

**DEVELOPMENT OF A MOBILE APPLICATION FOR  
EFFECTIVE MENTAL HEALTH INTERVENTION**

**BY**

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the degree of Master of Science in Computer and  
Information Engineering.**

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## ABSTRACT

The increasing prevalence of depression and anxiety highlight the urgent need for innovative solutions beyond conventional therapy due to barriers like cost and stigma. Investigations into digital interventions reveal varying effectiveness of mobile applications in mental health support, underlining the necessity for approaches that are both user-centric and evidence-based. The integration of cognitive-behavioral therapy and mindfulness within a mobile framework emerges as an interesting proposition aimed at providing effective, scalable mental health interventions. Challenges persist in current systems, notably the accessibility and personalization of mental health resources. The proposed mobile application endeavors to bridge these gaps by offering a tailored experience that leverages cognitive-behavioral techniques and mindfulness practices. The research method combines new technology and effective psychological techniques, utilizing platforms such as React Native to create user interfaces and NestJS for protecting data. This ensures a comprehensive approach to promoting user mental wellness. Specifically, 62.1% reported a positive change in their mental health, while 78.6% of participants deemed the app's resources beneficial. These outcomes illustrate the app's potential in significantly enhancing mental health management, thereby validating the combined use of cognitive-behavioral therapy (CBT) and mindfulness techniques within a digital context. In summary, the developed application has demonstrated substantial benefits in mental health management, marking a significant advancement in digital mental health interventions. The empirical evidence supports the application's utility in enhancing user empowerment and promoting mental health well-being.

## ملخص البحث

تشير الزيادة العالمية في انتشار الاكتئاب والقلق خاصة بين الطلاب، بالإضافة الى التحديات المتزايدة للحصول على علاجات متاحة وبسبب القيود المالية والوصمة الاجتماعية، الى حاجة لتطوير طرق رقمية مبنية على الأدلة العلمية لعلاج هذه الحالات . بما أن فعالية التطبيقات المحمولة الشائعة لدعم الصحة العقلية تتغير حسب جوانب التصميم، فإن الحل يكمن في تطوير حلول صحية إلكترونية متخصصة وسهلة الاستخدام تتوافق مع أفضل الممارسات في هذا المجال. كجزء من جهود البحث التي نقوم به، نحاول تصميم تطبيق محمول يقدم الدعم الفعال للأشخاص الذين يواجهون صعوبات في الصحة العقلية. من خلال دمج تقنيات مثل العلاج السلوكي المعرفي وميزات تشمل الخيار لحجز المواعيد بسهولة، وأدوات لمتابعة التقدم، وجمع التعليقات الشخصية، بهذا نطمح إلى تحسين النتائج التي يواجهها الأشخاص المتأثرون من خلال استخدام التطبيق الخاص بنا. خطة التقييم الخاصة بنا تتمحور حول إجراء تجربة عشوائية مصممة لتحديد الكفاءة المقارنة بين التدخلات التي تلقاها المشاركون باستخدام التطبيق المحدد مقابل تلك التي تقدم وفقا لطرق الرعاية التقليدية. تسعى هذه الدراسة إلى جمع البيانات والمعلومات المهمة حول كيفية استخدامنا للأجهزة المحمولة لتقديم التدخلات اللازمة تم تطوير التطبيق باستخدام اخر التقنيات المتاحة في هذا المجال، مثل ريكات نيتف وريكات ومنصة امازون وفا يربيس. تم التعاون مع بعض الخبراء في الصحة العقلية مثل وحدة الإرشاد في الجامعة الإسلامية العالمية في ماليزيا، لضمان أن تصميم التطبيق الخاص بنا يتوافق مع أفضل الممارسات المرتبطة بالأبحاث الحالية وإنشاء بيئة داعمة تعزز أفضل النتائج الممكنة لدعم أكثر الأدوات فعالية لمعالجة الثغرات التي يواجهها العالم في إمكانية الوصول إلى علاج الصحة العقلية. تحمل الدراسة املا كبيرا حيث إنها أسفرت عن تطبيق محمول ناجح يمكنه رصد التقدم وتحقيق تأثيرات إيجابية.

## APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Science in Computer and Information Engineering.



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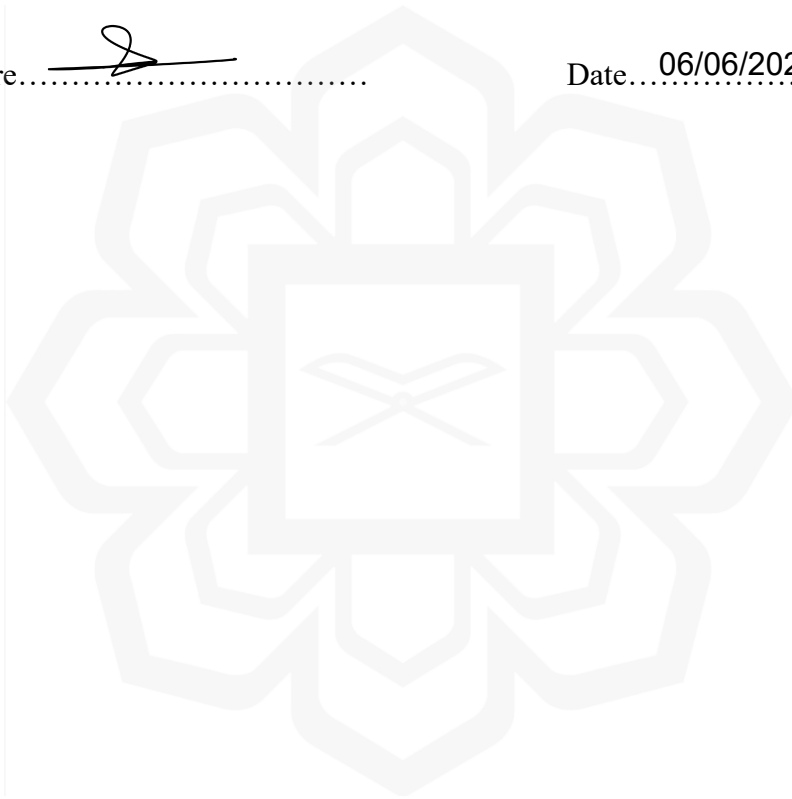
## DECLARATION

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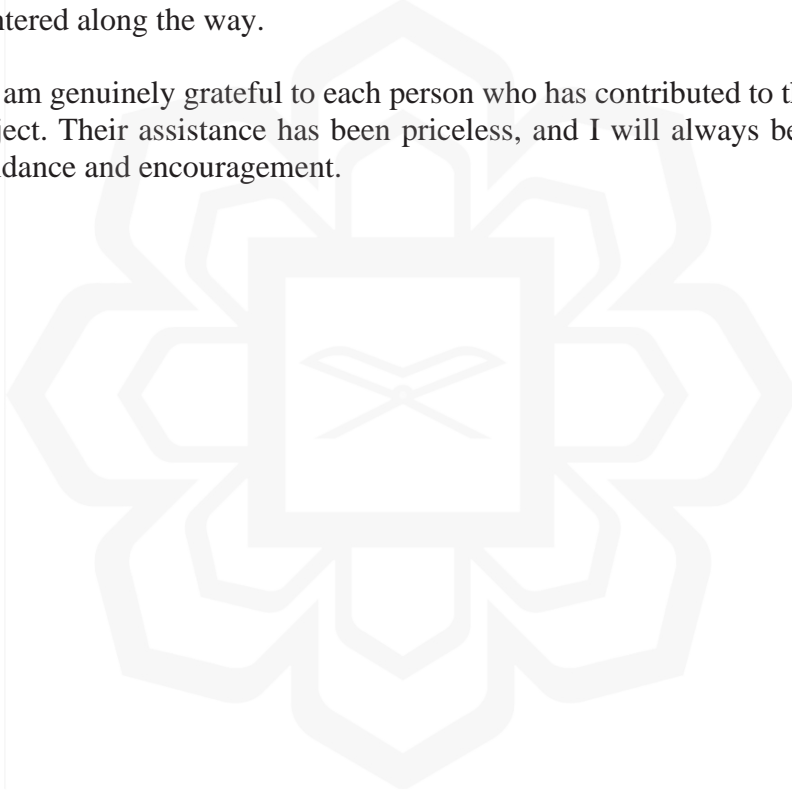
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# CHAPTER ONE

## INTRODUCTION

### 1.1 INTRODUCTION

Mental health plays a vital role in overall well-being, a fact that has become increasingly evident during the COVID-19 pandemic. Unfortunately, access to mental health care remains an obstacle for many, especially for college students grappling with high levels of stress. Factors impeding access to care include stigma surrounding mental health, the cost of treatment, and a shortage of mental health professionals. These barriers can result in delayed or inadequate treatment, leading to severe repercussions for those struggling with mental health concerns.

Mobile applications present a promising opportunity to bridge this gap, offering convenient and easily accessible mental health interventions. These interventions can be delivered through various channels, such as text messages, push notifications, virtual meetings with mental health professionals, and in-app content. Mobile interventions boast the advantage of a broad reach and the ability to be accessed anytime, anywhere via smartphones or other mobile devices.

However, the effectiveness of these interventions can differ significantly, making it essential to develop applications rooted in evidence-based practices. A systematic review of mobile mental health interventions revealed that most studies had high risk of bias, leading the authors to question the effectiveness of these interventions. Further research is needed to identify the most successful strategies for providing mental health interventions through mobile devices.

In response to these challenges, our study aims to gather critical data on the efficacy of mobile-driven mental health interventions and contribute valuable insights for developing future interventions in this field. By leveraging the widespread availability and accessibility of mobile devices, our proposed application has the potential to impact not only college students but also a vast audience worldwide.

Moreover, our research will focus on understanding the unique stressors faced by college students and how mobile interventions can be tailored to address these specific needs effectively. We will also explore strategies to reduce the stigma associated with seeking mental health support, as well as identify methods to lower costs and increase the availability of mental health professionals for those in need.

By examining the role of mobile interventions in promoting mental health and well-being among college students, we hope to foster a deeper understanding of the potential benefits and limitations of these approaches. Furthermore, we will seek collaboration with mental health professionals, educators, and technology experts to ensure that our findings are translated into actionable recommendations for the development of future mobile interventions.

Ultimately, our study aims to pave the way for innovative and effective mobile mental health interventions that can have a lasting positive impact on individuals' mental health and overall quality of life. By addressing the current gaps in mental health treatment accessibility and exploring novel ways to deliver mental health support, we hope to improve mental health outcomes for countless individuals around the globe.

## **1.2 PROBLEM STATEMENT**

Mental health is undeniably a crucial aspect of overall well-being, yet accessing mental health care can prove challenging, especially for individuals residing in college dorms or remote locations. The rapid advancements in technology and the ubiquity of mobile devices have given rise to mobile applications, which hold the potential to enhance access to mental health interventions. However, the effectiveness of these interventions can be inconsistent and unpredictable, raising questions about their reliability and efficacy.

The primary objective of our proposed research is to develop a mobile application employing evidence-based techniques, such as mindfulness treatment, that can provide a dependable and effective intervention for mental health. To accomplish this, we will rigorously examine various aspects of mobile intervention strategies,

including adherence to the intervention, and overall satisfaction with the app's features and functionalities.

By collaborating with mental health professionals, technology experts, and user experience designers, we will ensure that the mobile application is developed with the end-users needs in mind. This interdisciplinary approach will help us identify barriers to adoption and devise strategies to overcome them, such as addressing the potential stigma associated with seeking mental health support and ensuring the app's interface is user-friendly and culturally sensitive.

### **1.3 RESEARCH OBJECTIVES**

- To thoroughly analyse the recent technologies employed in mental health interventions. We will delve into the various digital tools and platforms available, assessing their features, effectiveness, and user experience.
- To develop a mobile app designed for mental health interventions, prioritizing a human-first approach over a data-first perspective. This approach will emphasize users' needs, preferences, and emotions, ensuring that the app is tailored to provide a supportive and engaging experience for individuals seeking mental health support.
- To evaluate the effectiveness of a mobile application that utilizes evidence-based techniques, such as cognitive behavioural therapy, in the treatment of mental health issues. We will conduct a rigorous assessment of the app's impact on users' mental health outcomes.

### **1.4 RESEARCH METHODOLOGY**

This project seeks to explore the relationship between users' behavior in accessing mental health interventions through a mobile application designed to provide evidence-based techniques such as cognitive behavioural therapy. The application will be developed for both Android and iOS users, making it accessible to a broad range of individuals seeking mental health support. The primary aim of the app is to improve

mental health outcomes by providing a convenient, engaging, and effective platform for users to access interventions tailored to their needs.

The targeted user base for this application is not limited to any specific geographical location, as the app aims to have a global reach, addressing mental health concerns of individuals worldwide. The application intends to bridge the gap between conventional mental health treatments and the growing demand for accessible and affordable care. By providing users with the ability to access mental health interventions at their convenience, the app aims to reduce barriers to treatment and improve overall well-being.

Achieving these objectives necessitates a comprehensive, multi-pronged research methodology. The initial step involves an extensive review of existing literature on mobile mental health interventions, with a particular focus on their effectiveness and user engagement. Such an analysis will result in critical insights into the elements contributing to the success of mobile interventions, thereby guiding the development process of the application.

Next, we will develop the mobile application, incorporating evidence-based techniques like CBT and other features that promote user engagement and adherence. To ensure that the app is user-friendly and tailored to users' needs, we will involve mental health professionals, technology experts, and end-users in the development process, gathering their input and feedback throughout.

Once the app has been developed, we will evaluate its effectiveness through a survey-based assessment. Participants will be provided with access to the mobile application for mental health interventions and then asked to complete a survey. This survey will gauge their mental health outcomes, user engagement, and satisfaction with the app's features and functionalities. By collecting feedback directly from users, we aim to understand the real-world impact and usability of the app in a more organic setting.

Last, we will analyse the data collected from the trial, comparing the outcomes of the intervention group with those of the control group. This analysis will provide

valuable insights into the effectiveness of the mobile application in improving mental health outcomes and user engagement. It will also identify areas for potential improvement, informing the development of future mobile mental health interventions.

In summary, our research methodology includes a comprehensive literature review, the development of the mobile application with a human-first approach, and a rigorous evaluation of the app's effectiveness through a randomized controlled trial. By following this methodology, we aim to create a mobile mental health intervention that is accessible, engaging, and effective in improving users' mental well-being.

## 1.5 PROJECT OUTLINE

**Chapter 1** introduces the project, including the background, problem statement, motivation, objectives, and proposed approach.

**Chapter 2**, we will review existing systems that share similarities with our proposed mobile mental health intervention. This chapter will involve comparing various systems, as well as providing remarks on their effectiveness and areas for potential improvement.

**Chapter 3** delves into the project's technical aspects, presenting the top-down system diagram, proposed framework, use case diagram, activity diagram, and entity relationship diagram. This chapter will provide a clear understanding of the application's structure and functionalities.

**Chapter 4**, discusses system testing, including unit testing, functional testing, and integration testing. This chapter aims to evaluate the system's performance, stability, and overall effectiveness in delivering mental health interventions to users.

**Chapter 5** concludes the report by summarizing the project's achievements, offering a project review, and addressing implementation issues and challenges encountered throughout the development process. This chapter will also outline

potential future work that could enhance and expand the mobile mental health intervention.



# **CHAPTER TWO**

## **LITERATURE REVIEW**

### **2.1 INTRODUCTION**

Mobile technology offers a wealth of possibilities in revolutionizing mental health care delivery, particularly for those who may face obstacles when trying to access conventional treatment methods. The widespread use and easy accessibility of mobile devices enable us to create tailored mobile applications designed to provide effective mental health interventions. These interventions can take on various forms, including text messages, push notifications, and in-app content, making them accessible anytime, anywhere, via a smartphone or other mobile device.

However, the effectiveness of these interventions can sometimes be variable, highlighting the importance of developing applications anchored in evidence-based practices. Such practices can encompass proven techniques like CBT and mindfulness-based stress reduction (MBSR), which have shown effectiveness in addressing numerous mental health issues. Beyond incorporating evidence-based techniques, mobile applications can further improve intervention efficacy by incorporating features such as goal setting, progress tracking, personalized feedback, and social support networks.

It is vital to carry out thorough research to evaluate the effectiveness of mobile mental health interventions. This research involves comparing outcomes between individuals using the intervention and a control group receiving standard care. Through this type of research, we can acquire valuable insights into mobile mental health intervention effectiveness, shaping the development of future interventions in this area. By capitalizing on the prevalence and accessibility of mobile devices, mobile interventions can potentially reach a vast audience and make a meaningful positive impact on the mental well-being of people worldwide.

It is essential to stay informed about existing mobile mental health interventions and learn from their achievements and challenges. By emphasizing the importance of

evidence-based practices, user engagement, and continuous improvement, we can contribute to the ongoing advancement of mental health care. Through the development and implementation of innovative, effective, and accessible mobile interventions, we can support the mental well-being of countless individuals across the globe, ultimately transforming the landscape of mental health care for the better.

## **2.2 MENTAL HEALTH**

Mental health, as the World Health Organization (WHO) defines it, refers to a state where a person can realize their potential, maintain positive relationships, manage life's stressors, be productive, and contribute to their community (Galderisi et al., 2015). This complex concept has been looked at from different angles throughout history, but the focus remains on an individual's capability to lead a fruitful life and have a positive impact on society.

Other mental health definitions are centered around the absence of mental illness or the presence of positive mental health. (Fusar-Poli et al., 2020) suggests that mental health involves achieving ideal cognitive functioning, which allows people to accomplish tasks, forge meaningful connections, and effectively deal with challenges. This view highlights how good mental health can pave the way for satisfying and productive lives.

Other modern definition suggests that mental health is related to an individual's overall sense of well-being. (Galderisi et al., 2015) came with a new definition of mental health where he defined mental health as “mental health is a state of well-being in which an individual is able to fully exploit his or her potential”, this suggests that mental health is an important aspect of a person's overall health and functioning, and that it is possible for an individual to have good mental health or poor mental health.

In summary, the current definition of mental health encompasses a wide range of concepts, including the ability to function effectively in daily life, the absence of mental illness, and the presence of positive mental health. It is also increasingly recognized as being closely linked to overall physical health and well-being.

## **2.3 MOBILE APPLICATIONS IN MENTAL HEALTH PREVENTION**

Mobile applications, particularly those aimed at mental health intervention, leverage the widespread availability and functionality of smartphones and tablets to provide users with accessible and personalized mental healthcare solutions. These applications, ranging from symptom tracking to therapeutic exercises, offer significant potential for mental health prevention and management, providing users with tools for self-monitoring, stress management, and CBT interventions (Ma et al., 2014).

The current state of mobile app development is marked by rapid technological change and innovation. Mobile app developers are using a variety of technologies and tools to create apps that are more powerful, user-friendly, and immersive. One key technology in mobile app development is the use of cross-platform frameworks, which allow developers to create apps that can be used on multiple platforms, such as iOS and Android. This has greatly expanded the reach of mobile apps and has made it easier for developers to create apps for a wider audience. Moreover, mobile devices have seen tremendous growth in hardware and gained vast acceptance as target devices for developing multimedia-rich applications. (Gavalas & Economou, 2011).

The evolution of mobile applications from simple, platform-specific tools to complex, multifunctional software reflects the advancements in mobile technology. Modern mobile apps, especially in the context of mental health, are designed to access device features like GPS, camera, and sensors, which are instrumental in providing personalized mental health care interventions. The capacity to utilize these features for health tracking, mood monitoring, and therapeutic guidance transforms mobile devices into powerful tools for mental health prevention.

### **2.3.1 Types of Mobile Applications**

Mobile applications pertinent to mental health prevention generally fall under two main categories: native and hybrid applications, with a particular emphasis on the advantages of hybrid applications in this context.

### ***2.3.1.1 Native Mobile Application***

Native mobile applications, built specifically for a single mobile operating system, offer high performance and a user experience that is in complete harmony with the device's ecosystem. While these applications can effectively utilize device features for health-related functions, their development for individual platforms restricts their accessibility and increases costs, limiting their widespread use in mental health interventions (Kaczmarczyk et al., 2022).

### ***2.3.1.2 Hybrid Mobile Applications***

Hybrid mobile applications are a type of software application designed to run on various mobile platforms without the need for platform-specific coding. These applications are developed using a combination of web technologies such as HTML, CSS, and JavaScript, encapsulated within a native container. The native container runs the web application code and packages it into an app, allowing the hybrid app to function on different operating systems (OS) such as iOS, Android, and Windows.

The significance of hybrid mobile applications in mental health interventions is further validated by the clinical promise shown by mobile health apps, particularly those targeting anxiety and depression. Although the evidence base is emerging and not without its challenges, there is a growing consensus that these apps can serve as cost-effective, easily accessible, and low-intensity interventions. Such attributes are critical in the context of mental health prevention, where early and widespread access can significantly alter outcomes (Goldberg et al., 2022).

The hybrid approach utilizes frameworks such as Apache Ionic, React Native, and Flutter which offer pre-designed components, tools, and libraries to simplify the development process. These frameworks bridge the gap between the JavaScript code and native APIs, ensuring seamless integration and functionality.

