

MyTherapyPal: A therapy progress and goal tracking application

Interim Report

TU856

BSc in Computer Science

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Abstract

The aim of this project is to create a cross-platform mobile and rich web application aimed at providing psychotherapists, counsellors and their clients with a platform and tools to facilitate tracking therapy progress as its primary focus. The application will be designed to have a user account system with login and authentication, a note taking system that will have a summarization and sentiment analysis feature using artificial intelligence for client users and a note expansion feature for therapist users who may take notes during therapy in shorthand.

Declaration

I hereby declare that the work described in this dissertation is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

Signed:

Shane Buckley\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Shane Buckley

20/11/2023

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Table of Contents

[1. Introduction 7](#_Toc152320089)

[1.1. Project Background 7](#_Toc152320090)

[1.2. Project Description 8](#_Toc152320091)

[1.3. Project Aims and Objectives 9](#_Toc152320092)

[1.4. Project Scope 9](#_Toc152320093)

[1.5. Thesis Roadmap 9](#_Toc152320094)

[2. Literature Review 10](#_Toc152320095)

[2.1. Introduction 10](#_Toc152320096)

[2.2. Alternative Existing Mental Health Assistance Applications 10](#_Toc152320097)

[2.2.1. Quenza 10](#_Toc152320098)

[2.2.2. Daylio 11](#_Toc152320099)

[2.2.3. Moodnotes 11](#_Toc152320100)

[2.2.4. eMoods 12](#_Toc152320101)

[2.2.5. Theratrak 12](#_Toc152320102)

[2.3. Technologies Researched & Selection 13](#_Toc152320103)

[2.3.1 Operating Systems 13](#_Toc152320104)

[2.3.2 Databases 15](#_Toc152320105)

[2.3.3 Frontend Framework 16](#_Toc152320106)

[2.3.4 Backend Framework 17](#_Toc152320107)

[2.4. Other Research you’ve done 18](#_Toc152320108)

[2.4.1 Mental Health & Psychotherapy 18](#_Toc152320109)

[2.4.2 Machine Learning 19](#_Toc152320110)

[2.5. Existing Final Year Projects 19](#_Toc152320111)

[2.6. Conclusions 20](#_Toc152320112)

[3. System Design 21](#_Toc152320113)

[3.1.Introduction 21](#_Toc152320114)

[3.2. Software Methodology 21](#_Toc152320115)

[3.2.1 Agile 21](#_Toc152320116)

[3.2.2 Waterfall 21](#_Toc152320117)

[3.2.3 DevOps 21](#_Toc152320118)

[3.2.4 Extreme Programming (XP) 21](#_Toc152320119)

[3.2.5 Feature Driven Development (FDD) 21](#_Toc152320120)

[3.3. Overview of System 21](#_Toc152320121)

[3.X. Other Sections 23](#_Toc152320122)

[3.X. Conclusions 23](#_Toc152320123)

[4. Testing and Evaluation 24](#_Toc152320124)

[4.1. Introduction 24](#_Toc152320125)

[4.2. Plan for Testing 24](#_Toc152320126)

[4.3. Plan for Evaluation 24](#_Toc152320127)

[4.4. Conclusions 24](#_Toc152320128)

[5. Prototype Development 25](#_Toc152320129)

[5.1. Introduction 25](#_Toc152320130)

[5.2. Prototype Development 25](#_Toc152320131)

[5.3. Other Sections 25](#_Toc152320132)

[5.4. Conclusions 25](#_Toc152320133)

[6. Issues and Future Work 26](#_Toc152320134)

[6.1. Introduction 26](#_Toc152320135)

[6.2. Issues and Risks 26](#_Toc152320136)

[6.3. Plans and Future Work 26](#_Toc152320137)

[6.3.1. GANTT Chart 26](#_Toc152320138)

[Bibliography 27](#_Toc152320139)

Table of Figures

[Figure 1 - Desktop Operating System Market Share Worldwide 15](#_Toc152250578)

[Figure 2 - High Level Architecture Map 20](#_Toc152250579)

[Figure 3 - Flutter Application Layers 21](#_Toc152250580)

# 1. Introduction

## Project Background

In a 2018 publication from the National Library of Medicine, it is noted that the potential of mobile apps in providing effective mental health interventions is considerable. With a shortage of psychiatrists globally and limited access to mental health care in rural areas, these apps have emerged as a practical solution to address the treatment gap in mental health. The utilization of technology has the capacity to revolutionize the delivery and accessibility of mental health treatment, emphasizing the need for the combined mobilization of science, regulation, and design to facilitate this transformative process. (1)

The concept for MyTherapyPal emerged from insightful conversations with two significant figures in my life—my mother, a seasoned psychotherapist, and my partner, an expert in psychology. These discussions shed light on the crucial need for clients to actively monitor their progress and work towards their goals within and beyond traditional therapy sessions. While traditional therapy undeniably has its merits, maintaining client engagement between appointments can be challenging. MyTherapyPal steps in to bridge this gap, providing a dynamic, interactive platform that empowers clients to take charge of their mental health journey and cultivate a personal sense of responsibility.

