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RESPITE: A USER-CENTERED DESIGN AND EVALUATION OF A PERSUASIVE TECHNOLOGY FOR REDUCING MOBILE PHONE AND SOCIAL MEDIA ADDICTION



AARON JOHN TETTEH

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RESPITE: A USER-CENTERED DESIGN AND EVALUATION OF A PERSUASIVE TECHNOLOGY FOR REDUCING MOBILE PHONE AND SOCIAL MEDIA ADDICTION

BY

AARON JOHN TETTEH

Thesis submitted to the Department of Computer Science and Information Technology of the School of Physical Sciences, College of Agriculture and Natural Sciences, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy degree in Computer Science.

OCTOBER, 2024

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the record of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature: …… Date: ……

Name: Aaron John Tetteh

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature: …… Date: .....

Name: Dr (Mrs) Alimatu-Saadia Yussif

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ABSTRACT

The rapid rise of smartphones and social media has transformed the way people engage with technology, creating both opportunities and challenges. While these innovations enhance connectivity and convenience, they have also led to growing concerns about mobile phone and social media addiction, which negatively affect mental health, productivity, and overall well-being. The central problem tackled in this research is the increasing prevalence of social media addiction, particularly among younger populations. The primary goal of this research is to develop and evaluate a persuasive mobile application that aims at reducing social media addiction and enhancing user well-being. The research methodology employs a user-centred design approach, ensuring the app meets the needs of individuals struggling with social media and phone addiction. The evaluation of the application involved two key phases. According to Nielsen's guidelines, usability experts first conducted a heuristic evaluation to identify areas where the app's functionality and interface needed improvement. Based on the experts' feedback, the app underwent iterative revisions. This was followed by unmoderated usability testing, where forty (40) users independently interacted with the app in real-world settings, providing natural feedback on its usability and effectiveness. The results demonstrated that the app received positive user feedback, with an average System Usability Scale (SUS) score of 71.5, indicating strong usability. The findings suggest that thoughtfully designed applications can help users regain control of their digital habits, leading to healthier behaviours and improved well-being. The application can be further improved in the future with AI-driven insights and sophisticated analytics to offer consumers tailored recommendations.

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KEY WORDS

Addiction

High-Fidelity

Iterative

Usability

User-centric

Wireframes

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DEDICATION

To Apostle Akomdo, my Mum and Siblings, for your faith in me.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
AVD	Android Virtual Device
CCPA	California Consumer Privacy Act
DSR	Design Science Research
GDPR	General Data Protection Regulation
HCI	Human–Computer Interaction
IDE	Integrated Development Environment
SUS	System Usability Scale
UCD	User Centered Design
UI	User Interface
UX	User Experience
VR	Virtual Reality

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CHAPTER ONE

INTRODUCTION

This chapter introduces the growing challenge of smartphone and social media addiction and establishes why technological interventions are necessary. The chapter also defines the purpose of the comparative analysis, evaluating Respite against existing digital-wellbeing tools, and articulates the study objectives, research questions, and significance.

Background to the Study

Recent advancements in hardware and software, particularly with the introduction of smartphones, have significantly enhanced the utilization of Information and Communication Technologies (ICT) in our daily lives (Salehan & Negahban, 2013). ICT has revolutionized the way we live, becoming an integral part of our existence. Many people, especially the youth, rely on these technologies for various purposes. Computers are used for studying, internet browsing, gaming, and other communication. Mobile phones have become ubiquitous today, with a staggering number of users relying on them for on-the-go connectivity.

The increasing prevalence of portable computing devices has sparked a lively debate in the media, prompting discussions about the evolving practices of users (Oulasvirta *et al*., 2012). These devices have brought about significant changes in socialization, task execution, and information sharing. However, concerns have emerged regarding the potential consequences of these technologies on everyday life. One recurring concern revolves around the formation of habits and the unforeseen effects that arise as a result. While the

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continuous access to social networks is widely appreciated, there are anxieties regarding the intrusion into private domains and the impact on work-life balance. It has been observed that gains in productivity through these devices do not automatically translate into more leisure time, but rather complicate the delicate balance between work and personal life. Sociologists have documented a shift in Westerners' time-use patterns, characterized by irregular, fragmented, and overlapping activities taking place in new and diverse locations.

Among portable computing devices, smartphones represent the latest milestone in the evolution of portable information and communication technology. Equipped with constant network connectivity and the ability to install various applications, smartphones have the potential to shape new habits related to Internet use. Despite the extensive usage time indicated by preliminary logging studies, which showed that smartphones are often utilized for up to 2.7 hours per day, there remains a lack of comprehensive understanding regarding the qualitative nature of these new habits and their significance within the fabric of everyday life. Exploring the specific characteristics and impact of these habits is crucial for gaining insights into the role of smartphones in shaping user behavior and their implications for well-being and social dynamics.

The assumption that life will not be possible without mobile phones is frequently emphasized in the media. Mobile phone commercials imply that our social or intergroup standing is decided by the brand of our phones, as mobile phones are always becoming "smarter" and more contemporary (Körmendi *et al*., 2016). The increased use of smartphones and social media has created new problems and worries about how people regulate their screen time and device

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usage behaviours. The primary use of a mobile phone is to stay in touch with others, followed by its role as a status symbol and as a practical safety measure.

Smartphone addiction is a widespread issue that affects adults. It shows up in their excessive phone use when doing other things like studying, driving, going out with friends, and even sleeping. The excessive use of these techniques has been associated with detrimental effects, including less physical activity, disturbed sleep, elevated stress levels, and worse academic performance (Alhassan *et al*., 2018). Smartphones have ceased to be cutting-edge communication devices and have become an integral part of people's lives. For smartphone users, smartphones are the first thing they look at when they wake up in the morning and the last thing they look at before they go to bed. According to a study by (Lee *et al*., 2014; Oulasvirta *et al*., 2012), people usually check their phones 34 times a day because it has just become a habit rather than because they need to. For smartphone users, excessive usage and repetitive monitoring of missed calls or texts can lead to compulsive use of the device or even mobile phone addiction.

The use of information and communication technology (ICT) has fundamentally altered how we live and have integrated into all aspects of our existence. Young people in particular utilize these devices often and for a wide range of purposes. People use computers for social interaction, gaming, internet research, and education. Nowadays, social networking refers more to who we are than it does to what we do. One may argue that social networking is a way of life. Social networking services differ significantly depending on their features and user base. Some are made for practically everyone, while others are made for persons of a certain race, religion, language, or career, examples

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include LinkedIn, Facebook, Twitter, WeChat and many others. People now live in a society that relies heavily on technology, making it hard for them to envisage a day when they are not linked to the internet. The term "social media addiction" describes an individual's excessive or obsessive usage of social media sites like Facebook, Twitter, and Instagram to the point where it has a detrimental influence on their everyday lives and well-being. With research showing high levels of addiction among young people, especially university students, social media addiction has become a significant worry in recent years (Kuss, Griffiths, & Binder, 2013). Social media's addictive qualities are mostly a result of the constant stream of stimuli and incentives that these platforms offer, including likes, comments, and shares (Lee *et al*., 2014).

Social media addiction is a significant problem affecting a substantial portion of the global population. A meta-analysis found that around 6% of the world's population have at least a base level of Internet addiction, equivalent to over 210 million individuals potentially affected (Longstreet & Brooks, 2017). Social media usage is a particular subset of Internet use that can also lead to addictive behavior. Social media is highly popular and addicting, with the average user spending 27% of their time online interacting with social media. This time spent on social media can lead to the development of a strong use habit, which can then lead to high levels of addiction to usage. Clinically, Internet addiction and social media addiction are treated seriously, with specific treatment approaches adopted in different countries to address the issue.

Through the application of computer technology, persuasive technology seeks to alter people's behaviour. Persuasive technology is to provide individuals with the information, criticism, and motivation they require to

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change their behaviour for the better. Its design is predicated on knowledge of human behaviour and decision-making techniques. This multidisciplinary area of study is gaining popularity and is being used in an expanding variety of fields, including health, the environment, and education (Kilian, 2022). Persuasive technologies may be used to create mobile applications that encourage people to adopt healthy use patterns in the context of minimizing phone and social media addiction.

There is a need for practical solutions that can assist people in managing their social media consumption and preventing addiction given the rising concern over excessive social media use and its effects on well-being. By creating a smartphone application that uses persuasive technologies to promote healthier and more balanced social media consumption patterns, this project will address the problem of social media addiction. The purpose of the study is to lessen addiction and enhance well-being, and the user-centred design approach will take into consideration the unique requirements and motivations of those who are battling with social media addiction.

The results of this study will provide light on how persuasive technologies may be used to combat social media addiction and can guide the development of future technological advancements that encourage social media use that is both healthy and balanced. Additionally, by encouraging healthier and more rewarding digital experiences, the creation of a mobile application that successfully combats social media addiction may have enormous ramifications for both individuals and society at large.

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Statement of the Problem

The proliferation of smartphones has had a profound impact on individuals' lives. While these devices offer undeniable advantages, they also come with inherent challenges that need to be addressed. This study focuses on the intersection of persuasive technology, mobile phone addiction, and social media addiction.

Smartphone addiction is a prevalent issue that encompasses various behaviours facilitated through smartphones, such as gaming, social networking, and online shopping. It refers to the compulsive and uncontrolled use of smartphones despite experiencing negative consequences in personal and social life. The functionality provided by the latest generation of smartphones, including untethered Internet access and mobile-optimized applications, has contributed to the growing concern. In recent years, as smartphone and mobile phone usage continue to rise worldwide, research on smartphone addiction has gained significant momentum. Beryl Noë's extensive literature review in May 2020 focused on enhancing the understanding of cell phone addiction by examining its definition and the characteristics of individuals affected by it.

In recent years, social media addiction has gained attention due to the multiple negative effects it has on both physical and mental health, as well as decreased productivity and quality of life. Despite more awareness of the problem, there are still few practical solutions that can help people control their use of social media and avoid addiction. By assessing and creating a smartphone application that makes use of persuasion technologies to encourage healthier and more balanced social media usage patterns, this study aims to close this gap.

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This research aims to contribute to the expanding body of knowledge on technology usage and well-being by offering a workable cure for social media addiction using a user-centered design approach.

In summary, this study aims to address the pressing issue of mobile phone and social media addiction through a user-centered design and evaluation approach. By synthesizing the existing knowledge on addiction, understanding user requirements, and leveraging persuasive technologies, we aspire to develop interventions that empower individuals to regain control over their digital behaviors. Through this research, we hope to contribute to the development of effective strategies that mitigate addiction, promote healthier usage patterns, and foster a more balanced relationship between individuals and their mobile devices.

Purpose of the Study

The main purpose of this study is to develop and evaluate a persuasive mobile application to reduce the impacts of social media addiction in people, promote well-being and decrease the negative effects of excessive social media usage. It also examines the value of a user-centred design approach in creating successful solutions to this problem. It seeks to understand how persuasive technology may be used to encourage more reasonable and healthy social media behaviour.

Research Objectives:

- To understand the specific needs and motivations of individuals struggling with social media addiction and utilize this information to inform the design of a user-centered mobile application.

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- To identify the most effective features and design elements for reducing social media addiction through a persuasive technology-based mobile application.
- To design prototypes for persuasive mobile applications for reducing social media addiction.
- To develop a persuasive mobile application to reduce social media addiction and promote well-being among individuals.
- To evaluate the usability of the persuasive mobile application in reducing social media addiction and promoting well-being among individuals.

Research Questions:

- What are the specific needs and motivations for individuals struggling with Social Media addiction?
- What are the most effective features and design elements for reducing social media addiction through a persuasive technology-based mobile application?
- How best can persuasive mobile applications prototypes be designed and evaluated?
- How can the persuasive technology for reducing mobile phone and social media addiction be developed?
- How usable is the persuasive mobile application in reducing social media addiction and enhancing well-being?

Significance of the Research

The importance of this research lies in its potential to advance knowledge of social media addiction and the role that persuasive technology

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may play in resolving this problem. The findings of this study may guide the creation of more useful and user-centred programs that can help people reduce their social media use and avoid addiction. The results of this research will also shed light on the best functionalities and aesthetics that may be applied in the creation of convincing technology-based apps. In addition, this study is to help address the rising concern over the detrimental effects of excessive social media use on well-being and the need for workable ways to avoid addiction.

Delimitations

The development and evaluation of a successful mobile app based on persuasive technology that intends to reduce social media addiction and enhance wellness will be the main focus of this project. The study will be conducted using a user-centred design process, which will consider the unique requirements and motivations of persons who are dependent on social media. The deployment of persuasive technologies within a mobile application will be the focus of the study, along with an investigation of how effectively these technologies work to avoid social media addiction and promote wellness

Limitations

It is important to acknowledge that this research also faces certain limitations. One limitation is the generalizability of the findings, as the research is focused on a specific population and may not capture the experiences of all individuals struggling with mobile phone and social media addiction. Additionally, the effectiveness of the mobile app may vary depending on individual differences and external factors. Other potential challenges include recruitment of participants for user research and the need for continuous updates

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and improvements to the app to keep up with evolving technologies and user needs.

Definition of Terms

- Persuasive Technology: Persuasive technologies are designed with an intended outcome, such as changing users' attitudes or behaviors, and the outcome occurs from a persuasion process enabled by the technology
- User-Centred Design: It emphasizes understanding the needs, preferences, and behaviors of users to create products that align with their expectations and requirements.
- Mobile Application: A mobile application is a piece of IT software created especially for mobile operating systems that are deployed on portable electronics like tablets and smartphones.
- Mobile phone addiction: is used to describe an obsessive condition when people's usage of mobile phones seriously impairs their social, psychological, and bodily functioning.

Organization of the Study

The thesis comprises five chapters, each serving a distinct purpose:

The introductory chapter presents an overview of the proposed mobile app for reducing mobile phone and social media addiction. The background of the project is discussed, highlighting the existing issues with current systems. The objectives and significance of developing the mobile app are also outlined, emphasizing its potential impact in addressing the growing concern of social media addiction.

The second chapter focuses on the comprehensive literature review. It delves into the historical background of mobile app interventions for addiction,

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explaining the concept, functionalities, and potential applications. The review analyses existing literature, explores the theoretical perspectives relevant to this study, and presents the project's contribution to existing knowledge.

Chapter three presents the detailed methodology used in developing the mobile app. The chapter restates the research objectives and design questions. Various testing methods, including usability testing and user interviews, are discussed, providing insights into the research approach.

In the fourth chapter, the focus is on the practical implementation and testing of the mobile app. Findings from the development process are explained, and discussions are made regarding the app's functionalities and features. The chapter provides an in-depth analysis of the app's performance and usability, ensuring its effectiveness in tackling mobile phone and social media addiction.

The final chapter offers a summary of the entire study, drawing conclusions based on the research findings. Recommendations are provided for further improvements and future work in the field of mobile app interventions for addiction. This chapter serves as the conclusion of the thesis, highlighting the significance of the developed mobile app and its potential impact on addressing social media addiction.

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CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter synthesizes the theoretical and empirical foundations relevant to digital addiction and persuasive technology. It reviews existing research on mobile phone dependency, reward-system behavior, user-centered design, persuasive technology frameworks, and system usability evaluation instruments, with an emphasis on the System Usability Scale (SUS). The chapter also maps out how current digital-wellbeing apps address (or fail to address) motivational, contextual, and behavioural factors.

Mobile Phone and Internet Addiction

The term "mobile phone addiction" or "mobile phone dependence" describes an obsessive condition in which people's social, psychological, and physical functioning are severely hampered by their usage of mobile phones. Many scholars believe that mobile phone dependence is an impulsive behavior with withdrawal symptoms (Guo, 2016), and it is a "behavioral addiction (Guifang, 2020) that is, mobile phone dependence is excessive. An addiction to mobile phones may not have any particular direct biological effects, but rather refers to an abnormal behaviour pattern that, as a result of repeated use, causes pain or has a major negative impact on a person's physical, mental, and occupational well-being (Wu, 2009)

According to a recent industry analysis, the average smartphone penetration rate across 47 nations is 44.6%, and this percentage is predicted to rise quickly (Yang, 2013). Smartphones are become essential devices for people's daily lives rather than just cutting-edge communication tools. The first

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thing that smartphone users' glance at in the morning and the final thing they look at before bed are their phones. Oulasvirta (2012) found that people check their phones 34 times a day, not because they have to, but rather because it has become natural to them. For smartphone users, excessive use and the habit of monitoring missed calls or texts can lead to compulsive use and even mobile phone addiction (Salehan M. &., 2013). Smartphones are used by people for stress relief or enjoyment. Although such usage might provide instant satisfaction, it can also result in continuous activity and a decreased feeling of volitional control (Thomée, 2012). Compulsive usage leads to mental health symptoms such as sleep disturbance and depression.

The Internet is becoming a vital component of people's life, yet it is also causing serious issues for both people and businesses. Young people have been greatly impacted by smartphones and the internet. On the one hand, users have benefited greatly from the Internet (Echeburúa, 2010). On the other hand, some people are unable to manage their usage because they have gotten fascinated with it. People have occasionally become so out of control of their mobile phone and Internet use that their actions have put their relationships and careers in danger. The physical, emotional, and psychological well-being of users may be impacted by this problematic Internet and mobile phone usage (PIU), (Bener, 2013). It has been established by some researchers that excessive Internet use, which is regarded as a behavioural addiction, may produce dependent symptoms similarly to those of drug misuse. According to (Beranuy, 2013), problematic Internet and Mobile phone users can suffer mood modification, loss of control, relapse, craving, tolerance, withdrawal, conflict, among others (Kuss, Griffiths, & Bin, 2013)

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Motivation and User Needs of individual internet addiction

Social media addiction is a complex phenomenon with a range of underlying needs and motivations. The desire for social connection plays a pivotal role in driving excessive social media use (Adreassen, Torsheim, Brunborg, & Pallasen, 2012). Individuals addicted to social media may feel an overwhelming need for constant interaction and validation, as these platforms offer a means to maintain relationships and stay connected with others. The instant feedback in the form of likes and comments can provide a boost to self-esteem, making it a potent source of validation (Deci & Ryan, 2000).

Entertainment and information-seeking behaviors are also prevalent among social media addicts (Adreassen, Torsheim, Brunborg, & Pallasen, 2012). These platforms provide a wealth of content, including videos, articles, and news, catering to users' appetite for novelty and information. The novelty factor on social media can further fuel addiction, as it satisfies human curiosity and the desire to explore new experiences.

As the world evolves, the trends in social media usage adapt to diverse market demands. Among various individuals and most college students, the reasons for engaging with social media encompass the need for socialization, reconnecting with old friends, seeking educational content, gathering information, promoting products and services, job hunting, information exchange, announcing news during specific events, and indulging in online games (Hamid, Ishak, Ismail, & Yazam, 2013).

Students can communicate with their tutors, access course materials, personalise their accounts, and create student communities using social media platforms in educational institutions. Additionally, social media might be

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utilised to create and involve students in a range of extracurricular activities and to support collaborative learning (Ansari & Khan, 2020).

Moreover, loneliness and social isolation can lead individuals to turn to social media as a way to cope with their feelings (Marazziti, Presta, Baroni, Silvestri, & Dell'Osso, 2014). These platforms act as substitutes for real-world social interactions, offering a sense of belonging and community to those who may lack such connections in their offline lives. The fear of missing out (FOMO) is another powerful motivator for social media addiction (Przybylski, Murayama, DeHaan, & Gladwell, 2013). People constantly check their social media feeds due to the anxiety of missing out on social events, news, or trends, making it challenging for them to disengage.