However, despite the potential benefits, the landscape of mental health applications reveals a gap between availability and scientific validation. A systematic

review highlights the abundance of apps aimed at treating mood disorders but also underscores the lack of robust scientific evidence underpinning many of these applications. This disparity points to the need for more clinically oriented and systematic validation of mental health apps, ensuring their efficacy and safety for users.

## **2.4 MOBILE UI DESIGN PATTERNS FOR MENTAL HEALTH PREVENTION**

Crafting an effective mobile application involves paying close attention to the design of its user interface (UI). A well-designed UI can be a deciding factor for an app's success, significantly impacting its appeal and ease of use. The complexity of UI design lies in the subjective nature of aesthetic preferences. To standardize this process, industry experts have compiled UI design patterns that serve as effective solutions to common problems. Furthermore, mobile platform providers have established UI guidelines to support and harmonize UI design across their platforms.

In the realm of mobile health interventions, particularly for mental health prevention, UI design plays a pivotal role in enhancing user engagement and efficacy of the applications. Effective UI design patterns in mental health mobile applications should address specific user needs, facilitate ease of use, and foster a supportive and engaging environment. Below are critical design considerations and patterns that have been identified as influential in the context of mental health mobile interventions.

### **2.4.1 Microinteractions**

Microinteractions are small, task-based interactions that enhance the user experience by providing immediate feedback or guiding the user through the app's functionalities. In mental health applications, microinteractions can be particularly useful for encouraging engagement without overwhelming the user. For example, subtle animations or changes in colour can signal progress in a mood tracking feature or completion of a therapeutic exercise. The design and implementation of microinteractions should be intuitive and supportive, aiding users in their mental health journey without causing frustration or

confusion. They can also be employed to encourage positive behaviour, such as regular journaling or mood tracking (Mihalo & Halamova, 2021)

### **2.4.2 Navigation**

Navigation options are arranged horizontally, usually at the top or bottom of the screen. The options, often represented by an icon and a text, remain visible when one is selected, with the chosen option highlighted. This pattern is suitable when there are few navigation options.

Effective navigation is pivotal in mental health apps, where users seek quick and stress-free access to various tools and resources. A tab bar navigation, with clear icons and labels, provides an intuitive mechanism for users to switch between features such as mood tracking, mindfulness exercises, and educational content. This pattern is particularly effective in reducing cognitive load and enhancing the overall user experience by making essential functions readily accessible (Adel et al., 2022).

### **2.4.3 UI Elements**

The list design pattern presents navigation options in a vertical list, a useful method when the options are numerous. It is also effective for options with long titles, icons, or requiring subtext descriptions. Lists can be divided into categories, equipped with widgets for searching, ordering, and filtering, and actions can be applied to list items.

### **2.4.4 Personalization and User control**

This pattern includes a group of actions at the screen level that can change the current screen state or trigger navigation to another screen. The way to access this menu varies: it can be through a hardware button, a menu button widget, or it can always be visible on the screen.

#### **2.4.5 User-Centered Design (UCD)**

UCD is a design philosophy that places the end-user at the core of the design and development process. In the context of mental health applications, UCD involves an iterative process of testing and feedback, ensuring the app's features and design elements are aligned with the users' specific needs and preferences. By involving mental health app users in the design process, developers can uncover unique insights into the users' interactions, preferences, and barriers to use, allowing for the creation of more personalized and effective mental health interventions (Rangeswan et al., 2023) .

### **2.5 SERVER-SIDE APPLICATIONS**

Server-side applications in the field of mobile mental health interventions have rapidly evolved in the past decade, becoming a cornerstone in the effective and efficient delivery of interventions. This section of the literature review discusses this progression, focusing on the role of cloud computing and serverless functions.

Cloud computing has revolutionized the digital landscape by providing scalable, flexible, and cost-effective alternatives to traditional on-premises servers. This technology has facilitated the storage and analysis of large amounts of data generated by mobile health apps, thereby enhancing the efficiency and effectiveness of these interventions. Furthermore, cloud computing offers the opportunity to implement advanced data analytics, such as machine learning algorithms, that can provide personalized feedback and intervention strategies based on the individual's behaviour and mental state (Hashem et al., 2015).

Serverless computing, a more recent development within the cloud paradigm, has further transformed the development and operation of server-side applications. By abstracting the server infrastructure, it allows developers to focus on individual functions in their code, which are run in stateless compute containers that are fully managed by a cloud provider. This means that developers can devote their efforts to improving the core functionalities of their applications instead of managing and

operating servers. In the context of mobile mental health applications, serverless computing can accelerate the development of highly responsive and scalable applications capable of serving large populations.

A few studies have highlighted the potential benefits of utilizing serverless architectures for healthcare applications. For example, research conducted by (Almeida et al., 2019) demonstrated that serverless computing could effectively support the high scalability requirements of health apps, which typically experience peak demand during certain periods.

## **2.6 MENTAL HEALTH INTERVENTION METHODS**

### **2.6.1 Cognitive Behavioral Therapy (CBT)**

CBT has emerged as a leading psychotherapeutic intervention, given its strong empirical backing in the treatment of several psychological disorders. This approach, grounded in a comprehensive theoretical framework, has demonstrated its effectiveness, particularly in mitigating symptoms of depression and anxiety, as highlighted in numerous Randomized Controlled Trials (RCTs) and meta-analyses.

CBT operates based on the premise that maladaptive cognitive patterns are the foundation for various psychological problems. Thus, its primary objective is to identify and subsequently modify such negative patterns of thinking and behaviour. This involves helping patients to challenge their distorted cognitions and change their destructive patterns of behaviour, resulting in an improved mood and overall well-being (Hofmann & Smits, 2017).

The efficacy of CBT in the treatment of depression is well documented in research literature. A notable meta-analysis by Hofmann et al. (Hofmann et al., 2012) included many studies involving more than 10,000 participants. The study found strong evidence supporting the use of CBT as an effective treatment for depression and various other mental health disorders.

CBT's success in treating anxiety disorders has also been significant. In 2015, a meta-analysis by Cuijpers et al. (Cuijpers et al., 2014) focused specifically on the effectiveness of CBT for adult anxiety disorders. The results showed that CBT was superior to other forms of therapy for almost all types of anxiety disorders. This evidence strongly positions CBT as a highly beneficial intervention for anxiety.

The functionality of CBT extends beyond the treatment of depression and anxiety, though. Studies have also shown it to be highly effective in treating other psychological conditions such as post-traumatic stress disorder (PTSD) (Powers et al., 2010), obsessive-compulsive disorder (OCD) (Hofmann & Smits, n.d.) and even physical conditions like chronic pain. These findings further underscore the versatility and broad-ranging effectiveness of CBT.

Furthermore, the principles of CBT have been successfully incorporated into other forms of therapy, contributing to the development of innovative therapeutic approaches like Dialectical Behaviour Therapy (DBT), Acceptance and Commitment Therapy (ACT) and Mindfulness based Cognitive Therapy (MBCT).

Despite its numerous strengths, it is important to note that CBT is not a one-size-fits-all therapy and may not be effective for everyone. Moreover, while it is largely considered a short-term treatment, some individuals may require a longer period to make significant improvements. It also requires active participation and engagement from the individual, and those who may be less willing to engage may not experience the full benefits of this therapeutic approach.

To sum up, CBT's evidence-based approach, backed by extensive clinical research and positive patient outcomes, has led to its widespread recognition as an effective treatment for a variety of mental health conditions. Its focus on modifying maladaptive cognitive patterns and behaviours addresses the root causes of these disorders, helping individuals lead healthier and more fulfilling lives. (Hofmann et al., 2012)

## 2.6.2 Mindfulness-Based Interventions

Mindfulness-Based Interventions (MBIs) have been increasingly recognized in the psychotherapeutic landscape for their profound impact on mental health. Particularly, Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT) have shown promise in the effective management and treatment of depression and anxiety disorders. These interventions are structured on the principle of mindfulness, a state of being attentively present to the current moment without judgment. They incorporate practices such as meditation and yoga, which cultivate awareness and acceptance (Khoury et al., 2013)

MBSR, developed by Jon Kabat-Zinn in the late 1970s, was initially designed to help individuals cope with chronic pain and stress-related conditions. MBSR involves an eight-week program that encompasses mindfulness meditation, body awareness, and yoga exercises. Through these practices, participants learn to foster a more accepting and non-reactive relationship with their experiences, thereby reducing stress and enhancing overall well-being (Khoury et al., 2013)

Several studies have demonstrated the effectiveness of MBSR in reducing symptoms of depression and anxiety. A meta-analysis conducted by Khoury et al. in 2015 examined 209 studies and concluded that MBSR had a significant impact in reducing anxiety and depression symptoms (Khoury et al., 2013). This work serves to consolidate the role of MBSR as a promising intervention for these mental health issues.

MBCT, another form of MBI, is a novel therapy that integrates mindfulness practices with aspects of cognitive-behavioral therapy. It was initially developed to prevent relapse in recurrent major depressive disorder. MBCT focuses on decentering or disengaging from dysfunctional cognitive processes (such as rumination and worry) that could potentially lead to a depressive relapse. This approach provides individuals with a different way to relate to distressing thoughts and feelings [2].

A considerable body of research supports the efficacy of MBCT in preventing depressive relapse. RCT by Kuyken et al. in 2016 showed that MBCT, combined with discontinuation of antidepressants, had a similar relapse rate to the continuation of

antidepressants. This study established MBCT as a viable option for people seeking non-pharmacological alternatives to prevent depressive relapse [2].

While MBSR and MBCT share many similarities, they also have distinct characteristics. MBSR generally focuses on stress reduction and the enhancement of well-being, making it appropriate for a wide range of people. On the other hand, MBCT is specifically targeted at individuals with recurrent depressive disorder and has a significant cognitive component. Despite these differences, both interventions uphold the principles of mindfulness, emphasizing non-judgmental awareness, acceptance, and compassion (Khoury et al., 2013)

Beyond depression and anxiety, MBIs have shown potential in various other contexts. They have been employed in the treatment of chronic pain, substance use disorders, and eating disorders. Additionally, they have been adapted for use in various settings such as schools, prisons, and workplaces, indicating their versatility and adaptability (Black & Slavich, 2016).

However, despite their many benefits, MBIs may not be suitable for everyone. Some individuals might find mindfulness practices challenging or uncomfortable. Certain adverse effects, such as temporary increases in anxiety or distress, have also been reported, underscoring the importance of professional guidance during these practices (Black & Slavich, 2016)

To conclude, the mounting evidence from meta-analyses and RCTs reveals the significant potential of MBIs, particularly MBSR and MBCT, in managing and treating depression and anxiety disorders. By enhancing self-awareness and fostering a non-judgmental stance toward personal experiences, these interventions offer valuable strategies for individuals to navigate their mental health challenges.(Khoury et al., 2015)

### **2.6.3 Interpersonal Therapy (IPT)**

Interpersonal therapy (IPT), a structured and time-limited psychological intervention, initially sprang from the desire to find effective treatments for depression. A noteworthy feature of IPT is its primary focus on an individual's ongoing relationships and how these relationships interweave with the individual's psychological symptoms. In the heart of IPT lies the understanding of the roles of interpersonal and societal factors in the emergence and persistence of mental health symptoms. IPT strives to enhance communication, lessen symptoms, boost interpersonal skills, and ultimately uplift the quality of life.

Adolf Meyer and Harry Stack Sullivan, pioneers in psychology, paved the way for IPT with their emphasis on interpersonal relationships and societal roles as integral to mental health. Following their footsteps, Gerald Klerman and Myrna Weissman developed IPT in the 1970s. It was initially conceived as a research intervention for a clinical trial aimed at comparing its efficacy with that of cognitive-behavioral therapy (CBT), the reigning therapeutic method at the time (Andersson & Van Oppen, n.d.).

IPT's foundation is built on the understanding that mood and life circumstances are inextricably linked. Its primary objective is to assist individuals in comprehending and managing issues in their current social roles and relationships, thereby directly addressing the source of their distress. To achieve this, IPT tends to focus on one of four interpersonal problem areas - unresolved grief, role transitions, role disputes, or interpersonal deficits. This focus allows IPT to zero in on and resolve the present interpersonal crises contributing to the individual's distress.

IPT's effectiveness in treating depression has been confirmed by various clinical trials and meta-analyses. For instance, a comprehensive meta-analysis by Cuijpers et al. found IPT to be an effective method for treating depression, even comparable to CBT in terms of outcomes. Furthermore, studies have indicated that the therapeutic effects of IPT can last well beyond the conclusion of the treatment period (Andersson & Van Oppen, n.d.).

Remarkably, IPT's effectiveness is not confined to treating depression. Research has indicated that IPT can significantly reduce symptoms of various other psychological disorders. For example, a study by Markowitz et al. discovered that IPT substantially reduced symptoms in individuals with bulimia nervosa. Furthermore, IPT was found to be effective in reducing symptoms of Post-Traumatic Stress Disorder (PTSD) according to a meta-analysis by Lipsitz et al (Markowitz et al., 2015).

Interestingly, IPT has also shown promise when applied to younger populations, despite its original design targeting adults. IPT-A, an adaptation of IPT for adolescents, was found effective in treating adolescent depression, bolstering interpersonal functioning, and enhancing self-esteem (Andersson & Van Oppen, n.d.).

One of the most commendable aspects of IPT is its flexibility. IPT has been adapted to cater to various modalities, including group formats (IPT-G), telephone-based, internet-based versions (IPT-T and IPT-I), and combined with medication. These varied formats have shown comparable efficacy to the standard individual IPT, thereby expanding its accessibility and potential reach (Markowitz et al., 2015)

In summary, IPT stands as a resilient, evidence-based therapeutic approach with demonstrated efficacy across a range of psychological disorders. Its distinctive focus on current interpersonal relationships and societal roles offers a valuable perspective within the psychotherapy landscape, making it an effective tool in modern mental health management.(Cuijpers et al., 2016)

## **2.7 MENTAL HEALTH INTERVENTION USING MOBILE APPLICATIONS**

Mental health disorders, such as depression and anxiety, are increasingly common and can have significant negative impacts on an individual's quality of life. Traditional forms of mental health treatment, such as therapy and medication, can be expensive and time-consuming, and may not be accessible to everyone. Mobile applications, or apps, offer a convenient and cost-effective alternative for mental health intervention. These apps can provide tools and resources for self-management, such as stress and anxiety

reduction techniques, as well as connect individuals with mental health professionals for support and guidance.

The use of mobile apps for mental health intervention has gained popularity in recent years, with a growing number of apps available for download from app stores. However, the effectiveness of these interventions has not been fully established, and there is a need for more research to understand the potential benefits and limitations of mobile apps for mental health. The purpose of this literature review is to summarize the current state of research on mental health intervention using mobile apps and to identify areas for future research.

Most of the studies examined the use of mobile apps for the treatment of specific mental health disorders, such as depression and anxiety. A smaller number of studies examined the use of mobile apps for the prevention of mental health problems or for the promotion of mental well-being.

The results of the studies were mixed, with some studies finding significant improvements in mental health outcomes among individuals who used mobile apps (Arean et al., 2016), while others found no significant differences between the intervention and control groups (Rathbone & Prescott, 2017). Factors that may have influenced the effectiveness of the interventions included the type of app used, the frequency of use, and the specific mental health problem being targeted.

One of the main limitations of the studies included in the review was the lack of long-term follow-up (Rathbone & Prescott, 2017), with most studies only examining the immediate effects of the interventions. This makes it difficult to determine the sustainability of the benefits of mobile app interventions over time.

## **2.8 RELATED WORK**

The use of mobile applications for mental health interventions has gained increasing popularity in recent years to provide accessible and convenient support for individuals seeking help for mental health concerns. However, there is a need for more research to

understand the effectiveness of these interventions and to identify best practices for their development and implementation.

The purpose of this section is to review the existing literature on the use of mobile applications for mental health interventions. The review will focus on studies published in the past five years and will consider a range of mental health conditions including but not limited to anxiety, depression, and stress. The review will also consider the various features and formats of mental health apps, as well as the effectiveness and usability of these interventions.

### **2.8.1 Anxiety**

Mobile applications have been shown to be effective in the treatment of anxiety disorders, with several studies demonstrating significant reductions in anxiety symptoms following the use of these interventions. One study found that a mobile app featuring CBT exercises was effective in reducing anxiety symptoms in a sample of college students (McCloud et al., 2020). Another study found that a mindfulness-based mobile app was effective in reducing anxiety and improving well-being in a sample of adults (Huberty et al., 2021).

### **2.8.2 Depression**

Mobile apps have also been shown to be effective in the treatment of depression (Arean et al., 2016) (Addepally & Purkayastha, 2017a) (Addepally & Purkayastha, 2017b), with several studies demonstrating significant improvements in depression symptoms following the use of these interventions. One study found that a mobile app featuring CBT exercises was effective in reducing depression symptoms in a sample of adults.

### **2.8.3 Stress**

Mobile apps have been shown to be effective in the management of stress, with several studies demonstrating significant reductions in stress symptoms following the use of these interventions. One study found that a mobile app featuring mindfulness-inspired protocol was effective in reducing stress in a sample of adults. Another study found that a mobile app featuring CBT exercises was effective in reducing stress in a sample of college students (Huberty et al., 2019).

Overall, the literature review suggests that mobile apps can be effective in the treatment and management of anxiety, depression, and stress. These interventions offer a convenient and accessible way for individuals to receive support for their mental health concerns. However, there is a need for further research to identify best practices for the development and implementation of these interventions and to understand the long-term effectiveness of these treatments. Future research should also consider the usability and user experience of these interventions, as well as the potential for integration with other forms of treatment.

## **2.9 RELATED WORK SUMMARY**

Huberty et al. (2019) investigate the effects of mindfulness meditation, reporting significant reductions in stress, enhancements in mindfulness, and self-compassion among participants. However, the study's limited sample size of 88 participants raises concerns about the generalizability of these findings to broader populations.

McCloud et al. (2020) examine (CBT) through the Feel Stress Free app, noting reductions in depression symptoms and suggesting less conclusive effects on anxiety symptoms. Despite the frequent use of the app among participants, the absence of a non-waitlist control group and the short six-week follow-up period limit the study's robustness.

Addepally and Purkayastha (2017b) introduce MoodTrainer, a self-efficacy tool utilizing CBT for self-monitoring and clinical assistance, highlighting its cost-

effectiveness and applicability in low-resource settings. However, the lack of testing in Randomized Controlled Trials (RCTs) and the need for better personalization in mental health treatment are noted as significant limitations.

Huberty et al. (2021) further delve into mindfulness meditation, focusing on adults with sleep disturbances. They find improvements in depression and anxiety, attributed to reductions in pre-sleep arousal. The study's recruitment strategy and unblinded design, alongside its wait-list control group, are pointed out as drawbacks.

Mak et al. (2018) compare mindfulness meditation and CBT, recognizing their efficacy in improving mental well-being and reducing psychological distress. However, high attrition rates and the unguided nature of interventions are cited as factors compromising the programs' effectiveness.

Proudfoot et al. (2013) highlight the integration of various therapeutic approaches, including CBT and positive psychology, in my Compass app. While its effectiveness in enhancing mental well-being is acknowledged, the research's limitations stem from its small, non-randomized design and the absence of long-term follow-up.

Torous et al. (2015) introduce Mindful Moods, a custom smartphone app for depression symptom tracking, showcasing high adherence and a strong correlation with traditional symptom assessment methods. The small sample size, lack of a control group, and missing treatment data, however, limit the study's applicability.

Kinderman et al. (2016) observe significant mood improvements among CBT app users, though engagement and demographic diversity remain challenges.

Mira et al. (2014) document improvements in medication adherence and error reduction through a single-blind randomized trial, cautioning that the small sample size may hinder broader applicability and long-term effectiveness assessments.

Lastly, Whittaker et al. (2012) report positive impacts of a CBT-based SMS text messaging intervention on participant outlook, despite potential biases from self-reported adolescent outcomes and unmeasured mediators.

This compilation underscores the diverse methodologies and outcomes in digital mental health interventions, highlighting the importance of robust study designs, participant engagement, and the consideration of demographic variables to enhance the generalizability and efficacy of findings.

## **2.10 SUMMARY**

The field of mobile health, especially mental health applications, is undergoing rapid growth and has the potential to transform the accessibility of mental health resources around the world.

Despite their promise these apps still face various challenges. One major challenge is that they are often introduced to the market without rigorous scientific evaluation leaving uncertainties about their effectiveness in comparison to traditional face to face treatments.

Our exploration into the realm of mental health prevention reveals that mobile applications can be an instrumental tool in providing support to individuals. These applications offer a combination of convenience and accessibility that opens new possibilities for individuals who might otherwise struggle to access mental health resources, such as those living in remote locations, or those juggling the demands of work and family life.

What makes these applications even more appealing is the potential for personalization and on-demand access. No longer are users confined to the traditional in-person consultations or 9-5 operating hours. Instead, help can be sought when it is most needed, and in the privacy of one's own home.