The timeliness and importance of this project are underscored by the growing demand for accessible mental health care and the widespread prevalence of mental health challenges. In our modern, tech-savvy world, where smartphones are practically an extension of ourselves, the development of a therapy app like MyTherapyPal feels not just relevant but essential. It's a response to the evolving needs of individuals seeking effective and user-friendly mental health support.

## Project Description

The MyTherapyPal project sets out to serve as a solution for the need for improved client engagement between therapy sessions and to utilize modern technology to improve patient well-being and outcomes. The application will be accessible through multiple platforms such as mobile (Android & iOS), web and desktop (Windows & MacOS) to ensure that the service is accessible to as many users as possible. The project aims to achieve this goal by using the frontend development framework Flutter, which is a frontend UI framework developed by Google that natively compiles applications for mobile, web and desktop from a single codebase written in Dart programming language.

The application will provide features such as user accounts with secure authentication and account creation, progress tracking by way of journaling/note taking functionality tied to a calendar, day to day mood tracking, which the user will self-report, therapist listings with extensive information on therapists available in locality, mapping function to find and display local therapists, secure end-to-end encrypted chat for communication between client and therapist, secure video/phone calling for virtual therapy sessions, payment processing so clients can pay their therapists through the application, the ability for therapists to review clients notes, assign tasks and provide feedback, natural language processing models for two features, the first being text summarization and classification from clients notes so that a therapist can see a short summary of their clients weekly notes and any inferences from those notes that the NLP model may detect, and the other feature being a note expansion feature for therapists who may write notes in short hand during therapy sessions.

The application will need to have a strong emphasis on security, especially in the realm of healthcare where maintaining the strict confidentiality is essential. By prioritizing security measures, the goal is not only to safeguard sensitive medical information but also to ensure compliance with GDPR regulations. This includes robust encryption protocols, access controls and authentication software to create a robust defence against any potential threats.

There will be an emphasis on a user-centric approach, prioritizing the user experience, incorporating feedback, and evaluating accessibility and ease of use. Evaluation will be conducted by providing working prototypes to mental healthcare professionals to test and provide feedback through the use of google forms to discover any flaws in the user experience.

## Project Aims and Objectives

Overall aim and some milestones along the way to achieve the aim

* Build a cross-platform application that is accessible and user-friendly.
* Progress tracking features (daily notes, mood tracking).
* User accounts.
* Therapist listings.
* Therapist Map (find local therapists).
* Secure text chat.
* Secure video/phone calling (virtual therapy sessions).
* Payment processing.
* Natural language processing models making use of AI technology to summarize client notes and expand therapist notes.

## Project Scope

This project does not intend to replace traditional therapy, instead, it complements and enhances the therapeutic process by addressing the challenge of maintaining client engagement between sessions. MyTherapyPal is not a diagnostic tool and does not aim to replace professional medical advice. It does not seek to replace the role of therapists but rather empower them with tools for more effective communication and engagement with their clients.

While the application incorporates natural language processing models, it is not a substitute for the nuanced understanding and empathy provided by human therapists. MyTherapyPal does not compromise on security and confidentiality, ensuring the protection of sensitive medical information, but it is not a comprehensive cybersecurity system beyond the scope of healthcare data. The project is not a one-size-fits-all solution, acknowledging that mental health needs are diverse, and individualized therapeutic approaches remain crucial.

MyTherapyPal is not static, it recognizes the need for continuous improvement based on user feedback but is not designed to replace the ongoing evolution and adaptability inherent in the field of mental health care.

## Thesis Roadmap

One sentence explaining what each of the following chapters is about.

# Literature Review

## Introduction

In this chapter, we delve into a comprehensive exploration of existing solutions and research within the realm of mental health interventions and technology applications. The purpose is to gain valuable insights and inform the development of MyTherapyPal, recognizing the significance of building upon established knowledge and experiences.

By critically examining the current landscape, we aim to identify gaps, successes, and potential pitfalls in the existing literature. This exploration serves as a foundation for shaping the innovative features and functionalities of our application. In navigating the expansive terrain of mental health technology, we seek to understand the strengths and limitations of prior endeavours, providing a context for the unique contributions MyTherapyPal aspires to make.