Theoretical Background

Addiction can be explained as having an unusually high dependence on a particular thing (Park, 2005). It is characterized by engaging in repetitive actions that have overall negative consequences (Manela, Ovadia, & Shemesh, 2021). Addicts often prioritize short-term satisfaction over long-term implications of their actions (Manela, Ovadia, & Shemesh, 2021). While they may have some recognition of the costs incurred in the future, they tend to have an incorrect or distorted image of it. Information technology plays a significant role in cultivating addiction among individuals. The experience derived from using technology becomes so enjoyable that individuals are willing to maintain it even at high costs (Csikszentmihalyi, 1990).

Addiction to technology can occur through a variety of means. For example, it may contribute to work addiction, a condition in which individuals use technology excessively for both job-related and personal purposes (Porter,

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2006). Such extensive use of technology in organizations can result in sacrificing other goals, such as neglecting commitments, decreasing social activities and contact with friends, and even physical inactivity leading to weight gain (Porter, 2006).

Media addiction is another type of technology-related addiction in which users turn to media for friendship, leisure, information, or escape (Park, 2005). The motivations for media use can be categorized into instrumental use (seeking information, arousal-seeking) and ritualistic use (habit, passing time) (Lanyon, 1984). The indications of internet addiction, a subset of media addiction, include poor self-esteem, loneliness, and feelings of isolation (Douglas, 2008). Mobile phone addiction is another type of technology addiction and can be categorized as problematic behavior. Problematic use includes the use of mobile phones in legally restricted, socially inappropriate, or hazardous circumstances, such as while driving. It is related to age, extroversion, low self-esteem (Bianchi, 2005), and high self-monitoring (Takao, 2003). While many studies suggest that mobile phone use can lead to addiction, (Oulasvirta, 2012) argue that mobile devices are more habitual than addictive. They discover that the "checking habit," which is linked to smartphone use, entails quickly and repeatedly examining dynamic material on devices that are enabled. This regular habitual usage is more appropriately described as an irritation than an addiction.

Social networking services have the ability to establish strong relationships and have an impact on users' life even outside of the online setting. They also alter human communication and interaction habits (Cheung, 2010). Web-based systems known as social networking services enable users to create

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a public or semi-public profile, list other users with whom they are connected, and browse and navigate both their own and other users' relationships inside the system (Beer, 2008). These services serve as a place for people to exchange information, share status, and entertain themselves (Clemons, 2009)

The features and user base of social networking services vary widely. Some platforms are designed for almost everyone, while others cater to specific ethnicities, religions, languages, professions, etc. Even within heterogeneous user groups, users often segregate themselves based on various social factors. Social networking services enable users to maintain existing relationships and form communities and forums by connecting with others who share common interests, ideas, beliefs, or even characteristics like nationality, race, or sexual orientation (Salehan M. &., 2013). In a study by Kuss, Griffiths, & Bin, (2013), they aimed at assessing the prevalence of clinically significant levels of Internet addiction, and to also discern the interplay between personality traits and specific Internet uses in increasing the risk for Internet addiction. An online cross-sectional survey was conducted using data from 2,257 students at an English university. The findings showed that 3.2% of the students were classified as Internet addicts. Personality traits and the amount of time spent online accounted for 21.5% of the variance in Internet addiction. The risk of Internet addiction was decreased by neuroticism and online purchasing, but increased by online gaming and receptivity to new experiences.

In this research, the use of persuasive technology to develop practical solutions for combating addiction is extensively discussed. The goal is to leverage persuasive techniques to help individuals overcome their addictive

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behaviors while considering the specific contexts of different addictive technologies.

The role of the reward system behavior in addiction

The role of the reward system and pleasure-seeking behavior in addiction is a well-documented phenomenon in psychological research (Volkow, 2015). According to the research, addictive behaviors, including mobile phone and internet addiction, are associated with alterations in the brain's reward circuitry, particularly involving dopamine neurotransmission (Everitt, 2016). Dopamine release in response to rewarding stimuli is considered a key factor in reinforcing addictive behaviors and promoting continued engagement with addictive substances or activities (Hyman, 2006). In the context of mobile phone and internet addiction, the use of these technologies has been shown to activate the reward system in the brain, leading to the release of dopamine and feelings of pleasure (Kuss D. J., 2017). This neurobiological response creates a positive reinforcement loop, where the pleasurable experiences associated with phone and internet use drive individuals to engage in these behaviors repeatedly (Starcevic, 2021). As a result, users may develop compulsive behaviors and experience difficulty in controlling their usage.

Persuasive technology has emerged as a promising approach to address addiction by leveraging the brain's reward system to promote positive behavioral changes ((Hekler, 2013) By incorporating gamification elements, rewards, and incentives into the design of mobile apps, developers can encourage users to adopt healthier habits and reduce addiction (Orji R. &., 2018). These strategies align with the principles of operant conditioning, where positive reinforcement strengthens desired behaviors ((Fogg B. J., 2009).

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However, it is essential to approach these interventions with caution to avoid inadvertently reinforcing harmful or addictive behaviors (Silverstein, 2019). User-centered design principles play a crucial role in ensuring that persuasive technologies are tailored to individual needs and preferences, maximizing their effectiveness in promoting behavior change (Harjumaa, 2009)

Persuasive Technology

Technology has been used more and more in recent years to try to influence and inspire individuals to engage in a variety of individually and collectively advantageous behaviours. Generally speaking, motivating systems like gamification and persuasive technologies are predicated on the idea that technology has the power to affect people's attitudes and behaviour. One may argue that all information systems have some sort of impact on their users. But in order for a technology to really be referred to be "persuasive," the persuasion must be deliberate; in other words, the technology must have been created with the objective of helping the user change their attitude or behaviour. It follows that a concept of a desired attitude or behavior has to guide the design process (Juho, Koivisto, & Pakkanen, 2014).

Persuasive technologies are designed with an intended outcome, such as changing users' attitudes or behaviors, and the outcome occurs from a persuasion process enabled by the technology. (Fogg B. J., 2003) introduced persuasive technology to the world, and the technology has since gained much attention from researchers and practitioners. This recognition has led to the development of many technological tools and applications to help influence behavioural, attitude, and motivation change. Several studies on persuasive

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technology have been found, and their application and use in the fields of wellness and behavior modification have been documented (Orji R. &., 2018).

(Hamari, 2014) Delves into the various design elements of persuasive technologies, focusing on primary task support, computer-human dialogue, perceived system credibility, and social influence, as key components in the development of effective mobile applications for reducing addiction.

- A fundamental aspect, according to their study of persuasive technology design is providing primary task support to users. Primary task support involves offering features that aid users in managing their core activities and behaviors related to addiction reduction (Fogg B. J., 2003). These features include tracking app usage, setting time limits on specific applications, and managing notifications. By empowering users with tools to take control of their digital habits, persuasive mobile applications become instrumental in helping users establish healthier screen time behaviors ((Bickmore, 2005)
- Effective communication between the mobile application and its users is vital for achieving behavior change. Computer-human dialogue support encompasses the provision of clear and meaningful feedback to users about their progress and achievements (Oinas-Kukkonen, 2013). By receiving positive reinforcement and personalized messages, users are motivated to sustain their efforts in breaking free from addictive patterns. This ongoing dialogue fosters engagement and encourages long-term commitment to the behavior change process (Fogg B. J., 2007). To gain users' trust and confidence, persuasive technologies must exhibit perceived system credibility. Design features that enhance the

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perceived trustworthiness and reliability of the mobile application are critical (Harjumaa, 2009). Transparent data usage, clear privacy policies, and evidence-based strategies are some of the elements that foster a sense of security among users. By addressing concerns about privacy and ensuring evidence-based practices, persuasive mobile apps create an environment conducive to user acceptance and adherence to recommended interventions (Orji R. &., 2018).

- Leveraging social influence is another powerful strategy in designing persuasive technologies to reduce mobile phone and social media addiction. By incorporating features that promote social interactions, such as leaderboards, shared achievements, and peer support forums, users feel a sense of belonging and camaraderie (Rimé, 2009) Social interactions within the mobile app provide positive reinforcement from peers, offering motivation and support to users on their journey towards healthier digital habits (Al-Rfou, 2016).

The Eight Step Process

Fogg (2009), elaborated an eight-step design process for creating persuasive technologies. The process begins with defining the persuasion goal to match a target audience with an appropriate technology channel and ends with expanding on success. This process is drawn from demonstrated successes in industry practice and provides best practices for designers to follow in the early stages of persuasive technology design.

1. Persuasion Goal: Identify the target audience and the behavior that needs to be changed.

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2. Technology Channel: Identify the appropriate technology channel that will be used to deliver the persuasive message.
3. Successful Examples: Identify successful examples of persuasive design and imitate them.
4. Rapid Trials: Perform rapid trials to fail fast and learn from mistakes.
5. Measure Behavioral Outcomes: Use technology to track and analyze user behavior.
6. Build on Small Successes: Use the data collected in the previous steps to refine the design and improve the effectiveness of the persuasive message.
7. Find Something That Works: Create an intervention that succeeds in helping the target audience to adopt a very simple target behavior that can be measured.
8. Expand on Success: Scale up the intervention and apply it to a larger audience or a more complex behavior.

The application of persuasive design principles outlined in the eight steps offers a structured and systematic approach to address mobile phone and social media addiction in the proposed research. By identifying the target audience and behavior that requires modification, the research can tailor the mobile app to effectively address the specific needs of users struggling with addiction.

Effectiveness of Persuasive Technologies on Enhancing Well-being

Research on the effectiveness of persuasive technologies in reducing social media addiction and enhancing well-being is still in its early stages. However, some studies have shown promising results. For example, a study by Lin *et al*. (2016) found that a mobile app that provided users with feedback on

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their social media use and encouraged them to take breaks from social media was effective in reducing social media addiction and improving well-being. Similarly, a study by Kim *et al*. (2018) found that a mobile app that provided users with mindfulness exercises and encouraged them to take breaks from social media was effective in reducing social media addiction and improving well-being.

The effectiveness of persuasive technologies in reducing social media addiction and enhancing well-being is still a topic of ongoing research. However, some studies have shown promising results, suggesting that persuasive technologies can be effective in changing behavior and improving outcomes related to social media use and well-being. It is important to consider the potential risks and unintended consequences of using persuasive technologies. For example, some users may feel that the technology is intrusive or may experience negative emotions when using the technology. It is important to carefully evaluate these risks and to design the technology in a way that minimizes potential harm.

The technology should be designed with the user in mind. This may involve using user-centered design methods to ensure that the technology is engaging, easy to use, and meets the needs of the target audience. Also, the technology should be evaluated using rigorous research methods to determine its effectiveness. This may involve conducting randomized controlled trials or other types of studies to test the effectiveness of the technology in changing behavior and improving outcomes related to social media use and well-being.

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The technology should be designed with the user in mind. This may involve using user-centered design methods to ensure that the technology is engaging, easy to use, and meets the needs of the target audience. The technology must also be evaluated using precise research methods in order to

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ascertain its effectiveness. It may be necessary to conduct randomised controlled trials or other types of studies to determine the efficacy of technology in changing behaviour and improving outcomes related to social media usage and wellness.

Technology Adoption Theories

Technology adoption theories explain how individuals and groups come to accept and use new technologies. Understanding these theories is crucial for the design and implementation of persuasive technologies, as user acceptance directly influences the success of behavioural change interventions such as those aimed at reducing social media and mobile phone addiction (Venkatesh, Thong, & Xu, 2012). Among the most influential theories is Rogers' Diffusion of Innovation Theory (DOI), which provides valuable insights into how innovations spread through populations and what factors determine the rate and success of adoption.

Rogers' Diffusion of Innovation Theory

Rogers' Diffusion of Innovation Theory, proposed by Everett Rogers in 1962, explains how new ideas, practices, or technologies are communicated and adopted within a social system over time (Rogers, 2003). According to Rogers, the adoption process follows five key stages: knowledge, persuasion, decision, implementation, and confirmation. Individuals initially gain awareness of an innovation, develop attitudes toward it, decide whether to adopt it, implement it into their lives, and finally confirm its continued use.

Rogers identified five characteristics of innovation that affect the rate of adoption:

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1. **Relative Advantage** – the degree to which an innovation is perceived as better than existing alternatives.
2. **Compatibility** – the extent to which the innovation fits users' existing values, needs, and experiences.
3. **Complexity** – how easy or difficult it is to understand and use the innovation.
4. **Trialability** – the ability of users to test the innovation on a limited basis before full adoption.
5. **Observability** – the visibility of the innovation's results to others.

Relevance of Technology Adoption Theory to Persuasive Technology and User-Centred Design

Integrating Rogers' theory with persuasive technology and user-centred design (UCD) offers a holistic framework for creating digital interventions that are both effective and widely accepted. Persuasive technology focuses on changing user behaviour through design, while UCD ensures that these interventions are tailored to the needs, motivations, and contexts of the users. The diffusion of innovation theory complements these approaches by highlighting the social and psychological factors that drive technology acceptance and sustained use (Orji & Moffatt, 2018).

User-Centered Design

The user-centered approach is a prominent and widely recognized design philosophy that places the end-users at the heart of the product development process (Norman, 2013). It emphasizes understanding the needs, preferences, and behaviors of users to create products that align with their expectations and requirements. This approach has gained significant attention

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in various industries, particularly in the fields of software development, product design, and user experience (UX) design (Friedman *et al*., 2017). By incorporating user feedback, conducting usability testing, and involving users in every stage of development, the user-centered approach aims to ensure that the final product is intuitive, efficient, and enjoyable to use (Kujala, 2003).

One of the fundamental principles of the user-centered approach is the emphasis on conducting extensive user research (Hassenzahl & Tractinsky, 2006). By employing various research methods, such as interviews, surveys, and observational studies, designers gain valuable insights into the target users' motivations, pain points, and goals. This deeper understanding enables designers to make informed decisions and prioritize features that are most relevant to the users, resulting in a product that caters to their specific needs.

Moreover, the user-centered approach involves iterative design and constant feedback loops (Rogers *et al*., 2016). Designers create prototypes and wireframes, allowing users to interact with the product at early stages. User feedback is then collected and incorporated into the design, facilitating continuous improvement and refinement. This iterative process not only enhances the product's usability but also helps identify and rectify any potential issues before the final product is launched.

In a study Involving end-users in the design process and conducting usability testing are crucial steps in creating mobile applications that meet user needs and preferences (Ismorsu & Kinnula, 2014). Collaboration between designers, engineers, and marketing teams is also essential to ensure that products meet both users' needs and business goals. By following user-centered

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design principles, developers can create successful mobile applications that provide a positive user experience and meet business objectives.

A study on mobile wellness applications suggests that a user-centered design (UCD) approach can be beneficial for the development of effective and engaging wellness applications. By involving users in the design process and understanding their needs, preferences, and behaviors, developers can create applications that are more usable, useful, and motivating for the users. The study identified several factors that can enhance the motivational value of wellness applications, such as personalization, feedback, social support, and goal setting.

These factors align with the principles of UCD, which emphasizes the importance of designing products and services that meet the needs and goals of the users. Therefore, a UCD approach can help developers create wellness applications that are more user-friendly, engaging, and effective in promoting healthy behaviors and lifestyles (Ismorsu & Kinnula, 2014).

Factors to Enhance the User-Centred Approach

Several factors can enhance the motivational value of these applications. These factors include personalization, feedback, social support, and goal setting. Therefore, a UCD approach for wellness applications may involve the following steps:

1. Identify the target users and their needs, preferences, and behaviors related to wellness management.
2. Conduct user research to gather insights into the users' experiences with existing wellness technologies and their expectations for new applications.

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3. Use the insights from user research to inform the design of wellness applications that are tailored to the users' needs and preferences.
4. Incorporate features that provide personalized feedback, social support, and goal setting to enhance the motivational value of the applications.
5. Test the applications with users to evaluate their usability, usefulness, and motivational value, and use the feedback to refine the design.
6. Continuously monitor and update the applications based on user feedback and changing user needs and preferences.

Usability

International Standard ISO 9241-11 has defined usability as the capability of the product to be understood, learned, operated, and ease of use to users and can be used by specified users in order to achieve certain goals with effectiveness, efficiency, and satisfaction. As mobile technologies become more widely utilised, some reseachers have concentrated on the usability issues with mobile devices. According to Harrison, Flood & Duce (2013), there are several usability problems with mobile devices, including connection, mobile context, tiny screens, varying display resolutions, restricted processing power and capacity, and data entry techniques for mobile users.

In their 2013 review on mobile application usability, Harrison, Flood, and Duce identified five key attributes that define usability. The first, efficiency, considers the resources users spend relative to how accurately and fully they can achieve their goals. Satisfaction involves both the absence of discomfort and the presence of positive attitudes towards using the product. Learnability focuses on how quickly new users can become proficient, allowing them to begin productive work with minimal delay. Memorability means that casual

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users should be able to return to the system after a period away without needing to relearn its functions. Lastly, errors should be minimized, so users encounter few issues, and any errors they do experience are easy to correct. Additionally, serious, system-threatening errors should be entirely prevented.

Usability Principles

The four principles, as shown in Table 1, of visibility, ease, efficiency, and enjoyment are the primary components that determine the usability of educational mobile applications, according to studies conducted by Wang & Huang (2015) on the subject of mobile e-book application usability. The principles are categorized based on the heuristic assessments of many writers on usability principles that are incorporated into their study. Additionally, they discovered that the visible principle is linked to the individual's perception, whilst the other principle is linked to the user's prior experience. The table below shows the detail for each element including interface attributes.

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Table 1: **Showing usability principles**

Usability Principle	Interface Attributes
Visibility	Simple presentation
	Obvious prompts
	Visible buttons
	Readable colour scheme
Ease	Easy to use
	Easy to read
	Easy to understand
	Easy to return
Efficiency	Smooth operation
	Cognitive match
	Consistent processes
	Memorable operation
Enjoyment	Graphic design
	Overall visualization
	Interesting operation

Source: (Researcher, 2024)

User Experience (UX)

User experience (UX) is a growing research field where UX often emphasized in any website and application development. User experience is defined as experience which includes every detail about the interaction between users and the product from their feelings 'while using the product' to if they understand the way the product works and if it fulfills their goals, needs, and expectations in any context they use the product in. User Experience (UX) covers the relationship between usability, context of use, and user emotions regarding an application. Improving the UX and usability of an application, especially mobile applications, can influence their acceptance by end users.

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Also, Vermeeren *et al*. (2008) stipulates that user experience can be measured as specific emotions such as anger, joy, excitement, unease, and satisfaction. Which they believe are influenced by factors such as aesthetics, usability and the personal significance of the product to the user.

User Experience Design Principles Mobile Apps

Design principles play a crucial role in creating engaging and user-friendly mobile apps that enhance user experience and satisfaction. Several design principles have been identified to guide app developers in designing intuitive and effective mobile applications (Hui *et al*., 2022) as follows.

- Simplicity and Clarity: Keep the app interface clean and straightforward, avoiding unnecessary complexity. Users prefer apps that are easy to navigate and understand, leading to a positive user experience and higher engagement.
- Consistency and Familiarity: Maintain consistent design elements and patterns throughout the app to provide a familiar user experience. Consistency helps users feel more comfortable and confident in using the app, leading to increased retention and revisits.
- Visual Appeal and Aesthetics: Focus on creating visually appealing interfaces with attractive colors and visuals. Aesthetically pleasing apps are perceived as more enjoyable and trustworthy, encouraging users to spend more time engaging with the app.
- Efficiency and Speed: Optimize app performance and responsiveness to meet users' expectations. Users expect apps to be fast and efficient, and a laggy or slow app can lead to frustration and disengagement.

