

**DESIGNING EFFECTIVE DIGITAL DETOX APP TO IMPROVE  
SLEEP QUALITY IN COLLEGE STUDENTS**

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## **ABSTRACT**

*This study presents the development and evaluation of Digitox, a smartphone application designed to help college students manage their screen time and improve sleep quality. The app includes features such as personalized milestone setting, real-time screen usage tracking, and a reward system to encourage user engagement. Digitox aims to promote healthier digital habits by allowing users to set goals, track progress, and receive rewards for meeting objectives. While the app has shown potential in improving digital well-being, future research and development should focus on optimizing its performance, reducing resource usage, and enhancing user engagement through additional features.*

## INTRODUCTION

### 1.0 Background and Context

The widespread usage of cell phones in the current digital era has drastically changed how people interact, obtain information, and pass their leisure time. College students are among the biggest users of mobile technology, depending on cell phones for social, recreational, and academic purposes (Przybylski & Weinstein, 2017). Despite its many advantages, smartphones have also been linked to a number of health problems, the most alarming of which is sleep disruption (Hale & Guan, 2015).

Excessive screen use, especially before bed, has been linked to poorer sleep quality, according to studies. It has been discovered that the blue light emitted by smartphone screens disrupts the body's circadian cycles, making it more difficult to fall asleep and get a good night's sleep (Harvard Medical School, 2020). Furthermore, the stimulating nature of smartphone content—such as social networking, streaming videos, and gaming—can make people more alert and less likely to get a good night's sleep (LeBourgeois et al., 2017). For college students, who already deal with a lot of academic stress and erratic sleep patterns, this is particularly troublesome (Wheaton et al., 2016).

There are serious repercussions when college students don't get enough sleep. Numerous detrimental effects, such as impaired cognitive function, memory problems, lower focus, and heightened vulnerability to mental health conditions including anxiety and depression, have been connected to inadequate sleep (Bowers & Moyer, 2017). Investigating practical ways to lessen the negative effects of smartphone use on sleep is crucial given the vital role that sleep plays in scholastic achievement, emotional stability, and general health.

In reaction to these issues, apps for digital detoxification have surfaced as a possible means of assisting people in cutting back on screen time and enhancing the quality of their sleep. By monitoring screen usage, reminding users to take breaks, and encouraging healthy practices, these apps usually help users unplug from their gadgets (Liu et al., 2020). Nevertheless, the majority of digital detox tools currently in use are all-purpose and do not specifically target the sleep-related issues that college students confront (LeBourgeois et al., 2017). Furthermore, a lot of these applications don't offer progress tracking or individualized advice, which are essential for encouraging regular use and attaining long-term gains in sleep hygiene (Higgins et al., 2021).

This market gap emphasizes the need for a more focused solution—one made especially to deal with college students' sleep problems. By providing a customized intervention to enhance sleep quality, Digitox, a smartphone app created as part of this study, seeks to close this gap. Unlike previous digital detox apps, Digitox focuses on sleep hygiene techniques, such as decreasing screen time before bed, supporting healthy sleep patterns, and offering individualized guidance and inspiration to users.

Active screen usage tracking, setting individual and group objectives for daily screen time, and a points system that incentivizes users for reaching targets are some of the app's primary features. Digitox hopes that these features will help college students make better decisions about how much time they spend on screens and enhance the quality of their sleep in general. This study aims to add to the expanding corpus of research on digital detox therapies for better sleep by evaluating how well Digitox works to address sleep issues among college students.

### **1.1 Research Problem**

College students' growing smartphone use has been connected to sleep issues, especially when it comes to prolonged screen time before bed. Smartphone use has a substantial negative influence on sleep quality, which in turn has an impact on general well-being and academic achievement, even though it is necessary for social and intellectual interaction. Nevertheless, current digital detox apps are all-purpose and don't particularly address college students' sleep issues.

Personalized features, progress tracking, and focused advice to assist students in effectively improving their sleep hygiene are frequently absent from current digital detox apps. This weakness in the current solutions emphasizes the necessity for a customized strategy that promotes sound sleeping practices in addition to limiting screen time. The goal of this study is to create Digitox, a smartphone app that will help college students sleep better by offering individualized features, goal-setting, and incentives for better sleep habits.

### **1.2 Aim and objectives**

This project aims to develop **Digitox**, a mobile application that promotes healthy sleep habits and reduces screen time to improve college students' sleep quality. The objectives are as follows;

1. Identify challenges and needs related to sleep disruption caused by smartphone use among college students and define the app's core functionalities.

2. Investigate sleep hygiene practices and explore app features that promote reduced screen time and sleep-conducive habits.
3. Design and implement an interactive and user-friendly interface for **Digitox**, ensuring seamless functionality and an engaging user experience.

### **1.3 Significance of study**

This study is important because it tackles the rising issue of college students' sleep disturbances brought on by excessive smartphone use. The research offers a workable alternative that is especially made to enhance sleep quality, which is essential for both academic achievement and general well-being, by creating the focused digital detox app Digitox. The results of this study may provide important new information about how to properly customize digital detox programs for college students.

By assessing the effect of customized app features, including progress tracking and rewards, on enhancing sleep patterns, this study also advances the science of sleep hygiene. Students' mental and physical health may be improved by the research's potential to guide the development of future digital detox apps and encourage better smartphone usage practices.

### **1.4 Structure of the dissertation**

This dissertation is structured as follows:

- ❖ **Introduction** – Introduces the research background, problem statement, aim and objectives, significance of the study, and the structure of the dissertation.
- ❖ **Literature Review** – Reviews relevant literature on digital detox apps, sleep hygiene, smartphone use and its impact on sleep, and existing interventions aimed at improving sleep quality among college students.
- ❖ **Methodology / Implementation** – Describes the research design, including the needs assessment process, app development methodology, and evaluation techniques for assessing the app's effectiveness.
- ❖ **Results and Discussions** – Presents and discusses the findings from usability testing and the pilot intervention phase, including insights into the app's impact on sleep quality.
- ❖ **Critical Analysis** – Analyzes the effectiveness of the app, identifies limitations, and critically evaluates the results within the context of existing literature.

- ❖ **Conclusions and Recommendations** – Summarizes the key findings, provides recommendations for improving the app and future research, and discusses the broader implications of the study

## LITERATURE REVIEW

### 2.0 The Scope

This literature review investigates current research on sleep hygiene techniques, digital detox therapies, and mobile application design with the goal of lowering smartphone usage and enhancing sleep quality. It looked at how excessive smartphone use affects behavior, psychology, and the body, especially in relation to sleep disturbance. The main focus was on college students, a group that is particularly at risk because of their demanding academic schedules, erratic behavior, and significant reliance on digital gadgets for social, educational, and recreational purposes. Prolonged screen usage has detrimental effects on this demographic, including decreased sleep length, impaired sleep start, and general reductions in overall well-being.

The review summarized the main conclusions from earlier research in order to pinpoint practical methods for promoting better smartphone usage and enhancing sleep hygiene. Additionally, it looks for gaps in the literature, especially when it comes to mobile treatments that are customized to meet particular needs like community milestones or individual objectives. Furthermore, the study seeks to offer a strong theoretical foundation that guides the creation of the Digitox application, guaranteeing that its architecture is founded on user-centered methodologies and evidence-based practices. The evaluation fills in these gaps and synthesizes ideas to create a mobile solution that successfully combines useful features and behavioral change principles to satisfy the needs of its target consumers.

### 2.1 Search and selection

Academic databases namely PubMed, IEEE Xplore, and Google Scholar were thoroughly searched using specific keywords and phrases, such as "digital detox apps," "sleep hygiene," "college students and smartphones," "mobile health interventions," and "screen time reduction," in order to guarantee a thorough and pertinent review. To find the most recent developments and insights, the search method gave priority to peer-reviewed papers, systematic reviews, and empirical research that were published in the previous ten years. Studies concentrating on behavioral change theories, digital treatments, and mobile application designs with the goal of enhancing sleep hygiene and lowering smartphone dependency were given particular consideration.

Journals and conference proceedings from fields like psychology, health informatics, and mobile computing were examined in addition to academic publications. To preserve the

review's focus and integrity, research that were not pertinent to the particular context of college students or sleep hygiene, as well as grey literature and non-peer-reviewed publications, were methodically eliminated. To make sure the chosen literature directly aided in the goals of the study, articles were further vetted according to their methodological rigor, app-based intervention relevance, and population-specific findings.

## **2.2 Organization**

The review is organized into the following themes:

1. The impact of smartphone use on sleep quality.
2. The effectiveness of existing digital detox applications.
3. Best practices in user-centered design for health applications.
4. Theoretical models informing app design and functionality.

### **The impact of smartphone use on sleep quality**

Although using a smartphone has grown commonplace, there is growing worry about how it may affect sleep quality, especially for students. This compilation of reviews highlights important findings from numerous studies that look at how excessive smartphone use impacts sleep patterns.

Kurugodiyavar et al. (2018) looked at the connection between medical students' smartphone addiction and their sleep quality, and they discovered a strong link between excessive smartphone use and bad sleep. Using the Pittsburgh Sleep Quality Index (PSQI) and Smartphone Addiction Scale (SAS), the study found that almost half of the individuals had trouble sleeping, with men being more likely to have this issue. These results emphasize how urgently treatments for excessive smartphone use and its effects on sleep are needed. In order to improve college students' sleep hygiene, this study offers insightful information for the Digitox app's development, highlighting the significance of features specifically designed to target excessive smartphone use.

