Development of a mobile wellness application for back pain patients using persuasive technology

By

Zeffree Kan

Progress Report

Bachelor of Technology (Hons)

(Information Communication Technology)

JULY 2012

University Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak Darul Ridzuan

ABSTRACT

The objective of this report is to conduct preliminary investigation & gathering of user requirements, design the system in accordance to selected software development methodology and develop a mobile wellness application for back pain patients using persuasive technology. The system is aimed to address the issue of low back pain, a medical problem largely affecting the society through the use of technology, specifically mobile technology and persuasive technology in guiding patients on back care using their smartphones. In the literature reviews, the domain of low back pain was researched and the existing implementations of persuasive technology and mobile wellness were reviewed. This vital information was then collectively analyzed in designing the application using the methodology chosen. A general structure of the application is then formed based on the data collected.

TABLE OF CONTENT

ABSTRACT 2

TABLE OF CONTENT 3

INTRODUCTION 5

1.1: Background 5

1.2: Problem Statement 5

1.3: Objectives 6

1.4: Scope of Study 6

1.5: Significance and feasibility of the project 6

LITERATURE REVIEW 7

2.1: Back Pain 7

2.1.1: Low Back Pain Examination 9

2.2: Low back pain study research among workers 12

2.3 Exercise and Back Pain 12

2.2 Persuasive Technology 13

2.2.1 Mobile Persuasive Technology 15

2.2.1 Persuasive Technology in Medicine 15

2.3 Mobile Wellness Application 17

2.4 Designing Mobile Application for Healthcare 19

2.5 Android 22

METHODOLOGY / PROJECT WORK 29

3.1 Choosing Software Development Methodology 29

3.2: The Phases 30

3.2.1 Planning – Data Gathering 30

3.2.2 Analysis – Data Analysis 30
3.2.3 Design – System Development 30
3.2.4 Implementation 31
3.2 Project Activities 32
3.3 Gantt Chart 33
Final Year Project Part I 33
3.4 Tools 35
Hardware 35
Software 35
For the software, the author had chosen Android development toolkit as the development tool of the prototype. 35
RESULTS AND DISCUSSIONS 36
4.2 Outline and design of proposed system 38
4.3 How the user will use the system 45
5.0 Conclusion and Recommendations 47
References 48

CHAPTER 1

INTRODUCTION

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

- Background of study
- Problem Statement
- Objectives
- Scope of Study
- Significance and feasibility of the project

1.1: Background

Back pain (also known as dorsalgia) is pain felt in the back that usually originates from the muscles, nerves, bones, joints or other structures in the spine.

There has been growing research in incorporating technology to improve general health and cure illness. One of the cost cutting technologies is using persuasive technology. Persuasive technology is broadly defined as technology that is designed to change attitudes or behaviors of the users through persuasion and social influence, but not through coercion. (Fogg B. J., 2002)

This project aims to look into how mobile technology can help in assisting back pain patients in improving their state of health. The project will is about developing an application that will provide patients with timely information needed to get better.

1.2: Problem Statement

Back pain, as most medical condition, require a proper treatment and the right information on the postural training and back care so that the patient can get better. The technology advances, especially in mobile technologies and persuasion techniques has not been fully utilize in this domain to help back pain patients in getting better. The

existing method on providing advices and guidelines through word of mouth and papers is not very effective in reminding patients on back care.

1.3: Objectives

- To explore areas of mobile technology that can support the treatment plan of back pain patients
- To design and develop a mobile wellness Android based application for assisting back pain patients to improve their condition
- To develop a suitable persuasive interface for displaying information effectively to back pain patients (persuasive technology)
- To evaluate user's perception on the developed application

1.4: Scope of Study

The application is targeted to help on acute back pain by using information on back care and postural training that is already being condoned and advised by experts in the domain.

The targets of this project are back pain patients and physiotherapist who are looking into improving the current process of disseminating information on back care.

The scope of study is the mobile technology and persuasion technology.

1.5: Significance and feasibility of the project

By researching in the domain and developing the application to support the back pain patients, we can improve the health of the patients and reduce their time and cost in getting better. Furthermore, the application can also be applied to general public that is aiming to get a better back care.

CHAPTER 2

LITERATURE REVIEW

This chapter mainly discusses on the general idea of the project. Several keywords are discussed among with problems addressed in the previous chapter until the idea of the proposed solution.

2.1: Back Pain

Back pain (also known as dorsalgia) is pain felt in the back that usually originates from the muscles, nerves, bones, joints or other structures in the spine. (Wikipedia - Back Pain)

Back pain is a symptom. Common causes of back pain involve disease or injury to the muscles, bones, and/or nerves of the spine. Pain arising from abnormalities of organs within the abdomen, pelvis, or chest may also be felt in the back. This is called referred pain. Many disorders within the abdomen, such as appendicitis, aneurysms, kidney diseases, kidney infection, bladder infections, pelvic infections, and ovarian disorders, among others, can cause pain referred to the back. Normal pregnancy can cause back pain in many ways, including stretching ligaments within the pelvis, irritating nerves, and straining the low back. (Shiel)

Back pain may have a sudden onset or can be a chronic pain; it can be constant or intermittent, stay in one place or radiate to other areas. It may be a dull ache, or a sharp or piercing or burning sensation. The pain may radiate into the arms and hands as well as the legs or feet, and may include symptoms other than pain, such as weakness, numbness or tingling. (Wikipedia - Back Pain)

Back pain is one of humanity's most frequent complaints. In the U.S., acute low back pain (also called lumbago) is the fifth most common reason for physician visits. About nine out of ten adults experience back pain at some point in their life, and five out of ten

working adults have back pain every year. (Atul & Abna, 2000) At any one time, about one-fifth of the adult population of the United States is affected by back pain. Approximately 80 percent will be afflicted by back pain at some point in their lives. Back pain also accounts for 7% of injuries in sports. (Shapiro, 2010).

Back pain can be divided as following:

Anatomically

- Neck Pain
- Middle Back Pain
- Lower Back Pain
- Tailbone Pain

Duration

- Acute (Less than 4 weeks)
- Subacute (4 – 12 weeks)
- Chronic (Greater than 12 weeks)

Low back pain affects 60-80% of the population of industrialized countries and accounts for approximately 52 million lost working days in the UK per year. 90% of back pain is self-limiting and will settle within 6-8 weeks regardless of treatment. (Group, 1994)

Mechanical disorders are the cause in about 90% of the cases of low back pain, with the remaining 10% of cases being due to a manifestation of a systemic illness. (Nachemson, 1976)

One potential source of back pain is skeletal muscle of the back. Potential causes of pain in muscle tissues include muscle strains (pulled muscles, muscle spasms, and muscle imbalances. However, imaging studies do not support the notion of muscle tissue damage in many back pain cases, and the neurophysiology of muscle spasm and muscle imbalances is not well understood.

Another potential source of low back pain is the synovial joints of the spine. These have been identified as the primary source of the pain in approximately one third of people with chronic low back pain, and in most people with neck pain following whiplash (Bogduk, 2005). There are several common and potential sources and causes of back pain: these include spinal disc herniation and degenerative disc disease or isthmic spondylolisthesis, osteoarthritis and lumbar spinal stenosis, trauma, cancer, infection, fractures and inflammatory disease. (Stroke, 2010).

The management goals when treating back pain are to achieve maximal reduction in pain intensity as rapidly as possible; to restore the individual's ability to function in everyday activities; to help the patient cope with residual pain; to assess for side-effects of therapy; and to facilitate the patient's passage through the legal and socioeconomic impediments to recovery.

For many, the goal is to keep the pain to a manageable level to progress with rehabilitation, which can lead to long term pain relief. Also, for some people the goal is to use non-surgical therapies to manage the pain and avoid major surgery, while for others surgery may be the quickest way to feel better.

2.1.1: Low Back Pain Examination

In diagnosing a patient on low back pain, the following several methods is commonly used.

