         if (newValue <= 7) {
121             Intent intent = new Intent(getApplicationContext(), BowPoseActivity.class);
122             intent.addFlags(Intent.FLAG_ACTIVITY_CLEAR_TASK);
123             intent.putExtra("name", String.valueOf(newValue));
124             startActivity(intent);
125         } else {
126             newValue = 1;
127             Intent intent = new Intent(getApplicationContext(), BowPoseActivity.class);
128             intent.addFlags(Intent.FLAG_ACTIVITY_CLEAR_TASK);
129             intent.putExtra("name", String.valueOf(newValue));
130             startActivity(intent);
131         }
132     }.start();
133     startBtn.setText("PAUSE");
134     MTimeRunning = true;

```

Figure 6.26 - Start Timer Code Snippet

In Figure 6.27, this method cancels the CountDownTimer, sets the MTimeRunning flag to false, and changes the startBtn text to START as shown in line 97 - 101.

```

97     private void stopTimer() {
98         countDownTimer.cancel();
99         MTimeRunning = false;
100        startBtn.setText("START");
101    }

```

Figure 6.27 - Stop Timer Code Snippet

In Figure 6.28, this method calculates the remaining time (MTimeLeftinmills) in minutes and seconds before formatting the time into a 'mm:ss' format and assigning it to the mtextview for display.

```

137     private void updateTimer() {
138         int minutes = (int) MTimeLeftinmills / 60000;
139         int seconds = (int) MTimeLeftinmills % 60000 / 1000;
140
141         String timeLeftText = "";
142         if (minutes < 10)
143             timeLeftText = "0";
144         timeLeftText = timeLeftText + minutes + ":";
145         if (seconds < 10)
146             timeLeftText += "0";
147         timeLeftText += seconds;
148         mtextview.setText(timeLeftText);
149     }

```

Figure 6.28 - Update Timer Code Snippet

As previously stated, people over the age of 60 may require increased physical activity to promote healthy ageing. Figures 6.29 and 6.30 show the only code differences between the two programmes, activity before and after age 60, which is the time required for age groups after and before 60 to achieve. Figure 6.29 shows that the time required for each exercise for the age group before 60 is one minute, but Figure 6.30 shows that the time required for each exercise for the age group after 60 is 1.5 minutes where this is the only difference between this two programs. Furthermore, the xml file is provided rather than java because the way the timer calculates on the backend side is the same for both programmes; only the number fed into the calculation differs the outcome. As a result, the timing computation will be same between the two programmes.

```
25      <Button
26          android:layout_marginTop="35dp"
27          android:id="@+id/time"
28          android:layout_width="150dp"
29          android:layout_height="150dp"
30          android:layout_marginLeft="130dp"
31          android:text="01:00"
32          android:textSize="28sp"
33          android:padding="15dp"
34          android:backgroundTint="#0000FF"/>
```

Figure 6.29 - Exercise Duration for Age Before 60 Code Snippet

```
25      <Button
26          android:layout_marginTop="35dp"
27          android:id="@+id/time"
28          android:layout_width="150dp"
29          android:layout_height="150dp"
30          android:layout_marginLeft="130dp"
31          android:text="01:30"
32          android:textSize="28sp"
33          android:padding="15dp"
34          android:backgroundTint="#0000FF"/>
```

Figure 6.30 - Exercise Duration for Age After 60 Code Snippet

#### 6.4.2 Fitness Tips

In Figure 6.31, it pulls two arrays (tStory for titles and dStory for details) from resources (strings.xml) as shown in line 25 - 26, and creates a ListView (listView) which populates it using an ArrayAdapter (adapter) with tStory data as shown in line 28 - 30. Each item in the list is styled with the row.xml layout.

```
25     String[] tStory = getResources().getStringArray(R.array.title_story);
26     final String[] dStory = getResources().getStringArray(R.array.details_story);
27
28     listView = findViewById(R.id.list);
29     ArrayAdapter<String> adapter = new ArrayAdapter<String>( context: this, R.layout.row, R.id.rowtxt, tStory);
30     listView.setAdapter(adapter);
```

Figure 6.31 - ListView and ArrayAdapter Code Snippet

In Figure 6.32, when a list item is clicked, the related details (dStory[position]) are retrieved as shown in line 35. Then it creates an intent to start FitnessActivityDetails class activity and passes the details “story” as an extra using putExtra() as shown in line 34 - 40.

```
32     listView.setOnItemClickListener(new AdapterView.OnItemClickListener() {
33         @Override
34         public void onItemClick(AdapterView<?> adapterView, View view, int position, long id) {
35             String t = dStory[position];
36             Intent intent = new Intent( packageContext: FitnessTipsActivity.this, FitnessActivityDetails.class);
37             intent.putExtra( name: "story", t);
38             startActivity(intent);
39         }
40     });
});
```

Figure 6.32 - ListView Item Click Listener Code Snippet

#### 6.4.3 Meditation

In Figure 6.33, when the user clicks on the meditation button, the application generates an Intent containing the action Intent.ACTION\_VIEW and assigns the data of the Intent to the video URL which will direct the user to the meditation video.