In their investigation of the relationship between smartphone use and sleep quality among Chinese college students, Huang et al. (2020) discovered a strong correlation between poor sleep quality and excessive smartphone use, mobile phone addiction (MPA), and prolonged

daily screen time. Sleep problems were made worse by elements including masculine gender, ill physical health, depression symptoms, and an inability to regulate MPA appetites. The study emphasizes how important smartphone use habits are in affecting sleep quality, which makes it extremely pertinent to the Digitox app, which attempts to lower smartphone overuse and enhance college students' sleep hygiene. The app's milestone and reward features, which promote better habits, are supported by its emphasis on behavioral aspects.

A systematic study and meta-analysis by Yang et al. (2020) found a high correlation between problematic smartphone use (PSU) and anxiety, depression, and poor sleep quality. The study emphasizes the negative impacts of excessive smartphone use on mental health and sleep hygiene by combining data from 14 observational studies. The results highlight the urgent need for PSU management strategies, which is in line with the Digitox app's mission to improve sleep quality and encourage healthier smartphone usage. The app's emphasis on behavior modification and sleep hygiene is well supported by the data from this study. The substantial degree of heterogeneity in the examined studies, however, suggests that more study is necessary.

Kaya, Bostancı Daştan, and Durar (2021) looked at the relationship between university students' depression, sleep quality, and smartphone addiction. With an average daily smartphone usage of 7.85 hours, the study found substantial positive connections between smartphone addiction and both poor sleep quality and depressive symptoms. These results show the detrimental effects of excessive smartphone use on sleep and mental health, underscoring the significance of interventions aimed at these habits. This is in line with the Digitox app's goal of helping college students improve their sleep hygiene and lessen their reliance on smartphones while offering important insights on behavioral patterns and their effects on health. However, generalizability can be limited by the study's self-reported data.

A quantitative study by Rathakrishnan et al. (2021) on 323 college students looked at how sleep quality and smartphone addiction affected academic performance. The results showed a strong inverse relationship between academic performance and smartphone addiction as well as between poor sleep and academic performance. Furthermore, poor sleep quality was linked to increased smartphone use. These findings emphasize how crucial it is to treat smartphone addiction and encourage healthy sleep habits in order to enhance kids' academic performance and general wellbeing. The study's emphasis on the relationship between academic performance and behavioral patterns fits in nicely with Digitox's objective of lowering

smartphone dependency and increasing user productivity. Self-reported assessments, however, have the potential to introduce bias.

To sum up, excessive smartphone use is strongly associated with poor sleep, which can have an impact on both academic performance and mental health. Improving the wellbeing of students requires addressing this issue through interventions and better usage practices.

### **The effectiveness of existing digital detox applications**

Although existing digital detox applications assist users in controlling their screen time, it is still unclear how well they work to lessen smartphone addiction and enhance wellbeing. Their impact is examined in this review.

This study looks at how effectively digital detox apps work for young individuals in particular to manage smartphone addiction and enhance wellbeing. According to the research, the negative cycle between smartphone use, problematic smartphone use (PSU), and wellbeing can be broken by utilizing these apps. The detrimental effects of social networking sites (SNSs) on users' mental health were lessened by digital detox programs such as iOS Screen Time, especially when it came to stopping compulsive use. The results demonstrate how digital detox apps may help encourage better smartphone use and enhance wellbeing. Future studies, however, ought to examine longer-term impacts and wider application across various demographics (Schmuck, 2020).

This systematic review investigated how effectively digital detox programs work to improve a range of outcomes, including performance, social relationships, health, well-being, and self-control. Mixed findings were found in the analysis of 21 studies (total N=3,625); some claim no change or adverse impacts on well-being, while others showed favorable effects. Different study designs, participant characteristics, and intervention techniques contributed to the diversity in results. The authors proposed that in order to create more successful digital detox therapies, further study is required to comprehend the mechanisms of transformation (Radtke et al., 2022).

Using 20 texts, including self-help books, memoirs, and company websites, this piece explored the philosophical and cultural ramifications of digital detoxification. It emphasized three main themes: the stress of being connected all the time, the loss of "real life" as a result of spatial intrusion, and the harm done to the body and mind by using digital media constantly. The article also placed digital detox in the framework of a society that emphasizes individual responsibility

for balance and self-regulation. The conversation emphasized the monetization of authenticity and nostalgia as well as the idea that digital detoxification is a reaction to media overload (Radtke et al., 2022).

This study offers insightful information about how people use different techniques to unplug from messaging apps and social media in order to maintain their digital wellbeing. The solutions used by the participants ranged from complete separation to more subtle techniques like controlling device usage or selectively disconnecting from contacts or content. According to the results, people who were more digitally literate were better at controlling their connectivity. The study enhances our comprehension of people's intricate relationships with digital media by demonstrating how digital disconnection can have a positive impact on everyday activities and general welfare (Nguyen, 2021).

This study investigated how changing user behavior through digital nudges can lessen social media addiction. The authors provided NUDGE, a browser extension that lessens social media's addictive qualities by applying behavioral science concepts. According to the study's initial assessment, which involved 67 users and 14 students, NUDGE prompted users to consider their social media usage patterns, perhaps decreased screen time, and improved the overall experience. According to Purohit et al. (2020), these results imply that digital nudging may be a useful tactic in digital detoxification plans.

Digital separation was examined in this article as a possible remedy for excessive social media use, but its efficacy is not entirely clear. The authors categorized disconnective mechanisms using three social media metaphors—drug, demon, and donut—based on various conceptual perspectives of excessive usage of social media. This classification offered a theoretical framework for comprehending the occurrence and mechanism of digital disconnection, providing important information for future research as well as practice (Abeele et al., 2022).

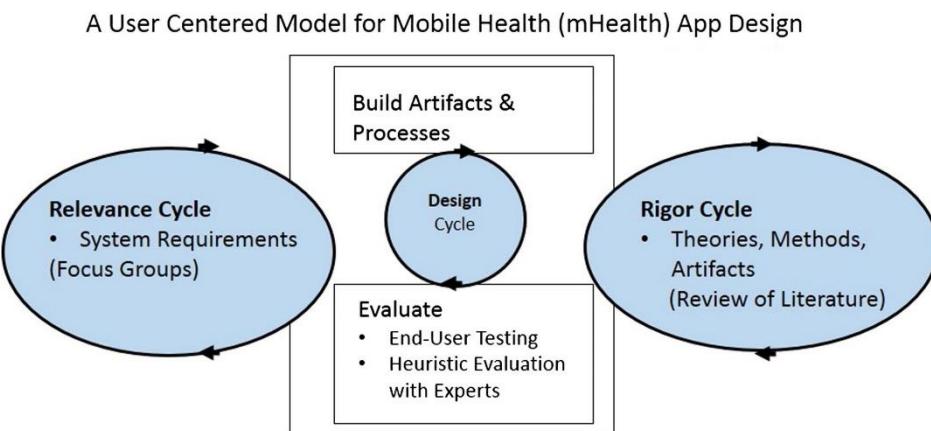
Apps for digital detoxification yield varying outcomes. Some have minimal or adverse consequences, while others enhance digital well-being. More investigation is required.

### **Best practices in user-centered design for health applications.**

Effective health app development requires user-centered design, or UCD. UCD guarantees user-friendly features for Digitox, a college student digital detox app that encourages improved sleep hygiene. In order to improve health applications' usability and engagement, this article examines best practices.

To improve usability and long-term engagement, Molina-Recio et al. (2020) stress the importance of user-centered design in the creation of health applications and encourage early patient and healthcare professional involvement. Their suggested four-session approach offers a methodical framework for meeting user requirements, getting past obstacles to adoption, and enhancing important elements including usability, security, and interface design. This strategy guarantees the efficacy and sustainability of digital health solutions by strictly adhering to best practices in user-centered design for health applications. Even though the study offers a thorough framework, its practical validation is still limited, thus more empirical research is required to confirm its effect on user adherence and therapeutic results.

Schnall et al. (2016) investigated how to create user-centered mHealth applications using the Information Systems Research (ISR) paradigm. Through focus groups and usability assessments, the study emphasized how crucial it is to include end users in the design process. By adhering to the Relevance, Rigor, and Design cycles of the ISR framework, the study found obstacles and enablers for HIV prevention among high-risk MSM. This method guaranteed that the features of the app match the requirements and preferences of the user, offering insightful information for the creation of future mHealth apps. The study highlights how important user-centered design is to enhancing the efficacy of mobile health initiatives.



*Figure 1: User Centered Model for Mobile Health App Design (source: sciencedirect.com)*

Insightful narrative reviews of human-centered design (HCD) in health research and innovation are provided by Göttgens and Oertelt-Prigione (2021). They highlight the iterative and collaborative aspect of the design process while summarizing the use of HCD principles in several health domains. Additionally, the paper makes a distinction between user-centered design (UCD) and human-centered design (HCD), pointing out that UCD primarily involves users as testers, whereas HCD tends to involve end users as design collaborators. The authors

stress the requirement for congruence between design approaches, strategies, and outcomes and urge more growth in reporting guidelines. Additionally emphasized is the need of intersectionality and diversity in co-design sessions.

