# Student Mental Well-Being Monitoring System: Integrating Wearable Technology and Mobile Application

by

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A thesis submitted in partial fulfillment of the requirements for the degree of
Bachelor of Electronic Engineering Technology (Electronic Network Design)

**Faculty of Electronic Engineering & Technology**
**UNIVERSITI MALAYSIA PERLIS**

2025

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## ACKNOWLEDGEMENT

First and foremost, I am deeply thankful to Allah SWT for granting me the strength, patience, and perseverance to successfully complete this thesis, titled "*Student Mental Well-Being Monitoring System: Integrating Wearable Technology and Mobile Application*." Without His guidance and blessings, this journey would not have been possible.

I would like to express my sincere appreciation to my supervisor, Ts Dr Rohani Mohamed Farook, for her continuous support, expert guidance, and valuable feedback throughout the duration of this project. Her encouragement and insight have been instrumental in the successful development of this work.

A heartfelt thank you goes to my family, whose love, understanding, and motivation have been a constant source of support throughout my academic path.

I am also grateful to all lecturers and staff members of the faculty for their assistance and for fostering a conducive and collaborative learning environment. Special thanks to those who facilitated online sessions via Google Meet, which helped maintain steady progress during the research process.

To my friends and fellow students, thank you for your cooperation, encouragement, and advice, which have helped me navigate the challenges of this project.

Lastly, I would like to acknowledge everyone who contributed directly or indirectly to the completion of the Student Mental Well-Being Monitoring System. Your support and contributions are truly appreciated and will always be remembered.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| HRV | Heart Rate Variability |
| SDLC | Software Development Life Cycle |
| UX | User Experience |
| PK | Primary Key |
| FK | Foreign Key |
| BLE | Bluetooth Low Energy |
| API | Application Programming Interface |
| BPM | Beats Per Minute |
| BMI | Body Mass Inder |
| mmHg | Millimeters of Mercury |

# LIST OF SYMBOLS

**Sistem Pemantauan Kesejahteraan Mental Pelajar: Integrasi Teknologi Boleh Pakai dan Aplikasi Mudah Alih**

## ABSTRAK

Isu kesihatan mental dalam kalangan pelajar universiti—seperti tekanan, kebimbangan, kemurungan, dan keletihan emosi—semakin membimbangkan dan memberi kesan besar terhadap prestasi akademik, kesejahteraan emosi, serta fungsi harian pelajar. Situasi ini menjadi lebih buruk apabila sistem sokongan tradisional tidak mampu memberikan intervensi yang tepat pada masanya disebabkan oleh kekurangan sumber dan pemantauan yang tidak efektif. Sebagai respons terhadap isu ini, projek ini membangunkan *Sistem Pemantauan Kesejahteraan Mental Pelajar*, satu penyelesaian bersepadu yang menggunakan teknologi boleh pakai (wearable) dan aplikasi mudah alih untuk memantau serta menyokong kesihatan mental pelajar secara masa nyata.

Sistem ini menggunakan peranti boleh pakai seperti jam tangan pintar untuk mengumpul data fisiologi dan tingkah laku secara berterusan, termasuk variabiliti kadar degupan jantung, corak tidur, tahap aktiviti fizikal, dan penunjuk tekanan. Data ini akan dihantar ke aplikasi mudah alih—yang dibangunkan untuk platform Android dan iOS—yang berfungsi sebagai antara muka utama bagi pelajar. Melalui aplikasi ini, pelajar boleh menjejak emosi mereka, menerima maklum balas peribadi, melakukan refleksi kendiri, dan menetapkan matlamat kesejahteraan. Aplikasi ini juga menyediakan visualisasi serta ringkasan data yang mudah difahami untuk membantu pelajar melihat corak dan trend kesihatan mental mereka dari semasa ke semasa. Selain itu, sistem ini membenarkan para pendidik dan profesional kesihatan mental (dengan kebenaran pelajar) untuk mengakses ringkasan data bagi tujuan pengesanan awal dan intervensi proaktif.

Projek ini memberi fokus kepada dua tujuan utama: memperkasakan pelajar untuk mengurus kesejahteraan mental mereka secara aktif dan menyediakan data bermakna kepada pihak profesional untuk sokongan yang lebih efektif. Privasi data, etika penggunaan, dan kebolehcapaian merupakan aspek utama yang ditekankan dalam reka bentuk sistem ini. Walaupun sistem ini mempunyai kekangan dari segi ketepatan peranti boleh pakai pengguna dan kebergantungan kepada penglibatan aktif pelajar, ia tetap menyediakan satu pendekatan yang praktikal dan berpotensi tinggi untuk meningkatkan kesejahteraan mental di institusi pendidikan.

Selaras dengan Matlamat Pembangunan Mampan 3 (Kesihatan dan Kesejahteraan yang Baik), *Sistem Pemantauan Kesejahteraan Mental Pelajar* bertujuan untuk merevolusikan pendekatan terhadap kesihatan mental di institusi pengajian tinggi. Dengan menggabungkan pemantauan masa nyata, maklum balas peribadi, dan sokongan profesional dalam satu platform mesra pengguna, projek ini beraspirasi untuk mewujudkan persekitaran pembelajaran yang lebih sihat, responsif, dan menyokong kesejahteraan mental pelajar secara menyeluruh.

**Student Mental Well-Being Monitoring System: Integrating Wearable Technology and Mobile Application**

## ABSTRACT

Mental health issues among university students—such as stress, anxiety, depression, and burnout—are becoming increasingly widespread and pose serious challenges to academic performance, emotional well-being, and daily functioning. These issues are often intensified by the limited availability of mental health resources and the inability of traditional support systems to offer timely and personalized intervention. In response to this growing concern, this project proposes the development of the *Student Mental Well-Being Monitoring System*, an integrated solution that leverages wearable technology and a mobile application to monitor and support student mental health in real time.

The system utilizes wearable devices such as smartwatches to collect continuous physiological and behavioral data, including heart rate variability, sleep patterns, physical activity, and stress indicators. This data is then transmitted to a mobile application—developed for both Android and iOS—which serves as the central interface for students. Through the app, students can track their mood, receive personalized feedback, engage in self-reflection, and set wellness goals. The application also features simple, interactive visualizations and summaries that help students understand their mental health trends over time. Additionally, the system allows educators and mental health professionals (with user consent) to access anonymized or summarized insights to support early identification of at-risk individuals and enable proactive intervention strategies.

The project focuses on a dual-purpose approach: empowering students to take charge of their mental wellness while equipping professionals with meaningful data to guide their support efforts. Data privacy, ethical use, and accessibility are key principles embedded into the system design. While the solution is limited by the accuracy of consumer-grade wearables and the need for regular student engagement with the app, it still presents a practical and scalable approach to improving mental health outcomes within educational settings.

Aligned with Sustainable Development Goal 3 (Good Health and Well-Being), the *Student Mental Well-Being Monitoring System* aims to transform how mental health is addressed in universities. By combining real-time monitoring, personalized insights, and professional support features into one user-friendly platform, this project aspires to cultivate a more supportive, responsive, and mentally healthy academic environment for students.

# CHAPTER 1 : INTRODUCTION

## 1.1 Project Background

Stress, anxiety, burnout, and other mental health issues among students are rather common and affect both personal well-being and academic performance. Restricted availability of timely mental health services delays some treatments and worsens the situation. Students face increasing anxiety during academic pressures (Fu et al., 2021). Incorporating a wearable device and a mobile application to monitor and promote mental performance of students' real-time wellness, the new system—the Student Mental Well-Being Monitoring System—would provide an innovative solution to this problem. This is a project that aims at providing students with customized self-management tools and offering teachers and mental health professionals data-driven insights to enable proactive support.

The system is designed to collect physiological and behavioural data such as heart rate variability, sleep patterns, level of activity, and stress indicators through portable gadgets such as smartwatches. It has been created for both iOS and Android. These devices feed data into a cross-platform mobile application that serves as the core user interface. By self-tracking their mood, drafting wellness plans, and receiving personalized recommendations, students are able to develop greater self-awareness and adopt healthy practices (Wang et al., 2021). The simple app architecture ensures inclusivity and accessibility for all users.

Examining the collected information, refined machine learning algorithms project patterns and detect abnormalities that may indicate changes in mental health. The system generates visualisations and targeted alerts for professionals and teachers, assisting in early identification and timely intervention. This dual focus on professional support and student empowerment creates a comprehensive mental health approach. The project is geared toward fostering a positive learning environment where students are equipped to thrive, with mental well-being placed as a top priority. Aligned with Sustainable Development Goal 3 (Good Health and Well-Being), the *Student Mental Well-Being Monitoring System* seeks to revolutionize mental health care in schools. By combining technology, analytics, and user-centered design, it aims to enhance student resilience, improve academic outcomes, and set a new standard for mental wellness support in education.

## 1.2 Problem Statement

- Mental health issues like stress, anxiety, and depression are rising among students, harming their academic performance and well-being. Traditional support systems often lack timely intervention due to limited resources.

- Existing methods for monitoring mental health do not provide real-time, data-driven insights, making it hard for educators and professionals to detect early signs and offer personalized support.

- Students lack accessible tools to actively manage their mental health, leaving them disconnected from their well-being data and support resources.

## 1.3 Objectives

Below are the project objectives:

- To design a system by creating a mobile app integrated with existing smartwatches to monitor students' mental well-being in real time, providing personalized feedback and insights for educators and professionals.

- To build an interactive and easy-to-use platform that motivates students to regularly monitor their mental health.

- To evaluate the system's in supporting mental well-being monitoring for students.

## 1.4 Scope / Limitation

The Student Mental Well-Being Monitoring System is aimed at helping university students better understand and manage their mental health through the use of wearable devices and a mobile application. The system will comprise the choice of wearable devices that can quantify major physiological parameters, including heart rate, sleeps, body activities, and stress rating. The data collected by these devices will be monitored continuously, although this data will be transferred to a mobile application which is the central hub where the students can view and engage well-being data. Other functions that will be incorporated in the app will involve mood logging, daily check-ins, and goals to set and achieve personally to facilitate active reflection of oneself.

Furthermore, the system will deliver feedback and information according to defined criteria and limits provided by implemented mental health study and the recommendations of recognized specialists. The insights will be presented in easy-to-read and understandable charts and summaries in order to set patterns as time goes by and help not only the students but also the educators to reach them. The project will accommodate many types of user roles and its users are the students as its main user and the educator/mental health professionals as an optional user who will have access to general trends to assist them in early intervention. Moral aspects of user acceptance, data security, and privacy will also be underlined in the whole design of the system to guarantee positive use of the personal information.

The few limitations affecting the performance and accuracy of this project are discussed. The information obtained under the wearable devices (including heart rate or sleep patterns), relies on the quality of the devices. Such devices are not always accurate, in particular, when they are not of a medical grade. Moreover, the system also presupposes that students track and continuously record their mood and actively use the app. In case the students forget or fail to use the app, the information can be partial and less valuable.

The system is also limited in how it processes and responds to data. It only provides general feedback and alerts based on simple rules, such as low activity or poor sleep, rather than detailed or personalized advice. The app needs an internet connection to sync data and show up-to-date trends, which may not always be available. Finally, while basic privacy steps will be taken, the system may not fully meet strict data protection rules due to the scope of a student-level project.

## 1.5 Summary

Mental health issues such as stress, anxiety, and depression are becoming more common among university students. These challenges often affect their academic performance, daily functioning, and overall well-being. However, traditional mental health support systems are often limited and may not provide timely intervention due to a lack of resources or delayed detection.

To address this gap, this project proposes a system that combines wearable technology and a mobile application to monitor and support student mental well-being. The wearable device collects physiological data such as heart rate, sleep patterns, physical activity, and stress indicators. This data is sent to the mobile app, where students can view their well-being trends, log their mood, and receive basic feedback.

The system also allows educators and mental health professionals to access summarized trends (with student consent) to help identify students who may need additional support. The feedback and alert mechanisms are based on expert-recommended thresholds from mental health research, rather than AI or automated predictions. This ensures the system remains practical and realistic for a student-level project while still being useful and informative.

Overall, the project aims to provide a simple, user-friendly, and informative platform that encourages students to engage with their mental health. It also supports early awareness and intervention through basic visualizations helping both students and professionals work together toward improved mental wellness in educational settings.

# CHAPTER 2 : LITERATURE REVIEW

## 2.1 Introduction

Mental health has become a growing concern in higher education, with increasing reports of stress, anxiety, depression, and burnout among university students. Traditional support systems often fall short in offering timely, personalized intervention. Recent advancements in wearable technology and mobile health (mHealth) applications have enabled new possibilities for real-time mental health monitoring and support. This literature review explores previous studies and technologies related to mental health tracking using wearable sensors, mobile applications, and integrated digital health systems. It also examines the effectiveness, challenges, and ethical considerations of such systems in academic environments.

## 2.2 Student Mental Well-Being Monitoring System

The *Student Mental Well-Being Monitoring System* is designed to assist university students in monitoring and managing their mental health through wearable technology and a cross-platform mobile application (Long et al., 2022). The system offers a structured and consistent approach by providing students with real-time access to their well-being data (Alhamada & Badron, 2024), replacing traditional methods that rely mainly on self-awareness or delayed support from counselors. Key features include mood tracking, biometric data monitoring (such as heart rate and sleep patterns), and basic feedback to encourage better mental health awareness (Bakker et al., 2016). Mood tracking is a key feature in modern mental health apps and allows users to reflect on their emotional fluctuations (Gaikwad et al., 2024).

This project specifically targets mental health concerns within academic environments, where students often face emotional pressure and high workloads. The system includes mood check-ins, task reminders, and visual summaries that allow students to reflect on their emotional patterns over time. Studies have shown that regular emotional self-assessment and early support can reduce stress and improve well-being and academic outcomes (Ismail et al., 2023; Tan et al., 2024). However, many students lack tools that are simple, engaging, and accessible for daily use, which this system aims to address.

The application is developed using React Native to support both Android and iOS platforms, with JavaScript as the primary programming language. Android Studio and Xcode are used for development and testing on their respective devices. For real-time data storage, user authentication, and data synchronization, the system integrates Firebase, allowing students to securely access their information across multiple devices. The app also includes limited offline functionality, enabling users to log essential information even without internet access. By combining data from wearable devices with a user-friendly mobile interface, the system supports proactive mental health management and promotes early detection of emotional irregularities. Wearable sensors play a crucial role in this process by continuously tracking physiological indicators related to stress and well-being (Sano, 2016). Moreover, wearable technology has significantly advanced healthcare applications, making it highly suitable for mental health monitoring in academic environments (Wu & Luo, 2019).

## 2.3 Related Works

This chapter reviews previous studies and existing technologies related to student mental health monitoring, focusing on key areas such as wearable devices, mobile mental health applications, mood tracking techniques, and real-time biometric data analysis. Mobile applications have been developed to raise mental health awareness and promote emotional support among students (Faraday & Martin, 2014). It also includes research and tools that support emotional self-awareness and early intervention strategies in educational settings. Mobile apps enhance user engagement through intuitive interfaces and personalized experiences, making them an effective medium for delivering mental health support (Bakker et al., 2016). These related works provide a strong foundation and justification for developing a mobile-based mental well-being monitoring system that helps students improve self-management, receive timely support, and promote overall mental wellness in academic life.

### 2.3.1 Alhamada & Badron (2024) – Development of a Mobile Application for Effective Mental Health Intervention

Recent advancements in mobile health (mHealth) technologies have enabled the development of innovative solutions to support mental health interventions. One notable study by researchers (J. Electrical Systems, 2024) introduced a mobile-based mental health prevention system that integrates evidence-based therapeutic practices with modern app development frameworks. Their project centers around a mobile application designed using React Native, emphasizing Cognitive Behavioral Therapy (CBT) and Mindfulness as core psychological approaches to guide user experience and therapeutic interaction.

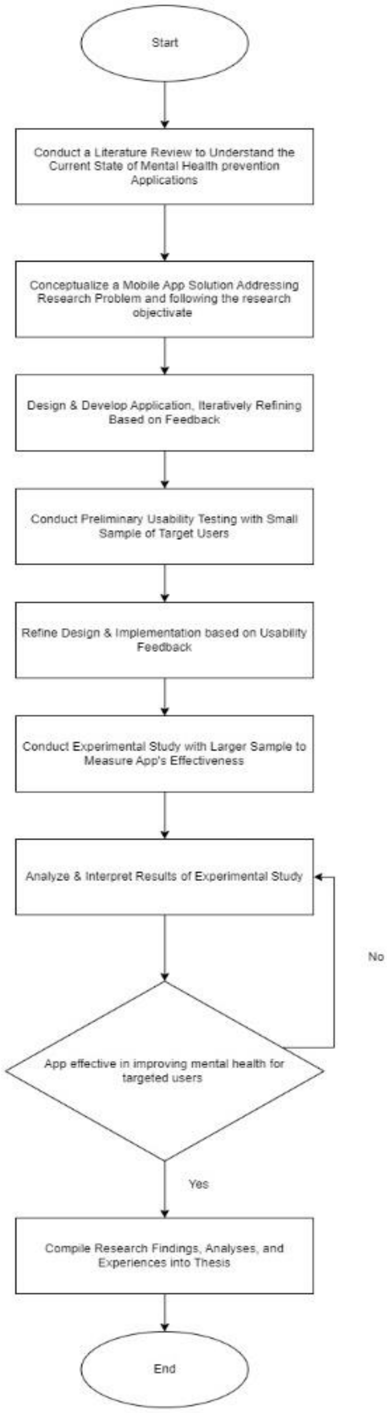


Figure 2.1 Proposed model of system by Alhamada & Badron (2024)

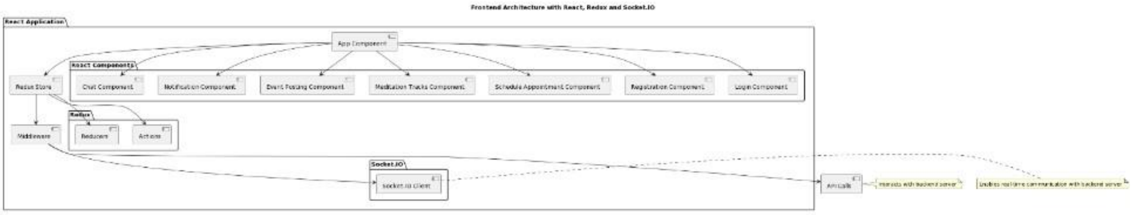


Figure 2.2 Front End Architecture by Alhamada & Badron (2024)

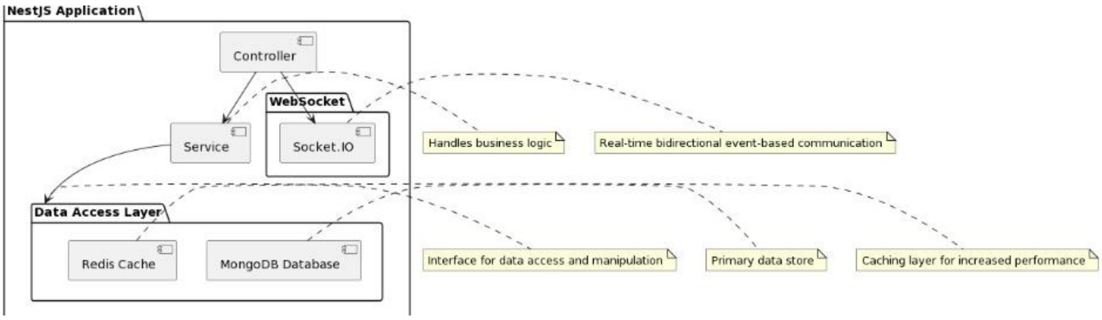


Figure 2.3 Back End Architecture by Alhamada & Badron (2024)

The system architecture proposed in the study demonstrates a comprehensive and scalable framework. It comprises a React-based Admin Dashboard, a React Native end-user application, and a NestJS-powered back-end, hosted on Amazon Web Services (AWS) and integrated with Firebase for functionalities like push notifications and third-party user authentication. Notably, the combination of REST APIs for static content and a Publish/Subscribe (Pub/Sub) model for real-time features like chat and alerts presents a hybrid backend communication strategy that prioritizes both stability and responsiveness—particularly relevant for time-sensitive mental health interactions.