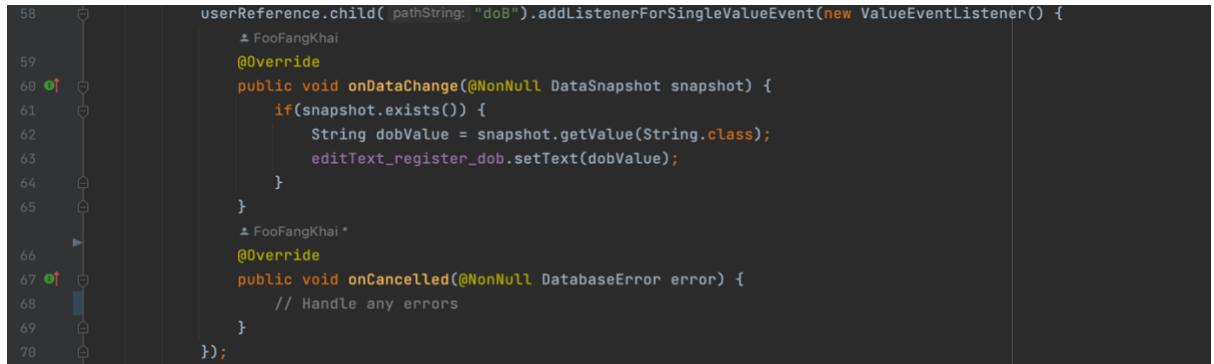
```
46
47     @Override
48     public void onClick(View view) {
49         String url = "https://www.youtube.com/watch?v=inpoK4MKVLM";
50         Intent intent = new Intent(Intent.ACTION_VIEW);
51         intent.setData(Uri.parse(url));
52         startActivity(intent);
    }
```

Figure 6.33 - Meditation Code Snippet

## 6.5 Progress Report

In the progress report page, the user can view either their user details, which include their date of birth and gender, or they can view the test assessment report with an overview of the date taken for each test and how many attempts they made to complete the test.

In Figure 6.34, if the snapshot exists (`snapshot.exists()`), the date of birth data is returned as a String and assigned to `editText_register_dob` as shown in line 60 - 65, which generates the user details, date of birth, on the progress report page.



```
58     userReference.child( pathString: "dob" ).addValueEventListener( new ValueEventListener() {
59
60         @Override
61         public void onDataChange(@NonNull DataSnapshot snapshot) {
62             if( snapshot.exists() ) {
63                 String dobValue = snapshot.getValue(String.class);
64                 editText_register_dob.setText(dobValue);
65             }
66         }
67         @Override
68         public void onCancelled(@NonNull DatabaseError error) {
69             // Handle any errors
70         }
71     });
72 }
```

Figure 6.34 - Date of Birth Data Retrieval Code Snippet

In Figure 6.35, similar to the previous listener, if the snapshot exists (`snapshot.exists()`), the gender data is returned as a String and assigned to `editText_register_gender` as shown in line 74 - 79, which generates the user details, gender, on the progress report page.



```
72     userReference.child( pathString: "gender" ).addValueEventListener( new ValueEventListener() {
73
74         @Override
75         public void onDataChange(@NonNull DataSnapshot snapshot) {
76             if( snapshot.exists() ) {
77                 String gender = snapshot.getValue(String.class);
78                 editText_register_gender.setText(gender);
79             }
80         }
81         @Override
82         public void onCancelled(@NonNull DatabaseError error) {
83
84         }
85     });
86 }
```

Figure 6.35 - Gender Data Retrieval Code Snippet

In Figure 6.36, it retrieves the current authenticated user from Firebase Authentication as shown in line 149. Then, it checks whether a user is currently authenticated as shown in line 151. If so, it proceeds to retrieve data from the Firebase Realtime Database where it will get the unique user ID (UID) of the currently authorised user as shown in line 152. Then it constructs a DatabaseReference pointing to the database location that corresponds to the current user's ID (userId) as shown in line 154. Following, it will add a ValueEventListener

to retrieve "i" data from the database for the current user's node which returns the total number of attempts as shown in line 156 - 191. Lastly, it will adds a ValueEventListener to retrieve detailed attempt data for each attempt key (attemptKey) as shown in line 168 - 183.

```

148     private void retrieveData() {
149         FirebaseUser currentUser = auth.getCurrentUser();
150
151         if (currentUser != null) {
152             String userId = currentUser.getUid();
153
154             DatabaseReference userReference = databaseReference.child(userId);
155
156             userReference.child( pathString: "i").addSingleValueEvent(new ValueEventListener() {
157                 @Override
158                 public void onDataChange(DataSnapshot iSnapshot) {
159                     if (iSnapshot.exists()) {
160                         int totalAttempts = iSnapshot.getValue(Integer.class);
161
162                         for (int i = 1; i <= totalAttempts; i++) {
163                             final int attemptNumber = i;
164
165                             String attemptKey = "attempts" + attemptNumber;
166                             DatabaseReference attemptReference = userReference.child(attemptKey);
167
168                             attemptReference.addSingleValueEvent(new ValueEventListener() {
169                                 @Override
170                                 public void onDataChange(DataSnapshot dataSnapshot) {
171                                     if (dataSnapshot.exists()) {
172                                         String attemptValue = String.valueOf(dataSnapshot.child( path: "attempts").getValue());
173                                         String dateValue = String.valueOf(dataSnapshot.child( path: "date").getValue());
174                                         TextView textViewAttempts = findViewById(R.id.textViewAttempts);
175                                         textViewAttempts.append("Test Assessment " + attemptNumber + "\n" +
176                                         "Attempt Value = " + attemptValue +"\nDate Taken = " + dateValue +"\n\n");
177                                     }
178                                 }
179
180                                 @Override
181                                 public void onCancelled(@NonNull DatabaseError error) {
182                                     // Handle any errors
183                                 }
184                             });
185                         }
186                     }
187
188                     @Override
189                     public void onCancelled(@NonNull DatabaseError error) {
190                         // Handle any errors
191                     }
192                 });
193             }
194         }
195     }

```

Figure 6.36 - Test Assessment Report Code Snippet

## 6.6 Deployment of Application

The Android phone should be unlocked and connected to your development machine via USB connection. Then, in Android, go to Settings > About phone and touch on the Build number seven times to activate Developer Options. Back under Settings, locate and select Developer options, then enable USB debugging there. Next, in Android Studio, connect your phone to the laptop via a cable and press the run button in the header or "Command + R" on the Mac and the application will be successfully simulated on the android phone.