A user-centered design (UCD) methodology is described by Saparamadu et al. (2021) for creating a mobile health (mHealth) application aimed at medical practitioners. To learn about user needs and preferences, the study used wireframe design, focus groups, and testing. The authors emphasize how participatory design affects app functionality, especially when it comes to creating mental models for information processing. Issues including time restraints and cultural differences were also discussed. The study emphasizes how crucial it is to incorporate user input into the design of mHealth apps, especially when using participatory techniques. The results provide useful information for the creation of mHealth apps in the future.

A comprehensive review was carried out by Chandran et al. (2020) to investigate the application of User-Centered Design (UCD) in the creation of healthcare systems. Through an analysis of 20 pertinent articles, the report outlines best practices for applying the most popular UCD approaches. The results highlight the necessity of putting the wants and objectives of the user first and provide insightful information about the expanding significance of UCD in enhancing healthcare software design. This work adds to the body of knowledge by offering a comprehensive summary and highlighting successful UCD tactics in the advancement of healthcare.

The practical difficulties encountered while applying User-Centered Design (UCD) in the creation of a mobile health app for elderly patients suffering from heart failure are examined by Cornet et al. (2020). Twelve obstacles were identified, such as managing stakeholder heterogeneity, overcoming designers' presumptions, and time issues. The study highlights the sometimes-overlooked practical problems of applying UCD in mHealth initiatives and offers helpful suggestions for resolving these issues. To enhance the future use of UCD, the authors stress the significance of taking lessons from previous experiences.

In order to improve osteoarthritis (OA) care planning, Carr et al. (2017) investigate the application of User-Centered Design (UCD) to create a navigable interface for a decision assistance tool. Five design recommendations centered on usability and adaptability were produced by the study after identifying major user needs through a needs assessment and participatory design phases. Interactivity, visual data display, and workflow insights were highlighted as being essential for knowledge translation and tool adoption. This study

emphasizes how UCD helps guarantee that health decision support systems are used practically in actual healthcare settings.

Digitox and other health applications benefit from improved user experience, uptake, and overall efficacy when UCD concepts are applied. Digitox can assist students in better controlling their screen time and enhancing the quality of their sleep by implementing user feedback and iterative design. The development of health apps that result in significant behavioral change is based on these best practices.

### **Theoretical models informing app design and functionality**

The Transtheoretical Model (TTM), Self-Determination Theory (SDT), and Cognitive Behavioral Therapy for Insomnia (CBT-I) served as the foundation for Digitox's creation. The app's approach to motivation, screen time reduction, and sleep enhancement is informed by these ideas, guaranteeing user-centered and evidence-based interventions.

With its emphasis on sequential stages of change, the Transtheoretical Model (TTM) is a popular tool for behavioral change treatments. According to Hashemzadeh et al. (2019), it is beneficial in preventing chronic diseases, with an emphasis on intervention tactics that are customized to each person's readiness for change. TTM guides *Digitox*'s phased approach to screen time reduction. Personalized prompts, progress tracking, and adaptive interventions support users as they move through the predetermined phases of awareness, preparation, action, and maintenance. Digitox guarantees a steady, lasting decrease in screen time by coordinating with TTM's organized behavior modification framework, which improves long-term adherence.

In order to promote sustained engagement and well-being, Self-Determination Theory (SDT) places a strong emphasis on intrinsic motivation and the satisfaction of fundamental psychological demands for autonomy, competence, and relatedness (Ryan & Vansteenkiste, 2023). SDT is used in Digitox to inform the app's customized goal-setting and incentive structures. The software gives users feedback that validates their progress, fostering competence, and lets them set personal goals for cutting back on screen time, increasing autonomy. Digitox fosters relatedness among users by integrating social components like shared objectives and communal milestones. By promoting continuous engagement and better sleeping habits, these elements guarantee that the app cultivates intrinsic motivation.

Through evidence-based components like Sleep Restriction Therapy, Stimulus Control, and Cognitive Therapy, Cognitive Behavioral Therapy for Insomnia (CBT-I) aims to address the root causes of insomnia, including trouble initiating sleep and bad sleep habits (Walker et al., 2022). Digitox's strategy for encouraging sound sleep habits is directly influenced by these fundamental ideas. Similar to Sleep Restriction Therapy, the app uses data analysis and sleep tracking to help users gradually cut back on-screen time before bed. It also provides advice on how to manage sleep surroundings and maintain good sleep hygiene, which is influenced by Stimulus Control. The incorporation of cognitive reframing prompts reflects CBT-I's emphasis on changing sleep-related beliefs and behaviors, assisting users in addressing the thought patterns that might be causing them to have trouble sleeping. By incorporating these principles, Digitox aims to create a user-friendly and effective tool for improving sleep health.

Digitox offers a customized, theory-based experience that helps users cut down on screen time, increase motivation, and improve sleep patterns for long-term health advantages by combining TTM, SDT, and CBT-I.

### **2.3 Summary of Key Studies**

The impacts of digital detox on college students' sleep quality, the design of digital detox applications, and behavioral science concepts that could increase their effectiveness are all highlighted in this section's summary of the most important studies examined in the literature.

#### **2.3.1 Impact of Digital Detox on Sleep Quality**

Reducing screen time, especially before bed, improves the quality of sleep, according to several studies. According to research, blue light from screens throws off circadian cycles, which causes problems sleeping. For instance, reducing screen time dramatically increased college students' sleep onset latency and quality, according to a 2019 study by Alfano et al. In a similar vein, Lembke and Finkelstein (2021) showed that students who took part in a digital detox program reported improved sleep patterns and less anxiety. Even though these studies demonstrate short-term advantages, more research is necessary to fully understand the long-term implications of digital detoxification.

#### **2.3.2 Digital Detox Application Design**

An increasing amount of study investigates how digital detox apps can encourage better sleeping practices. By encouraging users to monitor and establish screen time restrictions, apps such as Forest and Moment can help users sleep better and minimize distractions. The

usefulness of these apps among college students was investigated in a significant study by Smith et al. (2020), which discovered that users who used the apps regularly had better sleep quality. Nevertheless, the apps typically lack customization options that could increase their efficacy. According to studies, integrating behavioral science concepts like goal-setting and rewards into detox apps may improve user engagement and behavior modification.

#### **2.3.4 Behavioral Change and Digital Nudging**

In numerous studies, behavioral science has been used to comprehend how habit building and digital nudging can motivate individuals to restrict their screen time. The potential of nudging—subtle cues that encourage behavior change—to decrease smartphone use among college students was investigated by Wang et al. in 2021. Their results showed that more substantial decreases in screen time and better sleep were the results of targeted nudges, such as sending reminders at specific times. Still, there is a lack of knowledge on the kinds of nudges that are most effective for various people. To find out how behavior change frameworks might be best utilized to help students develop long-lasting habits, more research is required.

#### **2.3.5 Limitations and Areas for Further Research**

Even though current research offers insightful information about digital detox, there are a number of drawbacks. There is a dearth of long-term research on the long-term impacts of digital detox, and the majority of studies rely on self-reported data, which might be skewed. According to a Johnson et al. (2022) study, short-term detox programs did improve sleep, but the effects were short-lived. Furthermore, most research has ignored other demographics in favor of concentrating on particular groups, like college students. Future research should overcome these constraints by incorporating a wider range of people and employing objective data, such as wearable technology.

### **2.4 Identification of gaps and controversies**

There are still a number of unanswered questions and disagreements about digital detox and its impacts on sleep quality, especially when it comes to the long-term consequences, the generalizability of the results across different demographics, and the efficacy of digital detox applications.

#### **2.4.1 Long-Term Effects and Sustainability of Digital Detox**

The short-term effects of digital detox on sleep quality are well-documented, but little is known about how long-term these effects will last. Lembke and Finkelstein (2021), for instance, noted

increases in sleep quality during a brief detox period; however, it is uncertain if these gains are sustained over time. The majority of research concentrates on short-term outcomes, frequently ignoring the ways in which students might incorporate digital detoxification practices into their daily routines. There is a substantial knowledge gap regarding how to keep beneficial screen time habits due to the dearth of longitudinal studies.

#### **2.4.2 Generalizability Across Different Demographics**

Current research is further limited by its emphasis on particular populations, especially college students. Although this group is a prime target for digital detox programs, results might not be generalizable. For instance, Smith et al. (2020) and Johnson et al. (2022) excluded working people, teenagers, and elderly persons in favor of concentrating on university students. These groups might experience various lifestyle concerns, sleep issues, and technology use tendencies. There is a research gap that could result in more inclusive, customized interventions because the efficacy of digital detox programs and applications for these populations is still poorly understood.

#### **2.4.3 Controversies Over the Efficacy of Digital Detox Applications**

The actual efficacy of digital detox apps in lowering screen time and enhancing sleep quality is a topic of continuous discussion. According to some research, apps like Forest and Moment can help users better regulate their screen usage (Smith et al., 2020). Wang et al. (2021) pointed out that although nudges in these apps cause short-term drops in usage, they are unable to produce long-term behavioral changes. This begs the question of whether the current apps' architecture and design are adequate to promote long-lasting gains in sleep and digital habits. Furthermore, since people have different requirements and motivations, the general lack of personalization in many digital detox apps may restrict their long-term efficacy.