Through this literature review, we aim to not only acknowledge the strides made in the field but also to pinpoint areas where our project can offer novel solutions and foster advancements in mental health care technology.

## Alternative Existing Mental Health Assistance Applications

Some alternative existing applications that focus on mental health and in particular progress and mood tracking I have found include:

* Quenza – A digital health solution that helps therapists administer assessments and track patient progress over time.
* Daylio – A mood tracker and micro-diary with statistics and charts for mood trends.
* Moodnotes – A thought journal and mood diary with insights into mood patterns and incorporating CBT (Cognitive Behavioural Therapy) principles.
* eMoods – Mood tracking application for people with bipolar disorder.
* Theratrak – A digital platform enabling allied health therapists to track participant progress in between face-to-face sessions.

### 2.2.1. Quenza

Quenza is an application that allows professional practitioners (like therapists, coaches, counsellors, and social workers) to easily build beautiful ‘activities’, such as worksheets, exercises, psychoeducation, intake forms, reflection prompts, and surveys, and digitally share these with clients. These activities can be bundled into care pathways – timed series of engaging exercises that are shared with clients via email or as in-app notifications with automated reminders.

All client activity and results can be accessed through the client dashboard so the practitioner can monitor and stay on top of their clients’ progress. The main reason practitioners are working with Quenza is to keep clients engaged between sessions with custom homework exercises, reflections, meditations, and interventions. Other reasons include educating, onboarding, and assessing clients, evaluating their progress or the effectiveness of sessions, or simply to inspire them. (2)

### 2.2.2. Daylio

Daylio is a versatile micro-diary app designed to assist users in tracking various aspects of their lives effortlessly. Acting as a personal companion for goals such as fitness, mental health, nutrition, and gratitude, the app allows users to record daily activities and moods without the need for extensive typing. Its three guiding principles include promoting mindfulness for happiness and self-improvement, validating the impact of new habits, and providing a seamless, obstacle-free user experience.

Functionality-wise, Daylio operates on a simple two-step entry process, enabling users to pick their mood, add activities, and include optional notes. The app then compiles this data into statistics and a calendar, facilitating a better understanding of daily habits. Users can review their entries through charts and calendars, sharing them with friends if desired. The app offers features such as a large icon database for personalized activities, customizable moods using emojis, and in-depth statistics on a weekly, monthly, or yearly basis.

Daylio encourages the development of reflection as a daily habit, helping users discover what brings them happiness. With customizable colour themes, dark mode, and the option to set reminders, the app strives to make journaling a seamless and enjoyable experience. Privacy and security are prioritized, with data stored locally on the user's phone and optional backups to private cloud storage. The app's commitment to transparency ensures that users maintain control over their data, and measures such as PIN lock and encrypted channels for backups contribute to a secure journaling environment. (3)

### 2.2.3. Moodnotes

Moodnotes is a user-friendly mood tracker and journaling app designed to capture and enhance user moods while promoting positive thinking habits. Developed by design experts and clinical psychologists, the app draws on the scientifically supported principles of cognitive behaviour therapy (CBT) and positive psychology to empower users in tracking their moods, identifying triggers, and fostering well-being.

Key features of Moodnotes include the ability to track moods over time, automatic face scanning using the device camera, memory preservation through photos or images, and access to self-awareness articles crafted by mental health experts. The app facilitates the development of healthier thinking habits by educating users about common thinking traps and providing tools to avoid them. Additionally, Moodnotes aims to reduce anxiety, enhance well-being, and bring new, constructive perspectives to various situations.

Moodnotes Premium, available for members, unlocks additional features such as the ability to make unlimited entries per day, monitor personal statistics and mood insights, add notes to enrich entries, access the "Notable insights" section for a deeper understanding of moods, and discover more full-text articles for self-reflection. (4)

### 2.2.4. eMoods

eMoods is a highly rated mood tracking app designed for individuals managing Bipolar, Anxiety, and Depression. The app prioritizes user privacy by exclusively storing data on the device and avoiding cloud storage or external connections without explicit consent. It facilitates easy tracking of daily mood variations, sleep patterns, medications, and other symptoms associated with mood disorders. Notably, eMoods allows users to track medication changes, providing insights for informed discussions with healthcare professionals.