- Medical History

  Because many different conditions may cause back pain, a thorough medical history will be performed as part of the examination. Some of the questions asked may not seem pertinent but are very important to the doctor in determining the source of the pain. Doctor will ask about recent illnesses and associated symptoms such as coughs, fevers, urinary difficulties, or stomach illnesses. In females, the doctor will want to know about vaginal bleeding, cramping, or

discharge. Pain from the pelvis, in these cases, is frequently felt in the back. (Shiel)

- Physical Examination

  To ensure a thorough examination, the patient will be asked to put on a gown. The doctor will watch for signs of nerve damage while the patient walks on heels, toes, and soles of the feet. Reflexes are usually tested using a reflex hammer. This is done at the knee and behind the ankle. As he/she lie flat on his/her back, one leg at a time is elevated, both with and without the assistance of the doctor. This is done to test the nerves, muscle strength, and assess the presence of tension on the sciatic nerve. Sensation is usually tested using a pin, paper clip, broken tongue depressor, or other sharp object to assess any loss of sensation in your legs.

  Depending on what the doctor suspects is wrong, the doctor may perform an abdominal examination, a pelvic examination, or a rectal examination. These exams look for diseases that can cause pain referred to patient's back. The lowest nerves in the spinal cord serve the sensory area and muscles of the rectum and damage to these nerves can result in inability to control urination and defecation. Thus, a rectal examination is essential to make sure that the patients do not have nerve damage in this area of body. (Shiel)

- Imaging

  Doctors can use several tests to "look inside" to get an idea of what might be causing the back pain. No single test is perfect in that it identifies the absence or presence of disease 100% of the time. If there are no red flags, there is often little to be gained in obtaining X-rays for patients with acute back pain. Because about 90% of people have improved within 30 days of the onset of their back pain, most doctors will not order tests in the routine evaluation of acute, uncomplicated back pain.

Plain X-rays are generally not considered useful in the evaluation of acute back pain, particularly in the first 30 days. In the absence of red flags, their use is discouraged. Their use is indicated if there is significant trauma, mild trauma in those older than 50 years of age, people with osteoporosis, and those with prolonged steroid use.

Myelogram is an X-ray study in which a radio-opaque dye is injected directly into the spinal canal. Its use has decreased dramatically since MRI scanning. A myelogram now is usually done in conjunction with a CT scan and, even then, only in special situations when surgery is being planned.

Magnetic resonance imaging (MRI) scans are a highly detailed test and are very expensive. The test does not use X-rays but very strong magnets to produce images. Their routine use is discouraged in acute back pain unless a condition is present that may require immediate surgery, such as with cauda equina syndrome or when red flags are present and suggest infection of the spinal canal, bone infection, tumor, or fracture. (Shiel)

A CT scan is an X-ray test that is able to produce a cross-sectional picture of the body. CT scan is used much like MRI. (Shiel)

- Nerve Tests

  Electromyogram or EMG is a test that involves the placement of very small needles into the muscles. Electrical activity is monitored. Its use is usually reserved for more chronic pain and to predict the level of nerve root damage. The test is also able to help the doctor distinguish between nerve root disease and muscle disease. (Shiel)

- Blood Test

  Sedimentation rate or C-reactive protein are blood tests that can indicate whether or not inflammation is present in the body. (Shiel)

2.2: Low back pain study research among workers

In a research conducted by a group of 4 researchers to a group of six mixed-gender focus group aged between 20s to mid-70s, the result of the research was that on the experience with low back pain reoccurrences, a striking sentiment emerged was that "It's a constant, it's always there, and it's a re-occurrence – it comes and goes and comes and goes, but it's always there. Even the anxiety of it is always there".

Participants of the same test also reported that they undertook activities aimed at helping them avoid or cope with pain, such as walking an hour every day at lunch, doing stretching and abdominal exercises and yoga, has helped them avoid from the low back pain reoccurrence.

Notably, the participants also mentioned that low back pain is unpredictable, and it causes much distress to never know when it will hit them to the point that they could not function. Participants also reported not having access to financial or other resources needed to take time off or visit a health provider. As such, even though these people may have experienced a meaningful recurrence of their symptoms, this worsening would not be captured through the analysis of health care or lost-time data. (Young, Wasiak, Philips, & Gross, 2010)

2.3 Exercise and Back Pain

A typical response to experiencing back pain is to take it easy - either staying in bed or at least stopping any activity that is at all strenuous. While this approach is understandable and may even be recommended in the short term, when done for more than a day or two it can actually undermine healing. Instead, active forms of back exercises are almost always necessary to rehabilitate the spine and help alleviate back pain. (Peter, 1999)

When done in a controlled, gradual, and progressive manner, active back exercises distribute nutrients into the disc space and soft tissues in the back to keep the discs,

muscles, ligaments and joints healthy. Consequently, a regular routine of lower back exercises helps patients avoid stiffness and weakness, minimize recurrences of lower back pain, and reduce the severity and duration of possible future episodes of low back pain. Patients with ongoing back pain may find it takes weeks or months of stretching and other back exercises to mobilize the spine and soft tissues, but will find that meaningful and sustained relief of back pain will usually follow the increase in motion. (Peter, 1999)

Depending upon the patient's specific diagnosis and level of pain, the back pain exercises and rehabilitation programs will be very different, so it is important for patients to see a spine specialist trained to develop an individualized program of back exercises and to provide instruction on using the correct form and technique. (Peter, 1999)

To be effective, a patient's program of back exercises should be comprehensive, working the whole body even if it targets the back. Two back exercises commonly advised by physical therapists to treat back pain are McKenzie exercises and dynamic lumbar stabilization. A balanced workout of back exercises should include a combination of stretching, strengthening, and low impact aerobic conditioning. (Peter, 1999)

2.4 Persuasive Technology

Persuasive technology is broadly defined as technology that is designed to change attitudes or behaviors of the users through persuasion and social influence, but not through coercion (Fogg B. J., 2002). Such technologies are regularly used in sales, diplomacy, politics, religion, military training, public health, and management, and may potentially be used in any area of human-human or human-computer interaction. Most self-identified persuasive technology research focuses on interactive, computational technologies, including desktop computers, Internet services, video games, and mobile devices (Marja, 2008).

Persuasive technologies can be categorized by their functional roles. Fogg Proposes the Functional Triad as a classification of three “basic ways that people view or respond to computing technologies”: persuasive technologies can function as tools, media, or social actors – or as more than one at once. (Fogg B. , 1998)

As tools, technologies can increase people’s ability to perform a target behavior by making it easier or restructuring it. (Fogg B. J., 2002) For example, an installation wizard can influence task completion – including completing tasks (such as installation of additional software) not planned by users.

As media, interactive technologies can use both interactivity and narrative to create persuasive experiences that support rehearsing a behavior, empathizing, or exploring causal relationships (Fogg B. J., 2002). For example, simulations and games instantiate rules and procedures that express a point of view and can shape behavior and persuade; these use procedural rhetoric (Bogost, 2007)

Technologies can also function as social actors (Reeves & Nass, 1996). This "opens the door for computers to apply social influence" (Fogg B. J., 2002). Interactive technologies can cue social responses through e.g. their use of language, assumption of established social roles, or physical presence. For example, computers can use embodied conversational agents as part of their interface.

Persuasive technologies can also be categorized by whether they change attitude and behaviors through direct interaction or through a mediating role (Oinak-Kukkonen & Marja, 2008): do they persuade through e.g. human-computer interaction (HCI) or computer-mediated communication. The examples already mentioned are the former, but there are many of the latter. Communication technologies can persuade or amplify the persuasion of others by transforming the social interaction (Licklider, J., & Taylor, 1968), providing shared feedback on interaction (Dimicco, Pandolfo, & Bender, 2004), or restructuring communication processes (Winograd, 1986).

Persuasion design is the design of messages by analyzing and evaluating their content, using established psychological research theories and methods. Chak argues that the

most persuasive web sites focus on making users feel comfortable about making decisions and helping them act on those decisions (Chak, 2003) .

2.4.1 Mobile Persuasive Technology

The research in the area of persuasive technology specifically in mobile domain has been increasing in the recent years. 2 of great example of these are Using Mobile Phones for Promoting Water Conservation and Using Smartphones for Raising Awareness of Power Consumption by Rahuvaran Pathmanathan.

