Development of a Mobile Health Awareness Application for Back Pain Patients' Using Persuasive Technology

(MyBackRelief)

By

DEVASHNE R. SELVANATHAN

A dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information & Communication Technology)

Supervisor: Assoc. Prof. Dr. Dayang Rohaya bt. Awang Rambli

APRIL 2013

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CERTIFICATION OF APPROVAL

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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DEVASHNE R. SELVANATHAN

ABSTRACT

Back pain is one of the most neglected pain among adults and stretching is one of the best ways to prevent back pain in the long run for back pain patients. In this project, the author explores the prospectives on how to improve the state of back pain patients through mobile technology as well as looking into persuasive techniques suitable to persuade back patients to exercise. The main objectives of this project is to explore the use of mobile and persuasive technology for creating back care awareness among back pain patients. In addition, the objective is also to design and develop a mobile application on the Android operating system to accommodate back pain patients to have a companion which reminds and give the right guidance to improve their health state on back pain. Using Eclipse software, the author would develop a mobile application for Android named MyBackRelief. MyBackRelief is a mobile application that motivates the users to perform stretching through several persuasion techniques . Before developing the prototype, a sample group of users were taken to perform surveys to analyze in terms of technology as well as its effectiveness. The results and recommendations were shared by the end of the project as a key milestone for future renditions of the project.

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ABBREVIATIONS AND NOMENCLATURES

et al.	And others
etc.	Et cetera

CHAPTER 1

INTRODUCTION

This chapter will describe the overview of the project that covers the following topics.

- Background of Study
- Statement of Problem
- Purpose
- Objectives
- Research questions
- Central Phenomenon
- Significance and feasibility of the project

1.1 Background of Study

The back is a well-designed structure made up of bones, muscles, nerves and other soft tissues. Back pain (*also known as 'Back Sprains', 'Back Strain', 'Spine'*) is a pain felt in the back that originate from the muscles, nerves, bones, joints or other structures in the spine.

According to the National Institutes of Health, eight out of ten people will suffer from back pain at some point. In Malaysia, it is estimated that over 1 million people are at risk from osteoporosis, out of which 20% are men and the lifetime prevalence of back pain in the United States is approximately 80%, with a one-year prevalence rate of 15% to 20%, the highest prevalence is in the 45 to 64 age group.

However, **back pain is a neglected medical problem in the world.** It is faced by numerous people worldwide on a regular basis but most of the people do not take back pain seriously as it is considered to be a minor ailment and most people think it could be cured automatically or just by resting a little. The fact is, back pains can be long lasting pain and can lead to disabling if not taken care of at

early stages (National Library of Medicine, 2001).It is believed that active forms of back exercises could aid to rehabilitate the spine and help alleviate back pain (Peter, 1999).

The advancement of technology becomes a powerful tool when it allows the persuasive techniques to be more interactive rather than one way which is designed to change people's attitudes and behaviors without deception (Fogg B.J, 2002). Persuasive technology can have a positive, supporting role by convincing, stimulating, or motivating adults' user to engage in healthy behaviors. (Intelille S.S, 2004). Therefore, it is believed that there is a great potential in applying persuasive technology in the health arena that could help to increase human health and well-being.

The research aims to explore persuasive techniques that can be employed to raise awareness on the importance of muscle strengthening exercises and relevant medical practices among patients suffering from back pain and facilitate them to change their health behaviors via mobile applications.

1.2 Statement of Problem

Based on the research done by Chiropractic Specialist, at least 80% of the population in the world will experience back pain sometime in their lifetime. Americans spend at least $50 billion each year on back pain. Therefore, back pains are one of the most prevalent, costly and preventable of all the health problems today. The major cause of back pain is **poor posture**. Lifestyle behavior plays a crucial role in the prevention and treatment of this disease. A challenge in this work is to increase people's knowledge about proper health training and behaviors.

There are several telemedical systems are ready available in the market to assist the back pain patients to exercise, typically have limitation. They make little use of the persuasive potential of computers and mobile devices.

Therefore, it is believed that persuasive technology has great potential in changing people's attitudes and behavior and mobile application particularly well suited for supporting change of behaviors.

1.3 Purpose

The purpose of this study is to explore the techniques of persuasive technology that could be implemented in order to raise awareness and provide a companion for back pain patients to relief back pain via mobile applications.

1.4 Objectives

- To explore the use of mobile technology for creating back care awareness among back pain patients.
- To explore on the techniques of persuasive technology in order to facilitate an effective and interactive way to perform exercises in order to relieve back pain
- To design and develop a mobile application on the Android operating system to accommodate back pain patients to have a companion which reminds and give the right guidance to improve their health state on back pain.

1.5 Research questions

- How persuasive techniques can facilitate in raising awareness on the importance of muscle strengthening exercises and relevant medical practices among patients suffering from back pain to relief?
- Is it true that people are using mobile phones more often and consistent with their lifestyle?

1.6 Central Phenomenon

- What is it likely to have back pain and its cure?

The mobile application is targeted to help the back pain patients by creating awareness of users to exercise consistently. The target of this project is adults suffering from back pain at the range age of 18 to 55. The scope of the study is to use persuasive technology via mobile application to create awareness among users.

1.7 Significance and feasibility of the project

Conducive research is conducted on back pain patients and mobile application will be developed to create awareness and assist patients in improving their health state in an interactive and cost effective way. This project aims to explore the best way in using persuasive technology to inspire back pain patients to persistently use the application in order to avoid or reduce back pain. This application could be an advancement of the existing application available in the market with interactive features to relieve back pain.

The time frame of the project development will be two semesters of study, whereby the first semester will be focused on the planning, analysis, research and design phase and the second semester will be mainly on developing the prototype and usability testing before establishing the product in the market.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses on the general idea of the project. Several keywords discussed to address the statement of the problem in the previous chapter and a solution is proposed at the end of this chapter.

2.1 Understanding Back Pain

2.1.1 Definition of Back Pain

Figure 1 : Back Pain & Neck Pain

Back pain is a worldwide experience. Disabling back pain appears to be a problem for western and industrialized societies, possibly related to the development of welfare states.

The back is a well-designed structure made up of bones, muscles, nerves and other soft tissues. According to International Association for the Study of Pain, pain is defined as “an unpleasant sensory and emotional

experience associated with actual or potential tissue damage or described in terms of such damage". Back pain (*also known as 'Back Sprains', 'Back Strain', 'Spine'*) is a pain felt in the back that originate from the muscles, nerves, bones, joints or other structures in the spine.Back pain ranks second only to headaches as the most frequent location of pain (Mayo Clinic, 2000).

The back has three primary parts which, as shown in Figure 1:

i. Backbone or spine (also referred to as the spinal column or vertebral column)
ii. Back muscles
iii. Nerves or spinal cord.

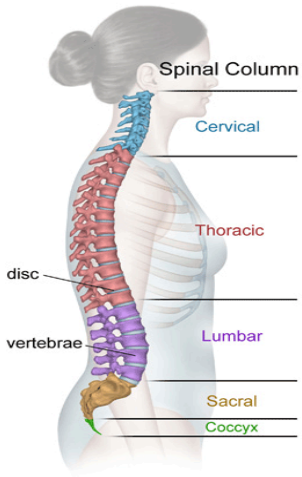


Figure 2 : Primary parts of the backbone

Essentially the backbone is not one long bone, but it is a separated twenty four bones called vertebrae as well as the sacrum and coccyx. The vertebrae stacked one on top of the other to form the backbone or spine. It provides mobility, flexibility and stability. (See figure 2) When it is viewed from the side, a normal spine will resemble a letter 'S'.

There are three curves in the spine which are :

- Gentle inward curves in the neck (cervical region)
- Low back (lumbar)
- An outward in upper back (thoracic)

Changes from these postures (normal curve) will increase the pressure on the spine and increase the risk of injury or back pain.

The points where two vertebrae or bones fit together are called joints (University of Washington, Department of Orthopedics and Sports Medicine, 2002). These joints make it possible for the spine to move and turn in different directions.

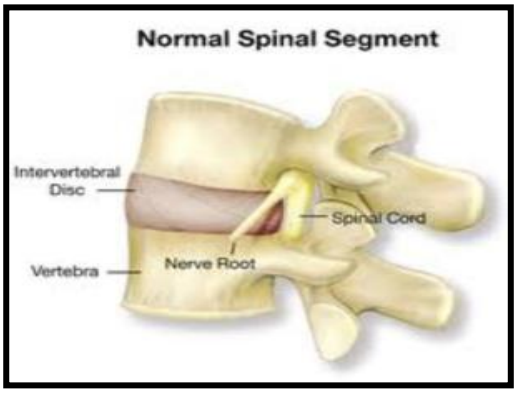


Figure 3 - Anatomy of lumber spine

The muscles of the back are attached to the spine (National Library of Medicine, 2001). There are 40 muscles and numerous connecting tendons and ligaments running from the base of the skull to the vertebra which helps the spinal column in a position (Mayo Clinic, 1997). The muscles provide support and stability for the spine and upper body.

Also, the spinal nerves are one of a major part of the central nervous system that extends from the base of the brain down to the lower back and that is encased by the vertebral column.(See figure 4) The cord connects the brain to all parts of the body via 31 pairs of nerves that branch out from the cord and leave the spine between vertebrae. These nerves

provide the feeling in the skin, help the contact on the muscles to move the arms and legs, and allow to feel pain when an injury has occurred.

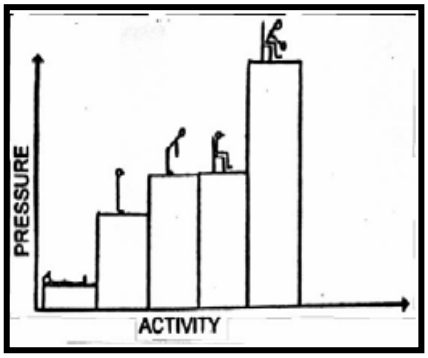


Figure 4 – Disc pressure versus activity level.

The discs present between each vertebra and act as shock absorbers dye to the gel like interior. It provides flexibility to the spine. Certain postures or positions could produce higher pressure than normal on the disc. (See figure 4) For example, lifting with a bent back could increase the pressure exerted on the disc which are very vulnerable to injury. This could cause pain in the ligaments and muscles.

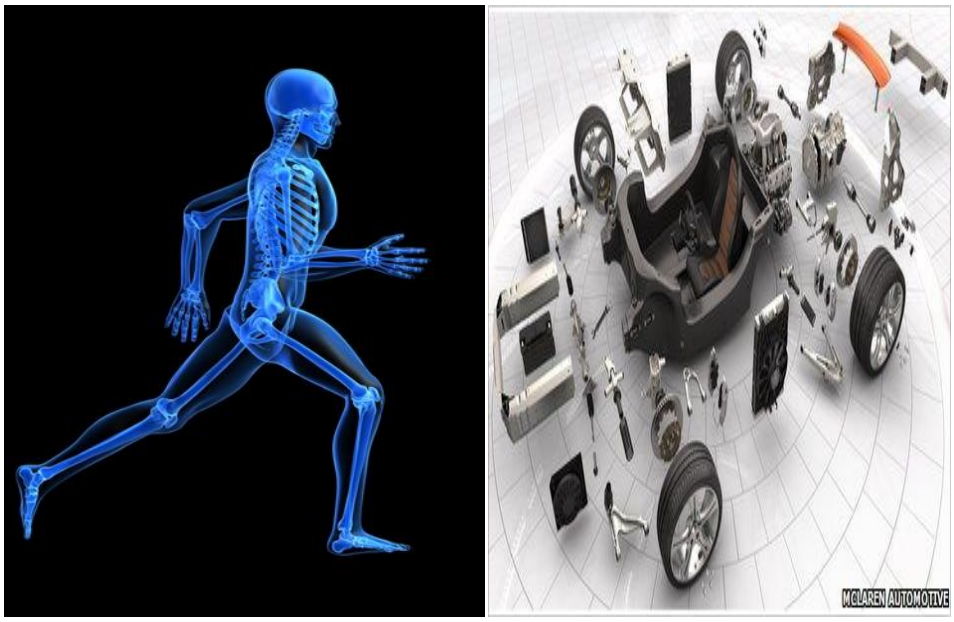


Figure 5 – Human versus car.

To visualize the delicate human backbone, cars have four wheels and other mammals walk using four legs but human is a unique piece of engineering whereby human stand and move with only two legs. Therefore, human backbone is a delicately balanced interworking of bones, muscles, ligaments, tendons and nerves to balance and bear the weight of the body and the loads carried. A negligible damage to any of the components of the back's structure can upset the frail balance and make movement painful (Mayo Clinic, 1997).

2.1.2 Causes of Back Pain

There are several causes of back pain that has been identified by the medial researchers. Back pain can be divided as follows:

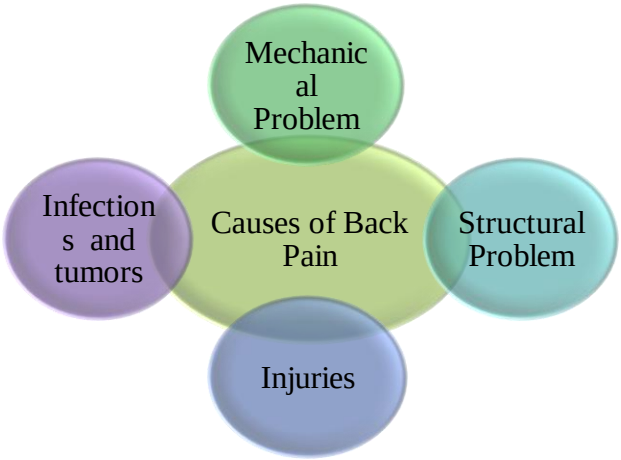


Figure 6 - Causes of back pain

- **Mechanical problem**

  A mechanical problem could be due to the way the spine move. It is one of the most common mechanical causes of back pain whereby it is called intervertebral disc degeneration, which means that the discs located between the vertebrae of the spine are breaking down with age. This problem can lead

to pain if the back is stressed. Other mechanical causes of back pain include spasms, muscle tension, and ruptured discs, which are also called herniated discs.

- **Structural problems**
  - **Bulging or ruptured disks** –Disks act as cushions between the vertebrae in the spine. At times, the soft material inside a disk may bulge out of place or rupture and press on a nerve.
  - **Sciatica** – a term refers to the painful inflammation of sciatic nerve, the longest and largest nerves in your body.
  - **Arthritis –** The joints most commonly affected by osteoarthritis are the hips, hands, knees and lower back. As the joints wear down, calcium, deposits, spurs and swelling may develop and cause restriction in movement and pain (Richard A.S, 2008).
  - **Osteoporosis –** Compression fractures of the spine's vertebrae can occur if the bones become porous and brittle.
- **Injuries**

  Spine injuries such as sprains and fractures can cause either short-lived or chronic back pain. Sprains are tears in the ligaments that support the spine, and they can occur from twisting or lifting improperly. (Janet M.P,2009)
- **Infections and tumors**

  In rare cases, back pain could be related to very serious or severe problems such that cancer in the spine and tumors.

However, the common cause of back pain is **bad posture** due to standing, sitting and lying with the adoption of incorrect body postures.

Figure 7- The good posture for standing

1. **Right standing posture** is one in which the spinal curves are maintained, the look ahead with the chin gently pulled in, the shoulder blades are gently pulled back and down, the stomach and buttock muscles are gently tightened and other muscles are relaxed.

Figure 8 - The good posture for sitting

2. **Right sitting posture** is one in which the spinal curves are maintained and sitting is well back on the chair, upright but relaxed. The support used from the lower back if sitting for long periods and keep hips, knees and ankles are at right angles with knees slightly higher than the hips.

Figure 9 - The good posture for lying

3. **Right lying posture** is one where the support surface is firm and supports the normal spinal curves. A mattress that sags in the middle can cause pain or stiffness.

GOOD BODY POSTURE	AVOID BAD POSTURE THAT
• Places minimal or balanced stresses on body parts • Requires minimal muscular effort to sustain • Confortable	• Bending forward or backward during any activites • Twist during activity • Encourge prolonged bending • Occur in sitting without back support

Besides that, there are other factors that are risk to the back pain problem which includes:

- Smoking (Nicholas U. Ahn,2001)
- Obesity
- Older age
- Female gender
- Physically strenuous work
- Sedentary work
- Stressful job
- Anxiety and depression

2.1.3 Symptoms of Back Pain

There are some signs that indicate the immediate need to see a doctor. These signs include numbness on the backbone, severe pain that does not reduce or improve with rest within three days or pain after a fall or injury (Janet M.P, 2008).

2.1.4 Diagnosing a Back Pain

There are several methods commonly used in diagnosing a patient with back pain.

- **MRI** - Magnetic resonance imaging (MRI) uses a magnetic field and radio frequency to create a picture of bones, soft tissues, and organs. It gives the doctor to visualize the patient's spinal cord, the nerves, and the discs of the spine, which usually, affected structures in cases of back pain. MRI scans are highly detailed test and it is costly. (Shiel.n.d)
- **X-rays** - X-rays of the lumbar spine will reveal if there's damage to bones from a fall or trauma. X-rays may be needed for trauma (for example, a fall or car accident), patients older than 50 years or those with other medical problems.
- **CT scans** - CT scans (or CAT scans) are more detailed X-rays that give a clearer picture of the anatomy of the bones.
- **EMG** - Electromyogram (EMG) is a nerve test that involves the placement of tiny needles into the muscles. During an EMG, the electrical activity of the muscles is examined during both contraction and rest, and the electrical activity in the muscle is amplified, displayed and recorded for analysis. If the muscle is not functioning normally, it may mean that a nerve is being irritated or pinched--perhaps a sign of a herniated disc or spinal stenosis.
- **Bone Scan** – Bone scan is a type of radionuclide imaging that can help a physician locate the affected area of the spine. It helps in

evaluating spinal tumors, infection or occult fractures more accurately than plain X-rays. During a bone scan, a radioactive chemical is injected into the bloodstream. The bone scan is safe since the levels of radiation in the chemical are lower than the X-rays. (Park Nicollet Institute, 2008)

2.1.5 Treatment for Back Pain

Treatments for back pain will vary depending on how long patients have the back pain and also how severe it is. The treatments for back pain are also based on the individual needs and preferences. Hereby, the treatment for back pain has been divided in two sections which are short term back pain and long term back pain.

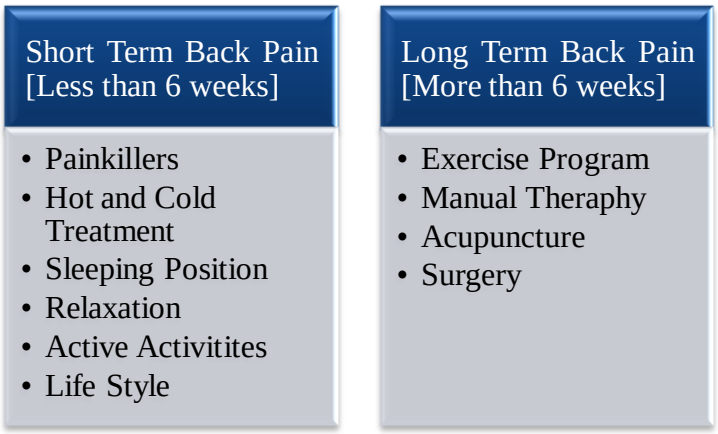


Figure 10 - Treatments for Back Pain Patients

In most cases of back pain that last no longer than six weeks will be treated under the category of short term back pain.