An essential feature of eMoods is its capacity to generate monthly PDF reports for users to share with their healthcare providers. This aids in communication and collaboration to identify triggers or events contributing to mood episodes or relapses. The app also includes in-app graphs and printable charts, enabling users to visualize trends and patterns for a deeper understanding of their symptoms between appointments. Customization options, such as adding emojis or language characters to medication names and free-form notes, enhance user flexibility.

Privacy is a core focus, with eMoods ensuring that all logged information remains securely stored on the user's device. For those seeking additional functionalities, the optional Pro version offers features like tracking custom symptoms and storing multiple timestamped notes per day through auto-renewing subscriptions with transparent terms. The app's commitment to user satisfaction and flexibility is evident in its clear subscription model, allowing users to cancel at any time. In summary, eMoods serves as a comprehensive and privacy-conscious tool for effective mood tracking and management. (5)

### 2.2.5. Theratrak

Theratrak is a mobile app that allows occupational therapists to capture meaningful information from therapy sessions and create customised home programs for children. Therapists have access to a database of therapeutic activity scaffolds which they can easily access within a therapy session. Therapists then attach photos and videos to create highly personal home programs, individual to each client’s needs. This allows the therapist to grade the activities to the child’s abilities and give specific verbal and written notes about task completion.

Therapists can use this tool concurrently with therapy sessions, helping to reduce the amount of lost paperwork or forgotten material. Theratrak gives the patient digital access to the home program the therapist prescribes, so that they continue with their treatment, better informed about their program, enabling them to take charge of their health. (6)

## 2.3. Technologies Researched & Selection

### 2.3.1 Operating Systems

In this section we will look at various operating systems that could be suitable as platforms for the application. A strong understanding of the target audience in terms of demographics and operating system popularity will weigh heavily in the operating system selection decision making process. Other factors that will need to be considered are the type of application we are developing, hardware considerations, development tools and testing strategies.

#### 2.3.1.1 Android

Android is an open-source operating system developed by Google, widely used for mobile devices such as smartphones and tablets. Known for its versatility and robust app ecosystem, Android provides a user-friendly interface and serves as the foundation for a diverse range of electronic devices.

In choosing Android as one of the operating systems for MyTherapyPal, I prioritize its widespread adoption and extensive user base. Android's global prominence ensures that the app has the potential to reach millions of users. The decision to incorporate Android aligns with a broader strategy of catering to diverse user preferences, and by leveraging Flutter's cross-platform capabilities, the app is poised to deliver a consistent and high quality experience across multiple operating systems. This approach not only maximizes the app's accessibility but also underscores its adaptability in a multi-platform landscape. (7)

#### 2.3.1.2 iOS

iOS is a mobile operating system developed by Apple Inc. It is the foundation that powers Apple's mobile devices, including iPhones, iPads, and iPod Touches. iOS is known for its user-friendly interface, security features, and seamless integration with other Apple products and services.

MyTherapyPal, being a healthcare-related application, could benefit from developing a version for iOS due to several reasons. Firstly, iOS has a reputation for providing a secure and controlled environment, ensuring the protection of sensitive health data. This aligns well with the privacy and confidentiality requirements often associated with healthcare applications. Apple's App Store is a well-established platform with a large user base. By releasing a version of MyTherapyPal on iOS, we gain access to a significant market share and potential users who prefer or exclusively use Apple devices. iOS devices are also known for their consistent hardware and software ecosystem. This uniformity makes it easier for developers to create and optimize applications for a standardized set of devices, resulting in a smoother and more reliable user experience. (8)

#### 2.3.1.3 Windows

Windows is a family of operating systems developed by Microsoft. It is one of the most widely used operating systems for personal computers, ranging from desktops and laptops to tablets and hybrid devices. Windows provides a graphical user interface and supports a wide range of software applications. Developing a version of MyTherapyPal for the Windows platform can be a strategic decision for several reasons. Firstly, Windows has a significant market share in the personal computing space. By targeting this platform, you can reach a diverse user base that includes individuals using various types of Windows-powered devices. Windows is commonly used in professional and enterprise environments. This presents an opportunity for MyTherapyPal to cater to healthcare professionals, clinics, or organizations that rely on Windows-based systems for their daily operations. Compatibility with Windows can facilitate the integration of MyTherapyPal into existing healthcare workflows. (9)

#### 2.3.1.4 MacOS

MacOS, formerly OS x, is an operating system developed by Apple Inc. for its line of Macintosh computers. It's built on a Unix-based foundation, providing a stable and secure environment for users. MacOS offers a user-friendly interface, advanced graphics capabilities, and seamless integration with other Apple devices and services. While MacOS would have a significantly smaller market share over Windows, it is still the second most popular desktop operating system globally. Since we are using flutter, it makes it a very simple process to compile for this operating system too so the decision to include MacOS as a platform was an easy one. (10)

A graph of a number of people

Description automatically generated with medium confidence

Figure 1 - Desktop Operating System Market Share Worldwide (11)

### 2.3.2 Databases

#### 2.3.2.1 Firebase Cloud Firestore

Googles Cloud Firestore in Firebase is a NoSQL document based database stored in the cloud which facilitates the efficient storing, synchronization and querying of data at a global scale. The database is structured with collections and documents that can be used for the building of hierarchies to store related data and quickly retrieve necessary data using expressive queries. Queries are scalable with the size of the result set rather than the size of the data set to maximize scalability.