Their development approach is grounded in User-Centered Design (UCD) principles. Iterative prototyping and validation via user interviews, focus groups, and usability testing were carried out to ensure the system effectively addresses user needs. This mirrors the importance of emotional and psychological sensitivity in interface design, where the user’s emotional state, stress levels, and perception of ease-of-use directly impact the app's effectiveness.

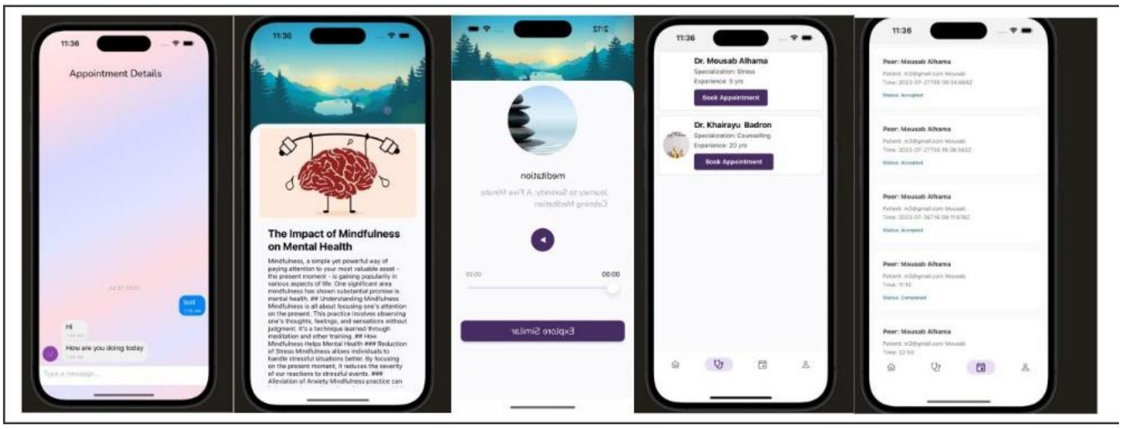


Figure 2.4 Mobile App Interfaces by Alhamada & Badron (2024)

Among the key features of their mobile app are modules such as "Blogs", providing curated mental health content, "Tracks Listening" for guided meditation sessions, a "Chat" system for real-time interactions with professionals or AI, and "Booking and Appointments" to streamline expert consultations. These features demonstrate a holistic approach to prevention and early intervention, combining educational resources, therapeutic engagement, and immediate access to professional help.

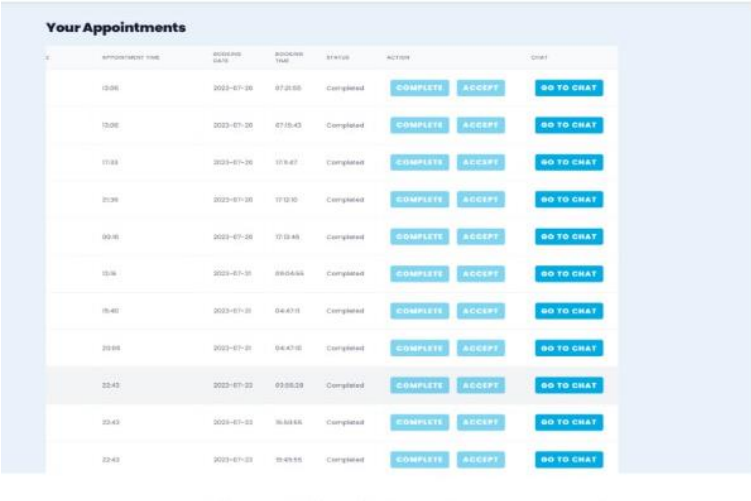


Figure 2.5 Appointment Management by Alhamada & Badron (2024)

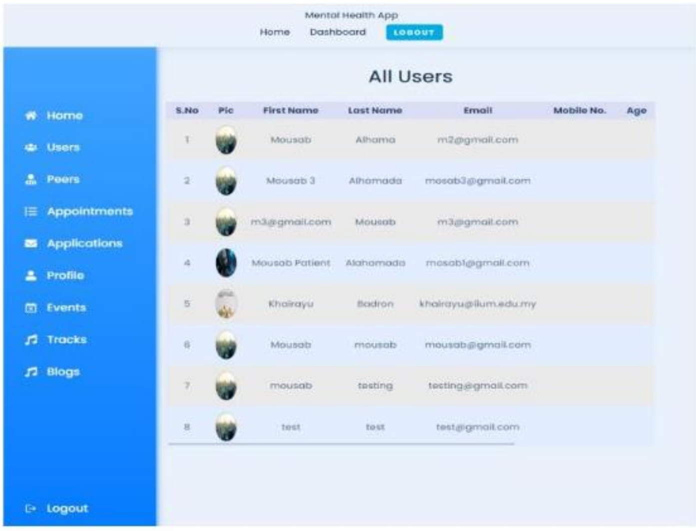


Figure 2.6 Admin Dashboard by Alhamada & Badron (2024)

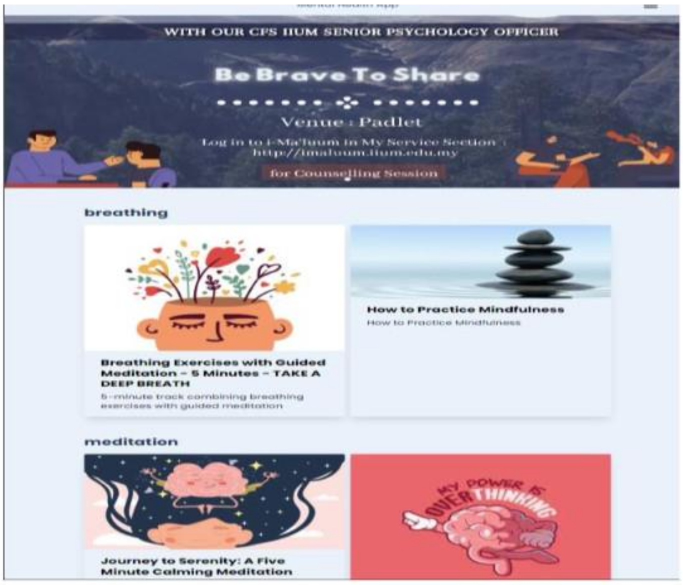


Figure 2.7 Main Page by Alhamada & Badron (2024)

The study also highlights the significance of cross-platform support, including a web version with identical functionalities and additional administrative controls. This extension allows peers and professionals to manage appointments and oversee system usage more effectively.

In conclusion, the work reviewed demonstrates how modern mobile and cloud-based technologies can be effectively utilized to deliver mental health support at scale. It provides a strong foundation for this current research project, which also aims to integrate wearable sensor data with mobile applications to monitor and enhance students' mental well-being. By drawing inspiration from these frameworks and methodologies, the current project builds upon proven practices while extending its application through real-time physiological data integration, thus offering a more personalized and proactive mental health monitoring solution.

### 2.3.2 Hernandez Rivera et al. (2019) – Motion-Based Heart Rate Evaluation Framework

Hernandez Rivera et al. (2019) proposed a motion-based heart rate evaluation framework using wearable technology in real-world workplace settings. Their study, titled *“Wearable Motion-Based Heart Rate at Rest: A Workplace Evaluation,”* published in the *IEEE Journal of Biomedical and Health Informatics*, focused on accurately estimating heart rate at rest by filtering out motion-induced noise—a common challenge in continuous physiological monitoring. The system utilized wrist-worn devices to gather heart rate data while participants carried out typical office tasks, allowing the team to assess the effectiveness of motion correction algorithms in real-life, non-laboratory conditions.

Although the study did not directly address mental health outcomes, it highlighted the potential of wearables to provide reliable biometric data passively throughout the day. This foundation is crucial for mental well-being systems, as heart rate variability is a known physiological marker of stress and emotional regulation. Unlike systems such as the *Student Mental Well-Being Monitoring System*, which integrates both emotional and behavioral data, the Hernandez Rivera et al. framework remains focused on enhancing the accuracy and usability of biometric measurements in dynamic environments.

By improving baseline physiological monitoring, this study contributes to future developments in stress-aware systems that rely on wearable devices for mental health support.

### 2.3.3 Bakker et al. (2016) – Mental Health Smartphone Apps: Review and Evidence-Based Recommendations

**Table 1.** Currently available iOS apps compared across recommended features.

| App | Recommended feature[a] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| AnxietyCoach | ✔ | ✘ | ✘ | ✔[b] | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ |
| Behavioral Experiments | ✔ | ✔ | ✘ | ✘ | ✔ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ |
| Breathe | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✔[c] | ✔ | ✔ | ✘ |
| DBT Diary Card and Skills Coach | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ | ✔[c] | ✘ | ✘ | ✘ |
| Depression Prevention | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ |
| Happify | ✘ | ✔ | ✔ | ✔[b] | ✘ | ✔ | ✔ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ |
| HealthyHabits | ✘ | ✔ | ✔ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ |
| HealthyMinds | ✔ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✔ | ✔[c] | ✔ | ✔ | ✘ |
| HIAF | ✘ | ✘ | ✔ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✘ | ✔ | ✘ |
| iCouch CBT | ✔ | ✔ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ |
| iCounselor[f] | ✔ | ✘ | ✘ | ✘ | ✔ | ✔ | ✘ | ✔ | ✔[d] | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ |
| iMoodJournal | ✘ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✘ | ✘ |
| In Hand | ✘ | ✔ | ✔ | ✘ | ✔ | ✔ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✘ |
| MindShift | ✔ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ |
| MoodKit | ✔ | ✔ | ✘ | ✘ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ | ✘ | ✔ | ✔[c] | ✘ | ✘ | ✘ |
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| Moody Me | ✘ | ✘ | ✔ | ✘ | ✔ | ✘ | ✔[e] | ✘ | ✘ | ✘ | ✘ | ✔ | ✔[c] | ✔ | ✘ | ✘ |
| Pacifica | ✔ | ✘ | ✔ | ✘ | ✔ | ✔ | ✘ | ✔ | ✔ | ✔ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ |
| Pocket CBT | ✔ | ✔ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ |
| SAM | ✔ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ |
| Smiling Mind | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✘ | ✔ | ✔ | ✘ |
| Stress & Anxiety Companion | ✔ | ✘ | ✔ | ✘ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✔ | ✘ | ✘ |
| SuperBetter | ✘ | ✔ | ✔ | ✔[b] | ✘ | ✔ | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ | ✘ |
| ThinkHappy | ✘ | ✔ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ |
| What's Up? | ✔ | ✔ | ✔ | ✘ | ✘ | ✔ | ✔ | ✔ | ✘ | ✔ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ |
| WorkOut | ✔ | ✔ | ✔ | ✘ | ✔ | ✔ | ✘ | ✘ | ✔ | ✔ | ✘ | | ✔[c] | ✔ | ✘ | ✘ |
| WorryTime | ✔ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✔ | ✘ | ✘ | ✘ | ✘ | ✔ | ✔ | ✔ | ✘ |

Figure 2.8 Table of Review Application by Bakker et al. (2016)

The Bakker, Kazantzis, Rickwood, and Rickard (2016) conducted an in-depth review of the state of mental health smartphone applications, analyzing both their therapeutic scope and empirical support. Published in *JMIR Mental Health*, the paper categorized existing apps into intervention types such as mindfulness, mood tracking, self-monitoring, psychoeducation, and CBT-based tools. Through a systematic analysis of app functionalities and scientific rigor, the authors identified a growing disconnect between app popularity and their clinical efficacy. Most apps lacked scientific validation, and only a small percentage were found to be grounded in peer-reviewed evidence or formal psychological frameworks.

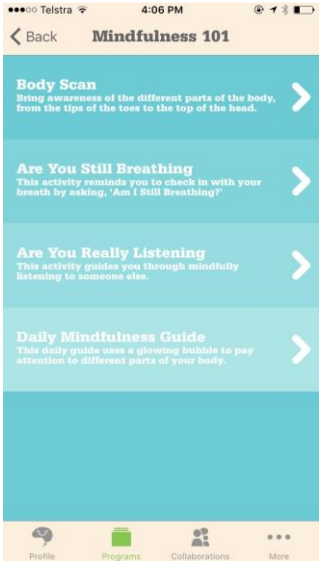



Figure 2.9 Smiling Mind by Bakker et al. (2016)

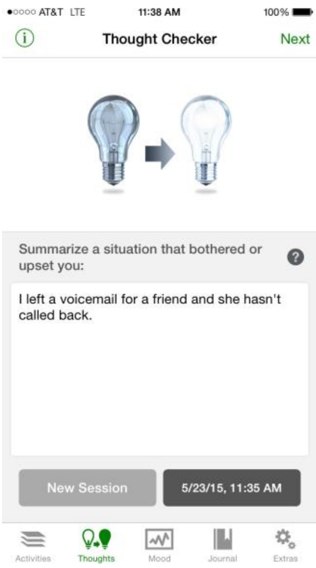



Figure 2.10 Moodkit by Bakker et al. (2016)


Figure 2.11 Smiling Mind displaying achievements by Bakker et al. (2016)

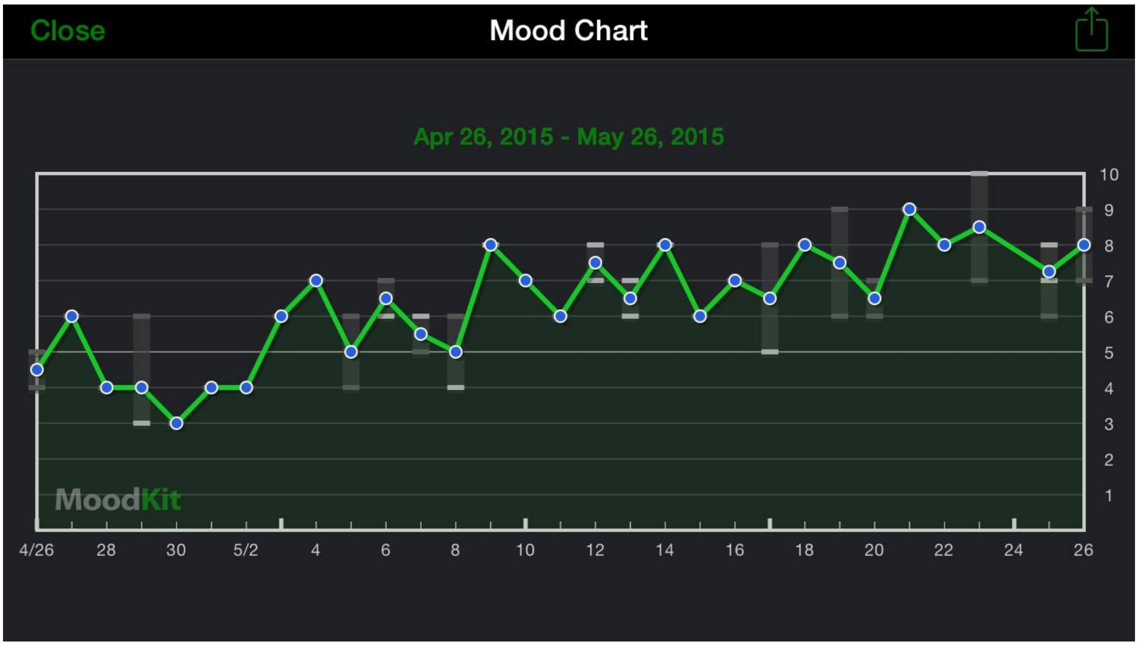



Figure 2.12 Moodkit displaying mood chart by Bakker et al. (2016)

The study offered several recommendations for improving future app development. These included the incorporation of validated psychological techniques, adaptive user feedback systems, personalization algorithms based on user input, and long-term engagement strategies. Moreover, Bakker et al. stressed the importance of integrating mobile apps with broader health systems and professional mental health services rather than treating them as standalone tools. The authors advocated for co-design processes involving mental health experts, developers, and users to ensure that digital interventions are not only technically feasible but also clinically effective and ethically sound. This review serves as a foundational reference for any research or development initiative involving mental health technologies, emphasizing the need for scientific grounding and ethical responsibility.