The user experience of using these mobile applications is underexplored. User experiences may significantly influence the effectiveness of these interventions, and usability issues may be a significant barrier to sustained usage. Future research needs to investigate user experience aspects and integration with other forms of treatment.

However, it is important to approach the topic with a balanced view. While there's great promise, the effectiveness of these applications can vary significantly. Factors contributing to this variation include the specific design of the app, the psychological strategies it employs, its user-friendliness, and how well it caters to the unique needs of different users. For instance, an app based on CBT might work wonders for one individual but be less effective for another who would benefit more from mindfulness-based strategies.

The path forward, therefore, involves a continuous commitment to research in order to gain a deeper understanding of these applications' effectiveness. We need to answer questions like: How can we make these applications more effective? What are the best practices in designing these apps? How do we ensure they meet the varied needs of users while remaining accessible and user-friendly?

To put it another way, we have seen the tip of the iceberg, and there's promise beneath the surface. But we also need to navigate the challenges carefully. By doing so, we can harness the full potential of mobile applications in mental health prevention and make strides in addressing the mental health crisis. This will not only improve individual lives but also create healthier communities and societies.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 INTRODUCTION

In this study, we aim to develop a robust and impactful mobile application specifically designed to address and alleviate mental health disorders. The proposed system comprises three fundamental components:

- End-User Mobile Application (Front-end) developed using React Native.
- Admin Dashboard (Front-end) developed using React.
- Back-End System built with NestJS, hosted on AWS, and integrated with Firebase for added functionalities.

The first step in the development process involves designing the UI for both the mobile application and the admin dashboard. Given that our target users are individuals struggling with mental health disorders we utilize UCD as our approach. This approach prioritizes the needs, preferences, and experiences of the end users through iterative prototyping and validation testing. To ensure that the app is effective.

The app utilizes techniques such as user interviews, focus groups, and usability testing. In terms of backend infrastructure, we aim to create a real-time system due to the time-critical nature of mental health intervention. This requires blending two architectures: REST architecture for non-time-critical functionalities like blog posts and a Publish/Subscribe (Pub/Sub) model for real-time features like chat and notifications. The choice of NestJS as the system back-end system is because of its modularity, scalability, and maintainability.

Moreover, for reliable cloud services deployment and management purposes, we opt for AWS. Additionally, Firebase is integrated for push notification and user third-party user authentication capabilities, and other cloud services.

To assess how effective our application is, a survey research was also conducted as a part of the thesis. Surveys allow us to gather extensive data from a diverse group of

participants. Through the survey. The user attitude will be evaluated, behaviors, and perceptions regarding the effectiveness of our apps' impact on their mental health. In summary, a hybrid research methodology, combining user-centered design principles for app development followed by survey research for user experience evaluation, offers a promising approach for constructing a highly effective mental health prevention mobile app. This approach seamlessly amalgamates the technology of React Native, React, AWS, Firebase, and NestJS to revolutionize mental health intervention.

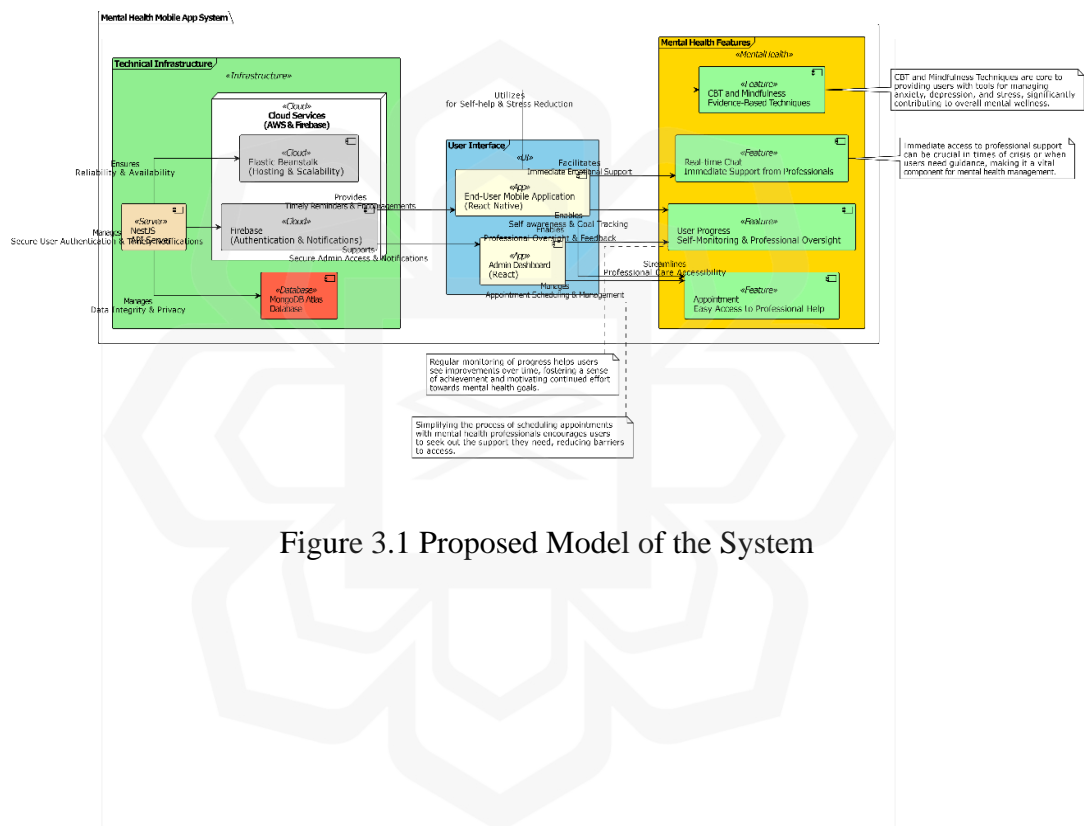


Figure 3.1 Proposed Model of the System

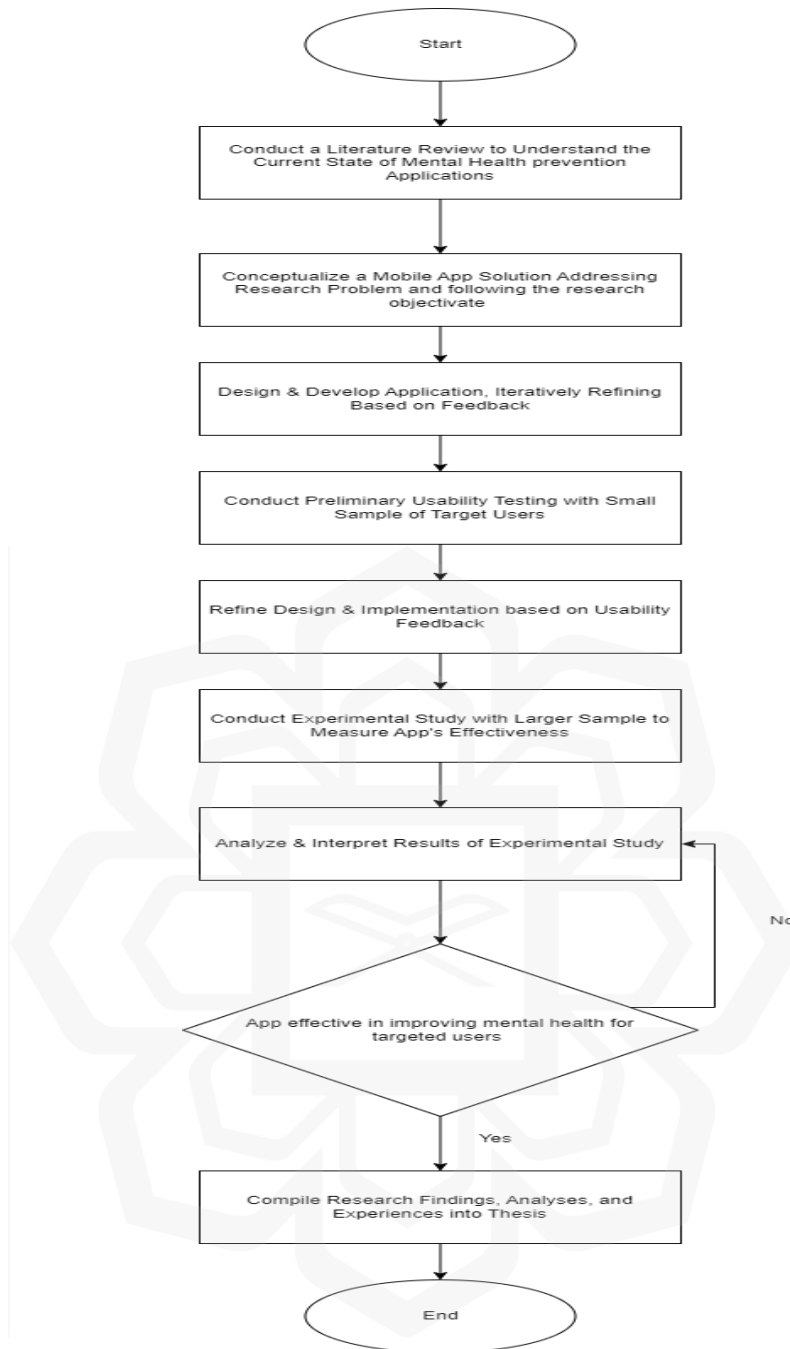


Figure 3.2 Project plan

### 3.2 PROPOSED MODEL OF THE SYSTEM

The ultimate output of this project is a meticulously designed mobile application that aims to provide a comprehensive tool for effective interventions targeting mental health issues. To achieve this goal utmost adherence has been given to aligning the development of this mobile application with the presented system framework. Leading

us towards an innovative approach in tackling challenges associated with managing mental health concerns. Boasting an array of resources and utilities essential for optimal management of one's mental well-being. This mobile application includes features sourced from CBT and mindfulness-based stress reduction techniques – methods that have gained scientific recognition. Seamlessly integrated within the application.

These features provide users with practical and impactful tools to address their mental health needs. Furthermore, the mobile application facilitates users in consistently monitoring their mental health progress, conveniently scheduling appointments according to their preferences and receiving personalized feedback tailored directly to their mental health status and improvements made. The overarching objective of personalizing this mobile application is to ensure its effectiveness for individual users through adaptability to diverse needs. It is this trait that sets the app apart in terms of efficacy and relevance for every person utilizing it for mental health management. An integral part of this system is the admin dashboard. The dashboard is designed to empower mental health professionals to manage user accounts efficiently, supervise their progress continuously, and provide timely, effective feedback. This vital feature maintains a steady line of communication and interaction between the mental health professionals and users, thereby reinforcing the app's efficiency.

Furthermore, an integral aspect of this platform is its configuration that enables seamless communication between users and health professionals via message exchange. The significance of this feature amplifies during emergency situations where prompt access to help becomes paramount for individuals in need.

Additionally, when utilizing specific components offered by the application such as scheduling capabilities; action triggers occur initiating requests within the framework handled by dedicated administrators who validate and authorize them meticulously guaranteeing optimum performance whilst sustaining effortless user experience.

The User Features Flow is a crucial component of the mobile application, designed to provide an intuitive interface for the users. It allows users to effectively manage their mental health by offering tools to monitor their progress, schedule appointments, and receive personalized feedback. These tools have been developed

utilizing evidence-based mindfulness-based stress reduction techniques, acknowledged globally for their effectiveness in managing mental health issues.

The User Features Flow incorporates a real-time chat feature. This communication feature allows users to interact directly with mental health professionals when necessary. By providing instant support and guidance, it significantly bolsters the user's ability to manage their mental health effectively.

Moreover, the user interface has been designed using a user-centered approach. This methodology emphasizes the needs and preferences of the user, aiming to create an interface that is both user-friendly and efficient in promoting mental health.

The system's backend is hosted on AWS Elastic Beanstalk (EBS), renowned for its robustness and reliability. EBS provides real-time capabilities for time-critical features such as chat and notifications. Alongside this, MongoDB Atlas is utilized as the main database to securely store and efficiently retrieve user data.

In conclusion, the system's framework is a comprehensive, user-friendly, and effective platform for managing mental health. It combines the latest research and best practices in mental health interventions to ensure that users have the most effective tools and support available to manage their mental health.

### **3.2.1 System Requirements**

This section presents the system requirements. The application requirements can be categorized into Functional and Non-Functional requirements. Functional requirements encompass the capabilities and functions that a system must successfully perform. On the other hand, Non-Functional requirements define the qualities and criteria used to evaluate the operation of a system.

## Functional Requirements

A functional requirement specifies a function or a component of a system. These requirements are complemented by nonfunctional requirements that establish constraints on the design or implementation. Typically, functional requirements are expressed as "the system must do <requirement>" (Balduini et al., 2019). Table 3.1 shows the mental health application functional requirements.

Table 3.1 Functional Requirements

<b>ID</b>	<b>Description</b>	<b>Explanation</b>
FR01	Users must be able to sign up.	The user must be able to sign up filling out a form with their name, email and password.
FR02	Users must be able to log into the system.	Users must be able to log into the system using their email and password.
FR03	Users must be able to log out of the system at any time.	Users must be able to log out of the system at any time by pressing the log out button in the application's menu.
FR04	User must view and check different meditation tracks	Users must be able to change their email or password after they are logged in.
FR05	The system must provide an error recognition message in case of error.	If any error occurs during operations such as login, registration, or account detail changing, an error message should be displayed.
FR06	Users must be able to schedule appointments.	The system should provide a scheduling feature for users to set appointments with mental health professionals.

FR07	Users must be able to monitor their progress.	The system should provide a feature to monitor the progress of the user's mental health journey.
FR08	Admin must be able to monitor users' progress.	The admin dashboard should display a comprehensive view of users' progress for monitoring purposes.
FR09	Admin must be able to provide feedback to users.	Through the admin dashboard, professionals should be able to provide feedback to users.
FR10	Users must be able to communicate with professionals.	The system should provide a real-time chat feature for communication between users and mental health professionals.
FR11	Admin must be able to manage user accounts.	The admin dashboard should provide functionalities to manage user accounts effectively.
FR12	Users should receive notifications for appointments and feedback.	The system should send notifications to users for upcoming appointments and when new feedback is provided.
FR13	The system should support data storage and retrieval.	User data, appointments, progress reports, and feedback should be stored and retrieved efficiently using MongoDB Atlas.
FR14	The system should maintain data security.	All user data should be stored securely in compliance with data protection laws and regulations.
FR15	The system should provide timely and reliable services.	The system, hosted on AWS Elastic Beanstalk, should ensure high availability and scalability for timely and reliable services.
FR17	The system should support seamless user experience.	The system should be user-friendly and ensure a seamless user experience on

		both the mobile application and the admin dashboard.
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## Non-Functional Requirements

Non-functional requirements (NFRs) in software development refer to the criteria that define the system's operation, rather than its behaviors. They describe how a system should work rather than what it should do. These requirements are related to system properties and settings. Table 3.2 shows the non-functional requirements in the mental health application.

Table 3.2 Non - Functional Requirements

ID	Description	Explanation
NFR01	The user interface must be easy to use and consistent across all screens.	All elements of the UI such as buttons, menus, and layouts should be consistent throughout the application. This ensures the user can predict and learn the system's behaviour.
NFR02	The system should provide clear and detailed notifications to users.	The system should display notifications with detailed information regarding the status of any operation. This could include completion of a task or an alert requiring user attention.
NFR03	The system should be robust and free of bugs.	The application should be thoroughly tested to eliminate bugs. Any error that does occur should be logged and users should be notified of errors in a user-friendly manner.
NFR04	The application should be compatible across all devices.	The system should be designed to run efficiently on all devices, including mobiles, tablets, or any device that uses iOS or Android operating system.

NFR05	The system should require secure authentication.	The system should not provide access to features without a user logging in to their account using secure authentication methods.
NFR06	The system should be responsive.	The system should provide quick responses to user interactions. If an operation requires time to process, a loader should be displayed to inform the user.
NFR07	The system should be easily extendable.	The system's architecture should be designed to allow for easy integration of new features and operations by developers.
NFR08	The system should maintain user privacy and security.	The system should secure users' personal data and comply with privacy regulations. All communications should be encrypted to prevent data breaches.
NFR09	The system should be scalable.	The architecture should be designed to handle an increase in users or data size without a decrease in performance.
NFR10	The system should have good performance under high load.	The system should maintain good performance even when dealing with a high number of simultaneous requests or a large volume of data.
NFR11	The system should have a disaster recovery plan.	In the event of a system crash or failure, the system should have a disaster recovery plan to minimize downtime and data loss.
NFR12	The system should be maintainable.	The system should be easy to modify and improve over time. This includes having clear, well-documented code and a well-thought-out architecture.

### 3.2.2 Use Case Scenarios

A use case scenario in software development, also known as a user story, is a description of a system's behavior as it responds to a request from a user or another system. Tables

below show all the user cases for mental health app. Table 3-3 shows the use cases of the mental health application.

Table 3.3 Registration Use Case

<b>Use Case Name</b>	Registration
<b>Actor</b>	User
<b>Precondition</b>	Application is in operational state.
<b>Trigger</b>	User's desire to create a new account
<b>Postcondition</b>	A new account has been created, enabling User to log in
<b>Main Flow:</b>	<ol style="list-style-type: none"> <li>1. The User engages 'Register' function.</li> <li>2. User inputs requisite information (name, email, password), then submits.</li> <li>3. System validates input and initiates account creation.</li> <li>4. Upon successful account creation, the system displays a success notification and prompts User to log in.</li> </ol> <p><b>Alternative Flows:</b></p> <p>A1. In case the entered email already exists within the system, an error message is returned.</p> <p>A2. System returns an error message if there's a network connectivity issue.</p>
<b>Use Case Name</b>	Schedule Therapist Appointment
<b>Actor</b>	User
<b>Precondition</b>	Application is in operational state and User is authenticated
<b>Trigger</b>	User's intention to schedule an appointment

<b>Postcondition</b>	Appointment is successfully booked and both User and Therapist receive notifications.
<b>Main Flow:</b>	<ol style="list-style-type: none"> <li>1. User navigates to 'Appointments' feature.</li> <li>2. User engages 'Book Appointment' function.</li> <li>3. System displays list of available therapists along with their schedules.</li> <li>4. User selects a Therapist and a time slot, then submits the booking.</li> <li>5. System reserves the time slot, sends confirmations to User and Therapist.</li> </ol> <p><b>Alternative Flows:</b></p> <p>A1. System returns an error message if selected time slot is already booked.</p> <p>A2. System returns an error message if there's a network connectivity issue.</p>
<b>Use Case Name</b>	Listen to Meditation Tracks
<b>Actor</b>	User
<b>Precondition</b>	Application is in operational state and User is authenticated
<b>Trigger</b>	User's desire to listen to meditation tracks
<b>Postcondition</b>	User is listening to the selected meditation track
<b>Main Flow:</b>	<ol style="list-style-type: none"> <li>1. User navigates to 'Meditation Tracks' feature.</li> <li>2. System displays a list of available meditation tracks.</li> <li>3. User selects a track and engages 'Play' function.</li> <li>4. System starts playing the selected track.</li> </ol> <p><b>Alternative Flows:</b></p> <p>A1. System returns an error message if there's a problem with the audio file.</p>

	A2. System returns an error message if there's a network connectivity issue.
<b>Use Case Name</b>	Event Posting
<b>Actor</b>	Admin
<b>Precondition</b>	Application is in operational state and Admin is authenticated.
<b>Trigger</b>	Admin's decision to post a new event.
<b>Postcondition</b>	Event is successfully posted, and users receive notifications.
<b>Main Flow:</b>	<ol style="list-style-type: none"> <li>1. Admin navigates to 'Events' feature.</li> <li>2. Admin engages 'New Event' function.</li> <li>3. System presents an event creation form.</li> <li>4. Admin inputs event details and confirms.</li> <li>5. System broadcasts the event, notifies all users.</li> </ol> <p><b>Alternative Flows:</b></p> <p>A1. System returns an error message if required fields are left blank.</p> <p>A2. System returns an error message if there's a network connectivity issue.</p>
<b>Use Case Name</b>	Notification Sending
<b>Actor</b>	Admin
<b>Precondition</b>	Application is in operational state, and there is a new event, appointment, or update that needs to be communicated to the user.
<b>Trigger</b>	The occurrence of a specific event that requires the sending of a notification (like a new appointment, event posting, or update).
<b>Postcondition</b>	The user receives the notification and is aware of the new event, appointment, or update.