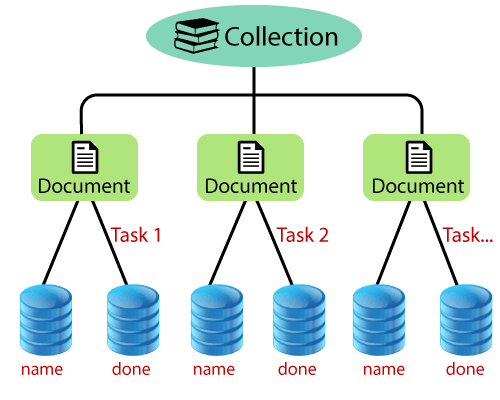


Figure 2 - Cloud Firestore Data Organization (12)

#### 2.3.2.2 MariaDB

MariaDB is an open source fork of MySQL relational database management system (RDBMS). It is a very popular choice among developers as a backend database for a range of use cases and provides a powerful solution for the management of large volumes of data. It has strong features suited to transactional and analytical workloads. MariaDB also supports a wide range of storage engines which enables users to tailor the database to a large variety of use cases. MariaDB has an active community that is continuously developing, improving, and contributing to the software.

#### 2.3.2.3 PostGreSQL

PostgreSQL is an open source object-relational database system with over 35 years of active development. An object-relational database (ORD) is a type of database management system (DBMS) that combines elements of both relational databases and object-oriented databases. In a traditional relational database, data is organized into tables with rows and columns, and relationships between tables are established through keys. On the other hand, object-oriented databases treat data as objects, each containing both data and the procedures that can operate on the data. Object-relational databases seek to bridge the gap between these two approaches by incorporating object-oriented features into a relational database.

In an ORD, you can store complex data types, such as images, audio, or even entire objects, within the database. This allows for a more natural representation of real-world entities and relationships. It also supports features like inheritance, encapsulation, and polymorphism, which are common in object-oriented programming.

#### 2.3.2.4 Selection (Firebase Cloud Firestore)

When selecting a database solution, it is crucial to carefully consider the compatibility and seamless integration with all other components within the software system. Given our decision to adopt Flutter as the frontend technology, Firebase Cloud Firestore emerges as the logical choice for our database solution.

### 2.3.3 Frontend Framework

When faced with the task of selecting the frontend programming languages and frameworks for a cross-platform application, several options present themselves, each with its set of strengths and considerations.

#### 2.3.3.1 React Native

React Native, leveraging JavaScript and React, is a widely embraced choice. Its appeal lies in the vast pool of web developers who can seamlessly transition to mobile app development. With a strong community backing, React Native supports efficient code sharing between platforms, making it a pragmatic choice for those looking to optimize development time. (13)

#### 2.3.3.2 Xamarin

Xamarin, on the other hand, utilizes C# and .NET, providing an advantage for developers familiar with Microsoft technologies. The framework allows for tight integration with existing C# codebases and offers access to a broad range of native APIs. Xamarin's performance is notable, and its ability to deliver a native user experience has made it a preferred choice for enterprises. (14)

#### 2.3.3.3 Selection (Flutter)

My ultimate decision led me to Flutter, developed by Google. Flutter takes a distinctive approach by employing Dart as its programming language. Dart is known for its simplicity and efficiency, providing a strong foundation for building scalable applications. Flutter's widget-based architecture ensures a consistent and visually appealing user interface across different platforms. The "hot reload" feature in Flutter significantly enhances the development workflow by enabling real-time code changes and rapid debugging.