## Chapter 7: Testing

This chapter explores the CogniCare Mobile Application's testing phase, highlighting its significance in ensuring the precision, stability, and robustness of the system. Test cases and user acceptability testing are the two primary forms of testing that are covered.

### 7.1 Test case

Table 7.0: Test Case 1 - Registration Process Validation

<b>Test Case ID:</b> 01	<b>Test Priority:</b> High			
<b>Test Title:</b> Registration Process Validation				
<b>Description:</b> This test case is to ensure seamless user onboarding				
<b>Pre-Condition:</b> <ol style="list-style-type: none"><li>1. User is on the login page provided with the “Get Started” option</li><li>2. User is not successfully logged in</li></ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user selects "Get Started" and completes the registration process.	The user clicks on the “Get Started” option and they will need to fill in all the needed credentials. The user will be routed to the test assessment page after they entered all the needed sign-up credentials and choose to continue or exit the test assessment.	The system shall allow them to complete the test and redirect them to the home page once registration is completed and the user will receive a confirmation email if they choose to continue. The system will return them to the main page if exit was chosen.	The system allowed them to complete the test and redirected them to the home page after registration was completed and the user received a confirmation email when continue was chosen. The system returned them to the main page when exit was chosen.	Success
<b>Post Condition:</b> The home page is displayed to the user successfully and the user can interact with the application after registering and completed the test or the main page is displayed to the user successfully after the user choose to exit.				

<b>Invalid Step – Email already registered or Password is too weak</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
During the registration procedure, the user entered a registered email address or a password that was too short.	The information typed in, including email or password, may be invalid during the registration procedure.	The system shall display an error message based on what is invalid in the details.	The system displayed an error message based on what is invalid in the details.	Success
<b>Invalid Step – Continue or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will be prompted to choose Continue or Exit after clicking the Register button during registration process.	The user will be prompted to choose Continue or Exit after clicking the Register button during registration process.	The system shall allow them to take the test if continue is chosen or return them to the main page if exit is chosen.	The system allowed them to take the test when continue was chosen or returned them to the main page when exit was chosen.	Success
<b>Invalid Step – Finish or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
After the test was completed, the user will be prompted to choose Finish or Exit the completed test.	After the test was completed, the user will be prompted to choose Finish or Exit the completed test.	The system shall save the user credentials into the database and display home page if finish is chosen or return them to the main page if exit is chosen.	The system saved the user credentials into the database and displayed home page if finish was chosen or returned them to the main page if exit was chosen.	Success

Table 7.1: Test Case 2 - Login Process Validation

<b>Test Case ID:</b> 02	<b>Test Priority:</b> High			
<b>Test Title:</b> Login Process Validation				
<b>Description:</b> This test case aims to verify that users can access the CogniCare platform after login				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the specified log-in option page</li> <li>2. User is not successfully logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user selects the login method they wish to use and completes the login process.	The user selects either “Sign in with Google”, “Sign in with Phone”, or “Sign in with Email” for the login option.	The system shall display the main page with different login options to the user.	The system displayed the main page with different login options to the user.	Success
<b>Post Condition:</b> The main page is displayed to the user successfully and the user can choose which login options to login with.				
<b>Invalid Step – Sign in with Email, Google, or Phone Number chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user can choose to login either with email, google, or phone number.	If the user chooses to sign in with email, users must enter their login credentials needed or have the option to use functions including Forgot password and Register. If the	If sign in with email or google chosen, the system shall retrieve and authenticates user credentials, and directs them to the home page upon successful authentication if sign in with email or google chosen.	The system retrieved and authenticated user credentials which directed them to the home page upon successful authentication if sign in with email or google chosen. The system	Success

	<p>user chooses to sign in with google, users must choose which google account to login with. If the user chooses to sign in with phone number, users must enter their login credentials and an OTP will be send to their phone number after credentials are authenticated.</p>	<p>sign in with phone number chosen, the system shall retrieve and authenticates user credentials, sends an OTP to their phone, verifies the OTP, and directs them to the home page upon successful authentication.</p>	<p>retrieved and authenticated user credentials, sent an OTP to their phone, verified the OTP, and directed them to the home page upon successful authentication if sign in with phone number chosen.</p>	
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#### **Invalid Step – Forgot password or Register chosen**

<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user can choose to either perform Forgot password or Register function in the Sign in with Email page.	The user can choose to either perform Forgot password or Register function in the Sign in with Email page.	The system shall display the respective page based on the user's chosen function.	The system displayed the respective page based on the user's chosen function.	Success

<b>Invalid Step – Email or Password entered is incorrect</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid credentials such as email or password during the Sign in with Email login process.	The user entered invalid credentials such as email or password during the Sign in with Email login process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success
<b>Invalid Step – Phone Number is invalid</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid phone number during the Sign in with Phone Number login process.	The user entered invalid phone number during the Sign in with Phone Number login process.	The system shall display an error message and user will have to re-enter the correct credentials.	The system displayed an error message and user will have to re-enter the correct credentials.	Success
<b>Invalid Step – OTP is invalid</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid OTP during the Sign in with Phone Number login process.	The user entered invalid OTP during the Sign in with Phone Number login process.	The system shall display an error message and user will have to re-enter the correct credentials.	The system displayed an error message and user will have to re-enter the correct credentials.	Success

Table 7.1: Test Case 3 – Overflow Menu Function Validation

<b>Test Case ID:</b> 03	<b>Test Priority:</b> High			
<b>Test Title:</b> Overflow Menu Function Validation				
<b>Description:</b> This test case ensures the proper functionality and accessibility of options within the Overflow Menu				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click the overflow menu in the upper right corner, which will display a drop-down menu with various functionalities for the user to choose.	The user will select the overflow menu, which will reveal a drop-down menu with the options Settings, Share, Terms & Privacy, and Log Out.	After the user clicks the overflow menu, the system displays a drop-down list of several functionalities, which then directs the user to the page with the functionalities they selected.	After the user clicks the overflow menu, the system displayed a drop-down list of several functionalities, which then directed the user to the page with the functionalities they selected.	Success
<b>Post Condition:</b> The overflow menu is successfully displayed to the user, allowing them to select the function to employ.				