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- Personalization and Customization: Offer users the ability to personalize their app experience. Allowing users to customize certain aspects of the app, such as themes or preferences, creates a sense of ownership and makes the app feel more tailored to their needs.
- Accessibility and Inclusivity: Design apps that are accessible to all users, including those with disabilities. Providing features like voice commands and screen reader support ensures that everyone can use the app, promoting inclusivity and widening the potential user base.

System Usability Scale and Heuristics

The science of system usability examines and evaluates how user-friendly software is. A approach for evaluating software programs from five perspectives learnability, efficiency, memorability, mistakes, and satisfaction is called usability, or usefulness. The heuristic evaluation (HE) and system usability scale (SUS) techniques can be applied to do usability testing or analysis. Experts participate in heuristic evaluation (HE), whereas end users participate in system usability scale (SUS) testing (Ependi, Kurniawan, & panjaitan, 2019).

Heuristic evaluation is a technique that assesses how well a user interface adheres to specific design principles. These are known as heuristics, and they are rules of thumb rather than extremely exact and comprehensive. Finding the parts of an interactive product that adhere to the heuristics and, more crucially, the parts that do not is the goal. Redesign can then be used to address and lessen such infractions. These guidelines can be compared to cue cards that you use to assess a user interface; they remind you to consider certain aspects

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that make up usability and, to a lesser extent, user experience (UX) (Komischke, 2022).

Ethical Implications of Using Persuasive Technology for Addiction

The use of persuasive technology for addiction management raises important ethical considerations due to its potential impact on individuals' behavior and autonomy. One key ethical implication is the concept of paternalism, where persuasive technologies may be designed to make decisions on behalf of users without their explicit consent (Brey, 2012). This can raise concerns about infringing on individuals' autonomy and self-determination, as users may be influenced to take specific actions or make behavioral changes without fully understanding or agreeing with the persuasive messages (Chitturi *et al*., 2021).

Another ethical concern is related to the principles of informed consent and transparency. Users must be fully aware of the persuasive elements embedded in the technology and understand how their data will be used to influence their behavior (Ibrahim & Latiff, 2018). Providing clear and accessible information about the persuasive features, the intended outcomes, and the potential risks involved is essential for ensuring informed decision-making and respecting users' right to autonomy and self-governance (Fogg, 2003).

Data Privacy

Data privacy and user consent are critical ethical considerations in the design and implementation of mobile app interventions, particularly those that utilize persuasive technology for addiction management. The collection and processing of user data through mobile apps raise concerns about the protection

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of users' personal information and their right to privacy (Barth, 2018). It is crucial for app developers to be transparent about the types of data collected, the purposes for which it will be used, and how long it will be retained (Wagner *et al*., 2021). Users must provide informed consent for the data they share, and they should have the option to revoke consent or delete their data at any time (Li *et al*., 2020).

To ensure data privacy, developers must implement robust security measures to safeguard sensitive user information from unauthorized access and potential breaches (Alomari *et al*., 2019). This includes encrypting data during transmission and storage and regularly updating security protocols to address emerging threats (Elmaleh-Sachs *et al*., 2020). Compliance with data protection laws and regulations, such as the General Data Protection Regulation (GDPR), is essential to safeguard users' rights and maintain ethical standards (Asghar *et al*., 2019).

User consent is equally crucial in mobile app interventions, especially when implementing persuasive technologies that may influence users' behavior (Davis & Nathan, 2019). Consent should be obtained explicitly and without any coercion or manipulation (Bozdag *et al*., 2018). Developers should clearly inform users about the app's persuasive features, their intended impact, and how user data will be used to deliver personalized interventions (Cheung *et al*., 2021). Additionally, app users should have the option to customize the level of persuasive influence they wish to experience and the ability to opt-out of persuasive features altogether (Kostkova *et al*., 2019).

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Impact on Mental Health and Well-being

The widespread use of mobile phones and social media has raised concerns about their potential impact on mental health and well-being. Several studies have examined the association between mobile phone and social media use and various aspects of mental health, including depression, anxiety, stress, and self-esteem. In a study by Elhai *et al*. (2017), excessive use of mobile phones was found to be associated with symptoms of depression and anxiety. The researchers suggested that individuals who use their phones excessively may experience negative psychological outcomes due to factors such as social isolation, sleep disturbances, and compulsive behavior.

Kross *et al*. (2013) also investigated the connection between social media use and wellbeing. The study discovered that more Facebook use was linked to lower levels of life satisfaction and general well-being. The researchers proposed that excessive social media use may lead to social comparison and negative self-perception, contributing to decreased well-being.

On the other hand, some studies have also highlighted the potential positive impact of mobile apps and persuasive technologies on mental health. For instance, a study by Whittaker *et al*. (2016) investigated the use of a mobile app intervention to reduce stress and depression. The results showed that the app had a positive impact on participants' mental health, with a reduction in stress and depressive symptoms.

Chapter Summary

Chapter two of this thesis explores crucial theoretical backgrounds that underpin the research on mobile phone and internet addiction. The chapter begins by delving into the concept of persuasive technology, which plays a

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significant role in addressing addiction issues. Persuasive technology involves the design and implementation of digital interventions aimed at influencing users' attitudes and behaviors positively.

Furthermore, the chapter delves into the user-centered design philosophy, which is essential for developing effective interventions. User-centered design places users at the core of the design process, emphasizing empathy, understanding, and iterative feedback loops. Through the exploration of persuasive technology and user-centered design, Chapter 2 lays the groundwork for the subsequent chapters, guiding the development of a mobile app that addresses mobile phone and internet addiction while prioritizing user satisfaction and engagement.

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CHAPTER THREE

METHODOLOGY

Introduction

The methodology employed in this research involves a mixed-methods approach aimed at developing a persuasive technology intervention to reduce mobile phone and social media addiction. User-centered design emphasizes the active involvement of users throughout the design and development process (Carroll & Rosson, 2021). By placing the needs, preferences, and experiences of the target users at the forefront, this approach ensures that the resulting mobile application effectively addresses their unique challenges and requirements.

Research Approach and Process

This study adopted a User-Centred Design (UCD) approach guided by the Design Science Research (DSR) methodology. The UCD approach was employed to ensure that the development of the *Respite* mobile application reflected the real needs, experiences, and motivations of end users. The DSR methodology was chosen because the study involved designing, developing, and evaluating a technological artefact aimed at solving a real-world problem—mobile phone and social media addiction.

The DSR process followed three iterative stages: design, development, and evaluation. During the design stage, user requirements were identified through initial interviews and informal discussions. These requirements informed the design of the app features and interface. The development stage focused on building the *Respite* prototype using an iterative process that allowed continuous improvement based on user feedback. Finally, in the evaluation

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stage, usability testing and heuristic evaluations were conducted to determine the effectiveness, efficiency, and user satisfaction of the app.

Research Design

The research design as shown in figure 1 in user-centred design usually includes techniques like focus groups, surveys, and interviews to gather information about users' experiences through usability testing and other user research methodologies into product creation through an iterative design process (Carol, 2020). These methods provide valuable qualitative data that inform the design and development of the solution. Additionally, usability testing is often conducted to evaluate the usability and effectiveness of the designed solution, involving real users performing tasks and providing feedback. This is an iterative process that allows for continuous improvement and refinement of the customer experience, leading to a more user-centric and effective design (Biswadip, 2023).

This study employed a Design Science Research approach, focusing on the design, development, and evaluation of an innovative artifact, specifically the *Respite* mobile application. The DSR framework enables iterative design and evaluation, ensuring that the solution is both functional and user-centred

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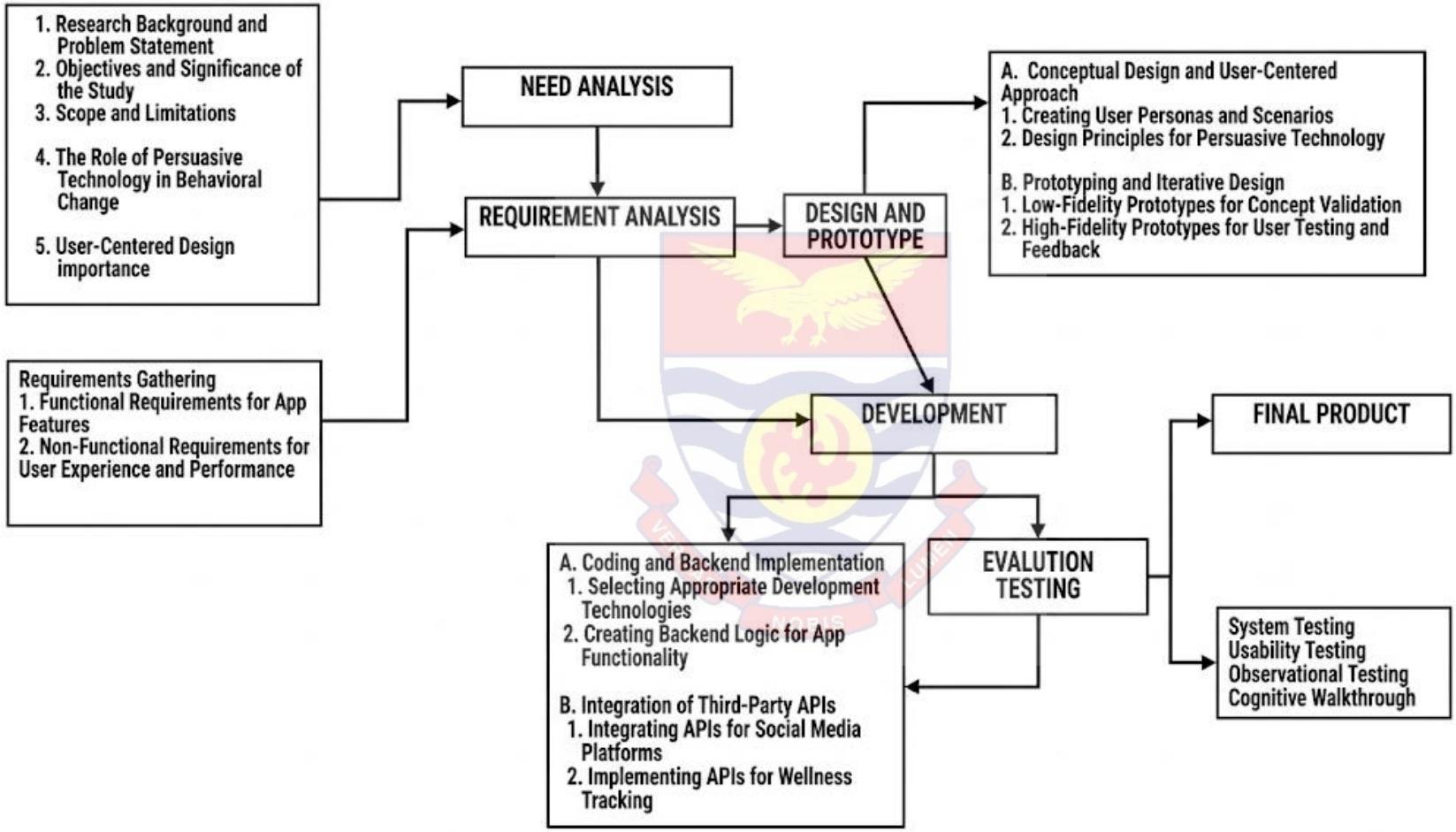


Figure 1: breakdown of research design (Researcher, 2024)

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Stages of the Research Design

The UCD stages, as shown in Figure 2, are followed to craft the mobile application that counters mobile phone and social media addiction. The stages encompass five fundamental stages: Needs, Context of Use, Requirements (Functional and Non-Functional), Design, and Evaluation. Each of these stages contributes indispensably to the development and refinement of the mobile app, ensuring its effectiveness and user-friendliness.

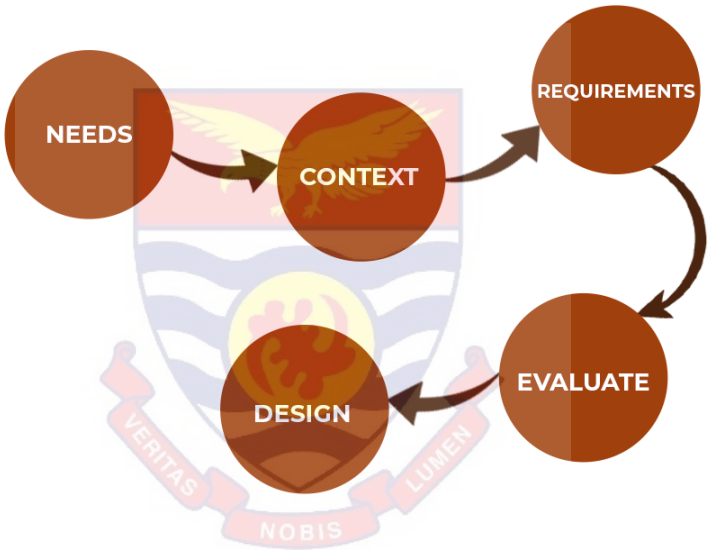


Figure 2: UCD fundamental stages

Needs Analysis:

The "Needs" phase takes into consideration the contextual framework within which the mobile app will be employed (Wilson, 2017). This involves discerning the diverse scenarios and environments in which users interact with their devices (Rogers *et al*., 2016). The needs of potential users, the research design seeks to uncover key functionalities that the mobile app must possess to effectively address addiction-related issues. These needs could range from better time management and reducing digital distractions to promoting mindful

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smartphone usage and enhancing overall well-being. Understanding user needs and context lays the foundation for the subsequent stages of the research design, guiding the development and design of the app to align closely with users' expectations and requirements.

Context

Understanding the context is a crucial element in designing a mobile app to address mobile phone and social media addiction. This involves delving into the everyday lives of potential users, considering their cultural norms, technological access, and behavioral habits. Such insights allow the app to be tailored to fit seamlessly into users' routines, offering relevant solutions to the challenges of addiction. Additionally, collaborating with experts in addiction and technology within this context ensures the app's effectiveness. For instance, push notifications and reminders can be customized to motivate users to adopt healthier usage patterns. This contextual approach aligns with the research design, which aims to create an app that not only addresses addiction but also respects the users' behaviors and values, ultimately contributing to their overall well-being (Preece, 2016).

Requirement

This phase serves as the foundation for the development of the mobile application aimed at addressing mobile phone and social media addiction while promoting wellness. It involves a meticulous analysis and specification of the essential components that the app must encompass to achieve its intended goals effectively. User research serves as the foundation for designing a user-centered mobile app. The insights gained from user research, including user needs, motivations, and pain points, inform the design requirements for the app

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(Budko, 2023). Prototyping helps translate these research findings into actionable design decisions by visualizing the app's interface and interactions.

Functional Requirements:

Functional requirements define the specific features, interactions, and behaviors that the mobile app must offer to users. These requirements outline the core functionalities of the app, encompassing tasks such as app blocking, usage tracking, personalized goal setting, reminders, and real-time interventions. Functional requirements define the essential features and actions the mobile app must offer. These requirements outline what the app should do and how users will interact with it.

Key Functional Requirements for Addiction-Addressing Mobile Apps:

- App Blocking: The ability to block or limit access to addictive apps and websites, allowing users to regain control over their smartphone usage.
- Usage Tracking: A feature that records and visualizes the time spent on various apps and platforms, helping users understand their digital behavior.
- Personalized Goal Setting: Providing users with the option to set customized goals for reducing screen time or specific app usage, fostering a sense of autonomy.
- Reminders: Sending timely reminders and notifications to encourage users to take breaks, adhere to their goals, or engage in alternative activities.
- Real-Time Interventions: Offering instant support or interventions when users exhibit excessive or addictive smartphone behaviors, redirecting them towards healthier choices.

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Non-Functional Requirements:

Non-functional requirements focus on the qualities and attributes that contribute to the app's overall performance, user experience, and ethical considerations. These requirements encompass factors such as data privacy, security measures, user interface design, responsiveness, and ease of use. Non-functional requirements focus on the overall performance and user experience of the app. These attributes ensure the app is reliable, secure, and easy to use.

Key Non-Functional Requirements for Addiction-Addressing Mobile Apps:

- Data Privacy: Implement robust data protection measures to safeguard user information, ensuring compliance with privacy regulations.
- Security Measures: Use security measures like authentication, encryption, and others to shield user data from breaches and illegal access.
- User Interface Design: Create an intuitive and visually appealing interface that enhances user engagement and usability.
- Responsiveness: Ensure the app is responsive and performs well across various devices and network conditions, offering a seamless user experience.
- Ease of Use: Prioritize user-friendliness and simplicity in app navigation and interaction to cater to a diverse user base.

Data Collection Methods

Data collection in this study involved both qualitative and quantitative methods to ensure a comprehensive understanding of user experiences and system usability. The methods were structured around the principles of user-

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centred design, where end users actively participated in testing and evaluating the prototype.

Data Sources and Participants

Two main groups of participants were involved in the study:

1. **Usability Experts:**

   Five experts in usability and human–computer interaction evaluated the prototype using Nielsen's Heuristic Evaluation principles. Their feedback was used to identify and correct usability problems before the user testing phase.

2. **End Users:**

   Forty (40) participants were selected to test the *Respite* app in real-world settings. Participants were purposively sampled based on their high daily phone usage and frequent engagement with social media platforms.

Data Collection Instruments

The study employed three main data collection instruments:

- **Observation Checklist:** Used to record user interactions, navigation patterns, and challenges encountered while using the *Respite* app.
- **System Usability Scale (SUS) Questionnaire:** Used to quantitatively assess the overall usability of the app after user testing. The SUS is a 10-item questionnaire with 5 response options (based on the Likert scale) consisting of the questions below:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.

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4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Data Collection Procedure

Data were collected in two main phases:

- **Phase One – Heuristic Evaluation:**

  The first phase involved the five usability experts who evaluated the prototype using Nielsen's ten usability heuristics. Their comments guided improvements in the layout, navigation, and interaction design.

- **Phase Two – User Testing:**

  In the second phase, the refined version of the app was distributed to end users. Each participant interacted with the app for one week, after which they completed the SUS questionnaire and participated in brief interviews. Observations were recorded during the testing sessions to capture user behaviour and engagement patterns.

All qualitative data (interviews and observations) were transcribed and later analysed thematically. The SUS questionnaire data were analysed quantitatively using descriptive statistics to generate a usability score.

Data Analysis

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Quantitative data were obtained primarily from the System Usability Scale (SUS) questionnaires. The responses were entered into Microsoft Excel for initial cleaning and coding. The cleaned data were then exported to Python for further analysis and visualisation. Using Python's data analysis libraries (such as *pandas* and *matplotlib*), descriptive statistics were computed to determine the overall SUS score, mean values, and standard deviations.

Visual representations such as bar charts and histograms were generated to illustrate user feedback on usability and effectiveness. The analysis results provided a clear numerical understanding of how users perceived the app's ease of use, efficiency, and overall satisfaction.

Heuristic evaluation data from usability experts were also summarised and categorised based on severity levels (minor, moderate, major). These results guided design refinements before the final user testing phase.

Mobile Application Design

The mobile application design involves the technologies and processes used to create the persuasive mobile application. The design in this chapter includes the technologies used, the flowchart diagrams, the use case diagrams and the sequence diagrams.