One of the key considerations that swayed my decision towards Flutter was its commitment to native-like performance across both iOS and Android platforms. The framework's single codebase approach reduces development overhead, ensuring that changes made on one platform reflect seamlessly on the other. The support from the growing Flutter community and the availability of comprehensive documentation added to its appeal. While React Native and Xamarin have their merits, my decision to opt for Flutter was influenced by Dart's efficiency, Flutter's widget-based architecture for UI consistency, and the productivity gains offered by the "hot reload" feature. The framework's single codebase advantage and the support from a vibrant community aligned well with the project's goals, making Flutter the optimal choice for this cross-platform application. (15)

### 2.3.4 Backend Framework

When considering backend technologies for a cross-platform application, various options exist, each with distinct strengths. Popular choices include Express.js with Node.js, Django with Python, Spring Boot with Java, Ruby on Rails, ASP.NET, and Firebase.

#### 2.3.4.1 Express.js with Node.js

Express.js with Node.js: Express.js is a lightweight and flexible framework built on Node.js, ideal for building scalable web and mobile applications. Its asynchronous nature makes it well-suited for real-time applications and microservices architectures, offering a robust solution for developers looking to leverage JavaScript skills. (16)

#### 2.3.4.2 Django with Python

Django with Python: Django, powered by Python, is renowned for its simplicity and readability. Its "batteries-included" philosophy provides a comprehensive set of features out of the box, making it efficient for rapid development, especially for projects with complex data models. Django's built-in admin panel, ORM, and security features contribute to its popularity. (17)

#### 2.3.4.3 Spring Boot with Java

Spring Boot with Java: Spring Boot is a robust framework for backend development, leveraging Java. Known for its convention-over-configuration approach, it simplifies development and ensures maintainability. Spring Boot is favoured for building scalable applications and seamlessly integrates with the broader Spring ecosystem. (18)

#### 2.3.4.4 Ruby on Rails

Ruby on Rails: Ruby on Rails is a web application framework based on the Ruby programming language. It is recognized for its developer-friendly syntax and convention over configuration principles, promoting rapid development. Ruby on Rails is often chosen for projects where simplicity and speed are paramount. (19)

#### 2.3.4.5 ASP.NET

ASP.NET: Developed by Microsoft, ASP.NET is a versatile backend framework suitable for building secure and scalable web applications. Its strong integration with the Microsoft ecosystem and the option to use C# or VB.NET make it a preferred choice for enterprises seeking robust solutions for web development. (20)

#### 2.3.4.6 Firebase

Firebase: Firebase, a comprehensive solution from Google, stands out for its full-stack capabilities. It includes services like Realtime Database, Authentication, and Cloud Functions. Firebase's seamless integration with Flutter, the chosen frontend framework, ensures synchronized data updates across devices in real-time, making it a powerful choice for cross-platform applications.

#### 2.3.4.7 Selection (Firebase)

In my case, the decision tilted towards Firebase, a comprehensive solution from Google. Firebase not only stood out for its real-time database and secure authentication but also for its exceptional synergy with Flutter, the chosen frontend framework. The seamless integration between Firebase and Flutter will significantly streamline the development process, as both technologies are designed to work harmoniously together. Firebase's real-time features align well with Flutter's reactive nature, making it an ideal choice for ensuring synchronized data updates across devices in real-time.

The Firebase-Flutter combination offers a cohesive development experience, with Firebase providing a robust backend and Flutter delivering a consistent UI across platforms. This interoperability played a crucial role in the decision, as it facilitated a more efficient and unified development workflow for the cross-platform application. While options like Express.js, Django, Spring Boot, Ruby on Rails, and ASP.NET are noteworthy, Firebase's exceptional compatibility with Flutter became a decisive factor. The combined strengths of Firebase and Flutter ensured a streamlined development process and a harmonious integration between the backend and frontend of the cross-platform application. (21)

## 2.4. Other Research you’ve done

### 2.4.1 Mental Health & Psychotherapy

#### 2.4.1.1 Technology and the Future of Mental Health Treatment

“How is technology used for mental health treatment?

Technology has opened a new frontier in mental health care and data collection. Mobile devices like cell phones, smartphones, and tablets are giving the public, health care providers, and researchers new ways to access help, monitor progress, and increase understanding of mental well-being.

Mobile mental health support can be very simple but effective. For example, anyone with a phone or computer can call, text, or chat the 988 Suicide and Crisis Lifeline at any time.”