In the first project, he promoted water conservation by providing tailored information to gardeners through the mobile application by using three sources of information; weather, expert's advice and community information. (Pathmanathan, 2011)

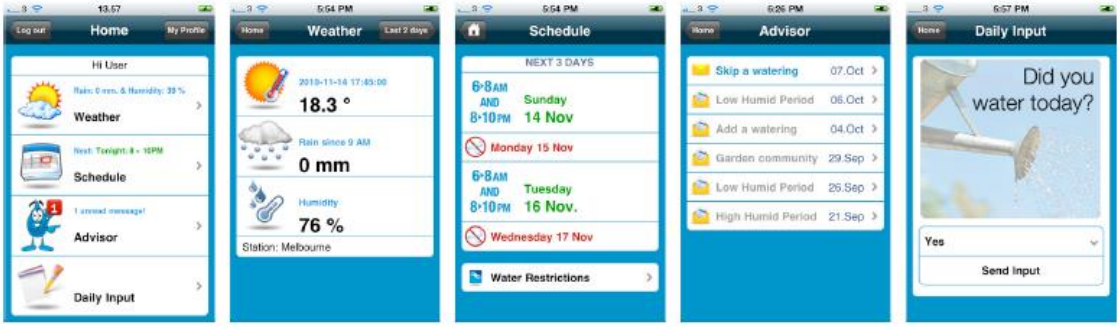


Figure: The menus in the advisor.

In his second project, he researched on raising awareness of power consumption through the use of smartphones. His solution involved giving timely consumption feedback and guidance to stimulate conversation and enable user to change their behavior.

2.4.2 Persuasive Technology in Medicine

There have been many implementations of using persuasive design in medicine. In the case of dementia patients, (Carlos Fern´andez-Llatas, 2011) studied on behavior pattern detection for persuasive design in nursing homes. The study presents a behavior pattern detection architecture based on the Ambient Assisted Living paradigm and Workflow

Mining technology to enable re-learning mechanisms in dementia processes via providing tools to automate the conduct disorder detection.

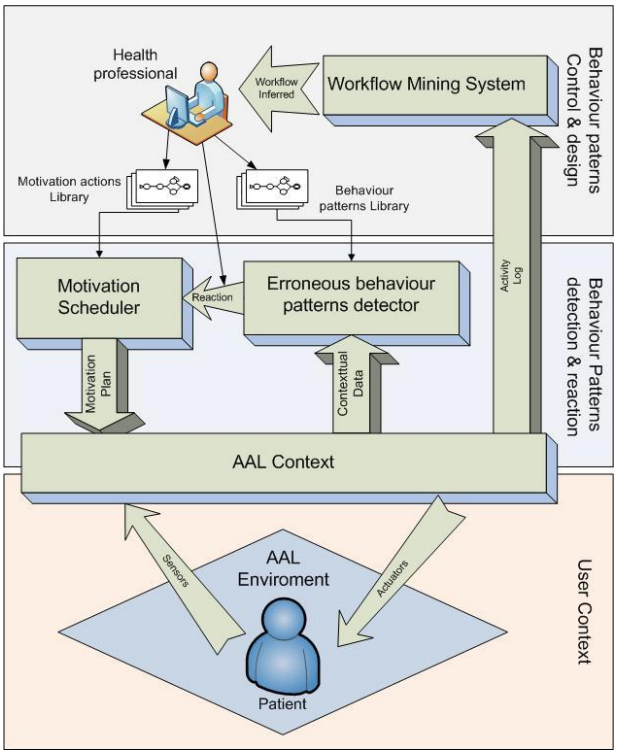


Figure: Architecture to detect behavior patterns of subjects in Nursing Homes to allow the application of persuasive technologies to correct conduct diseases.

This architecture fosters the use of workflows as representation languages to allow health professionals to represent persuasive motivation protocols in the AAL environment to react individually to dementia symptoms detected. Its architecture promotes the use of workflow technology to help dementia treatment via discovering conduct disorders in Nursing Homes patients. Dementia symptoms were founded by comparing the workflow based behavior models of the individual patients.

Initille (Initille, 2004) did a research on persuasive technology to motivate healthy aging based on the problem of the increase in the number of elder population and the costs of medical procedures in United States. In his research, he looked into healthier lifestyle decisions related to diet, exercise, dental care, stress management and maintaining social relationships to positively impact the overall quality of life and long-term health by

using technology to motivate these areas. The research explains the advantages of Just-In-Time Messaging and Behavior Change Motivation in delivering the necessary information to the user on the right time in order to have impact on behavior. By using sensors such as accelerometers worn on the body, we can infer posture, ambulation, and various household activities that involve physical activity and these activity detection algorithms will run on mobile phones and acquire sensor data from the wearable sensors. (Initille, 2004)

2.5 Mobile Wellness Application

Mobile wellness applications can motivate people to exercise more because of their ubiquitous presence and suitable technological possibilities. Wellness application utilizes several factors that can increase physical activity level of users, for example data tracking, social sharing and playfulness. (Ahtinen, Huuskonen, & Häkkilä, 2010).

Telemedicine applications are currently largely based on using mobile phones as user terminals. (Istepanian R, Dec. 2004) In a typical case, a mobile application is used to connect medical measurement devices with back-end information systems. Due to the limited processing power and user interface functionality, usability is a remarkable challenge for mobile health applications. Context sensitivity has been identified as a means for improving user experience by adapting the user interface and providing relevant information and services according to the user's information. (Kolari J, 2004)

Figure: Example of telemedicine with mobile phone as user terminals.

According to (Aino Ahtinen, 2008), user research and design of wellness application has mostly taken place in the developed world. This involve selection of off-the-shelf wellness applications that is relatively broad, ranging from wearable heart-rate monitors, activity monitors and step counters to mobile phone, web and PC applications for tracking eating habits, physical activity and so on.

An example of popular off-the-shelf application is the collaboration between Apple and Nike, Nike + iPod. Nike uses a sensor in their the built-in pocket beneath the insole of the Nike+ shoes which can then be paired wirelessly to iPod and iPhone devices. These devices will then have the Nike + iPod application which will then be able to provide the user with features such as a tracker for their time/distance/pace of running and calories burned. Additionally, the application can also send the user's workout data to nikeplus.com which the user can then see all of his/her completed runs and share motivation with runners across the world. (Apple)

Figure (left): Nike + iPod sensor. Figure (right): Nike + iPod application

In 2010, a group of researchers from DOCOMO did a research on wellness support using mobile handsets. The concept of wellness mobile is a novel mobile service wherein wireless handheld devices such as cell phones are equipped with a wellness monitoring application, enabling real-time self-wellness monitoring by the cell phone user. The wellness mobile will provide a safe and protective environment for an increasing cell phone user-population to help anti-wellness factors such as stress, fatigue and illness. (Aravind Kailas, 2010).

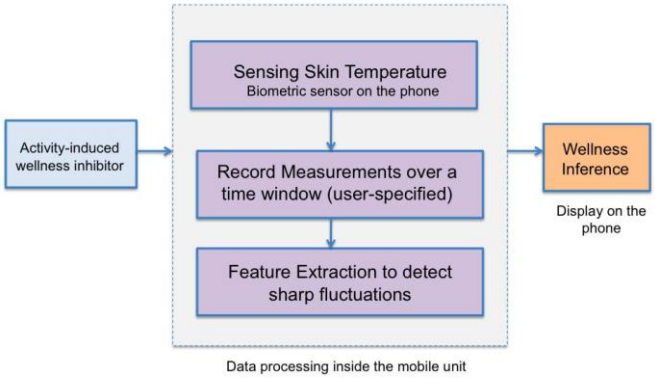


Figure: Docomo flowchart for wellness inference using biometric sensors.

2.6: Designing Mobile Application for Healthcare

As infrastructure and privacy issues are dealt more realistically, patients will become increasingly comfortable in using web-based services. Poorly designed user interfaces that require horizontal scrolling, clumsy searches, endless menus and chaotic layout will

eventually be replaced by compact design with clear layouts. Guidelines documents and usability testing can promote consistent and comprehensive system that provide consistent and comprehensive systems that provide good service to consumers and their professional healthcare providers.

The Pew Internet & American Life Project (www.pewinternet.org) has tracked online activities since early in 2000, including a focus on consumer use of online health information. The use of the Internet for health information is on the rise, although adult with chronic diseases are less likely to go online than healthy adults. (Pew Internet)

From the earlier example of research by Pathmanathan (Pathmanathan, 2011), he shared eight points to be aware of when designing persuasive mobile technology. The eight points are as following

1. Self-Comparison
2. Triggering Messages
3. Mobile Platform
4. Understandable Messages
5. Tailored Information
6. Community Information
7. Expert's Advice
8. Behavior Change Over Time

2.7: Mobile Application for Back Pain

In 2010, the BackCare team from United Kingdom created a free mobile application for iOS which provides information on all aspects of back care in order to help people with back pain. Users of the BackCare app are given basic facts about caring for their backs and how to avoid injuring them, illustrated with exercises shown on screen and videos showing the correct way to do them. The application also helps users in UK to find a practitioner close to them using location based tracking. Additionally, there is a feature called "Me and My Back" which allows people to keep a diary of their back pain, showing the areas affected and the level of pain. The data is saved and can be sent to the user's email address or sent to a practitioner of their choice prior to an appointment.