**Table 2.** Recommendations for future mental health apps.

| Evidence | Recommendation | Details |
|---|---|---|
| Demonstrably effective, but more research needed in MHapp field | 1. Cognitive behavioral therapy based | Start with an evidence-based framework to maximize effectiveness |
| | 2. Address both anxiety and low mood | Increases accessibility and addresses comorbidity between anxiety and depression. Also compatible with transdiagnostic theories of anxiety and depression |
| Probably effective, but more research needed in MHapp field | 3. Designed for use by nonclinical populations | Avoiding diagnostic labels reduces stigma, increases accessibility, and enables preventative use |
| | 4. Automated tailoring | Tailored interventions are more efficacious than is rigid self-help |
| | 5. Reporting of thoughts, feelings, or behaviors | Self-monitoring and self-reflection to promote psychological growth and enable progress evaluation |
| | 6. Recommend activities | Behavioral activation to boost self-efficacy and repertoire of coping skills |
| | 7. Mental health information | Develop mental health literacy |
| | 8. Real-time engagement | Allows users to use in moments in which they are experiencing distress for optimum benefits of coping behaviors and relaxation techniques |
| Supported by theory and indirect evidence but focused research needed | 9. Activities explicitly linked to specific reported mood problems | Enhances understanding of cause-and-effect relationship between actions and emotions |
| | 10. Encourage nontechnology-based activities | Helps to avoid potential problems with attention, increase opportunities for mindfulness, and limit time spent on devices |
| | 11. Gamification and intrinsic motivation to engage | Encourage use of the app via rewards and internal triggers, and positive reinforcement and behavioral conditioning. Also links with flourishing |
| | 12. Log of past app use | Encourage use of the app through personal investment. Internal triggers for repeated engagement |
| | 13. Reminders to engage | External triggers for engagement |
| | 14. Simple and intuitive interface and interactions | Reduce confusion and disengagement in users |
| | 15. Links to crisis support services | Helps users who are in crisis to seek help |
| Necessary for validation of principles | 16. Experimental trials to establish efficacy | It is important to establish the app's own efficacy before recommending it as an effective intervention |

Figure 2.13 Recommendations for future mental health apps by Bakker et al. (2016)

### 2.3.4 Faraday & Martin (2014) – Mental Health Awareness Building via Android Application

| | Android ✓ | Apple |
|---|---|---|
| User Friendly | X | X |
| Open Source | X | |
| Versatile Software | X | |
| Nonrestrictive App Policies | X | |
| Entry Level Access | X | |
| Learning Resources | More | Fewer |

Figure 2.14 Android vs. iPhone Decision Matrix by Faraday & Martin (2014)

Faraday and Martin (2014) designed and implemented an Android-based mobile application focused on increasing mental health awareness among university students. Published in the *Journal of Undergraduate Research at Minnesota State University, Mankato*, their work addressed a fundamental yet often overlooked aspect of mental health interventions: the lack of awareness and education among youth. The app included a variety of interactive features, such as daily mental health tips, quiz modules to test psychological knowledge, and emergency resource links. It aimed to foster early recognition of mental health symptoms and promote stigma reduction.

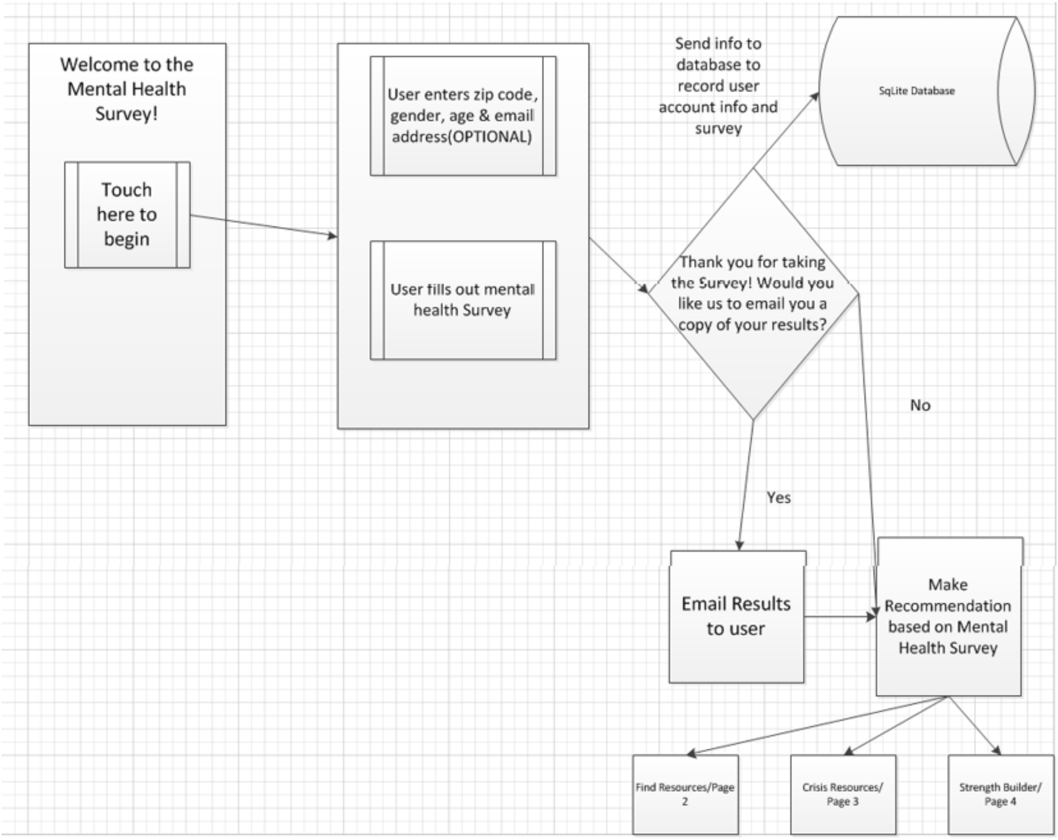



Figure 2.15 Flow of the Survey Screen and Decision Making by Faraday & Martin (2014)

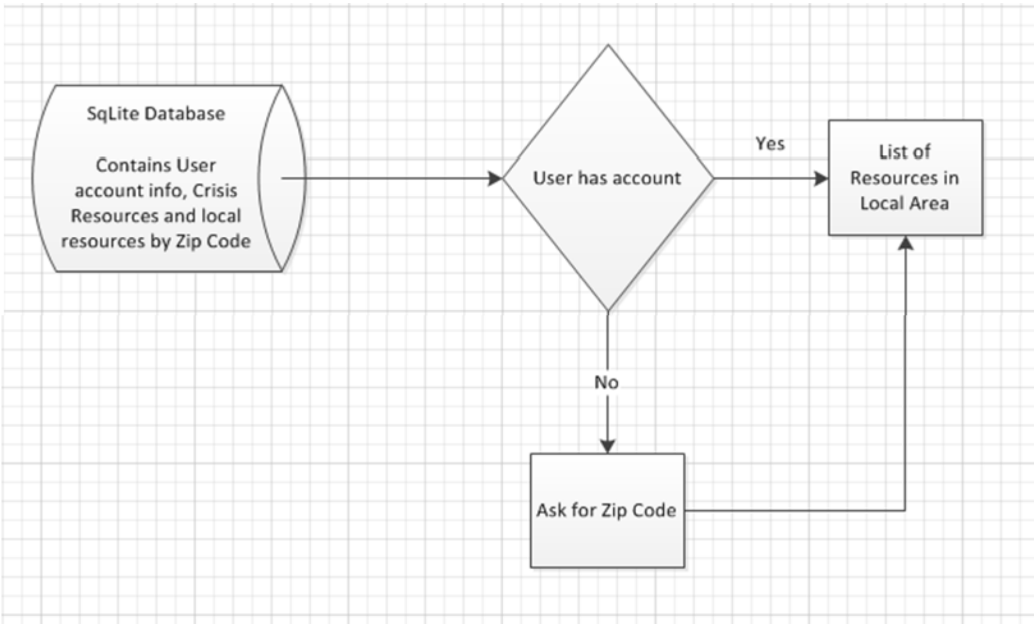



Figure 2.16 Flow of the Find Resources Screen by Faraday & Martin (2014)

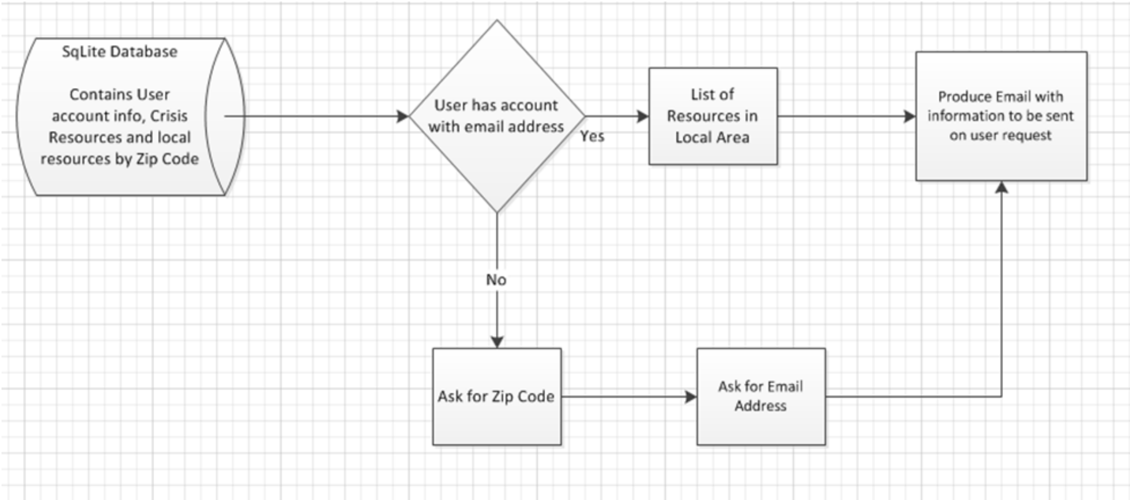



Figure 2.17 Flow of the Crisis Resources screen and Decision-Making Process by Faraday & Martin (2014)

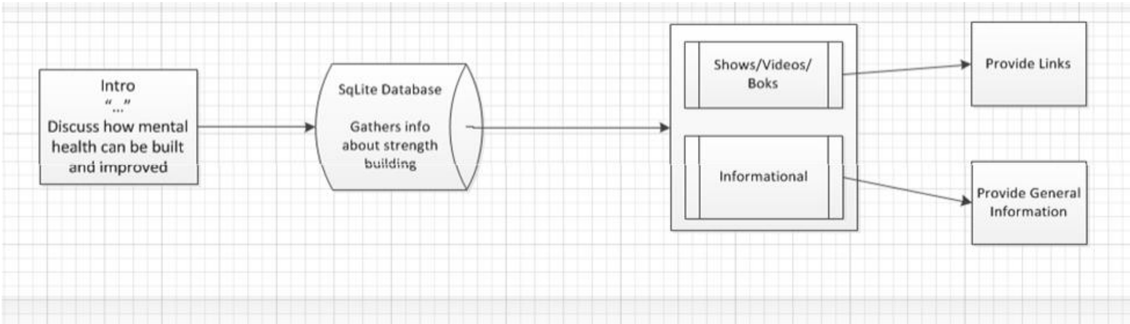



Figure 2.18 Flow of the strength Builder Screen by Faraday & Martin (2014)

The development process involved collaboration with student groups and campus counseling services to align the content with actual student experiences and needs. Faraday and Martin emphasized simplicity and accessibility, opting for a minimalistic design to cater to users unfamiliar with mental health terminology. The app's evaluation, based on surveys and focus groups, revealed a positive impact on students' awareness levels and willingness to engage with mental health resources. Although the app did not provide clinical interventions, its preventative and educational approach is a valuable contribution to public health strategies. Their study illustrates how even basic mobile technologies, when thoughtfully designed, can significantly influence mental health literacy among young populations.


Figure 2.19 Home Screen App by Faraday & Martin (2014)

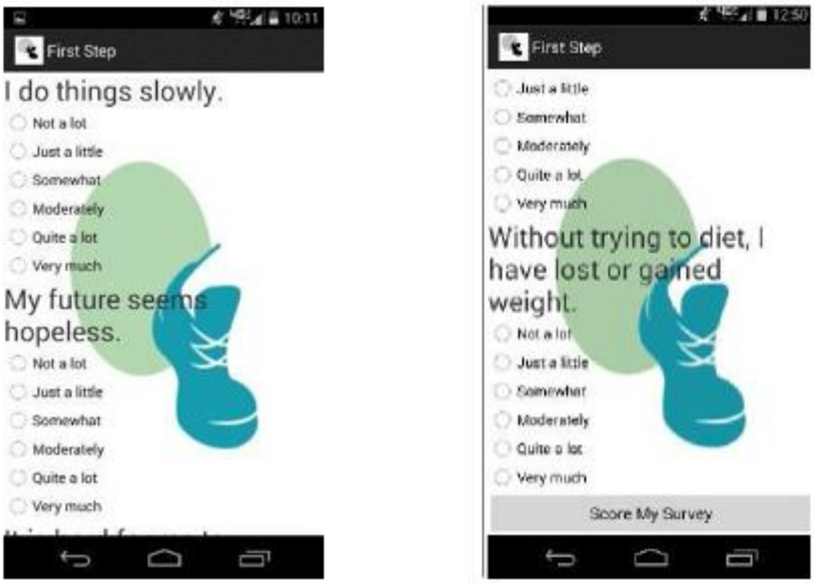



Figure 2.20 Survey Screen top (left), bottom (Right) by Faraday & Martin (2014)


Figure 2.21 Results and Recommendations of Survey by Faraday & Martin (2014)


Figure 2.22 Brain Health Resources Screen by Faraday & Martin (2014)

Figure 2.23 : Figure 12: Color Scheme Decision (top left) by Faraday & Martin (2014)

| **User Survey** | Strongly Agree | | Neutral | | Strongly Disagree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| The App is easy to use. | 84.6% | 7.7% | 0% | 0% | 7.7% |
| The App has a calming feel to it. | 53.9% | 23.1% | 15.4% | 0% | 7.7% |
| I feel tense or anxious using the App. | 7.7% | 7.7% | 0% | 23.1% | 61.5% |
| The results of the questionnaire were helpful to me. | 53.9% | 0% | 38.5% | 0% | 7.7% |
| The local resources listed were clear and concise. | 53.9% | 23.1% | 15.4% | 0% | 7.7% |
| I don't think there were any useful resources provided. | 7.7% | 0% | 30.8% | 7.7% | 53.9% |
| I would recommend this App to a friend who may have questions about mental health. | 53.9% | 38.5% | 0% | 0% | 7.7% |

Opened-ended Questions:
-Did you find any bugs or problems in the App? What were they?
-What ideas do you have for improving the App?
-Any additional comments?

Figure 2.24 User survey and results by Faraday & Martin (2014)

### 2.3.5 Gaikwad et al. (2024) – Mindful Meadows: A Mental Health App

Mindful Meadows is a mobile application introduced by Gaikwad et al. in the 2024 IEEE ICCUBEA Conference, aimed at delivering holistic mental health support through a feature-rich, integrated platform. The app addresses key gaps in existing mental health solutions by combining assessments, therapy access, self-care tools, and AI-based emotional support within a secure and scalable ecosystem.

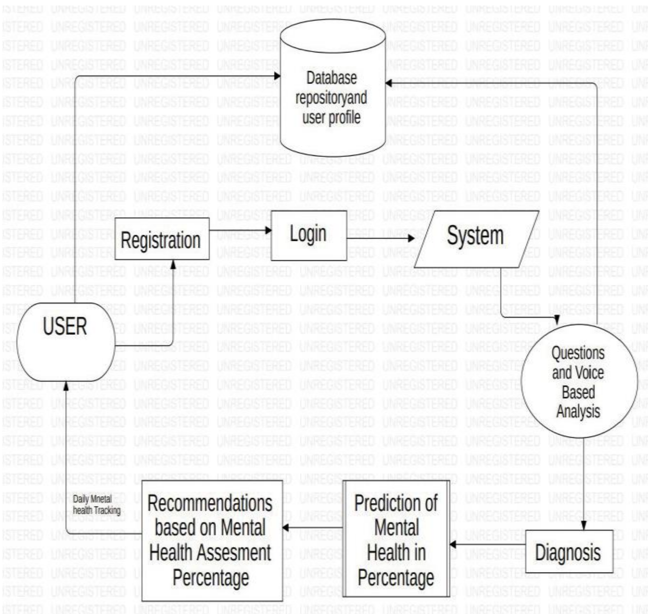



Figure 2.25 System Architecture of Mindful Meadows by Gaikwad et al. (2024)

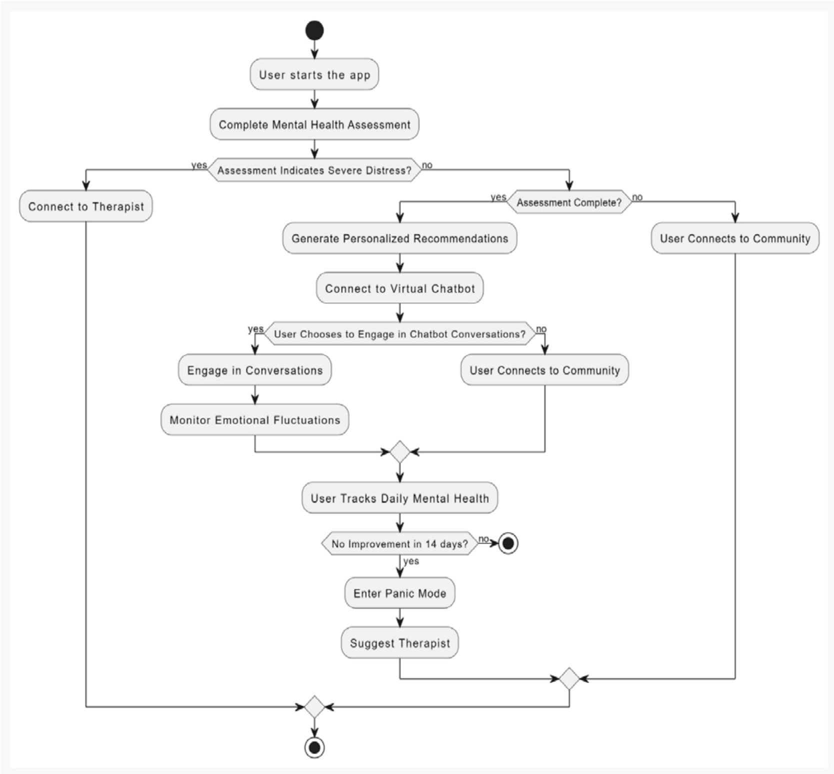


Figure 2.26 Activity Diagram by Gaikwad et al. (2024)

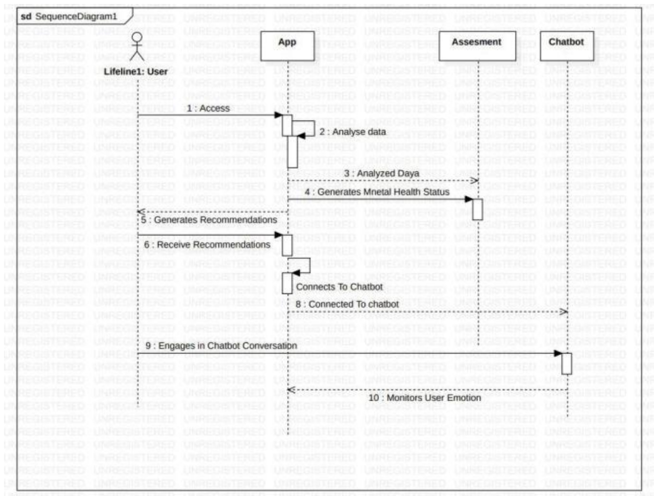


Figure 2.27 Sequence Diagram by Gaikwad et al. (2024)

The system architecture consists of a client-facing app, a secure server, external voice analysis services, and a privacy-focused database. It adopts a modular design, allowing for future expansion such as integration with wearables and health APIs. Key features include psychological assessments (e.g., depression, anxiety, bipolar disorder), personalized recommendations like mindfulness exercises and curated music, and the ability to book appointments with therapists directly from the app. A unique element is the AI chatbot, AURA-BOT, which provides confidential conversations using cognitive-behavioral strategies.