<b>Invalid Step – Share, Terms &amp; Privacy, Logout, or Settings function chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user can choose to employ the share, terms &	If the user chooses share function, the share page will be	If share function chosen, the system shall display the share	The system displayed the share page which allowed the user	Success

<p>privacy, logout, or settings function from the drop-down menu.</p>	<p>display to the user allowing them to share the application with others. If the user chooses terms &amp; privacy function, the terms &amp; privacy webpage will be displayed to the user. If the user chooses logout function, this enables users to logout of the application. If the user chooses settings function, this will reveal another drop down menu which consists of several functionalities.</p>	<p>page to the user, allowing them to share the application via platforms like WhatsApp. If terms &amp; privacy function chosen, the system shall display the Terms &amp; Privacy webpage, allowing them to view. If logout function chosen, the system shall log out the user account and return them to the main page. If settings function chosen, the system shall display the settings page with a dropdown menu consisting various options.</p>	<p>to share the application via platforms like WhatsApp if share function chosen. The system displayed the Terms &amp; Privacy webpage which allowed them to view if terms &amp; privacy function chosen. The system logged out the user account and returned them to the main page if logout function chosen. The system displayed the settings page with a dropdown menu consisting various options if settings function chosen.</p>	
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Table 7.3: Test Case 4 – Settings Function Validation

<b>Test Case ID:</b> 04	<b>Test Priority:</b> High			
<b>Test Title:</b> Settings Function Validation				
<b>Description:</b> This test case ensures the proper functionality and accessibility of options within the Settings drop-down menu				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> <li>3. User is on the Overflow Menu function</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click the Settings function provided in the overflow menu, which will display a drop-down menu with various functionalities for the user to choose.	The user will click the Settings function provided in the overflow menu which will have several functionalities in it including Update Email, Change Password, and Delete Profile.	After the user clicks the Settings function provided in the overflow menu, the system shall display a list of functions for the user to choose.	After the user clicked the Settings function provided in the overflow menu, the system displayed a list of functions for the user to choose.	Success
<b>Post Condition:</b> The Settings menu is successfully displayed to the user, allowing them to view and select which function to employ.				
<b>Invalid Step – Update Email, Change Password, or Delete Profile function chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user can choose to employ the	If the user chooses update email, change	The system shall retrieve user credentials for	The system retrieved user credentials for	Success

<p>update email, change password, or delete profile function from the drop-down menu.</p>	<p>password, or delete profile function, the system shall display the respective page where users input credentials to perform the action.</p>	<p>authentication purpose. If update email is chosen, after credentials authenticated, the updated email will be stored in the database, and sends a verification email to the user. If change password is chosen, after credentials authenticated, it allows the user to enter and validate a new password, which is then stored in the database. If delete profile is chosen, after credentials authenticated, the user will be prompted with either continue or cancel option.</p>	<p>authentication purpose. The updated email was stored in the database and sent a verification email to the user after update email function was chosen and credentials was authenticated. The system allowed the user to enter and validate a new password, which is then stored in the database after change password function was chosen and credentials was authenticated. The system prompted the user with either continue or cancel option after delete profile function was chosen and credentials was authenticated.</p>	
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<b>Invalid Step – Credentials entered incorrect</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid credentials during the update email process.	The user entered invalid credentials during the update email process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success
<b>Invalid Step – Credentials entered incorrect</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid credentials during the change password process.	The user entered invalid credentials during the change password process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success
<b>Invalid Step – Password entered not the same</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered password that is not the same in the validation state during the change password process.	The user entered password that is not the same in the validation state during the change password process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success

<b>Invalid Step – Credentials entered incorrect</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user entered invalid credentials during the delete profile process.	The user entered invalid credentials the during delete profile process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success
<b>Invalid Step – Continue or Cancel option chose</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will have to choose the options prompted by the system to either Continue or Cancel during the delete profile action.	The user will have to choose the options prompted by the system to either Continue or Cancel during the delete profile action.	The system shall retrieve and delete user credentials from the database if Continue is chosen, whereas the system shall redirect the user back to the delete profile page if Cancel is chosen.	The system retrieved and deleted user credentials from the database after Continue was chosen, whereas the system redirected the user back to the delete profile page after Cancel was chosen.	Success

Table 7.4: Test Case 5 – Forgot Password Function Validation

<b>Test Case ID:</b> 05	<b>Test Priority:</b> High			
<b>Test Title:</b> Forgot Password Function Validation				
<b>Description:</b> This test case ensures the proper functionality for forgot password				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on sign in with email page</li> <li>2. User is not logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user chooses the forgot password option provided in the sign in with email page.	The user chooses the forgot password option provided in the sign in with email page where the user will have to enter their credentials to get an email to reset their password.	The system shall retrieve user credentials for authentication purpose, redirects them to the main page upon authentication, and sends a password reset email.	The system retrieved user credentials for authentication purpose, redirected them to the main page upon authentication, and sent a password reset email.	Success
<b>Post Condition:</b> The forgot password function is successfully employed by the user and a password reset email was sent for password reset purpose.				