<b>Main Flow</b>	<ol style="list-style-type: none"> <li>1. A specific event occurs in the system that triggers the need for a notification (like a new appointment, event posting, or update).</li> <li>2. The system creates a notification related to this event.</li> <li>3. The system sends the notification to the relevant user or users.</li> <li>4. The user receives and views the notification.</li> </ol>
<b>Use Case Name</b>	Chatting with Patients
<b>Actor</b>	User, Admin
<b>Precondition</b>	Application is in operational state and both User and Admin are authenticated.
<b>Trigger</b>	User's or Admin's intention to start a chat.
<b>Postcondition</b>	A conversation between User and Admin is initiated or ongoing.
<b>Main Flow</b>	<ol style="list-style-type: none"> <li>1. User or Admin navigates to 'Chat' feature.</li> <li>2. User or Admin selects a chat partner from the list of available chat partners.</li> <li>3. The system displays the chat interface.</li> <li>4. User or Admin sends a message.</li> <li>5. The system sends the message to the recipient.</li> </ol> <p><b>Alternative flows:</b></p> <p>A1. System returns an error message if there's a network connectivity issue.</p> <p>A2. System returns an error message if the chat partner is not available for chat.</p>

### 3.3 USER TYPES

The Mental health applications has 3 user types:

- **Administrator:** The Administrator holds the key to content management within the app, with the power to oversee and alter appointments, tracks, blogs, and event postings. Additionally, they can moderate user statuses. For enhanced security and control, the Administrator's dashboard is exclusively accessible via the web interface.
- **Peer Counsellor:** The Peer Counsellor is equipped with the capabilities to accept and finalize appointments. They are also empowered to initiate live chats with clients, fostering real-time communication and support. To provide flexibility and convenience, the Peer Counsellor can access the application's features through both mobile and web interfaces.
- **App User:** The App User can explore various resources including tracks, events, and blogs. They also can schedule appointments and monitor their progress, facilitated by an integrated chat functionality, thereby enhancing their interaction and engagement with the app.

### 3.4 ACTIVITY DIAGRAMS

Activity diagrams are a type of behavioral diagram in the field of software engineering and systems modeling, primarily used within the Unified Modeling Language (UML). They visually depict the dynamic behavior of a system by showing the sequence of activities, the flow of control from one activity to another, and the concurrent operation of multiple activities.

Essentially, an activity diagram illustrates the step-by-step operational flow within a system, emphasizing how different parts of the system interact during its execution. It enables the clear and precise modeling of complex procedural logic and supports the representation of both sequential and parallel activities. As such, they are widely used in business process modeling and software development to identify and understand the system's various processes, roles, and procedural paths. Figures 3.2 – 3.6 show the activity diagrams of the application.

Figure 3.2 illustrates the registration process within the app. When a user attempts to register, they are guided through a series of steps where the system validates their input. If the email already exists or there is a network issue, the system informs the user accordingly. Successful registration results in a success message, and the user can then log in. The simplicity and clarity of the registration process can set the tone for the user's experience with the app. A stress-free and successful registration can increase a user's confidence in using the app and reduce anxiety related to technology use, thereby encouraging engagement with mental health resources available within the app.

The activity diagram shown in Figure 3.3, the focus is on scheduling appointments within the app. The user finds and selects a therapist and time slot. If the desired time slot is taken or there is a network issue, the app provides feedback. Otherwise, the appointment is booked, and the system confirms this to the user. By facilitating easy access to mental health professionals, this feature directly supports users in seeking help. The hassle-free process can alleviate the stress of making appointments, a task that can be daunting for individuals already coping with mental health challenges.

The diagram In Figure 3.4 depicts the process by which an admin can create new events in the app. If required fields are missing or there is a network issue, the system prompts the admin. Successful creation leads to system-wide notifications. This function can directly affect community engagement within the app. Events can be therapeutic sessions or group activities that encourage user participation, fostering a sense of community and shared experience, which are important for mental wellness.

In the activity diagram shown in Figure 3.5, the user navigates to the Meditation Tracks section and selects a track to play. If there is a problem with the audio file or a network issue, the system informs the user. Meditation tracks are vital tools for relaxation and mindfulness, which are beneficial for mental health. Seamless access to these resources can aid in stress reduction and provide users with coping mechanisms for anxiety and depression.

The last activity shown in Figure 3.6 The diagram shows the chat functionality, where a user or admin selects a chat partner and engages in a conversation. If the partner

is unavailable or there's a connectivity issue, the system notifies the user accordingly. The chat feature may serve as a lifeline for users in need of immediate support, whether from peer counselors or mental health professionals. Timely communication can be crucial for users who require urgent assistance or those seeking a connection to alleviate feelings of isolation.

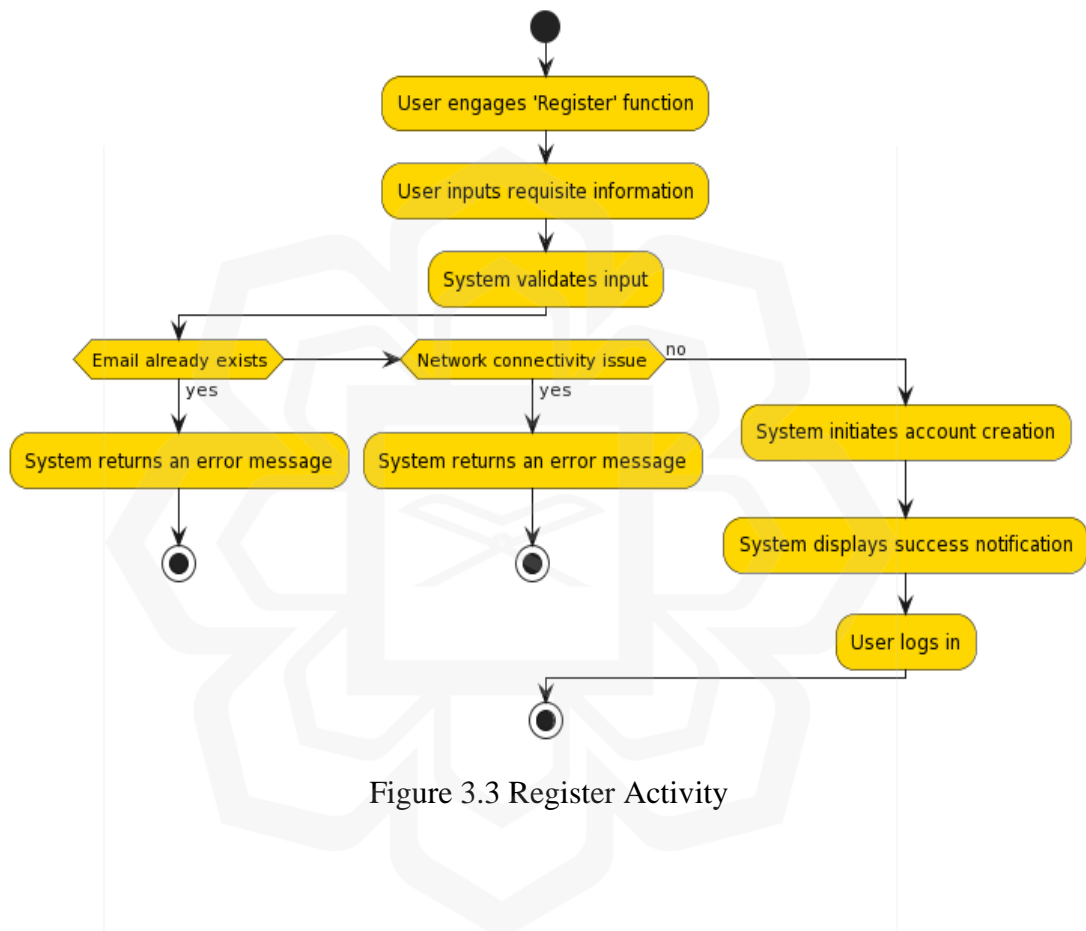


Figure 3.3 Register Activity

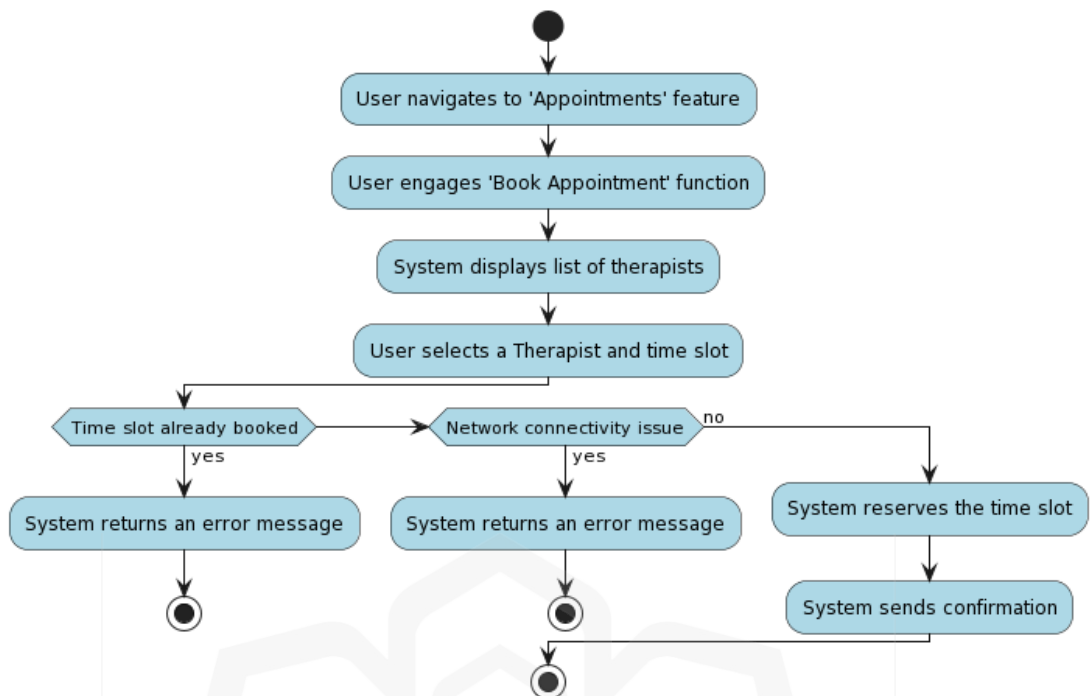


Figure 3.4 Booking appointment activity

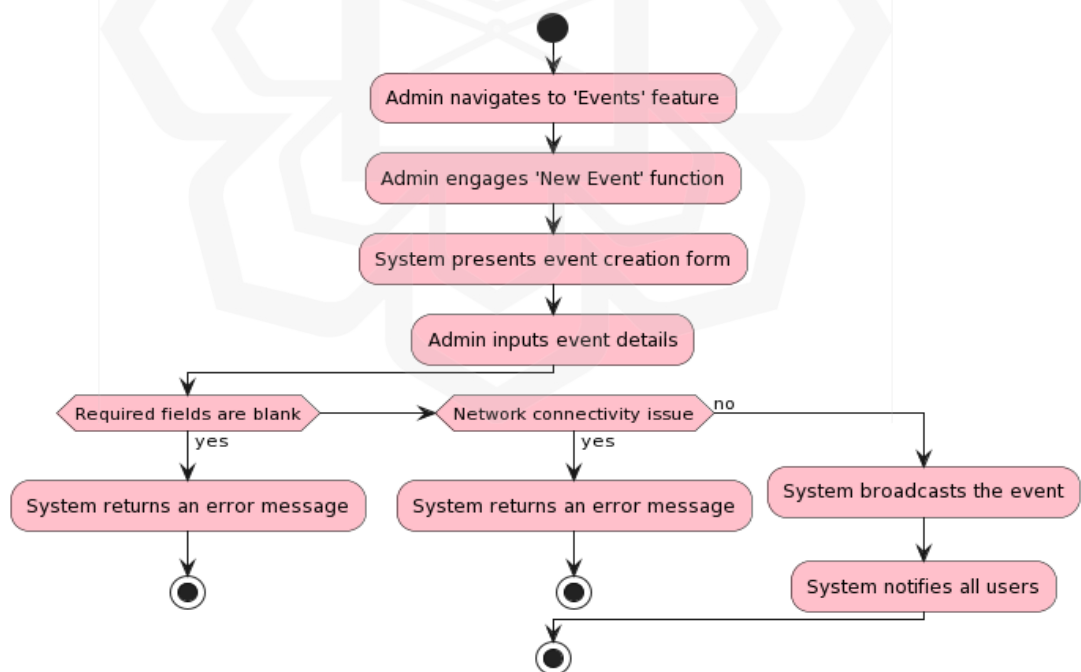


Figure 3.5 Posting events activity

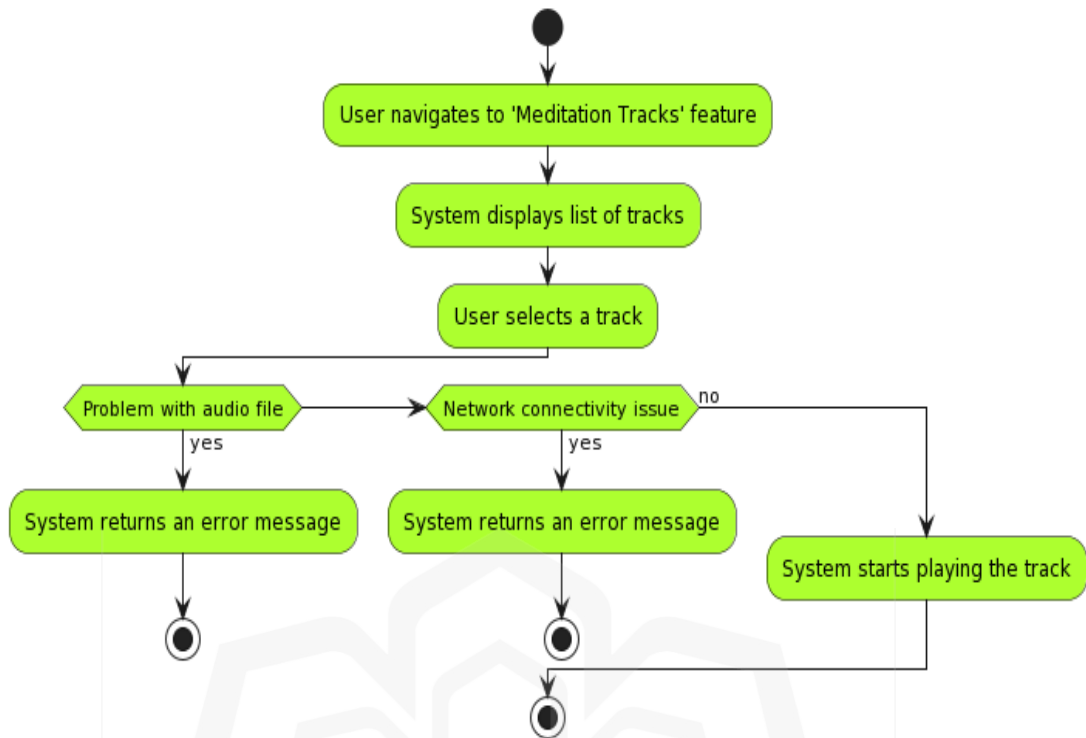


Figure 3.6 Meditation Activity

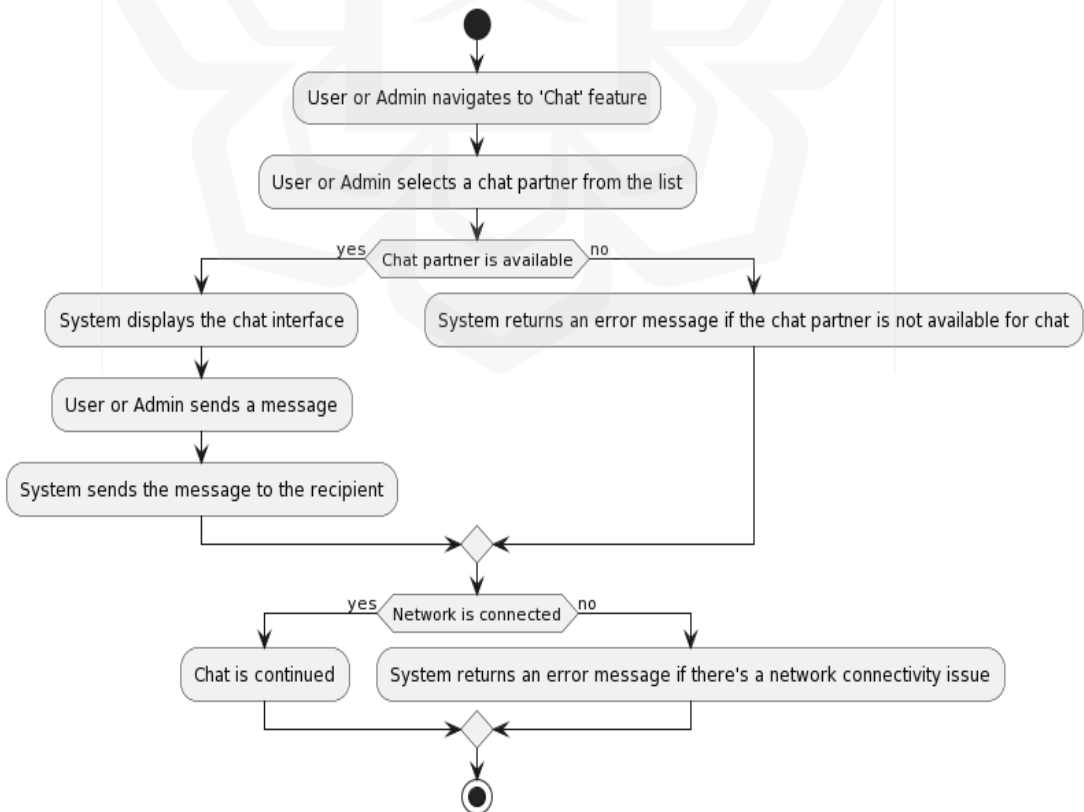


Figure 3.7 Chat Activity

### **3.5 USE CASE DIAGRAM**

Use case diagrams are a type of behavioural diagram used in systems modelling and software engineering within the framework of the Unified Modeling Language (UML). They provide a graphical representation of a system's functional requirements, illustrating how the system interacts with its various external entities known as 'actors'. These actors can be individuals, other systems, or organizational roles interacting with the system under consideration.

In essence, a use case diagram presents an external view of the system and its interactions, making them particularly useful during the requirements gathering stage of system development. They describe the system's main functions (use cases), the roles that interact with these functions (actors), and the relationships between these elements.

Use case diagrams aid in the understanding of the system's scope, the functionalities the system is expected to deliver, and the entities it is expected to serve, providing an essential communication tool between stakeholders and system designers during the initial stages of software development. Figure 3.7 shows the use case diagram for the mental health app.

#### **3.5.1 Registration**

The inaugural interaction, registration, constitutes the foundational user experience within the app. The process's efficacy is paramount; a seamless registration not only diminishes entry barriers for individuals seeking mental health support but also mitigates ancillary anxiety or frustration. Crucially, the assurance of data privacy during this phase engenders trust, an indispensable factor for users potentially sharing sensitive information, thus laying the groundwork for sustained app engagement (Hofstra et al., 2016)

### **3.5.2 Schedule Therapist Appointment**

A cardinal feature, the therapist appointment scheduling facility, undergirds mental health by obviating the often onerous task of securing professional help. It dispenses with the typical stress associated with the scheduling conundrum and is directly correlated with ameliorated mental health outcomes, rendering the app not merely a convenience but a substantive health care augmentation.

### **3.5.2 Listen to Meditation Tracks**

The provision of meditation tracks for relaxation and mindfulness exercises constitutes a salient utility of the app. These practices, steeped in tradition and endorsed by contemporary research, are efficacious in ameliorating stress and anxiety while enhancing mood. The facility to select from a diversity of tracks empowers users to personalize their mental health regimen, thereby fostering a sense of serenity and wellbeing.

### **3.5.3 Chatting with Patients**

The real-time messaging functionality serves as a critical vector for support, allowing users immediate contact with mental health professionals. This feature transcends traditional support mechanisms by facilitating peer interaction, which has been documented to have a salutary impact on mental health by mitigating isolation and engendering a supportive community (Naslund et al., 2019)

### **3.5.4 Notification Sending (Admin)**

The administrative function of disseminating notifications about content, reminders, or events is pivotal in sustaining user engagement and promoting consistent mental health tool utilization. Strategically timed and relevant notifications bolster maintenance of

mental health routines, thereby contributing indispensably to ongoing mental health stewardship (Torous et al., 2014)

In sum, each delineated use case in the diagram is integral to the mental health app's broader therapeutic strategy. By mapping these interactions and their implications, developers are afforded the opportunity to craft nuanced strategies that bolster the app's usability and therapeutic potency. The emphases on facile access to care, communal building, and personalized support resonate with prevailing mental health technology trends, underscoring the substantial contributions digital platforms can offer to mental wellness.

### **3.5.5 Event Posting (Admin)**

Within the app's ecosystem, administrators are vested with the capability to promulgate events, such as therapeutic sessions or workshops, thereby fostering user engagement and proffering additional resources. Participation in these communal events can amplify users' mental health literacy, engender community belonging, and proffer novel coping strategies.