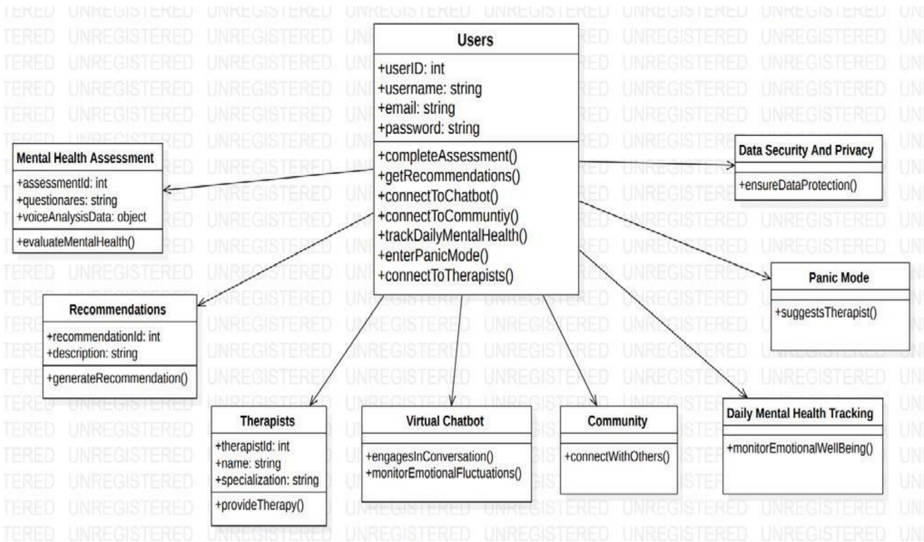



Figure 2.28 Class Diagram by Gaikwad et al. (2024)

The system architecture consists of a client-facing app, a secure server, external voice analysis services, and a privacy-focused database. It adopts a modular design, allowing for future expansion such as integration with wearables and health APIs. Key features include psychological assessments (e.g., depression, anxiety, bipolar disorder), personalized recommendations like mindfulness exercises and curated music, and the ability to book appointments with therapists directly from the app. A unique element is the AI chatbot, AURA-BOT, which provides confidential conversations using cognitive-behavioral strategies.

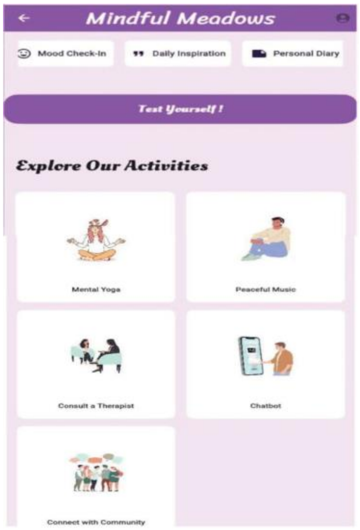



Figure 2.29 Dashboard App by Gaikwad et al. (2024)

The dashboard panel in Figure 29 displays app features such as "Mental Yoga," "Peaceful Music," "Consult a therapist," "Chatbot," and "Connect with Community," each of which represents a service that the app provides.


Figure 2.30 Depression Test Report by Gaikwad et al. (2024)

The "Test Report" panel in a mental health program is displayed in Figure 30. The "Severity of Disease" is marked as moderately impacted, and the "Total Score" is 13. The range of scores is also explained in the "Score Interpretation" section. The screen below offers instructional material with the title "What is Depression?" and a succinct explanation of the condition.

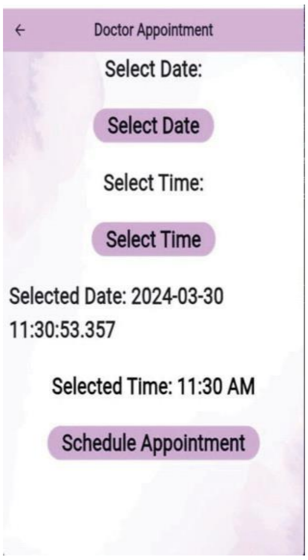




Figure 2.31 Dashboard Screen by Gaikwad et al. (2024)

A mobile application's "Doctor Appointment" scheduling interface is shown in Figure 13. The "Select Date" and "Select Time" buttons allow users to choose a time and day for their appointment. Below these options is a button that reads "Schedule Appointment," indicating that users can utilize this option to confirm their appointment details.

### 2.3.6 Wang et al. (2021, published 2023) – Investigating Mental Health App Usage During COVID-19

Wang, Markert, and Sasangohar (2021, originally published in 2023) conducted a behavioral analysis of popular mental health mobile application downloads and user activity during the COVID-19 pandemic. Appearing in *Human Factors*, their study leveraged app store data, user reviews, and app activity statistics to identify usage trends and functional preferences. The research highlighted a significant spike in downloads of apps related to stress relief, meditation, sleep assistance, and teletherapy during the pandemic's peak.

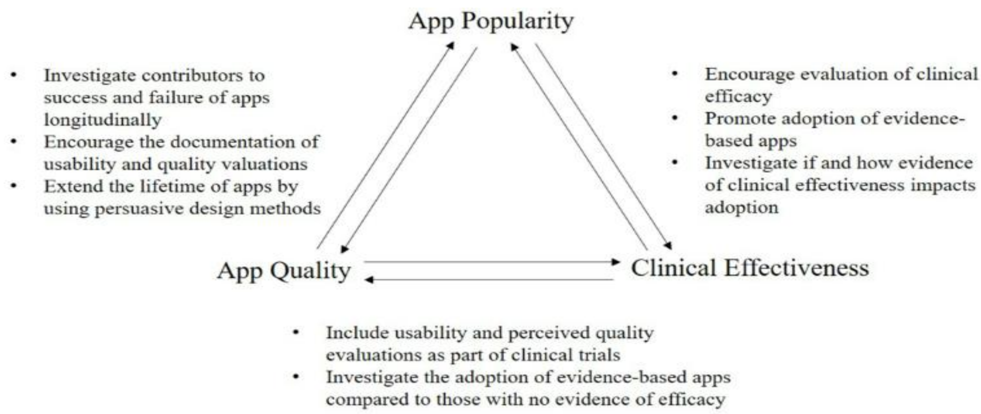



Figure 2.32 HFE’s role in bridging the three factors that affect the potential of mental mHealth apps by Wang et al.

Their analysis suggested that increased public awareness, heightened anxiety, and restricted access to in-person therapy were key factors driving the adoption of mobile mental health solutions. Importantly, the study found that users gravitated toward apps that offered immediate, on-demand support without requiring deep engagement or long onboarding processes. This reflects a shift toward more accessible, minimalist app design in times of crisis. Wang et al. also discussed the importance of sustained engagement, noting that while initial downloads surged, retention rates were often low unless apps incorporated adaptive feedback, gamification, or personalization. Their findings are critical for app developers seeking to design scalable solutions capable of supporting users during public health emergencies.

### 2.3.7 Matthews et al. (2008) – Designing Mobile Applications to Support Mental Health Interventions

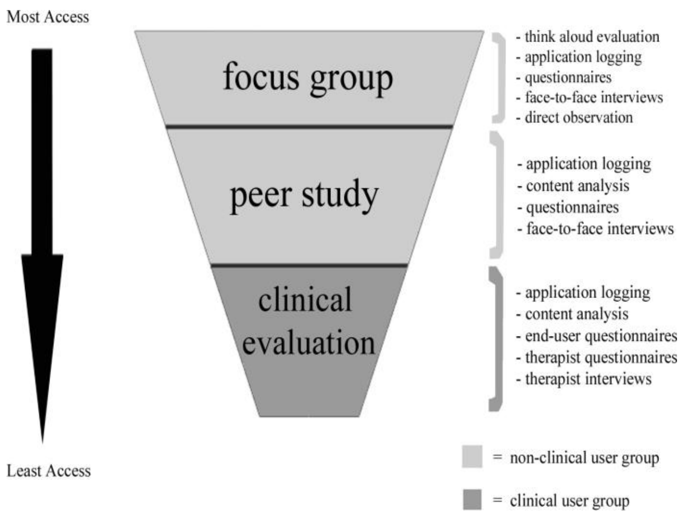



Figure 2.33 Three stage evaluation by Matthews et al. (2008)

Matthews, Doherty, Coyle, and Sharry (2008) provided early insights into the intersection of mobile technology and mental health therapy through their work in the *Handbook of Research on User Interface Design and Evaluation for Mobile Technology*. Their chapter discussed design strategies for creating mobile interventions that support both therapist-guided and self-guided mental health treatments. Drawing from clinical psychology and human-computer interaction, they proposed a framework for aligning mobile application interfaces with therapeutic goals.

| Date &Time | Energy How much energy do you have out of ten? (please put an 'X' on the scale) | Sleep How many hours did you sleep last night? | Mood How do you feel today out of ten? (please put an 'X' on the scale) | Diary – please describe how you feel today. |
|---|---|---|---|---|
| 1/05/06 10.15 | 1 2 3 4 5 6 7 8 X 10 very low very high | I slept __8__hours. | 1 2 3 4 5 6 7 8 9 X very low very happy | I feel great today, loads of energy. |
| | 1 2 3 4 5 6 7 8 9 10 very low very high | I slept ____hours. | 1 2 3 4 5 6 7 8 9 10 very low very happy | |

Figure 2.34 fragment of paper diary by Matthews et al. (2008)


Figure 2.35 Interface Mobile Mood Diary by Matthews et al. (2008)

The authors detailed case studies involving mobile-delivered CBT modules and adolescent therapy support apps, emphasizing usability testing, user feedback loops, and therapist integration. They argued that mobile applications can complement in-person therapy by enhancing engagement, supporting homework exercises, and improving the continuity of care. A notable strength of this work is its foresight in predicting the rise of mobile mental health tools long before the current digital health boom. Their principles—such as modular content delivery, personalization, and context-aware interfaces—remain foundational to today's mobile mental health application development and provide a theoretical backbone for ongoing innovations.

### 2.3.8 Prakash et al. (2025) – Android App for Managing Mental Health

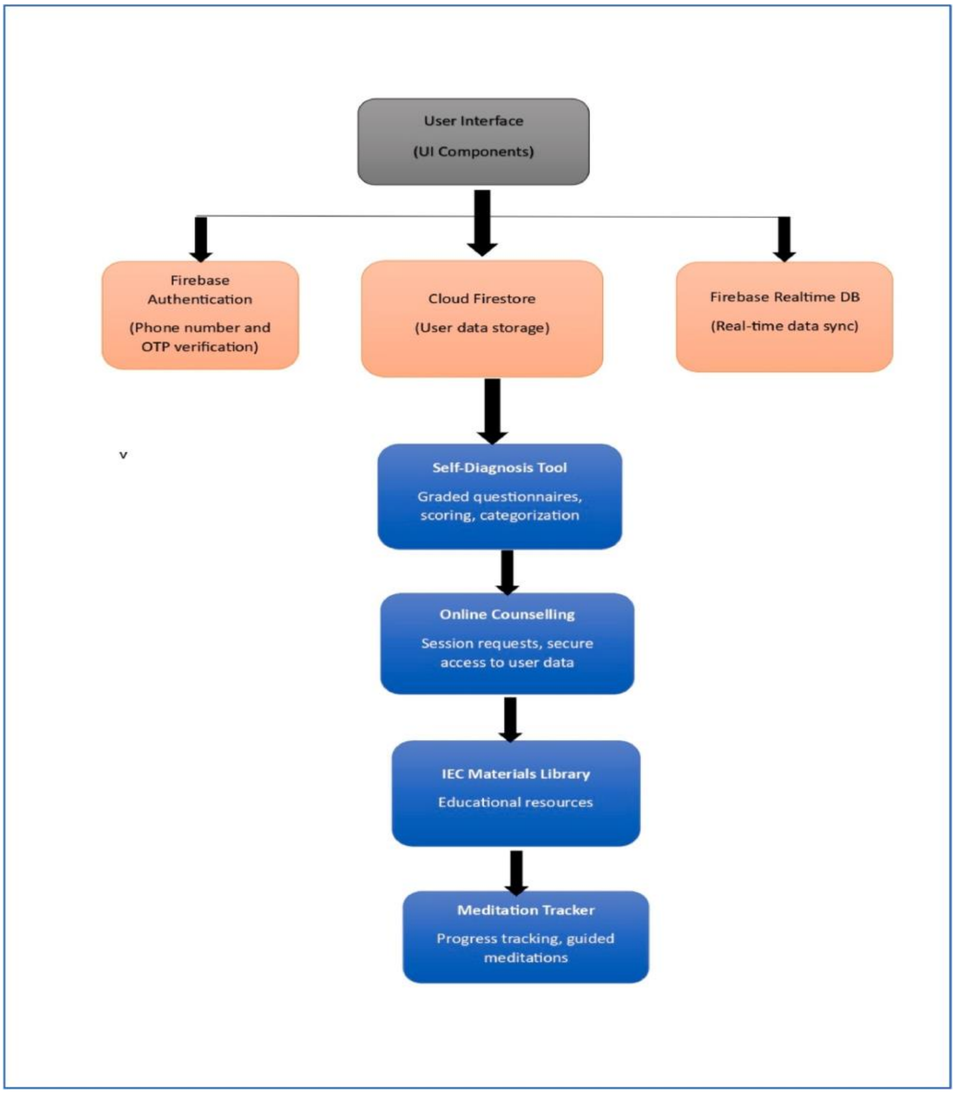



Figure 2.36 Phases development of the app by Prakash et al. (2025)

The Prakash, Kumar, Arun, Yadav, Gopi, and Garg (2025) developed and validated an Android-based mobile application aimed at assisting users in managing mental health conditions through self-monitoring and educational interventions. Published in *Clinical Epidemiology and Global Health*, their study detailed the app's architecture, which included symptom tracking, mental health screening tools, and access to cognitive restructuring exercises. The researchers conducted a validation study involving both mental health professionals and end-users to assess the app's reliability, user satisfaction, and therapeutic impact.

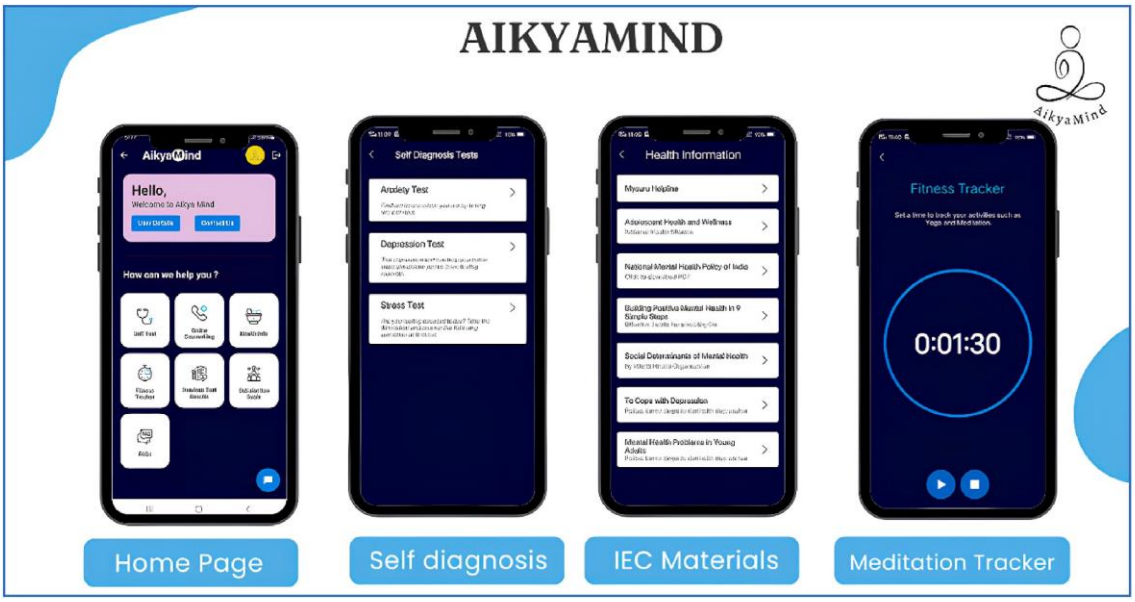



Figure 2.37 Interface of developed app by Prakash et al. (2025)

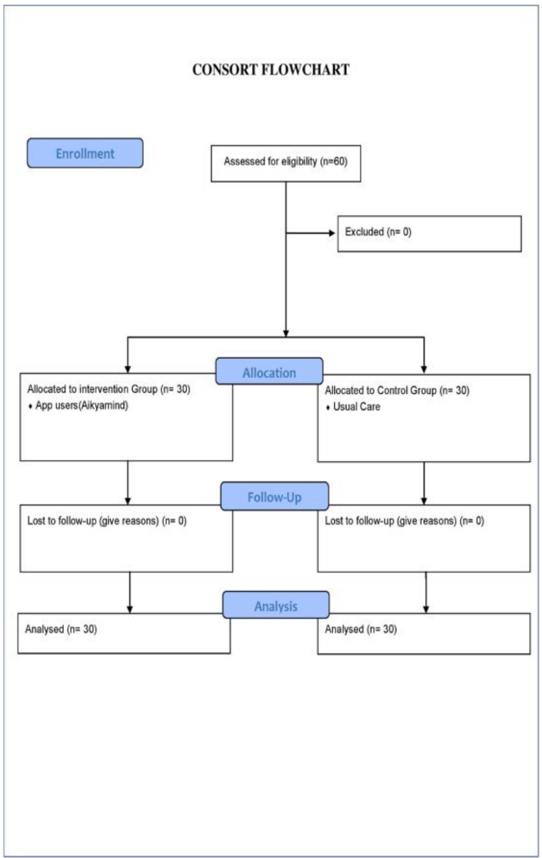



Figure 2.38 Data collection process in the validation of the app by Prakash et al. (2025)

| | | Groups | | | | chi-square | p-value |
|---|---|---|---|---|---|---|---|
| | | Experimental | | Control | | | |
| | | N | % | N | % | | |
| Gender | Male | 17 | 56.7 % | 14 | 46.7 % | 0.601 | 0.438 |
| | Female | 13 | 43.3 % | 16 | 53.3 % | | |
| Education Status | Class 9 | 15 | 50.0 % | 15 | 50.0 % | 26.615 | <0.001* |
| | Class 10 | 15 | 50.0 % | 15 | 50.0 % | | |
| Type of family | Nuclear Family | 22 | 73.3 % | 18 | 60.0 % | 2.400 | .301[b] |
| | Joint Family | 6 | 20.0 % | 6 | 20.0 % | | |
| | Three Generation Family | 2 | 6.7 % | 6 | 20.0 % | | |
| Socio-Economic Status (Rs/month) | 7008 ad above | 8 | 26.7 % | 3 | 10.0 % | 3.133 | 0.536 |
| | 3504 to 7007 | 6 | 20.0 % | 6 | 20.0 % | | |
| | 2102 to 3503 | 6 | 20.0 % | 7 | 23.3 % | | |
| | 1051 to 2101 | 5 | 16.7 % | 6 | 20.0 % | | |
| | Below 1051 | 5 | 16.7 % | 8 | 26.7 % | | |

Values are expressed as frequency and percentage. A chi-square test determines the p-value; a p-value of less than 0.05 is considered statistically significant.