- **Pain killers** - Paracetamol is effective in treating most cases of back pain. If the patients experience muscle spasms in their back, it is recommended in acquiring muscle relaxant, such as diazepam. However, painkillers have side effects and it is also addictive. It is advisable to take pain killers only after prescription from the doctor based on the patient's health condition.

- **Hot and cold treatments –** it is a treatment where heat is used to relieve back pain. For example a hot bath or a hot water bottle placed on the affected area, helps ease the pain.

- **Sleeping position -** A patient with back pain could reduce their back strain by changing their sleeping position. If patient practices sleeping sideways, they should draw their legs up slightly towards their chest and put a pillow between their legs. If patients sleep on their back, they should place a pillow under their knees to maintain the normal curve of their lower back.

- **Relaxation-** Relaxing is a vital part of easing the pain as muscle tension caused by worrying. It is proven that people who manage to stay positive despite the pain tend to recover faster and avoid long-term back pain.

- **Active Activities -** Most experts now agree that staying in bed, lying down or being inactive for long periods is actually bad for the back. People who remain active are likely to recover more quickly. Activity can range from walking, exercising and doing routine jobs as normal.

- **Lifestyle -** Regular exercise and being active on a daily basis will help to keep the back strong and healthy. Walking, swimming and yoga are popular choices. The important thing is to choose activities that are beneficial and does not cause pain.

For back pain lasting more than six weeks (known as chronic back pain), it is advisable to take and recommend the following treatments:

- **Exercise program -** It involves about eight sessions over a period of up to 12 weeks. The classes may include exercises to strengthen the muscles and improve posture, as well as aerobic and stretching exercises.

- **Manual therapy -** There are many kinds of manual therapy including manipulation, mobilization and massage, usually performed by physiotherapists.

- **Acupuncture-** This treatment involves inserting fine, solid needles at different points in the body, has been shown to help reduce low back pain.

- **Surgery** – This treatment is usually only recommended as a treatment option when all else has failed. One common procedure, called spinal fusion surgery, fuses the joint that is causing pain to prevent it moving.

2.2 Current Method in Creating Awareness

Awareness is described as a state or the ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. Generally, it is an attempt to raise public awareness of a topic or issue. The theory and practice of public awareness-raising has always drawn heavily on mass communication and social or "social change" marketing. The current trend in the world is by using printed materials, electronic and broadcast media as it has been identified to be the effective tool in creating awareness.

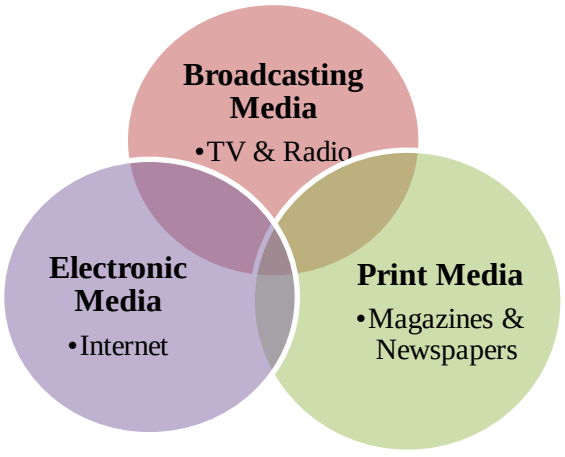


Figure 11 : Current types of channels used for creating awareness

As a whole, raising awareness among people is currently done through the traditional medium such as flyers, talks, documentaries and campaign. The question could be, how effective the current ways of raising awareness have impacted people's life. In 2009, only 16% of internet users clicked on advertisements on a campaign of creating awareness. HIV is the most killing disease worldwide; but more than 60% of people know little about the serious disease as the medium used to raise awareness could be seen has certain limitation to reach out to people due to lack of personal approaches. Therefore, raising awareness among people has always been a matter of concern. Thus, it is believed that persuasive technology could be a new approach in raising awareness via mobile applications.

2.3 Persuasive Technology

2.3.1 Definition of Persuasive Technology

s. Persuasion is concerned with the goal of making the receiver perform a certain action and the link relies on the fact that, apart from coercion, the only way to make someone doing something is to change his or her beliefs (Castelfranchi C., 1996).

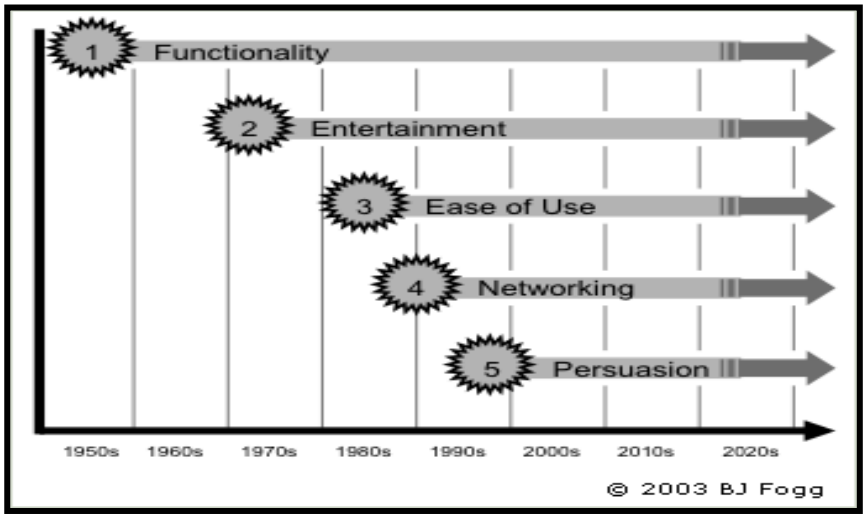


Figure 12 - Evolution of technology approaches

The figure 6 above shows the evolution in the focal areas of interactive technology (Fogg.B.J.,2003). In the past, persuasive technologies were

not significant in our lives. Technology was not ubiquitous, and software was not designed to change behaviors as it was focused on retrieving data and solve the complexity of information. However, the world today has shifted to persuasive technologies as we are surrounded with digital products designed to change what people think and do. Therefore, the definition of persuasive technology is an interactive system designed to change attitudes or behaviors of the users through persuasion and social influence (Fogg B.J., 2003).

Figure 13- Trend in Interactive Technology

Basically, persuasive technology can be seen as a vehicle to influence people's attitudes and bring some constructive changes in many domains such as marketing, health, safety, environment and etc.(Cheng.R.). It also provides an evolution through websites, video games, mobile phones and other technology devices specially designed to enhance human behaviors (Marja, 2008). Thus, the term currently used for persuasive technology is "Captology" whereby it clearly defines that computer as persuasive technology.

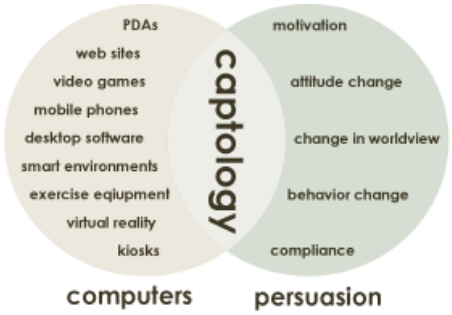


Figure 14 - Captology describes the area where computing technology and persuasion overlaps

Hence, captology focuses on the design, research and analysis of interactive computing products created for the purpose of changing people's attitudes or behaviors (Fogg B.J., 2003). Persuasive technologies are classified based on their three main roles which tools, media and social actors (Fogg B. J., 1998).

- A **medium** can be persuaded by allowing people to explore the cause and effect of a relationship and providing human with vicarious experiences that motivates using symbolic and sensory method. For example, the system allows the person to experience a certain diet to lose weight.
- A **tool** used to assist and lead people to perform certain activities effectively and efficiently. The application that helps in guiding a person through a step by step process of exercising regularly could be an example of a persuasive tool.
- A **social actor** can be persuasive via rewarding people with positive feedback and providing social support. A simple example of a social actor will be an online health expert.

Currently, persuasive technologies have been used in at least 12 domains and the most significant domains are marketing, health, safety and environment(King, P. & Terster,J.,1999). Within the health care field, it is anticipated that interactive technologies will be deployed to take on more than one role at a time. The technology used to persuade people to form a healthy habits and take preventive measures against illness. For example, a simple tool can measure obesity while also giving a reward upon attainment of a personal goal which could be a weight loss in a period of time. If several people are connected to a server through the Internet, then social support can be leveraged, which has been shown to impact motivation and behavior change (Samir Chatterjee, 2009). Therefore, persuasive technology in the healthcare domain motivates people to lead a

healthier lifestyle by mediating prevention and treatment. Such technology is extremely promising in cases where behavior is a key part of maintaining or improving one's health (TU/Eindhoven, 2011).

There are 7 tools that can be used as an approach in the persuasive technology.

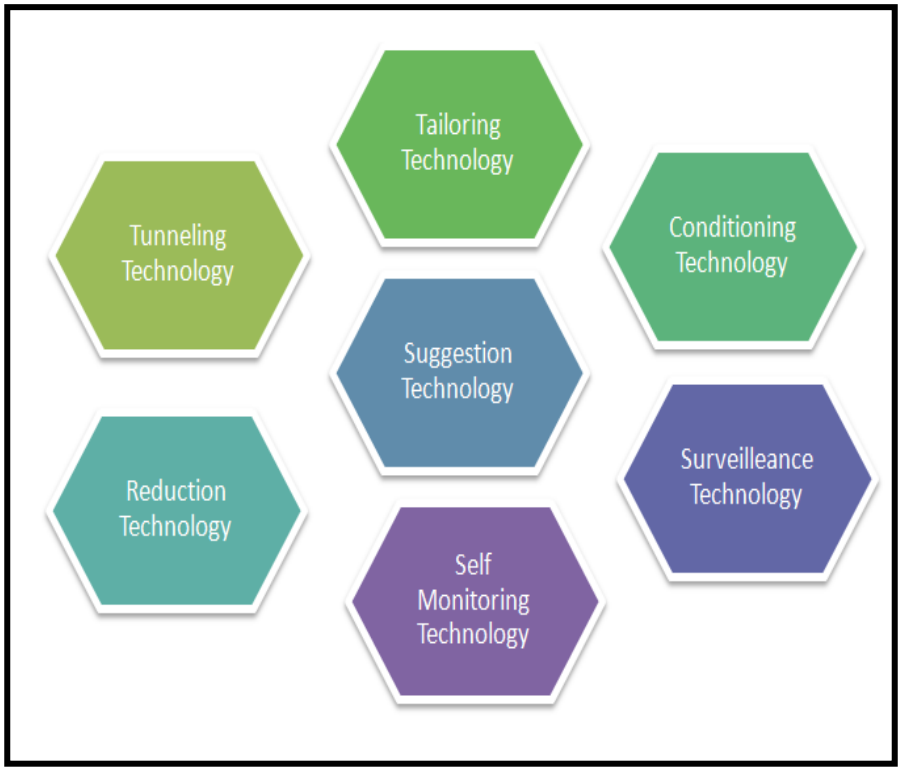


Figure 15 - 7 techniques of persuasive technology to persuade

- Tailoring technology provides personally relevant information to change a person's attitudes.
- Self monitoring technology allows people to monitor themselves so that they can modify their own behavior and attitudes.
- Conditioning technology uses principles of operant conditioning such as reinforcement and shaping to change one's behavior.
- Tunnelling technology leads users to a predetermined sequence of events, step by step process.

- Reduction technology is to reduce the complexity to a simple way of performing activities.
- Suggestion technology creates a good time decision point about a suggested behavior.
- Surveillance technology allows one party to monitor the behavior of another to modify their behavior in a specific way.

Basically, timing and framework is essential in changing attitudes and behaviors. Networking and mobile technologies create higher potential in persuading people at the optimal time and place. There are different principle with persuasive qualities that are applicable in persuasive computing, Kairos, Social Facilitation, Social Comparison and Competition (Fogg,2003)

i. Principle of Kairos

The mobile platform offers distinctive opportunities for persuasion, as it is constantly available to the user and can operate in the appropriate moments for persuasion.

ii. Principle of Social Facilitation

People are likely to carry out target behavior if they know that computer technology is capturing their behavior, or if they can comprehend that others are performing the target behavior along with them.

iii. Principle of Social Comparison

People will be more motivated to perform the target behavior if they can observe through computer technology that others are performing the target behavior.

iv. Principle of Competition

People can be motivated to perform the target behavior if computer technologies invoke human beings natural drive to compete.

There are eight steps outlines as best practices in early stages of persuasive design (Fogg,B.J.,2003).

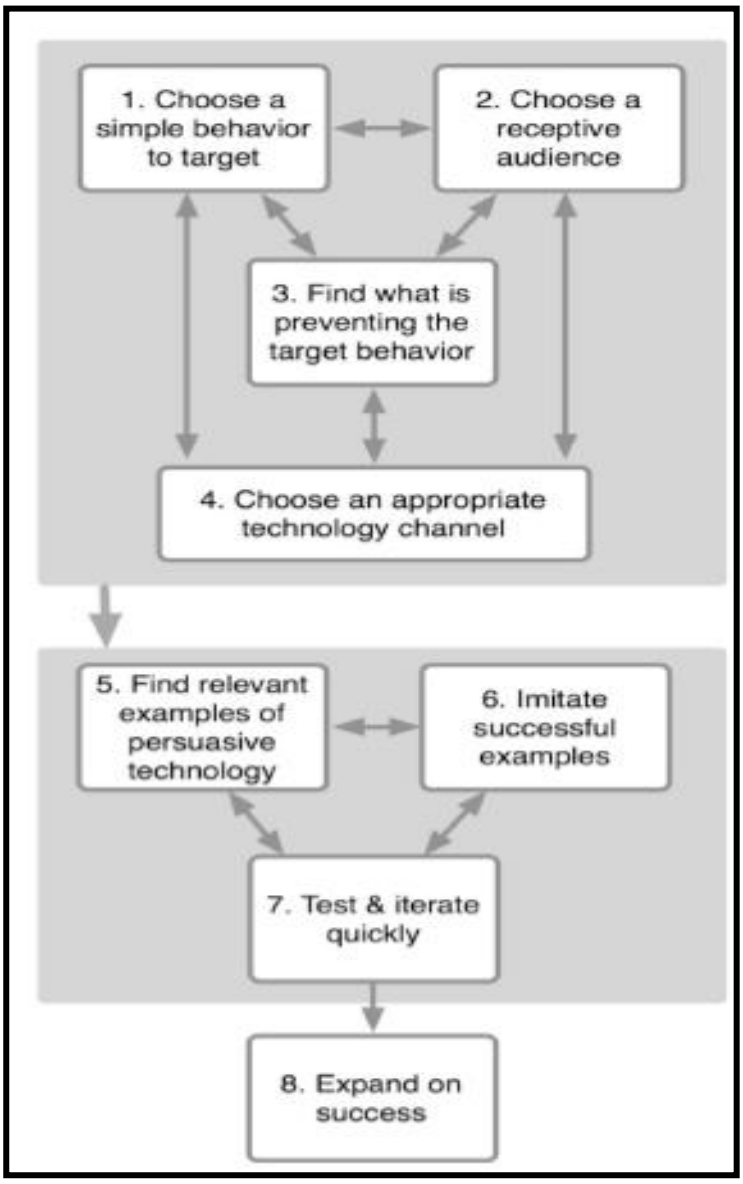


Figure 16 -Eight steps in early-stage persuasive design

i. Step 1 is to choose a simple behavior to target. This is crucial in designing a successful persuasive technology as simplest behavior could lead to achieve impactful behavior. For example,the aim is to reduce students sleeping habits in class. Thus, the target behavior would be stretch for every 20 minutes when prompted.

Therefore, it is a simple behavior that is measurable and getting people to do small things naturally leads to adopting more ambitious behavior in future.

ii. Step 2 involves in targeting the right audience to persuade. Naturally, it should be the audience that is likely to be receptive to the targeted behavior change. Following the example above, the target group will not be all students but students who attend morning class such 8am to 9am and familiar with the technology channel.

iii. Step 3 is basically analyzing the root cause that prevents the audience from performing targeted behavior. The cause could vary from one individual to another but the aim is to find the common problem for all so that there can be a solution for the problem. There are three categories such as lack of motivation, lack of ability of lack of time .

iv. Step 4 is to choose the best channel for the technology intervention. With the increasing number of technology channels for persuasion such as web, software, mobile phones and many others, the challenge will be choosing the right channel in order to match the target behavior.

v. Step 5 is to research on the examples of successful persuasive technologies that are relevant to the invention proposed.

vi. Step 6 is a way to adopt the current successes and reliable method of the proposed invention to the target behavior and audience.

vii. Step 7 us to test various persuasive experience quickly and repeatedly after the imitation of successful persuasive technologies. It is to access the response ideally by measuring behavior.

viii. Step 8 is to scale up the entire invention. This method is to make the targeted behavior more difficult or complex to support different target audience from the same field or others. The

expansion need to be systematic considering the success achieved in step 7.

Similar to human persuaders, persuasive technology conveys about positive changes in many domains by designing applications intentionally to change attitudes and behaviors in a predetermined manner. Computers are considered to be more credible than humans (Fogg, 1997) and hence a better choice for persuasion. There are two ubiquitous trends which are converging and creating a new opportunity in preventive health care (Intille,2004). The rapid improvements in mobile computing devices and the ability to carry these devices almost everywhere makes it possible for technology to be used for health care purposes at places where humans are not welcome (Fogg, 1997, Intille, 2004).

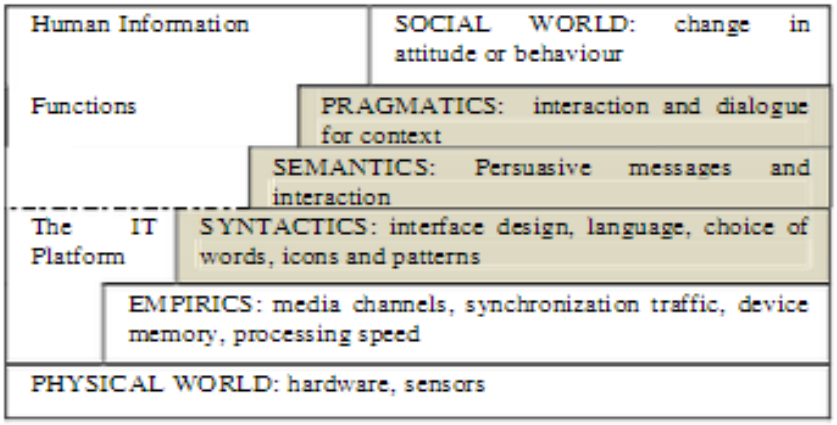


Figure 17- The semiotic framework of Persuasive Technology adoptedfrom (Liu 2000)

Persuasive technology has been used in health care management including self management of chronic disease. Thus , various kinds of persuasive strategies are applied to patients to increase their motivation or change their behavior. When developing applications and framework for health awareness and management, there are several conditions need to be considered. (Olofsson,E, 2010)

Below are the considerations that relate to the research work. (Mukhtar et.al, 2012)

I. The application should strive to encourge used to change attitudes or behavior towards their health management.

II. The application should assist users in determining and specifying health care related goals as well remind the user of achieving specific goals over the time.

III. The application should be able to support the users' objectives and goals by sharing relevant experience with others.

This table below will introduce four applications and the persuasive techniques used to encourage physical activity.

Table 1 – Four application using persuasive techniques.

