

A MODEL FOR MOBILE EXERGAME DEVELOPMENT TO PROMOTE
ANTI-SEDENTARY BEHAVIOUR

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This dissertation is dedicated to my parents for their endless support who made me see further by standing on their shoulders and also to all my friends.

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ABSTRACT

The term “exergame” is the combination word of exercise and videogames. Exergaming is playing exergames or any other video games to promote physical activity. Contemporary lifestyle has become increasingly sedentary: little physical (sports, exercises) and much sedentary (TV, computers) activity. The nature of sedentary activity is self-reinforcing, such that increasing physical and decreasing sedentary activity is difficult. As the growth of smartphones devices increased over the years, it becomes easier for an individual to play the exergame application in their mobile device anytime, anywhere. This research study mainly aims to promote anti-sedentary behaviour by using mobile exergame application. Therefore, a model has been proposed based on literature analysis on behaviour change models and survey experiment findings. The overall finding from the survey experiment suggest that by practising mobile exergame, an individual can expect a productive behaviour change which will motivate the user for a longer period of time. It also helps to identify the specific requirements of the prototype as well as contributes to the model development for this study. To evaluate the proposed model, a mobile exergame prototype called “FitUP” was developed as a proof of concept. Rapid Application Development (RAD) model was used as a guideline for the prototype development. In addition, a final survey was also conducted towards the end of this research study to gather the usability satisfaction data on the “FitUP” prototype which was developed for this research study.

ABSTRAK

Istilah “exergame” adalah perkataan gabungan daripada senaman (exercise) dan permainan video (videogame). “Exergame” merupakan permainan untuk meningkatkan aktiviti fizikal. Gaya hidup kontemporari telah menjadi semakin tidak aktif, iaitu sedikit fizikal dan lebih kepada aktiviti yang tidak aktif seperti menonton televisyen dan menggunakan komputer. Usaha untuk menambah aktiviti fizikal diri dan mengurangkan aktiviti yang tidak aktif dianggap sukar. Pertumbuhan peranti telefon pintar memudahkan seseorang individu untuk bermain “exergame” dalam peranti mudah alih mereka pada bila-bila masa dan di mana sahaja. Oleh itu, kajian penyelidikan ini bertujuan untuk mempromosikan kelakuan anti-sedatif dengan menggunakan aplikasi “exergame” mudah alih. Satu model telah dicadangkan berdasarkan analisis sastera pada model perubahan tingkah laku dan juga daripada penemuan kajian eksperimen. Penemuan keseluruhan dari eksperimen kajian selidik mencadangkan bahawa dengan mengamalkan “exergame” mudah alih, seseorang individu boleh mengharapkan perubahan tingkah laku produktif yang akan memberi motivasi kepada pengguna untuk tempoh masa yang lebih lama. Ia juga membantu untuk mengenal pasti keperluan khusus prototaip serta menyumbang kepada pembangunan model bagi kajian ini. Untuk menilai model yang dicadangkan, satu “exergame” prototaip mudah alih yang dinamakan “FitUP” telah dicipta sebagai bukti konsep. Model “Rapid Application Development” (RAD) digunakan sebagai panduan untuk pembangunan prototaip tersebut. Di samping itu, satu lagi kajian juga telah dijalankan pada akhir kajian penyelidikan ini untuk mengumpul data kepuasan kebolegunaan pada prototaip “FitUP” mudah alih yang telah dicipta khas bagi kajian penyelidikan ini.

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CHAPTER 1

INTRODUCTION

1.1 Overview

The number of health risk associated with sedentary lifestyle has increased in recent times. Sedentary lifestyle becomes more common in this digital era where it requires an adult to sit at one place to do their work without any major body movement. Some efforts have been taken to promote anti-sedentary behaviour of an individual lifestyle. However, a person has to comply with organizational rules and regulation where they have to stick in daily working routines in what they have been assigned. The problem is to solve the sedentary behaviour and the health risk associate within it efficiently by the use of technology in a person's daily routine.

As year progress ahead, advancement in technology has made the world a better place to live in. Technology has taken a space in every earthling that lives on this planet. The benefits of technology are diverse in many aspects such as educations, research and also creating awareness among human beings. Mobile devices and technologies have seen a rapid growth in the last few years. This growth in mobile technology development has lowered the prices for mobile devices allowing them to be available to the majority of people.

