A BROWSER BASED INTERVENTION APPROACH TOWARDS MANAGING INTERNET ADDICTION DISORDER

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Declaration

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the qualification of any other degree or diploma of a university or other institution of higher learning.

Signature of candidate

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Abstract

Significant technological advancements over the last two decades have led to enhanced accessibility to computer devices and the Internet. We are experiencing an increasing integration of the Internet into our everyday lives and it has transformed the way we conduct business, obtain and exchange information, interact and communicate with one another. Despite its positive impacts, overuse of the Internet can lead to the development of additive cyber-behaviours. In the long run this can negatively impact individuals' behaviours and many aspects of their lives.

This thesis presents the design and development of a web browser-based intervention approach to manage Internet addiction disorder. Two main aspects have been taken into account when developing and implementing this system, which are psychological and technical aspects.

This system, called SustainMe, is composed of three main modules that serve as one single monitoring and managing Internet use, which are Internet addiction screening test, a browser-based Internet monitoring and a user' Internet usage notification system. The monitoring feature embedded in a newly developed custom web browser and the notification system involving the patient's group of kin have made this approach unique, more potential and scalable in supporting the patient to manage his or her Internet addictive behaviours.

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Chapter 1

Introduction

1.1 Background

Internet addiction is a new phenomenon that has already led to many serious social and health problems. Young (2004) explains that prolonged addiction to online affairs can result in marital discord, separation or even divorce. Her earlier studies in 1998 also found that 58% of students produced poor or failed grades in school and possessed poor study habits as a result of their excessive Internet use.

Whilst Internet addiction can connote online pornography and gambling, milder forms encompass games, shopping, email, and online social networking. Effective behaviour monitoring and intervention are important and of great interest in addiction research and industrial communities today. The constraints of the current approaches depend on the participant's self-control and limited contact hours with a consultant. We propose a browser based intervention approach to address those limits, with the aim of managing Internet addiction disorder. The system consists of a newly developed browser that can calculate and monitor the participant's Internet usage behaviour and report the evidence to a cloud-based expert system for further data processing such as visualization and analysis. According to the rules pre-set during the treatment agreement, the system can automatically provide reminders or recommendations to the participant, his/her next of kin or a consultant via text messages and emails. In this way participants always feel connected (and cared about) to achieve their recovery goal.

1.2 Motivations

The worldwide system of computer networks, which we all know as the Internet, has grown exponentially since its first introduction and appearance to the public in the mid-1990s (Al Sheibani, 2015). Technological advancements over the last two decades have led to an enhanced accessibility to computing devices and the Internet. We experience the increased integration of the Internet in our everyday lives. In fact, the Internet has transformed the way we conduct business, exchange information, interact socially with each other (Yuan, Qin, Liu & Tian, 2011) and spend our leisure time.

Despite its positive impacts, the overuse of the Internet can lead to the development of addictive cyber-behaviours. In the long run, this can negatively impact an individual's behaviour, due to their heavy dependence on it. The American Psychiatric Association (Salicetia, 2015) considers a heavy dependence and increasing overuse of the Internet as an emerging disorder, also known as Internet Addiction (Zochil, 2015). While much research focuses on the detection of the cause and symptoms of Internet Addiction and the treatment of the aftermath of excessive Internet use (Douglas et al., 2008), little is known about a solution or prevention techniques, especially developed using an information and communications technology (ICT) that can avert people from spending too much time on the Internet. This paper aims to critically explore the current status of Internet Addiction. The main objective is to find an ICT-based solution/prevention technique to tackle the emerging problem.

Despite the storage of a vast amount of online information and the potential social and educational values of the Internet, many of its attributes can lead to some kind of online addictive behaviours (Daniel, 2009). Those attributes include 24 hours a day easy access to the Internet, free of charge or very affordable service provision, borderless communication and social networking, the provision of many opportunities to feel a sense of belongings, and the ability to escape from emotional problems and hardships.

More and more advanced technologies are being developed to facilitate the use of and access to the Internet, from aspects such as hardware equipment to software applications and the networking algorithms and breakthroughs that are used to improve speed and accessibility through a variety of devices and workstations. However, few of these technologies have put in place intervention systems to monitor and help eliminate the emerging problem of Internet addiction. The addictive power of the Internet has become a new and developing topic in addiction research in recent years. This addictive behaviour could have an unforeseeable social and economic impact on our society in the coming decades if no prevention techniques or solutions are found to tackle it. Therefore, this thesis is focused on designing a system that can manage and tackle the problem of Internet addiction.

1.3 Research Questions

This thesis is driven by an objective to find an ICT-based solution to manage the emerging addiction problem.. A browser based intervention approach is employed to monitor and manage the Internet users' addictive behaviours. We decided to implement our interventions and controls at the web browser level because this is one of the most common tools for Internet access and is also where online activities take place.

Our system model, which is discussed in Chapters 3 and 4, aims to address and answer the following problem statements:

- RQ1:How to measure, monitor and visualise the Internet usage of a user from their daily Internet access routine?
- RQ2:How to impose an intervention procedure to help prevent the user from Internet addiction based on the above information?

The above two research questions represent the core concepts of our research, that is, Internet addiction monitoring and intervention.

First we aimed to find out how we could monitor the participant's Internet access routine in a way that would allow us to obtain essential information to be further studied and analysed at later stages in our research. This information consists of the Internet usage, access date, duration of activity and the participant identification (ID) number. We then needed to transform the findings into graphic form in order to produce more comprehensive and organized results. The research problems in relation to the monitoring process are combined and summarised in research question 1 (RQ1).

Our second research question (RQ2) narrows in on the concept of intervention and notification. A good intervention and notification system can have an impact on a participant's Internet usage and influence the way they carry out their online activities. During the monitoring process, not only is the participant's online usage information being recorded and further analysed, but he/she needs to also go through an intervention process and receive notifications from time to time based on their usage data analysis.

Together, our research questions outline the fundamental core of our research, the problems we have to address and investigate, and most importantly act as a directional focus.

1.4 Contributions

In current studies and research, there has not been much contributions around designing a single effective system that measures and manages the two variables that can help to determine the severity of Internet addiction, these being time and usage. Internet addictive behaviours can be identified and studied by observing how long the user spends online and how much data usage results from his/her online sessions. It is also important to take into account his/her access location and environment to obtain accurate and reliable information about Internet usage behaviours. Effective feedback and notification functionalities between an ICT-based intervention system and its participating users is another area that has been lacking in research.

This thesis aims to address the technical shortage and gap in the literature by proposing a browser based intervention system as an approach to managing Internet addiction disorder. Our system is comprised of a web browser (equipped with an Internet monitoring tool); an online MySQL database, and a feedback and notification

system. It is designed to be an integrated model that has the capability to measure, monitor and analyse Internet usage, then inform the participant and his/her next of kin through feedbacks and warnings.

By developing such an effective intervention system, three main contributions to our research are claimed and summarised below.

1.4.1 Online Screening Questionnaires

We started our research with questions, one of which was how were we going to convince people to join/use our intervention system? We had to find out an individual's Internet usage level and convince them (based on the findings) that they may be experiencing Internet addictive behaviours.

By doing a literature review (in Chapter 2) on Internet addiction and related addictive problems, we found that many researchers have adopted the 20-items Internet addiction test (IAT) developed by Young (1998) to assess and determine a user's level of Internet addiction. We first carried out an initial analysis of Young's 20 items test. Our results found that these questions cover different degrees of how excessive Internet usage affects four main social aspects of the users, which are work and productivity, family and relationships, health and moods, and addictive behaviours.

In our research, we adopted Young's 20 items Internet addiction test as an online screening questionnaire to give our respondents a general idea of their level of Internet usage. The fact that Young did not design his 20-question Internet addiction test in the same order as their focus area might have made it difficult for the respondents to follow and understand the questions. Therefore, in our test, we reorganized the questions to make it easier for the respondents to follow and understand them, based on the four main focus groups found during the test questions analysis (Read more in section 4.2.2). Each questionnaire is answered using the following scale: 1 - Rarely;

2 - Occasionally; 3 - Frequently; 4 - Often; 5 - Always. The final score can range from 20 to 100 points. A higher score indicates higher Internet usage and potential Internet addiction. Participants- with a score higher than 40 points can be categorized as a medium to heavy Internet user and is recommended to join our Internet addiction intervention programme.

1.4.2 Custom Browser

We designed and developed a new fully functional web browser known as SustainMe browser, or as S browser for short, using Visual Basics programming language as an answer to one of our research problems. Besides having the main functionalities of a web browser, such as surfing the webs and watching online videos, the new browser is also specifically designed with a usage monitoring function that can calculate the user's internet data usage and online access duration.

In addition, information such as today's date, the user's real-time Internet usage and user identification (ID) number is displayed on the browser (next to the address bar) and will be automatically saved to our intervention database when the browser is closed. The data usage and access duration are stored in the database in kilobytes and minutes respectively.

1.4.3 Notification System (involving next of kin)

Our system database is developed using MySQL, which is further integrated with a Yii (PHP based) framework and an interactive JavaScript chart¹. Its main functions include analysing the data obtained from the S browser installed on the participant's computer, and initiating the appropriate processes based on the conditions and algorithms pre-set in the system, such as changing the users' intervention stages and statuses and updating

¹via http://www.highcharts.com/

the users' usage graphs. The database web application is also programmed to link to Simple Mail Transfer Protocol (SMTP)² and SMS Gateway³ to create a feedback and notification channels between our system, the participants and their next of kin (or their consultant). The participants and their next of kin will receive notifications in the form of emails and text messages informing them whether the participant is spending too much time online, engaging in high Internet usage or recording normal Internet usage.

Our proposed approach functions as one intelligent system that can monitor the user's online usage; send information to the database for storing and evaluation and lastly send out results and notifications to the user and the other stakeholders involved.

1.5 Limitations

As a recently emerging disorder, Internet addiction still has room for exploration and research. Our Internet addiction intervention system went through recurring development phases before all of its three mains aspects (monitoring, analysing, informing) were fully discovered and programmed to work smoothly with one another to produce a complete functional system. Nevertheless, different limitations, assumptions and conditions have to be considered and put in place to facilitate the overall system development and operation.

Firstly, the system is web browser based, which means the user must use our browser when participating in our Internet addiction intervention programme. We assume that a web browser is the most frequent tool for Internet access, the one where most online activities are carried out. In addition, Internet usage accessed outside our web browser, such as computer windows upgrades, third party downloading software, online gaming (via its standalone software) and Internet access from other mobile devices are not

²Yii framework SMTP extension

³via www.smsglobal.com

accounted for in our system.

Secondly, we use the 20-item questionnaire Internet addiction test (IAT) developed by Young as a tool to assess our participants, then classify them into three Internet user categories – normal, medium and heavy user. The numeric results of these questionnaires are then used to recommend and convince the test respondent to join our programme. Although it is the most frequently used tool for its purpose, the IAT has its limitations, one of which is that in most cases it can only be used as a short screening test for a small-scale population survey (Škařupová, Ólafsson & Blinka, 2015). Secondly, many users might question the accuracy and reliability of the results of these questionnaires.

Thirdly, the MySQL database we developed was built with a simple architectural designs and structure to serve as a working system model for this research. It is not equipped for advanced performance, nor does it have the security capability to accommodate large data and complex functionality. Therefore, if this system is to be used in a real life scenario, it will need further improvements and developments in many areas.

Lastly, the system is lacking testing and validation by actual Internet addiction patients, due to time constraints and the fact that the focus of this research is more about the concept and building development.



1.6 Thesis Structure

Figure 1.1: Thesis Structure

Our thesis research structure is depicted in Figure 1.1. Chapter 1 presents a general overview of Internet addiction; the thoughts and motivations behind this research; research problem statements; contributions; and also an explanations of certain limitations on the system design.

In Chapter 2, some aspects of Internet addiction are explored and described in detail. It is essential to have a basic understanding of the term "Internet Addition". The chapter goes on to give an explanation of different aspects of Internet Addiction based on the different viewpoints and outcomes from a variety of previous studies. Definitions of Internet addiction are also given and factors that affect Internet addiction are elaborated on. These two aspects are very important as they help to clarify some doubts and increase the researcher's comprehension about the main focus of this research. The Internet Addiction assessment tools have also became one of the focus areas in the literature review. One tool, the IAT, proved to be useful and became one of the main parts of the system design and development in Chapter 4. Towards the end of the chapter, addiction prevention and mediation strategies along with related articles on Internet addiction are summarized and discussed. After a thorough analysis of the literature, a potential research gap in the area of Internet addiction was identified, which assisted the constructs and developments of the research methodology in Chapter 3.

In Chapter 3, in-depth discussion of the methodology used for this research is carried out, which is known as the Multi-Methodological Approach. This integrated approach consists of four main research strategies - observation, theory building, experimentation and system development.

In Chapter 4, different components of the system's architecture and development are discussed in great details. The earlier part of the chapter focuses on the system's design. Details of the intervention systems are introduced and discussed. The remaining seven sections examine the system architecture, which is made up of the Internet addiction test (IAT), the custom web browser, the SustainMe system, the system web application, feedback/notifications, the intervention timeline and the future expansion of the system.

Chapter 5 elaborates on the user's experience of the system. There are two different user groups in our system, administrative users and participating users, and each user group possesses different roles and access rights to our system.

Chapter 6 contains a discussion of the whole system, covering two main aspects of the system the psychological aspects and the technical aspects.

Lastly, Chapter 7 sums up the overall achievements and overviews of the system developed in this research and the possibilities for future research in this area.

Chapter 2

Literature Review

2.1 Definition of Internet Addiction

The term Internet Addiction (IA) has been introduced to refer to the excessive and uncontrolled online activity with prolonged Internet use, especially on specific onlineapplications such as social networking, online-gaming, and pornography sites (Müller et al., 2016). To date, there has yet to be any universally accepted definition of Internet Addiction (IA). Many researchers describe and define IA differently. Some have described it as Compulsive Internet Use (Meerkerk, Van Den Eijnden, Vermulst & Garretsen, 2009), Behavioural addiction (Al Sheibani, 2015), Internet Addiction Disorder (Salicetia, 2015), Pathological Internet Use (Kuss, Van Rooij, Shorter, Griffiths & van de Mheen, 2013) and Internet 'dependence' (Lortie & Guitton, 2013). Some researchers simply refer to it as the excessive use of the Internet on diverse online activities such as online gaming, pornography, instant messaging, information acquisition, and social media. Mobile applications on mobile phones and tablets (Zochil, 2015) are also included. Similarly, as Lortie and Guitton explain, Internet addictive symptoms include losing control over Internet use and spending an excessive amount of time online; meaning that people want to spend time online more often and longer than needed and as a result, there is an increasing social isolation in the real world.



Figure 2.1: Types of Internet Addiction

Figure 2.1 shows six specific types of Internet Addiction that have been categorised accord with the American Centre for Online Addiction (Salicetia, 2015).