Health Care Application	Supported Activities	Evaluated Persuasive Technologies	Advantage	Disadvantage
UbiFit – an application to use on body sensing activity interference and a personal mobile display to affect people's sedentary lifestyles	Walking, cycling, elliptical trainer, running, stair machine	Glance able display	- Glanceable display could raise awareness - Persistent reminder	- Garden theme considered corny
MOPET – a wearable system that supervises a physical activity in an outdoor environment	Jogging, fitness	Embodied Agent	- Manage to create the feeling	- 3D agents annoying, distracted and poorly implemented
Houston – mobile phone application for encouraging physical activity by sharing step count with friends.	Walking, running	Social Sharing and competition	- Social sharing of fitness activities - Peer pressure has increased competition in reaching goals	
TripleBeat – mobile system to assist runners in achieving predefined exercise goals via musical feedback, virtual competition and a glance able interface to increase personal awareness.	Running	Competition, glance able display	- Social sharing	

Thus, there are several elements that could be considered as a guideline from the previous innovation using persuasive technologies.

- **Support persistent reminder of the goals (Oliver, N., de Oliveira, R., 2008)**

  Allowing the users to be constantly reminded of his/her behavior which can increase motivation to engage in physical activity.

- **Social Support (Consolvo, S. et al, 2002)**

  The sharing activity state and progress towards a goal, receiving and giving encouragement to increase levels of awareness and motivation.

- **Social Competition (Pivarnik, J., 2003)**

  Leveraging humans natural drive to compete is a factor to consider when aiming to encourage physical activity.

2.3.2 Mobile Persuasive Technology

Mobile computing can be broadly described as computing technology, comprising software, hardware and communications specifically associated with mobility (Zaslavsky and Tari, 1988). Smartphones creates the biggest opportunity to persuade the users (Petersen,D.,2009). Examples of hardware's include palmtop computers, laptops and mobile telephones, with more sophisticated devices integrating and combining functionality. The communications infrastructure comprises technology that enables mobile devices to connect and communicate over a network or directly with each other using wired or wireless technology, or a combination of both.

Mobile phones are an ideal platform to drive long-term transformation. Considering the increasing adoption of smart phones, mobile persuasion

technology increases the potential to persuade, intervene, and reward at the right time and place in many application domains, such as healthcare or environmental awareness (Lane N. D., Miluzzo E., Lu H., etc, 2010). Mobile applications are specifically designed for use on mobile devices and this application can be a general or specific application. The combination of mobile technology allows flexibility of exploring and adopting new ways of working. The adoption of mobile technology for personal use through to corporate application is evident and increasing. The adoption and use of mobile technology for service and application provision has gained a competitive advantage as mobile telephony and the Internet are the fastest growing businesses in the telecommunications market (Guardini et al., 2000).

Table 1 : Prediction adoption of technology by method

Information access by method	
Access methods	Number of users (million)
Internet PCs	549
Internet enabled TVs	134
Mobile phones and PDAs (microbrowsers)	705
Other internet devices	161

Tables 2 show predicted the adoption of technology and information access by a method in the year 2006. In this prediction the existence of mobile computing is significant (Hammed K., 2003).

2.3.3 Mobile Health Application

Based on National Health Service Plan UK (NHS, 2001),there is a forecast on the implementation of providing people a health service fit for the 21st Century which has been interpreted as adopting mobile technology, the recent technology into the health prevention and treatment. The application of mobile computing to health care has typically not been as extensive that of other technologies, such as medical imaging. But, developments in mobile computing and communication

have now enabled this technology to be applied in ways previously unseen (Istepanian & Shimuzu, 1999). As mobile has been a new culture in the society, the expectation and requirement for a supporting health care service will, no doubt, increase in corresponding. (Anogianakis & Maglavera,1997). A Tele medicine application currently focused on mobile phones as user terminals. (Istepanian R, 2004).

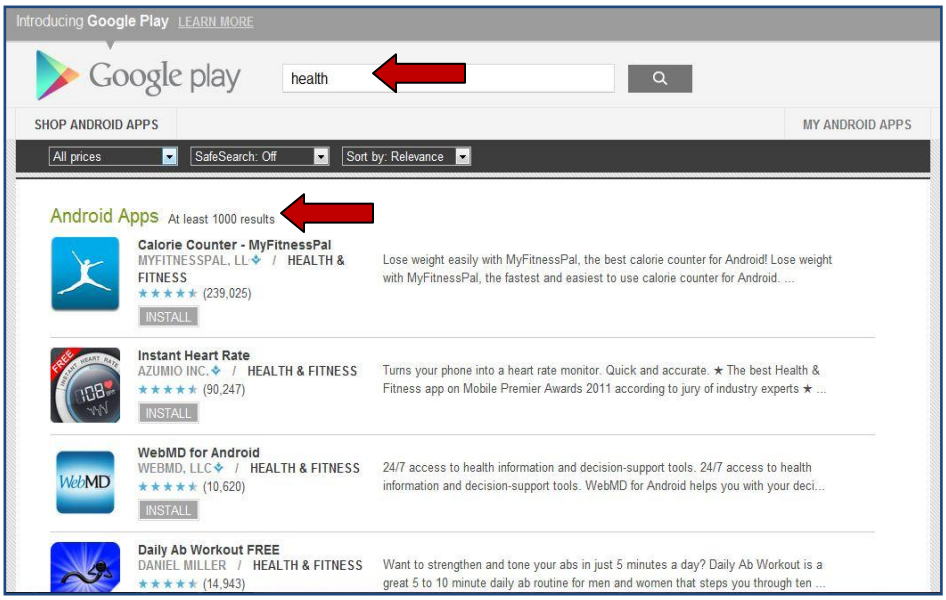


Figure 18 - Google play results on the health application available in the current market

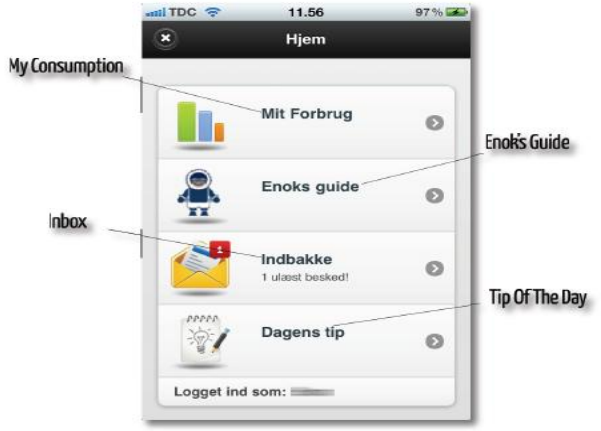
According to a Google Play online search on health application, users will be able to obtain at least 1000 results on health application that is available for use.

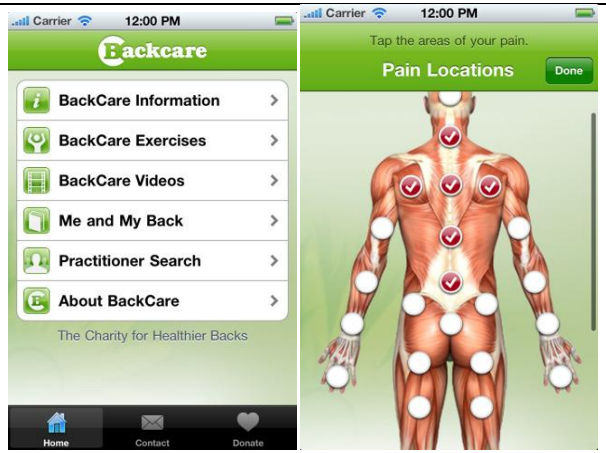
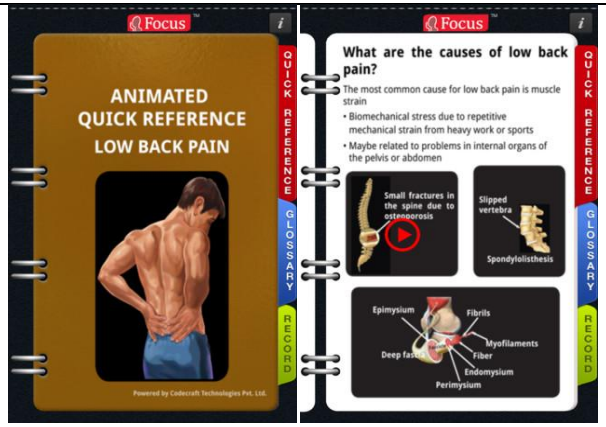
Therefore, the results indicate that people are now moving toward the trend of mobile health care which could be handy at the same time assist them in monitoring their health condition at anytime and anywhere.

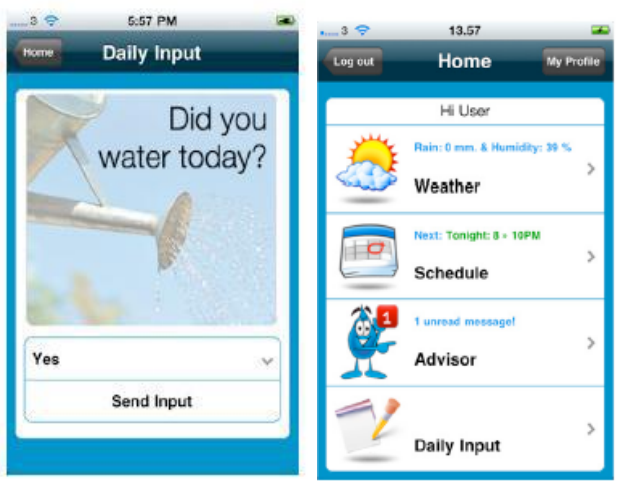
2.3.4 Existing Mobile Application on Back Pain

NAME	IMAGE OF THE PRODUCT/INNOVATION	APPROACH	DESCRIPTION
DailyAlert (Andong Z., Jong.H L., and Andreas T.,2011)	 **Figure 59 : DailyAlert**	- Mobile Persuasion Toolkit for Smart phones	DailyAlert offers two different applications which are a Wii-based home health monitoring system for elders with chronic illnesses and a mobile dietary analysis and persuasion application.
BackPainRelief (Bigo,2012)	 **Figure 20 : Back Pain Relief**	- -Mobile Application - Back Pain Relief Ebook	BackPain Relief is an application ebook called "Stop Sciatica Now! The Definitive Guide". Helps user to understand their spinal column and other related back pain matters.

Audio Book - Back Pain(Twayesh, 2012)	 **Figure 61 : AudioBook**	- Mobile application - Social awareness	Audio book back pain is an audio book application that provides information on all types of back pain. It uses text to speech technology and the content is available in English.
Molarcropolis (Soler, Zacarias, & Lucero, 2009)	 **Figure 22 : Molarcropolis**	- Mobile game for adolescence	Mobile Persuasive Game to Raise Oral Health and Dental Hygiene Awareness. It is a scrolling puzzle platform game where players must protect the oral world from external elements that try to cure the mouth. Uses three persuasion strategies to reach the target behavior of raising oral health: 1) Cause-and-effect-simulation, 2) suggestion 3)attractiveness

Movipill (Oliveira, Cherubini, & Oliver, 2010)	 **Figure 23 : Movipill**	- Mobile Game	Movipill is a mobile phone-based game that persuades patients to be more adherent to their medication prescription by means of social competition, targeted at elders.
Power Advisor (Pathmanathan, 2011)	 **Figure 24 : Power Advisor Application**	- Mobile web app - Integration with Automatic Meter Reader - Expert's advice - User input	Power advisor is a mobile web application that promotes better electricity consumption by providing information on their usage. The information from the user's automatic meter reader is taken and shown to the consumer at real time and persuades user to conserve electricity.

BackCare	 **Figure 25 : BackCare**	- Mobile application - Informational - Videos on exercise - Location tracker	BackCare is a free mobile application for iOs that provide information on Bac Care for users in UK. Information ranges from general back care info, exercises for back care, as well as where to find a practitioner nearest to user. (Apache Solutions Ltd, 2010)
Animated Quick Reference for Low Back Pain	 **Figure 26: Animated Quick Reference**	- Mobile application - Informational - Animated contents	The Focus Animated Quick Reference series provides an organized reference source full of information and facts that describe various diseases and disorders that affect the human body. (Focus Medica, 2012)

LumoBack	 **Figure 27 LumoBack**	- Mobile application - Custom sensor - Useful & attractive data representation - Real time information / Reminder	LumoBack is a wearable sensor patch. This patch provides a vibration when user slouches, and the application can receive the information and display it to the user in cute graphical interface. It can also process trend data to determine whether user's posture is steadily improving over time.
Smart Garden Watering Advisor (Pathmanathan, 2011)	 **Figure 28 Smart Gardening Watering**	- Mobile app - Updated information - Expert‟s advice - User input	SGW is promoting water conservation by providing tailored information technologies to gardeners to help promote water conservation. The application includes weather information, expert‟s recommendation and community information to guide gardeners in deciding whether to water their plants today.

Nike + iPod	 **Figure 729 - Nike Ipod**	- Sensors - Real time information - Social features	Nike + iPod is a pair of devices to form a system, combining a sensor that is used inside the insole of the shoes and the mobile application inside the user‟s iPod or iPhone device. The application features tracker on the user's running activities as well as sharing the user's accomplishment with other users around the world.
HAPItrack	 **Figure 30 - HAPItrack**	- Personal motivator - Sending messages - Real time information - It is packaged under application and online dashboard - Provides personalized coaching progress to keep active.	The HAPItrack is an activity tracker that motivates you to be more active, helps you stay in shape and captures your HAPImoments. Located in your pocket or clipped to your belt, the HAPItrack saves all the data related to your physical activity. It measures steps, distance, workout time, calories burned in real time and motivates you to reach your daily objectives.

There are plenty of mobile applications for back pain available in the market. It is believed that more application will be developed due to the demand on mobile health applications to assist health well being. Based on the author's perspective, there are several limitations identified on the current application. There are :

- Many applications are focused on giving users information on the back pain and some even has features such exercise manuals to guide users to practice.
- There are less user interaction, graphic and personalization in the current application.
- Mostly all applications are connected to random videos on back pain on YouTube
- Some application focuses on the overall backbone

Thus, a new mobile application using persuasive technology could be developed with some personalization and guidance on exercises related to back pain with interactive features could be implemented to cater the demand of mobile back care application at the same time raise awareness among users on back pain.

There are several elements of persuasive techniques were identified that could be useful in this development of MyBackRelief Application.

- The user of human sensors for effective learning which is the video allowing users to see, to touch and the hear before performing the exercises
- Tailored information on specific tips from the experts as a guidance for users

- Reducing complexity with the implementation of simple navigation design, minimum use of color and reasonable font for human interaction.
- Using the method of tunneling in providing step by step instruction for the list of exercises suggested for back pain.
- Suggestion technology is absorbed into the application whereby persuasion is used as a suggestion options for users to be reminded to perform exercises gradually.
- Rewarding system is introduce as a matter of motivating the users besides giving the empowerment for users to self monitor their performance on their back care daily.

2.3.5 Android Market

There are more than 6 billion mobile subscribers currently worldwide. Powering more than 250 million devices, the Android OS runs on half of all Smartphones shipped with a user base increasing by 700,000 subscribers each day.

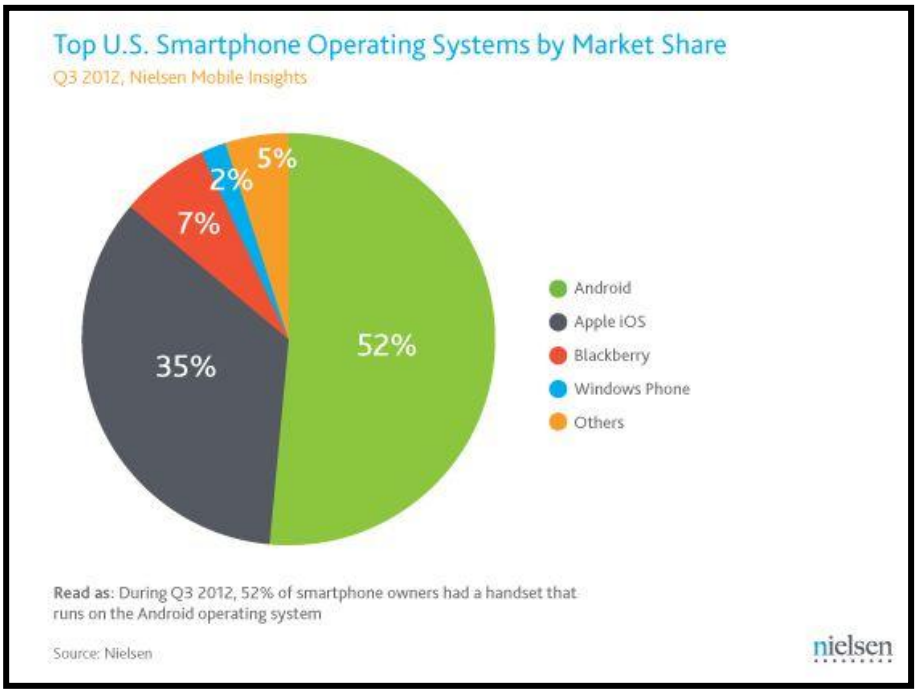


Figure 31 - Total US Smartphone Running on different OS

Hence, Android is a Linux based operating system (OS) that is designed and published by Google. By providing an open development platform, Android offers developers the ability and tools to build innovative applications based on creativity and demand from the markets. In year 2011, a total 115 million unit number of Google's Android shipped on 60 million Smartphones.

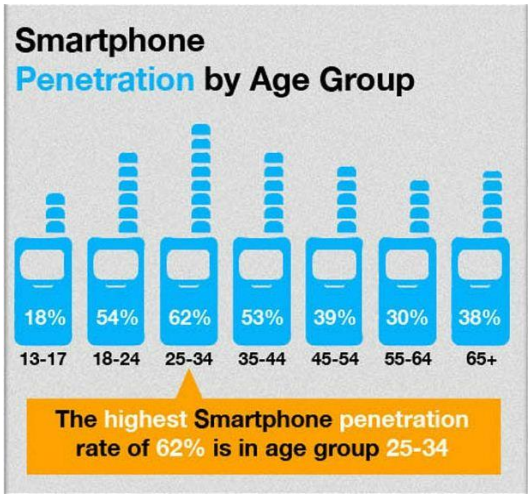


Figure 32 : Smart Phone penetration according to age group

Most mobile phone and smart phone developers choose to manufacture their product based on Android OS. The android was listed as the best selling Smartphone platform worldwide with more than 200 million users in the year 2011. The market share of the Android OS is increased to 48.5% in US market surpass Apple. Android has the highest **market share** with 46.9% – the iPhone has 28.7%. A higher percentage of Android users are below the age of 34 in comparison to iPhone users. Over **300,000 applications** have been developed in the past 3 years in Google Play and have been downloaded 10.9 billion times.