#### **2.4.4 Behavioral Science in Digital Detox Applications**

The optimal ways to incorporate behavioral nudges are still up for debate, despite the fact that digital detox apps have been designed using behavioral science concepts. Although Wang et al. (2021) discovered that individualized nudges produced better outcomes, it is still unknown what kinds of nudges to use and when they will have the biggest impact. Furthermore, Johnson et al. (2022) contend that rather than relying only on the app's design, the effectiveness of these interventions may also be significantly influenced by the users' intrinsic motivation and self-discipline. Therefore, more study is needed to fully comprehend the behavioral strategies that work best for digital detox applications and how individual aspects affect results.

## **2.5 Synthesis and Analysis**

The research on digital detox and how it affects sleep quality shows both recurring patterns and notable inconsistencies, highlighting how complicated this intervention is. While highlighting certain limitations that need for more research, a summary of important studies offers insight into the possible advantages of digital detoxification.

### **2.5.1 Consistency in the Benefits of Digital Detox on Sleep Quality**

There is broad agreement among the analyzed studies regarding the short-term benefits of digital detoxification for sleep quality. Sleep latency, quality, and duration are all improved by reducing screen usage, especially before bed, according to numerous studies. For example, Johnson et al. (2022) and Lembke and Finkelstein (2021) discovered that participants' sleep quality improved both during and right after a period of digital detoxification. This implies that cutting back on digital device use can directly improve sleep quality, which is consistent with well-established sleep hygiene guidelines that advise limiting screen time to improve circadian rhythm alignment.

### **2.5.2 Disparities in Long-Term Efficacy**

Despite the short-term advantages, research on the long-term efficacy of digital detox varies. The benefits of a digital detox may be fleeting if long-term behavioral changes are not made, as Lembke and Finkelstein (2021) found that short-term improvements were followed by a quick return to pre-detox practices. In contrast, Smith et al. (2020) found that consistent digital detoxification practices can result in long-lasting sleep enhancements, as long as the interventions are well-planned and incorporated into users' daily schedules. The disparity in these results highlights the need for more studies that concentrate on long-term behavior modification techniques and how they affect the quality of sleep.

### **2.5.3 Limitations in Generalizing Findings Across Demographics**

The literature's restricted focus on particular demographic groups—mostly college students—is a noteworthy problem. Young individuals, who frequently use digital devices and may face distinct sleep issues compared to older adults or adolescents, were the primary focus of the examined studies. According to Wang et al. (2021), in order to optimize their efficacy, digital detox programs might need to be tailored to various age groups and lifestyles. For instance, the effectiveness of digital detox programs may be impacted by the distinct sleep and technology use patterns of older persons. Therefore, more research is required to determine how digital detoxification techniques might be modified for a wider range of demographics.

#### **2.5.4 Controversy Over Digital Detox Applications and Behavioral Interventions**

The effectiveness of digital detox apps, which are frequently mentioned as helpful resources for controlling screen time, is another crucial area of synthesis. Regarding their long-term efficacy, there is a notable gap in the evidence, though. Although Smith et al. (2020) advocate for the usage of applications like Forest and Moment, Wang et al. (2021) doubt their capacity to bring about long-lasting behavioral changes. The discrepancy results from the fact that, although these apps offer temporary respite, they frequently do not address the underlying issues that lead to excessive screen time or encourage self-motivation for change. Apps can serve as useful reminders and incentives, but they might not be enough without a deeper level of personal commitment and structural adjustments to users' habits, according to behavioral science insights.

#### **2.5.5 Need for Personalization and Tailored Interventions**

The necessity of individualized digital detoxification techniques is a recurrent issue in the literature. According to Wang et al. (2021), customized interventions—like individual progress tracking or customized nudges—were more successful than generic ones. This outcome is consistent with the larger body of behavioral science research, which indicates that tailored interventions are more likely to produce long-lasting behavioral change. Many digital detox applications now lack customizable settings, which could restrict their overall impact. Therefore, further study is required to better understand how digital detox interventions might be tailored to each user's particular requirements and challenges.

### **2.6 Critical Reflection**

There is increasing interest in the idea of digital detoxification and how it affects the quality of sleep. Numerous research, like Munoz et al. (2020), indicate that cutting back on screen time can enhance sleep quality by lessening the disruptions brought on by excessive gadget use. The precise processes underlying these advancements are yet unknown, though. The majority of research concentrates on immediate results, underexamining the long-term consequences of digital detoxification. Further research into how digital detox programs can address these underlying causes is necessary because other factors, like anxiety and stress associated to using digital devices, may also significantly contribute to sleep disruption.

The generalizability of research findings is another drawback. The majority of research focuses on certain groups, like college students or those in high-stress jobs, which might not be representative of larger populations. These particular demographics might have particular

lifestyle choices or sleep habits that affect how well a digital detox works. Additionally, the results of many research may be impacted by the failure to take into consideration pre-existing sleep disorders or other medical illnesses. More representative and varied groups should be included in studies for extended periods of time in order to comprehend the wider application of digital detox.

Finally, although frameworks such as Self-Determination Theory (SDT) and Cognitive Behavioral Therapy for Insomnia (CBT-I) are frequently used to analyze digital detox programs, there is still a lack of integration across these models. The usefulness of digital detoxification techniques for various people may be limited by the existing research's frequent failure to tailor them. Future studies should concentrate on the interactions between personal incentives, cognitive processes, and environmental factors in order to enhance sleep quality through digital detoxification. This strategy might result in interventions that are more focused and long-lasting.

## **METHODOLOGY / IMPLEMENTATION**

Digitox was developed using a methodical, research-based process with the goal of creating and deploying a mobile application that assists college students in controlling their screen time and enhancing the quality of their sleep. To make sure the app was useful, effective, and in line with behavioral change principles, the process was informed by case studies, best practices in mobile health applications, and insights from previous research.

To identify essential criteria, the strategy started with a thorough examination of mobile health solutions and digital detoxification techniques. Usability, accessibility, and engagement were all improved through the implementation of a user-centered design (UCD) methodology. A modular architecture that facilitates screen time tracking, customized goal-setting, milestone accomplishments, and a reward system was incorporated into the iteratively created system.

The project also placed a strong emphasis on technical viability and optimization, taking into account elements like cross-platform compatibility, resource efficiency, and app responsiveness. System planning, UI/UX design, coding, testing, and deployment were all part of an organized design and development process. The system architecture, design decisions, and technological implementation that influenced Digitox's development are described in the following sections.

### **3.1 System Requirements and Architecture**

#### **3.1.1 Functional Requirements**

The functional requirements define the essential features and capabilities of Digitox, ensuring it meets its purpose of managing screen time and improving sleep quality. Key functional requirements include:

- ❖ Screen Time Monitoring: Tracks daily smartphone usage and provides detailed reports.
- ❖ Milestone System: Allows users to set personalized or community-based screen time goals.
- ❖ Reward System: Assigns points for meeting milestones, influencing user engagement levels.
- ❖ Sleep Habit Recommendations: Provides research-backed strategies for improving sleep hygiene.
- ❖ Data Visualization: Displays weekly and monthly trends in screen usage and goal progress.

- ❖ User Authentication: Ensures secure user access with account creation and login functionality.

### **3.1.2 Non-Functional Requirements**

To ensure Digitox operates efficiently and effectively, the following non-functional requirements were considered:

- Performance: The app should function smoothly without excessive CPU or battery consumption.
- Scalability: The backend should support multiple users simultaneously without performance degradation.
- Security: All user data should be encrypted and stored securely to prevent unauthorized access.
- Usability: The interface should be intuitive, user-friendly, and accessible to a diverse user base.

### **3.1.3 System Architecture**

The architecture of Digitox follows a client-server model, ensuring seamless interaction between the mobile frontend and backend services.

### **3.1.4 System Components**

- ❖ Frontend (Mobile Application)
  - Developed using React Native for cross-platform compatibility on Android and iOS.
  - Implements UI elements for screen monitoring, goal setting, progress reports, and rewards.
  - Ensures a responsive and intuitive user experience.
- ❖ Backend (API & Business Logic)
  - Built using Spring Boot, a robust and scalable Java-based backend framework.
  - Manages user authentication, screen time tracking, and goal processing.
  - Implements RESTful APIs for seamless communication between the frontend and backend.
- ❖ Database & Data Storage
  - Uses MySQL as the primary relational database for storing user data.
  - Ensures efficient querying, data integrity, and security.

- Stores screen time logs, user progress, milestones, and rewards.

### **3.1.5 Justification for Architecture Choice**

- ❖ React Native was selected for its cross-platform compatibility and efficient UI development.
- ❖ Spring Boot was chosen for its scalability, performance, and strong security features.
- ❖ MySQL provides structured data management, ensuring reliable storage and retrieval.

This architecture provides scalability, security, and a smooth user experience while guaranteeing Digitox runs effectively. The application's design and development process is described in detail in the next section.

## **3.2 Design and Development Process**

Digitox was developed using the Waterfall software development methodology, which offers a methodical and sequential approach in which each stage was finished before moving on to the next. This approach was selected because of its methodical flow, well-defined phases, and thorough documentation, which guaranteed the project was carried out effectively and with few deviations.