Kuss et al. (2013) further elaborates the meaning of Internet Addiction by looking at the symptoms in users such as:

- Loss of control over their behaviours.
- A conflict between the internal and interpersonal aspects of the users.
- The users' increasing preoccupation with the Internet.
- The use of the Internet to modify moods.
- Symptoms of withdrawal from the offline (external) environment.

2.2 Factors Affecting Internet Addiction

Factor	:1	Necessity to stay online
Factor	: 2	Ease of access of the Internet
Factor	r 3	Entertainment purposes
Factor	: 4	Use Internet as a way to express oneself
Factor	: 5	Use Internet to modify moods
Factor	: 6	Use Internet to isolate oneself

Figure 2.2: Factors affecting Internet Addiction

Figure 2.2 describes six main factors affecting Internet Addiction. The research findings by Ling, Ramadass, Altaher and Arjuman (2011) indicate that although factors affecting Internet use maybe be different for some people, there are some common factors found that can help to explain why many people choose to spend more time

online. First is the desire for a user's to stay online for school or work related purposes. Secondly, the ease of access to the Internet from places such as homes, schools and offices, and in public places such as Internet cafés, coffee shops, libraries, has allowed more and more people to access the Internet anytime, anywhere. This convenience means many people will engage more with the Internet and may become addicted without knowing it. The findings also suggest that there exists a strong motive for users to stay connected online for longer periods and one of the main motives is for the purpose of entertainment, especially when people have leisure time. Others may view the Internet as a way to express themselves and also to modify their moods. However, some people also use the Internet to isolate themselves or prevent themselves from having to communicate face-to-face with other people.

2.3 Internet Addiction Assessment Tools

By the end of 2014, forty-five tools assessing Internet addiction had been developed, but many face inherent challenges, such as insufficient psychometric validations and properties, rare usage, or being used in and supported by only one study (Laconi, Rodgers & Chabrol, 2014). A few tools have been of great interest to many addiction researchers and have been reused and modified many times. This section lists some of the most commonly used assessment tools for IA.

2.3.1 Internet Addiction Test (IAT)

Format: 20-item Questionnaire

The most common tool that many researchers have adopted to determine the levels of Internet addiction is the Internet Addiction Test (IAT). The IAT is a widely known tool that helps to assess many symptoms of the users' Internet Addiction. The results can be very helpful in determining the seriousness of problem but it is not a suitable tool for use in a large-scale population survey. In most cases, however, it can be used as a short screening test (Škařupová et al., 2015).

IAT, which was developed by Young (1998), is one of the most well-used diagnostic tools for Internet addiction. It consists of a 20-item questionnaire designed to measure users' psychological dependence, compulsive use of the Internet, withdrawal from the outside world and other related problems associated with an excessive use of the Internet. Young has classified the questions into five categories: academic; relationships; financial; occupational and physical. The respondents are required to rate each question on a five-point Likert scale, ranging from 1 (rarely) to 5 (always). The questionnaire covers the degree to which excessive Internet usage affects different aspects of the users lives, such as daily routines, social life, work productivity, eating, sleeping and feelings (Widyanto & McMurran, 2004). The test scores ranges from 20 (minimum) to 100 (maximum); the higher the score the higher level of Internet addiction. Those who have a score of 20-39 points are considered average or minimal Internet users who seem to have complete control over their Internet usage; a score of 40-69 is regarded as moderate, where users may experience occasional or frequent problems due to their Internet use; and a score of 70-100 denotes the excessive users who tend to have significant problems associated with their over dependence on the Internet (Karim & Nigar, 2014).

2.3.2 Compulsive Internet Use Scale (CIUS)

Format: 14-item Questionnaire

A person with compulsive Internet use, abbreviated to CIU, is regarded as someone who is incapable of controlling his or her online activities. CIU has five main characteristics: (1) Inability to stop using the Internet despite the intention to stop; (2) The Internet use has power and influence over the user's cognition and behaviour; (3) The user experiences unpleasant emotions when unable to access to the Internet; (4) The

Internet is used as a way to escape from negative feelings or emotions, and (5) Internet use can cause disputes and conflict with others or with oneself (Van der Aa et al., 2009).

In order to assess the severity of CIU, the compulsive Internet use scale (CIUS) was developed in 2009 (Meerkerk et al., 2009). It contains 14 items in a questionnaire with a 5-point Likert scale - 0, never; 1, seldom; 2, sometimes; 3, often; and 4, very often.

CIUS assesses five core elements of compulsive behaviours in relation to Internet use such as loss of control, preoccupation, conflict, withdrawal symptoms, and coping. It is known for its briefness and ease of use and hence these factors allow the test to be used with other measures. It has a contribution for many aspects of future research examining compulsive Internet use (Wartberg, Petersen, Kammerl, Rosenkranz & Thomasius, 2014).

2.3.3 Korean Scale for Internet Addiction (K-Scale)

Format: 20-item Questionnaire

South Korea was the first country in the world to establish national laws and systems to address the problem of Internet addiction. As part of their effort to tackle the problem, the Korean government developed the evaluation and diagnostic scale for Internet addiction known as the K-Scale (Korean Scale) (Koh, 2015).

The K-Scale was initially developed and introduced into middle and high schools across South Korea as a screening for addictive Internet users (D. Kim, Chung, Lee, Kim & Cho, 2008). It was later used in schools and professional counselling centres to diagnose Internet addicts.

The scale consists of 20 questions that measure seven factors, including positive anticipation, withdrawal symptoms, tolerance, virtual interpersonal relationship, deviant behaviours and disturbance of adaptive functions (Heo, Oh, Subramanian, Kim & Kawachi, 2014). The severity of the effects of the Internet is measured by the response

range, from 20 to 80 points, from 1, never, to 4, always yes.

2.3.4 Assessment for Internet and Computer Gaming Addiction Scale (AICA-S)

Format: 16-item Self-Reporting Questionnaire

The self-reporting assessment for Internet and computer addiction (AICA-S), was designed to measure the components of Internet addiction such as salience, withdrawal, tolerance, mood modification, relapse, and conflict (Wölfling, Müller & Beutel, 2010). This diagnostic tool is used in clinical settings and the response is based on the 5-point Likert scale, ranging from 0 (never) to 4 (very often) for the first 15 questions. The last question is about the presence of problems as a result of excessive or addictive Internet use and it is scored from 0.5 (if one problem is present) to 3 (if six or more problems are present).

2.3.5 Quick Big Five Personality Test (QBF)

Format: 30-item Questionnaire

According to Kraut et al. (2002), people with different personality traits tend to have different ways of using the Internet. In other words, some personality traits are closely related to Internet usage behaviours.

The Quick Big Five (QBF) is a shorter version of the original 100 item Goldberg's Big Five questionnaires, which was developed in 1992 (Goldberg, 1992). It is used to assess personality traits that can predict a variety of concepts and behaviours of a person in different situations (Vermulst & Gerris, 2005), and is based on five dimensions of personality. These are emotional stability, extra-version, agreeableness, conscientiousness and openness (H. J. Kim, Shin & Swanger, 2009).

The scale consists of a 30-item questionnaire (i.e., 6 items for each of the 5 personality traits). The response is based on a 7-point Likert scale, which ranges from 1 = completely incorrect to 7 = completely correct. A high score on each personality traits indicates a high level of that personality dimension (Van der Aa et al., 2009).

2.4 Addiction Prevention and Mediation Strategies

Regardless of what types of research methods or tools are used in the papers about Internet Addiction, they always focus on some if not all of the following steps (Lim, Bae & Kim, 2004):

- Identify the pattern of symptoms of Internet Addiction.
- Investigate the situation or causes that lead to Internet Addiction.
- Make a plan or prevention procedure to deal with Internet Addiction.

Below are some of the prevention and mediation strategies designed to solved the problems of Internet or related addictions.

2.4.1 Preventive Educational Materials

Lim et al. (2004) introduced a learning model that aims to address Internet Addiction in schools. His paper follows all the steps mentioned above and develops "preventive education materials" for students to increase their awareness about the negative consequences of Internet Addiction, helping them to develop self-control.

The material is composed of three modules, with each module presented and explained to the students by their class teacher. The diagnostic module allows the students to evaluate the degree of addiction by themselves, and the preventive activities module encourages each student to keep track of and share plans, records and the evaluation of their own Internet addiction preventive measures with other students.

2.4.2 Video-Based Intervention

Another study, by Turel, Mouttapa and Donato (2015) employs a video-based intervention that aims to change the Internet users' attitude towards their excessive Internet use. The aim of the intervention is to expose the viewers to the threat of Internet Addiction and show ways to deal with it. A survey is also given to students as soon as they have seen the videos to capture their instant feedback and reactions. This video, when shown together with the surveys, has proved to be effective, at least in the short run, because its informative and surprising contents about Internet Addiction have caught the viewers' attention and made them rethink their Internet routines.

2.4.3 Physical Education

Some researchers believe that physical education such as sports can act as an intervention at all levels of the Internet Addiction mechanism. It is believed that sports can bring psychological benefits that improve our cognitive behaviours, social interaction, biological and mental health. A study by Liao (2011) found that sports is a useful intervention in dealing with Internet addiction, and that students who play sport have a lower risk of it than other students. Similarly, (Liu & Dan, 2009) found that some physical unconscious needs can be met by doing some sport or exercise training.

2.4.4 Psychological Mediation

While Internet Addiction has not been officially recognized as a psychiatric disorder, much research and many studies recommend that those with a high-risk of Internet Addiction should see a doctor or another mental health professional to deal with it psychologically (Karim & Nigar, 2014). A study by Xiuqin et al. (2010) also found that mental symptoms and some personality traits such as introversion and psychoticism often occur simultaneously with IAD. Therefore, in order to effectively tackle the problem of Internet addiction, psychological mediation has to be gradually implemented and treated as part of the whole intervention process.

2.4.5 Parental Mediation

Parental mediation is described as the strategies employed by parents that aim to alleviate negative media effects on their children (Clark, 2011). Such media effects can be mediated by parents' efforts in monitoring and supervising their children's media consumption (Mesch, 2009). Parental mediation is considered as a form of parental socialization (Youn, 2008).

There are three forms of parental mediation strategies: active mediation, restrictive mediation and co-using. In active mediation, parents play an important role by talking to their children and engaging in discussion with them about appropriate media use. In restrictive mediation, however, parents set rules and regulations to control their children's media consumption. In co-using, parents aim to increase their children's awareness and educate them about media use via sharing the media experience with them (Shin, 2015).

2.4.6 Internet Network Mechanism Intervention

Little is known about ICT-based solutions or prevention techniques that can stop people from spending too much time on the Internet. An Internet network mechanism created by Weijia and Wenyong (2013) is amongst the very few ICT-based solutions to Internet Addiction. His approach consists of an Internet Addiction Control Database System, an Addiction to Online Assessment Service and a Host Sub System of the three parts. Basically, this system provides online assessment services of Internet addiction, manages all Internet usage and controls the users' online behaviours. This has proved to be an effective system in monitoring and preventing Internet Addictive behaviours. However, its limitation is that the system is only ideal for use at a controlled location, such as school or work place.

2.4.7 MobileCoach Intervention

MobileCoach is an open source behavioural intervention platform for fully automatic digital intervention. It was developed in Zürich, Switzerland and is designed to monitor behavioural states and trigger transition states to achieve the final intervention goals (Filler et al., 2015).



Figure 2.3: MobileCoach System Architecture

Figure 2.3 shows the overall system architecture of MobileCoach. It employs the concepts of web application for the purpose of online feedback and managementa and text messages in the form of the short message service (SMS) as the main mode of intervention. The intervention development and management are carried out via the web application of the MobileCoach server. Emails and SMS are sent from the server to the intervention participants via online SMS and email gateways services.

This intervention platform has so far been used mainly in Switzerland to address addiction problems in young people, such as smoking and excessive alcohol consumption (Haug, 2013; Haug, Schaub, Venzin, Meyer, John & Gmel, 2013; Haug et al., 2014).

2.5 Internet Addiction Related Articles

Table 2.1 lists and explains recent studies about Internet (or related) addiction. These studies provide some useful and interesting findings in relation to smartphone and social networking addiction and to less well-known but still effective Internet addiction assessment tools and additional addiction prevention and mediation strategies. The table shows information such as key authors, the method used, the study focus and the main findings of each study.

Authors	Methods	Focus	Findings
(Kuss, Shorter, Van Rooij, van de Mheen &	Questionnaire	Personal traits associ- ated with Internet addic- tion.	Some factors are found to be associated with an increased risk of Internet addiction, in- cluding personality traits.
Griffiths, 2014)			Factors such as low agreeable- ness and low emotional stabil- ity are found to be associated with Internet addiction com- ponent factors. This suggests that an addictive personality may increase the risk for In- ternet addiction via the pres- ence/absence of certain per- sonality traits.

Table 2.1: Recent Related Studies for Internet Addiction.

Authors	Methods	Focus	Findings
(Lee, Lee & Lee, 2016)	Online Survey	Smartphone addiction. The effectiveness of me- diation strategies.	Frequent use of social net- working site applications (apps), game apps, and video apps tend to exacerbate adolescent addiction to smartphones.
			Parental restriction tends to in- crease the likelihood of smart- phone addiction.
			Addiction prevention pro- grammes implemented in schools did not have any impact on preventing addiction.
(Munno et al., 2017)	Self-report ques- tionnaire	Personality differ- ences between ad- olescents with prob- lematic/pathological Internet use and those with normal Internet use.	IAT scores indicates some stu- dents have experienced prob- lematic Internet use and some have had Internet addiction.
			Schizophrenia and bizarre mental states are closely associated with problem- atic/pathological Internet use.
			Being male, attending voca- tional schools and an unhappy childhood are found to be risk factors for Internet addiction.

Table 2.1 – *Continued from previous page*

Authors	Methods	Focus	Findings
(Jelenchick et al., 2015)	Survey	Problematic and Risky Internet Use Screening Scale (PRIUSS).	PRIUSS has proved to be a valid screening instrument for problem Internet use (PIU) for adolescents and young adults. This screening process may also help to pinpoint those with a high corresponding risk for other mental health condi- tions.
(Andrisano et al., 2016)	Pre-experimental research design model.	Internet Addiction Action-Research Intervention.	There is a decrease in Internet addiction behaviours in both male and female participating groups observed in the lower score of post Internet addic- tion tests scores.

Table 2.1 – *Continued from previous page*

Authors	Methods	Focus	Findings
(Li et al., 2016)	Questionnaire	The mediating role of psychological needs sat- isfaction and coping style.	Stressful life events are posit- ively associated with Internet addiction.
			Positive coping skills are neg- atively associated with Inter- net addiction Psychological needs satisfaction is negat- ively associated to Internet ad- diction.
			Lower levels of stressful life events are associated with a lower level of psychological needs satisfaction.
			In other words, psychological needs satisfaction in adoles- cents brings about a relation- ship between stressful life events and Internet addiction.