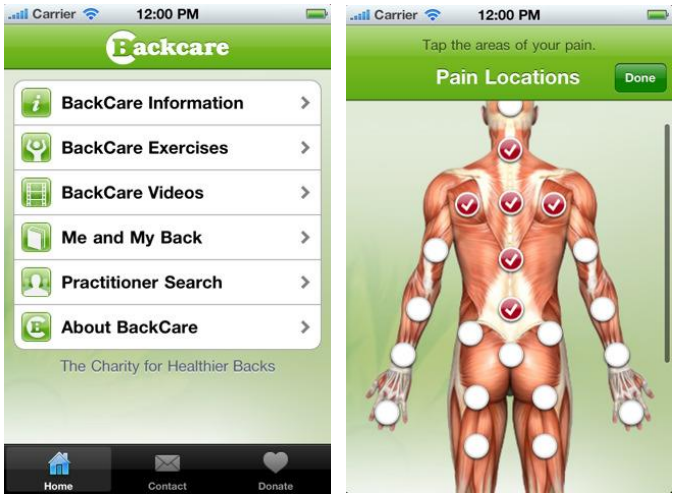
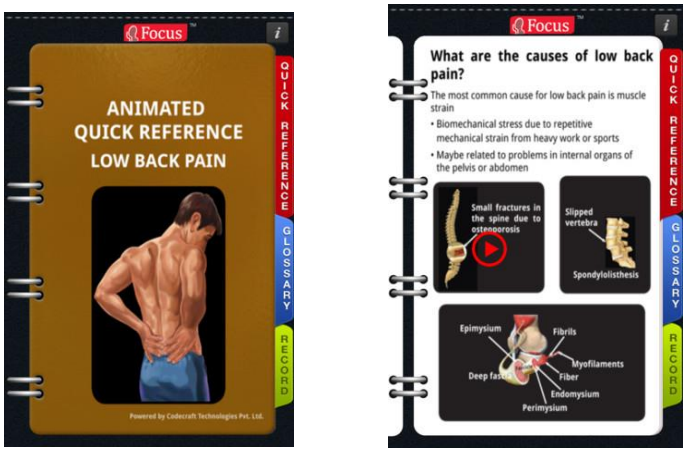


Figure: Some of the features available in the BackCare application.

In 2012, Focus Medica created an Animated Quick Reference guide for Low Back Pain. 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. Each title in the series addresses health concerns with authoritative content on a given condition and is supported by relevant images and lifelike animation videos besides a glossary of related terms and their meanings, and a section for maintaining the patient's record. This handy reference is designed for easy navigation between the content, glossary, images and videos that play independent of the internet once downloaded.



A more recent persuasive technology in medicine and mobile, specifically in the area of back pain itself is the latest LumoBack, a mobile solution for creating a perfect posture.

The whole solution consist of a device, which is LumoBack's wearable sensor patch that is worn on the waist or lower back and connects wirelessly to an iPhone 4s or the new iPad. 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. Over time, the app can process trend data to determine whether user's posture is steadily improving over time. (Farr, 2012)

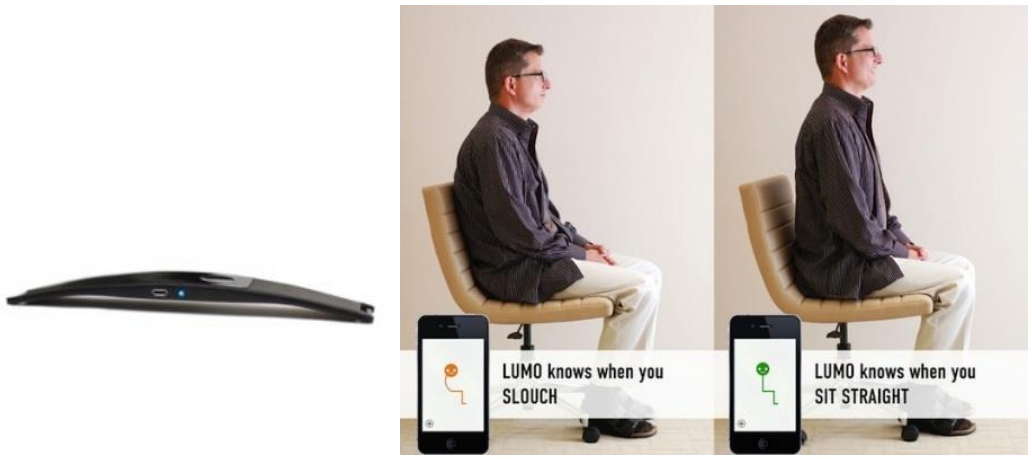


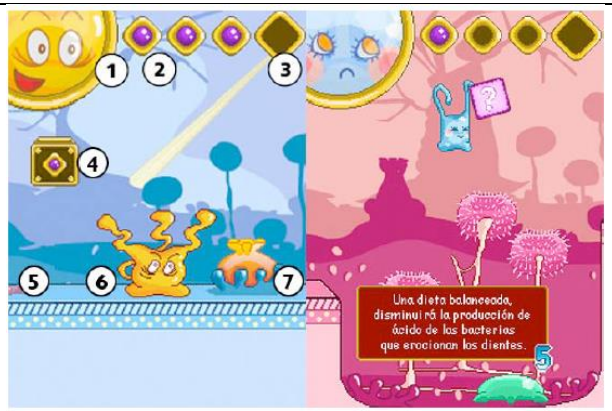
Figure: LumoBack wearable sensor patch and the LumoBack application.

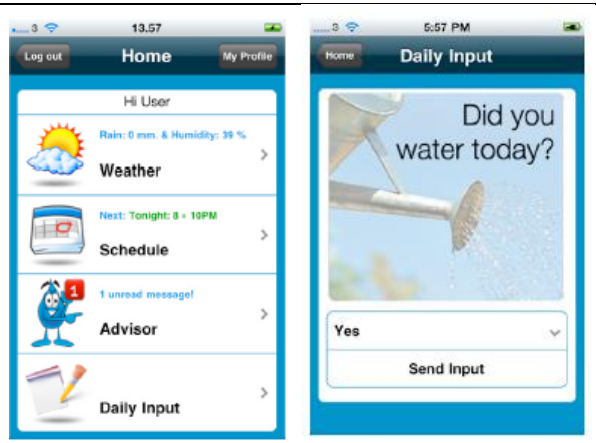
2.8: Android

Android is a linux-based operating system (OS) that is designed and published by Google, a search engine and internet giant. By providing an open development platform, Android offers developers the ability to build innovative applications. Developers are free to take advantage of the device hardware. Most mobile phone and smartphone manufacturers nowadays choose to develop their mobile phone to work on Android OS. The main advantage of Android based mobile phone is the OS is offered in various kind of nowadays popular mobile phone brand, mainly like HTC, Motorola and Samsung.

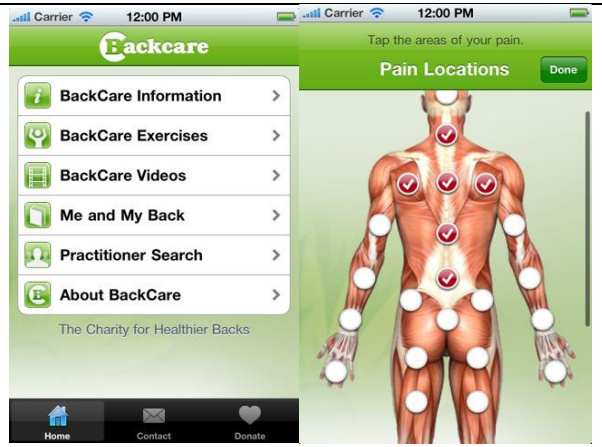
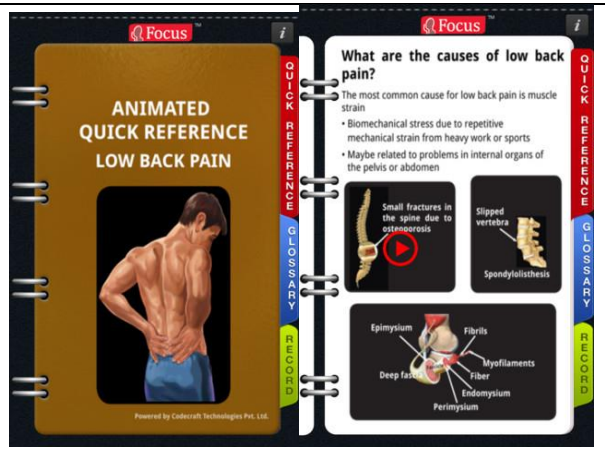
Android was listed as the best-selling smartphone platform worldwide in Q4 2010 by Canalys with over 200 million Android devices in use by 2011. As of December 2011, there are over 700,000 Android devices activated every day.