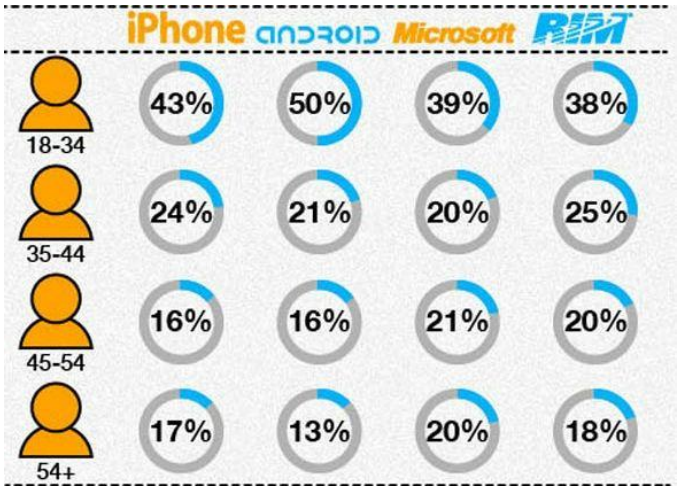


Figure 33 Penetration of Smartphone based on types of OS and age group

CHAPTER 3

METHODOLOGY

It is crucial to choose the right methodology in developing software or application. Different methodologies could cater different needs of a project in a period of time. Thus, this chapter will elaborate on:

- Methodology chosen
- Project phases
- Methods of data collection
- Data Representation
- Gantt chart
- Tools for development

3.1 METHODOLOGY

Rapid Application Development (RAD) is a development life cycle designed to provide much faster development and higher-quality results than those achieved with the traditional life cycle. RAD also enables organizations to develop strategically important systems faster while reducing development costs and maintaining quality. This is achieved by using a series of proven application development techniques, within a well-defined methodology (Beynon-Davies, 1999).

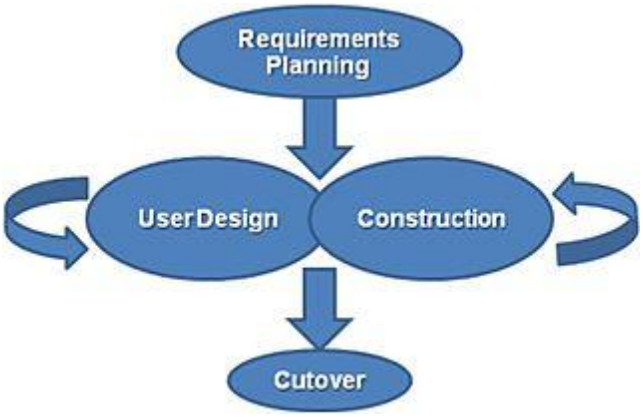


Figure 34: Describes the processes in Rapid Application Development (RAD)

3.2 PROJECT PHASES

Phase 1: Requirements Planning

In the RAD life cycle, requirements planning incorporates elements of the traditional planning and analysis phase.

1. ***Define research problem*** **-** For this project, the problem has been identified where the need to persuade back pain patients to change their attitudes and behavior to constantly exercise via mobile applications.

2. ***Review concepts and theories/ Review previous research findings*** - Critical analysis of the literature is conducted to have a better understanding of the research area and to review for any existing system in the market.

3. ***Gather project requirements/Data Gathering –*** To gather data and information on the user requirements using different methods of data collections.

Phase 2: User Design

During this period, users interact with systems analysts and develop models and prototypes that represent all system processes, inputs, and outputs. It is a continuous interactive process that allows users to understand, modify, and eventually approve a working model of the system that meets their needs.

Graphical User Interface

In the figure below, it shows some of the graphical user interface planned for the application. There were many iterations made in order to suit the system.

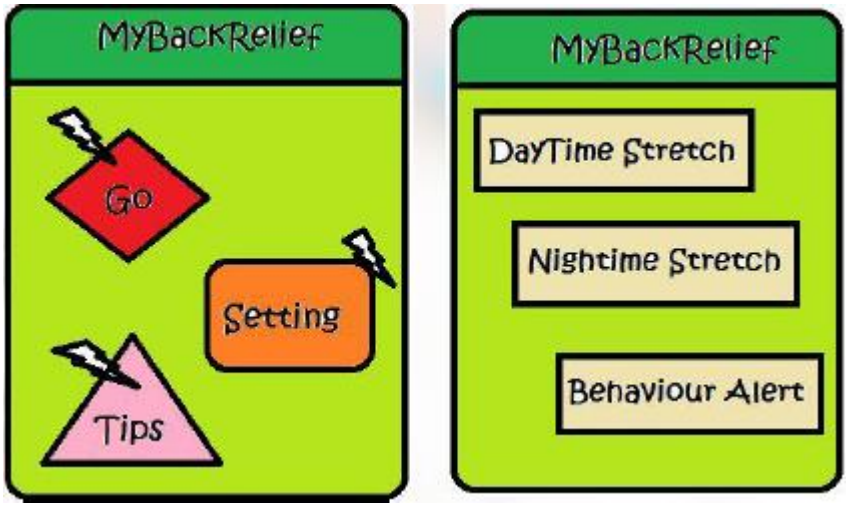


Figure 35 – Early designs for the main menu and go functions for the back pain application A

Figure 36- Early designs for the main menu and go functions for the back pain application

The user design phase determines how the application will be implemented in the real environment. In this case, the application that will be developed will act as a companion to remind and provide right guidance to improve health state of back pain besides creating awareness using persuasive technology. The illustration of the interface is done based on the findings received from requirement planning stage. In order to complete this phase, Android Development toolkits are needed.

The design strategies were as follows :

- Tailored information
- Expert's Recommendation
- Personalization
- Persistent reminder of the goals
- Reward for consistency
- User Interface Designs

Framework

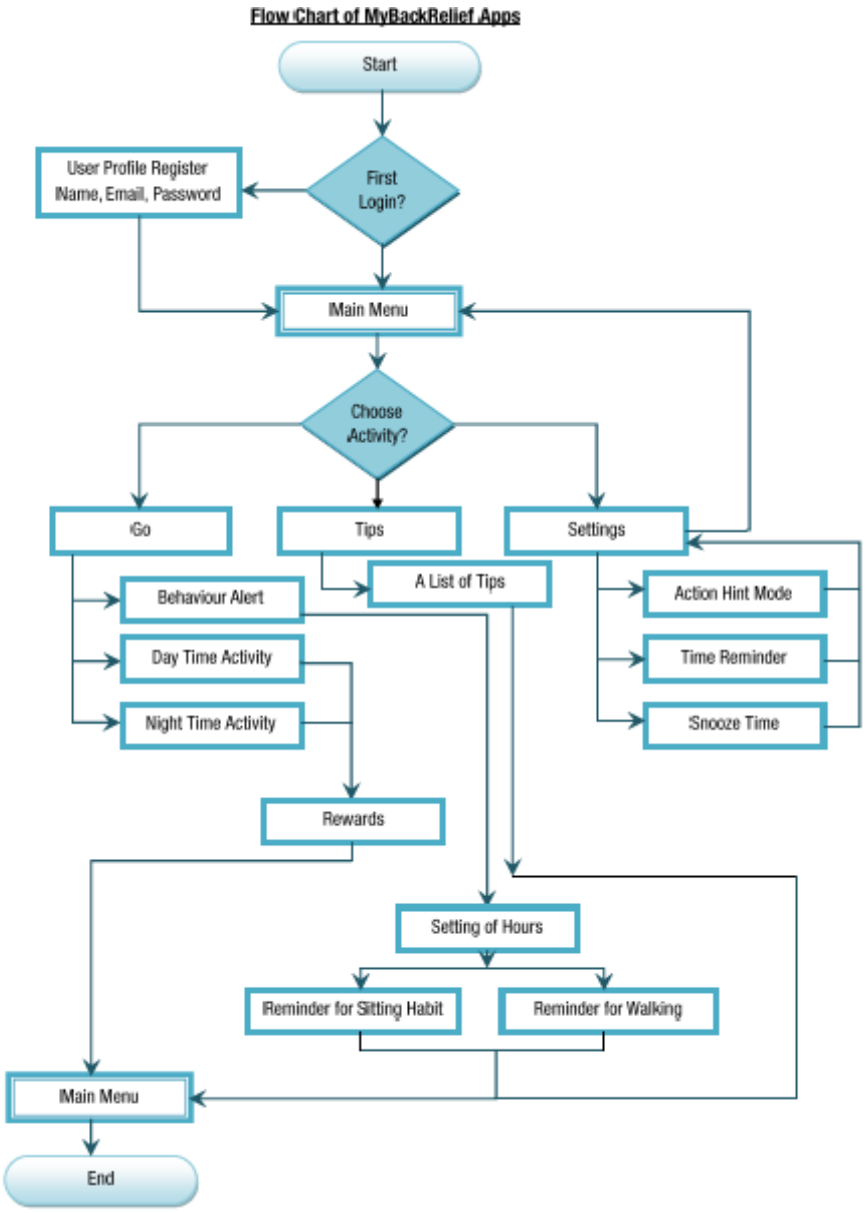


Figure 37- Flow Chart of MyBackRelief

The figure above shows the core user interaction with the planned system. The intended user will have to go through the following process in order to use the application.

Phase 3: Construction

This is the development phase where it is focused on the development and the implementation of the project. It is a process of converting a system specification into an executable system. This involves the actual development of the system. The tasks involved are programming and application development, coding, unit-integration and also system testing.

Phase 4: Cutover

Cutover is the delivery of the new application system to its end users. Planning for cutover begins early in the RAD process as it revolves rapidly. Cutover involves activities such deployment, including testing the system, training users, dealing with organizational changes, and running the new and old systems in parallel, but all these activities occur on an accelerated basis.

User Testing

The testing phase is divided into two phases which is experts opinion and user testing with selected users. In the usability test, the famous System Usability Scale (SUS) will be used because of the reliability in interpreting subjective issue especially in terms of system's usability and learnability.

i. Experts Opinion

To record the response on the usability and reliability of MyBackRelief application, an interview will be conducted with the physiotherapist from Hospital Pantai Rehab Centre, Ipoh. It is crucial to verify the information and exercises embedded in the application meet the objective of the entire project in creating awareness on back care among back pain patients.

ii. Application User Testing

An email with application and user manual will be sent to a random sample group of people from age range 21 to 45 years old regardless of gender. The users are required to utilize the application for minimum 3

days and answer a set of questionnaires. The questionnaire will be tested on several main scopes in order to ensure the success of MyBackRelief. For example:

- The ease of use in using the application
- The capability to understand the exercise instructions
- The usefulness of the application
- The user's perception of the application
- Feedback for improvement

3.3 SAMPLE DESIGN

3.3.1 DEFINING THE POPULATION

An acceptance survey or questionnaires will be conducted among UTP management staff. They are the targeted population and the first users of the proposed system. It will include staff from age range 21 to 50 years old, selected randomly from different departments.

3.3.2 SAMPLE SIZE

The estimated total number of management staff is around 150. Due to the time constraint, from the overall population, about 40 respondents will involve in the acceptance survey and questionnaires.

3.3.3 SAMPLE METHOD

In order to conduct the survey, a probability sampling method is chosen. For this type of sampling method, it is required to decide on the sample population. In this research area, the sample population has been highlighted and every element of the population has an equal chance to be selected that leads to the calculation of the selected sample. On top of that, there will be no bias if the sampling is properly conducted (Doherty, 1994). Precisely, the random sampling method will be applied for this research study seeing that conducting a survey is used as one of methods for data collection.

3.4 METHODS OF DATA COLLECTION

Data gathering will be conducted by using sources as listed below;

- Interview with a physiotherapist at KPJ Medical Centre, Ipoh to have a more comprehensive understanding on the current system implementation for back pain patients and what can be their requirements or recommendation.
- Acceptance survey or questionnaires will be forwarded to the related populations which are back pain patients from two different groups (20 respondents aged from 18 to 29 and another 20 respondent's aged range from 30 and above). The total population size would be 40 respondents. The survey will include both open-ended and close ended types of questions.
- Theoretical information will be gathered through review of related literature of current practices to treat back pain and the use of persuasive technology in the medical field.

3.5 DATA REPRESENTATION

Once data collection is complete, interpretation and analysis of data will be carried out to gather the information in both qualitative and quantitative methods.

- Qualitative Method: It concerns with the views and opinions of the sample population derived from the interviews with regards to how mobile application on back pain works. At the same time, it answers the 'why' questions which leads to a clearer view on how the application should be implemented.
- Quantitative Method: This method is concerned with the initial hypothesis made at the beginning (McBride & Schostak, n.d.). In this research study, the hypotheses will be;
    - **H0**: Back pain patients have less awareness on back pain exercises and are not motivated to perform exercises persistently.
    - **H1**: Back pain patients are aware of back pain exercises and are highly motivated to perform exercises persistently.

At the same time, this method uses numerical evidences to support the data gathered from the questionnaires or acceptance survey that will be carried out to the specific respondents. The data will be depicted in graphs and charts with percentages to be able to draw an informed conclusion.

3.6 GANTT CHART

See appendix A (Gantt chart)

3.7 TOOLS

3.7.1 Hardware

The debugging process during the application development requires a target machine connected to the development machine. The development machine is used to install and run Adobe Photoshop, Android SDK and Eclipse and other tools for the purpose of development only. Meanwhile, the target machine here is referring to an Android Smartphone connected to the development machine using USB cable.

Below are the specifications of the hardware used in the development of Stretch.

Development Machine Specification (CPU unit)

- Processor – AMD Turion X2 Dual Core (2.20ghz)
- RAM – 3.00 GB
- Platform – Microsoft Windows 7 (32-bit)
- Browser – Google Chrome 20.0.1132.57/Mozilla Firefox

Target Machine Specification (Samsung Galaxy Ace)

- CPU – Qualcomm MSM7227 800MHz
- GPU – Adreno (200GPU)
- RAM – 1GB

- Platform – Android 2.3.6 (Ginger Bread)
- Internet – 3G, GPRS, EDGE, Wi-F

3.7.2 Software

Application/Android Development

Eclipse (free and open source software)

For the development of the mobile application, the Eclipse for Android was used. It allows anyone to create software applications for the Android operating system (OS). It uses a graphical interface that allows users to drag-and-drop visual objects to create an application that can run on the Android system. This is suitable to meet the prototype requirement and the time constraint of the project.

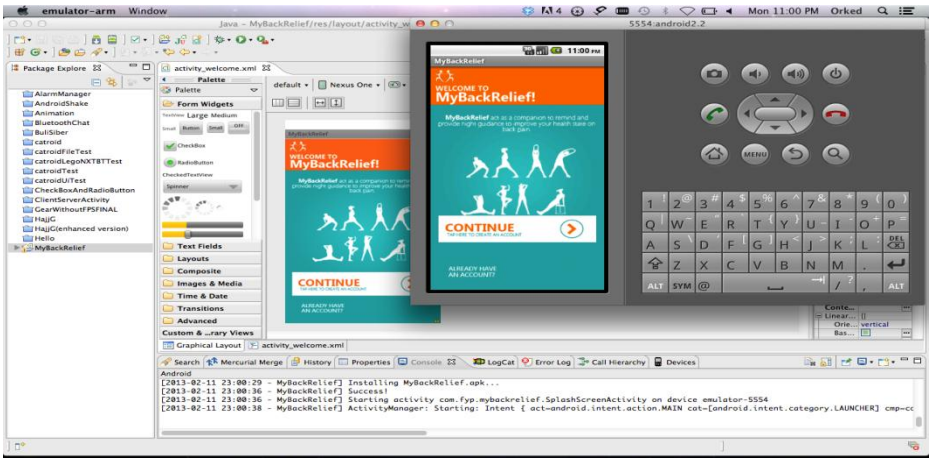


Figure 38 -Application Development Screen

Graphic Development

Adobe Photoshop CS5

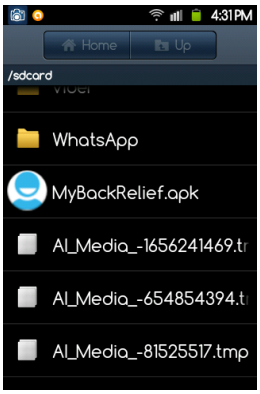
Adobe Photoshop is a popular designing application that is used to create graphic designs and photo manipulation. In this system, it was used to design the interface as well as components such as characters and buttons.

3.8 Running the application

In order for the user to run the application, the installation file has been pre-packaged though the software tool for the user to download. As a result, a file will be created with (.apk) extension, which could be easily downloaded and run on any android mobile. This file could be transferred into the intended mobile through USB connection.

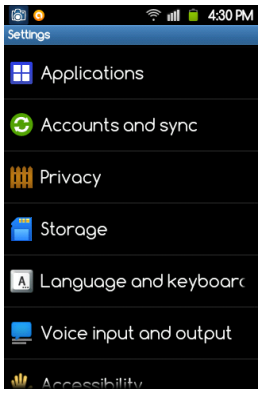
Below are the steps for configuring:

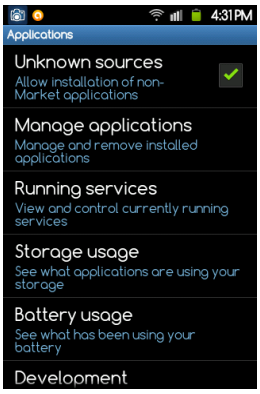
i. First would be transferring the application (MyBackRelief.apk) into mobile via USB connection.



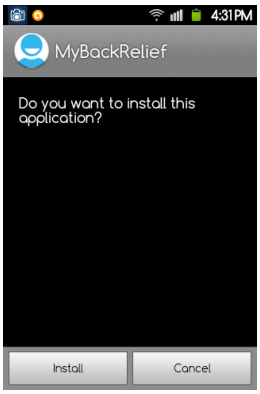
ii. Before installing the application, there are some configuration needed to allow an unknown source application to run in the mobile as the application is yet to be certified for use. Thus, the user needs to go to the phone setting and tick unknown source in the application tab. Once the user has ticked on the unknown sources, it will allow installation of non market applications.

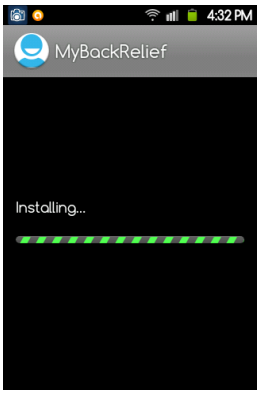
SETTING>>APPLICATIONS>>Unknown Sources (Tick Yes)



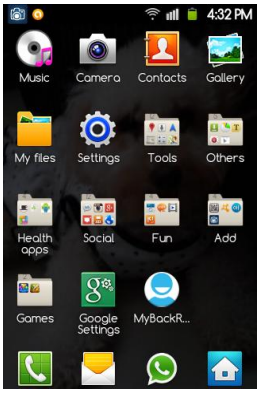


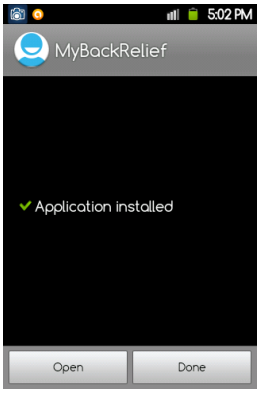
iii. To proceed, the user can navigate to the directory to retrieve the transferred file of MyBackRelief.apk and run the installation file.





iv. After the installation occurs, the user could easily click done and retrieve the application installed on the application list.





3.9 Problem and challenges

During the progress of this project, many challenges and hurdles were faced along the way. This section would highlight the problems faced and the changes made within the period.

i. First for most, the final year project structure in Universiti Teknologi PETRONAS has been changed from one year period of time to 8 months. Thus, this resulted in a shorter period of time in completing two phases which are Final Year Project I and Final Year Project II. Therefore, a proper planning was outlined in order to complete the entire project successfully.

ii. As for the data gathering, the author had to communicate with several hospitals around Ipoh and Batu Gajah in order to survey on back pain. Due to some protocol matters, there was a delay in data collection. However, persistent follow ups have contributed in creating a relationship with the Hospital Pantai Physiotheraphy Rehab, Ipoh for data gathering on back pain.

iii. During the development of the application, there were some difficulties in embedding videos into the application. With the assistance of some experts in forums online, the author manage to solve the problems effectively.

iv. For the application testing, the issues faced was to engage users to use the application for a few days to experience the functionalities of the application. Thus, a user manual was prepared to guide users to utilize the application for minimum 3 days before the post survey was conducted.