<https://www.nimh.nih.gov/health/topics/technology-and-the-future-of-mental-health-treatment>

#### 2.4.1.2 Do mental health mobile apps work: evidence and recommendations for designing high-efficacy mental health mobile apps by Pooja Chandrashekar

### 2.4.2 Machine Learning

#### 2.4.2.1 Natural Language Processing Models

#### 2.4.2.1.1 BERT

#### 2.4.2.1.2 Llama

#### 2.4.2.1.3 ChatGPT

#### 2.4.2.2 Sentiment Analysis

#### 2.4.2.3 Mental Health Datasets for AI research

## 2.5. Existing Final Year Projects

During the course of this project, some past projects were researched and one in particular stood out as being closely related to the problem domain of this project. Suaimhneas: A responsive web application for anxiety management and wellbeing by Ben McCormack (2023), which set out to investigate the best way to create an application that would allow users to use wellbeing and mindfulness techniques to better manage their anxiety. The outcome of the project was the development of a feature rich and responsive web application that is helping users manage their anxiety and allows mental health professionals to monitor their progress. The user management system and goal setting feature are particularly interesting, and this project may draw inspiration during the development stage.

Another past project that was researched is

## 2.6. Conclusions

# 3. System Design

## 3.1.Introduction

In this chapter, we will discuss the design of the system and research conducted on the relevant types of software development methodologies, design patterns and selections for this project. The system architecture will be explained and presented with the use of a high level architecture diagram, class diagrams, sequence diagrams and corresponding use cases.