Figure 2.39 Sociodemographic characteristics of the study participants by Prakash et al. (2025)

| Satisfaction Scores | Groups | | | | t-value | Mean difference | p-value |
|---|---|---|---|---|---|---|---|
| | Experimental | | Control | | | | |
| | Mean | SD | Mean | SD | | | |
| Bassline | 17.8 | 6.0 | 16.5 | 5.2 | 1.27 | 1.933 | 0.192 |
| After 1 month | 20.80 | 4.3 | 17.47 | 6.2 | 5.283 | 3.4 | 0.02 |

Values are expressed as mean and SD. An independent sample *t*-test determines the p-value; a p-value of less than 0.05 is considered statistically significant.

Figure 2.40 Comparison before and after app usage by Prakash et al. (2025)

### 2.3.9 Summary of Related Works

| Authors | Titles | Contributions | Advantages | Limitations |
|---|---|---|---|---|
| Alhamada & Badron (2024) | Development of a Mobile Application for Effective Mental Health Intervention | Developed a localized mental health app tailored to user needs in under-resourced contexts. | Culturally adaptive, privacy-focused, user-friendly design. | Lacks long-term clinical outcome validation. |
| Bakker et al. (2016) | Mental Health Smartphone Apps: Review and Evidence-Based Recommendations | Reviewed existing apps and proposed clinical integration and usability improvements. | Evidence-based recommendations; focus on personalization. | Most apps reviewed were not clinically validated. |
| Faraday & Martin (2014) | Mental Health Awareness Building via Android Application | Built an Android app to raise awareness among university students. | Increases literacy and reduces stigma; easy to use. | No clinical intervention or tracking features. |
| Fu et al. (2021) | Mobile Health Interventions for Mental Health Support During the COVID-19 Pandemic | Analyzed mHealth app effectiveness for students under pandemic stress. | Real-world data from lockdown scenarios; user feedback integrated. | Relies on self-reported data; short-term scope. |
| Gaikwad et al. (2024) | Mindful Meadows: A Mental Health App | Proposed a multi-feature mental wellness app using AI, journaling, and mindfulness. | Modular design; scalable; therapist dashboards. | Evaluation is limited to prototype and short trials. |
| Hernández Rivera (2019) | Wearable Motion-Based Heart Rate at Rest: A Workplace Evaluation | Evaluated accuracy of wearable heart rate monitoring in work environments. | Real-world sensor data; workplace relevance. | Affected by movement artifacts; limited generalizability. |
| Long et al. (2022) | A Scoping Review on Monitoring Mental Health Using Smart Wearable Devices | Mapped trends in wearable-based mental health monitoring research. | Comprehensive synthesis; highlights machine learning use. | Heterogeneous data; lack of standardization. |

| | | | | |
|---|---|---|---|---|
| Wang et al. (2021) | Investigating Mental Health App Usage During the COVID-19 Pandemic | Tracked download patterns and engagement of mental health apps. | Behavioral insights from large datasets. | Limited to metadata; lacks clinical outcomes. |
| Matthews et al. (2008) | Designing Mobile Applications to Support Mental Health Interventions | Proposed user interface and engagement principles for mental health apps. | Pioneering conceptual model; therapy-aligned design. | Dated tech context; limited empirical evaluation. |
| Nahum-Shani et al. (2020) | Just-in-Time Adaptive Interventions (JITAIs) in Mobile Health | Introduced the JITAI framework for real-time, context-aware intervention delivery. | High personalization; dynamic intervention logic. | Complex implementation; requires real-time data streams. |
| Prakash et al. (2025) | Development and Validation of Android Mobile Application in the Management of Mental Health | Developed and validated a CBT-based Android app for user self-care. | Scientifically validated; includes professional review. | Short trial period; region-specific context. |
| Sano (2016) | Measuring College Students' Sleep, Stress, Mental Health and Well-being with Wearable Sensors and Mobile Phones | Used wearables and smartphones for long-term stress and well-being tracking. | High data fidelity; predictive analytics; longitudinal scope. | Requires complex sensor setups; potential privacy concerns. |
| Wu & Luo (2019) | Wearable Technology Applications in Healthcare: A Literature Review | Reviewed wearable tech applications in healthcare including mental health. | Broad overview; practical applications in nursing and healthcare. | General scope; less focus on mental health specifically. |

In this context, the reviewed projects highlight various efforts to monitor and support mental health using wearable technology and mobile applications, particularly among student populations. These studies demonstrate the effectiveness of combining physiological data (such as heart rate, sleep, and activity levels) with mood tracking to detect early signs of stress, anxiety, or depression. While some systems excel in data collection or predictive modelling, they often lack features such as real-time feedback, educator involvement, or user engagement strategies.

The proposed *Student Mental Well-Being Monitoring System* builds upon the strengths of these previous works while addressing their limitations. By integrating wearables with a cross-platform mobile application, the system offers personalized insights, mood tracking, and basic trend analysis in a user-friendly interface. Unlike earlier projects that relied solely on machine learning or passive detection, this system emphasizes a balance between student self-awareness and professional intervention, aiming for a more practical, accessible, and ethically sound solution for supporting mental well-being in academic settings.

## 2.4 Research Technique

The development of the *Student Mental Well-Being Monitoring System* required a combination of software development tools, mobile frameworks, and testing platforms to ensure that the final product functioned seamlessly across devices while collecting and displaying data from wearable technologies. This section outlines the tools and environments used throughout the design and implementation process, including React Native, JavaScript, Firebase, Android Studio, Xcode, and Visual Studio Code. These research techniques were chosen to ensure cross-platform compatibility, scalability, and real-time interaction—essential aspects of a system designed to provide continuous mental well-being feedback to students and helpful insights to educators.

The system will build and test on macOS due to its flexibility in supporting both Android and iOS environments. The combination of wearable input, mood tracking, data visualization, and alerting mechanisms required robust frameworks and backend support. Therefore, careful planning was necessary to ensure that data collected from sensors or user input could be securely stored, processed, and displayed within the app. The development approach emphasized student usability, responsiveness, and smooth performance, considering that the target users are students who may have limited technical knowledge or attention span when using health-monitoring apps.

### 2.4.1 React Native and JavaScript Language

Figure 2.41 : JavaScript Logo

JavaScript was the primary programming language used to build the app logic, user interactions, and interface behaviors. Its asynchronous nature made it suitable for handling tasks such as retrieving data from the Firebase database and rendering graphs or feedback components in real time. Since JavaScript is widely supported and integrates well with third-party libraries, it allowed for quick integration of visual charting tools and responsive user interfaces. This helped create a modern and engaging mobile experience for students tracking their emotional well-being and for educators reviewing trend summaries.

Figure 2.42 : React Native Logo

React Native was selected as the core framework for developing the mobile application because of its ability to produce native-like performance while using a single codebase for both Android and iOS platforms. This choice was crucial for this project since the target users (university students) use a variety of mobile devices. Using React Native allowed for a consistent and smooth user experience across different operating systems without duplicating effort. The mood tracking features, data dashboards, and notification alerts were all implemented using React Native components, allowing rapid iteration and real-time previewing during development.

### 2.4.2 Firebase

Figure 2.43 : Firebase Logo

Firebase was implemented as the backend service for this project, offering essential services such as cloud storage, user authentication, and real-time database functionality. Its real-time syncing feature was vital for this project, allowing students' biometric or mood data to be instantly reflected in the app interface. Firebase Authentication was used to handle secure user login for students and restricted access for educators and mental health professionals, ensuring the right data visibility levels for each type of user.

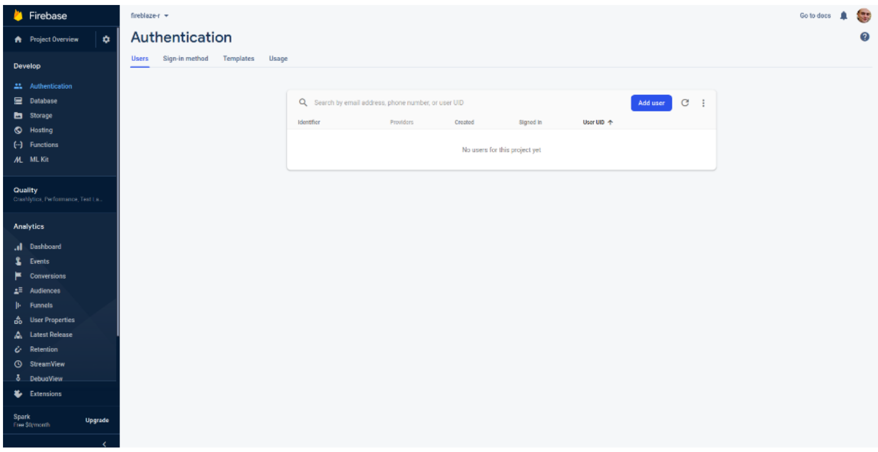



Figure 2.44 : Firebase Main Page

Additionally, Firestore—the NoSQL database service within Firebase—was used to store mood check-ins, wearable-generated values (such as stress indicators), and feedback messages. Firebase made it easy to manage collections of structured mental health data and generate insights for students and professionals. By using Firebase Hosting and Cloud Functions, automated alerts could be generated based on threshold values (e.g., if stress levels remain high for multiple days), supporting the goal of early intervention. Firebase's scalability also ensures that the app can support many users without performance issues, making it ideal for university-level deployments.

### 2.4.3 Android Studio for Android Testing

Figure 2.45 : Android Studio Logo

Android Studio was employed as the official development and testing environment for the Android version of the system. It was used to test the application on various Android devices and API levels to ensure compatibility with the wide range of phones used by students. The Android Emulator allowed for the simulation of different screen sizes, OS behaviors, and device conditions—such as low battery or offline scenarios—to see how the app would perform in real-world situations.

The use of Android Studio also helped to debug platform-specific issues that sometimes arise in cross-platform applications. For example, the behavior of notification alerts, sensor data integration from wearables, and file permissions were thoroughly tested using this tool. Since students might use budget or older Android phones, the app was optimized for lightweight performance and lower memory usage during testing on Android Studio, aligning with the project's usability objectives

### 2.4.4 Xcode for iOS Testing

Figure 2.46 : Xcode Logo

Xcode was used for testing the iOS version of the application. Since iOS applications require Apple's official development environment to simulate and debug apps, Xcode was installed and run on a macOS system. The iOS Simulator allowed testing on multiple virtual devices such as iPhone SE, iPhone 13, and iPhone 14 Pro to evaluate layout responsiveness, performance, and gesture-based navigation. This was critical for ensuring that iOS users—especially students using Apple devices—experienced the same app functionality as Android users.

iOS testing focused on key aspects such as permission handling (for health data access), background app behavior, and interface responsiveness under various memory and connectivity constraints. Xcode's Instruments tool helped measure memory and CPU usage, identifying potential issues with data-heavy screens such as the trend visualization page. Since educators may also use iPads, the app was tested for layout compatibility on larger screens. This made Xcode an essential tool in delivering a reliable and professional iOS version of the mental well-being monitoring app.

### 2.4.5 Visual Studio Code for Code Management

Figure 2.47 : Visual Studio Code Logo

Visual Studio Code (VS Code) was the primary code editor used during development. Its minimalist interface, integrated terminal, and extension support allowed for smooth and organized coding, especially when switching between React Native components, JavaScript logic, and Firebase configurations. The use of extensions like Prettier and ESLint ensured code consistency and reduced syntax errors across the development team. Git integration inside VS Code was also helpful for managing version control, especially when rolling back to previous states or collaborating between modules like mood tracking and educator alerts.

Moreover, VS Code provided real-time syntax highlighting, debugging support, and error detection, which helped speed up the development of features like mood logging forms, notification triggers, and dashboard displays. Since the system involved frequent communication between front-end elements and the Firebase backend, being able to test HTTP requests and review logs directly within VS Code improved productivity and accuracy. This tool formed the backbone of the coding process and helped maintain structured, readable, and testable code for this student-focused mental health system.

### 2.4.6 Summary

This project employed a combination of cross-platform mobile development tools and cloud-based services to build the *Student Mental Well-Being Monitoring System*. The research techniques were selected to ensure the system could support both Android and iOS platforms, handle real-time data collection from wearable devices, and offer an engaging and user-friendly interface for students. React Native was used as the core framework for mobile app development, supported by JavaScript for logic and interface behavior. These tools enabled rapid development and ensured a consistent experience across devices commonly used by university students.

Firebase was utilized to manage backend services such as authentication, data storage, and real-time synchronization of student mood logs and biometric data. Android Studio and Xcode served as the main testing environments for Android and iOS platforms respectively, allowing the team to simulate a variety of devices and ensure stable app performance. Visual Studio Code was the central code editor, supporting organized development and version control. Together, these research techniques ensured the system was scalable, reliable, and aligned with the real-world usage needs of students and educators involved in mental well-being monitoring.

# CHAPTER 3 : METHODOLOGY

## 3.1 Introduction

This chapter outlines the methodology followed in developing the *Student Mental Well-Being Monitoring System: Integrating Wearable Technology and Mobile Application*. The project was guided by the Software Development Life Cycle (SDLC), a structured model that breaks down the software development process into six essential stages: Requirement Analysis, System Design, Implementation, Testing, Deployment, and Maintenance. By following this model, the development process remained systematic, traceable, and adaptable to refinements at every stage. Each phase was crucial in ensuring the system met user expectations and could operate effectively across platforms, especially on Android and iOS devices.

The purpose of selecting SDLC was to guarantee a disciplined and iterative development process that could accommodate future improvements and be easily understood by other stakeholders or contributors. With the core focus on improving students' mental well-being through wearable integration and a cross-platform mobile application, SDLC ensured each function—from real-time mood tracking to visualizing mental health trends—was developed with consistency and purpose.

## 3.2 Methodology

This project uses the Software Development Life Cycle (SDLC) to guide the system development step by step. It ensures the app is built clearly from planning to testing.

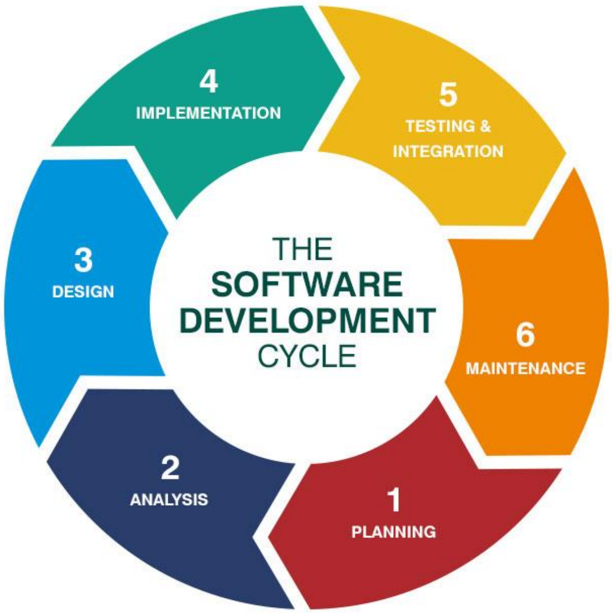



Figure 3.1 Software Development Life Cycle (SDLC)

The app was developed using React Native and JavaScript in Visual Studio Code. Testing was done with Android Studio and Xcode emulators. Firebase was used for data storage, authentication, and real-time updates. The system collects data from wearables and mood logs, then displays it in the app using simple charts.

### 3.2.1 Requirement Analysis

To The first and most critical step in the SDLC process was gathering and analyzing requirements. This involved identifying and understanding the needs of three main user groups: students (primary users), educators, and mental health professionals (secondary users). Several approaches were used to gather these requirements, including reviews of existing mental health research, case studies on similar wearable technologies, and informal interviews with students and faculty members.

Key insights from the research highlighted the need for features such as real-time biometric data monitoring, regular mood tracking, user-friendly interfaces, data visualization tools, and personalized feedback mechanisms (Matthews et al., 2008). Unlike commercial health apps, the system needed to be non-clinical in appearance but informative enough to be meaningful. It also had to handle user data ethically, avoiding sensitive diagnosis or AI-driven prediction to respect user trust and privacy.

The requirement phase also included specifying technical constraints and user expectations. Functional requirements such as real-time feedback, data input, secure authentication, and biometric integration were outlined. Non-functional requirements like responsiveness, cross-platform usability, low battery/resource consumption, and clear data visualization were equally emphasized.