Table 2.1 – *Continued from previous page*
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Authors	Methods	Focus	Findings
(Al-Gamal, Alzayyat & Ahmad, 2016)	Questionnaire	To measure the pre- valence of Internet ad- diction and its asso- ciation with psycholo- gical distress and cop- ing strategies among university students in Jordan.	Internet addiction was found in 40% of the participating stu- dents.
,			Students with a high level of mental distress were more likely to experience a high level of Internet addiction.
			Students with problem solving skills were less likely to exper- ience high level of Internet ad- diction.
			Students who use avoidance as a coping strategy were more likely to experience a higher level of Internet addic- tion.

Table 2.1 – Continued from previous page

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Authors Methods Focus		Findings			
(Błachnio & Prze- piorka, 2016)	Questionnaire	Are personality and pos- itive orientation linked to Internet and Face- book addition?	High level of Internet addic- tion is related to low level of positive orientation.		
/			People with a high level of Internet addiction possessed lower levels of consciousness, agreeableness, emotional sta- bility, and openness to experi- ence.		
			Facebook and Internet ad- dicts have some similarities in terms of personality traits and positive orientation.		
			Problematic use of Facebook and Internet is related to lower positive orientation, conscien- tiousness, emotional stability, and openness to experience.		

Table 2.1 – *Continued from previous page*

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Authors	Methods	Focus	Findings
(Khazaei, Khazaei & Ghanbari- H, 2017)	Face-to-face inter- views with therap- ist. Questionnaire	To evaluate the efficacy of positive psychology intervention in Internet addiction treatment.	Group-based positive psycho- logical intervention reduces the amount of Internet use in those with Internet addiction. Group-based positive psycho- logical intervention improves social adjustment of people with Internet addiction which consequently leads to im- proved mental health. The designed psychological intervention has proven to be effective in reducing the Inter- net addiction rate.
(Yao et al., 2017)	Face-to-face ther- apy. Meditation	The effects of group be- havioural intervention; therapy and mindful- ness meditation in redu- cing decisional impuls- ivity in young adults with Internet gaming disorder.	There is a sign of greater inter- temporal and risky decisional impulsivity amongst Internet gaming addicts. The Internet gaming addicts show lower levels of delay discounting rate and Internet gaming disorder severity after the intervention programme.

Table 2.1 – Continued from previous page

Kuss et al.'s (2014) study has reasonable sample sizes in their participating groups. It also produces a reliable result as the outcome of the adaptation of a variety of questionnaires on two different age groups (11-19 years and 18 - 64 years). Despite the differences in the questionnaires and age groups, the results show similarity in the personality traits associated with Internet addiction and also indicate some unique personal traits that are found only in the specific group.

Lee et al.'s (2016) paper provides good background information and discussion about smartphone addiction, mobile application use and mobile phone addiction mediation strategies. The results obtained have been through multiple regression analysis using SPSS software. Therefore, the results/findings obtained are quite comprehensive and reliable.

Munno et al.'s (2017) study uses two different questionnaires to obtain different information from the participants – an Internet addiction test to discover the participant's Internet addiction behaviours and its impacts; MMPI-A to investigate aspects such as temperament, reasoning, personality characteristics, adaptation styles and psychopathological manifestations. The two results are then evaluated using the Mann-Whitney test. This increases the credibility and accuracy of the findings.

The Problematic and Risky Internet Use Screening Scale (PRIUSS) in Jelenchick et al.'s (2015) study has 18 items and 3 subscales, which focus on three areas such as social impairment, emotional impairment and risky/impulsive Internet use. Statistical analyses were performed by SAS software on the results while validation was carried out on PRIUSS' internal consistency reliability of the three subscales (structural validity) and the scale's construct. The results shows that PRIUSS has been well analysed and constructed to become a valid screening instrument for PIU.

Andrisano et al.'s (2016) paper shows that the action-research intervention implemented was successful in addressing Internet addiction. The intervention was in the form of face to face interactions via a peer education programme. This method has proved to be effective judging from the lower Internet addition test score at the end of their programme. Also, the fact that the test results were analysed using a paired t-test helped to give more reliability and credibility to the findings in this paper.

Li et al.'s (2016) study uses a series of questionnaires to measure and assess different data and variables. The results have gone through a statistical analysis process before being further validated and compared with some national statistical data and literature reviews. Therefore, the results and findings in this paper can be regarded as wellassessed and of high credibility.

The design and methods used in Al-Gamal et al.'s (2016) study were conducted at six universities in central Jordan. This increases the credibility of the generalization of the results. Even though the questionnaires are in Arabic, they underwent a rigorous translation process to make sure that these questionnaires were valid and reliable prior to being used. The data was also analyzed using the IBM SPSS, which ensures the results and findings are comprehensive and credible.

Błachnio and Przepiorka's (2016) paper tends to treat Internet and Facebook addiction as one identity trait, based on the fact that all participants were required to be both Internet and Facebook users to take part in the study. Two studies were conducted with two different focuses – the first study focused on Internet usage addiction whereas the second study focus on Facebook usage addiction. The results are therefore known to be credible and reliable to a large extent.

Khazaei et al.'s (2017) paper has a good focus in that it aims to prove the effect of an individual/group-based treatment method in improving the Internet addicts' positive emotions and social relationships. However, one of the main limitations in this paper is the small 48 students experimental group, which raises concerns about the credibility and accuracy of its findings.

Yao et al.'s (2017) paper has a small experimental group of less than 50 people. The study encourages face-to-face interaction and social activities among a group of Internet gaming addicts and successfully achieves its goal of reducing the Internet gaming addicts' decisional impulsive behaviours.

The findings are the results of a comparison between two experimental groups (one with an Internet gaming disorder and the other with no symptoms of IGD). Therefore the findings are straight forward but meaningful despite coming from a small group.

By analysing the IA literature, we have identified a potential area t focus our research

on. There are still limited studies and research on an ICT-based solution to Internet Addiction. Regardless of the conditions or causes that lead us to be addicted to the Internet, or whether or not we now consider ourselves normal or excessive Internet users, there is still a need for a preventive solution to this new kind of addiction.

Chapter 3

Methodology

Research methodology incorporates many aspects such as the process, methods and tools that will be used when conducting research. The nature of this study is based on behavioural monitoring, which involves - a range of variables and dependencies, from the early screening stage to the end of the intervention process.

A Multi-Methodological Approach has been adopted in this study, due to the series of iterative implementations and testings involved. This methodology involves observation, theory building, experimentation, and system development. In addition, a total of eight research phases were conducted through two iterations to achieve the final system development concepts and design.



Figure 3.1: Multi Methodological Approach adapted from (Nunamaker Jr, Chen & Purdin, 1990)

Further details on activities at each iteration and phase are summarized in Tables 3.1 and 3.2 below.

Research	Methodology	Conclusive Results	
Phase	Phase		
1	Observation	Internet addiction is an emerging disorder.	
		Most studies on Internet addiction treatment involve psychological intervention. There are no ICT-based systems designed specifically to deal with Internet addiction.	
		IAT is a useful test to identify the different types of Internet user.	
2	Theory Building	Internet addiction is an emerging addiction disorde that can have affect social, academical and menta effects.	
		There must be a convincing reason or motivation to attract people to participate in an Internet Addiction intervention programme.	
		Internet addicts have to be monitored and notified from time to time with the help of ICT.	
		The intervention time-line should be long enough to produce evidence of usage fluctuations and improve- ments.	
		Appropriate Internet usage values and details should be defined for future comparison and analysis.	
		The participants/users should be notified and informed from time to time.	

Table 3.1: Research Phases (First Iteration)

Continued on next page

Research	Methodology	Conclusive Results	
Phase	Phase		
3	Experimentation	Learn from experiences from smoking and drink- ing intervention programme in Switzerland, the Mo- bileCoach behavioural intervention platform(Haug, Schaub, Venzin, Meyer & John, 2013; Haug, 2013).	
4	System Development	Adapt an open source solution from MobileCoach ¹ and use as simulation system for our Internet addiction intervention programme.	
		The simulated system addresses some research doubts and questions about the intervention system, how to register and impose intervention procedures.	
5	Observation	There are ways to measure Internet usage from web browsers.	
		There are also productivity software/applications that can record how much time we spend on different activ- ities on our computers (including Internet access).	

 Table 3.1 – Continued from previous page

Research	Methodology	Conclusive Results
Phase	Phase	
6	Experimentation	After research phase 5 from the first iteration of our re- search phase, two computer software experiments were used and tested. One was integrated at the browser level and the other is the fully functional software op- erating at the computer hardware and application level. (Read more in section 3.3)

Research	Methodology	Conclusive Results	
Phase	Phase		
7	Theory Building	The results of the experiment in research phase 6 have provided some ideas and concepts to calculate duration of use and actual usage in our proposed system when a person starts surfing the Internet.	
8	System Develop- ment	MySQL database to store usage data. Custom web browser to monitor Internet usage. Notification system that can notify and feedback to users via text messages and emails.	

 Table 3.2 – Continued from previous page

3.1 Observation

Observation is an essential stage in understanding and obtaining general ideas and in gathering information about what can be included in a study. Methodologies such as case studies, literature reviews and sample surveys can be used to help researchers formulate hypotheses. These hypotheses can be tested at the experimentation stage or used to provide generalizations about specific research topics or areas.

Internet addiction is still considered a new field of study. It has not attracted significant attention from researchers. Many studies focus on finding out the symptoms of Internet addiction (Jang, Hwang & Choi, 2008); the different types of Internet addiction (Müller et al., 2016); its behavioural patterns and risks (Mak et al., 2014), and on designing an assessment tool for Internet addiction (Lortie & Guitton, 2013). There are also studies that aim to define what Internet addiction is and how categorize it as a new type of disorder (Internet Addiction Disorder). Despite differences in these

studies in terms of their focus and expected outcomes, one thing they have in common are their sources of information. The majority of these studies obtained their results from surveys and questionnaires.

The literature review in Chapter 2 presented Internet Addiction from multiple perspectives and also identified assumptions about Internet addiction and its treatment. It is also at this observation stage that potential system ideas and concepts are identified.

3.2 Theory Building

This phase involves the development of new concepts and ideas. The conceptual frameworks, methods and models (e.g., mathematical models, simulation models, and data models), are also constructed and formed at this stage of the development cycle. Theories are generally related to generic system behaviours and subjected to thorough assessments and analysis. This process emphasizes generalization and the outcome often produces limited potential insights and impacts on practical applications. However, theories can suggest meaningful hypotheses and guide system experiment designs and observation processes (Nunamaker Jr et al., 1990).

In this study, all the concepts and ideas were brainstormed and finalized based on many initial doubts and questions. These questions are categorized into five different 'Wh' and one 'H' types of questions as below:

<u>Who</u>

- Who is our target group?
- Who are the stakeholders for this intervention system?
- Who will benefit from this system?

What

- What is Internet addiction?
- What are the technological and programming requirements to create a system that can address the problem of Internet Addiction?
- What are the things that we can do to help those with an Internet addiction problem?
- What types of interventions can we implement into the system?

Where

- Where is the Internet usage data obtained from?
- Where is the Internet usage data stored?

When

- When do we start?
- When do we stop?

Why

- Why is it important to tackle the problem of Internet addiction?
- Why would people be interested to join/use our system?

How

- How do we know if we are addicted to the Internet?
- How do we know how much Internet usage is too much?
- How do we check and monitor Internet usage?
- How do we retrieve and save Internet usage from the users?

- How do we evaluate that data?
- How do we track the records and create a visualization of that data?
- How do we convince people to join/use our system?
- How do we send notifications/warnings to the users/participants?
- How long is the intervention?

After generating these questions, we went back to explore and analyze the literature review in the previous chapter to look for answers to these doubts and questions. Our answers to some of these questions follow:

Who - Our target group is mainly adolescents and working adults who tend to spend a great deal of time online and who might experience occasional Internet addictive problems as a result.

What - Answers to some of the questions in this category can be found in the literature reviews in Chapter 2, including definitions of Internet addiction and types of intervention and mediation strategies.

Why - The literature review does not provide information or answers as to why it is important to tackle the problem of Internet addiction. It does however show what Internet addiction is and how it can affect different aspects of our daily lives.

How - We have learnt from the literature review that Internet addiction levels can be assessed using a variety of questionnaires, and the results of these questionnaires, such as IAT, can be used to convince people to join our system. We also learned that an intervention database can be employed to store and analyze the system data. Mobile phones and emails can also be used to receive notifications/warnings for the participants.

At the end of this theory building stage, our conclusions were:.

- Internet addiction is an emerging disorder that can affect many individuals socially and academically (Mei, Yau, Chai, Guo & Potenza, 2016) and mentally (Yoo, Cho & Cha, 2014).
- There has to be a convincing reason or motivation to attract people to participate in our programme (Young, 2004).
- Internet addicts have to be monitored and notified from time to time with the help of ICT (Weijia & Wenyong, 2013).
- The intervention timeline should be long enough to produce evidence of usage fluctuations and improvements.
- Internet usage analytics should be reviewed for future comparison and analysis (see the experimentation section for more details).

3.3 Experimentation

Experimentation includes research strategies and computer and experimental simulations. This development phase is carried out to validate the theories (discovered in the Theory Building section) and to discover technological requirements.

The diagramme in Figure 3.1 shows that experimentation is located in between theory building and system development. This is because experimentation is guided by the theories that were defined at an earlier stage, which were facilitated by the system development. The results obtained at this stage are useful in validating and refining theories and also improving the system development.

At the end of theory building phase, some useful theories were formed. Those questions and theories have shown and revealed the two main variables we have to take note of when dealing with Internet addiction monitoring and intervention. These variables are 'Duration' and 'Usage Amount'. Duration refers to the amount of time the user spends online surfing the Internet. Usage amount on the other hand, refers to the Internet data usage in terms of Kilobites per second (Kbps) or Megabit per second (Mbps).

In order to discover the level of a problem and how to deal with it, it is important to develop a system that can calculate and record both the duration and Internet usage amount when a person starts surfing the Internet.

To achieve this goal in our system development stage, two experimentations were carried out to explore the systems and architecture for our research. The first experiment was done using Google Chrome a web browser. It was selected for its popularity and the variety of plug-in supports and features. In this experiment we have tested in-built and lesser known features of the Google Chrome web browser, which is 'Monitor Web Bandwidth Usage²'. This feature, when accessed and run on the browser, enables the user to see the bandwidth usage details of that particular session. Figure 3.2 shows the web interface of the feature while it is in operation.

²http://osxdaily.com/2013/07/05/monitor-web-bandwidth-usage-easily-with-chrome/



Figure 3.2: Google Chrome Bandwidth Monitoring add on

The feature is accessed by typing the following command to the address bar on the browser.

chrome://net-internals/#bandwidth

This feature records a real-time Internet usage of a particular session and the data can be viewed in the Bandwidth Usage table. The value is known as Received and it is calculated and recorded in terms of Kilobit. This is a very useful feature to monitor and calculate the Internet usage amount.