By identifying mobile application can provide an attractive way to attract human as a learning and awareness platform, it is easily to convey by providing or creating a useful mobile application system on discouraging sedentary behaviour's where it can monitor them and also chances to decrease the health risk. According to Owen (2010), the physical, economic and social environments in which modern humans sit or move within the contexts of their daily lives have been changing rapidly. The changes in transportation, communications, workplace and domestic-entertainment technologies have been associated with significantly reduced demands for physical activity. However, these reductions in the environmental demands for being physically active are associated with another class of health-related behaviours.

According to the official website of World Health Organization (Obesity and Overweight, 2016), over 1.9 billion individuals worldwide are overweight or obese. One of the reasons for this phenomenon is positive energy balance, i.e., the condition where one's energy intake exceeds one's energy expenditure. Meanwhile, low energy expenditure is explained by an increasingly sedentary lifestyle where it involves little physical and much sedentary activity. The nature of the sedentary activity is often addictive and self-reinforcing. Although this may seem surprising, physical activity and sedentary behaviour are not mutually exclusive. Even if a person is physically active (e.g., biking to work in the morning), he or she can also be sedentary (e.g., by primarily sitting for the remaining waking hours). The effects of too much sitting are physiologically difference from too little exercise.

Hence, adjusting the energy balance by explicitly increasing the amount of physical and decreasing the amount of sedentary activity is not easy. To encourage physical activity, researchers and developers have created a variety of “exergames,” which encourage people to exercise by integrating exertion into the game mechanics. General research and a minor introduction about sedentary behaviour and exergames are as follows in the following subtopics.

1.1.1 Sedentary Behaviour

Sedentary behaviour (from the Latin *sedere*, “to sit”) include sitting during commuting, in the workplace and the domestic environment, and during leisure time. Sedentary behaviours such TV viewing, computer use, or sitting in an automobile typically are in the energy expenditure range of 1.0 to 1.5 METs (multiples of the basal metabolic rate). Furthermore, although individuals can be both sedentary and physically inactive, there is also the potential for high sedentary time and being physically active to co-exist. An example would be an office worker who jogs or bikes to and from work, but who then sits all day at a desk and spends several hours watching TV in the evening (Owen, 2010).

Common behaviours in which humans now spend so much time (TV viewing, computer use and electronic games, sitting in automobiles) involve prolonged periods of these low levels of metabolic energy expenditure. It is our contention that sedentary behaviour is not simply the absence of moderate-to-vigorous physical activity, but rather is a unique set of behaviour, with unique environmental determinants and a range of potentially-unique health consequences.

1.1.2 Exergame

Exergame was the most commonly used term primarily by researchers who do not have a health-related background. Since the term “exergame” is the most frequently used in the literature, media, and is a catchy word, it is proposed to continue using this term; however, we will take a deeper look at its definition. Yang (2010) stated that “exergaming” is the combination of exercise and video games”. A video game is “any game played on a digital device and encompasses a wide range of games played at arcades, on personal computers, or on dedicated game consoles such as mobile. Besides that, the researcher finds difficult to define definition of “exercise” for exergames because it may be hard for promoting physical activity because it will not include some healthy behaviour without the intention to maintain

or improve fitness. Meanwhile, a health benefit viewpoint suggests that, some physical activity is better than nothing.

1.2 Problem Background

Obesity, which is due in part to lack of physical activity, is a serious concern that requires the attention of the behavioural community. In this modern society, sedentary lifestyle include hours spent on sitting and watching TV or videos, using a computer which done by every adult mostly. According to Sofia et al., (2015) one of the population groups vulnerable to the problems of obesity and overweight are the individual between the age range of 20 to 30 years old. Whenever there is increased screen time there is usually a matching decrease in physical activity. Exergames have started to find their way into field-based settings, such as schools, communities and homes, as a possible solution to curbing physical inactivity and obesity (Gao & Chen, 2014). However, the exergames should also include Behaviour Change Support System (BCSS) characteristic for more productive outcomes.

A BCSS is defined as “a socio-technical information system with psychological and behavioural outcomes designed to form, alter or reinforce attitudes, behaviours or an act of complying without using coercion or deception” (Mian, 2006). Although there are excessive mobile application related to health and fitness, but there are very less mobile application design with behaviour change support system available (Gillis et al., 2013). For example, Wartena (2014) introduce “MATTIE” a mobile adaptive therapeutic tool in psycho-education. This mobile application specifically designed for youngsters with a mild intellectual disability targeting at behaviour change as a result. But, in the particular application there is very less game contents that can attract user to stay motivate for a longer time of period. Thus, BCSS is an important element that an exergame application should include to witness a productive behaviour change result for a long period of time.