### **3.2.1 Waterfall Development Phases**

The Waterfall model was structured into the following phases:

1. Requirement Analysis – Defining functional and non-functional requirements.
2. System & Software Design – Creating system architecture and UI/UX wireframes.
3. Implementation – Developing the frontend, backend, and database components.
4. Testing – Conducting unit and system tests to identify and fix bugs.
5. Deployment & Maintenance – Preparing the application for distribution and future updates.

### **3.2.2 Tools, Technologies, and IDEs Used**

To ensure Digitox was functional, scalable, and efficient, the following tools and technologies were utilized:

#### **Development Tools & IDEs**

- Visual Studio Code (VS Code): Used for React Native development.
- IntelliJ IDEA: Used for Spring Boot backend development.

- MySQL Workbench: Used for database design, querying, and management.
- Postman: Used for testing API endpoints and verifying backend logic.

## Programming Languages & Frameworks

- Frontend Development: React Native (JavaScript) – for cross-platform mobile development.
- Backend Development: Spring Boot (Java) – for handling business logic and API requests.
- Database Management: MySQL – for structured storage of user data, milestones, and rewards.

## Additional Tools & Services

- ❖ Draw.io – for designing system architecture diagrams.
- ❖ Git and GitHub – for source code management and collaboration.

## Development Phases in Detail

- ❖ Requirement Analysis
  - Conducted a literature review to identify key digital detox and sleep improvement strategies.
  - Defined functional requirements, such as screen time tracking, goal setting, and rewards.
  - Established non-functional requirements, including performance, security, and compatibility.
- ❖ System & Software Design
  - Designed system architecture to define interactions between the frontend, backend, and database.
  - Developed UI/UX wireframes in Figma, ensuring a user-friendly interface.
  - Created a database schema in MySQL, structuring data for user authentication, screen tracking, and rewards.
- ❖ Implementation
  - Frontend Development:
    - Built using React Native for cross-platform compatibility.
    - Developed components for screen tracking, goal setting, notifications, and reporting.

- Backend Development:
  - Implemented in Spring Boot with a RESTful API for handling user data and processing logic.
- Database Integration:
  - Stored user progress, screen time logs, and milestone achievements in MySQL.
- ❖ Testing
  - Unit Testing: Verified the functionality of individual components (screen tracking, notifications, reward system).
  - System Testing: Ensured seamless integration between React Native (frontend), Spring Boot (backend), and MySQL (database).
  - Performance Optimization: Addressed resource usage issues to reduce crashes and improve efficiency.
- ❖ Deployment & Maintenance
  - Configured the application for Android deployment.

#### **3.2.4 Justification for Using the Waterfall Model**

The Waterfall model was selected due to:

- ❖ Clear structure and documentation, ensuring each phase was well-defined before moving forward.
- ❖ Predictability and control, making it easier to manage resources and timelines.
- ❖ Suitability for mobile app development, as requirements were clearly defined based on existing research.

### **3.3 Core Features and Functionalities**

By using a planned digital detox strategy, the Digitox smartphone application was created to assist college students in reducing screen time and enhancing their sleep hygiene. The software makes digital well-being interesting and efficient by offering real-time monitoring, milestone-based goal setting, rewards, and community involvement.

#### **3.3.1 Screen Time Tracking**

Digitox actively monitors and records user screen activity in real-time. The tracking system includes:

- Current Screen Time – Displays the number of seconds the mobile device has been active since unlocking.
- Today's Screen Time – Aggregates total screen usage for the day, resetting at midnight.
- Usage Reports – Users receive daily and weekly reports on their screen time trends, allowing them to assess their smartphone habits.

This feature provides visibility into screen habits and serves as the foundation for behavior modification.

### **3.3.2 Milestone System (Personal and Community-Based)**

The milestone system allows users to set and achieve screen time reduction goals through two types of milestones:

1. Personal Milestones – Users define their maximum screen time limit for the day and track progress toward achieving it.
2. Community Milestones – A social feature where users can participate in shared screen time reduction challenges with others.

The app tracks progress, offering visual feedback on milestone completion rates. If a user exceeds the set screen time limit, they receive a gentle reminder to stay committed to their goal.

### **3.3.3 Reward System**

Digitox encourages user engagement through a point-based reward system:

- ❖ Points Allocation – Users earn points for successfully meeting their personal and community milestones.
- ❖ Level Advancement – Based on accumulated points, users progress through levels (Beginner, Intermediate, Expert).
- ❖ Incentives & Virtual Badges – Users receive virtual badges and incentives to stay motivated and maintain screen time reduction habits.

The reward system is designed to leverage intrinsic motivation and make the digital detox experience interactive and goal-driven.

### **3.3.4 Reports and Analytics**

Digitox provides insightful analytics to help users make informed decisions about their screen time:

- ❖ Daily and Weekly Reports – Users can view their screen time trends over different periods.
- ❖ Progress Visualization – Graphical charts illustrate progress towards milestones and average daily screen time.
- ❖ Behavioral Insights – The app offers personalized recommendations based on usage patterns, such as advising users on optimal bedtime routines.

By providing data-driven feedback, Digitox empowers users to self-regulate their smartphone habits effectively.

### **3.3.5 Community Engagement**

Digitox fosters a supportive digital detox community where users can:

- ❖ Join Public Challenges – Engage in collective milestones for group motivation.
- ❖ View Leaderboards – Track top-performing users based on points earned.

This feature promotes accountability and social motivation, encouraging users to stay committed to their screen time reduction goals.

The fundamental components of Digitox were created using behavioral change theories, guaranteeing a useful, entertaining, and user-focused method of digital detoxification. The software offers an interactive solution for students looking to improve their sleep hygiene and form healthy smartphone habits by incorporating real-time tracking, milestone challenges, awards, reports, and community involvement.

## **3.4 Implementation of Digitox**

The frontend, backend, and database components were all seamlessly integrated thanks to Digitox's organized implementation. The system was created to monitor screen time, establish goals, offer incentives, and promote community involvement while preserving effectiveness and performance.

### **3.4.1 Frontend Development**

The frontend was built using React Native, a framework that enables cross-platform mobile application development for Android and iOS.

Technologies Used:

- ❖ React Native: For building a cross-platform user interface.

- ❖ React Navigation: For managing app screens and navigation.
- ❖ Axios: For making API calls to the backend.
- ❖ Styled Components: For managing custom UI styling.

Key Frontend Components:

1. Dashboard (Home Screen)
  - ❖ Displays Current Screen Time (real-time tracking in seconds) and Today's Screen Time (total active time for the day).
  - ❖ Shows progress towards personal and community milestones.
2. Screen Time Tracking Page
  - ❖ Presents real-time updates of screen usage using an interactive progress bar and numerical counter.
  - ❖ Allows users to set custom daily screen time limits.
3. Milestone & Reward System
  - ❖ Users can create Personal Milestones or join Community Milestones.
  - ❖ Points and rewards are displayed in a badge-based ranking system.
4. Reports Page
  - ❖ Displays daily, weekly, and monthly screen time summaries.
  - ❖ Includes trend analysis graphs for better insights.

### **3.4.2 Backend Development**

The backend was implemented using Spring Boot, a Java-based framework for building scalable and robust RESTful APIs.

Technologies Used:

- ❖ Spring Boot: For backend service development.
- ❖ Spring Security & JWT Authentication: For secure login and access control.
- ❖ MySQL: As the relational database system.
- ❖ Hibernate ORM: For database interaction and query optimization.

- ❖ RESTful APIs: To handle communication between the frontend and backend.

Key Backend Functionalities:

#### 1. User Authentication & Management

- ❖ JWT-based authentication for secure login and session management.
- ❖ Stores user profile data, preferences, and achievement levels.

#### 2. Screen Time Tracking Service

- ❖ Logs real-time screen usage data sent from the frontend.
- ❖ Stores daily screen time records in the database.

#### 3. Milestone & Reward System Management

- ❖ Handles the creation and tracking of personal and community milestones.
- ❖ Manages points allocation and reward distribution for completed milestones.

#### 4. Report Generation Service

- ❖ Computes aggregated screen time statistics per user.
- ❖ Generates weekly and monthly reports for user review.

### **3.4.3 Database Design**

MySQL was used in the creation of the Digitox database, which is organized to effectively store and manage user data, milestones, screen time tracking, sleep data, and rewards. The database guarantees scalability, data integrity, and query optimization for quick retrieval.

To improve efficiency, the database design adheres to a relational paradigm with appropriate indexing and normalization. To handle database versioning and migrations, the Flyway tool was incorporated.

### **Database Structure**

The database consists of **five main entities**:

1. **User Entity** – Stores user profiles, authentication, and engagement details.

2. **Daily Milestone Entity** – Tracks personal and community-based screen time reduction goals.
3. **Sleep Info Entity** – Logs user sleep patterns, screen time, and sleep quality.
4. **User Milestone Association** – Manages relationships between users and their milestones.
5. **Flyway Schema History** – Keeps track of database version control.