CHAPTER 4

RESULTS AND DISCUSSIONS

This chapter discusses on all of the results collected from most of the phases in the system development process. The result helps to support the evidence towards achieving the objectives together with the discussion. This chapter will describe on several main aspects mentioned below.

4.1 Literature Review Findings

From literature review research, the findings are:

- Back pain is the most neglected disease that could be a chronic disease if no preventive measures taken at the early stage
- Low Motivation is one of the main reasons that people do avoid performing certain activities
- Thus, the use of persuasive technology in mobile application could be an effective way to motivate people to perform certain actions as there are 91% of people worldwide spend their time on mobile compared to desktops which is only 79%.
- A simple approach of persuasive technology can be developed by the emerging Android market to raise awareness and motivate back pain patients to perform simple exercises to improve their health state.

4.2 Declaration of contributions

MyBackRelief is the continuation a research project on back pain guide which is Stretch. According to Zeffree,K.,2009, Stretch is a mobile application using persuasive technology to motivate users to perform exercises. It has video featured to guide user to exercise and reward system to motivate users.

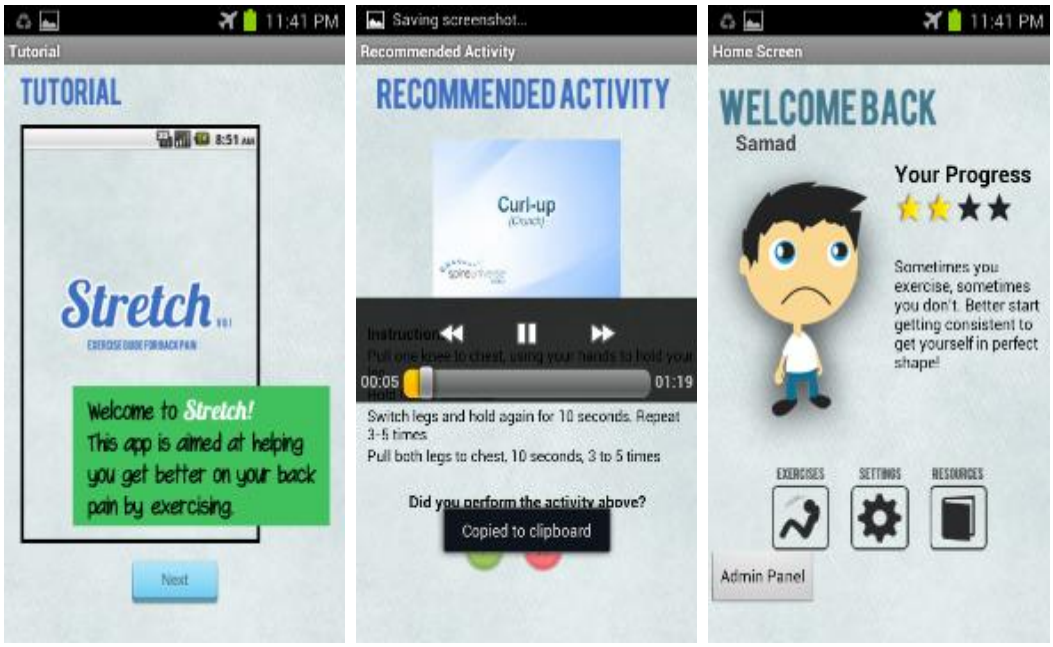


Figure 39 : Screenshot of the main home screen for the user character, recommended activity and profile and menu to navigate to other sections.

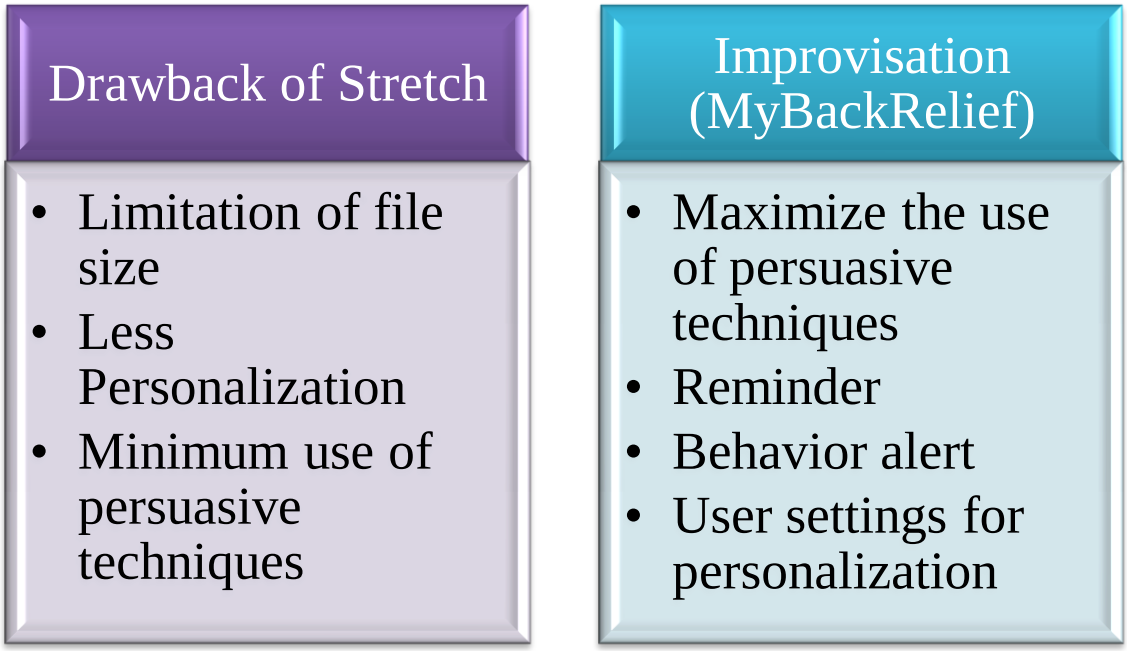


Figure 40: Comparison between existing solution with a proposed solution

4.3 Result of Pilot Study

Before the system was implemented, a pilot study was done earlier in order to understand more about the scenario in this problem. A set of questionnaire has been issued to 100 participants. Most of the participants were young adults from the age of 20 to 28.

Participants were given the questionnaire through email and social network. This question aims to help the developer understand the general perception on the issue of back pain and how they manage it.

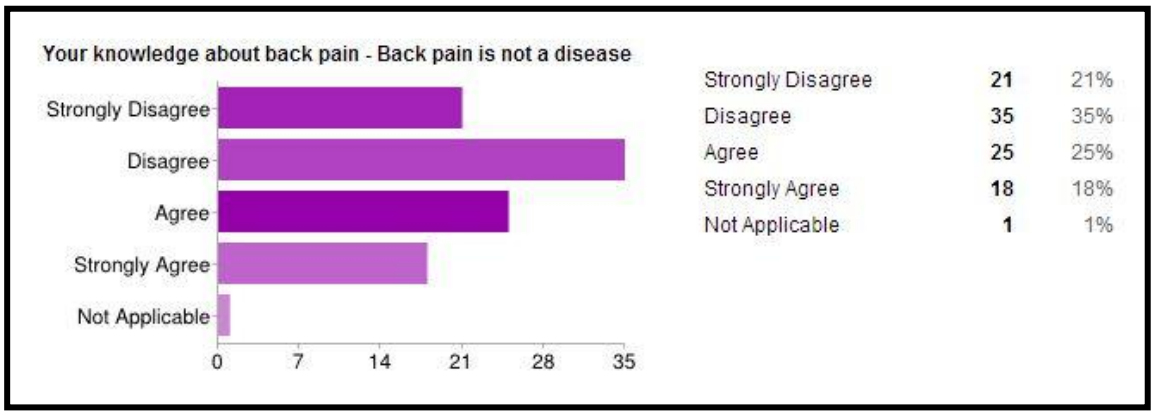


Figure 41 - Response to back pain is not a disease

Analysis - Apparently most people feel that back pain is a disease. This supports the problem statement of the project to people not having the right information about back pain.

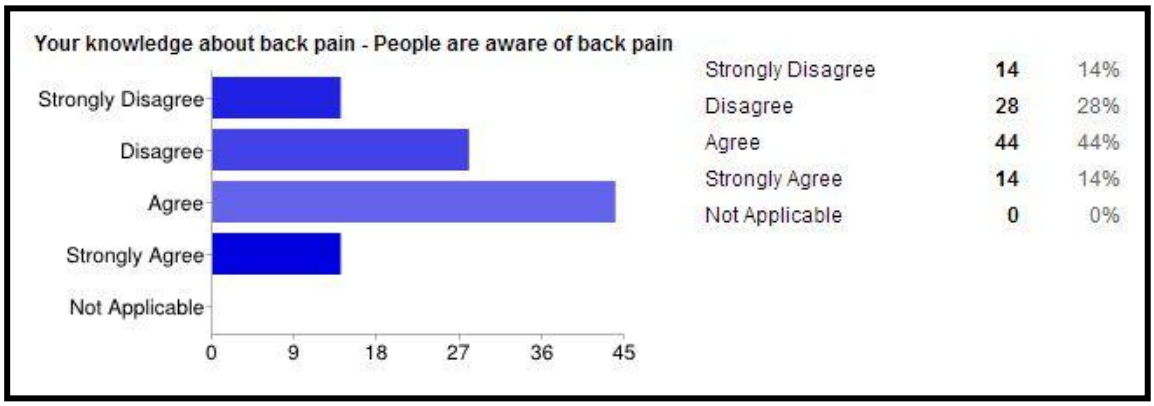


Figure 42- Response on user's awareness of back pain

Analysis - Most people agreed on their awareness of back pain. However, a large number of respondents are still not aware of back pain. Thus, it could be relevant to the project in order to create awareness as a whole to the public.

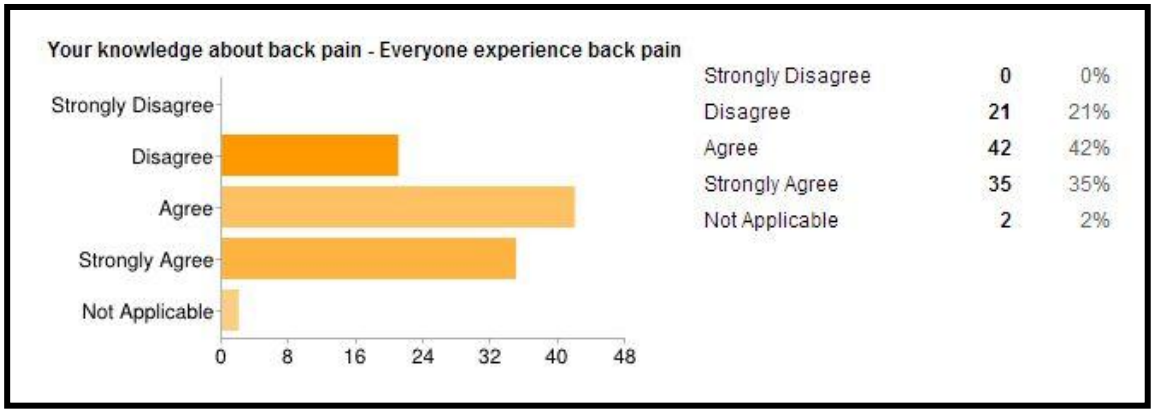


Figure 43 – Response on user's experiencing back pain

Analysis - Apparently most people have experienced back pain before. This supports the relevancy of the project as well as the literature reviews.

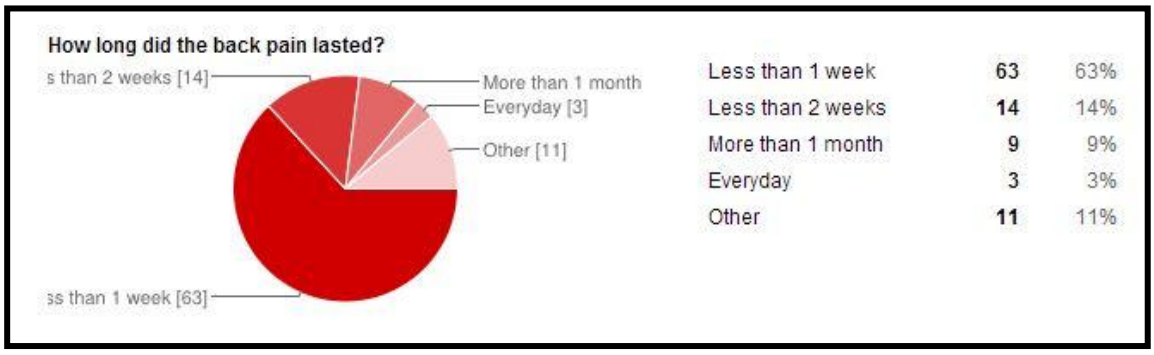


Figure 44 - Response on user's period of time back pain lasted

Analysis: Most respondents experience back pain for less than 1 week. The contributing factors could be incorrect sleeping posture, sitting posture and etc.

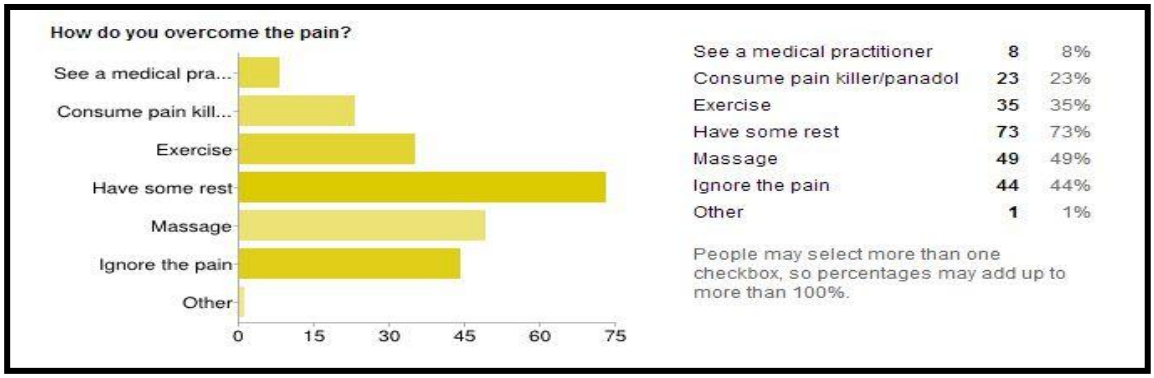


Figure 45- Response to how users overcome back pain

Analysis: Most participants have not or will not go to a doctor for back pain. One potential factor is that back pain is not considered a serious symptom thus respondents tend to just rest and assume that the pain will be relieved.

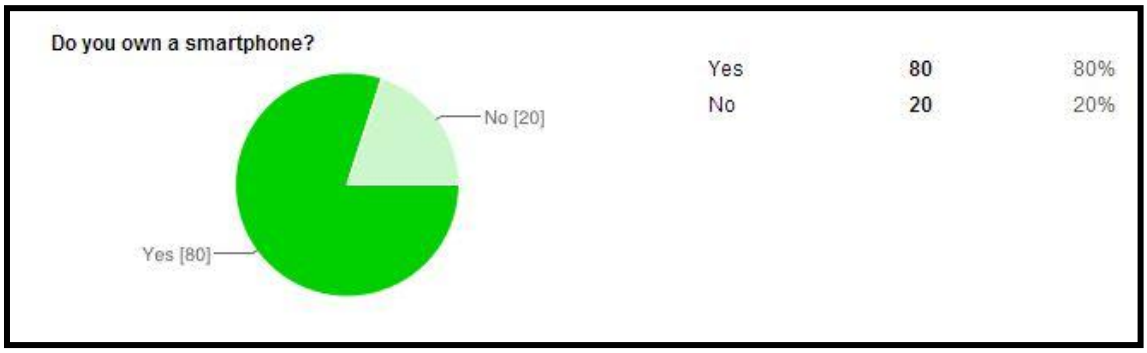


Figure 46 – Response on the percentage Smartphone respondents using a Smartphone

Analysis: According to the grapevine, most respondents do own and use a smart phone whereby it supports the relevancy of implementing the project on a Smartphone platform.

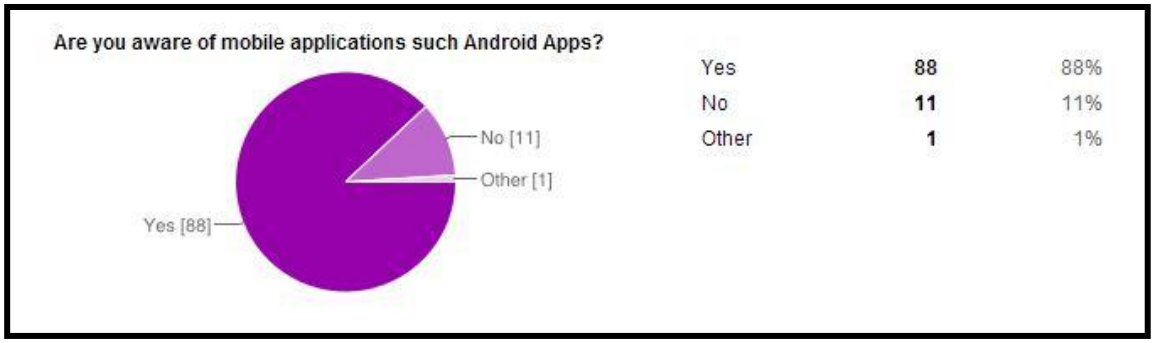


Figure 47 - Response on respondents' awareness of mobile applications

Analysis: Basically, the respondents are aware of the android applications accessible via smart phones. Therefore, developing an Android application could be the most feasible one as people are now into the mobile world.

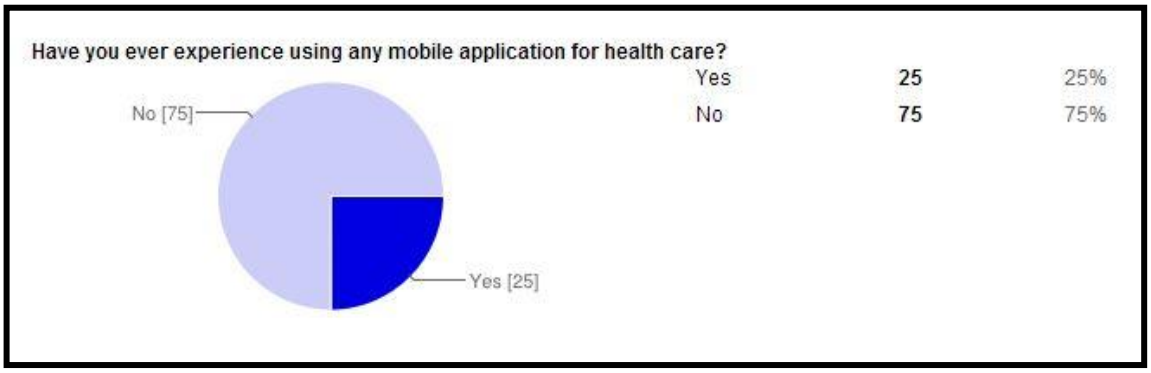


Figure 48 : Response on respondent experience using any health care applications

Analysis: The pie chart shows that most of the respondents have no experience in using a heath care application. Hence, it gives a unique opportunity for this project to venture into the health care division on mobile.