<b>Invalid Step – Email entered invalid</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user entered invalid credentials during the forgot password process.	The user entered invalid credentials during the forgot password process.	The system shall display an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	The system displayed an error message based on what is invalid in the details and user will have to re-enter the correct credentials.	Success

Table 7.5: Test Case 6 - Brain Stimulation Games Functionality Test

<b>Test Case ID:</b> 06	<b>Test Priority:</b> High			
<b>Test Title:</b> Brain Stimulation Games Functionality Test				
<b>Description:</b> This test case verifies the functionality of the brain stimulation games that allow users to access many sorts of games				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click the Brain Stimulation Games option provided in the home page and two type of games will be provided for the user to choose.	The user will click the Brain Stimulation Games option provided in the home page and two type of games will be provided for the user to choose.	The system shall redirect them to the Brain Stimulation Games page and allow them pick to play either Tic Tac Toe or Tetris.	The system redirected them to the Brain Stimulation Games page and allowed them to play either Tic Tac Toe or Tetris.	Success
<b>Post Condition:</b> The Brain Stimulation Games page was successfully displayed to the user, and they can choose which game to play.				
<b>Invalid Step – Return, Tic Tac Toe, or Tetris function chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click either the return button located at the top left of the page, Tic Tac Toe, or Tetris game provided in the Brain Stimulation Games page.	The user will click either the return button located at the top left of the page, Tic Tac Toe, or Tetris game provided in the Brain Stimulation Games page.	The system shall redirect them back to the home page if return button is clicked or the system shall display the game page for the chosen game.	The system redirected them back to the home page after return button was clicked. The system displayed the game page for the chosen game.	Success

Table 7.6: Test Case 7 - Tetris Game Functionality Test

<b>Test Case ID:</b> 07	<b>Test Priority:</b> High			
<b>Test Title:</b> Tetris Game Functionality Test				
<b>Description:</b> This test case verifies the Tetris game functionality test				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the Brain Stimulation Games page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click Tetris that is available under the Brain Stimulation Games option.	The user will click Tetris that is available under the Brain Stimulation Games option, and they will be led to the Tetris launcher page where they can play or exit the game.	The system will redirect them to the Tetris launcher page and allow them to do start or exit the game.	The system redirected them to the Tetris launcher page and allowed them to do start or exit the game.	Success
<b>Post Condition:</b> The Tetris launcher page was successfully displayed to the user, and they are able to start or exit the game.				
<b>Invalid Step – Start Game or Exit chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will choose either start game or exit from the Tetris launcher page.	The user will choose either start game or exit from the Tetris launcher page.	The system shall be able to perform actions based on the option chosen by the user.	The system redirected to the Tetris game page when start game was chosen and back to the Brain Stimulation game page when exit was chosen.	Success
<b>Invalid Step – Start or Exit chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will choose either start or exit from the game when they are in the Tetris game page.	The user will choose either start or exit from the game when they are in the Tetris game page.	The system shall initialize the game when start is chosen and return the user to Tetris launcher page when exit is chosen.	The system initialized the game when start was chosen and returned the user to Tetris launcher page when exit was chosen.	Success

Table 7.7: Test Case 8 - Tic Tac Toe Game Functionality Test

<b>Test Case ID:</b> 08	<b>Test Priority:</b> High			
<b>Test Title:</b> Tic Tac Toe Game Functionality Test				
<b>Description:</b> This test case verifies the Tic Tac Toe game functionality test				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the Brain Stimulation Games page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click Tic Tac Toe that is available under the Brain Stimulation Games option.	The user will click Tic Tac Toe that is available under the Brain Stimulation Games option, and they will be led to the Tic Tac Toe page where they can select different modes of playing.	The system shall redirect them to the Tic Tac Toe game page and allow them to select different modes of playing.	The system redirected them to the Tic Tac Toe game page and allowed them to select different modes of playing.	Success
<b>Post Condition:</b> The Tic Tac Toe game was successfully displayed to the user, and they are able to play different modes.				