In the second experiment, a software called 'RescueTime'³ was installed and used. It is a productivity software that monitors how long the user is on a computer. This software focuses on finding out how long (in minutes) the user spends on different activities on the computer. It not only tracks how long the user spends on any particular

³https://www.rescuetime.com/

computer application, such as Microsoft Office or Adobe Reader or photo editing tools installed on the computer, it also can be integrated to the web browser installed on that computer and track the user's duration on all the websites accessed using that web browser. Figure 3.3 shows what the software data statistics looks like.



Figure 3.3: RescueTime Analytics

RescueTime runs in the background and tracks time spent on applications and websites and, at the end of the day, it gives us detailed reports and data based on our daily computer usage. It also contains notification features that we can set up so we can be notified and be aware of when we spent a certain amount of time on a computer. Another useful thing that this time-management software does is to tell us, based on the software or websites that we use on our computer, how much of the time we spend are productive or are in being distracted. In the end, this experiment unveils one of the ways in which how we can monitor and measure Internet usage duration.

The two experiments proved to be very beneficial for designing the SustainMe system development.

3.4 System Development

In the software development cycle, the system development consisted of five stages (Nunamaker Jr et al., 1990), which are as follows:

- Concept design
- System architecture construction
- Prototyping
- System or product development
- Technology transfer

The development phase started with the adaptation of technological and theoretic concepts into real practical applications, before transforming it into a feasible proof-of-concept. The next step was the system or product development. For the software development project, the technology transfer was required to handover and deliver that technology or product to the organization or project owner.

In the context of this study, system development is regarded as the stage where all theories, outcomes of experiments and observations are put together to create a complete working system. Here we decided to adapt some of the stages mentioned above to suit the purpose and structure of our study such as concept design, system architecture construction, and prototyping and product development.

Concept Design

The adaptation and amalgamation of theories from the theory building stage, combined with the outcome of experimentation and observations, led to the concept design of the intervention system. The general concept of the system is to be able to monitor, measure and visualise the user's Internet usage. This information is then saved into an online database (more in section 4.4), which gives further information about processing and analysis. At some point, the proposed system should send out notifications to the users to update and/or warn them of their Internet usage situation.

System architecture construction

Having achieved some clear concept designs, the next step was to construct the system architecture. We had so far translated theories into practical concepts, so it was time to use these concepts to design the actual system.

Figure 3.4 depicts the high level process of the system architecture construction. The diagramme shows how each essential process is linked to the development of each part of the system. The web browser has the ability to monitor and measure Internet usage from the participant. The MySQL database is used for data storage, data processing and data analysis. Finally the system sends alerts to the user's mobile phone via a short message service (SMS) and also to the participant's email account.



Figure 3.4: System Architecture High level Process

Prototyping & Product Development

After the system concept design and the architecture construction process, we obtained a feasible proof-of-concept (OC) of the Internet intervention system. Based on the POC, we prototyped and developed three main products for this study - the custom web browser, the database and the notification system.

All three products were designed and developed separately due to the differences in requirements and functionalities. The custom web browser was developed to equip special features (more in section 4.3), using the Visual Basics programming language. It is known as the S browser. The database was developed using MySQL to serve as an online data storage and analyst. To allow the system to send text messages and emails to participants, we have to integrate the system with online SMS and SMTP gateway services (Read more in section 4.5).

Chapter 4

System Design and Development

Through the iterative methodological processes described in the previous chapter, some logical system concepts and designs were discovered. This chapter focuses on the development and transforming of those concepts into one complete functional system.



Figure 4.1: Chapter Structure

The overview of the chapter structure is shown in Figure 4.1. There are eight sections in this chapter, which represent different aspects of the system development framework, such as the system design, the Internet addiction test, the custom web browser, the SustainMe system, the SustainMe management web application, feedbacks or notifications, the intervention programme timeline and possible future work. Details of each part will be elaborated and explained throughout the eight sections in this chapter.

4.1 System Design



Figure 4.2: SustainMe Concept

Figure 4.2 above illustrates the high level concepts of SustainMe. We named this system SustainMe which means Sustainability Moderation Expert-Kin.

The word 'Sustainability' in this context refers to:

- The sustainable design of the system that not only the system is developed for long term use by supporting future growth and expansion, it also requires no complex or advanced knowledge or skills to install, manage and perform the work.
- The real-time availability and sustainable use of resources, such as an online database, a mobile phone and a desktop or laptop computer needed to join the intervention program.

Moderation refers to the aims of this proposed system, which include:

- Empowering individuals to learn about their own Internet usage behaviours in the least restrictive way as possible.
- Promoting self-control and self-discipline with regard to excessive Internet usage.

Lastly, 'Expert-Kin' represents additional stakeholders in the system who enable the intervention programme to be more productive and supportive. These stakeholders can be addiction experts or other professional such as psychologists, mental health professionals, counseling groups at schools or at workplaces. They can also be the patient's kin who would like to join the programme and be part of the intervention process.

SustainMe has three main stages: discussion with addiction consultants and/or with the patient's family to set up plans and rules; monitoring the patient's Internet use via a custom web browser installed on his/her computer, and sending feedbacks and notifications to the patient, his/her consultant or family via emails and text messages.

In stage 1 of the SustainMe system, an addiction consultant or a counselor such as psychologist, mental health professional, counseling groups at schools or at workplaces become part of this Internet addiction intervention programme to consult with the participants and their family. The participants can request their group of kin to be part of the monitoring programme to discuss their addiction problem. The goal is to set up plans and rules to be followed and achieved throughout the whole intervention period.

Stage 2 represents the Internet addiction monitoring phase. We developed and used a custom web browser for this monitoring purpose. The custom web browser is programmed to act as a tool to detect and sense the patient's Internet usage by calculating the user's Internet download data and also the amount of time (in minutes) he or she spends online. This information is sent to the SustainMe database for storage and analysis every time the custom browser is closed.

In the final stage, a cloud server-based database system is developed. This database

is design to store and analyze all the data and send pre-defined text messages to the participants. Upon analyzing the patient's usage data, the system will send out notifications and warning messages to all the stakeholders of the system – the patient (or participant) and his or her next of kin group and the consultant or counsellor via text messages and emails.

The processes of consultation, monitoring, analyzing, and providing feedback throughout the 3 stages will be carried out iteratively until the end of the intervention programme or until performance goals are accomplished.



Figure 4.3: SustainMe System Functionality

The functional sequence of the system with SustainMe acting as the central process, is shown in Figure 4.3. First we have to recruit potential candidates and one way to attract and convince people to join the programme is by using the Internet addiction test developed by Young (1998). The numeric results obtained from the 20 questions

suggests to the test respondents what type of Internet user they are and whether they need help with their Internet usage management. The respondents who would like to join the programme can do so by clicking on the 'Register' button at the end of the Internet addiction test and then completing our online registration form (Read more in Section 4.2.4).

After their successful registration, the participants will have to agree to install and only use the custom web browser (the S Browser) to access the Internet on their computer and to allow their Internet use to be monitored.

Figure 4.3 presents the functional sequences of the SustainMe system. First, we introduce a recruitment process and use a 20-question online Internet addiction test to categorize the test respondents into three different types of Internet users (average, medium and heavy). We also recommend whether they should join the intervention programme based on their total test score. Secondly, we propose the development of the IoT sensor device in the future expansion phase of the SustainMe system due to the time and skills limitations available to develop such a device.

More details on each system functionality will be discussed separately throughout this chapter.

4.2 Internet Addiction Test



Figure 4.4: Recruitment Process

IAT is used as a screening test as part of the recruitment process shown in Figure 4.4. It is in the form of an online webpage that the participants can access anywhere and anytime they want.

4.2.1 Purpose

Young (1998) developed the IAT to measure Internet use and score the users' addiction as mild, moderate and severe. The definition and the assessment procedures of Internet addiction still remain controversial, but Young's Internet addiction test questionnaires have become one of the most frequently used measurement scales to detect the level of Internet addiction.

We have adapted Young's 20-item Internet addiction test in our research (see Appendix A for the complete list of the 20 questions). These questionnaires are used as a screening test to discover the person's level of addiction. The results of the test can make the respondents aware of their Internet usage status and the possible consequences. The test can also be used to motivate and attract people to join an Internet addiction intervention programme, if their test results suggest they need an intervention.

4.2.2 Design

Before we used the 20-question IAT as a screening test for our paper, we decided to analyse the questions one by one, aiming to point out the areas that they cover and whether those areas were sufficient to draw a conclusion about the respondents' Internet addictive behaviours.



Figure 4.5: Internet Addiction Test Questions Analysis

Figure 4.5 shows the results of our analysis of the original 20-question Internet addiction test designed by Young(1998). We analysed key words and meanings in each question and used that to categorise them into different focus areas. The results showed that the questions were designed with four main focus areas: work and productivity; family and relationships; addictive behaviours, and health and moods. We found four questions (Q2, Q6, Q7, Q8) were designed to test how and to what extent the respondents' work and productivity was affected by his or her Internet use. Another four questions (Q3, Q4, Q5, Q19) aimed to find out whether the respondents' preoccupation with the Internet had a negative impact on their relationships with their family and loved ones. There were also questions that focused on aspects of health and moods. Six questions (Q9, Q10, Q12, Q13, Q14, Q20), relate to health and the mental wellbeing of the respondents. They are intended to explore the correlation between Internet use and changes in the health and state of mind of the respondents. The remaining six questions (Q1, Q11, Q15, Q16, Q17, Q18), can be linked to signs of addictive behaviours in relation to prolonged Internet use.

Through discovering these four main focus areas, we were able to link them to the consequences that result from Internet addiction - psychological, social, academic and work difficulties (Brand, Young & Laier, 2014). We therefore decided to use this set of questions as our online screening test to identify the respondents' level of Internet use.

4.2.3 Implementation

After adopting Young's 20-item questionnaire, we incorporated the questions into an interactive web page we developed using PHP (See Appendix B), to provide easy access and participation options for any interested party. The page serves as an online screening test and a recommendation tool to attract participants to our intervention programme.

The respondents to the questionnaire are required to rate each question on a fivepoint Likert scale, ranging from 1 (rarely), to 5 (always). These questions cover different degrees about how excessive Internet usage affects different aspects of lives of Internet users. The scores of the test range from 20 (the minimum) to 100 (the maximum), where the higher score represents a higher level of Internet addiction.

A score of between 20 and 39 indicates that the respondents are 'Average' Internet users and that they have control over their Internet usage and are free to decide whether to join the SustainMe intervention programme.

The 40 to 69 points scores are regarded as 'Medium' Internet users. These scores suggest that the participants might experience occasional or frequent problems as a consequence of their addictive Internet use. Therefore, they are encouraged to join the programme.

The upper score range is between 70 and 100 points. Those who obtain a score within this range are the excessive or 'Heavy' Internet users who tend to have significant problems associated with their over dependence on the Internet. This group of people is strongly encouraged to join the programme.

4.2.4 Usage

The Internet addiction test is used as part of the SustainMe recruitment process. Anyone who is interested in the programme will be contacted and the system is built in a way that enables it to send a link to the webpage where users have access to the IAT and are able to get their results instantly.



Figure 4.6: SustainMe Recruitment Process Flowchart

Figure 4.6 shows a flowchart that explains the steps involved in the SustainMe recruitment process. First the participants have to complete the 20 question Internet addiction test on our IAT webpage¹. Upon clicking the submit button at the end of the page, the participants' test results and recommendation messages are shown. If they are interested and decide to join the programme, they will then be directed to the SustainMe registration page². On the registration page (See Apendix C), the participants are asked to input their personal details for administrative purposes, which concludes the recruitment process.

¹addictiontest.php

²register.php

4.3 Custom Web Browser (S Browser)



Figure 4.7: S Browser

Figure 4.7 shows a simple workflow structure of the new custom web browser, the S browser. The browser is specially programmed to be able to detect and send information such as Internet usage, date access, the duration and the user ID to the online SustainMe system. Each time the participants close the browser at the end of their online sessions, all those variables will be automatically saved for further analysis and evaluation.

4.3.1 Purpose

The main objective of our research is to develop a system that can manage Internet addiction disorder, and to manage it we need to find a way to check and measure Internet usage from the participants' workstations.

We believe restricting and terminating (temporarily) Internet access is not an appropriate way to address an Internet addiction problem. We believe the participants should use the Internet when needed to, so we developed the S browser to manage Internet addiction disorder by measuring the participants' Internet behaviour and usage (via the S browser) from time to time while sending warnings and notification messages (via email and text messages) to help them be aware of their Internet use and to develop self-control to tackle this problem in the long run.

We did not use existing browsers, such as Firefox and Google Chrome, in our system because by having our own web browser, we can have full control of the browser and the participants will not be able to make or install any changes to the browser that might affect the Internet usage monitoring process. It also makes managing and implementing additional features (such as the Internet usage calculator and user log in) to the browser easier.

4.3.2 Design

We choose to develop a web browser instead of a standalone monitoring software in our research because web browsers are one of the most frequently used tools by which people have accessed the Internet in recently. Even though the Internet can be accessed from mobile applications on portable devices and wifi-enabled televisions, we still believe most people carry out their online activities through web browsers.

Another reason is that we want to obtain only the amount of Internet data usage of the participants. In other word, using a web browser as an Internet monitoring tool helps to eliminate irrelevant data uses such as occasional updates by the operating system or from software installed on their computers.

Figure 4.8 shows the design and the look of the new custom web browser known as the 'S browser'.

SBrowser				-	٥	×
File Edit Options User						
https://www.google.co.nz/?gws_rd=ssl	👚 🔪 Today's Date: 2017/03/05	User ID: 1	Usage Data	a: 94.59 KB		
Google						
Google+ Search Images Maps Play YouTube News Gmail More) •	<u>.</u>	l .		Sign i	in 🗱
	S New Zealand					
	TYON ZOURING					
	Google Search I'm Feeling Lucky					
	Google.co.nz offered in: Maori					
Advertising Business About			Privacy	Terms	Settin	gs

Figure 4.8: S Browser Design

The first step in our custom web browser is to show the necessary components or features that a normal browser should have, such as a browser name, a browser icon, a menu bar, a location bar and common buttons (e.g. Back, Forward, Search/Go, Home, Refresh). The next step involves ensuring that all the components and functions are linked and work properly, and most importantly our browser can display text and multimedia content, like reading news articles on the CNN website or watching videos on YouTube. After fulfilling all these standard requirements, special functions can then be programmed and added to the browser.

We used a Visual Basic programming language in the design and development of our web browser. One major benefit of using Visual basic is it allows us to use a graphic user interface (GUI) to choose and modify preselected sections of our codes while developing the product.

The final and most crucial step in our web browser design process was to design additional functions that help to address our research questions and achieve our goal of managing Internet addiction disorder. In order to do that we brainstormed and tested and the results are summarised in Table 4.1 below. In the table, functions required to address some of our research problems are listed in the first column, with modules developed in response to each research problems shown and explained in the second column (See Appendix D).