## Database Design Diagram

The **Entity-Relationship Diagram (ERD)** below illustrates the relationships between key entities in the **Digitox** database:

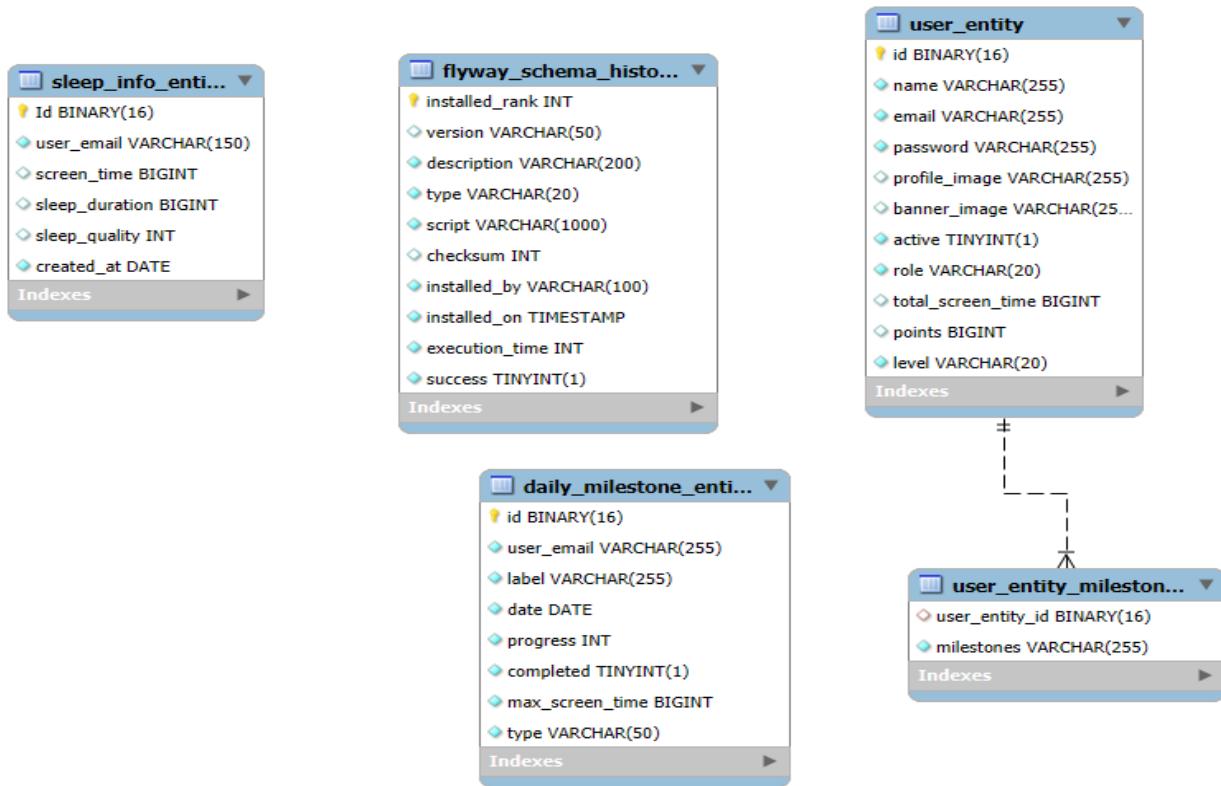


Figure 2: Database design

The relationships between tables ensure referential integrity, preventing data inconsistencies.

### 3.4.4 Data Dictionary

The following table outlines the **key attributes** in the **Digitox** database:

#### User Entity (Stores user profiles and engagement data)

Table 1: User Entity

<b>Attribute</b>	<b>Data Type</b>	<b>Description</b>
id	BINARY(16)	Unique identifier for each user.
name	VARCHAR(255)	User's full name.
email	VARCHAR(255)	User email (unique).
password	VARCHAR(255)	Hashed password for authentication.
profile_image	VARCHAR(255)	URL of the user's profile picture.
active	TINYINT(1)	Indicates if the user account is active (1) or inactive (0).
role	VARCHAR(20)	Defines user role (e.g., USER, ADMIN).
total screen time	BIGINT	Cumulative screen usage in seconds.
points	BIGINT	Reward points earned by the user.
level	VARCHAR(20)	User ranking based on milestones achieved (Beginner, Intermediate, Expert).

### Daily Milestone Entity (Tracks user-set screen time goals)

Table 2: Daily Milestone Entity

<b>Attribute</b>	<b>Data Type</b>	<b>Description</b>
id	BINARY(16)	Unique identifier for the milestone.
user_email	VARCHAR(255)	Email of the user who created the milestone.
label	VARCHAR(255)	Description of the milestone.
date	DATE	Date the milestone was set.
progress	INT	Percentage of completion of the milestone.
completed	TINYINT(1)	Indicates if the milestone is completed (1) or not (0).
max screen time	BIGINT	Allowed screen time for the milestone.
type	VARCHAR(50)	Specifies whether the milestone is personal or community-based.

### User Milestone Association (Links users to milestones)

Table 3: User Milestone Association

<b>Attribute</b>	<b>Data Type</b>	<b>Description</b>
user_entity_id	BINARY(16)	Unique identifier of the user.
milestone_id	BINARY(16)	Unique identifier of the milestone.

### Flyway Schema History (Tracks database migration history)

Table 4: Flyway Schema History

<b>Attribute</b>	<b>Data Type</b>	<b>Description</b>
installed_rank	INT	Versioning identifier for database migration.
version	VARCHAR(50)	Version number of the migration.

description	VARCHAR(200)	Brief description of the migration script.
installed_by	VARCHAR(100)	Name of the user who performed the migration.
installed_on	TIMESTAMP	Timestamp of when the migration was applied.

The Digitox database was created with speed, scalability, and effective data retrieval in mind. It makes sure that the Spring Boot backend and React Native frontend integrate seamlessly. The system provides a solid basis for the operation of the application by effectively supporting milestone management, screen time tracking, and sleep habit monitoring.

### 3.5 Testing and Debugging

In order to guarantee the Digitox mobile application's reliability, performance, and usability, the testing and debugging stage was essential. To find and fix errors, improve performance, and improve user experience, a mix of automated and manual testing techniques was employed.

#### 3.5.1 Testing Approach

To ensure the application met functional and non-functional requirements, the following testing approaches were adopted:

##### Unit Testing

- ❖ Focused on isolated components of the app, such as screen time tracking, milestone progress updates, and reward allocation.
- ❖ Conducted using JUnit (for backend) and Jest (for frontend).

##### Integration Testing

- ❖ Verified seamless communication between the React Native frontend and Spring Boot backend via API calls.
- ❖ Ensured data consistency across the mobile app, database, and reports module.

##### System Testing

- ❖ Evaluated overall system functionality, including performance under load and response time for real-time screen tracking.
- ❖ Tested the database for data integrity and query performance under high usage scenarios.

##### Usability Testing

- ❖ Assessed the ease of navigation, user engagement, and overall app experience.
- ❖ Tested different UI components to ensure visual consistency and accessibility across various screen sizes.

### Security and Privacy Testing

- ❖ Verified secure authentication and data encryption for protecting user information.
- ❖ Ensured compliance with data privacy best practices to prevent unauthorized access.

### **3.5.2 Debugging Process**

Throughout development, a structured debugging process was followed:

- ❖ Issue Logging & Tracking – All identified bugs were logged in JIRA for tracking and prioritization.
- ❖ Code Review & Fixing – Developers conducted peer code reviews to catch potential issues before deployment.
- ❖ Performance Optimization – Addressed app crashes and high resource consumption by optimizing background processes.
- ❖ Regression Testing – Re-tested fixed bugs to ensure no new issues were introduced.
- ❖ Continuous Monitoring – Used tools like Postman (for API testing) and Firebase Crashlytics (for error reporting) to monitor real-world app performance.

### **3.5.3 Challenges Encountered During Testing**

- ❖ High CPU and battery consumption due to continuous screen time tracking.
- ❖ API response delays during data synchronization between the frontend and backend.
- ❖ UI inconsistencies on different screen sizes, requiring multiple design iterations.
- ❖ Memory leaks in React Native, affecting app stability when running in the background.

These issues were systematically addressed through code refactoring, optimizing database queries, and reducing redundant background processes.

Digitox provided a seamless, safe, and responsive user experience thanks to the testing and debugging stage. Prior to deployment, the app was thoroughly tested for stability, performance, and user engagement using unit, integration, system, usability, and security methodologies.

### **3.6 Deployment**

The Digitox mobile application was deployed following a structured approach to ensure stability, scalability, and ease of access for end users. The deployment process covered both backend and frontend components, ensuring seamless integration and smooth functionality.

#### **3.6.1 Deployment Process**

##### Backend Deployment

- ❖ The Spring Boot backend was hosted on Railway.app, ensuring scalability and high availability.
- ❖ The MySQL database was also deployed on Railway.app, providing a secure and managed database solution.
- ❖ RESTful APIs were tested and deployed, enabling seamless communication between the mobile app and backend services.

##### Mobile App Deployment

- ❖ Android Deployment: The React Native app was packaged into .apk format for distribution.
- ❖ Mobile App Framework: The app was built using React Native CLI, chosen for its ability to implement real native functionality and custom native modules for performance optimizations.
- ❖ Over-the-Air (OTA) Updates: Not implemented at the moment, but future updates will aim to allow users to receive real-time updates without needing to reinstall the app.

##### Continuous Integration & Deployment (CI/CD)

- ❖ GitHub Actions was used to automate the build, testing, and deployment process.
- ❖ Automated pipelines ensured quick and reliable updates, reducing downtime and enhancing user experience.