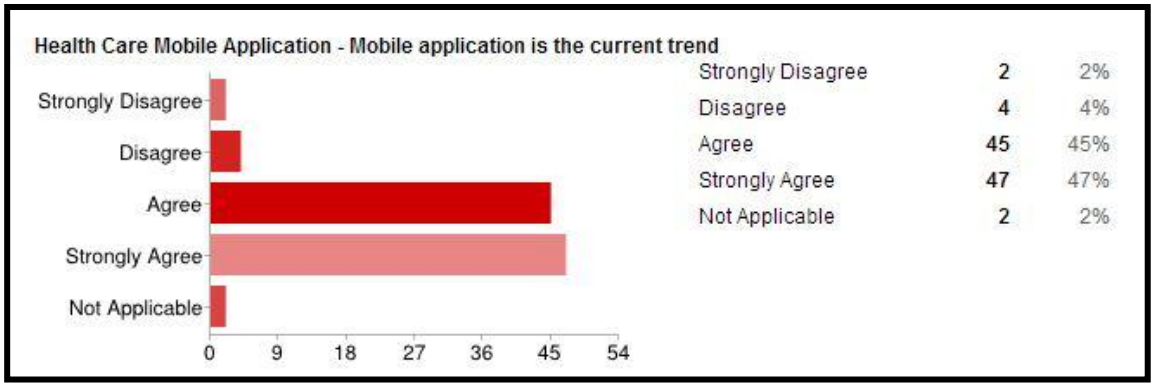


Figure 49 - Response on respondents' feedback on the current health care mobile application

Analysis: It has been relevant through the survey to conclude that the mobile application in smart phones is the current trend among most people. Thus, designing and developing a health care application via mobile technology could be the best method in raising awareness on health care.

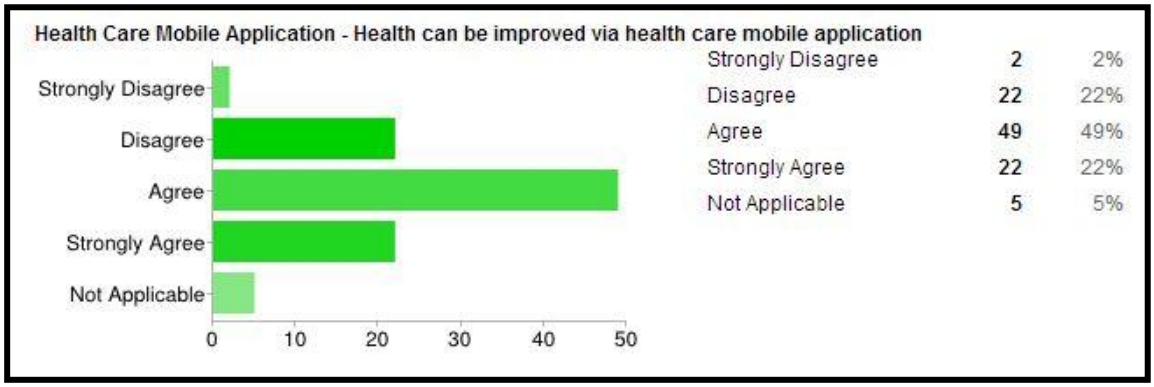


Figure 50 - Response on respondents believes whether health can be improved via health care applications

Analysis: Apparently most respondents believe that health care could be improved via health care applications as it could be the best companion to alert and notify daily.

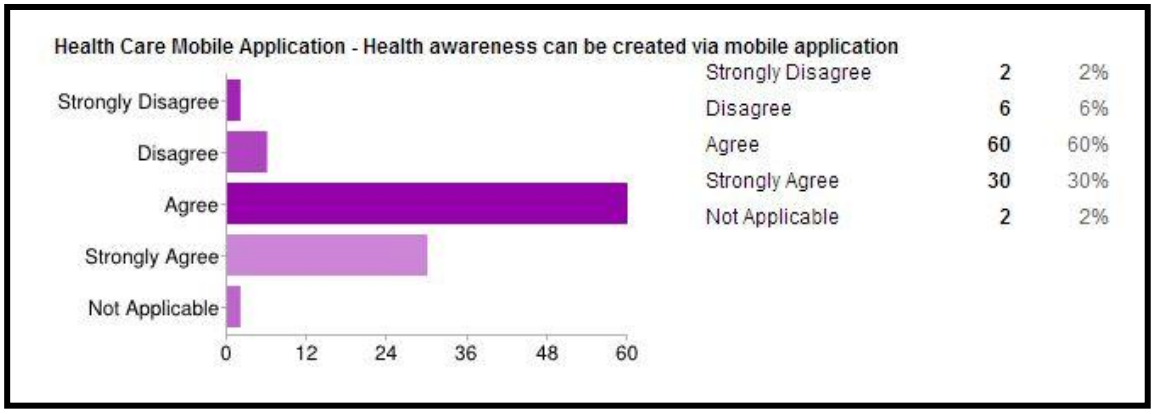


Figure 51 - Response on respondents believes on health awareness can be created via mobile applications

Analysis: It seems that most respondents agree that health awareness can be created via mobile applications. This could show the relevancy of the objective for the project in raising awareness among users about back pain using mobile technology.

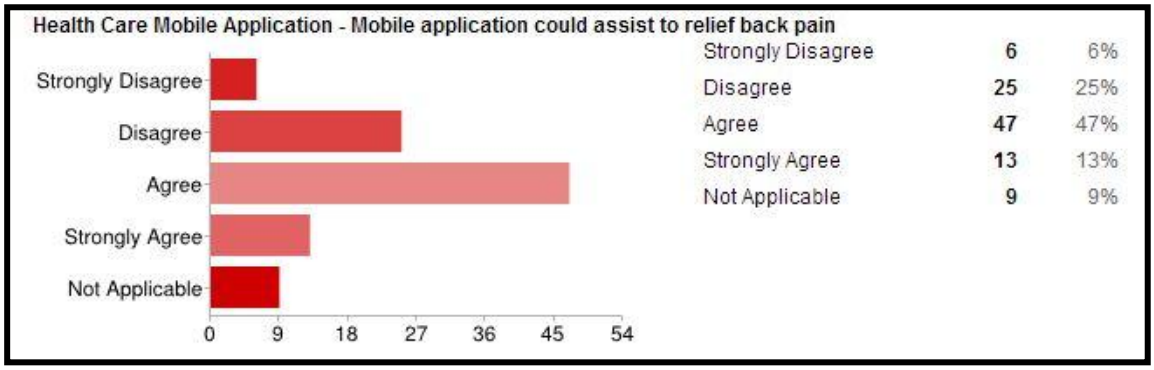


Figure 52 - Response on respondents believes that mobile application can assist to relieve back pain

Analysis: The result indicates that the respondents are accepting mobile application that could be one of the methods used to relieve back pain. Relating to one of the issues faces is that, people do not have enough time to exercise and keep their back state healthy. Thus, mobile application could be an easy way to exercise anywhere at any time.

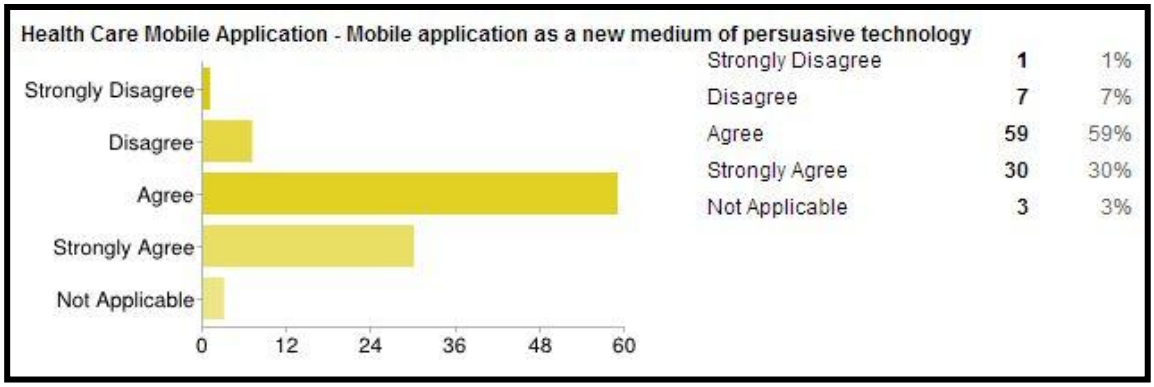


Figure 53 - Response on respondents believes that mobile application is a new medium of persuasive technology

Analysis: According to the graph, it could be said that mobile application is now being accepted as a new medium to persuade people to perform certain actions. It is a quick way to change people's behavior using mobile technology which directly related to the research subject.

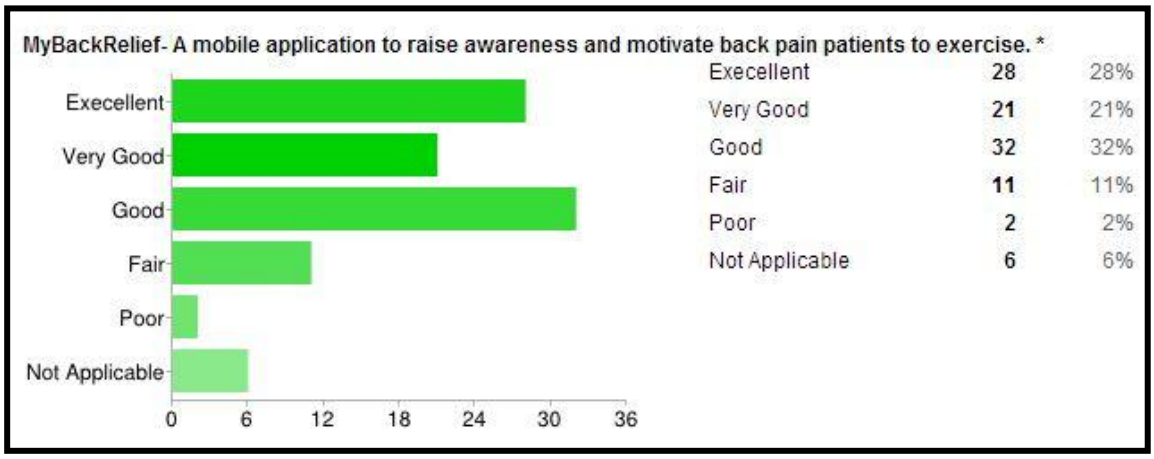


Figure 54 - Response on respondents believes that MyBackRelief could be a great solution

Analysis: Therefore, it can be concluded that a mobile application is apparently a fair method to raise awareness and persuade back pain patients to exercise.

Based from the questionnaire issued, it can conclude that the prospect of the project is relevant which fulfills the objective and overcome the actual problem in the current world. However the project has the responsibility in venturing into the right methods of persuasive technology to raise awareness and motivate the public to exercise to relieve back pain.

Discussion

As overall, the aim of the questionnaire is to identify the feasibility of the proposed topic on back pain application using persuasive technology via mobile for the early stage back pain patients. It is to create awareness among people suffering from back pain to care for their back.

Thus, according to the survey done, it could be clearly seen that most respondents are not aware of back pain and almost all have experienced back pain at some point of time in their life. Most symptoms of back pain that have been recorded are pain in the spine, neck pain, difficulties during stretching and others, most importantly the respondents have experienced the pain at least for more than a week. However, the sample respondents have given their feedback that they think resting is the best way to overcome back pain.

On the mobile health application, most respondents have never experienced using a mobile application for health care in spite of most of them have an Android OS Smartphone. Therefore, health care application via mobile is a new trend among people as people believe that health can be improved via mobile. To be exact, mobile devices function like an extension of us, present throughout every moment of our day; an arm's reach away at night, and panic-inducing when outside our reach. They are globally ubiquitous, and ownership frequently transcends economic and social boundaries.

As a result, designing and developing a mobile application in order to create awareness on back care among back pain patients using persuasive techniques could be effective in the current market as they are demand for it from the users and also the medical sector to improve the lifestyle of human.

4.4 Use Case Diagram

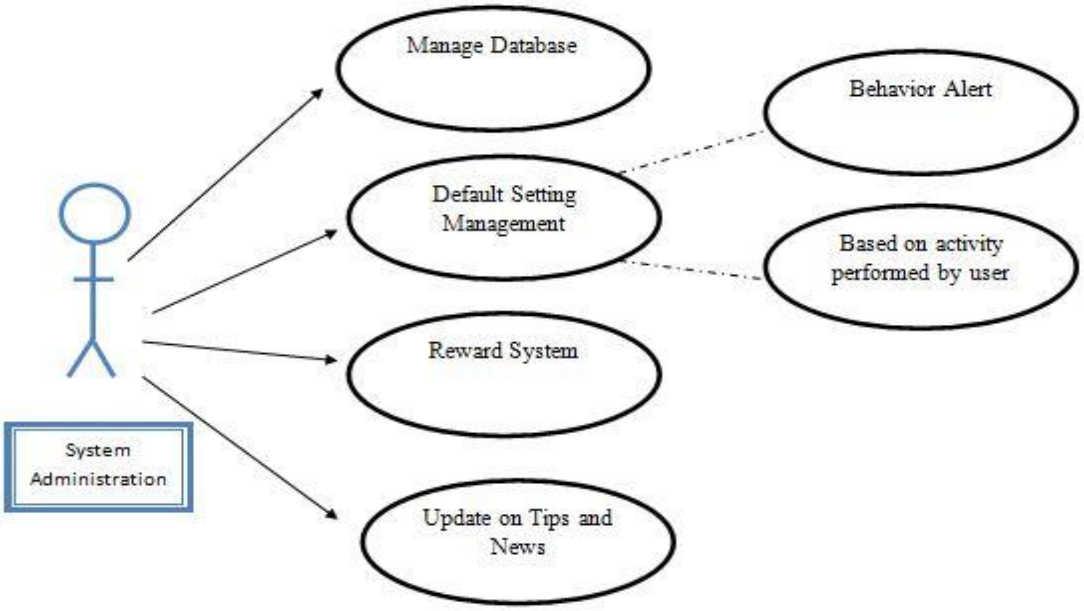


Figure 55 : Use case diagram for System Administator

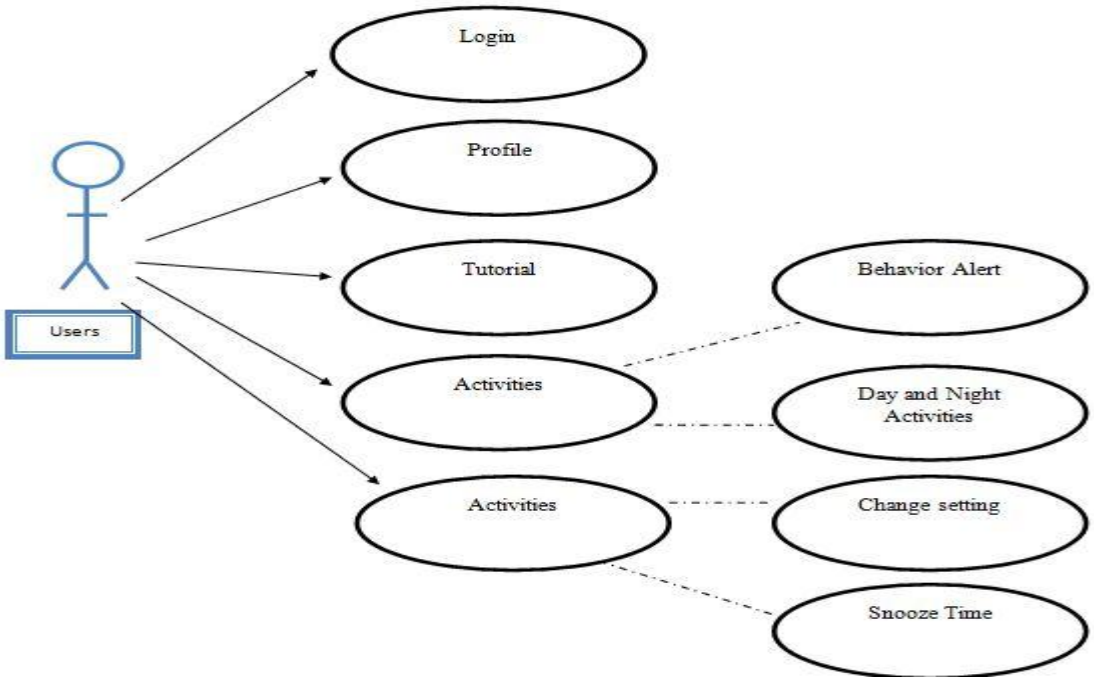


Figure 56 : Use case diagram for users

4.5 Application Screenshots

The system has a working prototype which can be used as the revision for the future development of the end product. Below are the screenshots of the application running on the test machine.