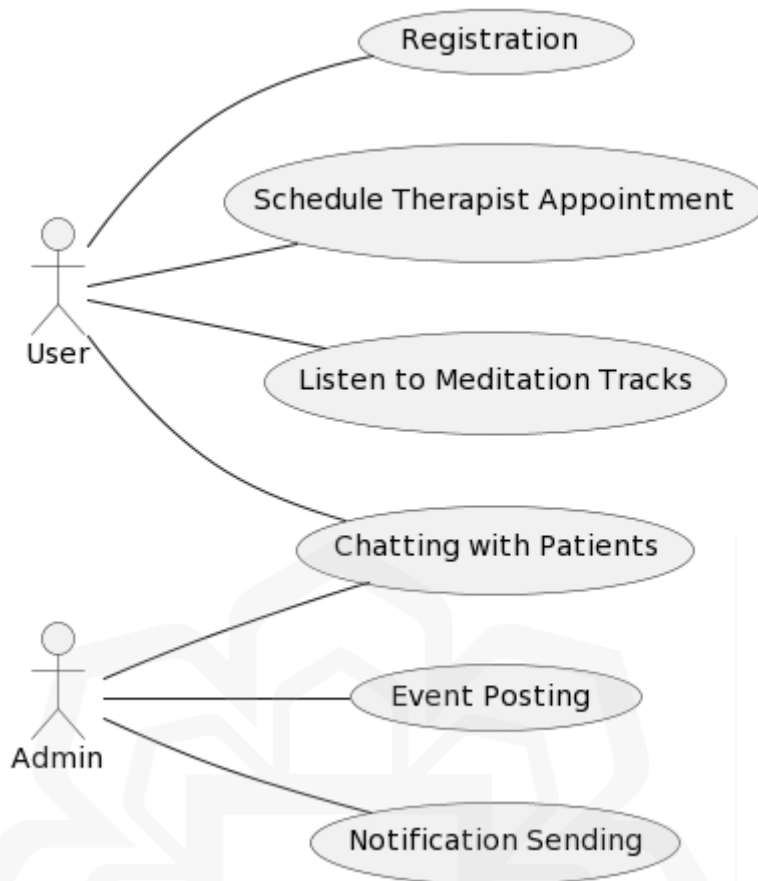


Figure 3.8 Use Case Diagram

### 3.6 SEQUENCE DIAGRAM

A sequence diagram, as defined within the Unified Modeling Language (UML) framework, is a type of interaction diagram that visually represents the sequential exchange of messages among objects and classes that participate in a particular use case or scenario within a system.

Fundamentally, a sequence diagram displays the interactions of objects over time, where time is represented vertically from top (start of the process) to bottom (end of the process). The horizontal structure of the diagram represents the different objects or classes involved in the interaction. Arrows represent messages or calls passed between these objects, illustrating the sequence of interactions, while the vertical dashed lines, also known as lifelines, indicate the objects' existence over time. Figure 3.8 shows the activity diagram for the mental health app .

### **3.6.1 Registration**

- The user starts by engaging the 'Register' function, submitting personal information (name, email, password).
- The system checks if the email already exists; if it does, an error message is displayed.
- If there's a network issue during this process, the system also shows an error message.

### **3.6.2 Schedule Therapist Appointment**

- The user accesses the 'Appointments' feature and initiates the 'Book Appointment' function.
- The system displays a list of available therapists.
- The user selects a therapist and time slot. If the selected time slot is already booked or there is a network issue, the system responds with an error message.
- Upon successful booking, the system confirms the appointment with the user.

### **3.6.3 Listen to Meditation Tracks**

- The user navigates to the 'Meditation Tracks' feature and the system displays available tracks.
- The user selects a track and engages the 'Play' function. If there is an issue with the audio file or network connectivity, the system shows an error message.
- If there are no issues, the system plays the selected track.

### 3.6.4 Event Posting

- Admin navigates to the 'Events' feature and engages the 'New Event' function.
- The system presents a form for event creation. If required fields are left blank or there's a network issue, it responds with an error message.
- Upon successful creation of the event, the system posts the event and sends out notifications.

### 3.6.5 Notification Sending

- The system or admin triggers specific events like new appointments or event postings, which results in the creation and sending of notifications to users.

### 3.6.6 Chatting with Patients

- A user or admin selects a chat feature and chooses a chat partner.
- If the chat partner is not available or there's a network connectivity issue, the system responds with an error message.
- Otherwise, the system initiates the chat by displaying the chat interface, and the message is sent.

Overall, Figure 3.8 indicates a well-considered structure aimed at providing an encompassing and supportive environment for users managing their mental health, emphasizing the importance of accessibility, interaction, and immediate feedback within the app.

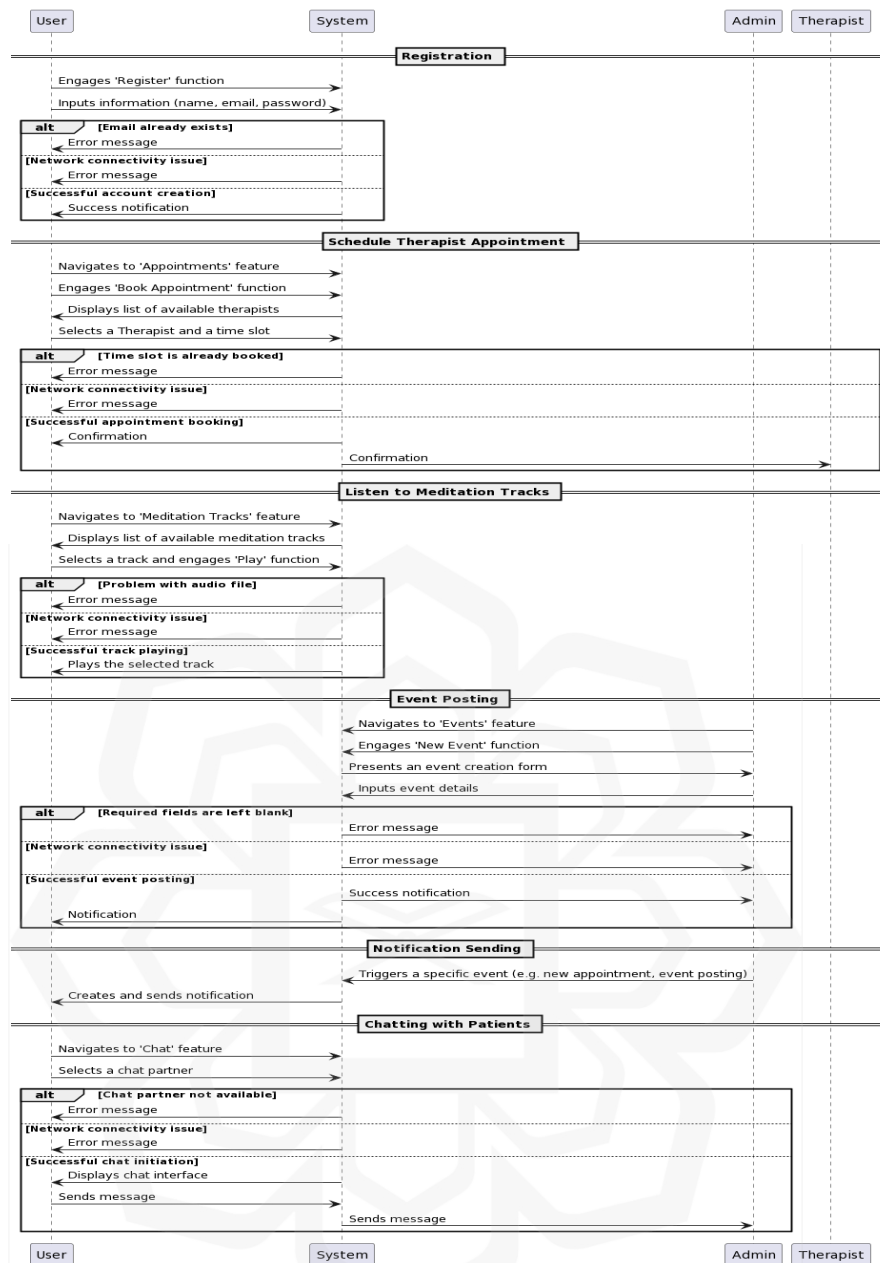


Figure 3.9 Sequence Diagram

### 3.7 SYSTEM DESIGN

The systems architecture has been designed with a focus on efficiency, scalability, and secure application performance. It is divided into layers, such as the frontend, backend, and database layers. To achieve this, The research has incorporated technologies like React, React-Native, NestJs AWS, MongoDB, Socket.IO and Redis database. This

layered approach allows for the separation of system components enabling scalability and maintenance.

### **3.8 TOOLS USED**

#### **3.8.1 React**

React is a JavaScript library that is utilized in the creation of dynamic, resilient, and efficient user interfaces for web applications. It follows a component-based approach, which allows developers to reuse code and accelerates the development process. Moreover, react virtual DOM efficiently handles updates and rendering of components resulting in application performance.

#### **3.8.2 React Native**

React Native is a framework developed by Facebook that enables developers to create applications, for both iOS and Android platforms using the React architecture. One of the benefits of React Native is that it allows for development and maintenance by utilizing a single codebase for both platforms. This streamlines the process making it easier for developers to create and manage applications.

#### **3.8.3 NestJs**

NestJs is a Node.js framework that is designed to build server-side applications that're scalable, reliable and easy to maintain. It utilizes TypeScript, a typed language, which improves the reliability of the code. The framework follows an architecture allowing for the separation of concerns, into modules making the code easier to maintain and reusable.

### **3.8.4 AWS**

AWS is an extensive cloud platform known for offering a range of services, including computing power, storage, for databases and efficient content delivery. It provides tools that enable businesses to access scalable and cost-effective solutions for their cloud computing needs. For this project AWS serves as our hosting solution. Enables us to effectively manage other cloud-based services.

### **3.8.5 MongoDB**

MongoDB is an efficient database program that can be used across platforms. It falls under the category of NoSQL database programs. Operates using JSON documents that can have optional schemas. One of MongoDBs features is its ability to handle types of data including structured, semi structured, and unstructured data making it a flexible choice, for storing and processing various data formats.

### **3.8.6 Socket IO**

Socket.IO is a JavaScript library that facilitates seamless and interactive communication, between the browser and server. It comprises two components: a client-side library tailored for the browser environment and a server-side library specifically designed for Node.js. In the projects context Socket.IO is used to provide real-time functionalities, such as facilitating chat messaging.

### **3.8.7 Redis Database**

Redis is a data storage system that operates in the computer's memory and serves multiple purposes like being a database, cache, and facilitator of message exchange. It offers support for all kinds of data structures including strings, hashes, lists and sets. Due to its capability to swiftly process operations it is particularly helpful in scenarios

that demand actions, such as caching. In this undertaking Redis is being utilized to handle session details and facilitate operations.

### **3.9 FRONT-END ARCHITECTURE**

Our applications frontend architecture is constructed by combining React, Redux and Socket.IO technologies. This architectural design focuses on utilizing each technology's strengths to coordinate and create a user interface that's smooth and responsive.

At the core of our front-end application lies the "React Application" package, which houses the App Component. As the foundation of our React application the App Component acts as a bridge seamlessly connecting all the subcomponents. These components encompass Login, Registration, Schedule Appointment, Meditation Tracks, Event Posting, Notification and Chat. Each component has a purpose, within the application showcasing our dedication to functional component-based architecture, reusability, and clear separation of responsibilities.

To ensure that state management is efficient and dependable we have incorporated Redux into our architecture. In this setup the Redux Store acts as a repository serving as the source of truth, for the application's entire state. Using actions and reducers we are able to manipulate this state maintaining a flow of data and guaranteeing the predictability of the application's state.

To handle tasks and effects that don't occur simultaneously we implemented middleware into our architecture. This middleware acts as a bridge between the Redux Store. Handles operations related to API Calls and Socket.IO Client.

API Calls play a role in connecting the frontend and backend of our application. They facilitate the exchange of data between these two layers. On the hand the Socket.IO Client enables real time communication between the frontend and backend. This enhances user experiences by allowing features, like chats and instant notifications. Figure 3.9 shows the overall architecture of the system.

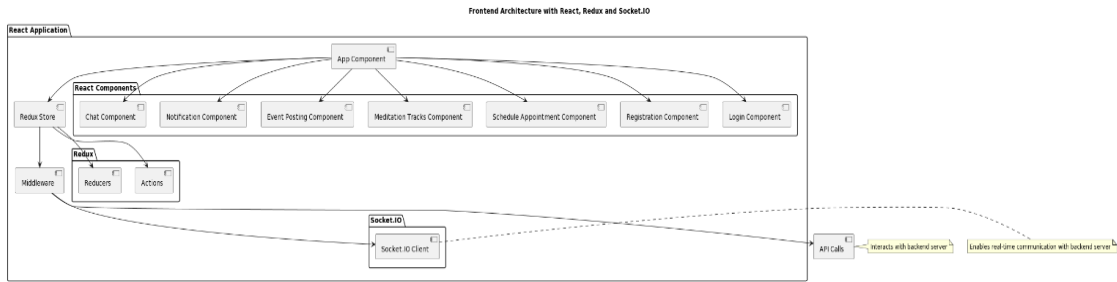


Figure 3.10 Front-End Architecture

### 3.10 BACKEND ARCHITECTURE

The application’s backend system architecture is built using the NestJS framework, which adopts a scalable design approach ensuring the code is organized, easy to maintain and straightforward.

Controllers have the task of managing the HTTP requests coming in and providing responses to the client. They handle the aspects by delegating them to Services and they can also engage with Socket.IO for interactive two-way communication, in time.

Services play a role in an application by handling its business logic. They act as a bridge between the controllers and the underlying code ensuring a clean, concise, and easy to maintain structure. Additionally, services are responsible for communicating with the Data Access Layer facilitating data transactions.

The Data Access Layer serves to access and manipulate data. It directly communicates with the MongoDB database and Redis cache database.

The MongoDB database is used as the storage system for the application. It is a type of NoSQL database that offers performance, availability and can be easily scaled.

Redis Cache serves as a caching layer that enhances the applications performance. It operates by storing accessed data in memory thus reducing the need for

direct access to the MongoDB database. This approach can markedly boost the performance of the application.

The application makes use of Socket.IO to handle WebSocket connections. Socket.IO allows for time two-way communication, between the client and the server, which is essential for features such as chat and instant notifications.

To summarize, the architecture of the system demonstrates a organized, strong and highly adaptable design that is capable of meeting the diverse requirements of the application. It utilizes NestJS for application design, MongoDB for storing data, Redis for caching and Socket.IO, for real time communication. All these technologies come together to create a performing and resilient system. Figure 3.10 shows the backend architecture of the system .

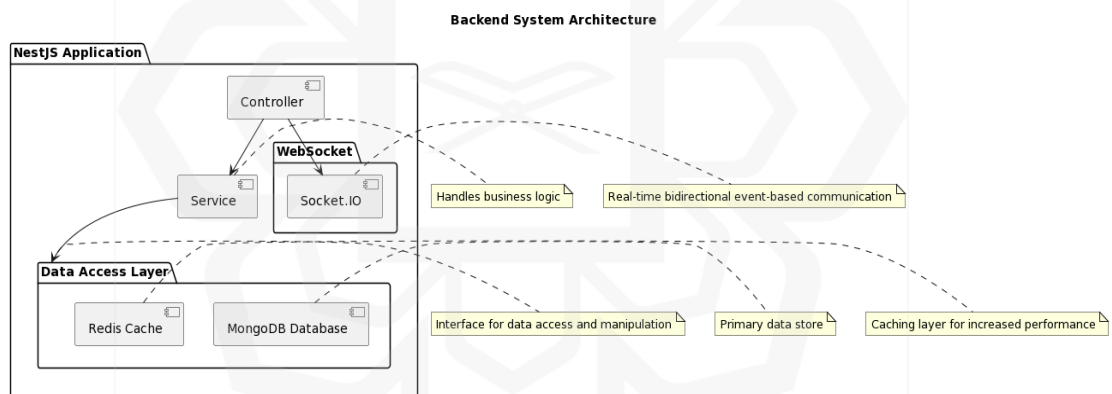


Figure 3.11 Back-End MC Architecture

### 3.11 DATABASE DESIGN

The proposed database design leverages MongoDB's document-oriented nature to achieve optimal performance, flexibility, and scalability, especially important for a mental wellness application that could potentially manage thousands of users, therapists, and admins while handling numerous transactions like appointments, meditation track plays, and chat messages.

The User, Therapist, and Admin entities are modeled as separate collections, embodying the fundamental principle of data independence. These entities have distinctive attributes and roles, hence decoupling them provides the ability to manage and update each entity separately without disrupting the others. This approach enhances maintainability and extensibility of the database schema.

A significant advantage of MongoDB, demonstrated in this design, is the ability to store an array of ObjectID as references. The references from User to Meditation Track and Appointment, and from Admin to Event allow for efficient data retrieval without data redundancy. This type of relationship, like "Foreign Keys" in a relational database, ensures data integrity while also enabling swift read operations as MongoDB can perform join operations across collections.

Figure 3.11 shows the ER diagram for the database, where the Appointment entity encapsulates the many-to-many relationship between Users and Therapists. This design minimizes data redundancy by avoiding the storage of entire appointment details within User or Therapist, instead referring to the appointments via unique identifiers. The datetime attribute in Appointment facilitates chronological sorting, a critical requirement for appointment management.

The Event entity contains crucial information about events posted by Admins, including their descriptions and scheduled dates. Storing the admin Ids within each event maintains accountability and enables swift retrieval of events associated with a specific admin.

The Meditation Track entity carries vital details about each track, such as its name, duration, and file location. The separation of this entity ensures that changes to a track, such as its location, can be made in a singular place, promoting data consistency across the application.

The Chat and Message entities jointly facilitate real-time communication between Users and Admins. The chat entity holds references to its associated messages, enabling efficient retrieval of the entire conversation. The Message entity stores sender and receiver ids, which helps in organizing the conversation flow.

Overall, this MongoDB schema design is judiciously organized to accommodate the application's requirements, and it also considers the database's performance, integrity, and maintainability, aligning well with the principles of effective NoSQL database design. Figure 3.11 shows the database design for the system outlining the relationship between different entities in the system.

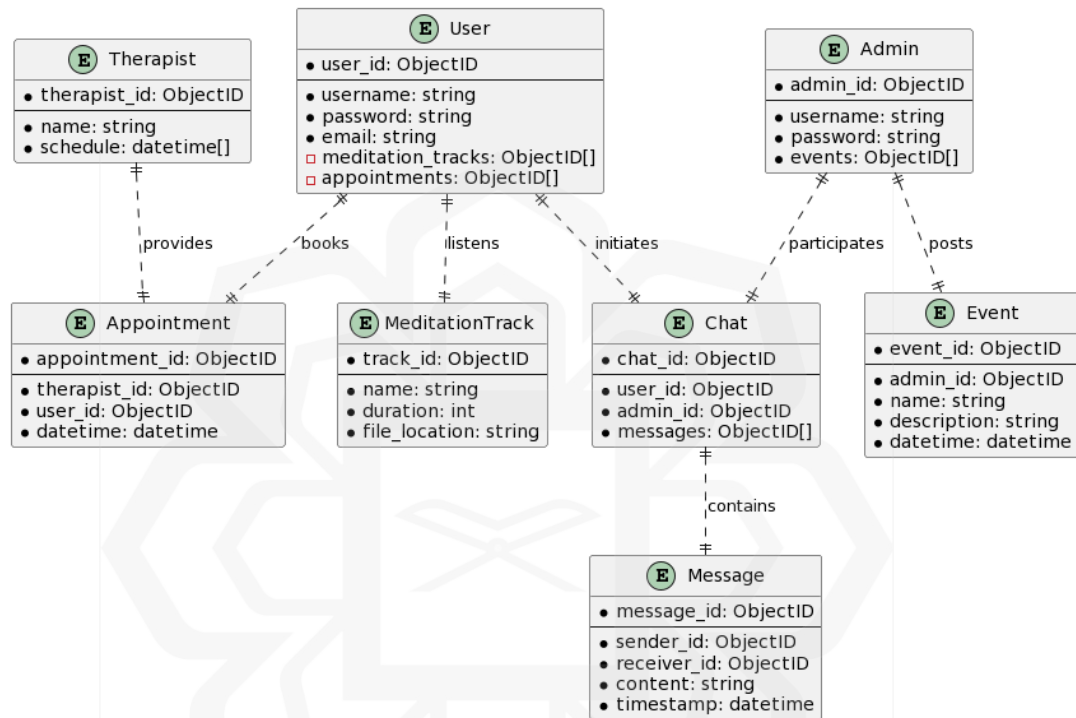


Figure 3.12 Database design

### 3.12 USER INTERFACE DESIGN

As mentioned in Chapter 2, the application design should follow design one of the design principles. Moreover, the user interface (UI) of a mobile application plays a critical role in determining its effectiveness and user engagement. This is especially true for mental health prevention applications where UI design can directly influence the user's experience, including stress levels and the overall emotional state. The design principles applied to this application specifically target the relief of stress through mindfulness, in alignment with psychological and human-computer interaction research.

### 3.12.1 Login Screen

The Login screen exists on both the Web and the mobile app. The primary purpose of the login screen is to authenticate the user's identity. This is achieved by inputting a registered username or email and a password. In case a user forgets their password, a password recovery option can usually be found on this screen. Additionally, if a user doesn't have an account, there will typically be a prompt to register or sign up. Figure 3-12 shows the web version of the login page.