Additional Functions	Products Developed	
Identify the user	Every user has to log in on the browser with their User ID (provided to them) on their first time use.	
Calculate/measure the Internet data usage	The browser is programmed to be able to start the Internet download usage calculator once the browser is started and calculate the total usage value once the user quits the browser.Today's Date: 2017/03/05User ID: 1Usage Data: 105.33 KB	
Information to be meas- ured and recorded	Usage Data (kbps): the total Internet download usage. Duration (minute): The amount of time the user spends on that session. Time Usage: The date the user starts browsing online. User ID: The identification number to identify the user on our database.	
Where and when the in- formation is saved?	Once the browser is terminated. The information is finalized and sent to SustainMe database. (more details in section 4.4)	

4.3.3 Implementation

The implementation of S Browser is done once the participant completed SustainMe recruitment process (See Figure 4.6). Once the database received the participant personal details from our registration web page, each participant will then be assigned a unique user identification (ID) number. An email containing the user identification (ID) number, a link to download the 'S Browser' and the browser installation and user guide is then sent to each participant. Before installing the browser, the participant will have to take note that the S Browser is designed to work only on computer running Microsoft Windows operating system.

4.3.4 Usage

As a strict requirement, participants have to install and only use our S browser on their computer for accessing the Internet. Once the browser is successfully installed, first thing that the participants have to do is to log in with the user identification (ID) number provided to them. Figure 4.9 shows how this can be done on the web browser on their first use.


Figure 4.9: User Login Process in S Browser

Step 1 – The participant clicks on 'User' on the menu bar and clicks 'Log in'. This is only done once on their first use.

Step 2 – In the pop up window named 'User Log in', the participant input his or her user identification (ID) number assigned and sent to them by email and click 'Log In'.

Step 3 – The participant accesses websites on the browser as desired and they view their usage, access date and user ID number displaying on the browser.

Step 4 – When the participant finishes his or her online access and closes the browser, all the information regarding the user's usage, duration, date and ID will be automatically sent to an online database for storage and evaluation.

4.4 SustainMe System



Figure 4.10: SustainMe System

SustainMe system acts as a core operating component of our intervention program. As shown in Figure 4.10, it is where all the data are stored, analysed and produced into graphical format and also where all the customs notification messages are generated and sent to the users.

4.4.1 Purpose

The purpose of building this system is mainly to serve as a central storage for all the data for easy accessibility and management. The system sits in the centre of the communication channels between all the components of the system – the browser, web pages, SMTP and SMS gateways. Conditional algorithms (See Figure 4.14) are added to the database to allow it to analyse the Internet usage data by monitoring the usage changes over time and trigger the right notification emails and text messages and send them the users.

4.4.2 Design and Implementation

We develop SustainMe database system using MySQL because MySQL is a free, opensource database management system (DBMS) which support database management web applications. Furthermore, MYSQL can be easily installed and set up on Linux, Unix or Windows environments. MySQL workbench is another reason why we choose MySQL for our database system. This tool enables us to visually design, model, generate, and manage our database. It also enables us to transform the designs and structures of our database into an entity relationship diagram (ERD) for easy understanding and management of the database.



Figure 4.11: Entity Relationship Diagram (ERD).

The first step in our database development is to create an entity relationship diagram or ERD. Figure 4.11 above shows the designer view of the ERD that consists of 9 tables illustrating the logical structure of the SustainMe system database. These tables represent all types of data collected and saved into the database such as the users' Internet addiction test results and registration information obtained during our recruitment process, Internet data usage details recorded and sent to the database from our S browser installed on the user computer. Additionally, other information such as client status, monitoring status, text and email messages are manually inserted into the database.

ERD Tables	Descriptions					
	This table stores all personal and statuses details of					
	every user in SustainMe system.					
	id = This is a unique userid (for log into S browser)					
	<pre>client_name = first name</pre>					
1	<pre>client_surname = last name</pre>					
client_info	dob = date of birth					
id : int(11)	tel = telephone number					
client_name : varchar(45)	email = email address					
client_surname : varchar(45)	password = preferred password to be used to log into					
dob : date	SustainMe web application address = address enroll_date = date in which the user registered to join					
tel : varchar(45)						
email : varchar(45)						
password : varchar(300)						
address : varchar(45)	our program					
enroll_date : date	<pre>client_status_id = Set to Stage 1 as default (registra-</pre>					
client status id · int (11)	tion stage) (see client_status table for more details of					
monitoring status id : int (11)	all available 4 statuses)					
montofing_status_id . Int (11)	<pre>monitoring_status_id = the user is initially assigned</pre>					
user_1d : varchar(45)	as active status (see monitoring_status table for more					
excess : tinyint (1)	details of all available 3 statuses)					
	user_id = This is a unique userid (for log into our					
	web application). The new user is initially assigned a					
	value of '0' indicating that the user is new user and the					
	system admin will then generate a new value (user id)					
	for each user later.					

Table 4.2: Entity Relationship Diagram.

ERD Tables	Descriptions				
	This table represents all the 4 stages in SustainMe				
client_status id : int(11) client_status_name : varchar(45) description : varchar(45)	<pre>system. id = a unique sequence number generated within the table client_status_name = Stage 1,2,3,4 description = Registration, Initialization, Monitoring, Assessment</pre>				
	This table represents all the 3 user monitoring statuses in SustainMe system. id = a unique sequence number generated within the				
monitoring_status	table				
id : int(11)	monitoring_status_name = Active, Suspended,				
monitoring_status_name :	Inactive				
varchar(45)	description = User is undergoing a monitoring				
description : varchar(45)	program (if Active)				
	User is temporarily suspended (if Suspended) User is no longer active in SustainMe system (If Inactive)				

Table 4.2 – Continued from previous page

ERD Tables	Descriptions				
	This table stores the Internet usage information				
	obtained from S browser installed on each user's				
	computer.				
	id = a unique sequence number generated within the				
data usage	table				
id : int(11)	time_usage = the date the user accesses the Internet				
time usage : date	from the S browser				
size : vereber(200)	size = the amount of download data (in Megabyte) the				
dete type id : int(11)	user uses in that session				
data_type_id . int(11)	date_type_id = the type of data obtained from the				
chent_hho_hd : hh(11)	user's computer. At this stage it is assigned as a				
duration : varchar(300)	download data usage				
	<pre>client_info_id = a unique user identification number</pre>				
	assigned to every user				
	duration = the amount of time (in minutes) the user				
	spends on that particular online session				
	This table represents types of data usage. At this				
	stage there is only one type of data which is the total				
datatype	download data				
id : int(11)	$\mathbf{d} = \mathbf{a}$ unique sequence number generated within the				
data_type_name : varchar(45)	a = a unique sequence number generated within the				
description : varchar(45)					
	data_type_name = lotal Data Usage				
	description = Total Download Data				

Table 4.2 – Continued from previous page

ERD Tables	Descriptions			
	This table stores test results of everyone who takes our			
test_results	online Internet Addiction Test (IAT).			
id : int(11)	id = a unique sequence number generated within the			
total_score : int(11)	table			
first_name : varchar(45)	total_score = total test score (out of 100)			
last_name : varchar(45)	<pre>first_name = the test taker's first name</pre>			
	last_name = the test taker's last name			
email_to_client id : int(11) date_sent : date email_message_id : int(11) client_info_id : int(11)	This table stores records of notification emails previously sent to users. id = a unique sequence number generated within the table date_scent = the date the email was sent email_message_id = 1,2 (see email_messages table for more information) client_info_id = a unique user identification number assigned to every user (to identify the receiver of each sent email)			

TT 1 1 1 0	a . 1	C	•	
Table 4.2 $-$	Continued	trom	previous	nage
14010 112	comment	<i>J</i> . <i>Oi</i>	prerious	page.

ERD Tables	Descriptions				
	These are two types of custom email messages				
	stored on SustainMe database (to be sent to users as				
	notification emails.				
	id = 1,2				
amail massagas	email_title = Normal Usage (if id = 1)				
id : int(11)	High Usage (if $id = 2$)				
Id : III((11)	email_detail = Your Internet usage is in a 'Normal'				
email_dute: varchar(45)	range. You can continue surfing the Internet as usual				
eman_detan : varchar(300)	(if id = 1)				
	Your Internet usage is in a 'High' range. Your Internet				
	usage might cause significant problems in your life.				
	Please consider its consequences and try to spend				
	more time offline (if $id = 2$)				
	This table stores manual of tout masses an invite				
	This table stores records of text messages previously				
	sent to users.				
message to client	id = a unique sequence number generated within the				
id : int(11)	table				
date send : date	date_scend = the date the text message was sent				
massaga id : int(11)	email_message_id = 1,2 (see messages table for				
aliont info id : int(11)	more information)				
chem_hho_id . hh(11)	<pre>client_info_id = a unique user identification number</pre>				
	assigned to every user (to identify the receiver of each				
	sent text message)				

TT 1 1 1 A	a . 1	C	•	
Table 4.2 $-$	Continued	trom	previous	nage
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ERD Tables	Descriptions				
	These are two types of custom text messages stored				
	on the SustainMe database (to be sent to users as				
	notification mobile text messages.				
	id = 1,2				
	message_name = Normal Usage (if id = 1)				
messages	High Usage (if $id = 2$)				
id : int(11)	message_detail = Your Internet usage is in a 'Normal				
message_name : varchar(45)	range. You can continue surfing the Internet as usual				
message_detail : varchar(300)	(if id = 1)				
description : varchar(300)	Your Internet usage is in a 'High' range and it might				
	cause significant problems in your life. Please				
	consider its consequences and spend less time online.				
	(if id = 2)				
	description = Normal Usage (if id = 1)				
	High Usage (if $id = 2$)				

Table 4.2 – *Continued from previous page*

Table 4.2 provides extended explanations and descriptions of entities in our database.

4.5 SustainMe Management Web Application using Yii Framework

The Yii framework has made the SustainMe system database more user-friendly for both system users and administrator. By integrating this PHP-based framework to our database, we were able to generate a web application for the SustainMe system. Figure 4.12 illustrates how the Yii framework was used to transform the tables in the SustainMe system database into an interactive web application.



Figure 4.12: SustainMe System Web Application

Through this web access platform, users can log in to view their data usage summary graph and the system administrator can view and manage all the information and activities on a neat and simple-looking web interface that can be accessed from anywhere via a web browser.

Yii is a high-performance PHP framework, known for its applications in web applications and APIs development. We decided to use this framework to develop our database web interface because it is a free, open-source Web application development framework. It is written in PHP language and has many useful extensions that facilitate further development and the expansion of functionalities and features to the system. In the context of our research, the Yii framework allows us to connect our database to an SMTP mail server and an online SMS gateway service to send out notification messages to the users' Gmail and mobile phone. All that can be done and managed from our database web application interface (more details can be found in our feedback/notification section).

4.5.1 Usage

There are two main types of database users in our research – the system administrator and the system users (participants). The system users log in to the database using their account information via our database web application to view their Internet usage monitoring graphs. The administrator has all the database administrative accesses and privileges.



Figure 4.13: SustainMe System Usage Diagram

Figure 4.13 shows a diagramme that explains how both the system administrator and the participant use and interact with the database.

Most of the interactions and usages happen between the database and the system administrator. As demonstrated in Figure 4.13, the system administrator has administrative accesses and the right to request, modify and initialize data and functions stored on the database. This includes users' authorization requests, system data changes, notification initialization and summary report monitoring and access. The participant, on the other hand, only has limited interactions with the database. less than two main scenarios that the database interacts with and responds to can engage with the participant's action. One is when the participant goes through the recruitment process and completes our online Internet addiction test and/or registration form. At this stage, the system or the database receives and stores all the information obtained from the two web pages. As another form of confirmation, the system also sends a confirmation email to the user, welcoming them to SustainMe system and explaining the terms and details of SustainMe. It also provides them with their user identification (ID) and downloads links to our S browser. The other time that the participant accesses or uses the system is when he/she logs into our web application page to check and view their Internet usage graphs.

4.6 Feedback/Notifications



Figure 4.14: Feedback/Notification Flowchart

The last core component of our final design is the feedback/notification system. A flowchart of the steps and conditions involved in the feedback/notification process is

shown in Figure 4.14.

The flowchart diagramme shows that our notification system requires two types of input data (daily Internet data usage and daily Internet duration usage) to be checked under three conditions, in order to produce and send out three types of notification messages as the final step.

First, the users' daily Internet data usage and Internet duration usage are obtained from the S browser that has been installed on the participant's computer.

If the participant's daily Internet duration usage value is more than 10 hours (or 600 minutes) the system will send notification messages informing the participant that he/she has spent too much time online on that day and that he/she should consider reducing the time they spend online.

If the participant's daily Internet duration usage is less than 10 hours but his or her daily Internet data usage is more than 5GB, the system will evaluate the situation regarding high Internet usage and inform the participant of the situation, while recommending him/her to spend his/her Internet time wisely and productively.

If the daily Internet duration usage is less than 10 hours and the daily Internet data usage is also less than 5GB, the participant will be notified and categorised as having a normal daily Internet usage and will not need to join the Internet addiction intervention programme.

4.6.1 Purpose

Feedback, or notification, is an essential part of our system. The main objective of this function is not only to inform the participants of their Internet usage monitoring status but also to make them aware and think about their online behaviour and how it might affect their lives and the people around them as they go through our intervention programme. We have also extended this notification system to send out emails or text

messages to the participants' next of kin or counselor (who might want to be part of the feedback or notification process).

We believe our proposed feedback/notification system will trigger some psychological thinking (or changes) that will help to increase the participants' self-awareness and control about their preoccupation with the Internet and therefore SustainMe system as a whole will gradually improve their Internet addiction behaviours in the long run.

4.6.2 Design and Implementation

Smartphones and computers are without doubt the two most popular devices to get online. They are becoming an inseparable part of our lives because of their role as a central hub of information and communication to fulfil our needs at work, school or for other purposes. Because of this, we decided that the best way to get our feedback and notification messages across to the participants and their next of kin would be via emails and text messages (containing the same monitoring status and notification details), which can be accessed anywhere, anytime from smartphones or computers. These email and short message services are widely available and accessible (free of charge) as long as the participants and their next of kin have a valid email address and a working SIM card.

With those prerequisites fulfilled, we introduced some changes to the SustainMe system web application to facilitate the sending of the notifications in the form of emails and text messages. With the Yii framework integrated to the SustainMe system, we are able to send notification emails to the participant via google Gmail (using SMTP Mail extension³) and text messages to the participant's mobile phone (using online SMS gateway service⁴) as shown in Figure 4.15.

³on http://www.yiiframework.com/extension/smtp-mail/

⁴on www.smsglobal.com



Figure 4.15: Feedback/Notification System

As it is a new system, the SustainMe system still lacks advanced functionalities such as automatic scheduling and sending of notification messages. These tasks have to be done manually by the system administrator, whose main responsibility is to closely monitor and manage all the activities in the system, including sending out notification messages to the participants.