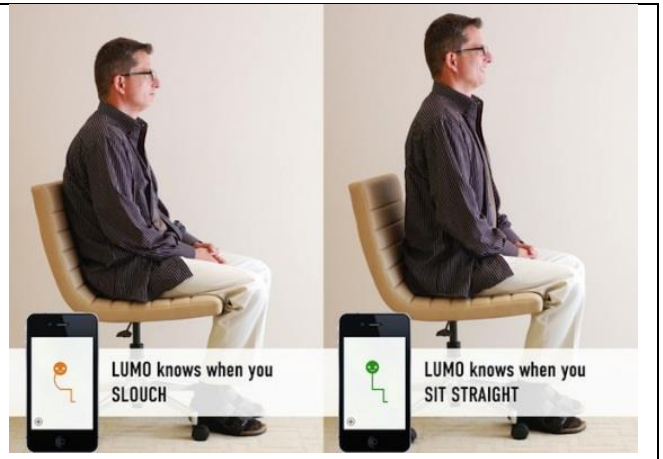
2.9: Summary of related projects

Name	Description	Approach	Picture
Molarcropolis (Soler, Zacarias, & Lucero, 2009)	Mobile Persuasive Game to Raise Oral Health and Dental Hygiene Awareness. It is a scrolling puzzle platform game where player 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 and 3)attractiveness	- Mobile game for adolescence	
Movipill (Oliveira, Cherubini, & Oliver, 2010)	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.	- Mobile Game - Social Competition	

Smart Garden Watering Advisor (Pathmanathan, 2011)	SGW is a research in 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.	- Mobile app - Updated information - Expert's advice - User input	
Power Advisor (Pathmanathan, 2011)	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.	- Mobile web app - Integration with Automatic Meter Reader - Expert's advice - User input	
Persuasive Technology on	Initille did a research in 2004 on using the advantages of Just-In-Time messaging and	- Sensors - Just in time	

Healthy Aging (Initille, 2004)	behavior change motivation to deliver the information taken from sensors attached to the elderly such as posture, physical activities and ambulation, using an accelerometer. This information is then ran on the mobile phone.	messaging - Behavior Change motivation	
Nike + iPod	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 user's accomplishment with other users around the world.	- Sensors - Real time information - Social features	 

BackCare	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.	- Mobile application - Informational - Videos on exercise - Location tracker	
Animated Quick Reference for Low Back Pain	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.	- Mobile application - Informational - Animated contents	

LumoBack	The whole solution consist of a device, which is LumoBack's wearable sensor patch that is worn on the waist or lower back and connects wirelessly to an iPhone 4s or the new iPad. 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. Over time, the app can process trend data to determine whether user's posture is steadily improving over time.	- Mobile application - Custom sensor - Useful & attractive data representation - Real time information / Reminder	

2.10: Proposed Solution

Based on the literature reviews, there has been a lot of different variations and examples of creating the system, even in the domain of back pain itself. The main challenge is however, to persuade or to change the behavior of the target audience through persuasion. This is a vital part of the project as the target users are aimed at not only appreciating the application, but to be able to enjoy using so on their own accord.

The focus of this project will be on the area of motivating the back pain patients to exercise in order to get better. It has been proven that doing exercise is better than just resting in a patients get well plan.

The design strategy for persuasion that will be implemented in this system is the following:

1. Tailored information
   The exercise activities and program will be tailored to user's profile after a session of profiling during user's first run of the application. From there, only certain exercises that are suitable will be chosen for the user.
2. Expert's Recommendation
   The exercise activities will follow a strict expert's choice and only relevant exercises that has been recommended by experts for back pain patients.
3. Emotion expression
   The user's profile will be displayed in an avatar, in which the facial expression of the 'user' will change based on the performance of the user on his/her exercise plans.
4. Reward for consistency
   The system will emphasize on consistency of the user with the exercise plans, and the effect will be shown on the user's avatar.

CHAPTER 3

METHODOLOGY / PROJECT WORK

For any software development it is an essential to plan well the project by gathering the requirement before designing and implementing the software. Different methodologies have been created to cater different needs of different project in a specific duration of time. Thus, this chapter will elaborate more about:

- Choosing System Development Methodology
- Planning, Analysis, Design and Implementation phases
- Project Activities
- Tools used
- Key Milestone

3.1 Choosing Software Development Methodology

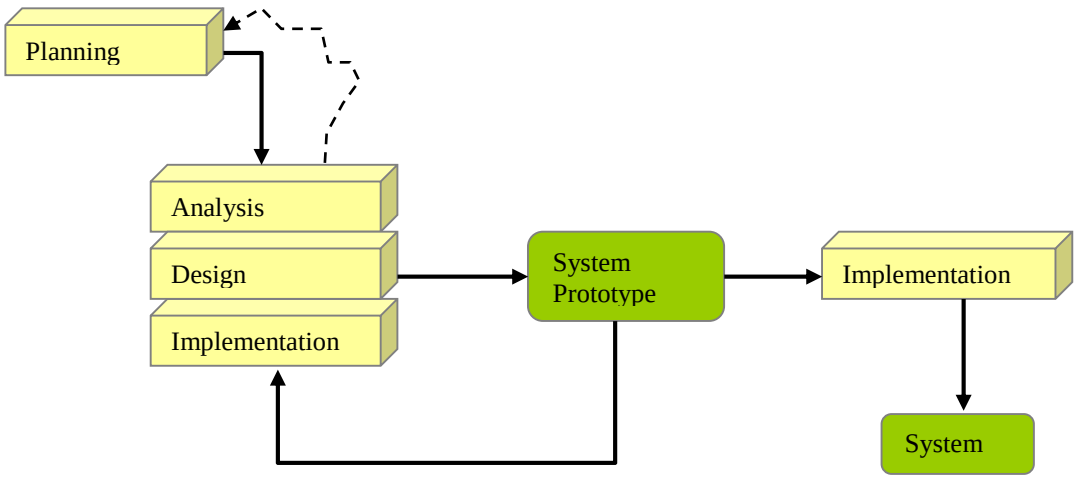


Figure 3: The Prototyping Model

This methodology is usually used when the process is likely to be changed as the project proceeds or when the stakeholder has little idea of what system to be built. All the Analysis, Design, and Implementation phases performed at the same time and on each cycle in producing a system prototype. The cycle repeated continually based on the comments until the system prototype successfully meets the requirements.

The last prototype will then be called the system. Prototyping development needs only initial basic analysis and design. Thus there is a possibility to revise the initial design decision and start all over again from the beginning. As for the advantage of using this model is that it can deliver system quickly to users, though it not exactly meeting the requirements.

3.2: The Phases

The processes are divided into four stages where it will be thoroughly followed through.

3.2.1 Planning – Data Gathering

The first stage is planning where the author finds the main reason why the system should be built as well as understanding its requirement. During this stage, it is necessary to be aware of the theory of mobile technology and back pain. Many phase of interview is expected to be scheduled with a physiotherapist in order to understand the problem deeply and look into solutions.

3.2.2 Analysis – Data Analysis

The activities such as problem identifying and predicting the potential problems of the project in the future are arise during this stage. The information gathered during planning stage are being analyzed therefore the literature review are done. During this stage, the author should identify the opportunity of helping patients of back pain through mobile application.

3.2.3 Design – System Development

The design phase determines how the system will works in the system environment. In this case, the system to help back pain patients through

persuasive technologies will be developed. On this stage, the illustration of the interface is done based on the findings received. To complete this part, Android Development toolkits are needed.