<b>Invalid Step – Single Player, Local, Multiplayer Mode, or Exit chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user can choose to play different modes of playing including Single Player	If the user chooses single player or local mode, the system shall display single player	If Single Player (Computer AI) or Local mode is chosen, the system shall redirect to the	After Single Player (Computer AI) or Local mode was chosen, the system redirected to the respective	Success

<p>(Computer AI), Local, Multiplayer mode, or Exit from the Tic Tac Toe game page.</p>	<p>game page and initiate the game for the user. If the user chooses multiplayer mode, the user will have to enter their player name before they could enter the game. If the user chooses to exit, the system will display the Brain Stimulation Games page.</p>	<p>respective page according to the chosen game mode and initialize the game. Once the game is finished, the system shall display two options to the user, to either start a new match or exit from the game mode selected. If Multiplayer mode is chosen, the system shall display the multiplayer mode page, where users can enter their player name. They will also have the option to continue or exit the game. If Exit is chosen, the system shall redirect the user back to the Brain Stimulation Games page.</p>	<p>page according to the chosen game mode and initialized the game. After the game had finish, the system displayed two options for the user to choose, start a new match or exit from the game mode selected. After Multiplayer mode was chosen, the system displayed the multiplayer mode page, where users entered their player name by also having two options to choose, continue or exit from mode. After Exit was chosen, the system redirected the user back to the Brain Stimulation Games page.</p>	
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<b>Invalid Step – Start New Match or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
After the match ended for Single Player mode, the system will prompt the user to Start New Match or Exit.	After the match ended for Single Player mode, the system will prompt the user to Start New Match or Exit.	If Start New Match chosen, the system initializes the game. Else, the system returns the user to the Tic Tac Toe game page.	If Start New Match chosen, the system initialized the game. Else, the system returned the user to the Tic Tac Toe game page.	Success
<b>Invalid Step – Start New Match or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
After the match ended for Local mode, the system will prompt the user to Start New Match or Exit.	After the match ended for Local mode, the system will prompt the user to Start New Match or Exit.	If Start New Match chosen, the system initializes the game. Else, the system returns the user to the Tic Tac Toe game page.	If Start New Match chosen, the system initialized the game. Else, the system returned the user to the Tic Tac Toe game page.	Success
<b>Invalid Step – Continue or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will choose to Continue or Exit when they are in the Multiplayer game page.	The user will choose to Continue or Exit when they are in the Multiplayer game page, which will initiate different operations.	The system shall return the user to the Tic Tac Toe game page when exit is chosen, while selecting continue will initialize the game.	The system returned the user to the Tic Tac Toe game page when exit is chosen, while selecting continue initialized the game.	Success

Table 7.8: Test Case 9 - Health News & Recipes Functionality Test

<b>Test Case ID:</b> 09	<b>Test Priority:</b> High			
<b>Test Title:</b> Health News & Recipes Functionality Test				
<b>Description:</b> This test case validates the functionality of Health News & Recipes that allow users to access different features				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user can choose to employ different functions including Search Recipe, Health News, or Exit from the Health Tips page.	The user will click Health Tips that is available under the home page, and they will be led to the Health Tips page where they can employ different functions.	The system shall redirect them to the Health Tips page and allow them to pick either Search Recipes, Health News, or Exit.	The system redirected them to the Health Tips page and allowed them to pick either Search Recipes, Health News, or Exit.	Success
<b>Post Condition:</b> The Health Tips page was successfully displayed to the user, and they are able to pick either Search Recipes, Health News, or Exit function.				
<b>Invalid Step – Search recipe, Health News, or Exit function chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user selects to employ one of the functions provided in the Health Tips page.	If the user chooses search recipe or health news, the system shall display the respective page for the user. If	If search recipe or health news is chosen, the system shall redirect them to the respective page according to	After search recipe or health news was chosen, the system redirected them to the respective page according to	Success

	the user chooses to exit, the system will display the home page.	the chosen function where they may execute the operations needed. If exit is chosen, the system shall redirect them to the home page.	the chosen function where they executed the operations needed. After exit was chosen, the system redirected them to the home page.	
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#### **Invalid Step – Done viewing**

<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user had done viewing the recipes.	The user will click on the return button after they had done viewing the recipes.	The system shall redirect them to the health tips page after the return button is clicked.	The system redirected them to the health tips page after the return button was clicked.	Success

#### **Invalid Step – Done viewing**

<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user had done viewing the news.	The user will click on the return button after they had done viewing the news.	The system shall redirect them to the health tips page after the return button is clicked.	The system redirected them to the health tips page after the return button was clicked.	Success

Table 7.9: Test Case 10 - Fitness Functionality Test

<b>Test Case ID:</b> 10	<b>Test Priority:</b> High			
<b>Test Title:</b> Fitness Functionality Test				
<b>Description:</b> This test case validates the fitness functionality which allow users to access different programs				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click the Fitness option provided in the home page.	The user will click the Fitness option provided in the home page where they can choose to access different programs including Before age 60, After age 60, Meditation, or Nutrition or tips.	The system shall redirect them to the Fitness page and allow them to access different programs.	The system redirected them to the Fitness page and allowed them to access different programs.	Success
<b>Post Condition:</b> The Fitness page was successfully displayed to the user, and they are able to access different programs.				