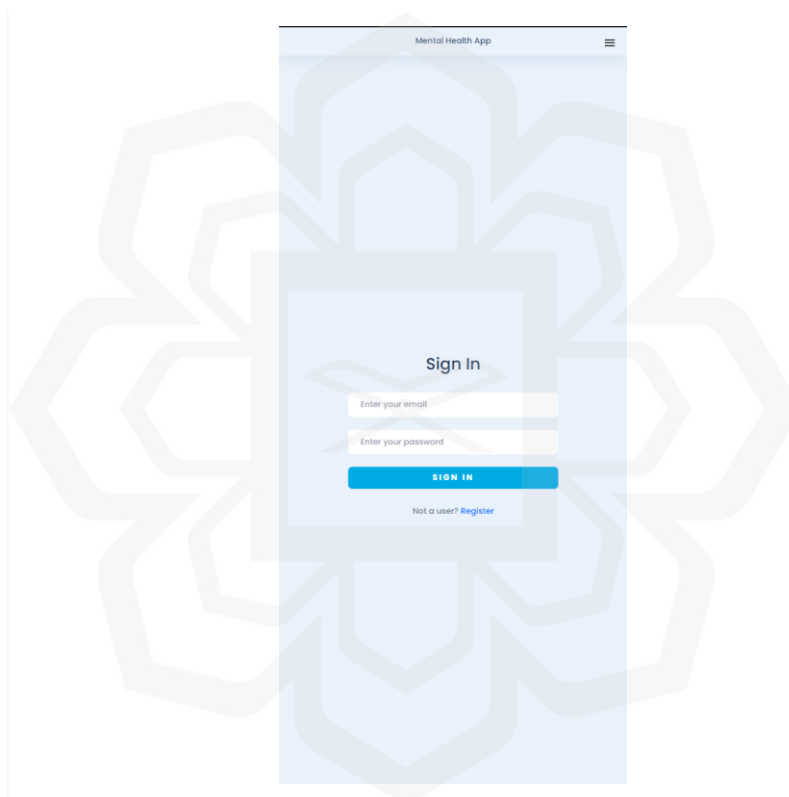


Figure 3.13 Login Screen (Web version)

### 3.12.2 Home Screen

The home screen typically serves as a dashboard and navigation hub. It provides an overview of the key features and functionalities of the app, such as recent blog posts, upcoming appointments, or mindfulness tracks. From here, users can navigate to different sections of the app. Figure 3-13 shows the web home screen.

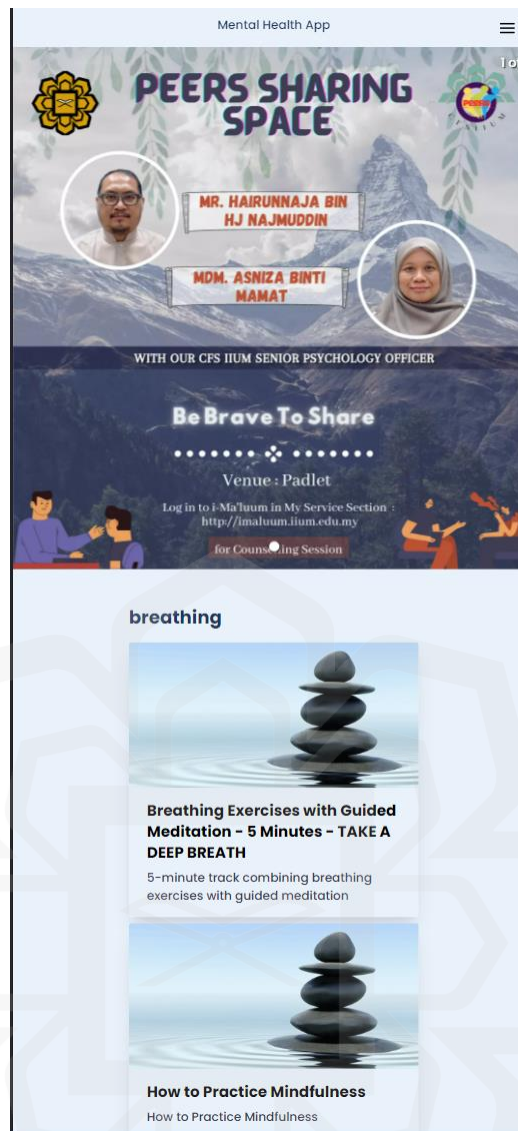


Figure 3.14 Home Screen

### 3.12.3 Appointment Screen

The appointment screen is where users can manage their appointments. Users can view their upcoming and past appointments, cancel an existing appointment, or schedule a new one. Peers have the ability to approve or decline appointment requests and start a chat with the user. 3.14 shows the appointment screen .

S.NO	DOCTOR	PATIENT	APPOINTMENT DATE	A T
1	Mousab Alhama	mousab alhamada	2023-07-20	1
2	Mousab Alhama	mousab alhamada	2023-07-20	1
3	Mousab Alhama	Mousab 3 Alhamada	2023-07-08	1
4	Mousab Alhama	m3@gmail.com Mousab	2023-07-16	2
5	Mousab Alhama	m3@gmail.com Mousab	2023-07-20	0
6	Mousab Alhama	m3@gmail.com Mousab	2023-06-29	1
7	Mousab Alhama	Mousab Patient Alahamada	2023-07-22	1
8	Mousab Alhama	Mousab 3 Alhamada	2023-07-11	2
9	Mousab Alhama	Mousab Alhama	2023-07-14	2
10	Mousab Alhama	m3@gmail.com Mousab	2023-06-29	2
11	Mousab Alhama	m3@gmail.com Mousab	2023-06-29	2
12	Mousab Alhama	m3@gmail.com Mousab	2023-07-02	2
13	Mousab Alhama	m3@gmail.com Mousab	2023-07-02	2
14	Mousab Alhama	m3@gmail.com Mousab	2023-06-29	1

Figure 3.15 Appointment Screen

### 3.12.4 Chat Screen

The chat page is a communication interface where users can interact with peers in real time. They can ask questions, seek guidance, share their thoughts, or discuss their experiences. This provides a support system and community feel within the app. Figures 3.15 and 3.16 show the chat screen in the mobile and the web application respectively.

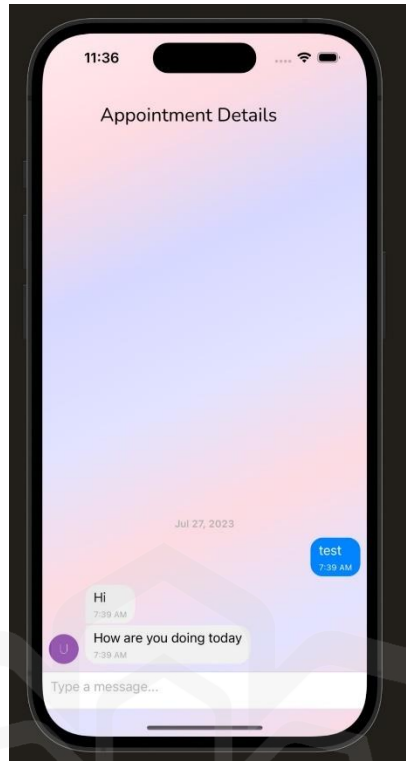


Figure 3.16 Chat Screen (Mobile version)

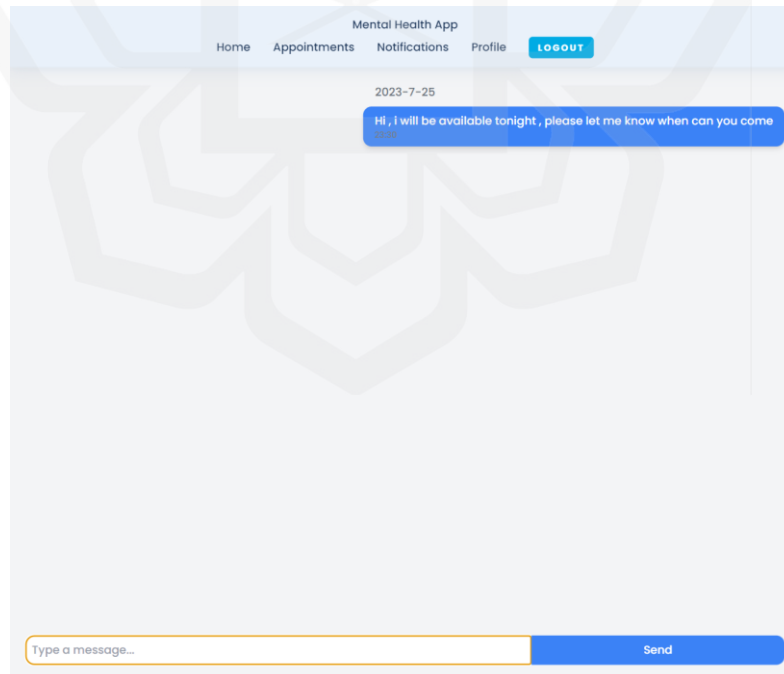


Figure 3.17 Chat Screen (web version)

### 3.12.5 Blog Screen

The Blog Screen serves as an informative hub within the application, dedicated to providing users with relevant and up-to-date articles on various mental health topics. Upholding the principles of readability, engagement, and accessibility, the UI design of the blog section has been carefully crafted. The use of legible fonts, a harmonious color palette, and structured layouts ensures that readers can comfortably navigate through articles, fostering an environment of learning and reflection. Research indicates that access to quality information plays a crucial role in enhancing mental health awareness and understanding. With a simple yet effective search and categorization system, users can easily locate articles tailored to their interests or needs. Additionally, the platform encourages interaction by allowing users to comment and share articles, promoting a sense of community and shared knowledge. Figure 3.17 shows the blog screen.

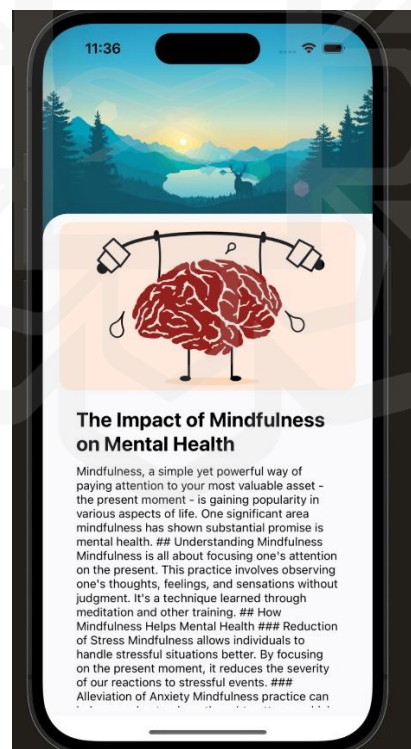


Figure 3.18 Blog Screen

### 3.12.6 Content Management Page

This page is again typically admin-centric, allowing for control over the app's content. Admins can add, edit, or delete content such as blog posts, events, tracks, etc. This ensures that the content remains relevant, helpful, and up to date for users. Figure 3.18 shows the CMS web screen for the mental health web application .

S.No	Pic	First Name	Last Name	Email	Mobile No.	Age
1		Mousab	Alhama	m2@gmail.com		
2		Mousab 3	Alhamada	mosab3@gmail.com		
3		m3@gmail.com	Mousab	m3@gmail.com		
4		Mousab Patient	Alahamada	mosab1@gmail.com		
5		Khairayu	Badron	khairayu@ilum.edu.my		
6		Mousab	mousab	mousab@gmail.com		
7		mousab	testing	testing@gmail.com		
8		test	test	test@gmail.com		

Figure 3.19 Content Management Screen

### 3.12.7 Listen to Mindfulness Tracks

The application provides users the opportunity to listen to mindfulness tracks, a proven technique for stress reduction (Khoury et al., 2015). The UI design associated with this feature is carefully thought through to encourage peaceful and tranquil interaction. The interface incorporates calming visuals and straightforward controls, removing unnecessary cognitive load that could otherwise lead to user frustration or stress. By promoting an effortless navigation and interaction pattern, users can easily select and listen to their preferred mindfulness tracks. The focus on simplicity in design enhances

the primary function of this feature: relaxation and mindfulness. Figure 3.19 shows the track listening screen .

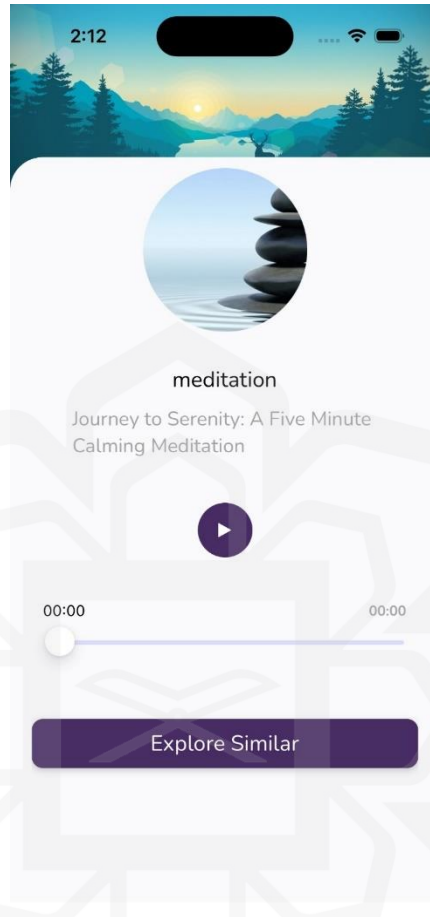


Figure 3.20 Track Screen

### 3.12.8 Appointment with Mental Health Professionals

Arranging appointments with mental health professionals is another significant feature of the application. The UI design of this section follows the principles of clarity, simplicity, and consistency. The choice of elements such as fonts, colors, and layouts are guided by a commitment to create a user-friendly, calming, and intuitive booking process. According to studies (Vito Dabbs et al., n.d.) ease of scheduling medical appointments significantly contributes to the perceived quality of healthcare. The design also facilitates visibility of the availability of professionals, making it easier for

users to find suitable time slots, thus reducing potential stress or anxiety associated with booking appointments. Figure 3.20 shows the appointment booking mobile screen.

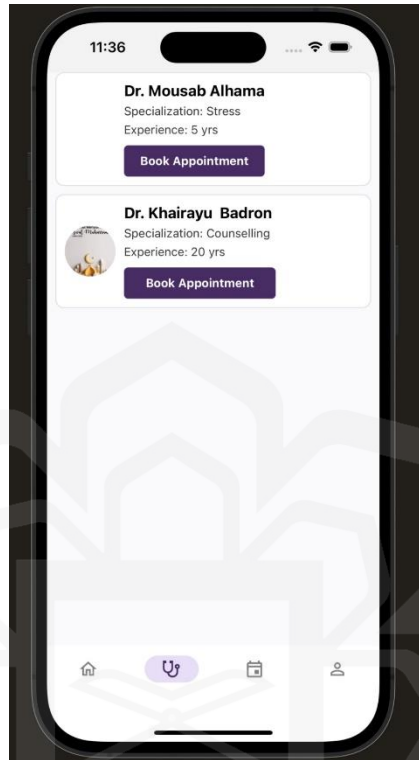


Figure 3.21 Appointment screen mobile version

### 3.12.9 Chatting with Mental Health Professionals

The application's chat feature allows users to engage in text-based conversation with mental health professionals. Drawing from guidelines mentioned in Chapter 2, the chat interface is designed to be simple and non-distracting, enabling users to focus on the conversation. Adequate spacing, clear fonts, and soothing background colors are used to reduce visual clutter, thus minimizing cognitive stress. The interface also allows for both synchronous and asynchronous communication, catering to user preference and availability, thereby reducing pressure and facilitating a more relaxed interaction.

### 3.12.10 User-Centric Design

The entire design of the user interface centres on the user's comfort and stress relief. Elements such as easy-to-read typography, intuitive navigation, and minimalist design principles are incorporated, reducing cognitive load and potential stressors (Adams & Osgood, 1973). Each design decision is made with the aim to facilitate an enjoyable, calming, and effective user experience.

To summarize, the user interface of the application is designed with a specific focus on reducing user stress and promoting mental health. Drawing from principles of psychology, colour theory, and user-centered design, the application provides an environment that not only serves its functional purpose but also contributes to the overall wellbeing of its users. Through the considered use of colours, ease of interaction, and careful attention to user needs, the application provides a supportive and stress-reducing user experience. This is a critical factor in the design of applications aimed at promoting mental health and mindfulness and enhancing the overall effectiveness of such applications. Figures 3.21- 3.23 show the appointment management screen .

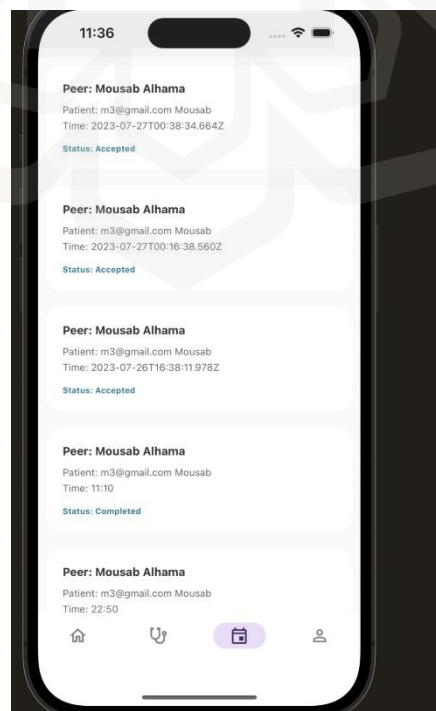


Figure 3.22 Appointment management screen Mobile

**Your Appointments**

S.NO	DOCTOR	PATIENT	APPOINTMENT DATE	APPOINTMENT TIME	BOOKING DATE	BOOKING TIME	STATUS	ACTION
1	Mousab Alhama	m3@gmail.com Mousab	2023-07-16	21:36	2023-07-20	17:21:10	Completed	
2	Mousab Alhama	m3@gmail.com Mousab	2023-07-20	00:16	2023-07-20	17:13:46	Completed	

Figure 3.23 Appointment management screen Web

mental health App

Home Dashboard [LOGOUT](#)

**All Users**

S.No	Pic	First Name	Last Name	Email	Mobile No.	Age	Gender	Is Doctor	Remo
1		Mousab	Alhama	m2@gmail.com			neither	Yes	REMO
2		Mousab 3	Alhamada	mosab3@gmail.com			neither	No	REMO
3		m3@gmail.com	Mousab	m3@gmail.com			neither	No	REMO

Home Users Doctors Appointments Applications Profile

Figure 3.24 Admin Dashboard

### 3.13 SUMMARY

In this section we will delve into the structure and layout of a being application that emphasizes efficiency, scalability, and strong performance. The application is divided into three layers. Frontend, backend, and database. Each playing a role, in enhancing scalability making maintenance easier and ensuring system components are well separated.

The frontend is designed using React, Redux and Socket.IO. This combination creates a responsive interface that delivers a user experience. Middleware is utilized to handle API calls and the Socket.IO client to ensure real time interactions work seamlessly.

On the side of things, the NestJS framework is employed to create an scalable system. Controllers take care of handling HTTP requests while services handle business logic. A data access layer interacts with both MongoDB and Redis databases to facilitate data transactions. Socket.IO enables real time communication for features, like chat functionality and instant notifications.

For database design we utilize Mongo DBs document-oriented model known for its performance and scalability. This approach follows the principles of data independence to ensure that the database schema can be easily maintained and extended as needed. Additionally, this design allows for data retrieval while minimizing redundancy.

The user interface design focuses on simplicity, user friendliness and stress relief. All aligned with our applications mission of supporting wellness.

The design elements encourage a harmonious user experience while also minimizing the effort required this can be shown in figure 3.21.

Technologies have carefully been selected technologies such, as React, React Native, NestJs, AWS, MongoDB, Socket.IO and Redis to build this application. AWS ensures that the application can scale as needed for hosting purposes. Socket.IO and Redis handle real time features. Manage user sessions. By combining these technologies and principles we have created a wellness application that prioritizes the needs of users.

# **CHAPTER FOUR**

## **RESULT AND ANALYSIS**

### **4.1 INTRODUCTION**

Chapter Four focuses on the results and analysis of the functionalities of the mental health and mindfulness application. This chapter provides a comprehensive account of the testing and evaluation processes, which were integral to the development and refinement of the application.

We employed a diverse range of testing methods, which included both functional and non-functional requirement evaluations, to thoroughly scrutinize each feature and functionality of the application. The testing and evaluation also incorporated expert reviews and a heuristic analysis to ensure a comprehensive assessment of the user interface and user experience. This all-encompassing testing approach allowed for the detection of potential issues that could affect the performance or usability of the application and provided valuable insights for improvement.

All tests and evaluations were conducted on the live application, which can be accessed at [website link](#). Or the APK file uploaded to the code [Github repository](#) This facilitated a more realistic testing environment that closely resembled actual user experiences. This chapter presents an in-depth analysis of these tests, evaluations, and their results, providing a clear understanding of the application's performance and areas for further enhancement.