3.2.4 Implementation

The most resource phase of all is implementation where the system is built, tested and installed for the users to use. This stage will been done to a few target users in order to get more information as well as their opinion on what the author had been done so far. Once the users satisfied with the prototype, the author will install the application to the users.

3.3 Project Activities

- Thinking aloud

According to Nielsen (1993) the method of thinking aloud allows us to understand how the users approach the system and what considerations the users keep in mind when using the system (J., 1993) . During the test procedure the users are asked to verbalize and describe their thoughts, feelings while interacting with the system. The main advantage of this method is a better understanding of the user's thoughts and interaction with the android system.

- Questionnaires

Questionnaires or survey are generally a common way to gather data and allow a quantitative analysis of results. The questionnaires that are well-designed can gather information on both the overall performance of the system as well as information on specific components of the system.

- Qualitative interviews

Although interviews may be different from questionnaires in the concept of their formality they should not be considered less important. Instead, they should be used in a better state that makes the best use of their strengths. Rubin (1981) suggests that interviews are used at the beginning and end of an evaluation, initially to gather general information to form the basis for a questionnaire and afterwards to clarify its results and fill in gaps. (T., 1988)

3.4 Gantt Chart

Final Year Project Part I

Action Items		JAN/FEB						MAC				APR			Key Milestones
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	
PLANNING	Read journal, articles														
	Draft out Literature Review														
	Discuss Literature Review with SV														Literature Review
	Identify Methodology to be used														Methodology
TECHNOLOGY	Explore development platform														Android SDK & Frameworks

	Identify technologies to use														Android
DATA GATHERING	Identify further info required														Connection with Pantai Hospital
	Interview														General flow of patient in back pain
	Survey														Survey question and result
DATA ANALYSIS	Validate Data														Analysis of survey and other info
	Document Data														Interim Report

Figure 2: Gantt chart of Project

3.5 Tools

Hardware

For this project, mobile devices such as android compatible devices will be used to demonstrate the completed system. In the development phase, a personal computer will be used as a workstation before demonstrate through mobile devices.

Software

For the software, the author had chosen Android development toolkit as the development tool of the prototype.

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.

- Result from consultation with expert on Back Pain

4.1 Result from consultation with expert on Back Pain

For the purpose of the study, a professional opinion on the idea of the project was shared with a psychiatrist from Pantai Hospital Ipoh, as well as discussed with the supervisor for this project, Associate Professor Dr Dayang bt Awang Ramli. The key items of the discussion were the following.

- Android application

The project had a strong support from both the supervisor and the psychiatrist as they are interested to see a development in the mobile application that could be useful for the patients and the general public. Android strikes as a perfect platform as smartphones running Android are available to the mass market at cheap and affordable prices.

- Provide graphical guidance on general daily activities

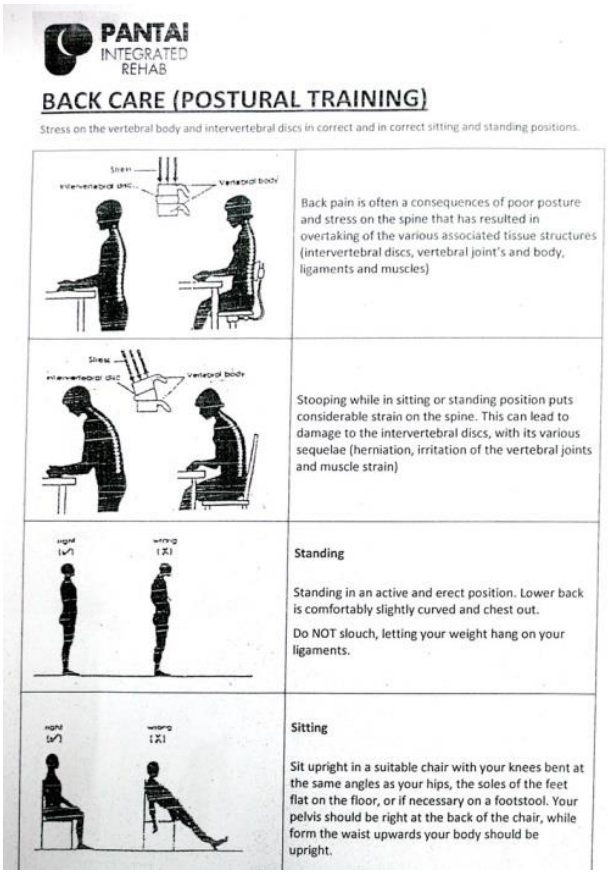


Figure 3: Example of current example of using printed material to disseminate information on back care

Previously, the hospital would educate the patients with printed materials with image and texts to guide the patients on the best practice in doing their daily activities. The idea of the application proposed was delighted as it could possess a better way to represent the necessary information to the patients more effectively.

- Provide diagnosis to general users / potential back-pain patients

  From the research that was studied, it was agreed that most people would face back pain problems at any time of their life. Hence, the application will take the opportunity of providing these users the chance to diagnose themselves on whether they are having a back pain problem or not.

- Utilize images for a more persuasive advisory

Both parties agreed that the application should utilize a lot on multimedia to engage users to use the application.

4.2 Outline and design of proposed system

The system will have 4 main features, each of them grouped to their similar functionalities. The 4 main items will be a symptom tracker, activity guide, exercise guide, and a reference to back pain resources.

Figure 4: A mockup of the starting page containing the key functions

Symptom Tracker

One of the common problems in healthcare and medicine as identified in the research is that during the time of treatment with the doctor, the identification of the problem may not be very accurate as the information that are presence during the pain/attack are lost. Back pain is one of the examples of this, as patients could not properly describe the areas that are they have issues with, and this affects the doctor's diagnosis on the problem. Therefore, the application will also look into catering to this issue to be able to help the patients to capture these vital information during the time of pain.

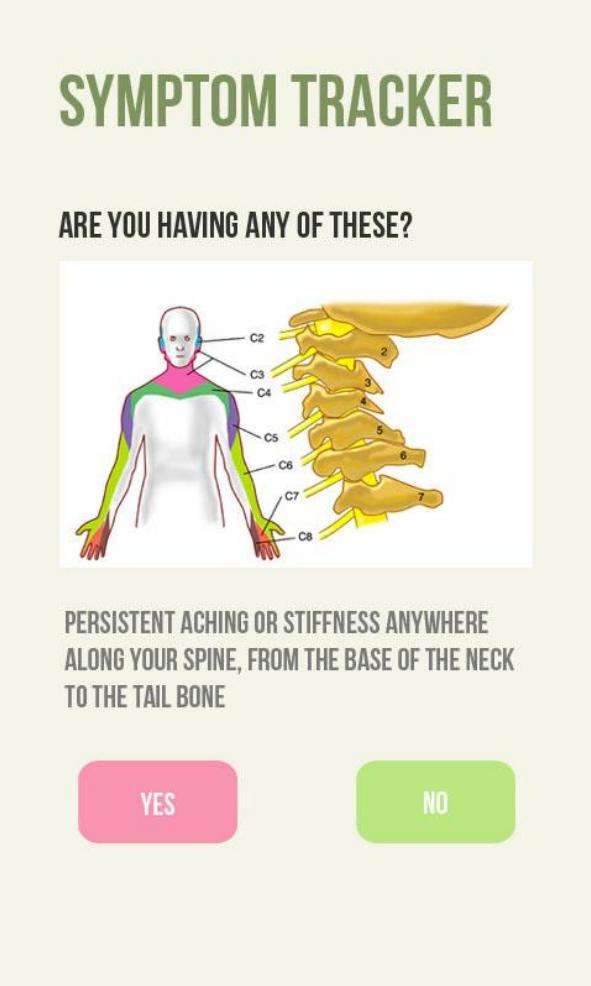


Figure 5 : Sample of question asked for the symptom tracker

The intended outcome of this feature is a report, which will be usable in assisting physiotherapists and doctors in pinpointing the health condition more accurately and perform better treatment. On a lower level, this function will provide the user with an idea, whether he or she is suffering from a back pain or not.

Activity Guide

The application will feature advisory and guidance for the low back pain patients in terms of how the individual should perform certain activities. This is also an improvement in terms of the existing system of providing printed materials to the patients.

Figure 7: Sample of Activity Guide tab

In the activity guide, user will choose the specific activities from a selection of thumbnails which user wants to learn on. The menu will include a thumbnail that will be more appealing rather than using just plain text. The user just simply needs to tap on the intended image to be brought to the next screen which will bring more information to the user.