Flowchart

The mobile app flowchart, as shown in Figure 3, depicts the user journey starting with sign-up or login options. Once logged in, users access the captivating dashboard with app usage statistics and social media addiction score. The app offers features like blocking apps, setting app block timers, activating quick block, and enabling Do Not Disturb mode. Users can also set reminders and provide feedback through the support section. The flowchart

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represents the user's seamless navigation through the app, fostering mindful mobile usage and a purposeful digital experience.

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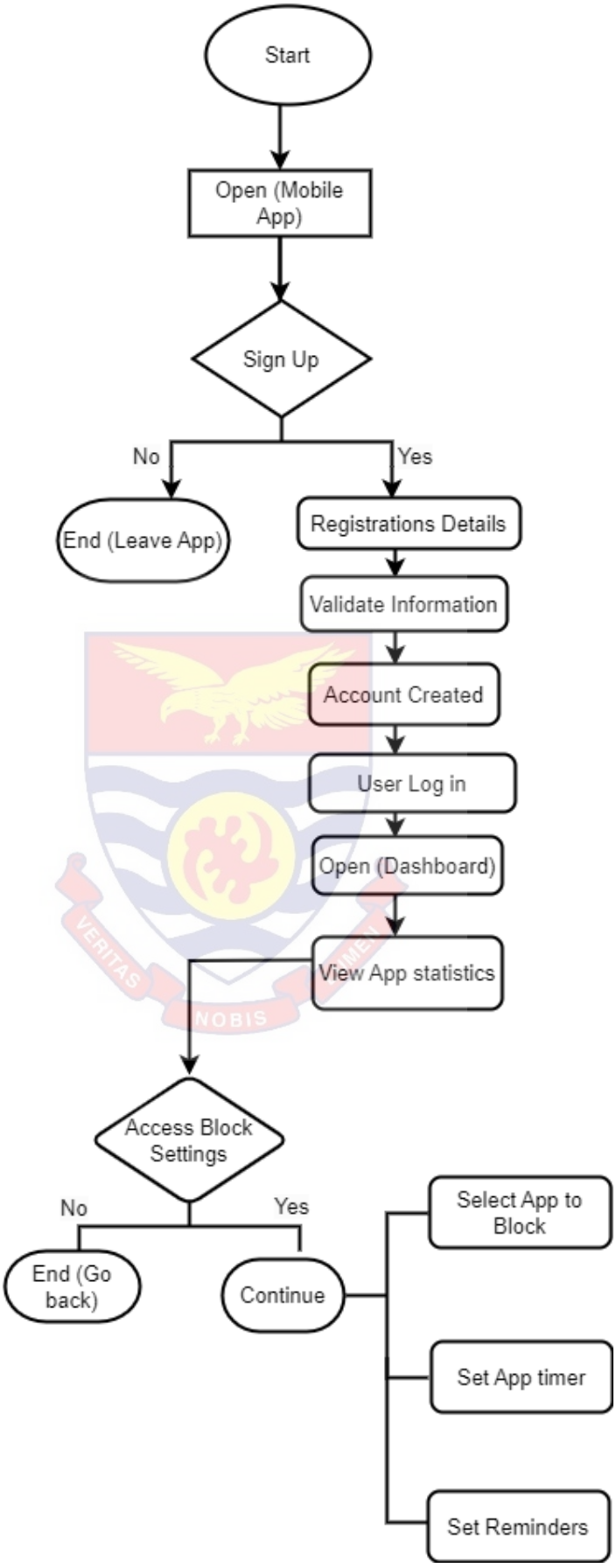


Figure 3: Flowchart diagram. Source: Researcher (2024)

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Use case

The use case diagram for the mobile app showcases the primary actors involved and the actions they can perform within the application. The main actors are the End-Users (Regular Users) and the Administrators, each having distinct roles and responsibilities. The use case diagram demonstrates the interactions between the actors and the app, providing a clear overview of the main functionalities available to end-users and the administrative capabilities held by administrators. It serves as a valuable reference for understanding the scope and purpose of the mobile app, highlighting the user-centered design and user management aspects essential to the success of the application.

End-Users (Regular Users)

Figure 4 shows how the regular users, also known as end-users, are the individuals who will be interacting with the mobile app to manage their mobile phone and social media addiction. They have access to a range of features and functionalities aimed at helping them reduce their addiction and improve their well-being. The actions they can perform include signing up to create an account, logging in to access their personalized dashboard, viewing app usage statistics and social media addiction score, blocking specific apps to limit their usage, setting app block timers to schedule focused work periods, activating the quick block feature for instant blocking, enabling the Do Not Disturb mode to silence notifications, setting reminders for app usage, and providing feedback to enhance the app's performance.

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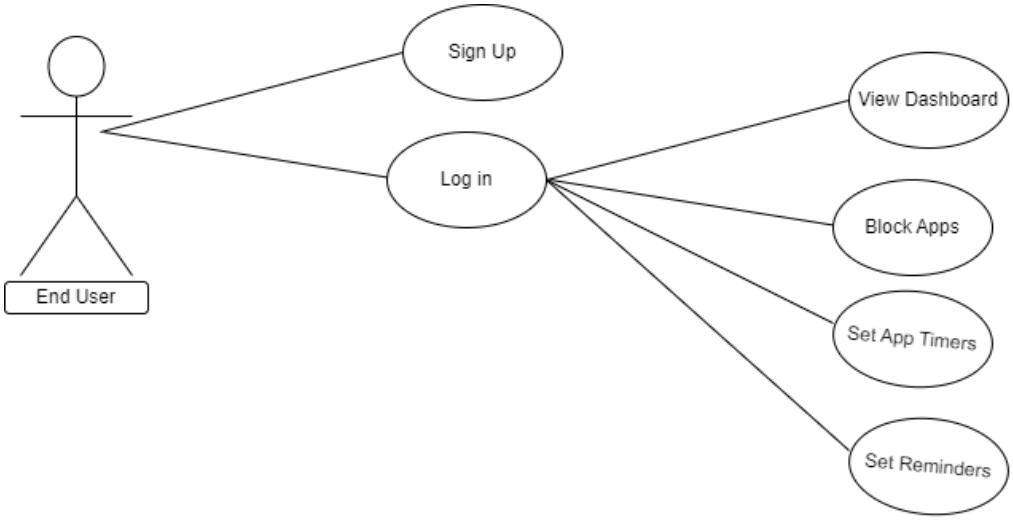


Figure 4: Use Case Diagram showing End actions (Researcher 2024)

Administrators

Figure 5 shows that the administrators are the privileged users responsible for managing the overall functioning of the mobile app. They play a critical role in overseeing user accounts, user analytics, and modifying app settings. By managing user accounts, administrators can ensure a secure and seamless user experience. They have access to user analytics, which allows them to gain insights into user behavior and app usage patterns. With the ability to modify app settings, administrators can make necessary adjustments to enhance the app's performance and user satisfaction. Additionally, administrators are equipped to provide support to users, ensuring that any queries or issues are addressed promptly.

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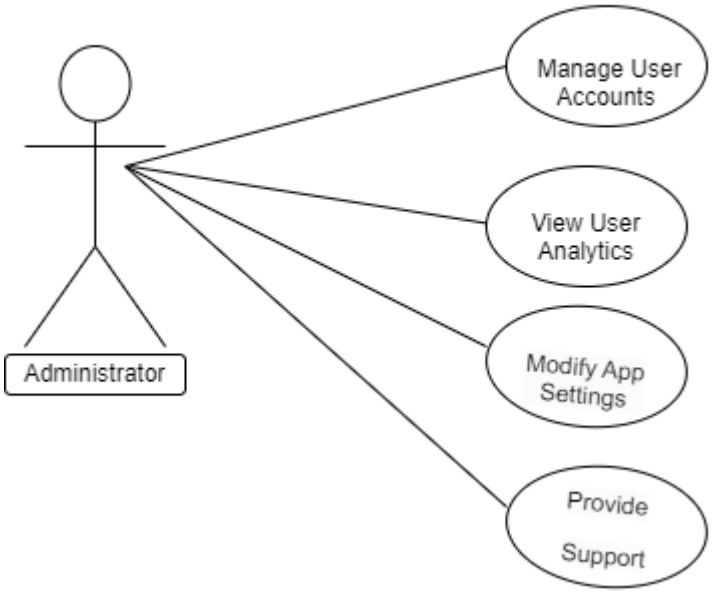


Figure 5: Use Case Diagram for Administrator actions. (Researcher 2024)

Sequence Diagram

The sequence diagram employed in this research a clear and concise overview of how end-users and administrators interact with the app's functionalities, showcasing the logical progression of actions from sign-up and login to accessing the dashboard and utilizing various features like app blocking, quick block, do not disturb, reminders, and feedback/support. By visualizing the sequence of actions, the diagram aids in identifying opportunities for optimization and facilitates a better understanding of the app's functionality and user experience, contributing significantly to the evaluation and improvement process. Figure 6 shows the sequence diagram of interaction flows between users and the system.

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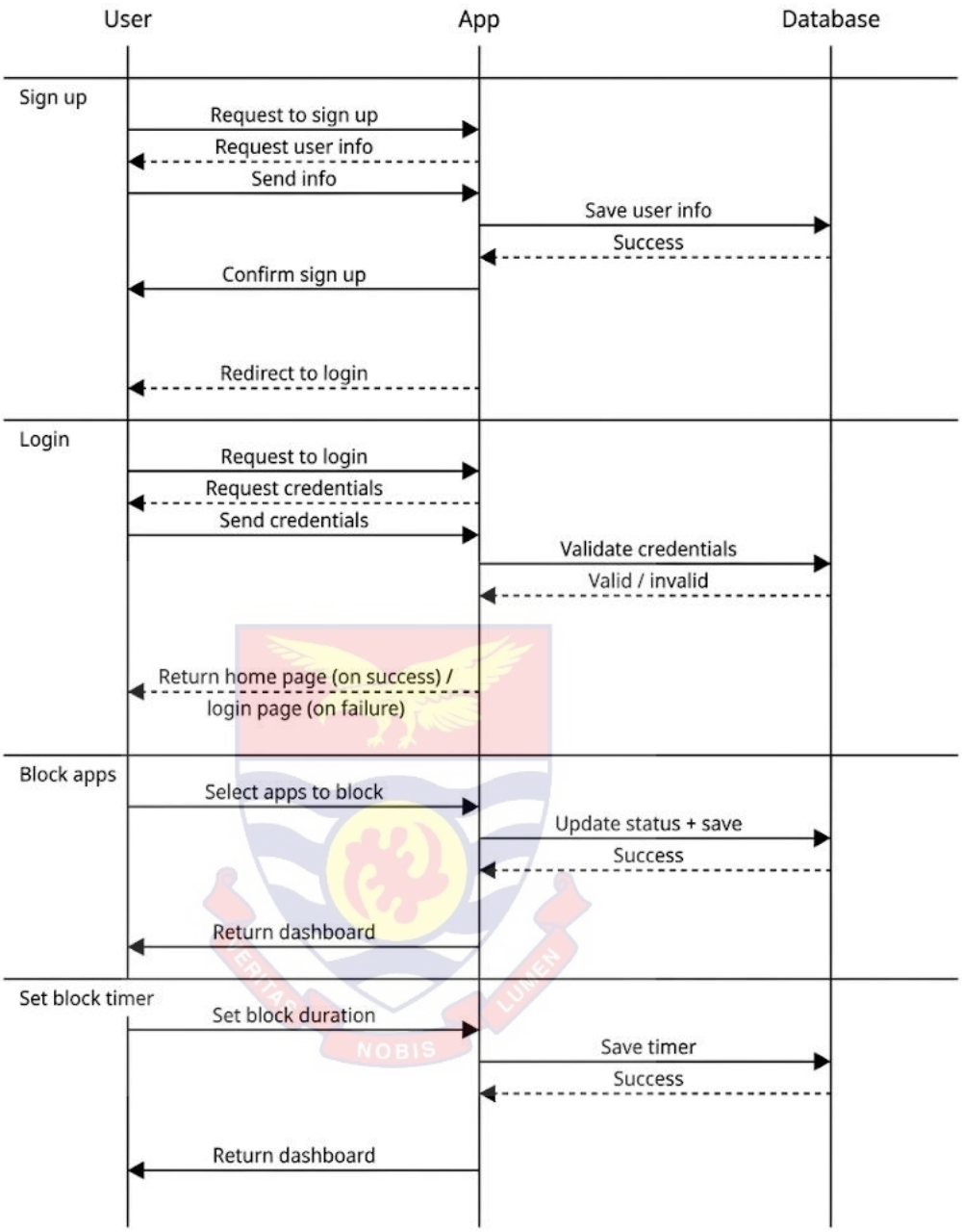


Figure 6: Sequence Diagram showing the flow of the Mobile App interactions (Researcher, 2024)

Prototyping

Prototyping is a crucial step in the app development process, enabling visualization, validation, and refinement of design concepts. It helps establish

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design requirements based on user research, and facilitates. Prototyping plays a crucial role in the app development process by providing a tangible representation of the mobile app before its actual development (Budko, 2023). It allows designers, developers, and stakeholders to visualize and interact with the app's functionalities, user interface, and overall user experience. By creating prototypes, the design team can effectively communicate their design ideas and gather valuable feedback to refine the app's concept and improve its usability.

Low Fidelity

A low-fidelity diagram showing the skeletal look of the application design process before a high-fidelity is created to get to the final look of the application. The low fidelity represents the idea for the first look of the application. Figure 7 shows various features of the application for the start, which would guide the further design and development process.



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Figure 7: Diagram showing the low fidelity designs (Researcher, 2024)

High Fidelity

Figure 8 represents the high-level diagrams designed with Adobe XD and Photoshop to represent the low-fidelity diagrams shown above. The high-level diagrams are those diagrams that are much closer to the actual final look of the application, and they guide the final development process and make it easy and faster. Each storyboard contains three images showing different functionalities at each stage or at each page of the application.

Features Adopted in the High-Fidelity design

The various features and parts of the application are shown in the high-fidelity diagrams below, and the various parts are explained below as well.

Welcome Page

The user is shown this page the very first time the mobile application is installed and opened for the first time. This page welcomes the user and asks the user to click the register or the login button shown on the welcome page.

Register

This page allows the user to create their first profile into the application. This is done through entering of simple details which include Email address and PIN to secure their account. The user would get the opportunity to update their other user details such as adding Username, changing email and other details.

Log in

After successfully creating the first user profile in the registration stage, the user can now log on to the application by entering their email address and PIN used. This allows them to get into the application for the very first time.

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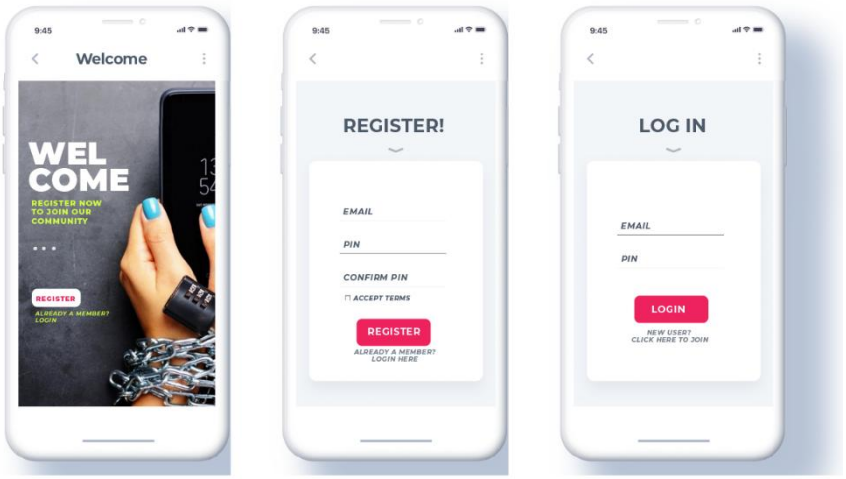


Figure 8: Mockup pages of mobile of the application. Researcher (2024)

Homepage

The first page that users are directed to when they finally log in to the mobile application. On this page, users can add the apps they wish to restrict. They also have access to navigate to all other parts of the application. Figure 9 shows this page

Dashboard

Statistics on the various usages the user performs on the application are shown on this page. Users can get access to statistical information like the total hours they have blocked an application and the total applications they have blocked through the application. Figure 9 shows this page.

App Block

Users have the option to block specific apps and to set the duration for which they want to block the apps. This feature allows users to experiment with different durations, such as hourly or daily blocks, to understand the impact of restricted usage on their addictive behaviors. Figure 9 shows this page.

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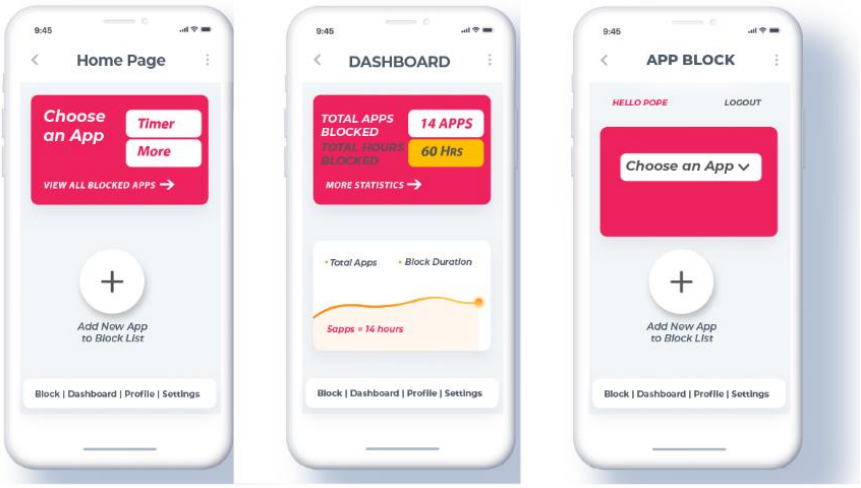


Figure 9: homepage, dashboard, and app block pages (Researcher (2024)

Profile

The profile page allows individuals to update their user details. Individuals get the opportunity to include other details in their profiles. They also get the opportunity to change other existing details on the profile page

Settings

On the settings page, as shown in Figure 10, the mobile application users get the opportunity to choose or change language, update the application themes, set notifications, update the application, and read about the application. Other settings would be included in future updates of the application.

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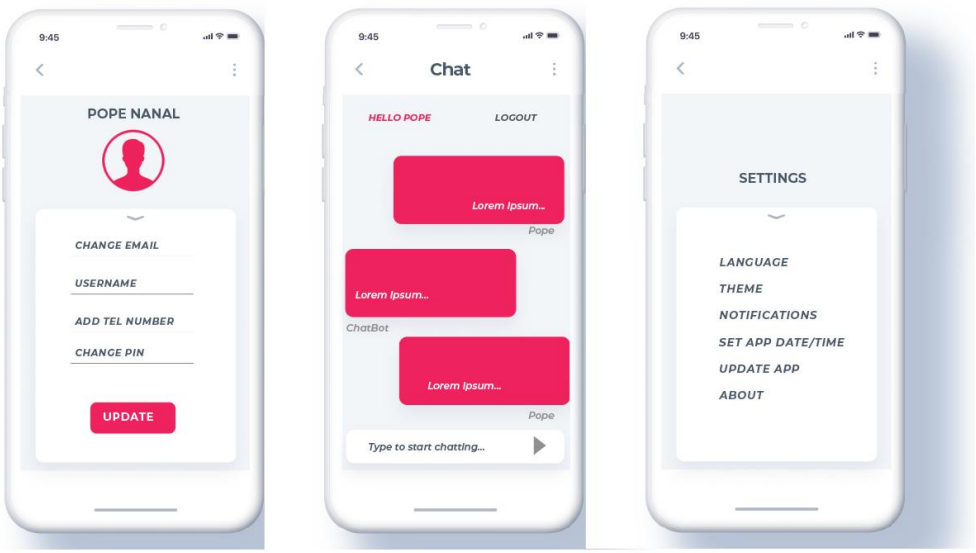


Figure 10: profile page, chat and settings (Researcher, 2024)

Evaluation

Evaluation is a crucial stage within the research design of developing a mobile app to combat mobile phone and social media addiction. It involves systematically assessing the app's functionality, usability, and effectiveness to ensure it aligns with the intended goals and user needs. Evaluation ensures that the developed mobile app effectively addresses addiction concerns while promoting wellness. Regular assessments, system tests, usability tests, and expert evaluations contribute to refining the app's design, functionality, and overall user experience.