Table 3.1 : Functional Requirements

| User Type | Feature | Requirement Description |
|---|---|---|
| Student | Login Access | Students must log in securely to access their personal dashboard. |
| | Smartwatch Connectivity | Students can connect a smartwatch via Bluetooth for real-time monitoring. |
| | Biometric Monitoring | System records heart rate, sleep patterns, stress levels, and activity. |
| | Mood Check-In | Students receive mood check-in prompts to record their emotional state. |
| | Goal Setting | Students can set mental health or wellness goals within the app. |
| | Personalized Feedback | Students receive feedback from educators based on mood and biometric data. |
| Educator | Login Access | Educators log in to access the admin dashboard. |
| | View Student List | Educators can view all registered students and their mental well-being status. |
| | Student Detail Access | Educators can select and review specific student’s data, goals, and trends. |
| | Alerts & Notifications | Educators can issue alerts or highlight risks based on analysis. |
| | Refer to Counselor | Educators can refer students to a counselor if risk is identified. |
| | Messaging System | Educators can send messages directly to students through the platform. |
| | Schedule Check-ins | Educators can set check-in schedules and add review notes for each student. |

Table 3.2 : Non-functional Requirements

| Category | Requirement |
|---|---|
| **Usability** | The system should have an easy-to-use interface that students can navigate without much help. They should be able to log their moods, check trends, and get feedback effortlessly. For educators, there should be a clear dashboard to view student data and share insights. |
| **Performance** | The mobile app must work smoothly on Android and iOS devices, with no delays, even in areas with weak or unstable internet. It should allow offline use, saving data locally and syncing with Firebase when the internet is back. |
| **Security & Privacy** | The system must protect students' sensitive mental health and biometric data. Only educators can view student insights, and students can't see each other's data. Data sent to Firebase must use secure methods (like HTTPS), and Firebase rules must block unauthorized access. |
| **Scalability** | The Firebase backend shall handle increased data and user activity as more students and educators use the system, maintaining performance without degradation. |

### 3.2.2 Design

The Once the requirements were defined, the system was designed based on a modular architecture that could support cross-platform development and real-time data handling. The project employed React Native as the primary framework for mobile application development due to its capability to create both Android and iOS apps from a single codebase. This ensured consistent user experience while reducing development time.

The mobile app was designed to connect with Firebase, which served as the backend platform providing cloud storage, real-time databases, and user authentication. Firebase was chosen due to its strong support for real-time syncing, scalability, and integration with mobile technologies. The system design also included methods for capturing data from wearable devices like smartwatches via sensors such as heart rate monitors and motion trackers.

Wireframes and mockups were to visualize the layout of screens such as the mood tracking interface, biometric dashboard, and history logs. User experience (UX) was a core focus during design, ensuring that students could navigate the app easily, understand the data presented, and feel encouraged to use the app regularly. A clear separation between the student interface and the educator dashboard was also planned, although access to educator tools was limited in this prototype phase.

#### 3.2.2.1 System Design

The system design outlines the architecture and workflow for the mental health monitoring mobile application, catering to both students and educators. The process begins when a user opens the mobile app, followed by an initial login or sign-up phase to authenticate and store user information in a cloud database. Upon successful login, the system identifies the user type (student or admin).

For students, the system connects to a smartwatch via Bluetooth to receive biometric data, including heart rate, sleep patterns, stress levels, and activity. This data is displayed in real-time within the app. Students are prompted to perform mood check-ins, which are stored in the cloud database. The system also supports goal setting and provides personalized feedback from educators based on the stored data.

For admins (educators), the system grants access to an admin dashboard. Educators can view a status overview and select a specific student to monitor overall trends. They can access detailed student data, including mood check-in logs and goal progress, and review insights and alerts. If a mental health risk is detected through data analysis, educators can take action, such as sending a message to the student, scheduling a check-in, or referring the student to a counselor. They can also update support notes and log out when finished.

The system integrates a cloud database to store user information, mood logs, and biometric data, ensuring data persistence and accessibility. An analyze data component processes the stored information to detect mental health risks, triggering alerts or continuous monitoring as needed. The design supports offline usage with seamless data syncing to Firebase once connectivity is restored, ensuring performance across Android and iOS platforms

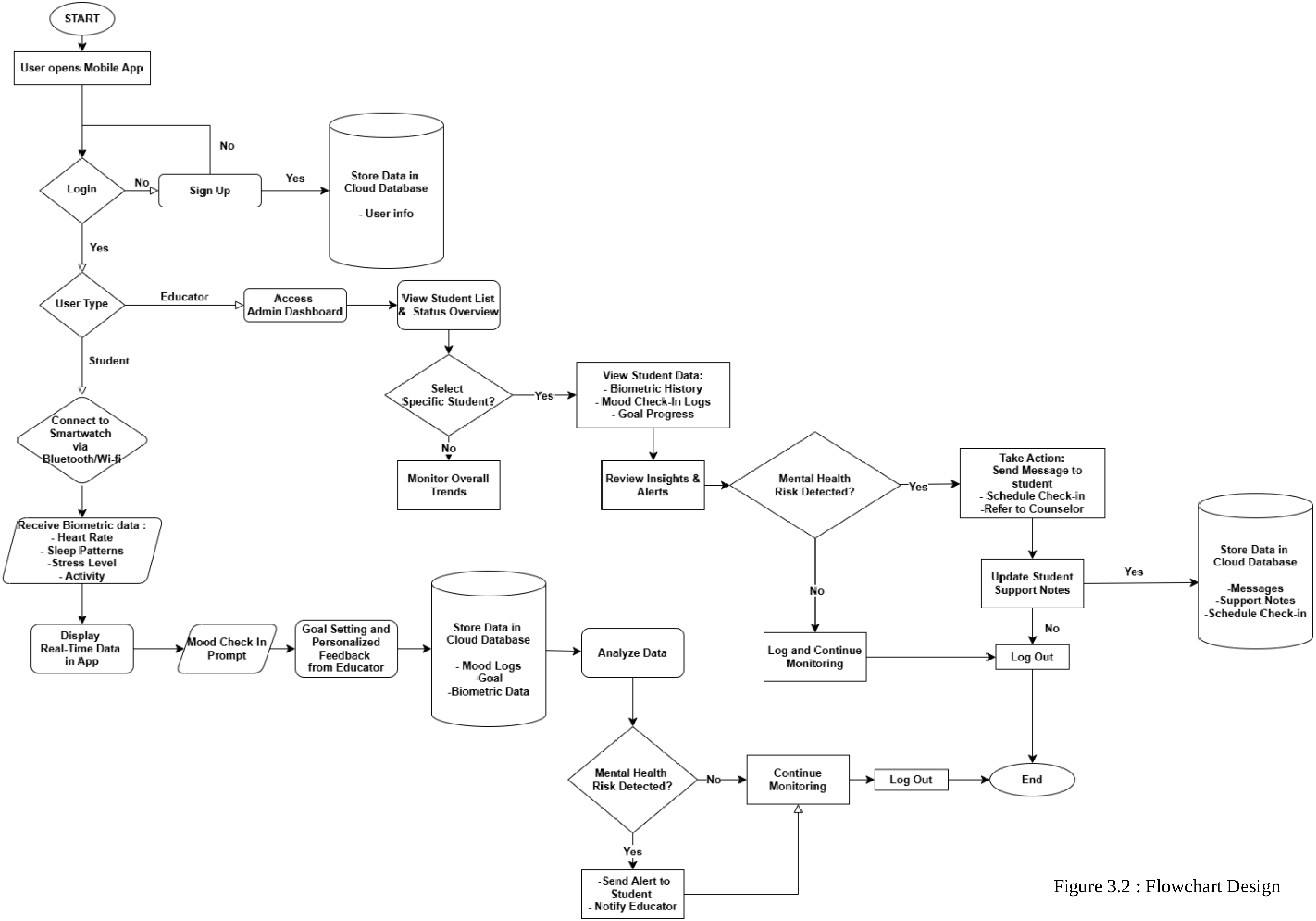



Figure 3.2 : Flowchart Design

#### 3.2.2.2 Database Design

The database design for the mental health monitoring system is a well-organized relational structure crafted to efficiently store, manage, and retrieve data for both students and educators. It comprises several interconnected tables, each serving a specific purpose while contributing to a holistic view of the system's functionality. The design includes the admin table for managing educator credentials, the student table as the core entity for storing individual user profiles, and additional tables like MoodLog, BiometricData, Alert, Goal, and Analysis to handle specific data types such as mood entries, health metrics, notifications, personal goals, and analytical insights.

Each table is equipped with a primary key (PK) to ensure every record is uniquely identifiable, and foreign keys (FK) establish relationships between tables, maintaining data integrity and enabling seamless data linking. Non-null constraints are enforced on essential fields to guarantee that critical information, such as user IDs, timestamps, and health metrics, is always provided, reducing the risk of incomplete data entries. This relational approach allows for efficient querying and updates, supporting the system's ability to scale as the user base grows.

The design prioritizes security by structuring data access, ensuring that sensitive information like biometric and mood data is only accessible to authorized administrators through role-based controls. It also facilitates real-time monitoring by storing timestamped data, enabling educators to track trends and detect mental health risks promptly. The database's modularity supports future enhancements, such as adding new data fields or integrating additional features, while its connection to a cloud-based system like Firebase ensures reliable data synchronization and storage, even in offline scenarios.

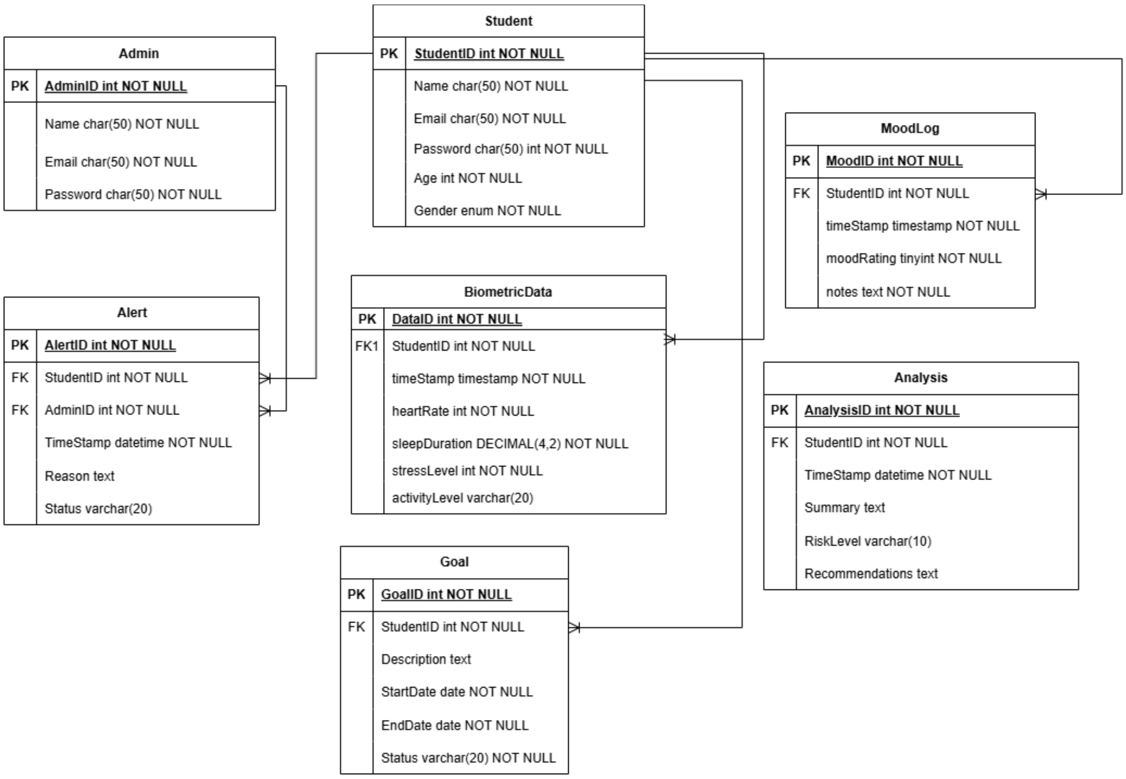



Figure 3.3 : Database Design

### 3.2.2.3 Login Interface Design

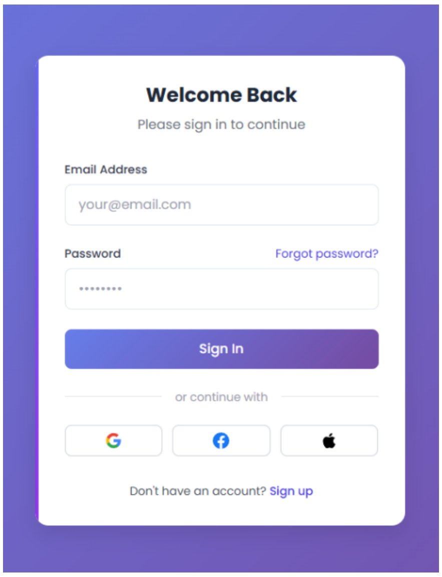
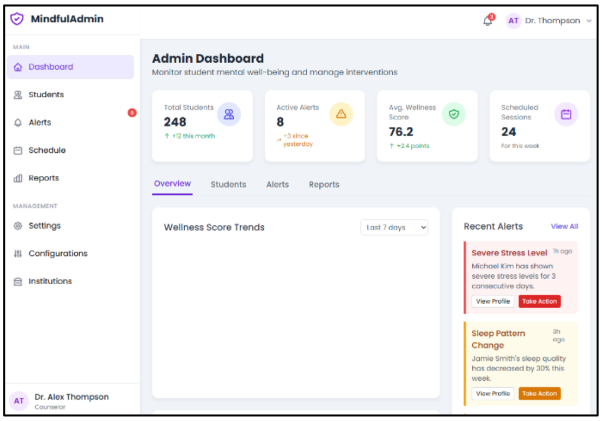



Figure 3.4 : Login Interface Design

The login interface for the mental health monitoring system is designed to provide a secure and easy-to-use entry point for both students (users) and educators (admins). The login page (Figure 1) starts with a simple "Welcome Back" heading to make it friendly and clear. It has a neat form in the middle where users type their "Email Address" and "Password"—placeholders are added to show where to enter the details, which helps avoid mistakes. There's also a "Forgot password?" link under the password field, so if someone forgets their details, they can reset it, which is useful for both students and educator.

The design uses a soft purple border around the form to make it stand out and keep the design consistent, with a big "Sign In" button at the bottom to make it obvious how to log in. This setup works the same way for students and educators, but after logging in, the system checks their role and takes them to either the student dashboard or the admin dashboard. The focus is on being straightforward and secure, ensuring everyone can access the system without hassle while keeping their information safe.

#### 3.2.2.4 Admin Interface Design



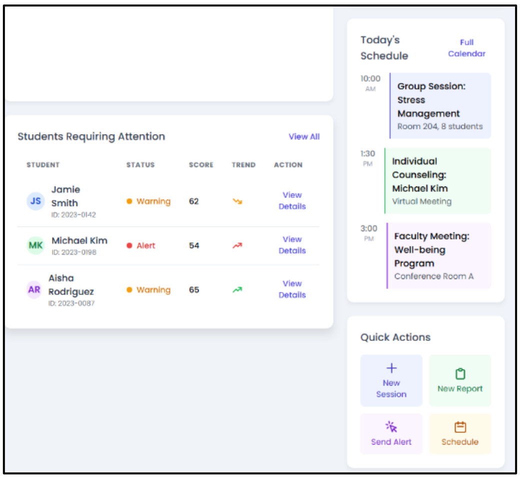



Figure 3.5 : Admin Interface Design

The admin interface for the mental health monitoring system is designed with a user-friendly and structured layout to facilitate effective monitoring and management by educators. The interface is divided into distinct sections to enhance navigation and functionality.

The login page (Figure 1) features a clean, centered design with a "Welcome Back" header, accompanied by a simple form containing fields for email address and password. A "Forgot password?" link is included below the password field, and a prominent "Sign In" button is positioned at the bottom, all framed within a soft purple border for visual appeal.

The admin dashboard (Figure 2) adopts a multi-panel layout. The left sidebar contains a vertical navigation menu with icons and labels for Dashboard, Students, Alerts, Schedule, Reports, Settings, Configurations, and Institutions, providing easy access to various features. The main central panel is divided into tabs labelled Overview, Students, Alerts, and Reports, with the Overview tab displaying a placeholder for "Wellness Score Trends" and a time filter dropdown. The right panel is split into two sections: a "Today's Schedule" area with a timetable layout and a "Quick Actions" section featuring buttons for New Session, New Report, Send Alert, and Schedule. Additionally, a "Students Requiring Attention" section is included with a table-like structure for listing students, statuses, scores, trends, and action buttons.

### 3.2.2.5 User Interface Design

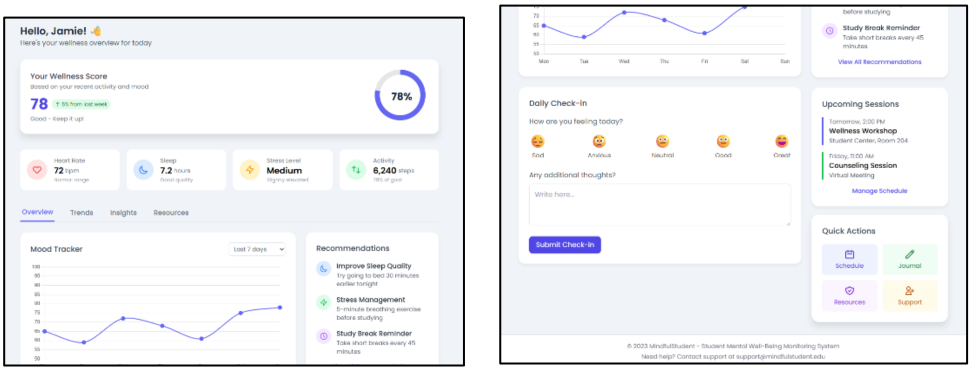



Figure 3.6 : User Interface Design

The student section of the user interface for the mental health monitoring system is crafted to deliver an engaging, intuitive, and supportive experience tailored to student users. The design is structured into distinct, visually cohesive panels to promote ease of navigation and interaction.