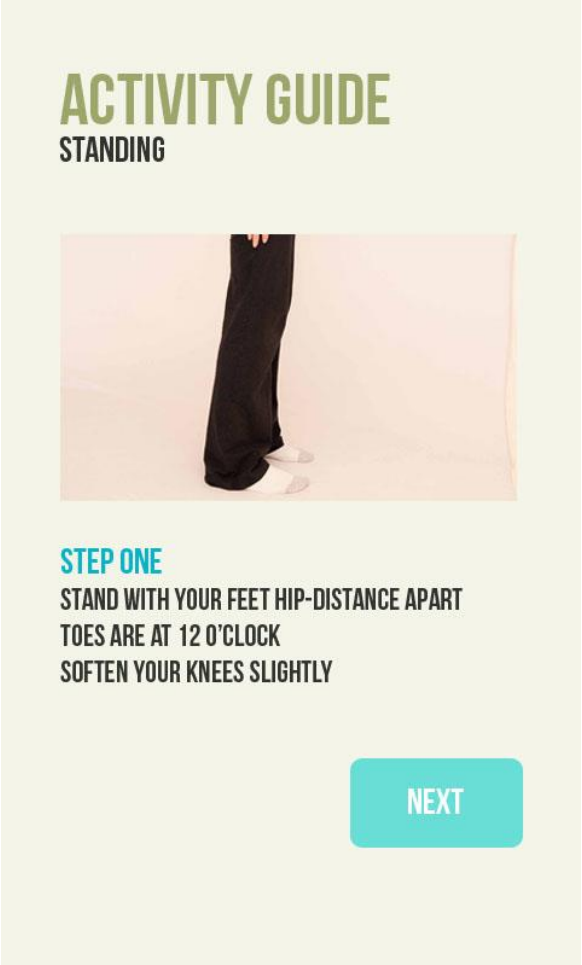


Figure 8: Sample of Activity Guide for Standing

From the previous screen, the user will be brought to the specific page of the activity. User can then follow a step-by-step guide on performing the activity at the best. These guides are referred from experts and redesigned to make it more appealing to the user.

Exercise / Routine Guide

The exercise guide is another key feature in the application which is vital to the back pain patients. Most people may not now that a back pain patient may not exercise using the same routine as normal people or they would face risks of injury. The exercise activities in this application are exercise program that is designed for low back pain patients to restore their back towards full recovery.

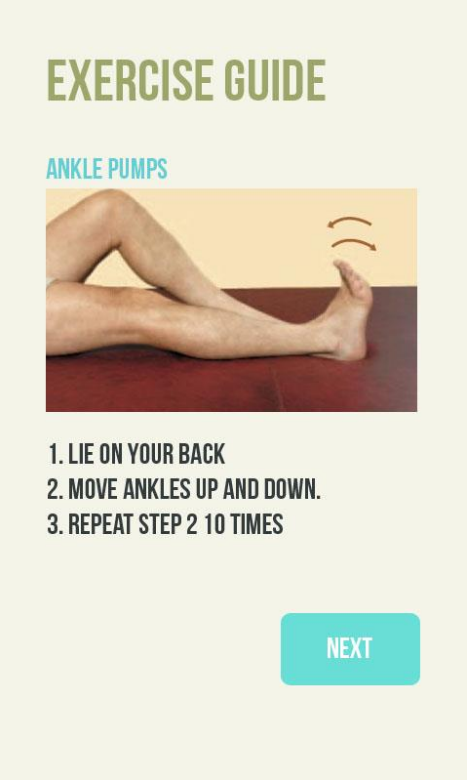


Figure 8: Sample of Exercise Guide page

Figure 9: Sample of Exercise Guide page after the user presses Next from previous screen

Back Pain Resources

In this page, it will be a compendium of resources that the user can refer to as points of contacts and further reading. These will include resources to online articles and websites that will help them on other related issues, as well as local Malaysian institutions on back pain for consultation.

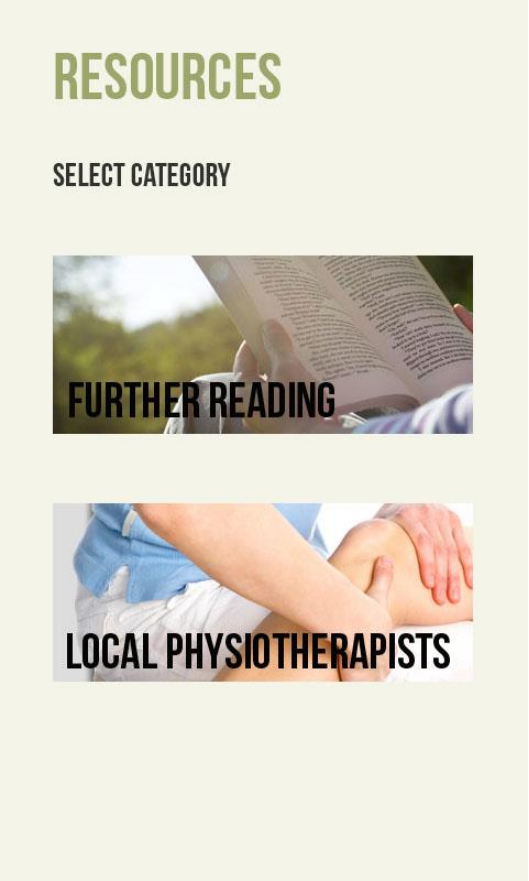


Figure 10: Sample of Resources page. User will choose between further reading for more information on back pain, or local physiotherapists where they can contact and get direct help.

Figure 11: Example of Further Reading resources. User will be given selection of websites that provide back pain resources. By clicking the icon on the right, user will be brought to the site through their mobile browser.

4.3 How the user will use the system

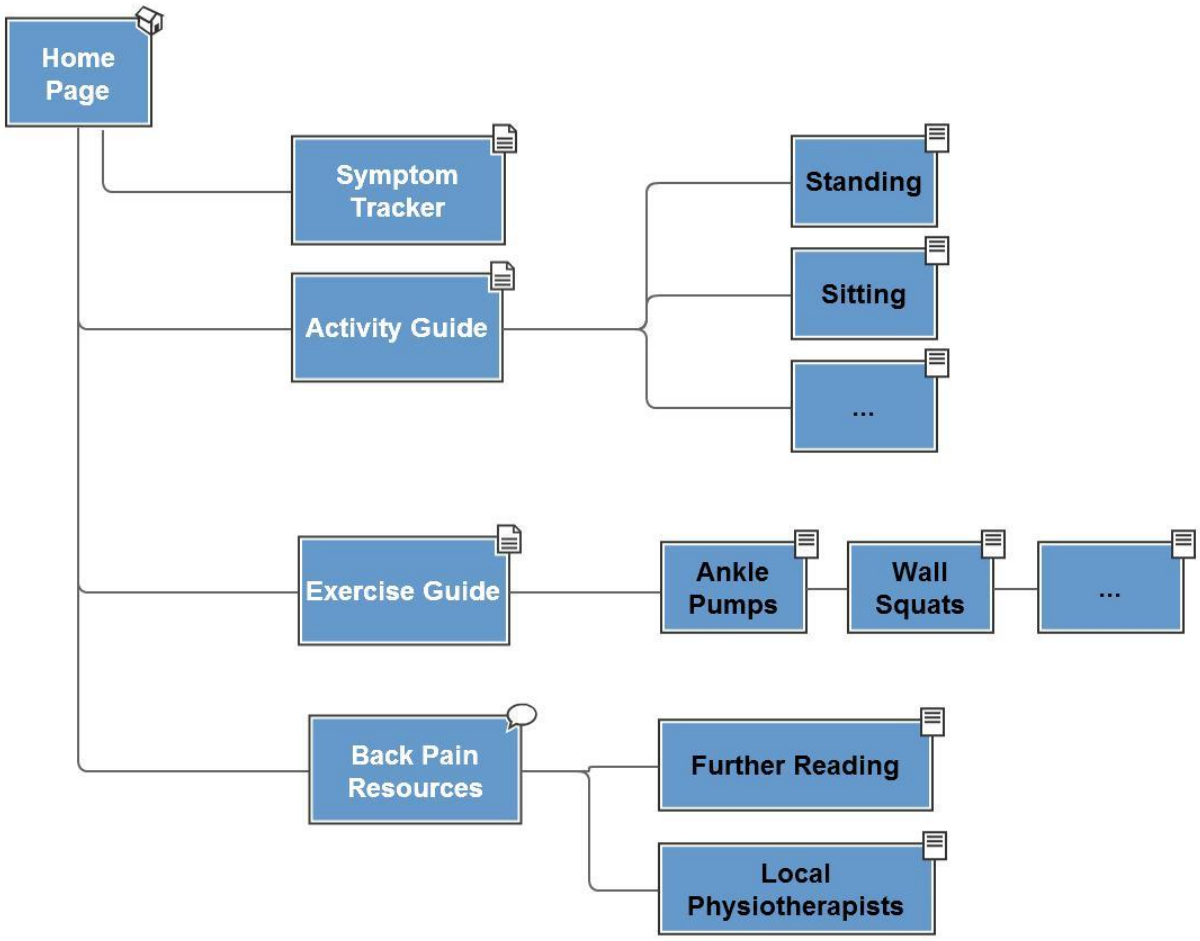


Figure 12: Flowchart of the Application

Firstly, the application will be available to the customer via 2 options.