Figure 57 - Splash Screen MyBackRelief

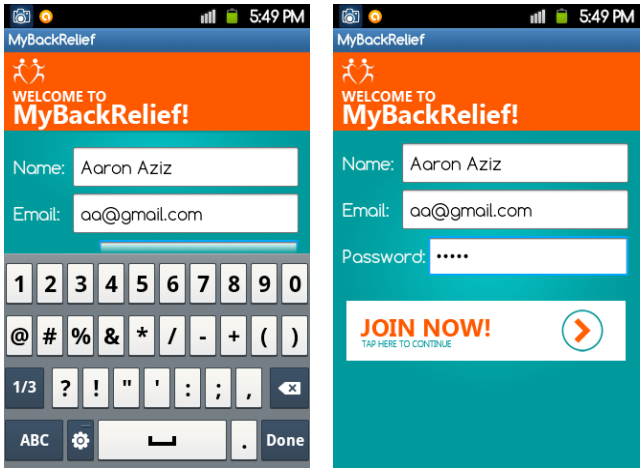


Figure 58– Screenshots for user profiling

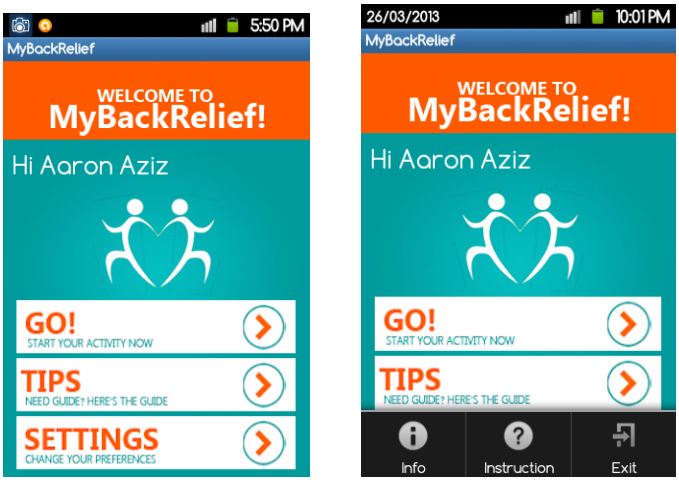


Figure 59 – Screenshots for Main Menu

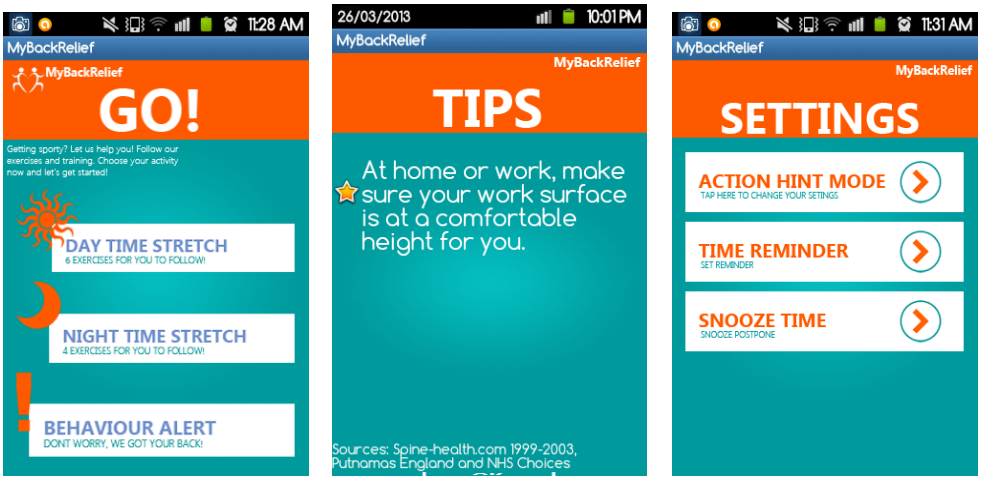


Figure 60– Screenshots of the main home screen sections

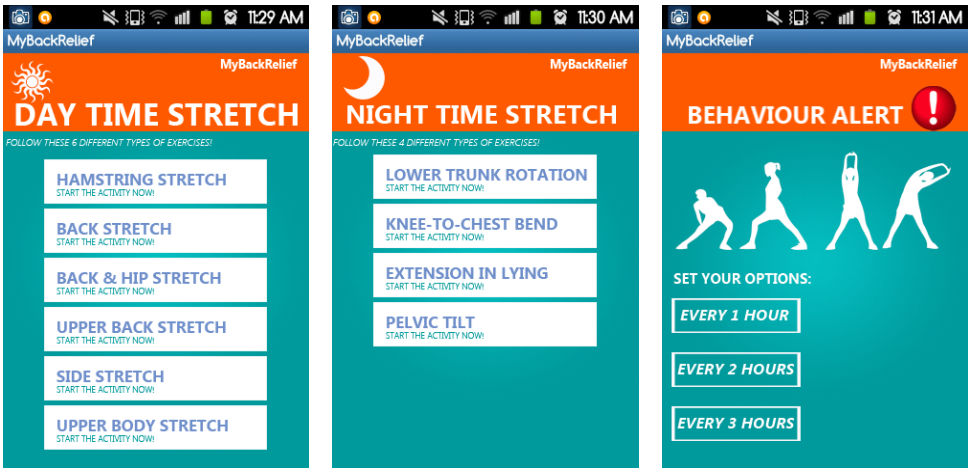


Figure 61– Screenshots of the activities listed in GO section

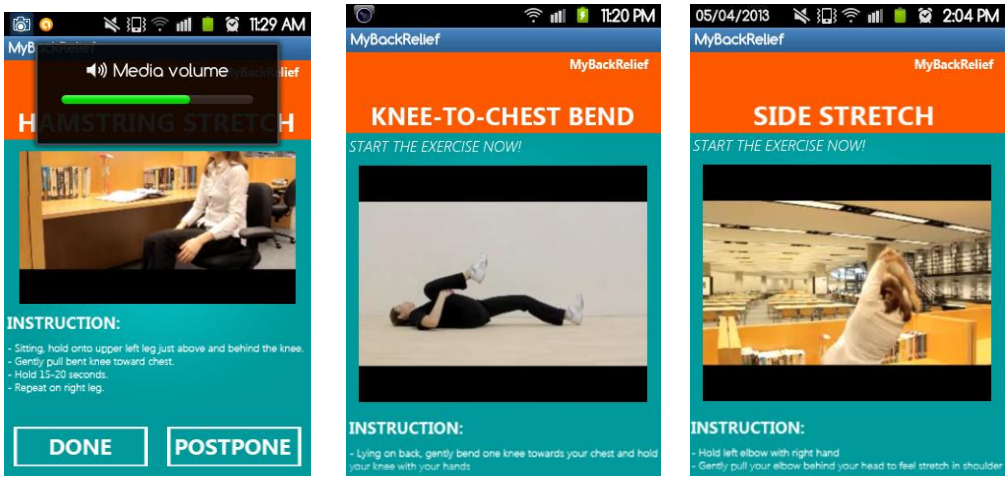


Figure 62– Screenshots of the exercises in the form of audio and video

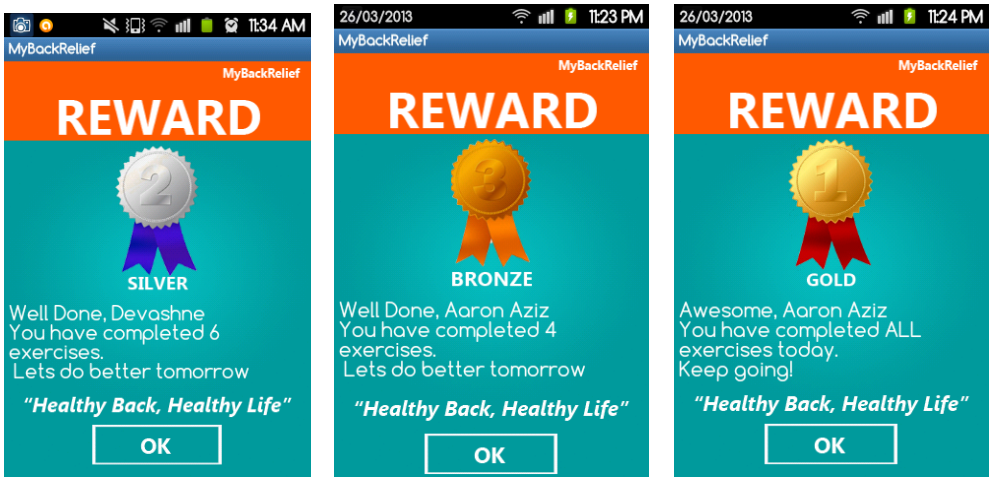


Figure 63– Screenshots of the reward system as a form of persuasive technology

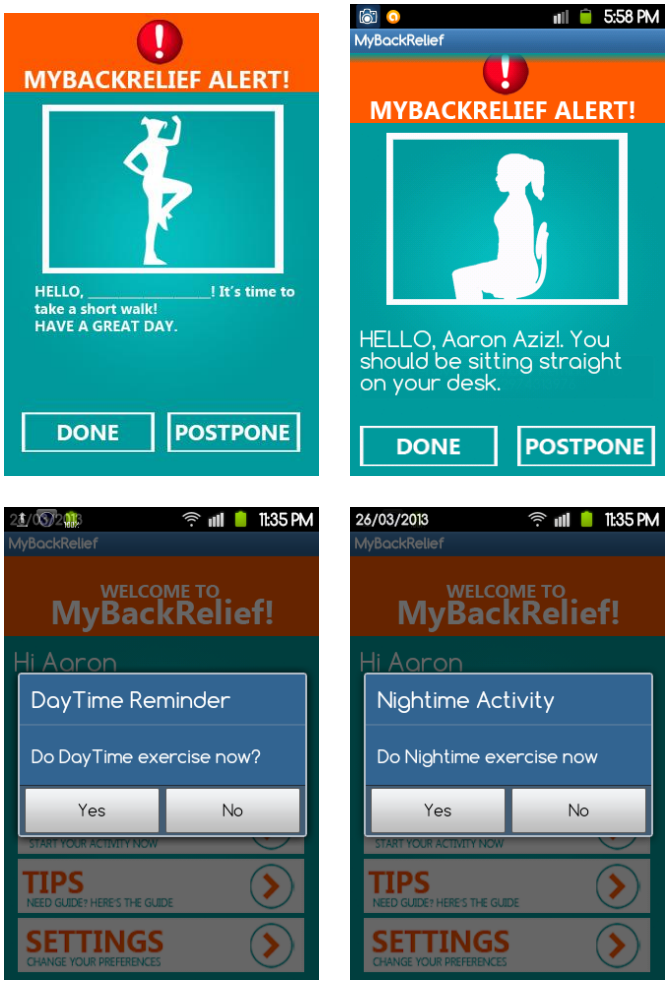


Figure 64– Screenshots of the behavior alert as a form of persuasion

4.6 Prototype Study and Post Survey

The application (MyBackRelief) was installed to the test machine was presented to 10 personnel to evaluate and test. This study was aimed at identifying the level of acceptance of the prototype as well as evaluating the user's perception of the application. The users were given 3 days to experience the application.

The post test was divided into two groups.

- ✓ **Users**
    - Five administration employees from UTP were chosen randomly to test the application. They were three male and two female from the age range of 30 to 45.
    - Five students were also selected randomly from age range 19 to 25 to operate the application.
- ✓ **Experts**
    - Ms Phooi Yee, a physiotherapist from Pantai Medical Hospital Ipoh was given this application to test and provide us the feedback on the usefulness of this application for first stage back pain patients.

Every personnel were given adequate time and explanation individually with a user manual on the system and functionalities during testing. Post testing, they were required to answer a questionnaire on their opinion after trying out the prototype.

These are questions listed in on the questionnaire :

1. Have you experienced back pain?
2. How often do you experience back pain?
3. What is the severity of your back pain?
4. How do you overcome the pain?
5. Have you used any mobile health application(s)?
6. The most interesting feature in the application
7. The least preferred feature in the application
8. How would you rate this application?
9. Do you think the alert functions have been useful in reminding you to care for your back?
10. Do you think the reward system introduced in the application is the best way to motivate you to perform more exercises daily?
11. Sharing your experience in using the application on Facebook will be a great sense of motivation and creating awareness.
12. If you could make a significant change to the application, what change would you make?
13. If you could make a significant change to the application, what change would you make?

The analysis from the study are as follows

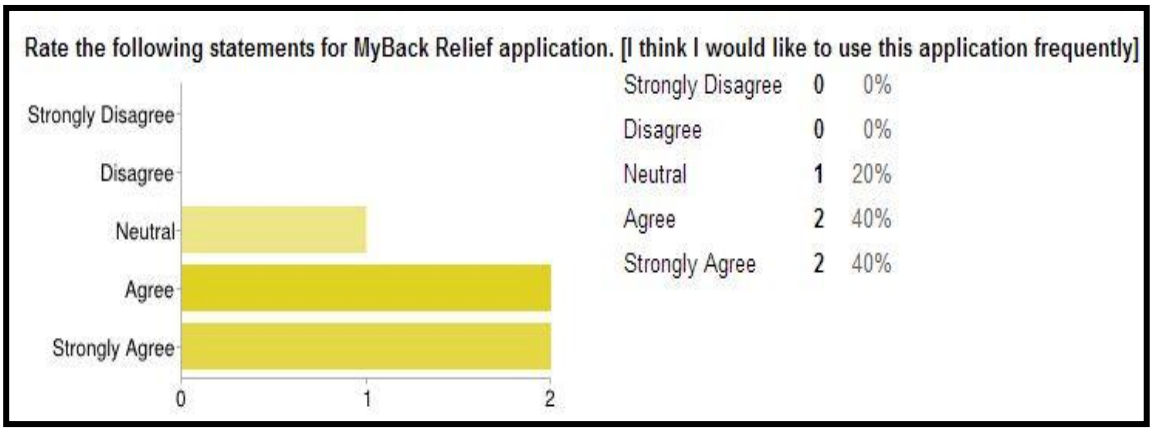


Figure 65 - Response on the respondents' likelihood of using MyBackRelief Apps

Analysis: The result indicates that the respondents would like to use the application frequently.

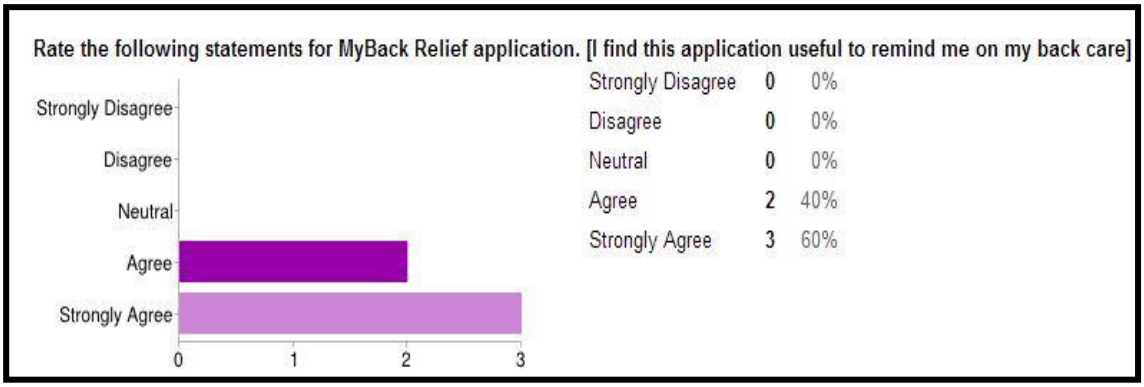


Figure 66- Response on the usefulness of the application

Analysis: The result indicates that the respondents would agree that MyBackRelief application can be useful in reminding them to exercise care for their back pain.

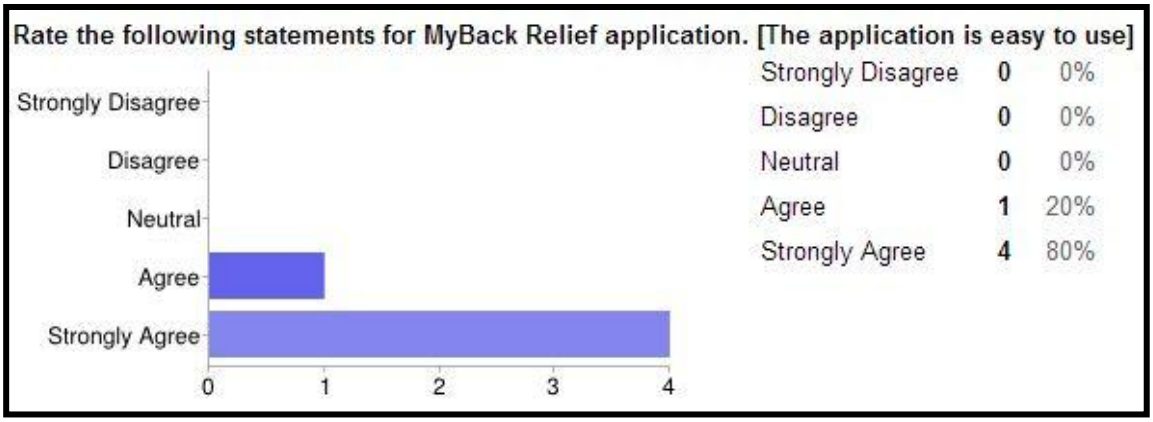


Figure 67 - Response on the usability

Analysis: The result indicates that most respondents think that the application is easy to use to achieve their goal.

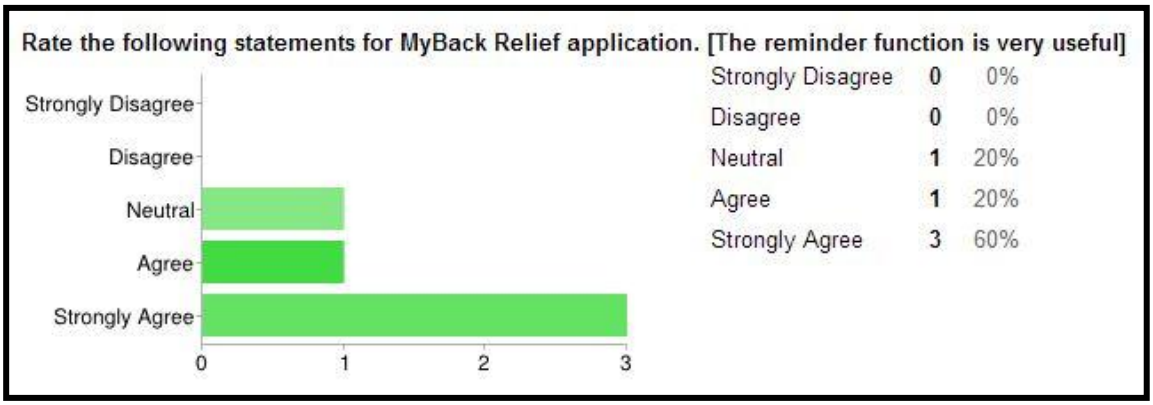


Figure 68 - Response on the reminder function in MyBackRelief Apps

Analysis: Reminder is one of the main functions in the application. Thus, based on the response, it can be concluded that most respondents feel that the reminder function is useful in order for them to persistently do the exercise.

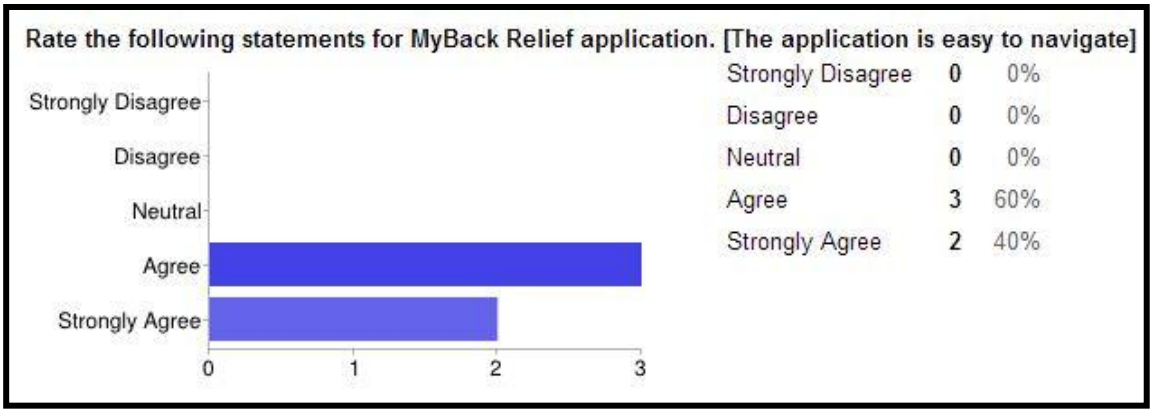


Figure 69 - Response on the application's navigation

Analysis: Based on the response above, most of the respondents think that the navigation in the MyBackRelief application is simple and comprehensible.

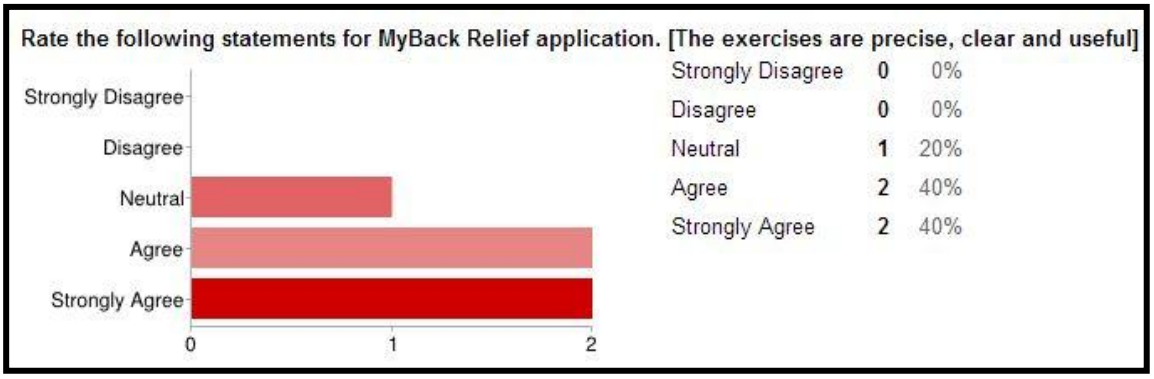


Figure 70 - Response on the exercises in MyBackRelief Apps

Analysis: The objectives of the application are to create awareness among back pain patients by persistently performing the exercises. Most of the respondents do agree that the exercises are precise, comprehensive and practical.