<b>Invalid Step – Before age 60, After age 60, Meditation, or Nutrition or tips chosen</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user selects to access one of the activities provided in the Fitness page.	If the user chooses before age 60, after age 60, meditation, or nutrition or tips,	If before age 60 or after age 60 is chosen, the system shall redirect them to	After before age 60 or after age 60 was chosen, the system redirected them to the	Success

	<p>the system shall display the respective page for the user and the user can select which exercise to do.</p>	<p>the respective page according to the chosen activity where the system shall display the chosen exercise details which includes additional features like Start, Exit, etc. If meditation is chosen, the system shall redirect them to the meditation page. If nutrition or tips is chosen, the system shall redirect them to the nutrition or tips page while displaying few tips &amp; diet information for the user to view.</p>	<p>respective page according to the chosen activity where the system displayed the chosen exercise details to the user. After meditation was chosen, the system redirected them to the meditation page. After nutrition or tips was chosen, the system redirected them to the nutrition or tips page and displayed few tips &amp; diet information for the user to view.</p>	
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<b>Invalid Step – Start or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will click on either the Start or Exit button provided on the chosen exercise page for before age 60 activity.	The user will click on either the Start or Exit button provided on the chosen exercise page for before age 60 activity which will perform different tasks.	If start is clicked, the system shall start the timer for the chosen exercise. If exit is clicked, the system shall display the before age 60 activity page.	After start was clicked, the system started the timer for the chosen exercise. After exit was clicked, the system displayed the before age 60 activity page.	Success
<b>Invalid Step – If timer pause or timer didn't pause</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will have the option to pause the timer after started on the chosen exercise page for before age 60 activity.		If timer is paused, the system shall pause the timer for the chosen exercise. If timer is not paused (counts down automatically), the system shall display the chosen exercise details again.	After timer was paused, the system paused the timer for the chosen exercise. If timer was not paused (counts down automatically), the system displayed the chosen exercise details again.	Success

<b>Invalid Step – Start or Exit chosen</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will click on either the Start or Exit button provided on the chosen exercise page for after age 60 activity.	The user will click on either the Start or Exit button provided on the chosen exercise page for after age 60 activity which will perform different tasks.	If start is clicked, the system shall start the timer for the chosen exercise. If exit is clicked, the system shall display the after age 60 activity page.	After start was clicked, the system started the timer for the chosen exercise. After exit was clicked, the system displayed the after age 60 activity page.	Success
<b>Invalid Step – If timer pause or timer didn't pause</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user will have the option to pause the timer after started on the chosen exercise page for after age 60 activity.	The user will have the option to pause the timer after started on the chosen exercise page for after age 60 activity.	If timer is paused, the system shall pause the timer for the chosen exercise. If timer is not paused (counts down automatically), the system shall display the chosen exercise details again.	After timer was paused, the system paused the timer for the chosen exercise. If timer was not paused (counts down automatically), the system displayed the chosen exercise details again.	Success
<b>Invalid Step – Done viewing</b>				
<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user had done viewing the nutrition or tips details.	The user will click on the return button after they had done viewing the nutrition or tips details.	The system shall redirect them to the fitness page after the return button is clicked.	The system redirected them to the fitness page after the return button is clicked.	Success

Table 7.10: Test Case 11 - Progress Report Functionality Test

<b>Test Case ID:</b> 11	<b>Test Priority:</b> High			
<b>Test Title:</b> Progress Report Functionality Test				
<b>Description:</b> This test case validates the progress report functionality that allow users to take the test assessment and view the report generated regarding their progress over time				
<b>Pre-Condition:</b> <ol style="list-style-type: none"> <li>1. User is on the home page</li> <li>2. User is logged in</li> </ol>				
<b>Valid Test</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
The user will click the Progress Report option provided in the home page.	The user will click the Progress Report option provided in the home page where they are needed to select between two options, Continue or Exit.	The system shall redirect them to the Progress Report page, where the user will be prompted with Continue or Exit option.	The system redirected them to the Progress Report page, where the user was prompted with Continue or Exit option.	Success
<b>Post Condition:</b> The Progress Report page was successfully displayed to the user.				
<b>Invalid Step – Continue or Exit chose</b>				
Test Step	Test Description	Expected Result	Actual Result	Status
After being led to the Progress Report page, the user must choose whether to Continue or Exit.	After being led to the Progress Report page, the user must choose whether to Continue or Exit, which will initiate different operations.	The system shall let the user to check their progress report after retrieving user credentials from the database have the option to take the test assessment after	The system let the user to check their progress report after retrieving user credentials from the database have the option to take the test assessment after	Success

		assessment if the user chooses Continue. Otherwise, the system shall redirect the user back to home page if Exit is chosen.	the user chooses Continue. Otherwise, the system redirected the user back to home page after Exit is chosen.	
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#### **Invalid Step – Take test assessment chose**

<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
In the progress report page, the user chose to take the test assessment.	In the progress report page, the user chose to take the test assessment for progress tracking purpose.	The system shall display the test assessment page and allow the user to take the test.	The system displayed the test assessment page, and the user was allowed to take the test.	Success

#### **Invalid Step – Done viewing**

<b>Test Step</b>	<b>Test Description</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Status</b>
The user had done viewing the progress report.	The user will click on the return button after they had done viewing the progress report.	The system shall redirect them to the home page after the return button is clicked.	The system redirected them to the home page after the return button is clicked.	Success

## 7.2 User Acceptance Testing

User Acceptance Testing (UAT) is the process by which end users test the functionality of a system or programme to ensure it fulfils their needs and expectations. It ensures that the system performs as expected in real-world settings and is ready for deployment.

### 7.2.1 UAT1

*Table 7.11: User Acceptance Testing 1*

CogniCare Application					
Tester Name: Foo Suan Teng	Position: Grandfather			Date: 30/5/2024	
Name of Category	Score (1 is the lowest, 5 is the highest)				
	1	2	3	4	5
Experience with the brain stimulation games function				/	
Experience with the search recipe function					/
Experience with the health news function					/
Experience with the fitness function			/		
Experience with the progress report function					/
Navigation is intuitive				/	
Interface design		/			

Comment From Tester	The font size is too small for persons with presbyopia to view clearly.