This is a very important step in our intervention programme as the information or warning sent can have a great psychological impact on the participant's Internet addictive behaviours. Notification messages will be sent to the participant's and his/her next of kin's email addresses and phone numbers provided by the participant on their online registration form.

Week	Description	Stage	Stage Description		
1	Online Internet Addiction Test; Install a browser on the user computer	1	Registration		
2	Start Intervention	2	Initialization		
3	Monitoring	3	Monitoring		
4	Intervention; Send updates and alerts				
5	Situation Assessment, Send online survey				
6	Monitoring				
7	Program Summary	4	Assessment		
8	End of Program				

4.7 Intervention Timeline

Figure 4.16: Internet Addiction Intervention Programme Timeline.

Figure 4.16 depicts a detailed timeline for the SustainMe Internet addiction intervention programme. It explains the duration and stages involved in our intervention. It is an 8-week intervention programme categorised into four main stages.

Stage 1 is the Registration stage. In this first stage, the participants have to complete our online Internet addiction test and complete our online registration form (if they want to join our programme). They will receive a confirmation email detailing information about SustainMe system, their user indemnification (ID) number and their account details (which will be used to log into our system), and a download link of our S browser.

Stage 2 is the 'Initialization stage. This is the second week of the intervention and it is when the participants have successfully installed and begun using our S browser on their computer.

Stage 3 of our intervention is the Monitoring stage. This stage covers a long period, four weeks (week three to week six). The main activities that occur in this stage are Internet usage monitoring, Internet usage analysis, sending feedbacks/notifications and/or situation assessment via online survey/emails.

The last two weeks of our intervention focus on the overall assessment of the participants' Internet usage behaviours based on the data collected throughout the past six weeks. The assessment results are then summarised and emailed to the participants and their next of kin (if any).

4.8 Future Work using IoT

The current SustainMe design has proved to be a complete functional system in itself. However, there is a great potential for future improvements and expansion of the system design. As a result, we plan to develop an Internet of Things (IoT) sensor device to accommodate and support voice message notifications in the future expansion phase of our research.

We incorporated IoT technology in our system because we believe that with the right tools and knowledge, IoT technology can be used to develop a kind of device that can act as an Internet sensor and become an innovative tool with promising possibilities. These include Wi-Fi connection capability, sending and receiving voice messages as a form of notification or warning.

This IoT device, once equipped with Wi-Fi connectivity and voice messaging support, could be used as a type of communication device if it can be successfully engineered. Having no physical screen will however make the device less attractive to use, as in turn it helps its users become less addicted to the Internet because they spend less time on a mobile device when they are only required to use this device in lieu of their normal smartphone while undergoing the Internet addiction intervention programme.

Not only can the programme be used to sense Internet connectivity, we believe it can gradually become something of the future that we can use to meet our simple telecommunication needs, such as calling and messaging without being distracted by other things we see on our normal computer and smart devices every day. As a result, it can play a big role in helping us to spend less time online and hence becoming less addicted to the Internet.



Figure 4.17: SustainMe Future Expansion



designed and developed for the future expansion of the SustainMe system. It will be a simple looking device without a screen; equipped with Wi-Fi connectivity features and also able to send and receive voice messages to and from the SustainMe system.

The two directional arrows in the diagramme indicate two ways to communicate between the IoT device and the SustainMe system. The device can receive voice messages/notifications from the system and users can also send their responses (in the same voice message form) to the SustainMe system for real-time interaction and intervention.

Chapter 5

User Experience

The earlier sections explained in detail how the components of each system were developed, implemented and used. This section will focus on how the system operations work as a whole and discuss how our actual system works and what types of users are involved.

The main interaction between the users and the SustainMe system occurs via the online web application. This client-server software application transforms and arranges information in our database into more manageable and user-friendly online interfaces. Different users have restricted access to certain functions and information when using this online web interface, depending on their roles and responsibilities in the system. There are two main types of system users in our intervention programme - the system administrator and the normal users (participants).

5.1 Administrative Users

As mentioned earlier, most interactions and usages happen between the SustainMe system and the system administrator. With full administrative authority and accessibility, the system administrator is in charge of the routine running and managing of the entire system.



Figure 5.1: System Web Application Walk-Through Diagramme

Figure 5.1 shows the web application walk-through diagramme of all the tasks and responsibilities the administrative user (administrator) has to perform and monitor in our system via our Internet addiction intervention programme web application platform.

When logging in with an administrative account, the system administrator first comes across an 'Admin Menu' tab on the page, which when clicked unveils the list of the 12 main web pages in the SustainMe web application. Each page is linked to its respective table in our online database for real-time updates and management. They are also given the same names as our database tables for easy referencing and monitoring.

Here is the list of all 12 main pages:

- Screening Test Results
- Client Information
- Client Management
- Client Status

- Monitoring Status
- Text Messages
- Email Messages
- Data Type
- Sent Text Messages
- Sent Emails
- Data Usage
- User

5.1.1 Test Results

This page displays records of all the test results obtained from our online Internet addiction screening test (IAT), which is stored in the 'test_results' table in our database.

Internet Addiction I	ntervention Program	ו (IAIP) 🔺 Home ס	Admin menu 👻		
Home / Test Results / M	anage				
Manage TestResu	lts				Operations IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
Q Advanced Search	 First Name 	Last Name	Displa Total Score	ying 1-3 of 3 results. ↓	
1	John	Grey	42	• 🖍 📋	
2	Seng	Souligna	80	♥ ≠ 前	
2 3	Seng Bryan	Souligna Adam	80 28	● / î ● / î	
3	Seng Bryan	Souligna Adam	80 28	© / î ⊙ / î	

Figure 5.2: Test Results Web Page

As shown in Figure 5.2, this is a list of all the IAT takers and their test results (score out of 100). In the list we have the test taker's first name, last name and total score. It is

a simple page serving the purpose of recording and displaying the details of the IAT taker and their score for future referencing.

👁 🖍 🛍

Figure 5.3: Editing Features

On the page to the right of the 'Total Score' column, there are three options available - view, update, delete (as shown in Figure 5.3). As the names suggest, the 'view' feature simply displays details of that particular record in a new page, which is separated from the rest of the records. All records can also be updated or changed (in any of the fields) with the 'update' feature. Lastly, the administrator is allowed to delete any or all the records by clicking on the 'delete' feature icon.



Figure 5.4: Filtering Features

There is also a filtering feature, which allows the administrator to look for specific record/s based on the four categories available, such as ID, First Name, Last Name and Total Score. All he or she has to do is type a filtering value in any empty box under each of the four category titles (shown in Figure 5.4) and click enter.

All records can be rearranged and sorted in numeric or alphabetic order (based on the properties of each column). This is achieved by moving the cursor to the far right of each column and clicking on the small arrow that appears, (for example as a small arrow that is shown on the right of the 'Total Score' title shown in Figure 5.4).

In addition, the administrator can also create a new record (with manual input data) by clicking on the 'Create TestResults' operation icon on the top right of the page.

5.1.2 Client Information

The second item listed in the 'Admin menu' tab is a link to the page 'Client Information'. This page is one of the most important of all the pages, as it has the detailed records of all the people (participants) undergoing our Internet addiction intervention programme. It is here that the system administrator is not only able to see all the participants' personal details, but also is able to monitor their Internet usage status.

On this page, in addition to viewing the users' information, we show that the administrator has other roles such as: updating the users' personal information, changing or updating the users' client, monitoring and excess status from time to time based on the conditions set for each field.

Inte	ernet Ad	diction I	nterventio	on Program	ı (IAIP) 🖬 Home	Admin							
Но	ome / Clien	t Infos / Ma	inage										
Ma	nage C	lientInfo	s									Operat I≣ List	ions ClientInfos
٩	Advanced	Search										+ Crea	ate ClientInfo
										Displaying 1-	8 of 8 re	esults.	
ID	Client Name	<u>Client</u> Surname	Dob	Tel	Email	User Id	Address	Enroll Date	Client Status	Monitoring Status	Exces	s	
									•	•			
1	Seng	Souligna	16/02/1983	64273869860	ss.souligna@gmail.com	1	Auckland	2017- 03-04	Stage 1	Active	Yes	0 🔪	
2	Mike	Dan	18/02/1984	64235689752	kasz27@gmail.com	12	Wellington	2017- 03-04	Stage 1	Active	No	• /	
3	Doris	Lee	13/03/1979	64238965231	ss.souligna@gmail.com	3	Napier	2017- 03-04	Stage 1	Active	Yes	•	
4	Mark	Starky	16/03/1984	64273869860	ss.souligna@gmail.com	0	Melbourne	2017- 03-04	Stage 1	Active	No	* *	

Figure 5.5: Client Information Web Page

Figure 5.5 shows a screen-shot of the client information web page. Here we can see records of all the clients (participants). Each record contains information about the client (participant), such as an ID number, first name, last name, date of birth, telephone, email address, user id, enrolment/registration date, what stage they are at, their monitoring status and whether they are currently having excessive Internet use. The ID number that has been auto generated in the very first field of the user's information record on

this page is sent to its designated user by an email. Each user has to use this unique ID number to log in to the S browser on his or her first use.

In addition, the user id field (which is different from the ID field mentioned earlier) is by default set to be '0', (this is to identify this record as a new registered user and its value will be reassigned/changed by the system administrator later on). Their client status is set to 'Stage 1'; monitoring status set to be 'Active' and their excess value is set to 'No', (meaning they are currently not experiencing excessive Internet use). These values are manually changed by the administrator from time to time (see the client information management section for more details). The administrator can also change the user's monitoring status to be active, suspended or inactive, in accord with the current situation of the user in our system. The meaning of each monitoring status is explained in Figure 5.6 below. An other important thing that the system administrator does is monitoring the users' data usage and changing the value of 'Excess' from 0 (means No) to 1 (Yes) when the user is exceeding his or her daily intended usage (5GB of data and 10 hours of usage online). With the right value of 'Excess' status (Yes or No), our system can send the correct notification/warning messages/emails to the user.

Internet Addiction Interver	tion Program (IAIP)	Home 🔹 Admin menu 👻		Welcome seng 👻
Home / Monitoring Statuses / Man	age			
Manage MonitoringStatu	ses			Operations ■ List MonitoringStatuses
Q Advanced Search				Create MonitoringStatus
		Displaying	1-3 of 3 results.	
ID	Monitoring Status Name	Description		
1	Active	User is undergoing a monitoring program	● 🖊 📋	
2	Suspended	User is temporarily suspended	● ∕ 📋	
3	Inactive	User is no longer active in our system	♥ /	

Figure 5.6: Monitoring status Web Page

In terms of functionality, the common features, such as updating, deleting, sorting,

filtering and creating new records are also available on this page, allowing the administrator to carry out those basic tasks when needed.



Figure 5.7: View Graph Feature

However, what is special about this page is the feature embedded into the view icon (as shown in Figure 5.7). When the view icon is clicked, the administrator is redirected to a new page containing two graphic diagrammes which represent the user's Internet usage details to date.



Figure 5.8: User's Graphic Usage Diagrammes

Figure 5.8 shows, in graphics, an example of two Internet usage diagrammes for a user Seng Souligna. These graphs represent the total Internet usage, both in terms of download size and access duration.

Auto-generated, the usage data obtained from the S browser installed on each participant's computer, becomes an important graphic documentation that allows the users to visualize his or her usage from time to time, which could also help a third party (such as next of kin or an addiction counsellor) to monitor the participant online.

The two graphs correlate to each other. One shows the total data usage size of the user on a particular day, while the other tells us the total amount of time that particular person spent online on the same day.

The graph in Figure 5.8 shows the Internet download data usage line graph. From the graph, we can see the participant's Internet data usage (in MB) on a specific date. The x axis represents the date the Internet access took place, while the y-axis represents the amount of Internet (download) data usage. As the user spends more time online using our S browser, we are able to easily see the changing usage trend in the graph.

The second graph is in the form of a bar chart. The graph makes use of the bar-like property to distinguish itself from the data usage graph. With this distinctive look, the administrator and the user can easily tell the two graphs apart and comprehend the results with ease. In the second bar chart graph, each bar represents the total amount of time (in minutes) the user spent online on a specific day. The x-axis shows the dates the user spent time online. This is the same as the dates shown in the earlier data usage graphs.

There is also a section at the bottom of the page that displays the detailed information about the user (whose these graphical results belong to).

This graphic page can be accessed by the administrator by clicking on the view icon (Figure 5.7), which is positioned towards to right in each user's record on the 'Client Information' page. Participants, however, have to log into our system with the provided username and password to be able to access and view their usage graphs (more details can be found on the section on 'Normal Users').

5.1.3 Client Management

Int	ernet Addiction	n Intervention I	Program (IAIP)	🔒 Home 🔹 A	Admin men	u -		
F	lome / Client Infos							
Lis	st ClientInfos							
СІ	HANGING STAGES	SEND EMAIL SENI	D SMS					
							Displaying 1-4 of	f 4 results.
	Client Name	Tel	Email	Enroll Date	Client Status	Monitoring Status	Excess	
					•	•		
	Seng	64273869860	ss.souligna@gmail.com	2017-03-04	Stage 1	Active	Yes	● 🖍 📋
	Seng Mike	64273869860 64235689752	ss.souligna@gmail.com kasz27@gmail.com	2017-03-04 2017-03-04	Stage 1 Stage 1	Active Active	Yes No	● / 前 ● / 前
	Seng Mike Doris	64273869860 64235689752 64238965231	ss.souligna@gmail.com kasz27@gmail.com ss.souligna@gmail.com	2017-03-04 2017-03-04 2017-03-04	Stage 1 Stage 1 Stage 1	Active Active Active	Yes No Yes	 / ii / ii / ii

Figure 5.9: Client Management Web Page

Figure 5.9 shows a client management web page. This page is an extension of the previous client information page as both link to the same table (client_info table) on the database. The information here is mostly the same as on the client information page, but with fewer columns.

Despite its simple look and data duplication display, this page contains the three essential functions required for the successful operation of the SustainMe system, including changing stages, sending emails and sending text messages, as shown in Figure 5.10 below.



Figure 5.10: Three Main Management Features.

Visual changes found on this page include the three buttons at the top of the table, 'changing stages', 'send email' and 'send sms'; and a checked box in front of each user record. These checked boxes are selected when the system administrator requires an action/change to any or all of the user records listed on the page.

Once a user record (or all records) are selected, the system administrator can then decide what action needs to be imposed, based on the three functional buttons available.

Each of the three buttons are programmed to perform the function that their name suggests. More details are described as below:

• Changing Stages

There are four stages in the Internet addiction intervention programme, which are known as: Registration (Stage 1), Initialization (Stage 2), Monitoring (Stage 3), Assessment (Stage 4). These are shown in the client status web page (Figure 5.11). All four stages cover different number of days throughout our eight week intervention programme. When the administrator clicks on this button, the system checks for the selected user/s the number of days he or she has been on our system. If the users (participants) are only in our system for less than a week (or seven days), they will be assigned 'Stage 1' as their client status. After seven days, they are assigned 'Stage 2'; and after 14 days - 'Stage 3' and after 42 days - 'Stage 4'.