During development, continuous evaluation occurs to monitor progress and address any emerging issues promptly. This involves regular testing, debugging, and refinement based on user feedback. After development, a comprehensive assessment of the app's features and functionalities takes place to verify their proper implementation. Below are the various evaluation methods used in the study.

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System Test:

System testing is conducted to ensure that the app's components function harmoniously as a whole. It involves rigorous testing of various scenarios to identify any errors, inconsistencies, or vulnerabilities that could affect the app's performance.

Usability Testing:

Usability testing is a user-centric evaluation method where real users interact with the app to uncover usability issues, navigation difficulties, and user experience challenges. Test participants perform specific tasks while their interactions are observed and recorded, providing valuable insights into how users engage with the app and where improvements are needed. The System Usability Scale was the scale used to test the usability of the system.

Expert Heuristic Evaluation

Expert cognitive walkthroughs involve usability experts simulating user interactions to predict potential usability problems and challenges. This method helps identify design flaws or complex interactions that might hinder users' ease of use.

Heuristic evaluation is a popular method for finding usability problems in user interfaces. It was developed by Jakob Nielsen and Rolf Molich in 1990. They drew on their extensive experience in usability engineering to create a set of guidelines that can be used to identify potential issues in user interfaces. This method is widely used today because it is relatively inexpensive and can be conducted quickly.

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Identifying User Needs and Motivations

One of the primary drivers of social media addiction is the profound need for social connection. Social media platforms offer a means to maintain relationships and receive instant validation, with likes and comments providing a significant boost to self-esteem.

Entertainment and information-seeking behaviors are prevalent among social media addicts. The platforms provide a vast array of content, satisfying users' curiosity and desire for novel experiences.

Loneliness and social isolation can lead individuals to seek solace on social media. These platforms act as substitutes for real-world social interactions, providing a sense of belonging and community.

The fear of missing out on social events, news, or trends drives individuals to constantly check their social media feeds. This anxiety about missing out on the latest happenings can make it challenging for them to disengage.

Mobile Application Features to Address Mobile Phone and Social Media Addiction

To effectively address mobile phone and social media addiction, the mobile application includes several key features designed to align with the objectives of the thesis. These features aim to evaluate the effectiveness of persuasive technologies, identify effective design elements, understand user needs and motivations, and explore factors influencing the success of persuasive technology interventions.

- Account Creation and Login: Users are provided with the ability to create an account and log in to the application. This feature enables

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personalized experiences, captures user information, and facilitates the understanding of specific needs and motivations of individuals struggling with social media addiction.

- App Blocking: Users can select and add addictive apps to the block list. This feature empowers users to customize their experience and take control of their usage. By blocking access to selected apps, users can break the cycle of addiction and reduce distractions.
- Notification Management: The application includes a feature to block notifications from addictive apps. By reducing the constant stream of notifications, users can mitigate distractions and stay focused on their tasks or goals.
- Flexible Block Duration: Users have the option to set the duration for which they want to block specific apps. This feature allows users to experiment with different durations, such as hourly or daily blocks, to understand the impact of restricted usage on their addictive behaviors.
- App Usage Timer: The app incorporates a timer that automatically blocks the selected addictive apps for a specified period. By utilizing this feature, users can manage and track their app usage, gaining insights into their addictive behaviors and evaluating the effectiveness of persuasive technology interventions.
- Quick Block Functionality: The quick block feature enables users to instantly block all selected addictive apps with a single tap. This provides users with a convenient and efficient way to limit their social media usage and promote healthier habits.

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- Do Not Disturb Mode: The application offers a comprehensive do not disturb mode, which silences and blocks the entire phone. By minimizing distractions from calls, messages, and notifications, users can create uninterrupted periods of focus and reduce the temptation to engage in addictive behaviors.

Technologies

The various technologies and stacks used in this research to help develop respite are discussed in this section below:

Flutter Framework

Flutter is a popular tool for building mobile apps. It's made by Google and lets you create apps that work well on both iPhones and Android phones. It uses the same code for both platforms, making it efficient and easy to learn. Flutter apps look and feel like native apps, meaning they blend seamlessly with the phone's operating system (Dahl, 2019).

To build the mobile application combating phone and social media addiction, the development journey starts with the installation of Flutter. Developers can obtain Flutter by cloning the repository from GitHub, with the flexibility to choose versions such as stable or beta based on specific project requirements. The stable channel is recommended for its reliability, while the beta channel offers access to new features and improvements for developers. Ensuring the correct development environment is crucial, achieved by running "flutter doctor" in the command line. This command, in Figure 11, checks for updates, IDE compatibility, and device compatibility, ensuring a smooth development experience.

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flutter doctor -v

Figure 11: Checking Flutter Compatibility.

Although the "flutter doctor" check may identify components like Chrome, essential for Flutter Web but unnecessary for mobile platforms, Flutter remains adaptable to the specific needs of addiction-combating app development.

```
Running flutter doctor...
Doctor summary (to see all details, run flutter doctor -v):
[√] Flutter (Channel stable, 3.13.4, on Windows A.B chipset, locale en)
[√] Windows version (Installed version of Windows is version 10 or higher)
[!] Android toolchain - develop for Android devices
[!] Chrome - develop for the web
[√] Visual Studio - develop Windows apps (version 2022)
[!] Android Studio (not installed)
[√] VS Code (version 1.81.1)
[√] Connected device (1 available)
[√] Network resources

! Doctor found issues in 3 categories.
```

Figure 12: installing flutter doctor (Researcher, 2024)

Leveraging the Dart programming language's capabilities, Flutter utilizes pub.dev, the Dart package manager, to incorporate community-reviewed packages. This streamlined process allows developers to add packages to their project efficiently, enhancing productivity and reducing development time.

Other Necessary Tools

In addition to Flutter, developers require essential tools such as IDEs and application simulators. The choice between Android Studio and Visual

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Studio Code, both supported by Flutter and Dart, depends on developers' preferences. These IDEs offer distinct strengths, and their installation involves accessing the latest stable version from respective official websites.

Android Studio, a popular choice, integrates an Android Virtual Device (AVD) Manager to create virtual Android device simulators. Flutter seamlessly interacts with these simulators, installing and running the application on the virtual device's screen. Alternatively, physical devices can be used by connecting them via USB cables, automatically detected by Flutter (Figure 7). This adaptability ensures efficient testing and deployment for combating mobile addiction applications.

Dart Programming Language

Dart is an object-oriented language, and it supports programming language concepts such as classes and interfaces. The following code snippet, shown in Figure 13, exemplifies a Dart class, showcasing its similarity to other common object-oriented languages:

```
1  import 'dart:math';
2
3  void main() {
4    Random rnd = new Random();
5
6    int a = rnd.nextInt(10);
7    int b = 3;
8
9    String result = multiply(a, b);
10
11   print('$a * $b = ${result}');
12 }
13
14 String multiply(int a, int b) {
15   return (a * b).toString();
16 }
17
```

Figure 13*: Example code of Dart.*

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Dart features a clean and readable syntax, incorporating familiar concepts from other programming languages like JavaScript and Java. Researchers can quickly grasp Dart's syntax and structure, reducing the learning curve and facilitating efficient development. Dart supports object-oriented programming principles, with classes, inheritance, and interfaces, making it suitable for building complex mobile applications.

Kotlin

Kotlin enables the seamless implementation of native functionalities, such as app blocking, by leveraging its compatibility with Android platforms. By utilizing Kotlin, the Flutter app can effectively manage and restrict app usage to combat addiction, enhancing its capabilities.

Firebase

Firebase is a development platform designed by Google, on this platform, they have something called Realtime Database. This database lets data be stored and synced between users of your application in real time. Firebase provides a secure and reliable mechanism for user authentication, allowing users to securely log in and register. With Firebase authentication, users can access personalized features and settings within the application while ensuring their privacy and data are protected.

Packages and frameworks used

Table 2 provides a summary of the various packages used in the mobile app development process, along with their purpose and relevance. These packages play a crucial role in implementing key functionalities within the app. Each package contributes to enhancing the overall user experience and

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providing necessary features for effective management of mobile phone and social media addiction.

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Table 2: Table showing various Flutter packages and their relevance

Package Name	Purpose	Relevance
syncfusion_flutter_charts	Drawing graphs and charts within the application, facilitating visualization of usage stats	Visual representation enhances user awareness and motivation for behavior change
usage_stats	Fetching app usage statistics from the device, providing insights into user's digital habits	Access to usage stats enables analysis and monitoring of user behavior, supporting personalized recommendations
device_apps	Fetching list of installed apps on device, allowing identification and targeting for blocking	Customization of blocking functionalities based on user preferences, supporting effective management of app usage
get	State management within the app, enabling efficient management of app states and interactions	Smooth and responsive user experience, enhancing usability and performance during navigation and interaction
shared_preferences	Saving persistent data locally on device, such as user preferences and settings	Retention of user preferences and settings across sessions, providing a seamless and personalized user experience
app_settings	Routing users to device settings from the app, facilitating configuration of permissions	Direct access to device settings enhances user control and customization, supporting management of app permissions
permission_handler	Checking and requesting app permissions required for accessing device features	Ensuring proper app permissions enhances user privacy and security, enabling access to necessary resources

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Table 2 continued

fluttertoast	Displaying toast notifications within the app, providing important information to users	Non-intrusive communication of important messages or alerts, enhancing user awareness and engagement
firebase_core & firebase_auth	Initializing Firebase app connection and implementing user authentication, respectively	Secure user authentication and data management, enabling personalized experiences while maintaining data integrity
loader_overlay	Displaying loading overlays during asynchronous tasks or data fetching operations	Visual feedback during data processing or background tasks, improving user experience and perception of app responsiveness
animated_bottom_navigation_bar	Implementing animated bottom navigation bar within the app	Facilitating easy navigation between app screens and functionalities, enhancing user accessibility and engagement

Source: (Researcher, 2024)

Chapter Summary

This chapter introduced the methodology employed in this research, which is the User-centred Design Approach and focused on investigating the effectiveness of persuasive technology in reducing mobile phone and social media addiction. The research design involved several stages, including user research, prototyping, and usability testing with iterative design. User research methods such as interviews and surveys were used to identify user needs and motivations, while prototyping facilitated the development of wireframes and

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visual design. Usability testing allowed for the evaluation of the app's usability and refinement based on user feedback.

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CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

This chapter presents the results of the development and evaluation of the "Respite" mobile application. The goal of developing Respite was to address mobile phone and social media addiction. The research aimed to accomplish various specific goals, and this chapter presents how each objective was met.

Features of Respite Mobile Application

The first research objective was to identify the most effective features and design elements for reducing social media addiction through a persuasive technology-based mobile application.

To effectively address mobile phone and social media addiction, the mobile application includes several key features identified to align with the first objectives of the thesis. Some of the most effective features include;

- Account Creation and Login: Users are provided with the ability to create an account and log in to the application. This feature enables personalized experiences, captures user information, and facilitates the understanding of specific needs and motivations of individuals struggling with social media addiction.
- App Blocking: Users can select and add addictive apps to the block list. This feature empowers users to customize their experience and take control of their usage. By blocking access to selected apps, users can break the cycle of addiction and reduce distractions.
- Notification Management: The application includes a feature to block notifications from addictive apps. By reducing the constant stream of

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notifications, users can mitigate distractions and stay focused on their tasks or goals.

- PassCode Management: User are given the opportunity to allow other users the trust to set a PassCode which they would be set on certain addictive mobile applications. This PassCode is advised to be set by different people to make its purpose efficient.
- Flexible Block Duration: Users can set the duration they want to block specific apps. This feature allows users to experiment with different durations, such as hourly or daily blocks, to understand the impact of restricted usage on their addictive behaviours.

App Usage Timer: The app incorporates a timer that allows a user to set the duration to which an app has been blocked. This keeps the user updated on their progress and prompts them to unblock an app. automatically blocks the selected addictive apps for a specified period. These features guide the prototype design and development of the Respite mobile application. Respite incorporates features including app block functionality, app alarm timer, and setting up a passcode for block management.

Prototype Design

The second objective of the thesis was to design prototypes for persuasive mobile applications that would help reduce social media and mobile phone addiction.

The system development process went through various design stages including low-fidelity and high-fidelity prototype designs. All these were done

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before the main system development happened. This section delves into the various outcomes of the design processes and interfaces.

Low Fidelity

The low fidelity represents the idea for the first look of the application. Figure 14 shows a storyboard of the Respite mobile application illustrating that from the welcome page after the user launches the application, the user first has to register before logging in after which they can perform other services. .

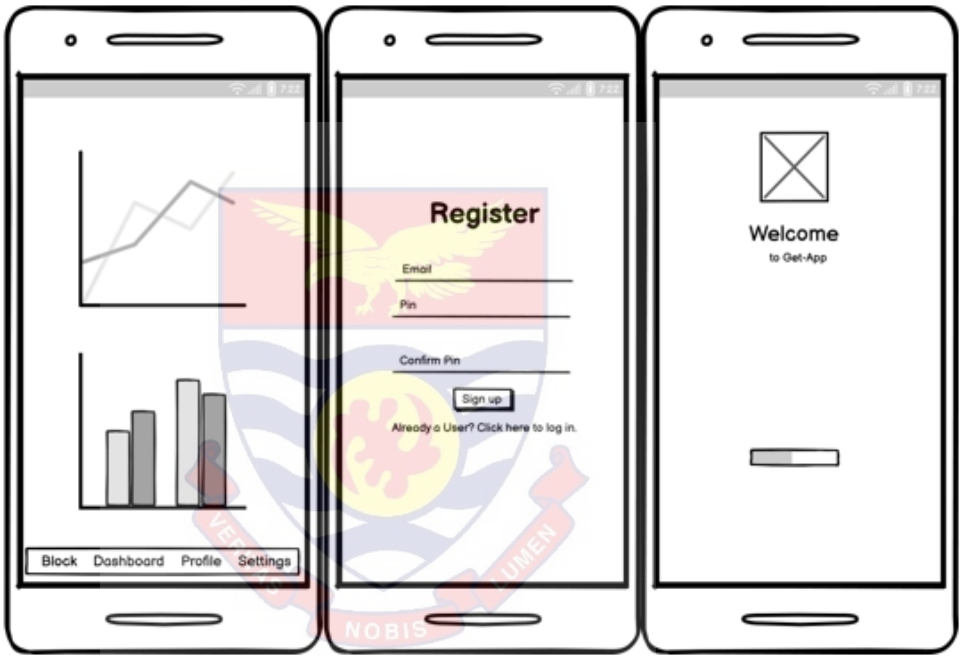


Figure 14: Diagram showing the low fidelity designs (Researcher (2024)

High Fidelity

The low-fidelity diagrams in figure 14 serve as input for this stage. The high-fidelity was developed using Adobe XD and Photoshop. Various interfaces of Respite are illustrated and discussed below.

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Welcome Page

After the user launch the Respite application he is presented with figure 15, the welcome page. This page welcomes the user and asks the user to click the register or the login button shown on the welcome page.



Figure 15: Welcome page Researcher (2024)

Register Page

This page as shown in figure 16 allows the user to create their first profile into the application. This is done through entering of simple details which include Email address and PIN to secure their account. The user would get the opportunity to update their other user details such as adding Username, changing email and other details.

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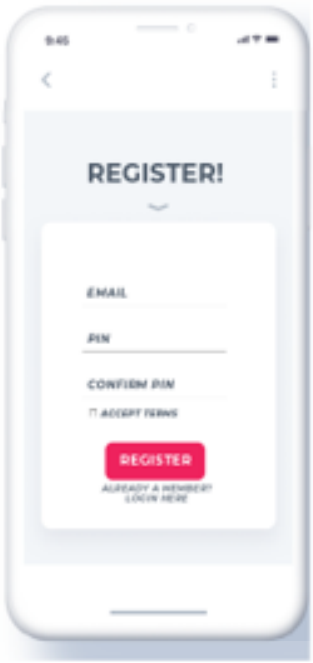
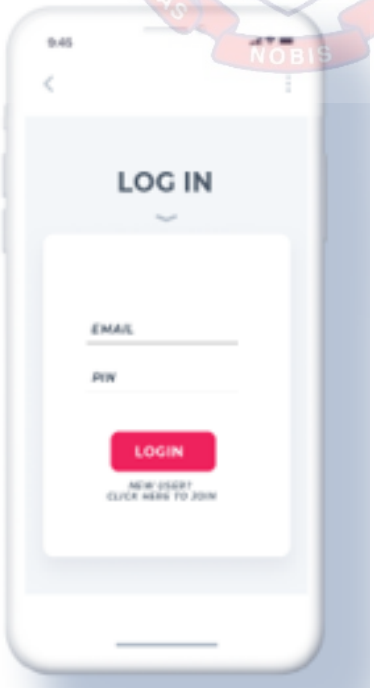


Figure 16: Register page (Researcher (2024)

Login Page

After successfully creating the first user profile in the registration stage, the user can log on to the application by entering their email address and PIN. This allows them to get to the homepage. Figure 17 shows the login page.



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Figure 17: login page (Researcher, 2024)

Homepage

Figure 18 shows the first page where users are directed to when they finally login to the mobile application. On this page, users can add the apps they wish to restrict. They also have access to navigate to all other parts of the application.

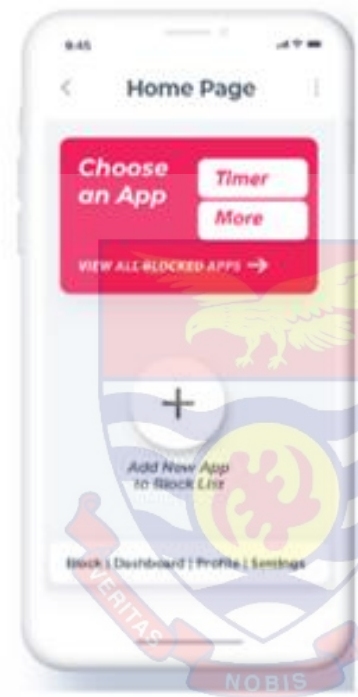


Figure 18: Homepage Researcher (2024)

Dashboard

Statistics on the various usages the user performs on the application are shown on this page, Figure 19. Users can access statistical information like the total hours they have blocked an application and the total applications they have blocked through the application.