Action Taken by Developer	Change the font size to a larger size and try to standardize it across several pages.

## 7.2.2 UAT2

Table 7.12: User Acceptance Testing 2

CogniCare Application					
Tester Name: Chan Ah Fong	Position: Grandmother			Date: 30/5/2024	
Name of Category	Score (1 is the lowest, 5 is the highest)				
	1	2	3	4	5
Experience with the brain stimulation games function					/
Experience with the search recipe function					/
Experience with the health news function				/	
Experience with the fitness function			/		
Experience with the progress report function					/
Navigation is intuitive					/
Interface design				/	

Comment From Tester	The workouts in Fitness should have some animation that demonstrates how to perform the exercise.
Action Taken by Developer	Added animation that demonstrates how to perform the exercise.

## **Chapter 8: Critical Evaluation and Conclusion**

This chapter contains a full evaluation of the project's methodology and self-assessment, an examination of the problems encountered throughout its implementation, and a discussion of potential future improvements.

### **8.1 Process Evaluation**

The creation of CogniCare, a smartphone application meant to assist patients with dementia, was motivated by a crucial need in existing caring practices. Despite efforts to encourage independence, people with dementia frequently lose their ability to do Activities of Daily Living (ADLs) over time. This deterioration not only lowers their quality of life, but also increases the caring load on families and healthcare providers. According to research, dementia gradually reduces cognitive and functional abilities, making it difficult for individuals to maintain their autonomy. This degradation underscores the critical need for novel therapies that can successfully maintain cognitive capacities and daily life among dementia patients. CogniCare seeks to overcome these difficulties by providing a comprehensive solution via a smartphone app. CogniCare aims to help dementia sufferers regain and retain their independence by delivering cognitive training programmes and tracking their progress. This approach is consistent with holistic care philosophies and evidence-based approaches, ensuring that the application is both user-friendly and scientifically proven for effectiveness.

The first part entailed doing a comprehensive review of existing literature. The project included an evaluation of a wide range of technological domains, including Android Studio, React Native, Java, Dart, Firebase, SQLite, APIs, and more. The thorough investigation provided in this comprehensive study formed a solid foundation and guided the project's following actions. Then, a diary study was undertaken to gain more information about the existing application that could assist persons with dementia by giving brain stimulation games, etc. Following that, the system needs were supplied in the form of a Use Case Diagram, as well as software and hardware requirements, to guarantee that the system can provide services that help dementia sufferers preserve their cognitive capacities and daily lives. The system's structure was then drawn out using the ERD diagram, Activity Diagram, Class Diagram, and System Architecture. Then, design principles were explored to ensure that the system is user-friendly and easy to use. Finally, the prototype design for the system was then created.

The system was then constructed using Android Studio, with the data stored in a Firebase database. Java was used to pass data from the frontend to the backend depending on the situation. Following creation, the system was tested with persons with dementia to gather feedback and make changes based on that feedback to ensure the system was free of defects.

## 8.2 Challenges

One important problem encountered while developing the CogniCare mobile app using Android Studio was the use of deprecated techniques. Deprecated methods are ones that the Android platform no longer recommends for usage, usually because they have been superseded by newer, more efficient equivalents or are no longer maintained. Using deprecated techniques can cause a number of issues:

1. Compatibility Concerns
  - a. Deprecated techniques may not be maintained in future Android versions, resulting in compatibility concerns as the platform evolves.
2. Maintenance
  - a. Codebase maintenance gets increasingly difficult as reliance on deprecated methods results in inefficiencies and issues transitioning to newer Android versions.

Hence, the approach chosen to handle the difficulty of deprecated methods during the development of the CogniCare mobile application included a concerted attempt to self-learn and adapt to new methods, as indicated by the Android platform documentation.

## 8.3 Self Evaluation

Throughout the creation of the CogniCare application, I began on a tough yet gratifying adventure. I started the project with no expertise developing Android apps, which made for a steep learning curve. Here's a look at how I rated myself and grew during this project. Developing an Android application for people with dementia appeared difficult from the start. I rapidly realised that my lack of prior experience with Android coding presented a huge obstacle. Rather than getting discouraged, I saw this as a chance for development and learning.

## **Learning Journey:**

1. Initial challenges and realizations
  - a. As I progressed through the assignment, I met various problems. Understanding the Android development environment, navigating through Android Studio, and grasping the complexities of Java programming were all initially daunting. This phase emphasised the value of patience and effort in mastering a new skill.
2. Overcoming challenges
  - a. Throughout the development process, I experienced a variety of challenges, ranging from debugging sophisticated Firebase integration issues to adjusting UI designs for optimal user experience. Each issue gave an opportunity for problem solving and progress, emphasising the value of resilience and resourcefulness in development efforts.
3. Seeking guidance and feedback
  - a. Regular peer consultations, as well as input from mentors and experienced developers, were critical components of my learning experience. Constructive comments and insights helped me fine-tune my approach and improve the overall quality of the application.

To summarise, the experience of developing CogniCare has been transformative, pushing me outside of my comfort zone and reinforcing my commitment for using technology to make a significant difference in healthcare and beyond.

## **8.4 Future Enhancement**

Even if the existing system meets the system's requirements, there are a few improvements that can be made to improve it, such as developing more games that can train users' cognitive skills so that they don't get bored with only Tic Tac Toe and Tetris, and providing a list of activities on what to do, what to cook, etc., based on their cognitive progress, so that it works like a tailored programme for each individual based on their dementia progression over time.

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