Internet Addiction Intervention	n Program (IAIP)	🔒 Home 🕻	🕈 Admin menu 👻		
Home / Client Statuses / Manage					
Manage ClientStatuses					Operations ■ List ClientStatuses
Q Advanced Search					
			Displaying 1-4	4 of 4 results.	
ID	Client Status Name		Description		
1	Stage 1		Registration	• 🖍 🗎	
2	Stage 2		Initialization	• 🖍 🛍	
3	Stage 3		Monitoring	۵ 🖌 🕲	
4	Stage 4		Assessment	۵ 🖍 🕲	

Figure 5.11: Client status Web Page

• Send Email

This function sends out an email to the participants or their next of kin (if specified) using the email address provided under the 'email' field when the user (participant) registers online at the early stage of our programme. In the email, they find the message describing the current status of the participant Internet usage status. They may find a normal or high usage (more details about the message contents can be found in Figure 5.12 below). This is one of the two modes of notifications sent to the user from our system.

Internet Ad	diction Interv	/ention Program (IAIP) ♠ Home ♦ Admin menu ~		Welcome seng -
Home / Emai	I Messages / Man	age		
Manage Ei	mailMessag	es		Operations ≣ List EmailMessages ♣ Create EmailMessages
Q Advanced	Search			•
		Displaying 1-	2 of 2 results.	
ID	Email Title	Email Detail		
1	Normal Usage	Your Internet usage is in a 'Normal' range. You can continue surfing the Internet as usual.	● 🖌 🏛	
2	High Usage	Your Internet usage is in a 'High' range. Your internet usage might cause significant problem in your life. Please consider its consequences and try to spend more time offline.	is 👁 🖍 🛍	

Figure 5.12: Email Messages Web Page

Figure 5.12 shows the contents of the messages of the two types of emails our system has prepared to be sent to the users to keep them informed and to notify them about their current Internet usage situation. The first type of email is titled 'Normal Usage' and its contents are "Your Internet usage is in a 'Normal Range'. You can continue surfing the Internet as usual. The second type of email is sent saying 'High Usage' and says "Your Internet usage is in a 'High Range'. Your Internet usage might cause significant problems in your life. Please consider its consequences and try to spend more time offline.

This function retrieves the phone number provided by the user from the database and sends a notification message to the user in the form of text messages. In this message, users find the message describing the current status of the participant Internet usage status. Either they are experiencing a normal or a high usage. The contents of the text messages are the same as the ones sent in the form of an email (as shown in Figure 5.12), which the user either being notified being an Internet user in a normal range or high range.

5.1.4 Sent Emails and Text Messages

Internet Addiction Interven	ition Program (IA	NP) ♠ Home	✿ Admin menu ◄		۷
Home / Email To Clients / Manage					
Manage EmailToClients					Operations ■ List EmailToClients
Q Advanced Search					Create EmailToClient
			Displaying	g 1-2 of 2 results.	
ID	Client Info	Date Sent	Email Messages		
	•			T	
1	Seng	05/03/2017	High Usage	. ● 🖊 🏛	
2	Modozky	08/03/2017	Normal Usage	● 🖊 🏛	

Figure 5.13: Sent emails Web Page

Figure 5.13 is a table that records the lists of all the emails that have been sent to different users from our system. In the table, there are two record, which show that the first email was sent to a user named Seng on 5 March 2017, with the title 'High Usage'. The second email was sent to Modozky on 8 March 2017, with the email title 'Normal Usage'.

Although the page only display the type of email messages each user received, the user in fact receives the full email content in relation to that email message (as stored and shown in Figure 5.12).

Similarly to text messages, all sent text messages are stored and displayed on the

'Sent text messages' web page (as shown in Figure 5.14). This has the same stored data as the 'Sent Emails' page with the only difference being the nature of the communication channel (via email or text message).

Internet Addiction Interven	tion Program (IA	NP) ♠ Home	✿ Admin menu ▼		Weld
Home / Message To Clients / Mana	age				
Manage MessageToClier	nts				Operations iii List MessageToClients
Q Advanced Search					Create MessageToClient
			Displa	aying 1-2 of 2 results.	
ID	Client Info	Date Send	Messages		
	•			•	
3	Modozky	08/03/2017	Normal Usage	⊘ ≠ 1000	
5	Seng	09/03/2017	High Usage		

Figure 5.14: Sent Text Messages Web Page

5.1.5 Data Usage

Having stored important information, such as user's Internet usage, the 'Data Usage' page will be one of the most frequently visited by the system administrator as he or she has to check all the users' Internet usage often in order to correctly update some of the system pages and implement the right notifications to each user.

Internet Addictic	n Interver	ntion Program (IA	AIP) 🕈 Home	🗢 Admin menu 👻			
Home / Data Usage	s / Manage						
Manage DataU	sages						Operations ≣ List DataUsages ✦ Create DataUsage
Q Advanced Search					Displaying 1.5 c	f E roquito	
					Displaying 1-5 c	To results.	
ID	Client Info	Time Usage	Size	Duration	Data Type		
	Client Info	Time Usage	Size	Duration	Data Type		
ID 7	Client Info Seng	Time Usage	Size 58	Duration 5	Data Type Total Data Usage		
ID 7 8	Client Info Seng Seng	Time Usage 2017-03-03 2017-03-04	Size 58 89	Duration 5 15	Data Type Total Data Usage Total Data Usage	•/ Î •/ Î	
ID 7 8 10	Client Info Seng Seng Mark	Time Usage 2017-03-03 2017-03-04 2017-03-05	Size 58 89 312	Duration 5 15 25	Data Type Total Data Usage Total Data Usage Total Data Usage	● / Î ● / Î ● / Î	
ID 7 8 10 41	Client Info Seng Seng Mark Seng	Time Usage 2017-03-03 2017-03-04 2017-03-05 2017-03-05	Size 58 89 312 160	Duration 5 15 25 30	Data Type Total Data Usage Total Data Usage Total Data Usage Total Data Usage Total Data Usage	♥ / Î ♥ / Î ♥ / Î ♥ / Î	

Figure 5.15: Data Usage Web Page

Figure 5.15 shows a list of the Internet usage records of all the users in our system. This information is obtained directly from the S browser installed on the users' computers. The page shows the client name; their total daily usage (in MBs), how long they have spent online (in minutes); their date of usage access and the type of data.

This page requires no interaction/update from the system administrator. All he or she has to do is to monitor and take note of the daily usage of each user, and whether they have spent more than 5GB of data or eight hours per day. If they did, the system administrator will have to change their excess status about the client information page so the system is up to date and correct notifications can be sent to the users. This is guaranteed.

5.1.6 The User

Though it is positioned last in the list under the 'Admin menu' tab, this user management task is one of the first things the system administrator has to do. The username and password shown on the 'User' page (Figure 5.16) give the user the account credentials that are provided to each user (participant) in our system and with these details they can log into our web application to view the online usage graphs. (More details can be found in the next section under 'Normal User').

Internet	t Addiction In	ntervention Pr	rogram (IAIP) 🛛 🔒	Home 🔹 Admin menu 👻		
Home /	Users / Manage					
Manag	le Users					Operations I≣ List Users I Create User
Q Advar	nced Search					
				C	Displaying 1-4 of 4 results.	
ID	Name	Surname	Username	Password	Displaying 1-4 of 4 results.	
	Name	Surname	Username	Password	Displaying 1-4 of 4 results.	
ID 1	Name Seng	Surname	Username ss.souligna@gmail.com	Password 5f4dcc3b5aa765d61d8327deb882cf99	Displaying 1-4 of 4 results. Tel 64273869860 • 1 1	
ID 1 12	Name Seng Mike	Surname Souligna Dan	Username ss.souligna@gmail.com kasz27@gmail.com	Password 5f4dcc3b5aa765d61d8327deb882cf99 5f4dcc3b5aa765d61d8327deb882cf99	Displaying 1-4 of 4 results. Tel 64273869860 • / 1 • / 1 • / 1	
ID 1 12 142	Name Seng Mike ss	Surname Souligna Dan s	Username ss.souligna@gmail.com kasz27@gmail.com	Password 5f4dcc3b5aa765d61d8327deb882cf99 5f4dcc3b5aa765d61d8327deb882cf99 5f4dcc3b5aa765d61d8327deb882cf99	Displaying 1-4 of 4 results. Tel 64273869860 • / = • / = • / =	

Figure 5.16: User Web Page

Upon receiving the information from new users via our online registration form, the system administrator creates a user account, which can be found on the 'Client Information' page. On the top right of this page is a link called 'Create User'. This is where the administrator manually inputs all the information needed to create an account for the user such as name, surname, username (his or her email address), password and telephone number (optional).

The administrator then takes note of the ID number of that new record, as this is the user id number of that specific new user. The administrator will then go to the client information page and update this ID value. From then, the user will have his or her own unique user id number and they will use this number to log into the S browser on their first use so the browser can identify the user and send the usage data to the right user in our database.

5.2 Participating Users

Normal users refers to all the successfully registered participants to the SustainMe system via the online registration form. Upon completing the form, an email is sent to the participants informing them about their online account creation and giving the link to access their online Internet usage graphs.

The username and password need to be specified and input by the participants when completing our online registration process. The system administrator takes note of the new user's registration details and creates a new account for them on the User web page (Figure 5.16) with their email address as their username and their password being the same as that specified in the online registation form. Another essential step the system administrator has to take note of is the ID number generated in the User web page (when creating the new user account). This user ID has to be assigned and updated to the User ID field (originally being set as '0') in the record for that user on the Client Information page by the system administrator. This is to make sure that once the users log in with their account details, they will be able to view their actual usage graphs.

There are two different main types of user (the administrative user and normal user). The differences between them are pointed out in Figure 5.17. The first noticeable difference is the username for both users. The administrator uses his first name as the username to log into the system, while the normal user (participant) will uses their email address as their login username. Once both type of users log in, an additional tab will appear on the page next to the Home tab. Normal users will see a tab named "User menu'. Only one function is embedded within this tab, which is 'Internet Usage'. This function redirects the user to their usage online graphs page, which shows their current Internet usage in a graphic form (summarized in Figure 5.18 and Figure 5.8).


Figure 5.17: Different Users Login



Figure 5.18: Participating User Login

The administrative user, also known as the system administrator, has access to a different tab called 'Admin menu'. This tab lists all the pages that incorporate all the

information and functionalities that the system administrator has to monitor and manage (shown in Figure 5.1).

Chapter 6

Discussion

In the previous section, we presented the system design and development of the Internet addiction intervention programme which aims to manage Internet addiction disorder. In this section, we will provide further discussions and justifications of the terms 'Internet Addiction' and also the SustainMe system.



Figure 6.1: Two Main Aspects of SustainMe System

The Internet addiction intervention programme, also known as the SustainMe system has been developed to address and manage the emerging Internet addiction disorder. In order to address the Internet addiction problem with this proposed ICT-based system approach, there are two main aspects that we have to take into account when developing and implementing this web browser based approach.

The two main aspects are categorized into psychological and technical aspects as shown in Figure 6.1 and it is very important to discuss these aspects so as to limit any uncertainties or doubtful assumptions about the SustainMe system. The psychological aspects cover some controversial topics in Internet addiction, such as:

• If the Internet is considered as a utility, does it mean addiction if we spend more

time on it?

- Different ubiquitous devices lead to different types of addictions.
- If the person spends more time online for work purposes, does it mean he or she is addicted to the Internet?

The technical aspects section discusses the availability of assessment and support tools for Internet addiction and the SustainMe system. It further elaborates the reasons why we propose this approach in the form of a web browser and the limitations and credibility of the SustainMe system through the validation/testing processes.

6.1 Psychological Aspects

6.1.1 Internet as utility

Since there is no universal definition of the term 'Internet Addiction', it is hard to judge if people are addicted to the Internet or how much online time is considered too much before we can regard them as Internet addicts.

We are living in a globally connected society where we can connect and communicate with one another from almost anywhere as long as there is an Internet connection. There is no doubt that the Internet is slowly becoming an inseparable part of our daily life. Many of us rely on the Internet for almost everything, from work to education, communication, business and also leisure purposes. The increasing existence of the Internet in many households and workplaces has made the Internet an integral part of the services required to keep a household and a business running. In other words, the Internet can be considered as an utility that we are heavily dependent on, both at home and at work.

This has raised a controversial argument about whether we consider ourselves to be

addicted to the Internet if we spend more time and data usage online, since the Internet is known to be useful in our homes and workplaces.

6.1.2 Ubiquitous Devices

The emergence of fast speed Internet, social networking, the social web and mobile applications have influenced the way in which we access and use the Internet. It allows us to be more productive by having a wider access to more information and to communication channels. On the other hand, we tend to be more addicted to the Internet as we spend more time online and engag in online activities.

The widespread availability and integration of the Internet into our everyday lives ranging from what we wear (e.g. smart-watches); what we see (e.g television) and what we carry around with us (mobile phones, tablets and computers). This has made us online dependent. Equipped with wifi and Internet connectivity capability, these devices allow us to spend a longer time with them and eventually we become very addicted to them.

Internet addiction disorder can be referred to as an excessive use of the Internet over a prolonged time. This can be extended to include an excessive and prolonged Internet usage on any Internet capable device, since there are different types of these devices around. In fact, we seem to show addictive behaviors towards each of them based on our intention or purpose of use.

As an example, many of us spend a lot of time on our smart televisions (which can access our home wifi networks) watching movies and entertainment programmes that are available online. Our desktop and laptop computers are meant to be used for work purposes or for personal entertainment like web browsing, online gaming and video streaming. Mobile phones and tablets on the other hand are devices for personal and social communication and for portable entertainment. We use our phones mainly to communicate with one another via the many mobile applications available now. In addition, these mobile devices can also be used to engage in mobile gaming and video streaming anywhere we have our phone or tablets with us, as long as they are connected to the Internet. Not forgetting even the small wearable devices we wear on our wrists now, which come equipped with Internet access directly and indirectly (via Bluetooth connection to mobile phone). These devices are mainly used as activity trackers and for health monitoring purposes, as they monitor our heart-rate, mood, blood-pressure and our physical activities through the complex sensors embedded in the devices. Even though this Internet capable wearable technology is still something new, it can be found on many wrists worldwide.

In general, we conclude that despite the need to access the Internet, different types of Internet addiction can also be influenced and categorized by the (Internet capable) devices we own, which reflect the types of addictive patterns and behaviours.

6.1.3 Addictive vs Workaholic Behaviors

We often associate Internet addiction with spending too much time on our computers, which are available to us almost everywhere we go - school, library, the workplace and at home.

Students and office workers are two groups of people with a higher use of computers than most of as they require and use network computers with Internet connectivity. People may spend hours everyday in front of their computer screens, both at work and at home. This can be seen as an addictive behaviour if we judge it by the number of hours and the amount of downloaded data.