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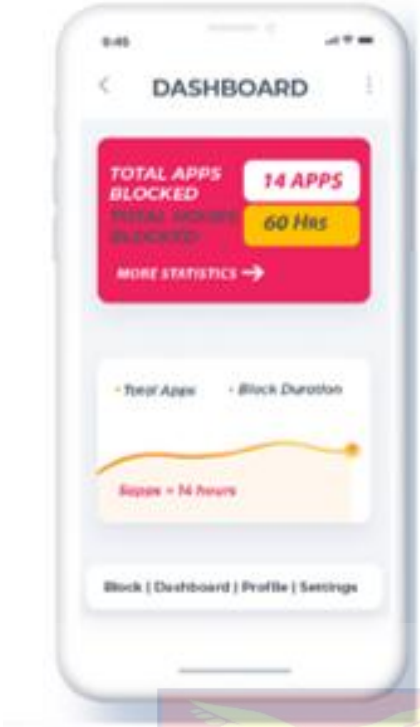


Figure 19: Dashboard (Researcher, 2024)

App Block

Users have the option to block specific apps and to set the duration for which they want to block the apps. This feature allows users to experiment with different durations, such as hourly or daily blocks, to understand the impact of restricted usage on their addictive behaviors. Figure 20 shows this interface.

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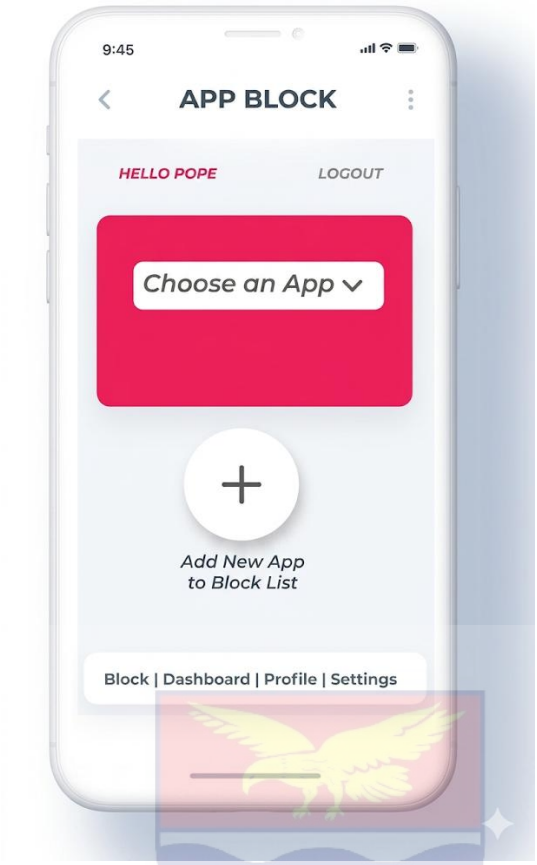


Figure 20: App Block page (Researcher, 2024)

Profile

The profile page, as shown in Figure 21, allows individuals to update their user details. Individuals get the opportunity to include other details to their profile. They also get the opportunity to change other existing details from the profile page.

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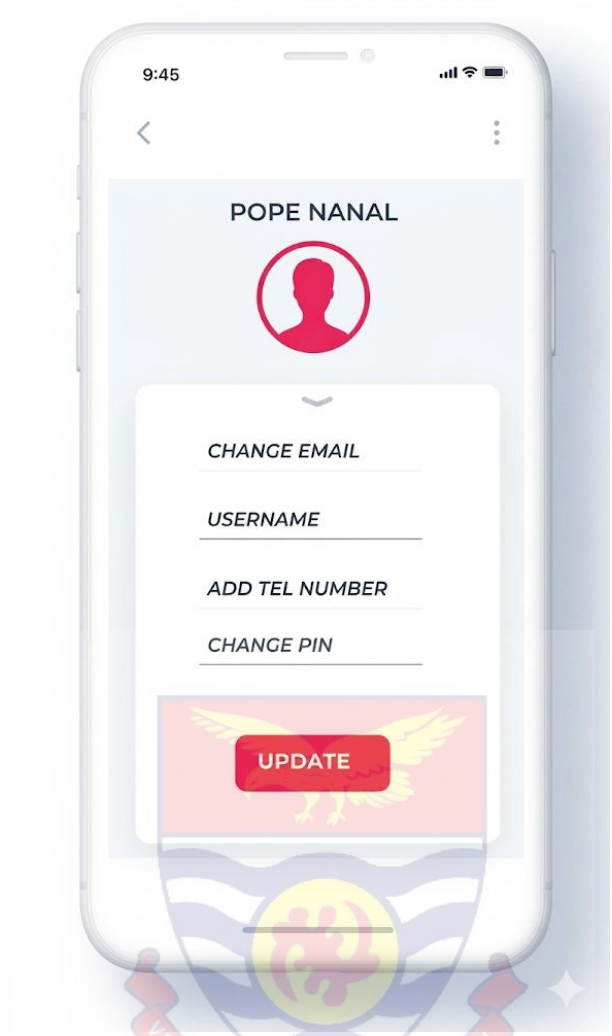


Figure 21: Profile Page (Researcher, 2024)

Settings

On the settings page, the mobile application users get the opportunity to choose or change language, update the application themes, set notifications, update the application, and read about the application. Other settings would be included in future updates of the application. Figure 22 shows the settings page.

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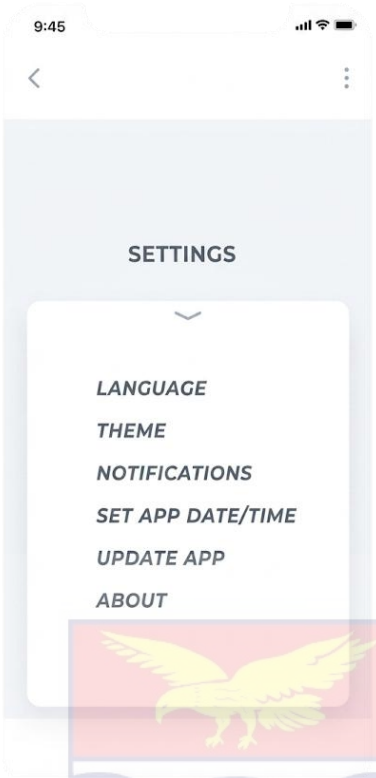


Figure 22: Settings Page (Researcher, 2024)

System Evaluation Results

This section explores the various evaluation techniques used to test and evaluate the system. The evaluation processes adopted two usability testing techniques: heuristic testing and unmoderated Usability testing. These methods help people understand how easy it is to use the app and whether it helps them with their mobile phone and social media habits. They are explained below.

Heuristics Evaluation Testing Results

A heuristic evaluation was conducted based on Jakob Nielsen's usability principles to evaluate the usability of the initial Respite mobile app shown in Figure 35. Three experts reviewed the app's interface and features to identify any usability issues. Each expert examined the app independently, focusing on

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areas such as system visibility, user control, consistency, and overall design. Table 3 summarizes the key issues found by the experts, along with their recommendations for making the app more user-friendly.

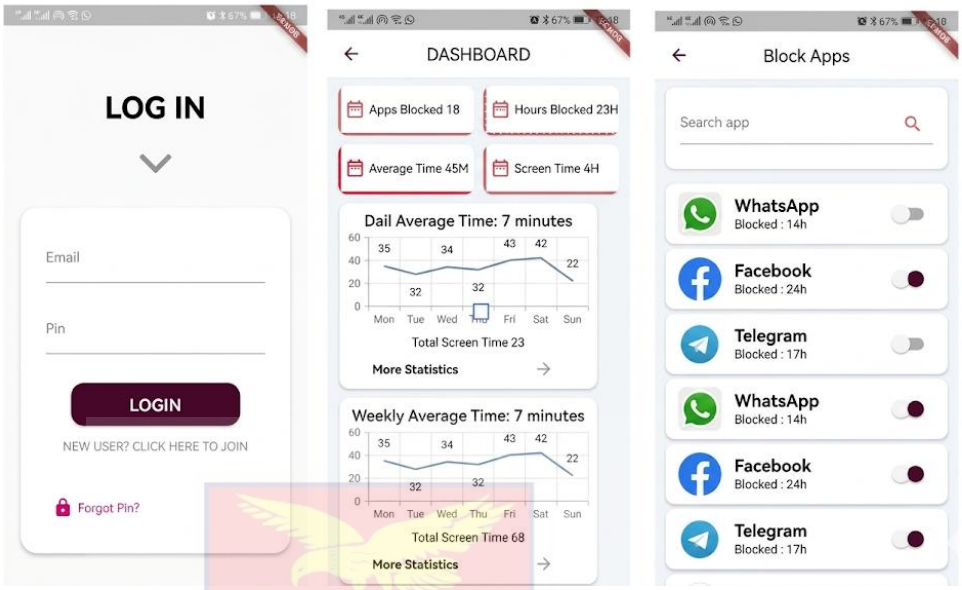


Figure 23: interface showing the first respite application (Researcher, 2024)

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Table 3: Expert heuristic feedbacks

Principle	Expert 1 Feedback	Expert 2 Feedback	Expert 3 Feedback	Recommendations
Visibility of System Status	The app doesn't always show what's happening (e.g., loading times).	It's not always clear when a task is taking time (e.g., blocking apps).	No updates when blocking apps; users don't know if it's working.	Add loading bars or status updates so users know when something is happening.
Match Between System and Real World	Words are easy to understand.	Some icons and buttons aren't very clear.	Some terms don't match what users expect on mobile apps.	Use common words and icons that people are used to seeing in other apps.
User Control and Freedom	No easy way to undo blocking an app.	Too many steps to unblock apps once blocked.	Hard to reset or unblock apps quickly.	Add an "undo" button or make it easier to unblock apps quickly.
Flexibility and Efficiency of Use	No shortcuts for users who are familiar with the app.	Block timers need more custom options for experienced users.	Settings could be easier for users who use the app often.	Add shortcuts and preset options for blocking apps or setting timers.
Aesthetic and Minimalist Design	The app looks clean, but some parts are still too busy.	The dashboard has too much going on and feels crowded.	The design is simple, but some screens feel overwhelming.	Simplify busy screens like the dashboard to make it easier to focus on key features.
Recognition Rather than Recall	Users have to remember how to block apps; it's not easy to follow.	Blocked apps aren't clearly shown in the menus.	Users forget which apps are blocked without opening several menus.	Show blocked apps clearly in the menu so users don't have to remember everything.

Source: (Researcher, 2024)

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The experts reviewed the Respite app, as shown in Table 3, and provided helpful insights on how to improve its usability. They pointed out that users need better feedback from the app, so they always know what's happening during tasks like blocking apps. Some icons and terms weren't as clear as they could be, which made navigation a bit confusing. There was also a need for easier ways to undo actions and unblock apps, as the current process felt too long. Generally, the experts suggested simplifying the design, making common actions easier, and ensuring users always get clear feedback from the app.

Updated Respite Mobile Application Interfaces

In developing the updated mobile application, an iterative approach was chosen to ensure compatibility across different platforms and facilitate easier implementation of updates. This decision was driven by the need to reach a wide range of users, regardless of their device preferences. Some of the features of the Respite application are described with sample code for functionality.

Signup Page

Users are required to create an account, and the above interface and code snippet are how the respite app user is created for the first time. Through the text field provided, we grab this information using the controller variables created in order to pass this information for creating a new user on Firebase. Details, including Email and Passwords, are taken for the Registration process. Password textfield contains obscureText since we would want to hide that information when inputted by the user. Figure 25 shows this page.

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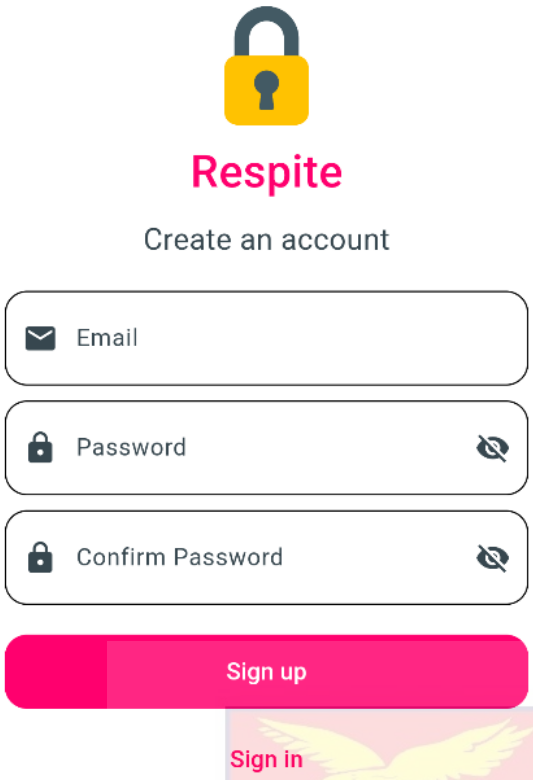


Figure 24: sign-up page (Researcher, 2024)

Login Page

Users can log in to the respite app by providing their email and password through the text fields provided. The information is then passed to Firebase for authentication using controller variables.

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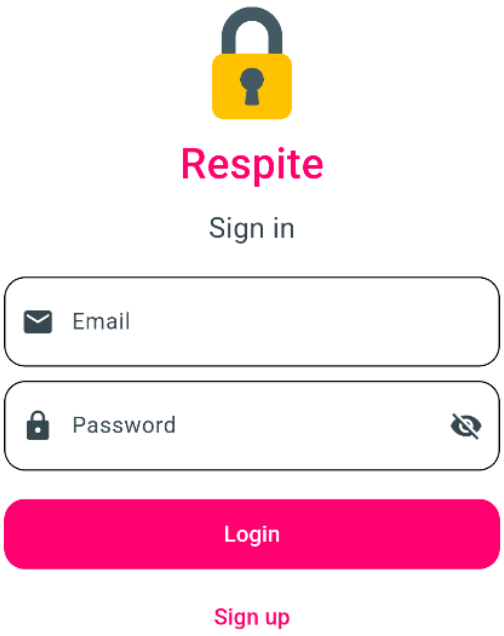


Figure 25: respite login page (Researcher, 2024)

App Permissions

As shown in Figure 27, Respite needs three system permissions to work with, as described below

- **System Overlay**: This permission allows the app to display content over other apps or parts of the device's UI. In Flutter, this was achieved using the `loader_overlay ` package, which enables the app to draw widgets on top of other UI elements.
- **Usage Access:** This permission grants the app access to the device's usage statistics, including information about which apps are being used and for how long. In Flutter, the `usage_stats` package can be utilized to fetch this data. This permission is often used in apps that track user activity, such as screen time monitoring or productivity tools.
- **Push Notifications**: This permission allows the app to receive notifications from a server or backend system, even when the app is not

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actively running. It's a fundamental feature for real-time communication and engagement with users.

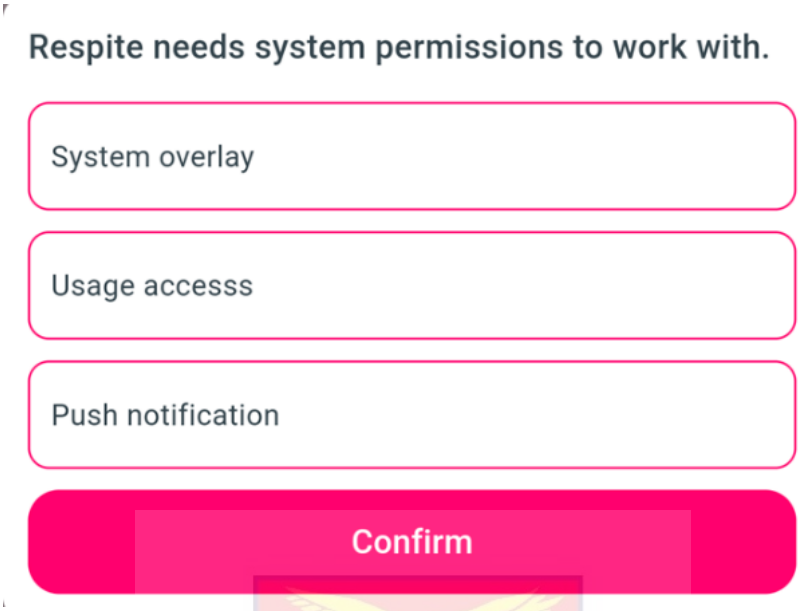


Figure 26: App permissions page (Researcher, 2024)

Get System Apps

The app utilizes the device_apps package to retrieve information about the system apps installed on the user's device. This functionality allows users to view a comprehensive list of apps present on their device, empowering them to select and manage which apps to include in their usage monitoring and restriction settings. Figure 28 shows this page

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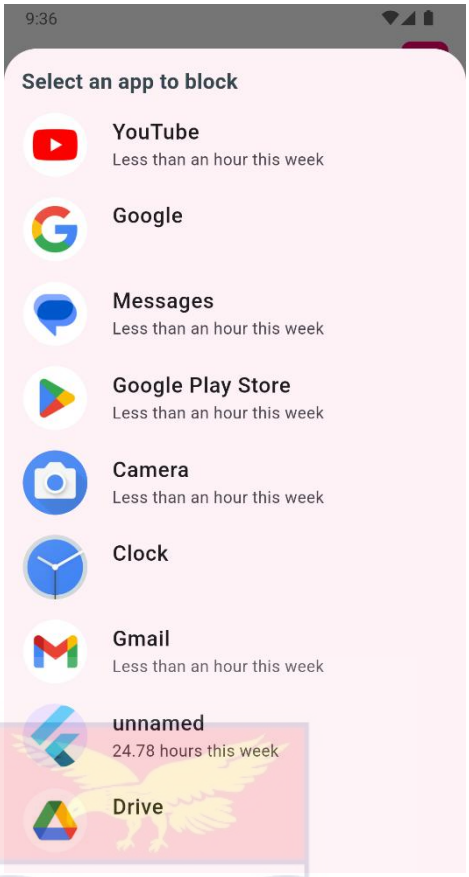


Figure 27: Respite interface for system apps (Researcher, 2024)

Dashboard

The dashboard, as shown in Figure 29, provides users with visual representations of their mobile and social media usage using interactive charts powered by the syncfusion_flutter_charts package. These charts display app usage statistics fetched through the usage_stats package, allowing users to track their digital habits, identify trends, and make informed decisions about managing their screen time.

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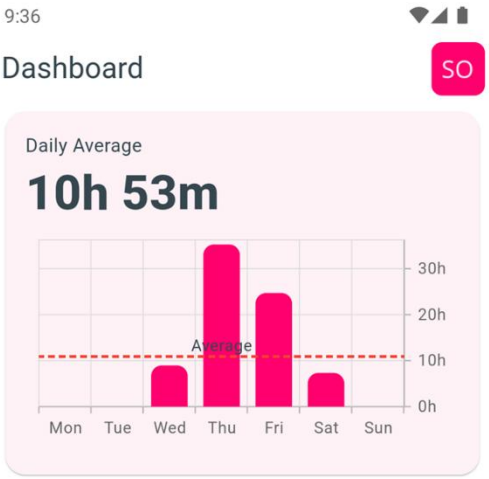


Figure 28: Dashboard interface (Researcher, 2024)

App Blocking

The blocking logic consists of several key components to effectively restrict users from accessing specific applications:

- Storage of App Package Names: The app stores a list of package names corresponding to the applications that the user wants to block. These package names are kept in memory for easy access and reference.
- Foreground Service: A foreground service is initiated to continuously monitor the apps that are opened by the user. This service runs in the foreground, ensuring that it remains active and can promptly detect when a blocked app is launched.
- Overlay Display: When the foreground service detects that a blocked app is being opened, it triggers the display of an overlay on top of the app's interface. This overlay typically prompts the user to enter a pin code or perform another action required to access the app.
- User Interaction Prevention: The overlay effectively prevents the user from interacting with the blocked app by intercepting touch events or other user inputs. This prevents the user from bypassing the blocking mechanism and accessing the restricted app.