## 3.2. Software Methodology

### 3.2.1 Agile

### 3.2.2 Waterfall

### 3.2.3 DevOps

### 3.2.4 Extreme Programming (XP)

### 3.2.5 Feature Driven Development (FDD)

## 3.3. Overview of System

A diagram of a computer

Description automatically generated

Figure 3 - High Level Architecture Map

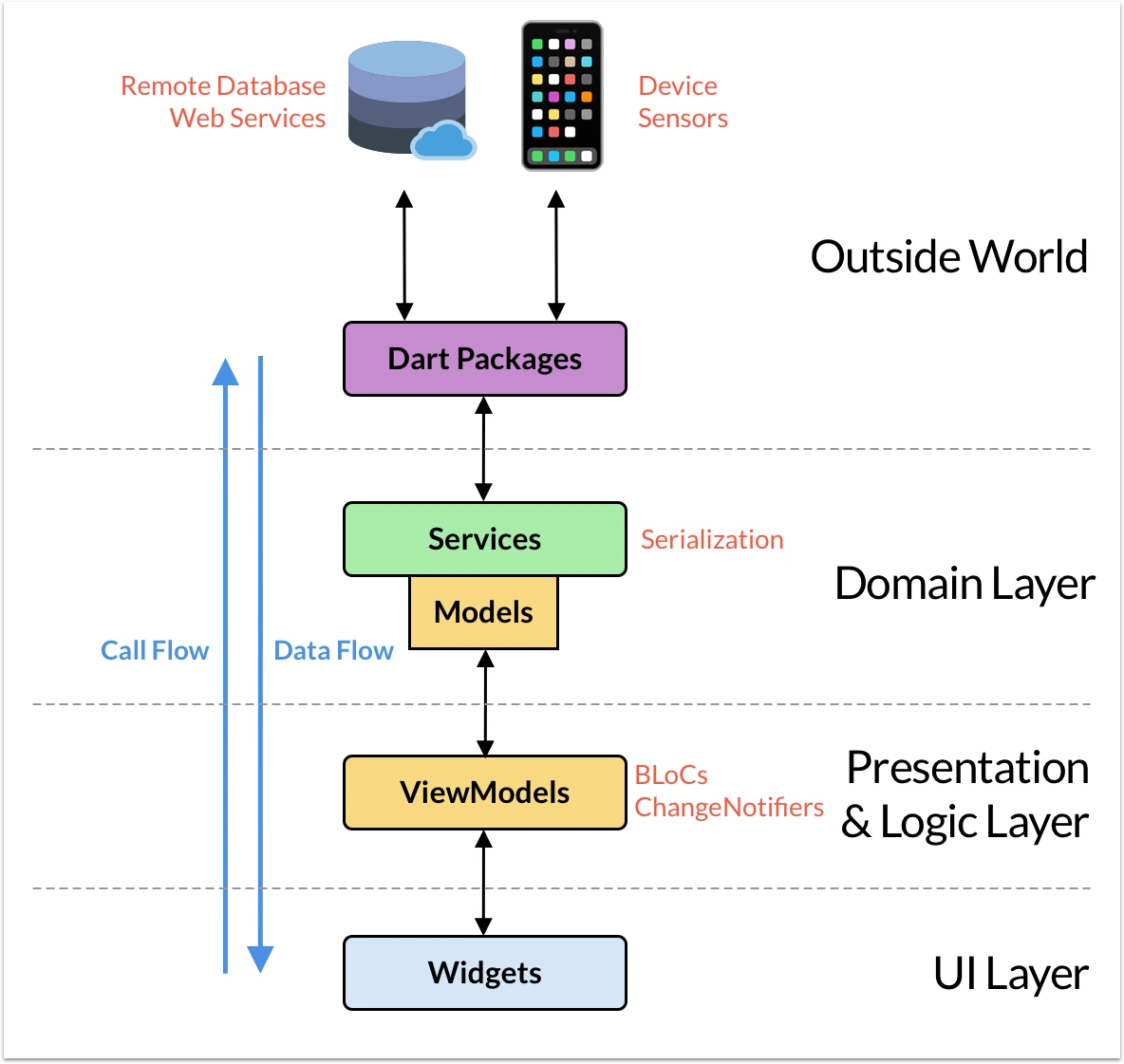


Figure 4 - Flutter Application Layers

## 3.X. Other Sections

## 3.X. Conclusions

# 4. Testing and Evaluation

## 4.1. Introduction

Testing and evaluation play a crucial role in the software development process, in which steps are taken to ensure that the application will function as intended and to iron out as many issues as possible in order to produce a polished and refined software system. In some software development methodologies, testing is integrated as part of the development process in a continuous manner, such as in DevOps methodology of continuous integration and continuous delivery (CI/CD). Testing can be extremely time consuming when performed manually or ad-hoc, which may be ok for smaller projects but for larger systems and for scalability, automated testing is crucial to the success of the system. There are various forms of testing strategies such as unit testing, in which individual components of a software system are tested in isolation with automated tests, but this is just one of many options when planning for a testing strategy and we will discuss in more depth the different testing options in the following sections.

## 4.2. Plan for Testing

There are an abundance of options that need to be examined when it comes to testing strategies in software development, with some being more suitable for our application than others, and certain aspects of testing need strong consideration to ensure good performance and solid security measures. Various strategies will be defined, explored, and selected for our testing plan.

### 4.2.1 Unit Testing

### 4.2.2 Integration Testing

### 4.2.3 Functional Testing

### 4.2.4 Regression Testing

### 4.2.5 Performance Testing

### 4.2.6 User Acceptance Testing (UAT)

### 4.2.7 Security Testing

### 4.2.8 Usability Testing

### 4.2.9 Smoke Testing

### 4.2.10 Exploratory Testing

### 4.2.11 Selected testing strategies

With flutter there are 3 categories for which automated testing falls, unit tests, widget tests (i.e. component test) and integration tests. According to flutter documentation, a well-tested application will have many unit and widget tests which are then tracked by code coverage (a software engineering concept which is defined as a percentage measure of the degree to which the source code of a program is executed when a particular set of tests are executed), along with enough integration tests to cover all important use cases.

## 4.3. Plan for Evaluation

### 4.3.1 Nielsens Heuristic Evaluation

Based on Jakob Nielsen's usability heuristics, it involves expert evaluators assessing the user interface against a set of 10 predefined usability principles which are:

1. Visibility of system status – Keeping users informed about what is happening.
2. Match between system and the real world – Matching the user’s language based on region, follow real-world conventions.
3. User control and freedom – Provide easy ways to undo actions and escape from errors.
4. Consistency and standards – Follow platform conventions, maintain uniformity.
5. Error prevention – Anticipate user errors and prevent them where possible.
6. Recognition rather than recall – Minimize users memory load, make actions and options visible.
7. Flexibility and efficiency of use – Cater to both novice and expert users.
8. Aesthetic and minimalist design – Present only essential information, no extraneous details.
9. Help users recognize, diagnose, and recover from errors – Offer clear, concise error messages and guidance.
10. Help and documentation – Provide relevant, accessible information to assist users.

A screenshot of a computer

Description automatically generated

Figure 5 - Nielsens 10 Heuristics (22)

### 4.3.2 Benchmark Testing

### 4.3.3 User Surveys and Feedback

### 4.3.4 Usability Testing

### 4.3.5 Feature Analysis

### 4.3.6 Cost-Benefit Analysis

### 4.3.7 Compliance Testing

### 4.3.8 Scalability Testing

### 4.3.9 Reliability Testing

### 4.3.10 Accessibility Testing

### 4.3.11 Selected Evaluation Strategies

## 4.4. Conclusions

# 5. Prototype Development

**As least 2 pages, but as many as you like (but lots of code samples).**

## 5.1. Introduction

## 5.2. Prototype Development

## 5.3. Other Sections

## 5.4. Conclusions

# 6. Issues and Future Work

## 6.1. Introduction

## 6.2. Issues and Risks

## 6.3. Plans and Future Work

### 6.3.1. GANTT Chart

A screenshot of a project

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