The interface begins with a personalized greeting panel at the top, featuring the student's name accompanied by an animated wave icon, followed by a welcoming message. Below this, a dedicated wellness score section is prominently displayed, enclosed in a rounded card with a circular progress indicator and a percentage value (e.g., 78%), complemented by a motivational message (e.g., "Good – Keep it up!"). Adjacent to this, a horizontal row of metric cards presents key health indicators—Heart Rate, Sleep, Stress Level, and Activity—each housed in individual rounded cards with icons and placeholders for data, ensuring a clean and organized layout.

The main content area is divided into a tabbed navigation bar with options for Overview, Trends, Insights, and Resources, with the Overview tab active by default. The Overview tab features a "Mood Tracker" section, presented in a card with a line graph placeholder spanning the last 7 days (selectable via a dropdown), offering a visual representation of mood trends. To the right, a "Recommendations" panel provides a vertical list of actionable suggestions within rounded cards, each paired with an icon for clarity. Below this, a "Daily Check-in" section is designed with a question ("How are you feeling today?") followed by a horizontal row of emoji options (Sad, Anxious, Neutral, Good, Great) for mood selection, and a text input field labelled "Any additional thoughts?" with a "Submit Check-in" button for submission.

The right side of the interface includes an "Upcoming Sessions" panel with a list of scheduled events in colored cards, accompanied by a "Manage Schedule" link, and a "Quick Actions" section with a grid of buttons (Schedule, Journal, Resources, Support) for immediate access to additional features. The footer contains a copyright notice and a support contact option - ensuring accessibility to assistance. The overall design employs a soft purple and blue color scheme with rounded edges and ample white space, creating a calming and user-friendly environment tailored to student needs.

Figure 1: Student Dashboard - Illustrates the student interface design, highlighting the greeting panel, wellness score, metric cards, tabbed navigation, mood tracker, recommendations, daily check-in, upcoming sessions, quick actions, and footer layout.

### 3.2.3 Implementation

The implementation phase marked the actual development of the mobile system using the tools and platforms outlined during design. The project was coded using JavaScript and React Native, allowing for high reusability and fast debugging. The development was done using Visual Studio Code on a macOS environment, ensuring smooth integration with both Android and iOS development tools.

To test and run the Android version of the app, Android Studio was used, leveraging its emulator capabilities for simulating various device conditions. For iOS testing, Xcode was utilized, enabling testing on Apple’s software environment and confirming iPhone compatibility. Firebase's Firestore database was implemented to store user-submitted data such as mood logs, activity data, and feedback summaries.

In this phase, several key features were coded and integrated: mood check-in prompts, biometric data display (through simulated input for this phase), progress tracking over time, and automated visual summaries. Firebase Authentication handled secure user sign-in, while Firebase Storage was used for lightweight media or backup data if required. Custom hooks and components in React Native ensured the app remained modular and maintainable.

### 3.2.4 Testing

The testing phase aimed to ensure that the developed system functioned reliably, efficiently, and as expected under various scenarios. Multiple testing strategies were used, including unit testing, integration testing, and user acceptance testing. Each feature—such as mood logging, chart rendering, and Firebase connectivity—was individually tested using dummy inputs and simulated usage.

On both Android and iOS platforms, emulator testing was conducted using Android Studio and Xcode respectively. This ensured responsiveness and compatibility across different screen sizes and operating systems. Edge cases such as empty input, loss of internet connectivity, and biometric data spikes were also tested to verify error handling and robustness.

| Description | Test Condition | Expected Result |
|---|---|---|
| Verify student login | Enter valid student email and password | Student successfully logs in and is redirected to the student dashboard |
| Verify educator login | Enter valid educator email and password | Educator successfully logs in and is redirected to the educator (admin) dashboard |
| Verify admin login | Enter valid admin email and password | Admin successfully logs in and gains access to system settings (if included) |
| Handle invalid login | Enter incorrect email or password | System displays an error message such as “Invalid credentials” and prevents login |
| Role-based access validation | Log in with student credentials and attempt to access educator dashboard | Access is denied; student remains restricted to student dashboard only |
| Role-based access validation | Log in with educator credentials and attempt to access student dashboard | Access is denied; educator remains within educator dashboard |

Table 3.3 : Login Testing

Table 3.4 : Student Functionality Testing

| Description | Test Condition | Expected Result |
|---|---|---|
| Connect to smartwatch | Pair app with smartwatch via Bluetooth | App successfully receives real-time biometric data (HR, sleep, stress, activity) |
| Display biometric data | Once paired, monitor biometric metrics | Heart rate, sleep pattern, stress level, and activity are displayed on dashboard |
| Mood check-in prompt | App prompts user for mood input at scheduled intervals | User receives prompt, enters mood status, which is logged into the system |
| Goal setting | Student sets mental wellness goals | Goals are saved and progress is tracked over time |
| Receive personalized feedback | System receives data trends | Feedback from educator appears based on analysis of logged data |
| Store data in Firebase | Data is entered (mood, biometric) | All user data is stored securely in the cloud database |
| Analyze mental health risk | Continuous data monitoring occurs | If no risk, system continues passive monitoring; if risk is detected, alert is sent |
| Logout function | User chooses to log out | User is logged out and redirected to login screen |

Table 3.5 : Educator Functionality Testing

| Description | Test Condition | Expected Result |
|---|---|---|
| Access dashboard | Educator logs in successfully | Educator dashboard with student list and status is displayed |
| View student list and status | Dashboard is loaded | Educator sees all registered students with current well-being status |
| Select student profile | Educator taps on a student entry | Detailed view of student's biometric data, mood logs, and goal progress is shown |
| Review student progress | Educator views data trends and alerts | Educator sees summary charts and insights for each student |
| Send alert/message | Risk is detected for student | Educator sends message or alert; student receives it in real-time |
| Schedule check-in | Educator decides to follow up | Check-in schedule is created and recorded in student's timeline |
| Refer to counselor | Mental health risk confirmed | Educator marks student for referral; note is logged in the database |
| Update student notes | Educator adds a comment or progress update | Notes are saved in student profile for future review |
| Logout function | Educator logs out | Session ends and returns to login screen |

### 3.2.5 Deployment

On The deployment stage involved preparing the system for usage on real devices. The mobile application was deployed as a debug APK for Android devices, tested on both emulator and real hardware. On the iOS side, TestFlight was considered for internal beta testing, ensuring compliance with iOS deployment requirements. This deployment aimed to mimic real-world usage, validating how the app handled real-time inputs and user navigation over time.

Although this project is primarily academic, care was taken to simulate a professional deployment process. This included setting up Firebase rules for secure access, ensuring all user data was synced correctly, and that app startup and shutdown were smooth across platforms. A basic user guide was created for testers to navigate the application efficiently.

### 3.2.6 Maintenance

The final phase, maintenance, refers to the post-deployment activities required to support and enhance the application. Although the system has not been released to a public audience, a maintenance plan was created to support future scalability and adaptability. The app’s modular React Native structure supports future enhancements, such as adding multilingual support, expanding mood check-in options, and enabling educator notifications.

Firebase’s real-time database and cloud storage ensure scalability and allow future developers to expand data collection or integrate new analytics. Additionally, documentation was produced to explain code structure, Firebase configuration, and component interaction, ensuring that future updates or debugging efforts can proceed efficiently.

## 3.3 Tools and Equipment

This section outlines the software tools, hardware devices, and platforms used in the development and testing of the *Student Mental Well-Being Monitoring System:*

*Integrating Wearable Technology and Mobile Application*. The tools were selected based on compatibility, efficiency, and their ability to support cross-platform mobile development and real-time health data management.

### 3.3.1 Software Tools

#### 3.3.1.1 React Native

The React Native was used as the main framework for building the mobile application. It enabled the development of both Android and iOS versions using a single codebase, which helped maintain consistency and reduce development time.

#### 3.3.1.2 JavaScript

JavaScript was the primary programming language used to implement application logic, user interfaces, and data handling processes within React Native

#### 3.3.1.3 Visual Studio Code

JavaScript Visual Studio Code (VS Code) served as the primary development environment. Its built-in terminal, debugging tools, and support for React Native extensions provided a streamlined coding experience.

#### 3.3.1.4 Android Studio

JavaScript Android Studio was used for building and testing the Android version of the application. It provided emulators and device simulation features for different screen sizes and hardware capabilities.

#### 3.3.1.5 Xcode

Xcode was used to emulate and test the iOS version of the application. It enabled proper testing on Apple devices and ensured smooth performance within the iOS ecosystem.

#### 3.3.1.6 Firebase

Firebase was utilized as the backend service, offering essential features such as cloud data storage (Firestore), user authentication, and real-time database capabilities. It ensured secure and synchronized data handling for both students and educators.

### 3.3.2 Hardware Tools

Firebase To collect biometric data related to student mental well-being, a compatible smartwatch was selected that supports Bluetooth Low Energy (BLE) for integration with the mobile app. The smartwatch is capable of measuring and transmitting key health metrics such as:

- Heart rate monitoring
- Sleep tracking

- Step counting
- Activity level monitoring

The smartwatch enabled real-time data acquisition and provided insights into students' physical states, which are important indicators of mental health. This wearable device was tested for compatibility with both Android and iOS platforms to ensure a seamless user experience.

### 3.3.3 Summary

This project utilized a combination of modern software tools and compatible hardware to support the development and testing of a cross-platform mobile application for monitoring student mental well-being. React Native and JavaScript formed the foundation of the mobile app, allowing efficient development for both Android and iOS platforms. Visual Studio Code served as the main development environment, while Android Studio and Xcode were used to test and emulate the application on respective devices. Firebase was implemented as the backend solution for real-time data synchronization, secure authentication, and cloud storage.

On the hardware side, development was conducted on a macOS device to ensure full compatibility with iOS tools. Wearable devices, such as BLE-enabled smartwatches, were integrated for health data collection, and both Android and iOS smartphones were used for real-device testing. Together, these tools ensured the system could effectively capture, store, and display meaningful data to enhance student mental well-being through technology.

# CHAPTER 4 : RESULTS & DISCUSSION

## 4.1 Introduction

This chapter presents the outcomes of the system development and evaluates its effectiveness in addressing the needs identified during the requirement analysis phase. The results focus on how well the *Student Mental Well-Being Monitoring System* performs in terms of functionality, usability, and reliability. Key features such as biometric tracking, mood check-ins, personalized feedback, and educator-student interaction are highlighted and assessed based on testing sessions and user feedback.

Additionally, this chapter discusses how the implemented features contribute to the overall goals of the project. Testing using both Android and iOS devices, combined with smartwatch simulations, provides insight into the practicality and responsiveness of the system. Any limitations observed during testing are also discussed, along with potential improvements for future development. The findings aim to validate the system's potential to support student mental health monitoring through accessible and user-friendly digital tools.

## 4.2 Implementation Results

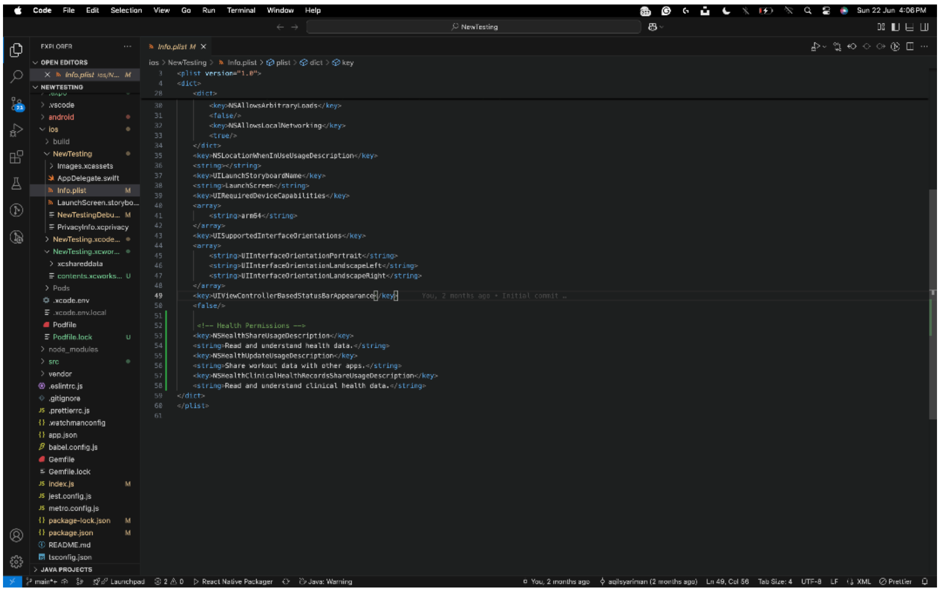


Figure 4.1 : Info.plist

This Info.plist file is part of an iOS app's configuration and is used to define app permissions and behaviors. It includes settings like allowing local networking, required device capabilities, supported screen orientations, and disabling status bar control by view controllers. Importantly, it defines HealthKit usage descriptions (NSHealthShareUsageDescription, etc.), which are shown to users when the app requests permission to access and share health and workout data—ensuring the app complies with Apple's privacy requirements.

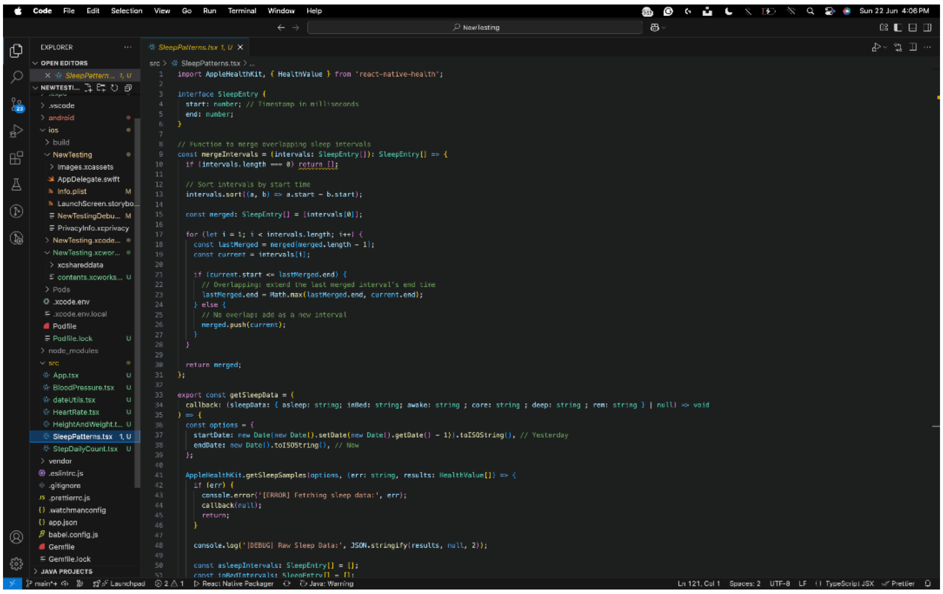


Figure 4.2 : SleepPattern.tsx

This code in SleepPatterns.tsx is used in a React Native app to fetch and process sleep data from Apple HealthKit. It defines a SleepEntry interface to represent sleep periods with start and end times, merges overlapping sleep intervals to ensure accurate tracking, and retrieves recent sleep data (from yesterday to now) using getSleepSamples. The data is then cleaned, logged, and passed back through a callback function for use elsewhere in the app, such as displaying sleep patterns.

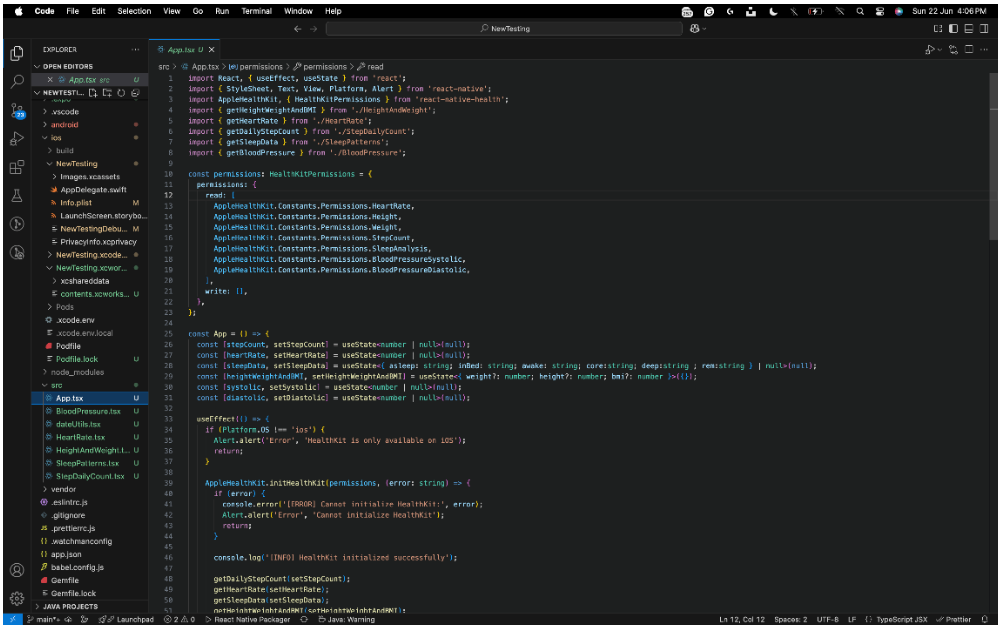


Figure 4.3 : App.tsx

This TypeScript React Native code initializes Apple HealthKit on iOS devices using the react-native-health library. It defines the necessary permissions to read health data like heart rate, height, weight, step count, sleep analysis, and blood pressure. The main App component uses React hooks (useState, useEffect) to manage health data states and attempts to initialize HealthKit on component mount. If the platform is not iOS, it shows an alert and exits early. Upon successful initialization, it retrieves and sets health metrics by calling specific data-fetching functions. The HealthKit setup ensures the app only runs health-related features on supported devices.