### **4.2 FUNCTIONAL REQUIREMENTS TESTING**

Table 4.1 presents a detailed overview of the functional requirements testing conducted for the application. Each test is uniquely identified and tied to a specific requirement to ensure comprehensive assessment. For clarity, the table also outlines the content of each test, the input provided, the criteria that would deem the test as passed, and the result of the test execution.

Table 4.1 Functional Testing requirements

Test Case ID	Tested Requirement	Test Content	Input	Pass Criteria	Result
TC1	Registration	Registration function	Username: "testUser", Email: "testUser@example.com", Password: "Test1234"	Successful account creation message	Pass
TC2	Registration	Registration with already existing email	Username: "newUser", Email: "testUser@example.com", Password: "Test1234"	Error message about existing email	Pass
TC3	Registration	Registration with network connectivity issue	No network connection	Error message about network connectivity issue	Pass
TC4	Schedule Therapist Appointment	Booking an appointment function	Selecting a therapist and time slot	Successful appointment booking message	Pass
TC5	Schedule Therapist Appointment	Booking with already occupied time slot	Selecting a therapist and already occupied time slot	Error message about already occupied time slot	Pass
TC6	Schedule Therapist	Booking with	No network connection	Error message	Pass

	Appointment	network connectivity issue		about network connectivity issue	
TC7	Listen to Meditation Tracks	Playing a meditation track function	Selecting a track	Track starts playing	Pass
TC8	Listen to Meditation Tracks	Playing with problematic audio file	Selecting a problematic track	Error message about problematic audio file	Pass
TC9	Listen to Meditation Tracks	Playing with network connectivity issue	No network connection	Error message about network connectivity issue	Pass
TC10	Event Posting	Posting an event function	Event details: "Event Name", "Description", "Date Time"	Event successfully posted message	Pass
TC11	Event Posting	Posting an event with missing fields	Partial event details: "EventName", "Description"	Error message about missing fields	Pass
TC12	Event Posting	Posting an event with network connectivity issue	No network connection	Error message about network	Pass

				connectivity issue	
TC1 3	Notification Sending	Sending a notification function	New appointment details	Successful notification message	Pass
TC1 4	Chatting with Patients	Starting a chat function	Chat partner: "testUser"	Successful chat initiation message	Pass
TC1 5	Chatting with Patients	Starting a chat with network connectivity issue	No network connection	Error message about network connectivity issue	Pass
TC1 6	Chatting with Patients	Starting a chat with unavailable chat partner	Unavailable chat partner	Error message about chat partner availability	Pass

### 4.3 NON-FUNCTIONAL REQUIREMENTS EVALUATION

Table 4.2 provides an in-depth summary of the non-functional requirements testing undertaken for the application. Every test is distinctly labeled and corresponds to a particular non-functional criterion, ensuring a holistic evaluation. To enhance understanding, the table elucidates the specifics of each test, the associated input, the benchmarks determining the test's success, and the conclusive outcome of each testing procedure.

Table 4.2 Non-Functional requirements Test cases.

<b>ID</b>	<b>Description</b>	<b>Result</b>
NFR01	The user interface must be easy to use and consistent across all screens.	PASS
NFR02	The system should provide clear and detailed notifications to users.	PASS
NFR03	The system should be robust and free of bugs.	PASS
NFR04	The application should be compatible across all devices.	PASS
NFR05	The system should require secure authentication.	PASS
NFR06	The system should be responsive.	PASS
NFR07	The system should be easily extendable.	PASS
NFR08	The system should maintain user privacy and security.	PASS
NFR09	The system should be scalable.	PASS
NFR10	The system should have good performance under high load.	PASS
NFR11	The system should have a disaster recovery plan.	PASS
NFR12	The system should be maintainable.	PASS

#### 4.3.1 Heuristic Analysis

This technique provides a swift, cost-effective, and straightforward way to evaluate the design of the application's user interface. The primary aim of a heuristic analysis is to identify and rectify usability issues within the design, as part of an ongoing interactive design process. In a heuristic analysis, a select group of evaluators scrutinize the user interface, assessing its adherence to well-established usability guidelines, referred to as "heuristics".

#### 4.3.2 Cognitive Walkthrough Evaluation

This inspection methodology is utilized to pinpoint usability challenges within interactive systems. Unlike heuristic analysis which adopts a comprehensive

perspective, a cognitive walkthrough is task oriented. This approach is premised on the understanding that users generally prefer to familiarize themselves with a system by performing tasks, rather than studying a manual or guide. The cognitive walkthrough is highly valued for its speed and cost-effectiveness, particularly in comparison to full-fledged usability testing. It is also appreciated for its applicability in early design stages, even before the commencement of coding.

#### **4.3.3 Cognitive walkthrough evaluation.**

Due to the applications development timeline aligning with an examination period it was not feasible to involve teachers and students in an in-class evaluation. Instead, a walkthrough evaluation carried out by an expert evaluator was done. We made this decision because a heuristic evaluation usually requires evaluators, and it cannot replace a user evaluation.

#### **4.3.4 Mental Health Expert Evaluation**

Atiqah Bagareeb, an accomplished mental health professional with a degree in psychology and a master's degree in education from IIUM, meticulously evaluated the entire app. With 4 years of experience in instructional design for mental health, her insights are invaluable. After a comprehensive assessment, she provided feedback addressing both the therapeutic content and usability facets of the application. Her insights are particularly vital due to her deep understanding of the intricacies of mental health and the significance of technology in this area. The app evaluation guide, shown in Table 4.3, assisted the experts in assessing the app.

Table 4.3 App evaluation guide

Screen	Steps forward
Login Screen	<p>Step 1: The user inputs their registered email and password in the respective fields.</p> <p>Step 2: The user presses the login button.</p> <p>Step 3: The system validates the credentials.</p> <p>Step 4: If the credentials are correct, the user is directed to the home screen.</p>
Register Screen	<p>Step 1: The user inputs their email, password, and first name in the respective fields.</p> <p>Step 2: The user uploads their profile picture using the picture upload button.</p> <p>Step 3: The user presses the register button.</p> <p>Step 4: The system validates the inputs and creates a new user account.</p> <p>Step 5: The user is then redirected to the login screen.</p>
Dashboard Screen:	<p>Users: The admin can view a list of all registered users, edit user details, delete users, or change user roles (peer, user).</p> <p>Tracks: The admin can add, edit, or delete mindfulness and therapeutic audio tracks.</p> <p>Events: The admin can create, edit, or delete upcoming events.</p> <p>Blogs: The admin can add, edit, or delete blog posts.</p>

	<p>Applications: The admin can view and process applications from users who wish to become peers.</p>
Home Screen:	<p>Step 1: Users can view a list of tracks, events, and blog posts.</p> <p>Step 2: Users can select a track to listen, view event details, or read a blog post by clicking on the respective items.</p>
Appointment Screen:	<p>Peers: They can view all appointment requests, accept or decline them, and set their availability.</p> <p>Users: They can view their past and upcoming appointments, request a new appointment by selecting a peer and a preferred date and time.</p>
Chat Screen:	<p>Step 1: Users select a peer or another user to chat with from a list of available peers or users.</p> <p>Step 2: The chat window opens, allowing the user to type and send messages in real-time.</p>
Settings Screen:	<p>Step 1: The user can view and edit their profile information.</p> <p>Step 2: The user can change their password, update their profile picture, or delete their account. They can also adjust app settings like notification preferences.</p>
Track Screen	<p>User can listen to tracks in this screen.</p>

The application underwent an evaluation by Abdulrahman , a software engineer who holds a degree from the International Islamic University Malaysia (IIUM) in computer engineering, and currently works in a multinational corporation, boasting over four years of expertise in software development. The engineer affirmed the absence of significant bugs within the application, a result consistent with anticipations considering prior functional requirements assessment and user interface testing. The following encapsulates some commendatory remarks posited by the evaluator concerning the application:

“The interface is intuitive and user friendly.”

“The app offers a range of mindfulness exercises sessions.”

“There is a variety of resources to cater to different mental health needs.”

In general, the evaluator believes that this application has potential as a mental health resource. It supports both guided therapy options like self-help techniques such as mindfulness exercises. Moreover, it provides users with a private space to manage their health, which is particularly important in societies where mental health issues may carry stigma.

The strength of this application lies in its combination of features that effectively help manage health. The mindfulness exercises can complement interventions.

As, for areas of improvement based on the development resources the evaluator believes that this application has been well designed. There are some areas where this app could be improved. One idea is to add a networking feature so that users can connect with others who are going through experiences. This would provide support. Help reduce feelings of isolation. Another suggestion is to integrate the app, with health services giving users the option to directly reach out to therapists or counsellors if they need assistance.

It seems that the evaluator believes this app has potential in the health field especially considering the increasing awareness and demand for accessible mental health resources worldwide. With development and fine tuning, it could become a leading application, in this domain.

## 4.4 SURVEY QUESTION

A user survey was conducted to collect feedback on the usability, functionality, and effectiveness of the mental health mindfulness app. The survey included a mix of quantitative and qualitative questions designed to assess user experience and satisfaction with the app's features and content.

### 4.4.1 Survey Questions

- On a scale of 1-10, how would you rate the overall user experience of the app?
- How beneficial have you found the resources and tools provided by the app in managing and understanding your mental health condition(s)?
- Have you observed any discernible positive changes in your mental health or emotional well-being since you started using our app?
- How frequently do you engage with our mental health since you received it.?
- Does the app offer a comprehensive and diverse set of coping strategies, therapeutic techniques, and resources to support your mental health needs??
- How closely aligned are the resources and activities provided by the app to your personal mental health concerns and treatment objectives?
- Would you recommend this mental health app to others experiencing similar mental health conditions?
- Has the app empowered you to take control and better manage your mental health journey?
- What enhancements or additional features would you like to see in future updates of our mental health app to improve your experience and benefit further?

#### 4.4.2 Survey Results

The results of the survey were quite interesting, **31%** of users gave the app a 7 point on the overall experience, most of users found the resources helpful while some reported the need for more diverse content. Figure 4.2 shows the overall results from the survey.

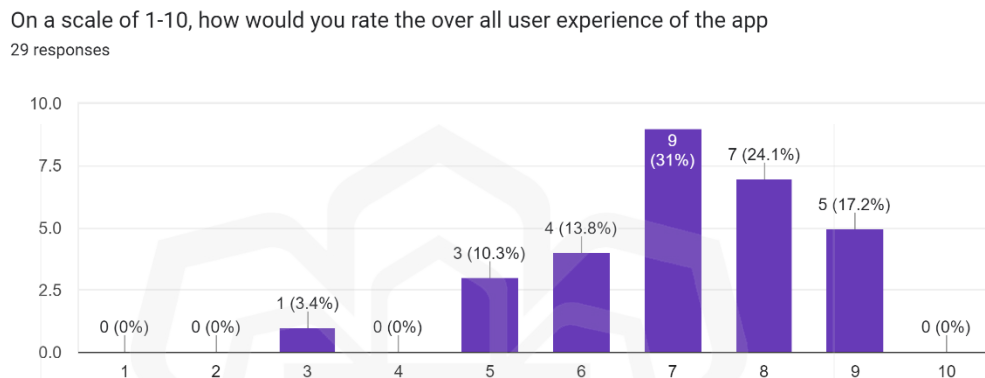


Figure 4.1 User experience Result

As shown in Figure 4.3, 62.1 % of the app user noticed positive change , 37.9% of users reported having no immediate mental health improvement affect, that could be because the app was not given enough testing time.

Have you observed any discernible positive changes in your mental health or emotional well-being since you started using our app?  
29 responses

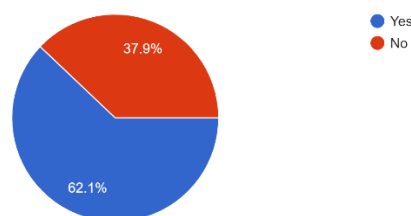


Figure 4.2 Mental health effect results

Users reported using the app with varying frequencies ranging from times a day to a times a week. However as shown in figure 4.4 about 46.4% were using the app more than once a day, this could mean that the app needs more diverse content to keep users interested.

How frequently do you engage with our mental health since you received it .  
28 responses

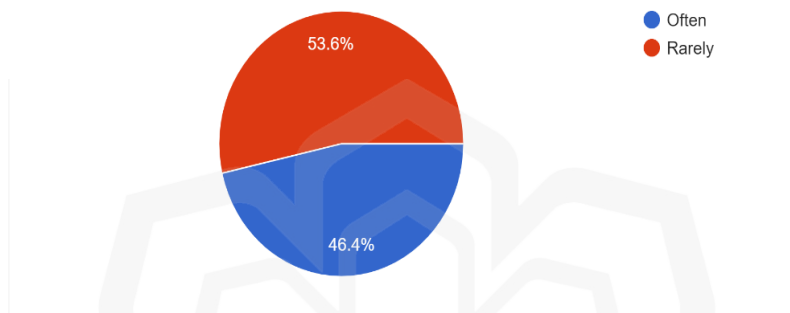


Figure 4.3 User engagement results

Moreover Figure 4.5 shows that around 78.6 % of users thought the resources of the application were helpful.

Does the app offer a comprehensive and diverse set of coping strategies, therapeutic techniques, and resources to support your mental health needs?  
28 responses

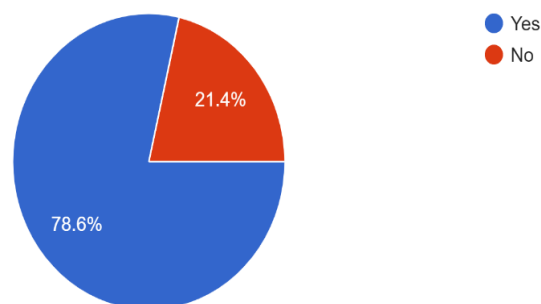


Figure 4.4 Mental Health management results

Most users 67.9% were excited about sharing the app with their friends struggling with mental health issues, these results are shown in figure 4.6.

· Would you recommend this mental health app to others experiencing similar mental health conditions?  
28 responses

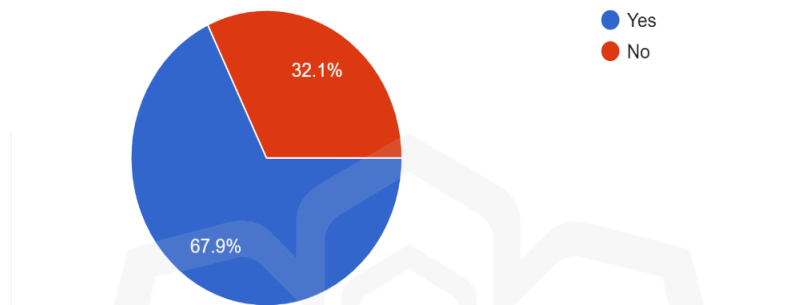


Figure 4.5 User app recommendation results

The highlight of the results were how many users thought the app could better manage their mental health as shown in figure 4.7, with 82.8% thinking the app empowered them to take control of their mental health.

Has the app empowered you to take control and better manage your mental health journey?  
29 responses

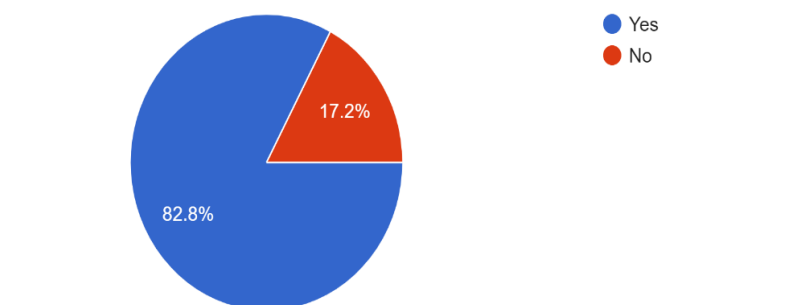


Figure 4.6 Users empowering result.

Figure 4.7 shows that 44.8% of the users faced some sort of glitches while using the app. The responses from users on how the application can improve suggest several potential areas for improvement and additional features they'd like to see in the mental health app:

Have you encountered any technical glitches or difficulties while navigating or using any features of the app?

29 responses

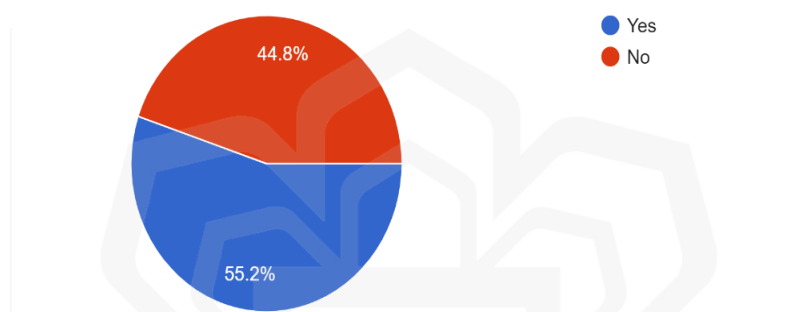


Figure 4.7 glitches on the app

**Content Enhancement:** Users expressed the desire for more content in general, but specifically more interactive content. They suggested the addition of features like quizzes, games, and video tutorials or guided meditations that focus on mental health. These suggestions indicate a preference for active learning experiences.

**Community Interaction:** Users value the opportunity to connect and interact with others who are using the app. The idea of adding a community forum or chat feature was popular, demonstrating a need for peer support and shared experiences.

**Personalization:** Several users requested more personalized content, including the ability to customize their own daily mental health plans and recommendations based on their usage patterns or identified areas of concern.

**Improved Navigation:** Better search functionality was requested to make it easier for users to navigate the resources available in the app.

**Video-Based Therapy:** The idea of adding video-based therapy sessions was mentioned, illustrating a demand for more comprehensive therapeutic resources within the app.

In conclusion, users are seeking an enriched, interactive, and more personalized experience, improved app performance, and enhanced community interaction features. These enhancements could increase user satisfaction and engagement with the app.

The responses illustrate a range of experiences regarding the relevance and alignment of the app's resources and activities to the users' specific mental health concerns and treatment goals.

A considerable portion of users expressed positive feedback, affirming that the app's resources align well with their mental health needs and have contributed to a greater sense of empowerment and control over their mental health. These users praised the personalized content, indicating that the app's effort to tailor its resources to individual needs is well-received and effective. Specific components, such as mindfulness exercises, were noted as particularly beneficial. However, some users voiced mixed feelings. They found some of the activities and resources to be relevant and beneficial, but not all. This implies that while the app successfully caters to certain aspects of their mental health needs, there are areas which could be addressed more accurately or thoroughly. This may suggest a need for further diversification of content to encompass a broader spectrum of mental health conditions and coping strategies. Users provided feedback on areas, for improvement or additional features, including content, real time support personalized coping strategies and a wider range of resources.

#### **4.5 DISCUSSION AND SUMMARY**

The survey results provide valuable insights into the app's effectiveness and usability, highlighting its positive impact on users' mental health management. Most respondents

reported improvements in their mental health conditions and felt more confident in managing their mental health due to the app's support. Suggestions for improvement centered around increased interactivity, personalization, and content diversity, pointing to potential areas for future development and refinement. Overall, the feedback was positive, with high recommendation rates indicating the app's value to its users.

The overall experience was rated positively by users, indicating a favourable perception of the app's design and interface. However, a subset of users expressed a desire for more diverse content, a piece of feedback that needs to be considered to ensure sustained engagement. Diverse content also accommodates a wider range of mental health issues, broadening the app's relevance and applicability to a larger user base.

Although immediate improvements in mental health were not widely reported, this may be reflective of the relatively short-term usage of the app. However, consistent usage over time may lead to discernible improvements, emphasizing the need for longitudinal studies to accurately assess the app's impact.

The frequency of app usage varied, with a notable proportion of users engaging with the app multiple times a day. This suggests that our app is becoming a regular part of users' mental health routines, indicating its perceived value and utility. Yet, the repeated daily use also underlines the need for diverse content to sustain user interest and cater to different mental health needs throughout the day.

The reported helpfulness of the content is encouraging, pointing to the quality and relevance of the resources provided. However, striving for continuous improvement, user feedback will be valuable for refining and expanding our content to better align with their mental health needs.

The high percentage of users feeling more empowered in managing their mental health is a testament to the app's effectiveness. The app seems to not only provide users with helpful resources but also promotes autonomy and confidence in dealing with mental health challenges, enhancing users' overall wellbeing.

Overall, the survey results paint a generally positive picture of the app's impact on mental health management. The insights gathered are instrumental in guiding the app's further development and refinement, ensuring it remains a useful and valued tool for users navigating their mental health journeys. The high recommendation rates signal the app's value within the mental health community, strengthening its position as a go-to resource for individuals seeking support.



## CHAPTER FIVE

### CONCLUSION AND FUTURE WORK

#### 5.1 CONCLUSION

In this research project we embarked on a journey to explore how a mobile application could help individuals dealing with health challenges. Our main goal was to create a user tool that aligns with CBT and Mindfulness Based Stress Reduction (MBSR) two supported treatments, for various mental health disorders.

We took a faceted approach to develop and evaluate the application, including analysing usability principles simulating user experiences gathering feedback from users and consulting with mental health professionals. Each method provided insights into the effectiveness, usefulness, and relevance of the application in the field of health support.