However, we believe that people who work compulsively or excessively hard for long hours are not Internet addicts. Workaholic behaviour is not one of the six main types of Internet addiction described in Figure 2.1 by the American Centre for Online Addiction (Salicetia, 2015). Secondly, we also believe that there is a big difference between Internet addictive and workaholic behaviours. When someone is addicted to something (the Internet in this case), he or she will show signs of a constant desire to get online and will spend most of their time on a computer. These symptoms will occur repetitively and might become a serious permanent habit as time goes by. However for the workaholic, their constant desire to go online to finish their work is seen as temporary and will go away once the job is done. This is also consistent with previous findings that noted problematic Internet use symptoms are more correlated with recreational Internet use than work- or school-related use (Tao et al., 2010).

6.2 Technical Aspects

6.2.1 Lack of assessment and support tools

To the best of our knowledge, there is still a lack of assessment and support tools for Internet addiction disorder. Many researchers believe that the best way to address the problem of Internet addiction is to find out what causes the addiction disorder in the first place and to impose interventions in a psychological manner through a series of consultations and online surveys.

Despite the fact that Internet addiction has only come into existence because of technological advancements in the Internet and computer infrastructures, there is still not many information systems or programmes that have been designed to assess and address this emerging online disorder.

To fill this gap in demand for such systems, we propose a browser based intervention approach towards managing Internet addiction disorder. We have called our system the Sustainability Moderation Expert-Kin system, or SustainMe in short. This system employs online Internet addiction tests as an assessment tool to find out the participants' Internet addiction level in relation to their Internet usage behaviours. In addition, in order to help and support addictive Internet users, the system sends notification messages to every user, aiming to increase their self-awareness about their behaviours and hence to improve their Internet addiction status.

6.2.2 A web-browser based approach

Given the variety of online devices for Internet consumers to choose from, it is difficult to design a system that can manage and handle the different levels of complexity and operating platforms on all those devices. In other words, it is hard to control and monitor Internet addictive behaviours across all the Internet capable devices from one single system. Therefore, we have to look through those devices and analyze their popularity before we finally decide to develop a web-browser based system as an approach to manage an Internet addiction disorder.

A web-browser was selected as our Internet monitoring tool because we believe that many online activities are carried out on computers, both at home and at work, rather than on mobile phones and tablets. Also there are many attractive and useful features that can be found on a web browser, which means many people access the Internet via a web browser. Some of the features include the ability to bookmark websites and to install add-ons to allow the browser to do more than just browse the web

For these reasons, we believe that a browser-based intervention approach, known as the SustainMe system, which has been develop in this research, is a reliable and effective system to obtain the right Internet usage information from users and to send out powerful messages to them in the form of text messages and email notifications. These simple tasks (of usage monitoring and sending notifications) mean we believe we can increase the users' awareness of their excessive Internet use and change the way they use and spend time on the Internet.

6.2.3 SustainMe System Validation/Testing

We have designed and developed the SustainMe system to serve two main purposes that will help to manage Internet addiction disorder - one being that it is able to detect and calculate how long the user has spent online and how much data they have used; the second being the ability to send warnings and notifications to the users based on their usage data analysis.

Although the system is complete and fully functional, we did not test our system on external users, only ourselves. This might bring up issues of uncertainties and the credibility of our SustainMe system. Nonetheless, the significance of our research lies in the concepts and methodology used when designing the system. The system might not be really innovative and prominent, but it incorporates algorithms and components so simple and yet complex that when put together they serve as a single intelligent system that manages Internet addiction disorder.

Because it is a new kind of system, we did not compare our approach with others. The fact that the final system outcomes are able to address our two research problems, finding a way to measure, monitor and visualize Internet usage and how to impose intervention procedures to help users with their Internet addiction has proved that the SustainMe system is a capable and fully functional system by its own measures.

Chapter 7

Conclusions

7.1 Conclusions

Today the Internet is widely available and accessible almost anywhere through our mobile devices and computers via the widespread use of Wi-Fi and cellular network technology. This easy access to the Internet has led to an exponential increase in Internet use in our lives and has become a concern for many individuals, especially parents, in recent years. In some cases, this ease of availability has led to excessive and additive Internet use when someone fails to control and manage his or her Internet use wisely and productively.

To address this problem, this thesis presents a browser-based intervention approach to manage Internet addiction disorder. This system approach is designed to help the users monitor and be aware of their Internet usage in order to prevent or reduce Internet addictive behaviours. It consists of three main functional components: a custom web browser to measure and monitor the users' Internet use; The SustainMe system to store and analyze data, and a notification system to send alerts and warnings to the users.

Instead of trying to educate and inform users about the risks and consequences of excessive Internet use or to implement restrictive mediation strategies, we introduced this web-based intervention approach in an attempt to increase self-awareness and promote self-assessment about the users' Internet usage. Users are constantly notified about the amount and duration of their daily Internet use. We believe this kind of intervention process can have a psychological impact on them, resulting in less addictive and more manageable Internet behaviours in the long term.

One of the challenges encountered in this study was related to discovering and designing all the main components to meet the objective of our study. Through literature review and other observations, we discovered that many people are addicted to smart phones and computers as a way to get online. Therefore we decided to design and implement the SustainMe approach to deliver intervention outcomes and messages to these addictive devices. We embedded our monitoring function into a custom web browser, which reflects the actual usage data from the users' computers. By accumulating the numeric data and comparing it to preset conditions, the SustainMe system can then send out relevant notifications or feedbacks to users' mobile phones and computers in the form of text messages and emails.

We also identified a challenge in convincing and attracting people to join the SustainMe programme. After researching the topic, we found the IAT to be a very useful tool in categorizing users into different groups based on their level of Internet use. Therefore we adopted the IAT questions in this study and used the test results and associated feedback to convince and encourage test takers to participate in the SustainMe programme.

Through a series of experiments and tests, SustainMe was fully developed to function as a management system for Internet addiction disorder. With such functionality and capability, this system has the potential to be applied in future research into areas such as behavioural change support and cyber-related addictions.

7.2 Future Work

In this thesis, we have described and explained our proposed system of a web browserbased approach to manage Internet addiction disorder. The work was carried out within a limited time frame, so some areas could be further enhanced in future development.

Firstly, our custom web browser could be programmed to work on a wider range of operating system platforms such as Linux, Macintosh (for computers); Android and IOS (for mobile devices) to extend the intervention and monitoring operations to more devices.

Secondly, the SustainMe system could be enhanced to support automatic scheduling and notification. The current version of SustainMe is one of a kind and newly developed, so it still requires manual controls and management for most tasks, such as changing a client's status and sending emails and text messages.

Thirdly, the monitoring capability and potential of the system could also be enhanced using IoT provided there was more time and resources available to investigate and develop the connection between the two technologies.

Fourthly, SustainMe currently performs its Internet usage monitoring only at a browser level. Its monitoring framework could be furthered enhanced and incorporated with local area and cellular networks to obtain broader and better control of the users' Internet use.

Lastly, testing and validation (by actual IA patients) should be carried out to identify and address any potential systematic problems in the current system. Such testing and identification will also enable the SustainMe system to be compared with other approaches, thereby helping to increase the effectiveness and significance of this new approach.

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Appendices

Appendix A

Internet Addiction Test - 20 Questions

The 20 questions Internet Addiction Test have been analyzed and reorganized into four main focus areas, as shown below:

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Table	n .1.	INI	Question	mane
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Internet Addiction Test Questions				
1st Main Focus Area: Addictive behaviours				
Q1	How often do you find that you stay online longer than you intended?			
Q2	How often do you find yourself anticipating when you will go online?			
Q3	How often do you feel preoccupied with the Internet when off-line, or			
	fantasize about being online?			
Q4	How often do you find yourself saying "just a few more minutes" when			
	online?			
Q5	How often do you try to cut down the amount of time you spend on-line			
	and fail?			
Q6	How often do you try to hide how long you've been online?			
	2nd Main Focus Area: Work and productivity			
Q7	How often do you neglect household chores to spend more time online?			

Q8 How often do your grades or work suffer because of the amount of time you spend online?
Q9 How often do you check your email before something else that you need to do?
Q10 How often does your job performance or productivity suffer because of the Internet?

3rd Main Focus Area: Family and relationship

- Q11 How often do you prefer the excitement of the Internet to intimacy with your partner?
- Q12 How often do you form new relationships with fellow online users?
- Q13 How often do others in your life complain to you about the amount of time you spend online?
- Q14 How often do you choose to spend more time on-line over going out with others?

4th Main Focus Area: Health and moods

- Q15 How often do you become defensive or secretive when anyone asks you what you do online?
- Q16 How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet?
- Q17 How often do you fear that life without the Internet would be boring, empty, and joyless?
- Q18 How often do you snap, yell, or act annoyed if someone bothers you while you are online?
- Q19 How often do you lose sleep due to late-night logins?
- Q20 How often do you feel depressed, moody or nervous when you are offline, which goes away once you are back online?

Appendix B

Internet Addiction Test Web Page

This IAT web page is developed using PHP. The design and look of the page is shown in Fig B.1.

Internet Addiction Intervention Program (IAIP)

Internet Addiction Test

Please input your fullname

First Name

* Last Name *

Please answer all the questions below:

Q1. How often do you find that you stay on-line longer than you intended?	0 1 = Rarely	O 2 = Occasionally	3 = Frequently	O 4 = Often	○ 5 = Always *
Q2. How often do you neglect household chores to spend more time on-line?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
Q3. How often do you prefer the excitement of the Internet to intimacy with your partner?	O 1 = Rarely	O 2 = Occasionally	○ 3 = Frequently	O 4 = Often	○ 5 = Always *
Q4. How often do you form new relationships with fellow on-line users?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	◯ 5 = Always *
Q5. How often do others in your life complain to you about the amount of time you spend on-line?	0 1 = Rarely	O 2 = Occasionally	O 3 = Frequently	O 4 = Often	○ 5 = Always *
Q6. How often do your grades or school work suffers because of the amount of time you spend on-line?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
Q7. How often do you check your email before something else that you need to do?	0 1 = Rarely	O 2 = Occasionally	3 = Frequently	O 4 = Often	○ 5 = Always *
Q8. How often does your job performance or productivity suffer because of the Internet?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
Q9. How often do you become defensive or secretive when anyone asks you what you do on-line?	O 1 = Rarely	O 2 = Occasionally	○ 3 = Frequently	O 4 = Often	○ 5 = Always *
Q10. How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
Q11. How often do you find yourself anticipating when you will go on-line again?	0 1 = Rarely	O 2 = Occasionally	○ 3 = Frequently	O 4 = Often	○ 5 = Always *
Q12. How often do you fear that life without the Internet would be boring, empty, and joyless?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
Q13. How often do you snap, yell, or act annoyed if someone bothers you while you are on-line?	0 1 = Rarely	O 2 = Occasionally	3 = Frequently	O 4 = Often	○ 5 = Always *
Q14. How often do you lose sleep due to late-night log-ins?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	5 = Always *
Q15. How often do you feel preoccupied with the Internet when off-line, or fantasize about being on-line?	O 1 = Rarely	O 2 = Occasionally	O 3 = Frequently	O 4 = Often	○ 5 = Always *
Q16. How often do you find yourself saying "just a few more minutes" when on-line?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	◯ 5 = Always *
Q17. How often do you try to cut down the amount of time you spend on-line and fail?	O 1 = Rarely	O 2 = Occasionally	O 3 = Frequently	O 4 = Often	○ 5 = Always *
Q18. How often do you try to hide how long you've been on-line?	1 = Rarely	2 = Occasionally	3 = Frequently	O 4 = Often	5 = Always *
Q19. How often do you choose to spend more time on-line over going out with others?	O 1 = Rarely	O 2 = Occasionally	○ 3 = Frequently	O 4 = Often	○ 5 = Always *
Q20. How often do you feel depressed, moody or nervous when you are off-line, which goes away once you are back on-line?	1 = Rarely	2 = Occasionally	3 = Frequently	4 = Often	○ 5 = Always *
	Calculate Tota	I Score			

Figure B.1: IAT Web Page

Appendix C

Registration Web Page

Internet Addiction Intervention Program (IAIP)

Registration Form

Registration Status: Incomplete

Please fill in all your information below:

First Name		*
Last Name		*
Date of Birth	Year V month V date V *	
Phone (start with a country code e.g 6427******)		*
Email (This will be your Username)		*
Password		*
Address		*
	Submit	

Figure C.1: Registration Web Page

Appendix D

End Sub

S Browser Special Features Code Samples

```
Private Sub BandwidthPerSec()
   Dim i As Integer
   Dim networkInterfaces As New System.Diagnostics.PerformanceCounterCategory("Network Interface")
   Dim nics As String() = networkInterfaces.GetInstanceNames()
   sumByteReceived = 0
   sumByteSent = 0
   Try
       For i = 0 To nics.Length - 1 ' read all network bytes from each NIC
           ipv4Stats = System.Net.NetworkInformation.NetworkInterface.GetAllNetworkInterfaces(i).GetIPv4Statistics
            'in case there are more than one active network interfaces,
           'all bytes sent/received are summed up
           sumByteReceived = sumByteReceived + ipv4Stats.BytesReceived
           sumByteSent = sumByteSent + ipv4Stats.BytesSent
       Next
   Catch ex As Exception
   End Try
```

Figure D.1: Internet Data Usage Calculation Code Sample

```
Private Sub Sbrowser_FormClosed(sender As Object, e As FormClosedEventArgs) Handles Me.FormClosed
    BandwidthPerSec()
    dateAccess = DateValue(Now)
    finTime = DateTime.Now
    finByteSent = sumByteSent
    finByteReceived = sumByteReceived
    totalByteSent = finByteSent - initByteSent
    totalByteReceived = ((finByteReceived - initByteReceived) / 1048576)
    'Calculating Internet Duraration Usage
    sessionTime = DateDiff(DateInterval.Minute, startTime, finTime)
    User.txtUserID.Text = UID
    MysqlConn = New MySqlConnection
    MysqlConn.ConnectionString = "server=localhost;userid=root;password=;database=iaid"
    Dim reader As MySqlDataReader
    'Saving Information to the Database
    Try
        MysqlConn.Open()
        Dim query As String
        query = "insert into data_usage (client_info_id,data_type_id,time_usage,size,duration)
values ('" & My.Settings.UserName & "','1','" & dateAccess.ToString("yyyy/MM/dd") & "',
         '" & totalByteReceived & "','" & sessionTime & "')"
        command = New MySqlCommand(query, MysqlConn)
        reader = command.ExecuteReader
        MessageBox.Show("Data Saved")
        MysqlConn.Close()
    Catch ex As MySqlException
        MessageBox.Show(ex.Message)
    Finally
        MysqlConn.Dispose()
    End Try
End Sub
```

Figure D.2: Internet Duration Usage Calculation and Saving to Database Code Sample