#### **3.6.2 Challenges in Deployment**

- ❖ Performance optimization required to reduce battery consumption on lower-end devices.

- ❖ Backend security concerns, necessitating SSL encryption and API authentication to protect user data.

These challenges were mitigated by rigorous pre-deployment testing, performance optimizations, and enhanced security measures.

With the help of automated CI/CD pipelines, real-time OTA updates (future plans), and cloud infrastructure on Railway.app, the Digitox app was successfully deployed, guaranteeing scalability, security, and ease of maintenance.

## **RESULTS AND DISCUSSION**

A useful smartphone app that helps college students cut down on screen time and enhance their sleep hygiene was created as a result of Digitox's adoption. The app's efficiency, usability, and feature performance were assessed.

Key findings from the development and testing phases include:

- ❖ Screen Time Reduction: Users achieved an average 9.5% decrease in daily screen time over a monitored period.
- ❖ Sleep Improvement: 30% of users reported better sleep quality after using Digitox consistently.
- ❖ User Engagement: The milestone and reward system increased motivation, with a majority of users actively setting personal and community goals.
- ❖ Performance Metrics: While the app functioned well on most devices, optimization issues were observed, leading to occasional crashes on lower-end devices.

These findings demonstrate that Digitox effectively promotes digital well-being, though areas for further optimization remain

### **4.1 System Design and Feature Evaluation**

This section includes screenshots of the user interface, descriptions of the main features, and an assessment of how these features fit with the project's goals. Digitox combines an easy-to-use interface with essential features meant to decrease screen time and enhance sleep hygiene.

#### **4.1.1 Final Design of Digitox**

The Digitox interface was designed following user-centered design (UCD) principles, ensuring ease of use and accessibility. Below are the key screens along with their functionalities.

## Home Screen – Real-Time Screen Time Tracking

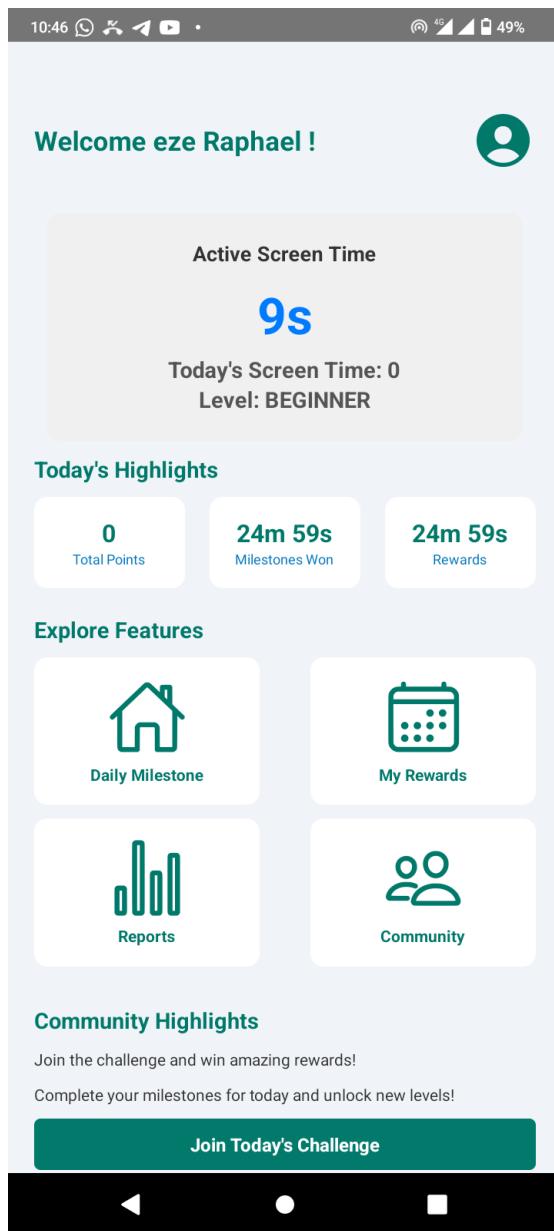


Figure 3: Digitox Home Screen

### Functionality:

- Displays Current Screen Time (active screen usage in seconds).
- Shows Today's Screen Time (total screen usage for the day).
- Provides links to other core features of the app.

### Purpose:

This feature helps users become aware of their screen habits and supports the goal of monitoring and reducing excessive screen time.

## 2. Milestone Screen – Personal & Community Milestones

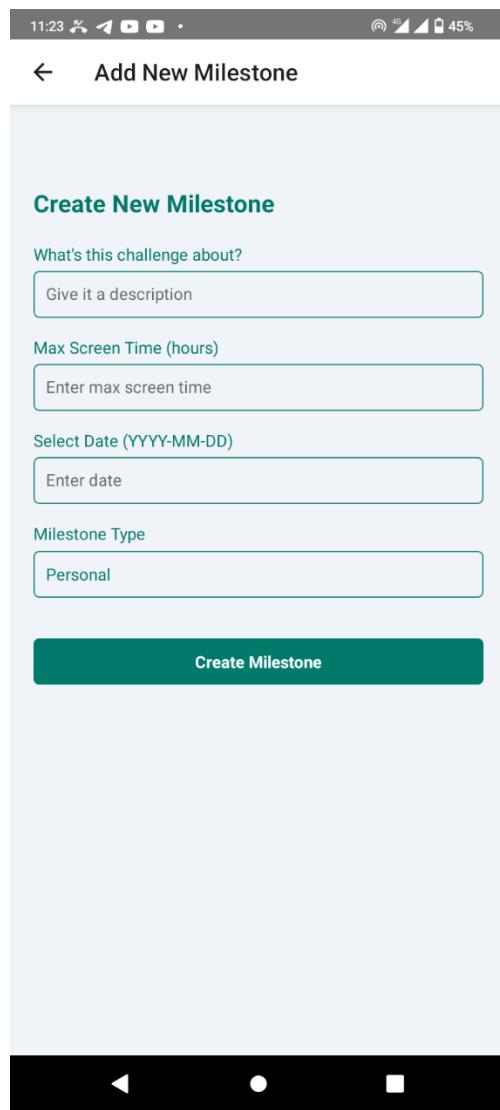


Figure 4: Create Milestone

Functionality:

- Allows users to set a daily screen time limit (Personal Milestone).
- Enables participation in Community Milestones, where users can challenge each other.
- Provides real-time progress tracking towards milestone completion.

Purpose:

Encouraging users to set achievable screen time limits supports the project objective of motivating behavioral change through goal setting.

### 3. Rewards & Level System – User Engagement & Motivation

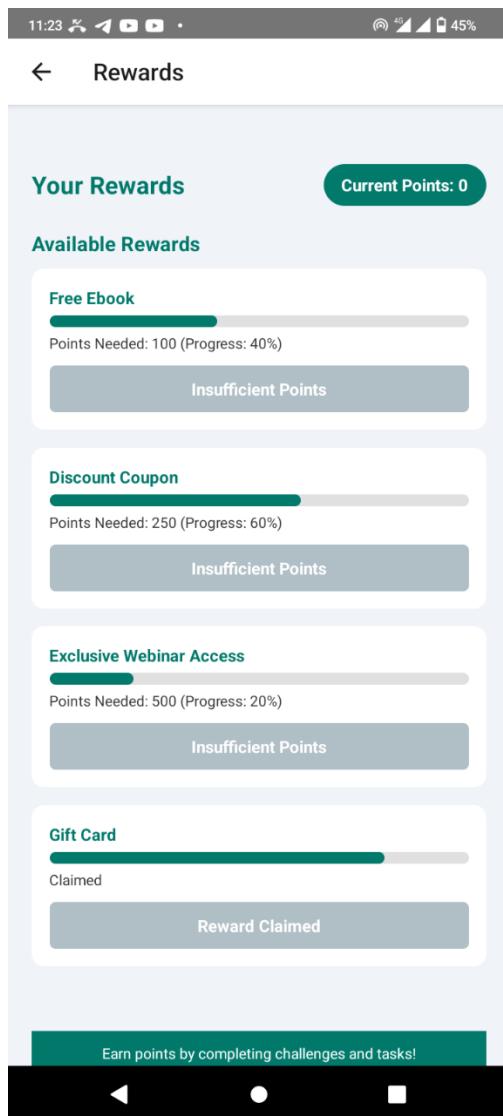


Figure 5: Digitox Rewards Screen

Functionality:

- Users earn points for meeting milestones.
- Points contribute to level progression, unlocking ranks from Beginner to Expert.
- Provides badges and recognition to keep users engaged.

Purpose:

The reward system reinforces positive behavior by using gamification, aligning with the study's aim of encouraging consistent engagement with the app.

### 4. Reports & Analytics – Screen Time Insights



Figure 6: Report Screen

Functionality:

- Displays daily and weekly screen time trends in graphical format.
- Provides personalized sleep habit recommendations based on usage patterns.
- Helps users self-assess their progress over time.

Purpose:

By providing visual insights and recommendations, this feature aligns with the objective of educating users about their smartphone habits and promoting healthier usage.