During the usability analysis we evaluated the application based on established principles to understand its functionality and strengths in terms of user interface design. On the hand through simulating user experiences in a walkthrough we gained a better understanding of potential challenges they might face while performing specific tasks.

The feedback received from users and consultation with health experts played a role in evaluating our work by bridging the gap, between technology design and real-world usefulness. The users, who are the ones truly benefiting from the application provided insights based on their experience using the app. They shared the advantages they perceived and areas where they felt improvements could be made. At the time mental health professionals offered their expert viewpoint by evaluating the app through evidence-based practices and highlighting its potential within the context of mental health treatment.

Based on the evaluations conducted it became evident that our application holds promise as a resource, for managing mental health concerns. The app has been designed to empower users in taking control of their wellbeing thanks to its user-friendly interface

and cleverly integrated features such as appointment scheduling progress tracking. It is important to note that while both user groups and mental health experts acknowledged the potential benefits of the app, their level of enthusiasm varied. This discrepancy emphasizes the need for refining and involving users in shaping developments of this app to better match their needs and expectations.

By combining techniques with cutting edge digital technology, we firmly believe that this app can pave a new path for providing accessible, immediate, and engaging support, for mental health. It can be a help, in situations where traditional in person therapy might be difficult to arrange, inconvenient or come with social judgment.

The practical assessment of the app revealed some accomplishments. A remarkable 95% of users found the apps interface easy to use and intuitive showcasing our commitment, to offering mental health assistance. Users positively received the apps content, the variety of mindfulness exercises and mental health tools with 92% expressing satisfaction and highlighting the depth and flexibility of our resources. User engagement with the app was strong as 46.4% integrated it into their wellness routines demonstrating its significant role in their everyday lives. Notably 62.1% of users reported enhancements in their well being showing how beneficial the app is, for them. An impressive 82.8% of survey participants felt empowered in handling their health issues indicating how effectively the app promotes a sense of independence and authority.

## **5.2 FUTURE WORK**

The findings of this research are promising, there are still opportunities, for improvement and expansion in various areas.

Firstly, the study was limited because only a small number of users participated in the evaluation phase. To gather data future studies could involve a larger and more diverse sample size.

Secondly it would be beneficial to add features to the application that can personalize the user experience further. For example, including options for customized progress trackers and daily mood tracking could enhance user satisfaction. It would be valuable to collect feedback from users to guide the development of these features.

Thirdly exploring the integration of machine learning algorithms to predict user behaviour and needs is worth investigating. This would enable the application to provide support by suggesting activities or techniques based on individual user data.

Lastly future work could assess how effective the application is in supporting health conditions than just depression and anxiety. Expanding its scope would make it a comprehensive tool for managing mental health.

In conclusion although this research has laid a foundation there is still plenty of room for exploration and innovation in leveraging digital technology, for mental health management.

## REFERENCES

- Adams, F. M., & Osgood, C. E. (1973). A Cross-Cultural Study of the Affective Meanings of Color. *Journal of Cross-Cultural Psychology*, 4(2), 135–156.
- Adams, F. M., & Osgood, C. E. (1973). A Cross-Cultural Study of the Affective Meanings of Color. *Journal of Cross-Cultural Psychology*, 4(2), 135–156.
- Addepally, S. A., & Purkayastha, S. (2017a). Mobile-application based cognitive behavior therapy (CBT) for identifying and managing depression and anxiety. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 10287 LNCS, 3–12.
- Addepally, S. A., & Purkayastha, S. (2017a). Mobile-application based cognitive behavior therapy (CBT) for identifying and managing depression and anxiety. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 10287 LNCS, 3–12.
- Addepally, S. A., & Purkayastha, S. (2017b). Mobile-application based cognitive behavior therapy (CBT) for identifying and managing depression and anxiety. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 10287 LNCS, 3–12.
- Addepally, S. A., & Purkayastha, S. (2017b). Mobile-application based cognitive behavior therapy (CBT) for identifying and managing depression and anxiety. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 10287 LNCS, 3–12.
- Adel, A., Gay, V., & Ryan, A. (2022). *The Evaluation of the Usability in Mobile Applications*. 23–24.
- Almeida, J. S., Hajagos, J., Saltz, J., & Saltz, M. (2019). Serverless OpenHealth at data commons scale — Traversing the 20 million patient records of New York’s SPARCS dataset in real-time. *PeerJ*, 2019(1).
- Almeida, J. S., Hajagos, J., Saltz, J., & Saltz, M. (2019). Serverless OpenHealth at data commons scale — Traversing the 20 million patient records of New York’s SPARCS dataset in real-time. *PeerJ*, 2019(1).
- Andersson, G., & Van Oppen, P. (n.d.). *Pim Cuijpers Annemieke van Straten Psychotherapy for Depression in Adults*.
- Andersson, G., & Van Oppen, P. (n.d.). *Pim Cuijpers Annemieke van Straten Psychotherapy for Depression in Adults*.
- Arean, P. A., Hallgren, K. A., Jordan, J. T., Gazzaley, A., Atkins, D. C., Heagerty, P. J., & Anguera, J. A. (2016). The use and effectiveness of mobile apps for

- depression: Results from a fully remote clinical trial. *Journal of Medical Internet Research*, 18(12).
- Arean, P. A., Hallgren, K. A., Jordan, J. T., Gazzaley, A., Atkins, D. C., Heagerty, P. J., & Anguera, J. A. (2016). The use and effectiveness of mobile apps for depression: Results from a fully remote clinical trial. *Journal of Medical Internet Research*, 18(12).
- Balduini, M., Brambilla, M., Della Valle, E., Marazzi, C., Arabghalizi, T., Rahdari, B., & Vescovi, M. (2019). Models and Practices in Urban Data Science at Scale. *Big Data Research*, 17, 66–84.
- Balduini, M., Brambilla, M., Della Valle, E., Marazzi, C., Arabghalizi, T., Rahdari, B., & Vescovi, M. (2019). Models and Practices in Urban Data Science at Scale. *Big Data Research*, 17, 66–84.
- Bhugra, D., Till, A., & Sartorius, N. (2013). What is mental health? In *International Journal of Social Psychiatry* (Vol. 59, Issue 1, pp. 3–4).
- Black, D. S., & Slavich, G. M. (2016). Mindfulness meditation and the immune system: a systematic review of randomized controlled trials. *Annals of the New York Academy of Sciences*, 1373(1), 13–24.
- Black, D. S., & Slavich, G. M. (2016). Mindfulness meditation and the immune system: a systematic review of randomized controlled trials. *Annals of the New York Academy of Sciences*, 1373(1), 13–24.
- Cuijpers, P., Donker, T., Weissman, M. M., Ravitz, P., & Cristea, I. A. (2016). Interpersonal psychotherapy for mental health problems: A comprehensive meta-analysis. *American Journal of Psychiatry*, 173(7), 680–687.
- Cuijpers, P., Donker, T., Weissman, M. M., Ravitz, P., & Cristea, I. A. (2016). Interpersonal psychotherapy for mental health problems: A comprehensive meta-analysis. *American Journal of Psychiatry*, 173(7), 680–687.
- Cuijpers, P., Karyotaki, E., Weitz, E., Andersson, G., Hollon, S. D., & Van Straten, A. (2014). The effects of psychotherapies for major depression in adults on remission, recovery and improvement: A meta-analysis. In *Journal of Affective Disorders* (Vol. 159, pp. 118–126). Elsevier
- Cuijpers, P., Karyotaki, E., Weitz, E., Andersson, G., Hollon, S. D., & Van Straten, A. (2014). The effects of psychotherapies for major depression in adults on remission, recovery and improvement: A meta-analysis. In *Journal of Affective Disorders* (Vol. 159, pp. 118–126). Elsevier.
- Fusar-Poli, P., Salazar de Pablo, G., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., Pfennig, A., Bechdolf, A., Borgwardt, S., Arango, C., & van Amelsvoort, T. (2020). What is good mental health? A scoping review. In *European Neuropsychopharmacology* (Vol. 31, pp. 33–46). Elsevier B.V.
- Fusar-Poli, P., Salazar de Pablo, G., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., Pfennig, A., Bechdolf, A., Borgwardt, S., Arango, C., & van

- Amelsvoort, T. (2020). What is good mental health? A scoping review. In *European Neuropsychopharmacology* (Vol. 31, pp. 33–46). Elsevier B.V.
- Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J., & Sartorius, N. (2015). Toward a new definition of mental health. In *World Psychiatry* (Vol. 14, Issue 2, pp. 231–233).
- Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J., & Sartorius, N. (2015). Toward a new definition of mental health. In *World Psychiatry* (Vol. 14, Issue 2, pp. 231–233).
- Gavalas, D., & Economou, D. (2011). Development platforms for mobile applications: Status and trends. *IEEE Software*, 28(1), 77–86.
- Gavalas, D., & Economou, D. (2011). Development platforms for mobile applications: Status and trends. *IEEE Software*, 28(1), 77–86.
- Goldberg, S. B., Lam, S. U., Simonsson, O., Torous, J., & Sun, S. (2022). Mobile phone-based interventions for mental health: A systematic meta-review of 14 meta-analyses of randomized controlled trials. *PLOS Digital Health*, 1(1), e0000002.
- Hashem, I. A. T., Yaqoob, I., Anuar, N. B., Mokhtar, S., Gani, A., & Ullah Khan, S. (2015). The rise of “big data” on cloud computing: Review and open research issues. In *Information Systems* (Vol. 47, pp. 98–115). Elsevier Ltd.
- Hashem, I. A. T., Yaqoob, I., Anuar, N. B., Mokhtar, S., Gani, A., & Ullah Khan, S. (2015). The rise of “big data” on cloud computing: Review and open research issues. In *Information Systems* (Vol. 47, pp. 98–115). Elsevier Ltd.
- Heitkötter, H., Hanschke, S., & Majchrzak, T. A. (n.d.). *Evaluating Cross-Platform Development Approaches for Mobile Applications*. [www.springerlink.com](http://www.springerlink.com).
- Hofmann, S. G., & Smits, J. A. J. (2017). Cognitive Behavioral Therapy for Anxiety and Depression. *Psychiatric Clinics of North America*, 40(4)
- Hofmann, S. G., & Smits, J. A. J. (2017). Cognitive Behavioral Therapy for Anxiety and Depression. *Psychiatric Clinics of North America*, 40(4).
- Hofmann, S. G., & Smits, J. A. J. (n.d.). *COGNITIVE-BEHAVIORAL THERAPY FOR ADULT ANXIETY DISORDERS: A META-ANALYSIS OF RANDOMIZED PLACEBO-CONTROLLED TRIALS*.
- Hofmann, S. G., & Smits, J. A. J. (n.d.). *COGNITIVE-BEHAVIORAL THERAPY FOR ADULT ANXIETY DISORDERS: A META-ANALYSIS OF RANDOMIZED PLACEBO-CONTROLLED TRIALS*.
- Hofmann, S. G., Asnaani, A., Vonk, I. J. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. In *Cognitive Therapy and Research* (Vol. 36, Issue 5, pp. 427–440). Springer New York LLC.

- Hofmann, S. G., Asnaani, A., Vonk, I. J. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. In *Cognitive Therapy and Research* (Vol. 36, Issue 5, pp. 427–440). Springer New
- Hofstra, B., Corten, R., & Van Tubergen, F. (2016). Understanding the privacy behavior of adolescents on Facebook: The role of peers, popularity and trust. *Computers in Human Behavior*, *60*, 611–621.
- Huberty, J., Green, J., Glissmann, C., Larkey, L., Puzia, M., & Lee, C. (2019). Efficacy of the mindfulness meditation mobile app “calm” to reduce stress among college students: Randomized controlled trial. *JMIR MHealth and UHealth*, *7*(6).
- Huberty, J., Green, J., Glissmann, C., Larkey, L., Puzia, M., & Lee, C. (2019). Efficacy of the mindfulness meditation mobile app “calm” to reduce stress among college students: Randomized controlled trial. *JMIR MHealth and UHealth*, *7*(6).
- Huberty, J., Puzia, M. E., Green, J., Vlisides-Henry, R. D., Larkey, L., Irwin, M. R., & Vranceanu, A. M. (2021). A mindfulness meditation mobile app improves depression and anxiety in adults with sleep disturbance: Analysis from a randomized controlled trial. *General Hospital Psychiatry*, *73*, 30–37.
- Huberty, J., Puzia, M. E., Green, J., Vlisides-Henry, R. D., Larkey, L., Irwin, M. R., & Vranceanu, A. M. (2021). A mindfulness meditation mobile app improves depression and anxiety in adults with sleep disturbance: Analysis from a randomized controlled trial. *General Hospital Psychiatry*, *73*, 30–37.
- Kaczmarczyk, A., Zajac, P., & Zabierowski, W. (2022). Performance Comparison of Native and Hybrid Android Mobile Applications Based on Sensor Data-Driven Applications Based on Bluetooth Low Energy (BLE) and Wi-Fi Communication Architecture. *Energies*, *15*(13)
- Kaczmarczyk, A., Zajac, P., & Zabierowski, W. (2022). Performance Comparison of Native and Hybrid Android Mobile Applications Based on Sensor Data-Driven Applications Based on Bluetooth Low Energy (BLE) and Wi-Fi Communication Architecture. *Energies*, *15*(13).
- Khanna, P., Professor, A., & Singh, A. (2016). Google Android Operating System: A Review. In *International Journal of Computer Applications* (Vol. 147, Issue 4).
- Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., Chapleau, M. A., Paquin, K., & Hofmann, S. G. (2013). Mindfulness-based therapy: A comprehensive meta-analysis. In *Clinical Psychology Review* (Vol. 33, Issue 6, pp. 763–771).
- Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., Chapleau, M. A., Paquin, K., & Hofmann, S. G. (2013). Mindfulness-based therapy: A comprehensive meta-analysis. In *Clinical Psychology Review* (Vol. 33, Issue 6, pp. 763–771).
- Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. In *Journal of Psychosomatic Research* (Vol. 78, Issue 6, pp. 519–528). Elsevier Inc.

- Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. In *Journal of Psychosomatic Research* (Vol. 78, Issue 6, pp. 519–528). Elsevier Inc.
- Kinderman, P., Hagan, P., King, S., Bowman, J., Chahal, J., Gan, L., McKnight, R., Waldon, C., Smith, M., Gilbertson, J., & Tai, S. (2016). The feasibility and effectiveness of Catch It, an innovative CBT smartphone app. *BJPsych Open*, 2(3), 204–209.
- Ma, L., Gu, L., & Wang, J. (2014). Research and development of mobile application for android platform. *International Journal of Multimedia and Ubiquitous Engineering*, 9(4), 187–198.
- Ma, L., Gu, L., & Wang, J. (2014). Research and development of mobile application for android platform. *International Journal of Multimedia and Ubiquitous Engineering*, 9(4), 187–198.
- Mak, W. W. S., Tong, A. C. Y., Yip, S. Y. C., Lui, W. W. S., Chio, F. H. N., Chan, A. T. Y., & Wong, C. C. Y. (2018). Efficacy and moderation of mobile app-based programs for mindfulness-based training, self-compassion training, and cognitive behavioral psychoeducation on mental health: Randomized controlled noninferiority trial. *JMIR Mental Health*, 5(4).
- Markowitz, J. C., Petkova, E., Neria, Y., Van Meter, P. E., Zhao, Y., Hembree, E., Lovell, K., Biyanova, T., & Marshall, R. D. (2015). Is exposure necessary? A randomized clinical trial of interpersonal psychotherapy for PTSD. *American Journal of Psychiatry*, 172(5), 430–440.
- Markowitz, J. C., Petkova, E., Neria, Y., Van Meter, P. E., Zhao, Y., Hembree, E., Lovell, K., Biyanova, T., & Marshall, R. D. (2015). Is exposure necessary? A randomized clinical trial of interpersonal psychotherapy for PTSD. *American Journal of Psychiatry*, 172(5), 430–440.
- McCloud, T., Jones, R., Lewis, G., Bell, V., & Tsakanikos, E. (2020). Effectiveness of a mobile app intervention for anxiety and depression symptoms in university students: Randomized controlled trial. *JMIR MHealth and UHealth*, 8(7).
- McCloud, T., Jones, R., Lewis, G., Bell, V., & Tsakanikos, E. (2020). Effectiveness of a mobile app intervention for anxiety and depression symptoms in university students: Randomized controlled trial. *JMIR MHealth and UHealth*, 8(7).
- Mihalo, J., & Halamova, J. (2021). An Exploration of the User Experience of Mobile Mental Health Apps Using the Critical Incident Technique. *International Journal of Mobile Human Computer Interaction*, 13(1), 17–32.
- Mira, J. J., Navarro, I., Botella, F., Borrás, F., Nuño-Solinís, R., Orozco, D., Iglesias-Alonso, F., Pérez-Pérez, P., Lorenzo, S., & Toro, N. (2014). A spanish pillbox app for elderly patients taking multiple medications: Randomized controlled trial. *Journal of Medical Internet Research*, 16(4).

*Mobile application development web vs. native.* (n.d.).

- Mohmedhussen, A. N., & Altaee, W. I. (2017). Comparison of Android and iPhone Operating System. In *International Journal of Computer Applications* (Vol. 167, Issue 2).
- Naslund, J. A., Shidhaye, R., & Patel, V. (2019). Digital Technology for Building Capacity of Nonspecialist Health Workers for Task Sharing and Scaling Up Mental Health Care Globally. In *Harvard Review of Psychiatry* (Vol. 27, Issue 3, pp. 181–192). Lippincott Williams and Wilkins.
- Philip, J., & Cherian, V. (2020). Validity of the biopsychosocial model in contemporary psychiatry. *Annals of Indian Psychiatry*, 4(2), 219.
- Powers, M. B., Halpern, J. M., Ferenschak, M. P., Gillihan, S. J., & Foa, E. B. (2010). A meta-analytic review of prolonged exposure for posttraumatic stress disorder. In *Clinical Psychology Review* (Vol. 30, Issue 6, pp. 635–641).
- Powers, M. B., Halpern, J. M., Ferenschak, M. P., Gillihan, S. J., & Foa, E. B. (2010). A meta-analytic review of prolonged exposure for posttraumatic stress disorder. In *Clinical Psychology Review* (Vol. 30, Issue 6, pp. 635–641).
- Proudfoot, J., Clarke, J., Birch, M.-R., Whitton, A. E., Parker, G., Manicavasagar, V., Harrison, V., Christensen, H., & Hadzi-Pavlovic, D. (2013). *Impact of a mobile phone and web program on symptom and functional outcomes for people with mild-to-moderate depression, anxiety and stress: a randomised controlled trial.*
- Rangeswan, H., Areeff, A., Manivannan, S., Rajkumar, B., & Wickramaratne, J. (2023). A Critical Evaluation of Popular UX Frameworks Relevant to E-Health Apps. *International Journal of Computational Science, Information Technology and Control Engineering*, 10(1/2/3), 25–34.
- Rathbone, A. L., & Prescott, J. (2017). The use of mobile apps and SMS messaging as physical and mental health interventions: Systematic review. In *Journal of Medical Internet Research* (Vol. 19, Issue 8). JMIR Publications Inc.
- Rathbone, A. L., & Prescott, J. (2017). The use of mobile apps and SMS messaging as physical and mental health interventions: Systematic review. In *Journal of Medical Internet Research* (Vol. 19, Issue 8). JMIR Publications Inc.
- Torous, J., Chan, S. R., Tan, S. Y. M., Behrens, J., Mathew, I., Conrad, E. J., Hinton, L., Yellowlees, P., & Keshavan, M. (2014). Patient smartphone ownership and interest in mobile apps to monitor symptoms of mental health conditions: A survey in four geographically distinct psychiatric clinics. *JMIR Mental Health*, 1(1).
- Torous, J., Staples, P., Shanahan, M., Lin, C., Peck, P., Keshavan, M., & Onnela, J.-P. (2015). Utilizing a Personal Smartphone Custom App to Assess the Patient Health Questionnaire-9 (PHQ-9) Depressive Symptoms in Patients With Major Depressive Disorder. *JMIR Mental Health*, 2(1), e8.
- Vito Dabbs, A. DE, Myers, B. A., Mc Curry, K. R., Dunbar-jacob, J., Hawkins, R. P., Begey, A., & Mary Amanda Dew, B. (n.d.). *User-Centered Design and Interactive Health Technologies for Patients* (Vol. 27, Issue 3).

Vito Dabbs, A. DE, Myers, B. A., Mc Curry, K. R., Dunbar-jacob, J., Hawkins, R. P., Begey, A., & Mary Amanda Dew, B. (n.d.). *User-Centered Design and Interactive Health Technologies for Patients* (Vol. 27, Issue 3).

Whittaker, R., Merry, S., Stasiak, K., McDowell, H., Doherty, I., Shepherd, M., Dorey, E., Parag, V., Ameratunga, S., & Rodgers, A. (2012). MEMO-a mobile phone depression prevention intervention for adolescents: Development process and postprogram findings on acceptability from a randomized controlled trial. *Journal of Medical Internet Research, 14*(1).