Besides that, from previous study the current models of BCSS did not cover all the requirement that should comply with exergame application and according to Preece (2010) to achieve better outcomes from BCSS's, an exergame should be designed by using persuasive systems design and models. Thus, this research will propose a model for a mobile exergame application based on BCSS elements. Then, a mobile exergame prototype will be developed as a proof of concept.

1.3 Problem Statement

Mobile exergames research has dominated the study of sedentary behaviours in recent years. The volume of mobile exergames research in the sedentary behaviour context expanding constantly, until it becomes more difficult to evaluate each and everything. Therefore, a problem statement for this project has also been identified which is “How to promote anti-sedentary behaviour using mobile exergame application?”

1.4 Research Question

There are many research aspects that will be covered throughout this project. Therefore, many research questions will arise from research study. To simplify the research area, below are the defined research questions to be answered as follows:

- i. What are the important factors required for a mobile exergame application which would able to promote anti-sedentary behaviour?
- ii. What are the steps to develop a model for mobile exergame application based on the characteristic of Behaviour Change Support System (BCSS)?
- iii. How to develop a mobile exergame prototype which able to integrate anti-sedentary behaviour as a proof of concept?

1.5 Objectives

The proposed mobile exergame application prototype will be designed and developed by the researcher with various objectives. The main objectives are:

- i. To identify all the important factors required for a mobile exergame application which would able to promote anti-sedentary behaviour.
- ii. To develop a model for mobile exergame application based on the characteristic of Behaviour Change Support System (BCSS).
- iii. To develop a mobile exergame prototype which able to integrate anti-sedentary behaviour as a proof of concept.

1.6 Scope of Study

The scope for mobile exergame application are designed and developed within behaviour change criteria's. A behaviour change support system is an information system designed to form, alter or reinforce attitudes, behaviours or an act of complying without using deception, coercion or inducements. The reason is the research helps to provide a unique opportunity to measure the system success.

Besides that, the proposed mobile exergame application helps to reduce sedentary behaviours in an individual lifestyle. This will lead them to the improvement health, awareness and to avoid chronic diseases. To be more specific the proposed mobile exergame prototype concerns more towards office workers as they are the target respondents for this project. An office worker spends hours of sitting in front of their desk with their daily work. They need to realize the dangerous of sedentary behaviour and find a way to overcome the problem by increasing the physical activity. A survey experiment was conducted among UTM office workers with the existing mobile exergame application on Google Play Store for the contribution of the model development for this research study.

Apart from that, this mobile exergame application focuses solely for android user. This is because android platforms provide many useful and attractive functions for any mobile applications. Besides that, creator will utilize the programming basic aptitudes adapted in the university with a specific end goal to finish the proposed project in following semesters. All the notes and slides are used as the references while developing the mobile application and its interfaces. This is where author can also apply the theoretical knowledge as stated in the dissertation guideline.

1.7 Significance of the Study

First and foremost, this research has to be done to realize the importance of reducing sedentary behaviour lifestyle by the support of Behavioural Change Support System (BCSS) characteristics. The study/research on mobile exergame plays a significant role to identify the effectiveness of exergames at increasing physical activity among the users. From the research done, the benefit of mobile exergames is to encourage physical activity as it can transform tedious exercise into an enjoyable experience. Many exergames have the capability to measure activity levels through monitors built into game equipment, and preliminary analysis indicates that exergame measures are significantly correlated with external measures of caloric expenditure, duration of play, and balance.

Furthermore, using mobile exergame could be cost saving, save time, and provide a more natural gaming experience compared to the use of other external measures. There is no doubt that, mobile exergames can generate significantly more energy expenditure than sedentary activities. Besides that, with the problems such as obesity rising, it's important to note that exergames can assist in burn calories and helps to loss body weight loss. Exergaming can help improve coordination and body movements. Although exergaming can be played alone in the privacy of your living room, it can also be a social way to keep fit. Moreover, online exergaming communities offer a place where exergamers can meet and compete.

Besides that, exergame helps office employees to take a little break from their work. By doing this regularly, they will gain the many benefit such as shaping their body into fit and directly relaxes their mind. Thus, the significance of study based on exergame is very important before the creator start to develop the mobile exergame application prototype. It really helps to determine how the application should be designed and developed based on all the criteria's, benefits and user requirements from the study.

1.8 Summary

This chapter introduces an overview about developing a mobile exergame application prototype which would able to promote anti-sedentary behaviour. A general introduction on the sedentary behaviour and exergame definitions are included into paragraphs. Furthermore, this chapter also includes problem background and problem statement. The research objectives which maps with the defined research questions were also identified. The scope of the research and the significant of the study is highlighted at the end of this chapter.

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