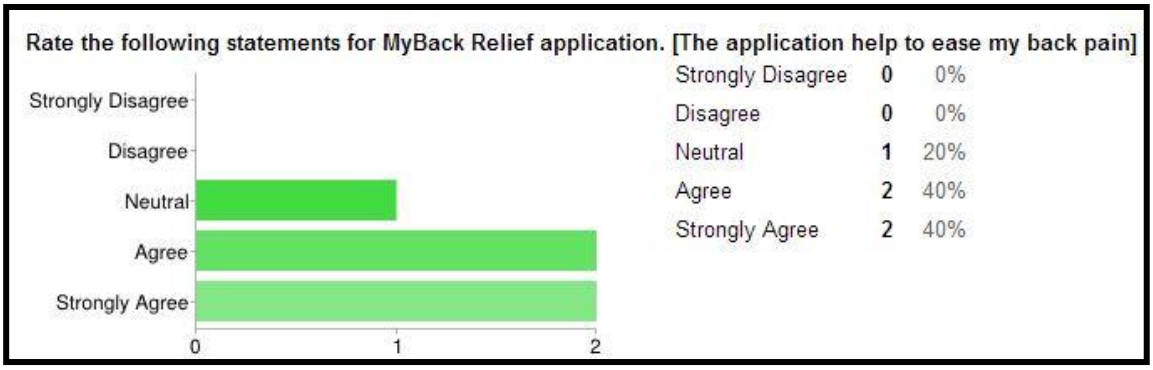


Figure 71 - Response on the function of MyBackRelief Apps

Analysis: The initial purpose of MyBackRelief application is to assist the user in relieving back pain. Thus, most respondents have given their feedback that after using MyBackRelief for three days, it helps to ease their back pain.

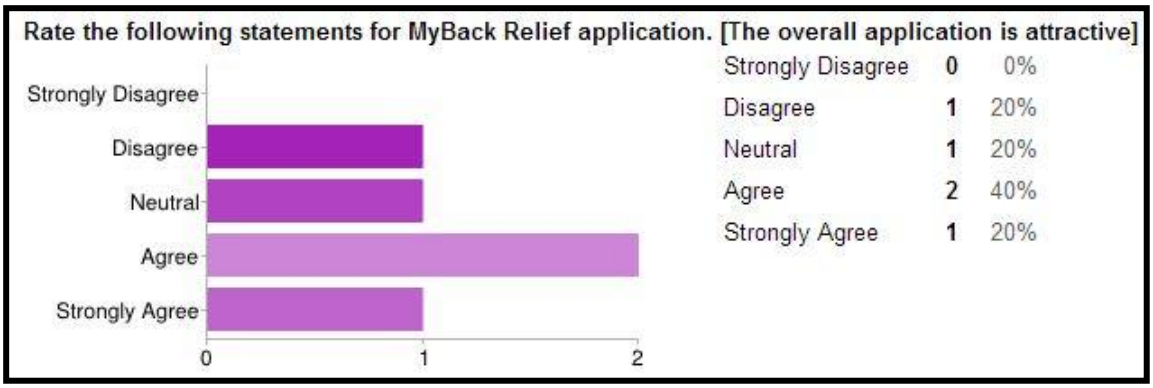


Figure 72 - Response on design and interface of MyBackRelief Apps

Analysis: Most respondents responded that the application is overall attractive to use and fun to explore.

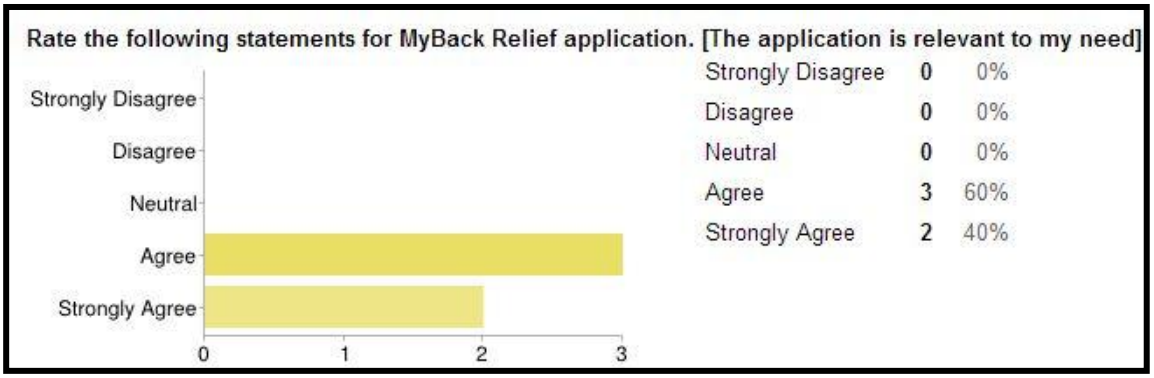


Figure 73 - Response on the relevancy of MyBackRelief Apps

Analysis: Most respondents agree that the application is relevant to the need to assist in relieving back pain.

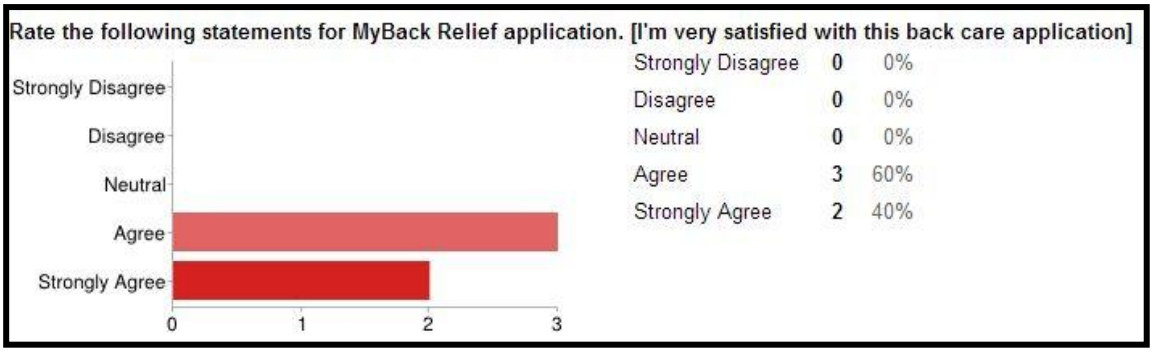


Figure 74 - Response on the user satisfaction using MyBackRelief Apps

Analysis: Based on the graph, it could be said that the sample users testing the application are very satisfied with the back care application as it is simple and structured.

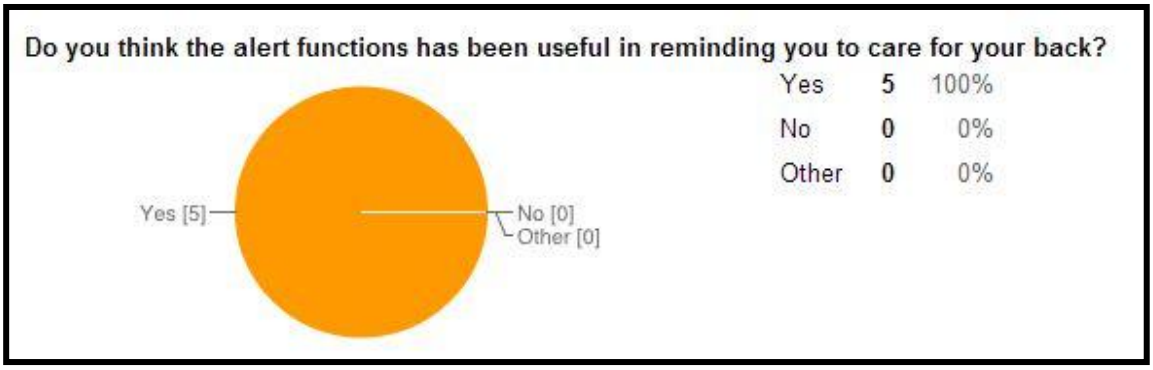


Figure 75 - Response on the alert function in MyBackRelief Apps

Analysis: The alert function is one of the key features of the application. It is important in order to persistently remind user to perform activities to relieve back pain. Thus, all the respondents agreed that the alert feature in the application is accommodating in reminding the users to care for their back.

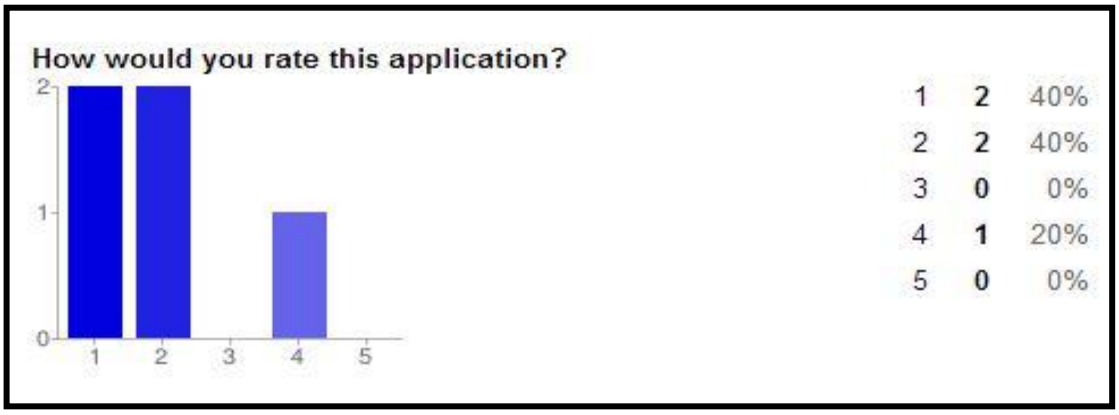


Figure 76 - Response on user rating on MyBackRelief Apps

Analysis: The rating scale indicate 1 for excellent to 5 for worse . According to the survey, it could be concluded that most respondents feel that the application is useful compared to other application for back pain in the market.

Users Overall Feedback

Students

- "A cool apps. Didnt realize all these days, back pain actually can be serious"
- "Overall good. Slight drawback: Problem with the "exit" option/button."
- "its good overall just that i am not that satisfied with its appearance"
- "its very nice... cool wan also.. luv the videos and the steps are easy to follow, espceially for the office"
- "More exercise for future. Well done with the application"

Employees - Staff from UTP

- "Cantik and senang nak guna"
- "Behavior alert macam menarik. Exercises simple tapi segan nak buat"
- "The instrution font is quite small, but overall its good."
- "Reminder is very useful. I like the fact that it is ringing for every hour making me realize that i have my body to care about. Hahaha."

Discussion

According to the results from the post survey, MyBackRelief could be a better solution for back care compared to other existing application for back pain. This is because it utilizes various methods of persuasion such that could persistently motivate the users to care for their back by following the exercises listed in the application. Some of the persuasive techniques that are utilized:

- **Tailoring Technology** - providing users a list of tips for back pain that they can slide from right to left. The emphasize was given to the font size and color for easy reading as the user's aimed are from age range 21 to 45.
- **Reduction Technology** – is by reducing complexity in providing information. Thus, emphasize was given on the exercise activities chosen whereby there are only 10 activities precisely described. The activities are also divided as for day

and night. The activities chosen for the day is merely simple and could be done anywhere at any time at any place.

Respondents acknowledged the use of personalization in the setting options that could be relevant for employees working different hours and days. Besides that, some users particularly liked the professional looking interface of the application with the minimum use of color and fonts.

Besides that, the highlight of the application which is the behavior alert with exercise alert has been accepted by the respondents as they think it is very useful during the day as the reminder is continuous by hours and appealing.

To conclude, MyBackRelief is a simple and structured mobile application that can be remarkable in changing people's behavior to persistently exercise to relieve back pain and lead a healthy living in long term.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Relevancy of the objectives

As stated previously, the objective of this research is to explore on the techniques of persuasive technology in order to facilitate and interactive way to perform exercises in order to relieve pain. In this case, this Android mobile application is designed and developed to assist the back pain patients to get the right guidance to improve their health state using persuasive techniques . In terms of relevancy, it can be concluded that it is relevant to the objectives proposed earlier where the documentation is a supporting material to assist the development of MyBackRelief.

Thus, several conclusions have been made:

- It is important to raise awareness among people to prevent back pain.
- Persuasive technology could be applied in order to create more effective and interactive applications.
- Mobile technology is relevant to the current emerging trend to be a companion in assisting patients in healthcare, specifically back pain.
- Android OS could be the right platform in order to reach out to more audience as it is the leading operating system worldwide.

In short, the proposed solution does follow the objectives and scope defined. The activities that have been conducted which includes research and theories being practiced are relevant to the objectives specified.

5.2 Suggested Future Work For Expansion And Continuation

In developing a system, there are always rooms for expansion. Implementation of augmented reality in guiding users to stretch would be able to increase the level of motivation among the users. In order to increase the effectiveness of the persuasion and application, integrating other hardware such as sensors is a good path to explore as there can be a more engaging in terms of interaction with users. Users nowadays have already explored all the potentials of mobile applications through other mobile applications that already exists, and the only way to stay competitive is to create a good difference in the future. Interviewing doctors in future on back pain will cultivate more understanding about the disease to be able to create an informative and useful application to assist back pain for all types of users. Besides that, a new edge whereby implementing this back care application in flights could be effective as most passengers on a flight experience back pain as they travel for long hours.

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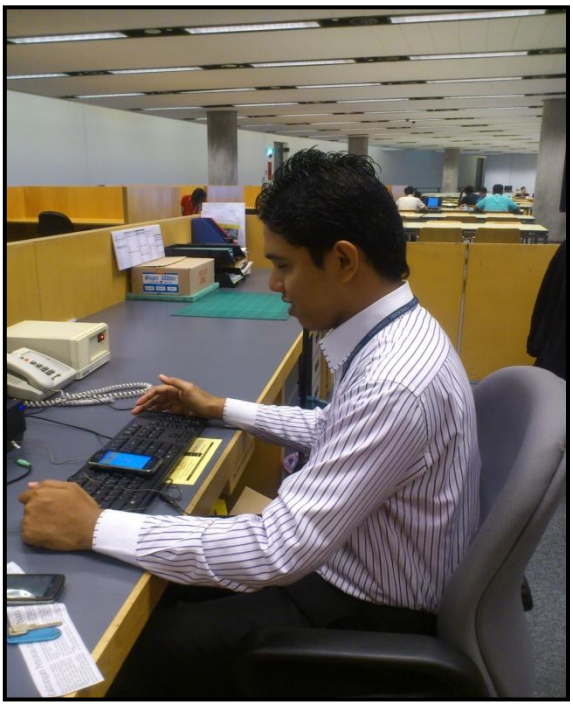
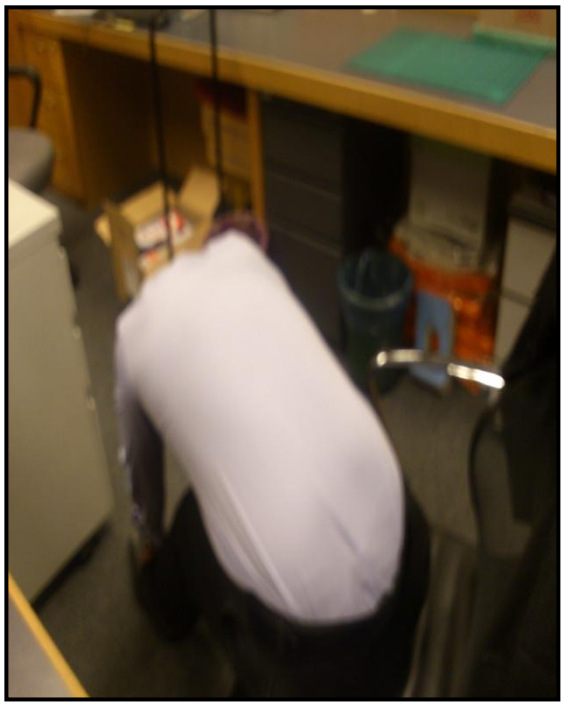
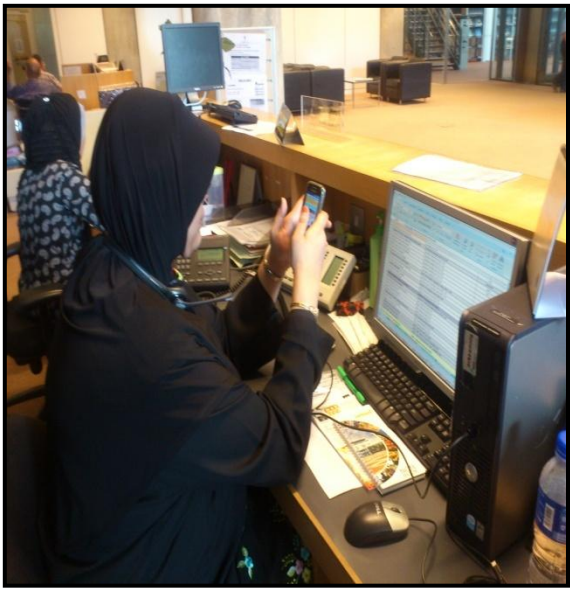
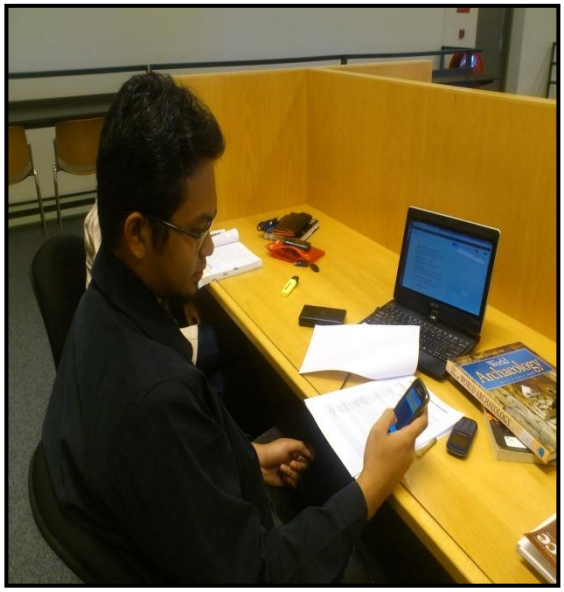
APPENDICES A

Gantt Chart

No	Activities	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May
1	[FYPI]Selection of the project topics									
2	[FYPI]Preliminary research									
3	[FYPI]Submission of preliminary research									
4	[FYPI]Seminar 1: Preliminary report									
5	[FYPI]Project work on progress 1: 5.1 Literature review 5.2 Identify project requirements									
7	[FYPI]Submission of progress report 1									
8	[FYPI]Seminar 2: Progress report 1 Project work on interim report 8.1 Literature review 8.2 Design 8.2.1 Plan system 8.2.2 System design 8.2.3 Interface design									
9	[]FYPI] Oral presentation									
9	System development									
10	[FYPII]Seminar 1: Submission of progress report 1									
11	[FYPII]Testing 11.1.1 System testing 11.1.2 User testing									
12	[FYPII]Poster exhibition & pre- edx									
13	[FYPII]Submission of dissertation - softbound									
14	[FYPII]Oral presentation									
15	[FYPII]Submission of dissertation - hardbound									

APPENDICES B

Data Gathering

Usability Testing