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Set PassCode

Users can select a specific app from the list of installed applications and designate a passcode to restrict access to that app. This functionality enhances privacy and security by adding a layer of protection to sensitive or addictive apps, thereby assisting users in managing their mobile phone and social media usage more effectively.

The passcode setting, interface as shown in Figure 30, functionality is facilitated by calling the 'setPasswordInNative' native Kotlin function through method channels. This approach allows the Flutter app to communicate with the underlying Android platform and leverage Kotlin's native capabilities to implement the passcode feature. By invoking this native function, the app can securely set and manage passcodes for chosen applications, enhancing user privacy and control over their mobile usage habits.

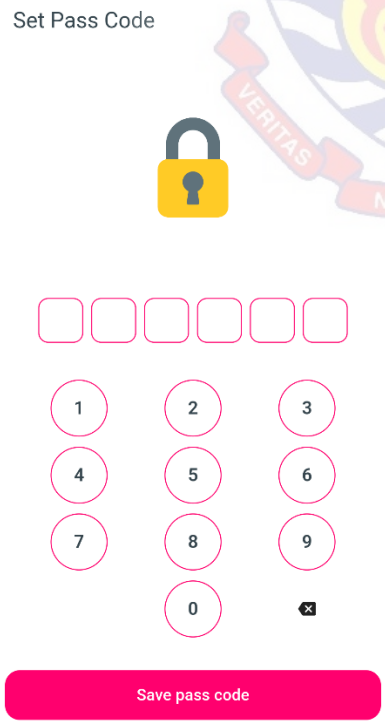


Figure 29: Setting passcode (Researcher, 2024)

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Set Timer

The feature allows users to set a countdown timer that reminds them to unblock a blocked app after a specific number of hours. This helps users manage their app usage and ensure they only use certain apps during designated times. Once the timer ends, the app will notify the user that the blocked app can now be unblocked. Figure 31 shows the steps in setting a timer

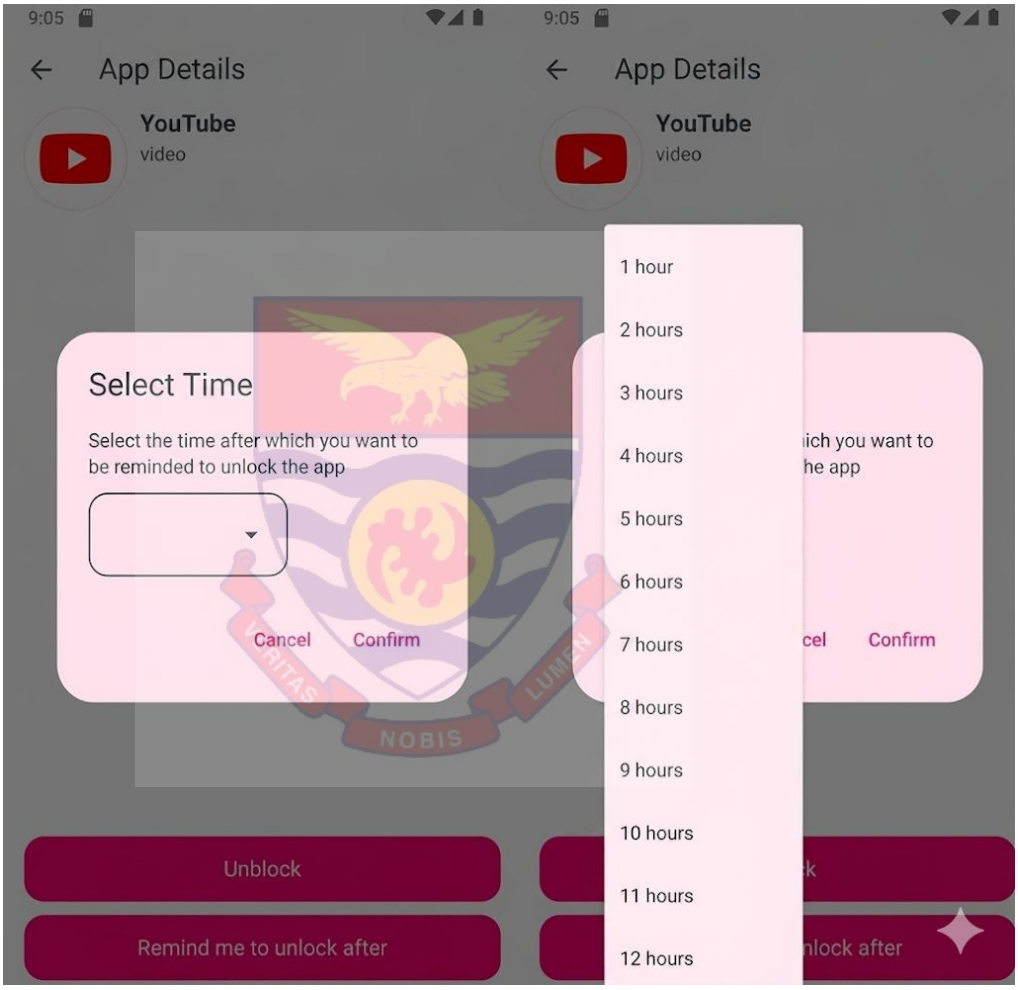


Figure 30: setting timer interface (Researcher, 2024)

Profile

Users can log out of the app through the profile. This would have many more updates in the future. Figure 31 shows this interface.

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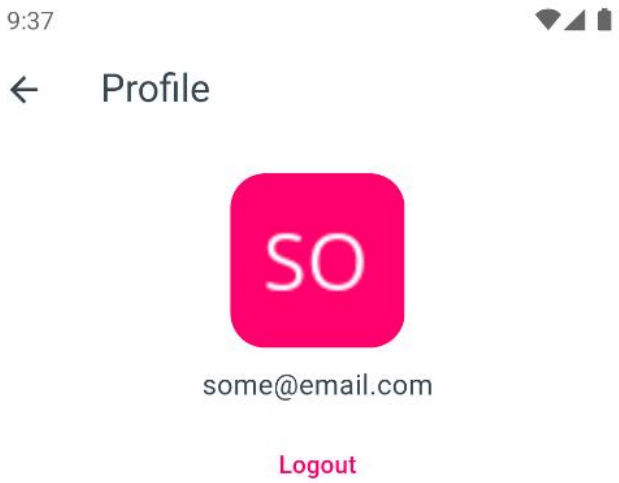


Figure 31: profile page (Researcher, 2024)

Settings

The settings page, shown in Figure 32 in Respite lets users easily adjust how the app works. It provides a simple way to change preferences to fit their needs and improve their experience. Users Can change Settings such as setting passcode and editing profiles from here.

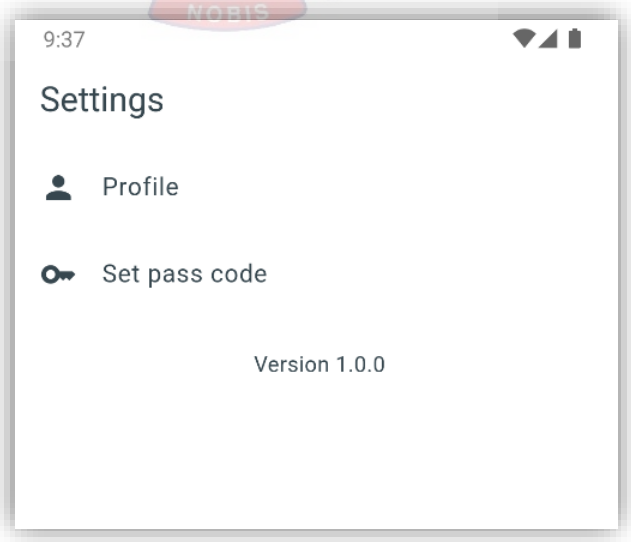


Figure 32: settings page (Researcher, 2024)

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Un-moderated Usability Testing

After the expert review, the updated Respite interface was tested through usability testing. This testing helps evaluate how users interact with the app and their overall experience. For this research, un-moderated usability testing was used, where participants used the app on their own, without anyone guiding or supervising them in real time. This approach allowed users to interact naturally with the app, providing valuable insights into its ease of use and effectiveness.

Un-moderated usability testing was chosen to gather insights from less experienced evaluators who struggle with mobile phone addiction. This approach allowed them to interact with the app in their environment and at their own pace. The evaluators, in this case, fall under the category of less experienced evaluators who also fell under the category of users who admitted to being addicted to their mobile phones. Before testing, each test user was provided with an introduction about what the application is, what its intended uses are and how it is meant to help individuals.

The System Usability Scale (SUS) Results

John Brooke invented the System Usability Scale (SUS) in 1986 as a 'quick and dirty' usability scale for evaluating practically any system. (Thomas, 2019). The System Usability Scale is one of the most efficient ways of gathering statistically valid data and giving a clear and reasonably precise score about any system. According to the ISO standard ISO 9241 Part 11, a system's usability can only be assessed by considering its context of usage, which includes the users' identity, purpose, and surroundings. Measurements of usability have several different aspects which include:

- Effectiveness (can users successfully achieve their objectives)

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- Efficiency (how much effort and resource are expended in achieving those objectives)
- Satisfaction (was the experience satisfactory)

It provides a quick and reliable way to assess the overall usability of a product from the user's perspective. The SUS test typically involves participants completing a questionnaire comprising ten statements related to various usability aspects, such as ease of use, efficiency, and satisfaction. Each statement is rated on a scale from 1 to 5, ranging from "Strongly Disagree" to "Strongly Agree", as show in Figure 34, (Alimatu-Saadia, et al., 2021). After completing the questionnaire, the scores are standardized and combined to calculate a single usability score, ranging from 0 to 100. Higher scores indicate better usability, with scores above 70 generally considered acceptable.

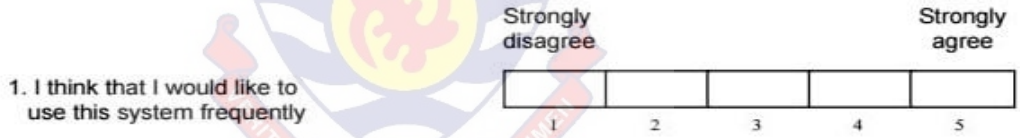


Figure 33: SUS sample questionnaire Likert scale (Betteridge, 2021)

SUS is a 10-item questionnaire with 5 response options (based on the Likert scale) (Brooke 1996) as shown below;

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.

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7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system

Justification for using the SUS Scale

The System Usability Scale (SUS) is an inexpensive, yet effective tool for assessing the usability of a product, including Web sites, cell phones, interactive voice response systems, TV applications, and more. It provides an easy-to-understand score from 0 (negative) to 100 (positive).

- The SUS tool offers a standardized benchmark for evaluating the usability of the Respite app. This allows the team to compare the app's usability against other similar systems, which is particularly valuable when assessing an application designed to influence user behaviour like reducing social media addiction. A SUS score above 70 is generally considered acceptable, and this provides a clear target for the app's development team to strive towards.
- The Respite app is designed for a wide audience, including both tech-savvy individuals and those less familiar with technology. The flexibility of SUS makes it applicable to this diverse user base, ensuring that the usability evaluation captures the experiences of all users, regardless of their technical proficiency.
- SUS provides a numerical score that quantifies the overall usability of the Respite app. This is crucial in assessing whether the app is intuitive and easy to use, which is essential for an application aimed at helping

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users change their habits. A high SUS score would indicate that users find the app easy to navigate and effective in supporting their goals to reduce social media use, while a lower score would highlight areas needing improvement.

Users

All participants involved in the two testing phases were required to complete a System Usability Scale (SUS) test. This test was administered after all updates were implemented, and the latest version of the application was finalized. A Google Form containing the standard SUS questionnaire was distributed to these users for completion.

Calculation of SUS Scores

Step 1: Convert the scale into numbers for each of the 10 questions

i. Strongly Disagree: 1 point
ii. Disagree: 2 points
iii. Neutral: 3 points
iv. Agree: 4 points
v. Strongly Agree: 5 points

Step 2: Calculate

i. X = Sum of the points for all odd-numbered questions - 5
ii. Y = 25 - Sum of the points for all even-numbered questions
iii. SUS Score = (X + Y) x 2.5

The rationale behind the calculation is very intuitive. The total score is 100 and each of the questions has a weight of 10 points.

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SUS Results

Table 4: Table showing sample SUS questionnaire score analysis

USER	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
1	1	5	1	4	2	5	1	4	1	1	82.5
5	2	4	1	4	2	1	3	5	2	5	72.5
5	2	5	1	4	1	4	5	5	1	5	82.5
4	1	5	1	5	2	4	1	4	2	4	87.5
1	2	5	2	4	2	5	1	4	1	1	77.5
4	1	4	4	4	1	3	1	4	1	4	77.5
1	1	5	1	5	1	2	2	2	3	1	67.5
5	1	5	4	2	1	5	2	5	3	5	77.5
4	1	4	4	4	1	3	1	4	1	4	77.5

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USER	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
5	1	5	2	5	1	5	2	5	1	5	95
5	1	4	1	4	2	2	5	4	1	5	72.5
4	1	4	4	4	1	3	1	4	1	4	77.5
5	1	4	1	4	2	2	5	4	1	5	72.5
3	3	4	3	3	4	3	3	3	2	3	52.5
5	1	5	4	5	1	5	2	5	5	5	80
3	2	4	2	2	1	3	3	1	3	3	55
4	1	5	1	1	4	5	2	4	1	4	75
5	1	4	1	4	2	2	5	4	1	5	72.5
5	1	4	1	4	2	2	4	4	1	5	75
5	1	4	1	4	2	2	4	4	1	5	75
5	1	4	1	4	2	2	4	4	1	5	75

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USER	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
4	2	5	2	4	1	2	5	5	1	4	72.5
5	1	4	1	4	2	2	5	4	1	5	72.5
5	1	5	4	5	1	5	2	5	5	5	80
1	1	5	1	5	1	2	2	2	3	1	67.5
5	1	5	4	5	1	5	2	5	5	5	80
2	1	4	4	4	2	4	1	5	4	2	67.5
5	2	5	2	5	5	5	2	1	2	5	70
4	4	5	1	5	2	2	5	5	4	4	62.5
5	1	4	2	1	5	3	5	1	3	5	45
5	2	4	1	2	4	5	5	2	4	5	55
1	1	5	1	5	1	2	2	2	3	1	67.5
4	4	4	1	5	5	3	2	5	1	4	70

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USER	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
4	1	4	4	2	1	2	4	5	2	4	62.5
4	1	5	4	2	2	2	4	5	4	4	57.5
4	1	4	4	2	2	5	4	5	2	4	67.5
4	1	5	3	3	1	4	5	5	4	4	67.5
4	1	4	2	4	2	4	5	5	3	4	70
4	1	5	2	4	2	4	5	5	4	4	70
4	1	4	1	5	2	4	4	5	4	4	75

Source: (Researcher, 2024)

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SUS Score Analysis

The System Usability Scale (SUS) scores from the usability evaluation of the mobile application yielded insightful data regarding the system's overall usability. The analysis of the SUS scores provides a comprehensive understanding of user perceptions and the effectiveness of the application in addressing social media addiction and promoting well-being.

The mean SUS score across all participants was 71.5, indicating that the application generally offers a good level of usability. This score suggests that most users found the application fairly easy to use and aligned with their expectations for a tool designed to assist in reducing social media addiction. However, there are some differences in individual responses, as seen in users' neutral or slightly disagreeing ratings on specific statements. These responses suggest that while the system is generally usable, there may still be areas for improvement to address any inconsistencies or complexities that users may have encountered.

The median SUS score was 72.5, closely aligning with the mean, which further reinforces that the majority of users had a positive experience with the system. This central tendency measure indicates that half of the users rated the system above this score, and half rated it below, underscoring the consistency in user feedback.

The standard deviation of the SUS scores was 9.59, reflecting a moderate variation in user experiences. While most users rated the system within a similar range, this variation highlights that some users had experienced significantly above or below the average, suggesting areas where the application could be further refined to ensure a more uniform user experience.

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The minimum SUS score recorded was 45.0, indicating that at least one user encountered considerable challenges with the application, perhaps finding it difficult to use or not fully meeting their needs. On the other hand, the maximum SUS score was 95.0, showing that other users found the system exceptionally user-friendly and effective.

Histogram Distribution of SUS Scores:

This plot provides a visual distribution of the SUS scores, as shown in Figure 35. It helps in understanding how the scores are spread across the users, showing how many users fall within specific score ranges.

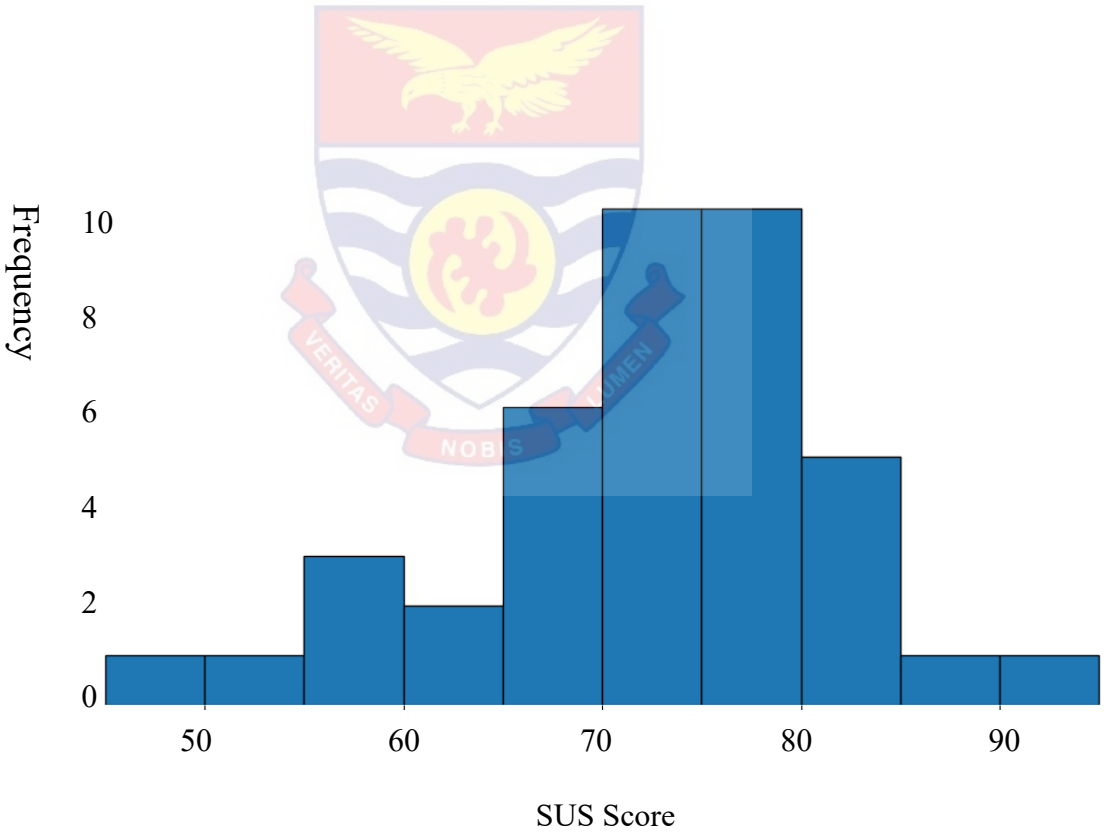


Figure 34: Histogram Distribution of SUS Scores (Researcher, 2024)

Boxplot of SUS Scores

The boxplot offers a concise summary of the SUS scores, displaying the median, interquartile range (IQR), and potential outliers. The median line within

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the box indicates the central value of the SUS scores, while the edges of the box represent the first and third quartiles, showing the spread of the middle 50% of the data. Whiskers extend to the minimum and maximum values within 1.5 times the IQR, and any points outside this range are considered outliers. This visualisation helps in identifying any extreme scores and understanding the distribution's symmetry or skewness. Figure 36 shows the box plot.