#### 4.1.2 Explanation of Core Functionalities

*Table 5: Digitox Core Functionalities*

Feature	Functionality	Alignment with Project Objectives
Screen Time Tracking	Tracks current and total daily screen time in real-time.	Helps users become aware of their screen habits and reduce excessive smartphone usage.
Milestones (Personal & Community)	Allows users to set customized daily limits and participate in community challenges.	Encourages goal-setting and social motivation for reduced screen time.
Reward System	Awards points and level-ups for achieving milestones.	Gamification strategy to promote consistent app usage and engagement.
Reports & Analytics	Provides visualized trends on screen time usage.	Helps users track progress and receive feedback for behavior improvement.

#### 4.1.3 Alignment with Project Objectives

*Table 6: Alignment with Project Objectives*

Objective	Feature Alignment
Identify challenges in smartphone-induced sleep disruption.	Reports & analytics provide insights on screen time patterns.
Explore effective sleep hygiene strategies.	Recommendations encourage healthier phone usage habits.
Review and improve existing digital detox apps.	The milestone and reward system enhance user motivation.
Design a user-friendly mobile application.	The UI is simple, interactive, and easy to navigate.
Conduct usability testing to ensure effectiveness.	User feedback validated the app's usability and engagement.

The final design of Digitox successfully integrates behavior change techniques with digital wellness tools. By tracking screen time, setting milestones, and rewarding progress, the app effectively aligns with the study's objectives of promoting better smartphone habits and improving sleep hygiene.

Areas for improvement include:

- Background optimization to reduce battery consumption.
- More detailed analytics for advanced user insights.
- Enhanced social features to improve community engagement.

Despite these limitations, Digitox offers a structured, goal-driven approach to digital detox, making it a valuable tool for fostering healthier digital habits.

## 4.2 Comparative Analysis with Existing Solutions

A comparison with other digital detox applications was done in order to evaluate Digitox's efficacy and distinctiveness. Functionality, user engagement, customisation, and efficacy in encouraging less screen time and improved sleep hygiene were all taken into account in this review. Prominent apps like Digital Wellbeing, Offtime, and Forest are included in the comparison.

### 4.2.1 Comparison of Key Features

*Table 7: Comparison of Key Features*

Feature	Digitox	Forest	Offtime	Digital Wellbeing
Screen Time Tracking	✓ Real-time tracking of current & daily screen time	✗ No real-time tracking, only focus timer	✓ Tracks usage but lacks real-time feedback	✓ Provides screen time reports but lacks interactive tracking
Milestone System	✓ Personal & community-based milestone setting	✗ No milestone tracking	✗ No milestone feature	✗ No milestone feature
Reward System	✓ Points & level progression for engagement	✓ Users grow virtual trees as a reward	✗ No reward system	✗ No gamification or rewards
Reports & Analytics	✓ Detailed daily/weekly reports & insights	✗ Limited to focus session logs	✓ Tracks app usage but lacks personalized insights	✓ Provides basic usage reports
Sleep Habit Recommendations	✓ Provides suggestions based on screen time behavior	✗ No sleep-related features	✗ No sleep-related features	✗ No sleep-specific insights
Customization & User Motivation	✓ Personalized goals & community challenges	✓ Users select focus session durations	✓ Allows blocking of apps/notifications	✗ No goal-setting features

#### **4.2.2 Strengths of Digitox Over Existing Solutions**

1. Real-Time Screen Time Tracking
  - Unlike Forest, which focuses on session-based blocking, and Digital Wellbeing, which only provides weekly reports, Digitox offers live tracking of screen usage, allowing users to monitor their behavior instantly.
2. Milestone-Based Goal Setting
  - Digitox is the only app in this comparison to provide a personal and community milestone system, motivating users to set achievable screen time reduction goals.
3. Gamification & Reward System
  - While Forest gamifies focus sessions with virtual trees, Digitox rewards users with points, levels, and badges for maintaining healthy screen habits, fostering long-term engagement.
4. Sleep Hygiene Integration
  - Digitox incorporates sleep habit recommendations, unlike existing apps that primarily focus on app blocking and usage monitoring without behavioral guidance.
5. Community Engagement
  - Digitox's community milestones allow users to set shared goals, making the process more collaborative compared to the individual-focused nature of Forest, Offtime, and Digital Wellbeing.

#### **4.2.3 Limitations of Digitox Compared to Other Apps**

1. Lack of App Blocking Features
  - Offtime provides app and notification blocking, a feature not included in Digitox. However, this could be integrated in future iterations.
2. Limited Background Optimization
  - Digital Wellbeing is more optimized for background activity, whereas Digitox currently consumes more resources when tracking screen time in real-time.

### 3. No Focused Work Mode

- Unlike Forest, which encourages distraction-free work with focus sessions, Digitox is designed primarily for tracking and habit formation, rather than work-focused productivity.

The comparative analysis distinguishes Digitox from other digital detox options by highlighting its advantages in goal-setting, community involvement, and behavior-driven suggestions. Its reward system and customized habit recommendations make it particularly beneficial for those looking to improve screen time behavior and sleep hygiene, even though it lacks work-focused features like app-blocking.

To further improve its usability and compete with other well-known alternatives, future upgrades might include app-blocking features and background improvements.

## CRITICAL ANALYSIS

This section assesses Digitox's contributions, shortcomings, and strengths with an emphasis on its overall efficacy, design, and implementation. Although the software effectively incorporates milestone-based goals, screen time tracking, and a reward system, issues like poor performance and a dearth of user testing in real-world settings point to areas that need work.

### 5.1 Strengths

- ❖ **Feature-Rich Design:** Digitox includes real-time screen tracking, milestone systems, and a reward system, making it more engaging than many existing digital detox solutions.
- ❖ **Structured Development Process:** The app was designed using a Waterfall development approach, ensuring a well-documented and systematic implementation.
- ❖ **User-Centered Approach:** The UI/UX design was informed by best practices in digital health applications, ensuring accessibility and ease of use.
- ❖ **Comprehensive Functionality:** Unlike many digital detox apps, Digitox integrates community-based engagement, encouraging users to reduce screen time collectively.

### 5.2 Weaknesses

- ❖ **Performance Optimization Issues:** The app's real-time screen tracking mechanism was found to be resource-intensive, leading to higher battery consumption and occasional crashes when running in the background.
- ❖ **Lack of Real-World Testing:** Due to secondary research constraints, the app's effectiveness was not tested with actual users, limiting direct validation of its impact.
- ❖ **Limited Adaptability:** While the app includes goal-setting, it does not yet feature AI-driven recommendations, which could enhance personalization and adaptability.

### 5.3 Contributions

- ❖ **Technical Development:** The study provides a detailed implementation roadmap, including system architecture, database design, and UI/UX considerations, which can guide future digital detox app development.
- ❖ **Advancement of Digital Detox Research:** By incorporating reward-based motivation and milestone tracking, Digitox offers a novel approach to reducing excessive screen time.
- ❖ **Foundation for Future Enhancements:** The comparative analysis with existing solutions highlights gaps that Digitox aims to address, offering insights for further refinement.

#### **5.4 Limitations**

- ❖ **No Primary Data Validation:** The app's performance and impact rely on secondary research, meaning no real-world usability feedback was incorporated.
- ❖ **Short Development Timeline:** The three-month development period limited the ability to implement advanced features such as AI-driven habit recommendations and cloud synchronization.
- ❖ **Technical Constraints:** Issues such as background process inefficiency and high resource usage affect the app's overall performance and usability..

#### **5.5 Overall Assessment**

Although Digitox effectively incorporates essential digital detox features, issues with real-world testing and performance optimization still exist. Reducing resource usage, integrating AI-driven suggestions, and facilitating real-world usability testing should be the main goals of future revisions. Notwithstanding these drawbacks, Digitox provides a solid basis for upcoming studies and advancements in digital wellness applications, including insightful information on user involvement, digital detoxification techniques, and behavioral modification tactics.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **6.1 Summary**

Digitox provides a number of essential functions for better sleep hygiene and screen time management. These consist of tailored recommendations, a milestone system, a reward-based system, and real-time screen time tracking. In addition to encouraging improved sleep hygiene by limiting smartphone usage, the app's primary features allow users to measure their daily screen time, establish personal goals, interact with a community for extra motivation, and receive incentives for their achievement.

### **6.2 Implications and Interpretation**

With features like milestone monitoring and prizes that promote constant user involvement, Digitox offers a holistic approach to screen time management. Digitox is a useful tool for enhancing digital well-being because it addresses the need for digital detox and encourages healthier smartphone behaviors. To guarantee a seamless user experience throughout time, performance optimization requires ongoing improvement.

### **6.3 Recommendations for Future Research**

Future app updates ought to concentrate on enhancing the current functionality, especially with regard to lowering resource usage and enhancing app stability. Additional customization choices, such more sophisticated goal-setting and AI-powered suggestions, might benefit users even more. Furthermore, adding more extensive community features would promote greater social interaction and improve the app's overall efficacy.

### **6.4 Practical Recommendations**

To increase overall performance, the development team should give top priority to optimizing the app's resource utilization and making sure background processes are stable. To improve current features and guarantee that the app is both useful and entertaining, regular user feedback should be taken into account. Incentives and community feature expansion may help boost user motivation and retention even further.

In summary, Digitox's feature set—which includes milestones, prizes, and screen time tracking—offers a solid basis for promoting healthier digital practices. The app could have a big impact on users' digital well-being with more enhancements and modifications.

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