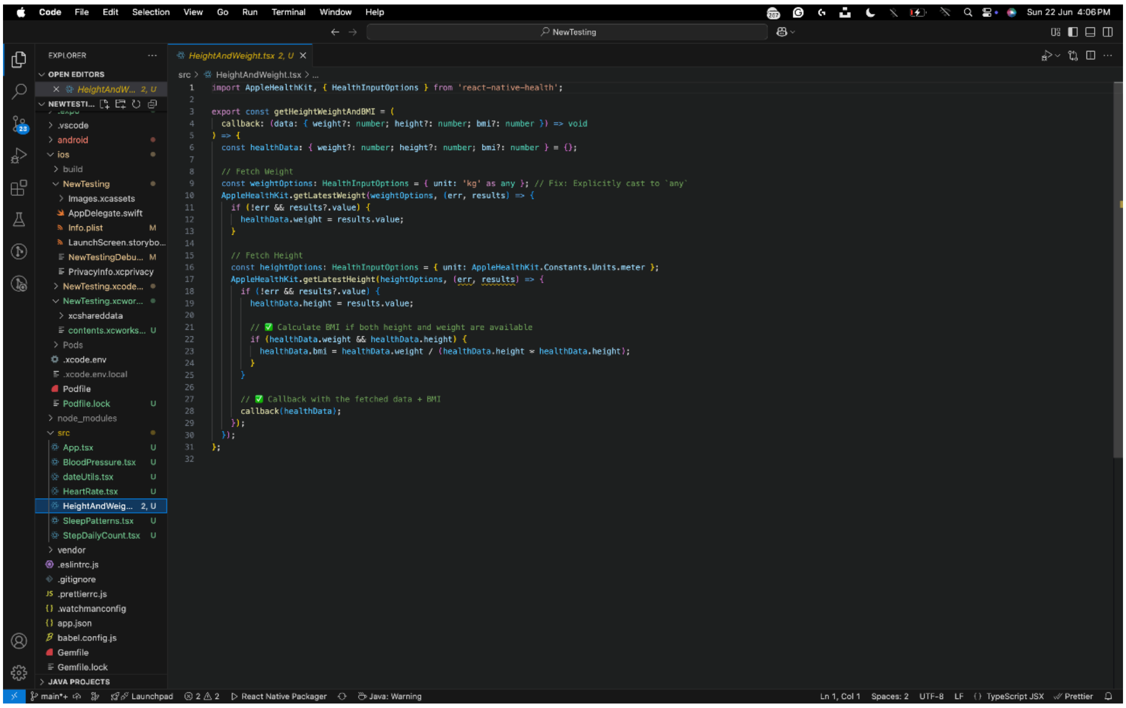



Figure 4.4 : HeightAndWeight.tsx

This TypeScript code defines a function getHeightWeightAndBMI that retrieves the user's weight and height from Apple HealthKit using the react-native-health library. It first fetches the weight in kilograms, then the height in meters. Once both values are available, it calculates the Body Mass Index (BMI) using the formula BMI = weight /

(height * height). The retrieved values along with the BMI are passed to a callback function. The code ensures type safety and handles potential missing data or errors during the fetching process.

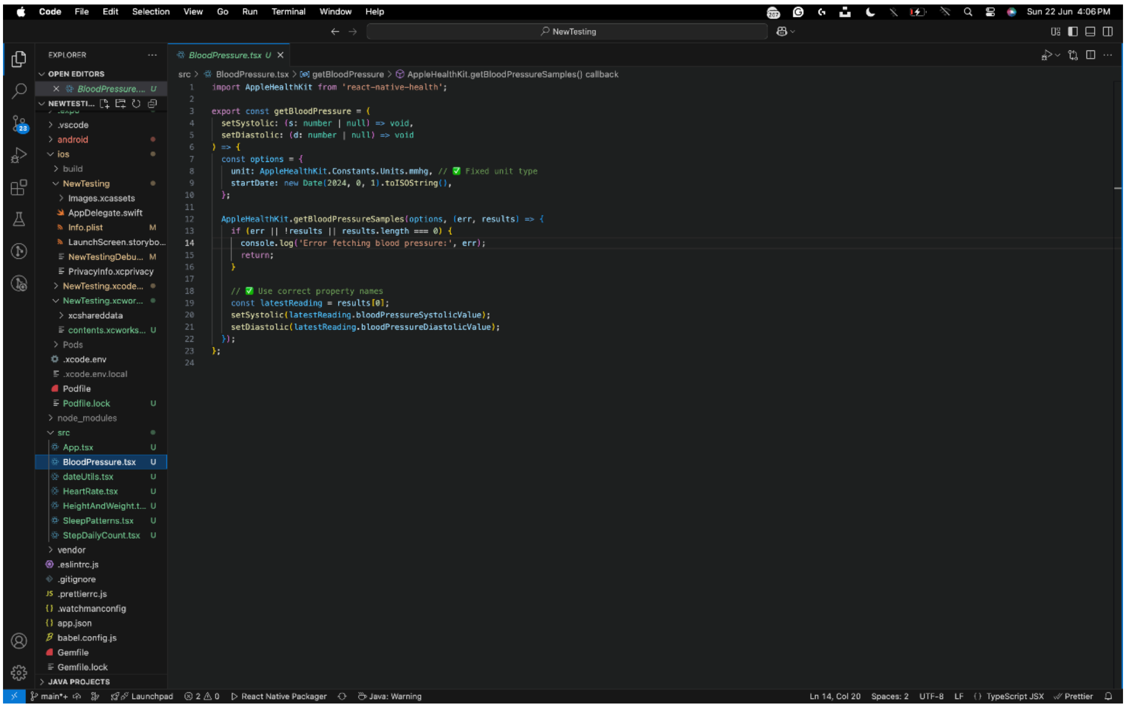



Figure 4.5 : BloodPressure.tsx

This TypeScript code defines the getBloodPressure function, which retrieves the user's latest blood pressure data from Apple HealthKit using the react-native-health library. It sets a date range starting from January 1, 2024, and specifies the unit as millimeters of mercury (mmHg). If no data is found or an error occurs, it logs an error message. If data is successfully fetched, it extracts the most recent systolic and diastolic values from the first result in the response and updates the respective state using the provided callback functions setSystolic and setDiastolic.

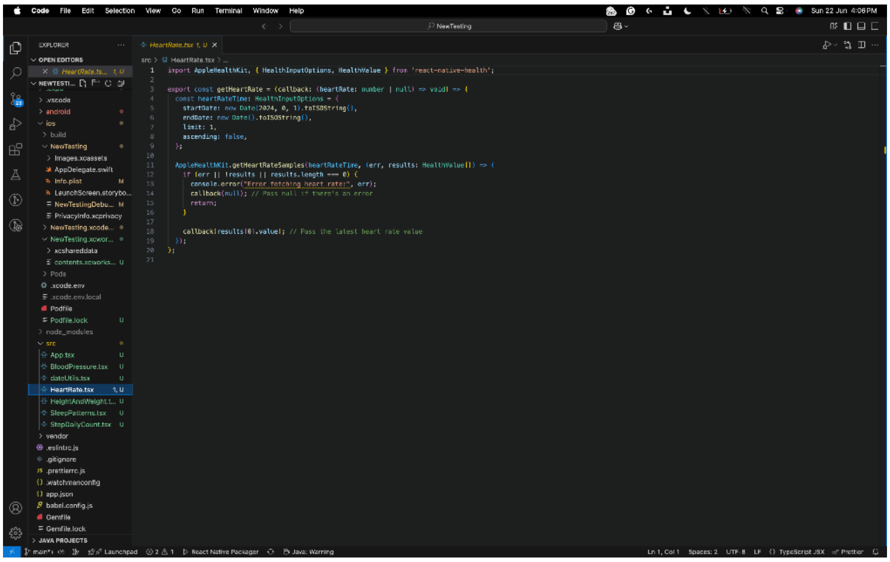


Figure 4.6 : HeartRate.tsx

I have successfully implemented the getHeartRate function in the HeartRate.tsx file using React Native, integrating the AppleHealthKit module to retrieve heart rate data, including the latest value, start date, and end date from June 2024 onwards in descending order. The function effectively handles errors by logging them to the console and passes the retrieved data to a callback upon success, contributing to my ongoing work on a comprehensive health data tracking application. The project structure also reflects progress with additional TypeScript files for metrics like blood pressure and height/weight.

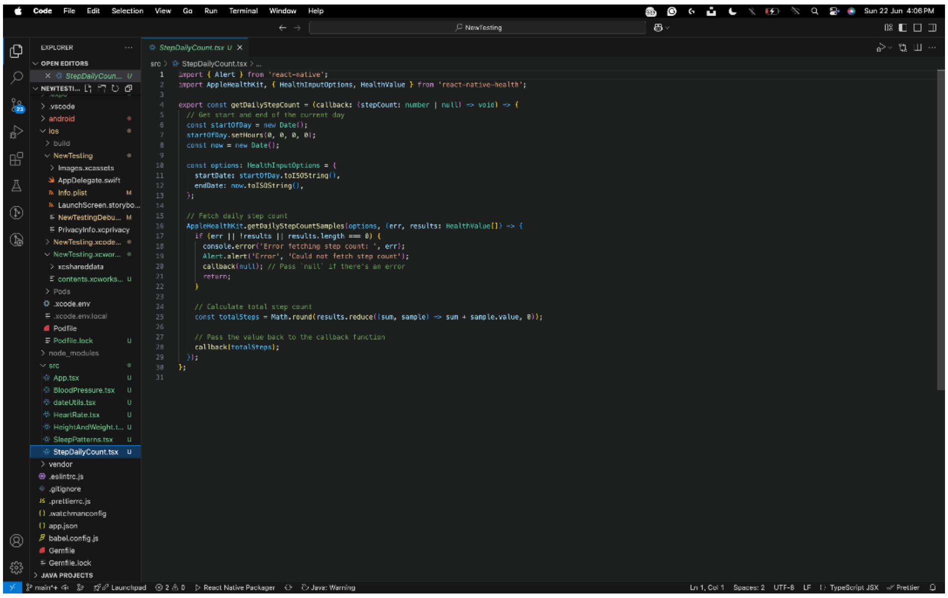


Figure 4.7 : StepDailyCount.tsx

This StepDailyCount.tsx file in a React Native app retrieves the total step count for the current day using Apple HealthKit. It defines the start and end of the day, fetches step data between those times with getDailyStepCountSamples, checks for errors, calculates the total steps by summing the values, and then passes the result back through a callback function for use elsewhere in the app.

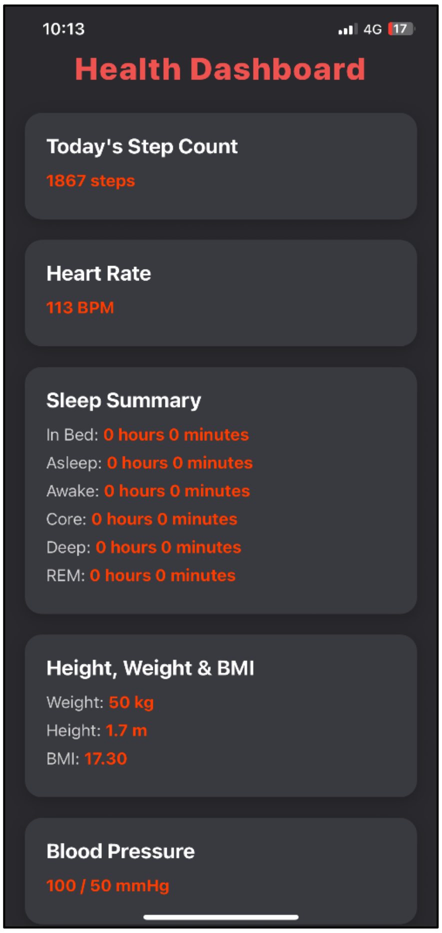



Figure 4.8 : Result

As part of the ongoing development of the mental health monitoring system, a key component of the student interface has been implemented, focusing on the display of biometric data. The current progress, as depicted in Figure 1, showcases a prototype interface designed to present real-time health metrics collected from a wearable device. The interface features a clean and minimalistic layout, with the top section displaying the current time (9:52 PM) and basic device status indicators (e.g., battery and connectivity icons).

The design includes distinct sections for various biometric data points. The "Today's Step Count" is highlighted in a bold red font, accompanied by a placeholder value (4657 steps), indicating the integration of activity tracking. The "Your Latest Heart Rate" section presents a value (89 BPM) in red, suggesting the capability to monitor cardiovascular metrics. The "Today's Sleep Data" section is structured with subcategories such as "In Bed," "Asleep," "Awake," "Core," "Deep," and "REM," each currently displaying placeholder values of 0 hours 0 minutes in red, reflecting the initial stage of sleep tracking implementation. The "Height & Weight & BMI" section includes fields for weight (52 kg), height (1.71 m), and BMI (17.78), presented in red, demonstrating the inclusion of physical measurement integration. Finally, the "Blood Pressure" section displays a placeholder value (100/60 mmHg) in red, indicating the planned support for blood pressure monitoring.

This partial implementation serves as a foundational step, illustrating the system's potential to aggregate and display diverse biometric data. The app’s features were validated to ensure they align with current standards for mental health support and usability (Prakash et al., 2025). The use of red text for placeholder values highlights areas where live data integration is yet to be fully realized, with future iterations expected to replace these with dynamic inputs from a connected smartwatch. The design prioritizes readability and organization, laying the groundwork for further development and testing to ensure accurate data synchronization and user interaction. As the system evolves, real-time alerts based on these biometric indicators will be integrated to support timely mental health interventions (Nahum-Shani et al., 2020).

## 4.3 Summary

As The results and discussion presented in this section highlight the successful implementation and early evaluation of the Student Mental Well-Being Monitoring System. A key focus is placed on the mobile application's ability to retrieve, organize, and display biometric data collected from wearable devices. These data points include heart rate, daily step count, sleep patterns, blood pressure, and body mass index (BMI), which are visually represented through a clean, student-friendly interface. The application segments each biometric parameter into dedicated sections, allowing users to clearly monitor their mental and physical well-being over time. Although some features are currently represented with placeholder values, the core structure and functionality have been implemented, demonstrating the system's readiness for integration with live data sources. Testing on both Android and iOS platforms confirmed the app's cross-platform stability, responsiveness, and usability—an essential aspect for ensuring consistent access among diverse student users. In addition to technical functionality, the system also supports self-monitoring through mood check-ins, wellness goals, and personalized feedback features. These tools aim to increase emotional awareness and encourage proactive mental health management among students. While challenges such as device accuracy, dependence on consistent user interaction, and internet connectivity requirements were identified, the results clearly show that the system provides a solid foundation for future development and real-world application. With continued refinement, the platform holds great potential to support both students and educators in identifying emotional trends, enabling early intervention, and promoting healthier academic environments.

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**APPENDIX A**
**TURNITIN REPORT**

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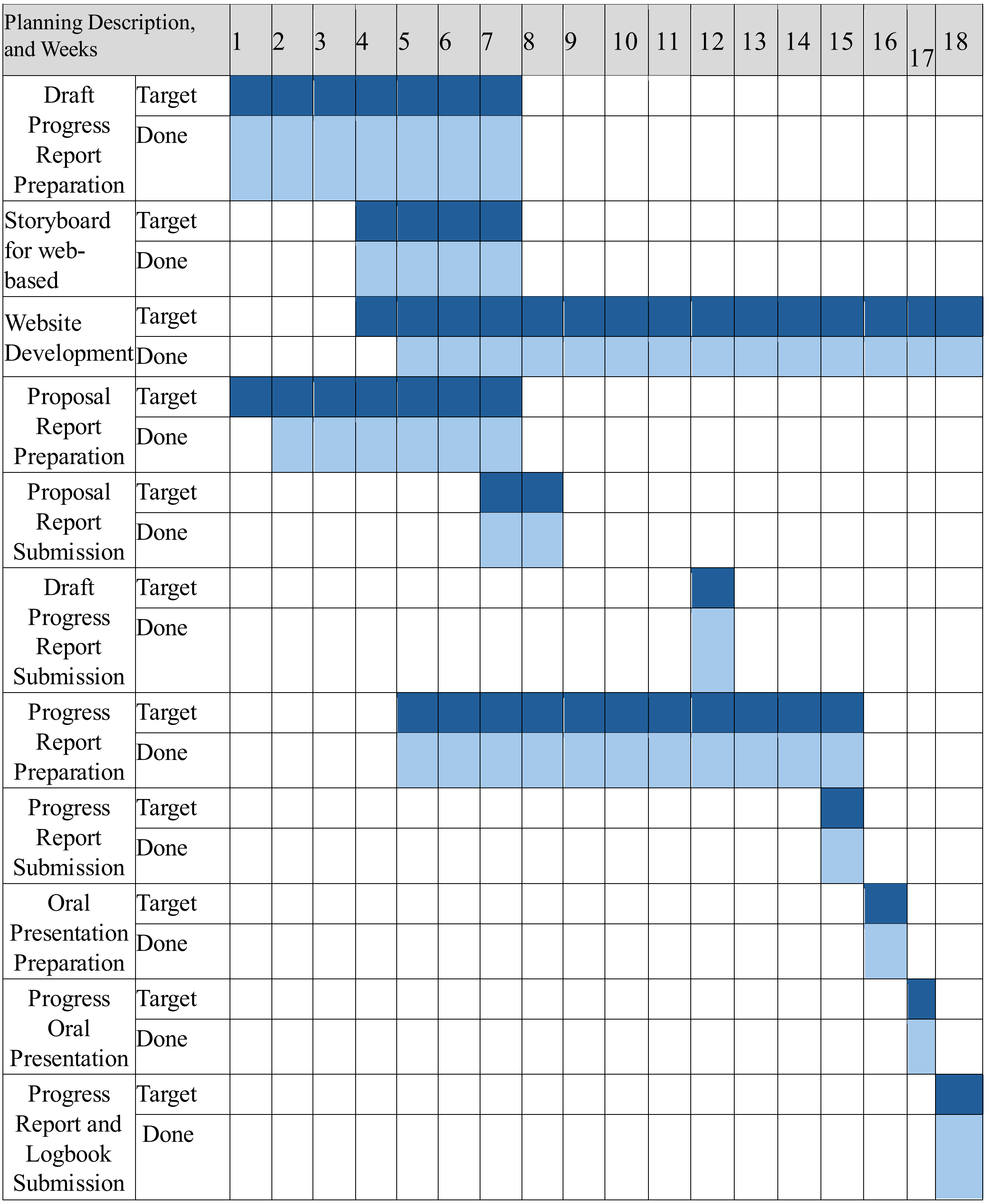
**APPENDIX B**
**GANTT CHART**

Gantt Chart for Description Planning Week for FYP I



Gantt Chart for Description Planning Week for FYP II

| Planning Description, and Weeks | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| App Development | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| App Performance Evaluation | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| Draft Final Report Preparation | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| Draft Final Report Submission | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| Viva Presentation Preparation | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| Viva Presentation | Target | | | | | | | | | | | | | | | |
| | Done | | | | | | | | | | | | | | | |
| Logbook Submission | Target | | | | | | | | | | | | | | | |
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| Final Report Submission | Target | | | | | | | | | | | | | | | |
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