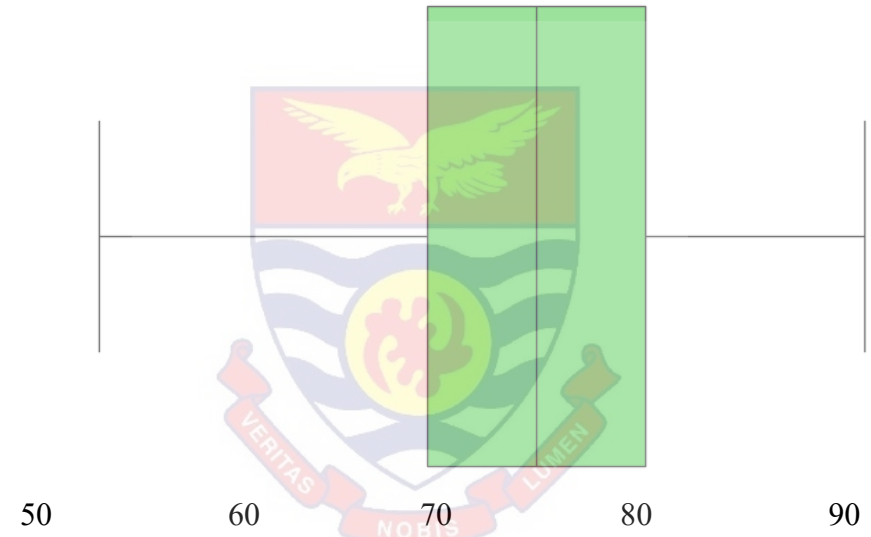


Figure 35: Boxplot of SUS Scores (Researcher, 2024)

Mean Scores for Each Question

Figure 37 shows the bar plot of mean scores for each SUS question, providing an overview of how users responded to individual questions on the usability scale. By calculating the average score for each question, this visualisation highlights which aspects of the system were perceived positively or negatively. For instance, higher mean scores on questions related to ease of use suggest that users found the system intuitive, while lower scores may indicate areas that need improvement. This analysis is essential for pinpointing specific strengths and weaknesses in the system's usability.

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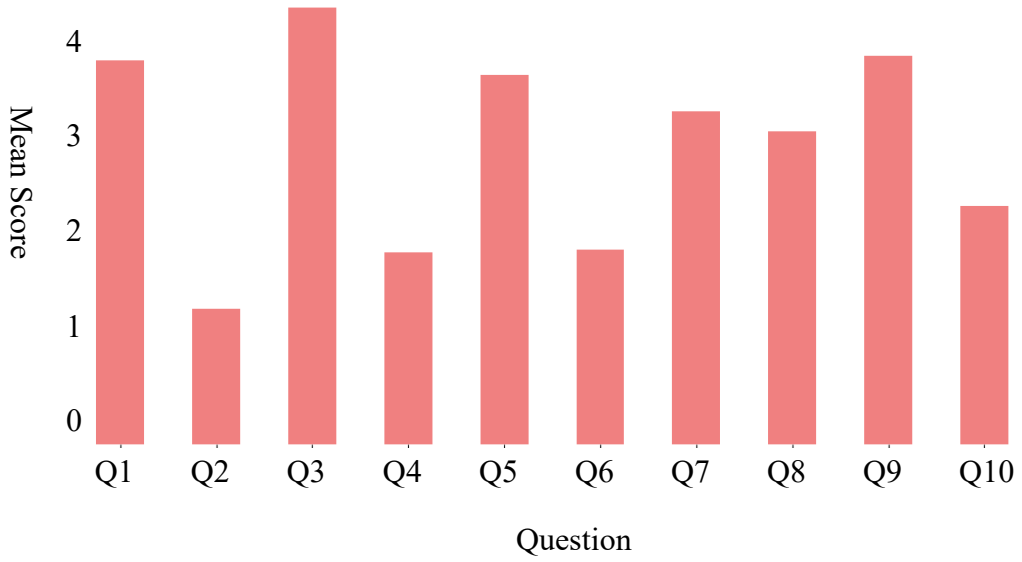


Figure 36: Mean Scores for Each Question (Researcher, 2024)

Respite Performance Comparison with other similar applications

Table 5: Table showing various apps and how respite performs

App Name	Limitations of Competitor	How Respite Performs Better	Link
Digital Detox (Android)	Rigid schedules, harsh interface, limited session customization.	Gentle, supportive reminders; flexible custom sessions; minimal, user-friendly design.	Google Play
QualityTime (Android)	Overwhelming analytics focus (graphs, stats), weak blocking features.	Prioritizes distraction blocking over data overload; simple, clutter-free experience.	Google Play
Flipd (iOS/Android)	Hides apps completely, which frustrates users; reports of bugs.	Balanced approach: blocks distractions without making users feel 'locked out'; more mindful usage.	Google Play / App Store
Forest (iOS/Android)	Relies on gamification; does	Direct blocking of distracting apps;	Google Play /

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	not block apps natively.	practical for professionals and students who prefer focus over games.	App Store
YourHour (Android)	Heavy addiction scoring, can feel judgmental; weak live blocking.	Encourages healthier breaks with reminders; proactive blocking + mindfulness support.	Google Play
Clearspace (iOS)	Mainly targets social media cravings; core features behind subscription.	Broader productivity use-cases (study, work, self-care); accessible without forcing premium upgrade.	App Store
Anti Addiction: Screen Time (Android)	Feels like parental control, complex UI.	Designed for personal empowerment, not surveillance; modern, minimal, easy-to-use interface.	Google Play

Source: (Researcher, 2024)

Why Respite Stands Out

1. **User-Centered Design**

While competitors like QualityTime and Anti Addiction overwhelm users with data or complex controls, Respite focuses on simplicity and ease of use. Its minimal interface lowers friction, ensuring users spend time focusing—not configuring.

2. **Empowerment Over Punishment**

Apps such as Flipd and Digital Detox adopt a harsh, lockout-style approach. This creates frustration and resistance. Respite instead uses gentle reminders and custom sessions, promoting mindful self-regulation rather than forced compliance.

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3. **Productivity Over Gimmicks**

Forest relies heavily on gamification (trees and virtual rewards), which can feel juvenile or distracting for serious users. Respite keeps the focus where it belongs: boosting productivity and reducing digital clutter.

4. **Accessibility**

Unlike Clearspace, which locks core features behind a subscription, Respite ensures that essential tools for focus and self-care remain accessible to all users

System Development Challenges

Throughout the development of the application, several obstacles were encountered, reflecting the challenges inherent in creating a solution within the expected time frame. Understanding the diverse needs and preferences of users, particularly those struggling with mobile phone and social media addiction, proved to be a difficult task.

Moreover, the learning curve associated with mastering Flutter and Dart while simultaneously developing the application posed significant challenges. As bugs emerged during development, addressing them became time-consuming, leading to setbacks in the project timeline. These setbacks, compounded by the evolving nature of the codebase, necessitated frequent adjustments to maintain consistency and functionality.

Despite these challenges, the development process was both exhilarating and demanding. The project provided invaluable experience in navigating the complexities of cross-platform application development, software publishing, and adhering to the Software Development Cycle. Through perseverance and adaptation, the application successfully transitioned from conceptualization to

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production, marking a significant milestone in the journey towards addressing mobile phone and social media addiction effectively.

Chapter Summary

This chapter delved into the results and discussions from the development, testing, and evaluation phases of the mobile application aimed at reducing mobile phone and social media addiction. The chapter outlines the systematic development process, highlighting the prototypes developed and the final application developed through the integration of various technologies such as Flutter, Dart, Kotlin, and Firebase to create a robust and versatile application framework.

The chapter also discusses techniques that went into evaluating the mobile application. Also discussed were the obstacles encountered during development, including challenges related to understanding user preferences and addressing technical bugs within a limited timeframe. However, despite these challenges, the experience gained throughout the development process provided valuable insights into mobile application development, usability testing, and the software development cycle.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Overview

This chapter delves into the conclusion and future aspects of the project, where various recommendations are outlined for future enhancements and iterations. The purpose of these future recommendations is to provide a roadmap for ongoing development and improvement of the application.

Summary

This research discussed the development of the Respite mobile app, designed to help reduce mobile phone and social media addiction. It explained how the app was created using a user-centred design approach to ensure that it meets users' needs. The research also reviewed how the app was evaluated using expert reviews and unmoderated usability testing. Feedback from these tests led to improvements in the app, making it easier to use.

Conclusions

Developing the Respite application was both a challenging and rewarding journey, driven by the goal of providing a practical tool to combat mobile phone and social media addiction. By prioritising user-centred design and iterative testing, the application was refined to ensure usability and effectiveness. Key features, including the dashboard for usage insights, app-blocking functionality, and passcode settings, were designed to empower users to manage their screen time. The positive SUS score of 71.5 reflects user satisfaction with the app's usability, while ongoing refinements based on feedback continue to enhance its functionality.

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Recommendations

Planning for future enhancements and iterations is paramount to the long-term success and sustainability of any project or application. The key areas of focus for future recommendations involve a wide range of considerations, each aimed at maximising the effectiveness, usability, and impact of the application. These areas include:

User Experience (UX) Enhancement: Continuously improving the user experience is critical to retaining users and driving engagement. Future recommendations may involve refining the application's interface, streamlining user workflows, and optimising navigation paths to ensure a seamless and intuitive experience for users.

Feature Expansion: Future recommendations could include the addition of new functionalities, such as advanced data analytics, personalised recommendations, or integration with emerging technologies like augmented reality (AR) or virtual reality (VR).

AI Integration: Integrating artificial intelligence (AI) into the application represents a significant opportunity for enhancing its capabilities and providing users with personalised, intelligent experiences. AI-powered features can analyse user behaviour, preferences, and usage patterns to deliver tailored recommendations, insights, and assistance.

Security and Privacy: Protecting user data and privacy is paramount in today's digital landscape. Future recommendations may include strengthening security measures, implementing encryption protocols, and ensuring compliance with data protection regulations such as the General Data Protection Regulation (GDPR) or the California Consumer Privacy Act (CCPA).

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APPENDIX

SAMPLE CODES

1. Authentication (Flutter/Dart)

These functions handle user registration and login via Firebase.

User Sign-Up:

Dart

```
Future<AuthenticationResults> signUpWithEmailAndPassword(
    {required String email, required String password}) async {
  AuthenticationResults _res;
  try {
    UserCredential userCredential = await _firebaseAuth
        .createUserWithEmailAndPassword(email: email, password: password);

    _user = userCredential.user!;
    String _name = email.split('@')[0];
    final String _photoURL =
        "https://ui-
avatars.com/api/?name=${_name}&background=ff006e&color=ffffff";

    await _user?.updatePhotoURL(_photoURL);
    _user = _firebaseAuth.currentUser;

    _res = AuthenticationResults(success: true, message: 'User created.');
  } on FirebaseAuthException catch (e) {
    String message = errorDescriptions[e.code] ?? "An error occurred";
    _res = AuthenticationResults(success: false, message: message);
  } catch (e) {
    _res =
        AuthenticationResults(success: false, message: "An error occurred.");
  }
  update();
```


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```
 return _res;
}
```

User Sign-In:

Dart

```
Future<AuthenticationResults> signInWithEmailAndPassword(
   {required String email, required String password}) async {
 AuthenticationResults _res;
 try {
  UserCredential userCredential = await _firebaseAuth
      .signInWithEmailAndPassword(email: email, password: password);

  _user = userCredential.user!;
  _res = AuthenticationResults(success: true, message: 'Signed in.');
 } on FirebaseAuthException catch (e) {
  String message = errorDescriptions[e.code] ?? "An error occurred.";
  _res = AuthenticationResults(success: false, message: message);
 } catch (e) {
  _res =
      AuthenticationResults(success: false, message: "An error occurred.");
 }
 update();
 return _res;
}
```

2. Permission Logic (Flutter/Dart)

Methods used to trigger or check system permissions.

Requesting Permissions:

Dart

```
Future<bool> askNotificationPermission() async {
 await Get.find<PermissionController>()
```


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```
    .getPermission(Permission.notification);
 isNotificationPermissionGiven = await Permission.notification.isGranted;
 update();
 return isNotificationPermissionGiven;
}

Future<bool> askOverlayPermission() async {
 try {
  return await platform
    .invokeMethod('askOverlayPermission')
    .then((value) async {
   log("$value", name: "askOverlayPermission");
   isOverlayPermissionGiven = (value as bool);
   update();
   return isOverlayPermissionGiven;
  });
 } on PlatformException catch (e) {
  log("Failed to Invoke: '${e.message}'.");
  return false;
 }
}

Future<bool> askUsageStatsPermission() async {
 try {
  return await platform
    .invokeMethod('askUsageStatsPermission')
    .then((value) async {
   log("$value", name: "askUsageStatsPermission");
   isUsageStatPermissionGiven = (value as bool);
   update();
   return (value as bool);
  });
 } on PlatformException catch (e) {
  log("Failed to Invoke: '${e.message}'.");
```


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```
    return false;
  }
}
```

Checking Permissions:

Dart

```
Future<bool> checkOverlayPermission() async {
  try {
    return await platform
        .invokeMethod('checkOverlayPermission')
        .then((value) {
      log("$value", name: "checkOverlayPermission");
      isOverlayPermissionGiven = value as bool;
      update();
      return isOverlayPermissionGiven;
    });
  } on PlatformException catch (e) {
    log("Failed to Invoke: '${e.message}'.");
    isOverlayPermissionGiven = false;
    update();
    return isOverlayPermissionGiven;
  }
}

Future<bool> checkNotificationPermission() async {
  return isNotificationPermissionGiven =
      await Permission.notification.isGranted;
}

Future<bool> checkUsageStatePermission() async {
  isUsageStatPermissionGiven =
      (await UsageStats.checkUsagePermission() ?? false);
```


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```
 update();
 return isUsageStatPermissionGiven;
}
```

3. App Locker Logic (Flutter/Dart)

Logic for managing the list of blocked apps and syncing with the native layer.

Toggle Block Logic:

Dart

```
toggleAppBlock(Application app) async {
 try {
  if (_blockedApps.contains(app)) {
   log("REMOVING ${app.packageName} FROM LOCKED APPS");
   if (canBeSuggestedToBeBlocked(app: app) &&
     !_suggestedApps.contains(app)) {
    _suggestedApps.add(app);
   }
   _blockedApps.removeWhere((em) => em.packageName ==
app.packageName);
   Get.find<MethodChannelController>().addToLockedAppsMethod();
  } else {
   log("ADDING ${app.packageName} TO LOCKED APPS");

   if (_blockedApps.length < 16) {
    if (_suggestedApps.contains(app)) {
     _suggestedApps.remove(app);
    }
    _blockedApps.add(app);

    Get.find<MethodChannelController>().addToLockedAppsMethod();
   } else {
    Fluttertoast.showToast(
      msg: "You can add only 16 apps in locked list");
```


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```
    }
   }
  } catch (e) {
   log("------$e", name: "addToLockedApps");
  }
  prefs.setStringList(AppConstants.lockedApps,
     _blockedApps.map((e) => e.packageName).toList());
  update();
}
```

Syncing Passcode and Block List:

Dart

```
// Set Passcode via Method Channel [cite: 8]
Future setPassword() async {
  final prefs = await SharedPreferences.getInstance();
  try {
   String data = prefs.getString(AppConstants.setPassCode) ?? "";
   if (data != "") {
    await platform.invokeMethod('setPasswordInNative', data).then((value) {
     log("$value", name: "setPasswordInNative CALLED");
    });
   }
  } on PlatformException catch (e) {
   log("Failed to Invoke: '${e.message}'.");
  }
}

// Sync Blocked List via Method Channel [cite: 12]
addToLockedAppsMethod() async {
  try {
   Map<String, dynamic> data = {
    "app_list": Get.find<MainController>().blockedApps.map((e) {
     return {
```


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```
        "app_name": e.appName,
        "package_name": e.packageName,
        "file_path": e.apkFilePath,
      };
    }).toList()
  };
  await setPassword();
  await platform.invokeMethod('addToLockedApps', data).then((value) {
    log("$value", name: "addToLockedApps CALLED");
  });
 } on PlatformException catch (e) {
  log("Failed to Invoke: '${e.message}'.");
 }
}
```

4. Native Implementation (Kotlin)

Method Channel Handler:

```
override fun onCreate(savedInstanceState: Bundle?) {
  super.onCreate(savedInstanceState)
  saveAppData = applicationContext.getSharedPreferences("save_app_data",
Context.MODE_PRIVATE)
  GeneratedPluginRegistrant.registerWith(FlutterEngine(this))
  MethodChannel(flutterEngine!!.dartExecutor.binaryMessenger,
channel).setMethodCallHandler { call, result ->
    when {
      call.method.equals("addToLockedApps") -> {
        val args = call.arguments as HashMap<*, *>
        println("$args ----- ARGS")
        val greetings = showCustomNotification(args)
        result.success(greetings)
      }
```


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```
            call.method.equals("setPasswordInNative") -> {
                val args = call.arguments
                val editor: SharedPreferences.Editor = saveAppData!!.edit()
                editor.putString("password", "$args")
                editor.apply()
                result.success("Success")
            }
            call.method.equals("checkOverlayPermission") -> {
                result.success(Settings.canDrawOverlays(this))
            }
            call.method.equals("stopForeground") -> {
                stopForegroundService()
            }
            call.method.equals("askOverlayPermission") -> {
                result.success(checkOverlayPermission())
            }
        }
    }
}
```

Permission and Service Definitions:

```
private fun checkOverlayPermission(): Boolean {
    if (!Settings.canDrawOverlays(this)) {
        val myIntent =
Intent(Settings.ACTION_MANAGE_OVERLAY_PERMISSION)
        startActivity(myIntent)
    }
    return Settings.canDrawOverlays(this)
}

private fun isAccessGranted(): Boolean {

private fun startForegroundService() {
```


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```
    if (Settings.canDrawOverlays(this)) {
        setIfServiceClosed("1")
        ContextCompat.startForegroundService(this, Intent(this,
ForegroundService::class.java))
    }
}

private fun stopForegroundService() {
    setIfServiceClosed("0")
    stopService(Intent(this, ForegroundService::class.java))
}

private fun showCustomNotification(args: HashMap<*, *>): String {
    lockedAppList = emptyList()
    val appInfo =
packageManager.getInstalledApplications(PackageManager.GET_META_DA
TA)
    val arr : ArrayList<Map<String, *>> = args["app_list"] as
ArrayList<Map<String, *>>

    for (element in arr) {
        run breaking@{
            for (i in appInfo!!.indices) {
                if (appInfo!![i].packageName.toString() ==
element["package_name"].toString()) {
                    val ogList = lockedAppList
                    lockedAppList = ogList + appInfo!![i]
                    return@breaking
                }
            }
        }
    }

    var packageData: List<String> = emptyList()
```


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```
    for (element in lockedAppList) {
        val ogList = packageData
        packageData = ogList + element.packageName
    }

    val editor: SharedPreferences.Editor = saveAppData!!.edit()
    editor.remove("app_data")
    editor.putString("app_data", "$packageData")
    editor.apply()

    startForegroundService()
    return "Success"
}
```


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