Google Play (Android Application Marketplace)

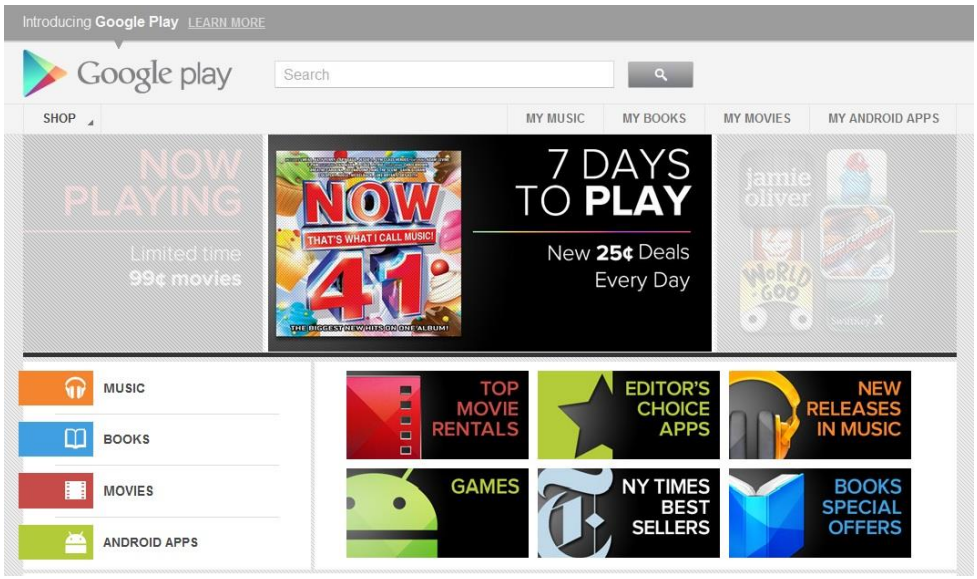


Figure 13: Google Play website screenshot.

The application will be published at the Google Play marketplace whereby user will be able to download it through their Android device by navigating to the application in the Google Play. The reason behind this is that by publishing the application through the Google Play, it will be easier to manage the statistics and information, as well as increasing the reach of the application to every user.

Direct install via .apk file

This approach is to provide direct installation to the user on the Android device with the .apk file. This purpose will be used during the testing phase, as well as during the time before the application is published on the Google Play marketplace. This will be fast and quick solution. This can also be continued post-testing phase as one of the main methods, in which we could send the installation file via email or file transfer. Once installed, user can start using the application.

5.0 Conclusion and Recommendations

To be inserted later as they application has yet to be completed

References

Ahtinen, A., Huuskonen, P., & Häkkilä, J. (2010). Let's All Get Up and Walk to the North Pole: Design and Evaluation of a Mobile Wellness Application. *Proceedings: NordiCHI*.

Aino Ahtinen, S. R. (2008). Design of Mobile Wellness Application: Identifying Cross-Cultural Factors. Cairns, QLD, Australia: OZCHI.

Android. (n.d.). *What is Android?* Retrieved 3 11, 2012, from Android Developers Guide: http://developer.android.com/guide/basics/what-is-android.html

Anon. (2009, June 23). *Back Pain*. Retrieved 3 10, 2012, from AllAboutPain: http://www.allaboutpain.com.my/article.php?aid=22

Aravind Kailas, C.-C. C. (2010). *Wellness Support Using Mobile Handsets.* Palo Alto, CA: DOCOMO Communications Laboratories USA, Inc.

Atul, T. P., & Abna, A. (2000, March 15). *American Academy of Family Physicians*. Retrieved 5 3, 2012, from http://www.aafp.org: http://www.aafp.org/afp/2000/0315/p1779.html

Bogduk, N. (2005). *Clinical anatomy of the lumbar spine and sacrum.* Edinburgh: Churchill Livingstone.

Bogost, I. (2007). Persuasive Games: The Expressive Power of Videogames. MIT Press.

Carlos Fern´andez-Llatas, J. M.-G. (2011). Behaviour patterns detection for persuasive design in Nursing Homes to help dementia patients. *33rd Annual International Conference of the IEEE EMBS*.

Chak, A. (2003). Guiding Users with Persuasive Design. (C. Perfetti, Interviewer)

Dimicco, J. M., Pandolfo, A., & Bender, W. (2004). Influencing Group Participation with a shared display. *Proceedings of CSCW* (pp. 614-623). Chicago, Illinois: ACM.

Fogg, B. (1998). Persuasive computers: perspectives and research directions. *Proceedings of CHI 1998*, 225-232.

Fogg, B. J. (2002). Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann.

Group, C. S. (1994). *Report on Back Pain.* London: HMSO.

Initille, S. S. (2004). A New Research Challenge: Persuasive Technology to Motivate Healthy Aging. *IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE,*.

Istepanian R, J. E. (Dec. 2004). Introduction to the special section on M-Health and Global Wireless Health-Care Connectivity. *Information Technology in Biomedicine*, 405-414.

J., N. (1993). *Usability Engineering.* New York: Academic Press.

Kolari J, L. T. (2004). Context-Aware Services for Mobile Users - Technology and User Experience. VTT Publications 539.

Licklider, J., C. R., & Taylor, R. W. (1968). *The Computer as a Communication Device.*

Marja, O.-K. H. (2008). A Systematic Framework for Designing and Evaluating Persuasive Systems. *Proceedings of Persuasive Technology: Third International Conference*, (pp. 164-176). Oulu, Findland.

Nachemson, A. (1976). The Lumbar Spine: an Ortopedic Challenge. *Spine*, 59-76.

Oinak-Kukkonen, H., & Marja, H. (2008). A Systematic Framework for Designing and Evaluating Persuasive Systems. *Proceedings of Persuasive Technology: Third International Conference*, (pp. 164-176).

Pew Internet. (n.d.). Cancer 2.0: a summary of the recent research. pewrsr.ch/Cancer20.

Reeves, B., & Nass, C. (1996). The Media Equation: how people treat computers, television, and new media like real people and places. Cambridge University Press.

Shapiro, T. E. (2010, 1 12). *Back Pain and Sports*. Retrieved 3 19, 2012, from Spine Universe: http://www.spineuniverse.com/wellness/exercise/back-pain-sports

Stroke, N. I. (2010, 05 19). *Back Pain Information Page*. Retrieved 03 01, 2012, from National Institute of Neurological Disorders and Stroke: http://www.ninds.nih.gov/disorders/backpain/backpain.htm

T., R. (1988). User Interface Design for Computer System. Chihester: Ellis Horwood.

Ting. (2012, 03 19). Physiotherapist at Pantai Integrated Rehab. Ipoh, Perak, Malaysia.

Vanwye, W. (2010). Nonspecific low back pain: evaluation and treatment tips. *The Journal of family practice*, 445-8.

Winograd, T. (1986). A Language/action perspective on the design of cooperative work. *Proceedings of the 1986 ACM conference on Computer-supported cooperative work*, (pp. 203-220).

Young, A. E., Wasiak, R., Philips, L., & Gross, D. P. (2010). Worker's perspectives on low back pain recurrence: "It comes and goes and comes and goes, but it's always there". *International Association for Study of Pain.* Elsevier B.V.

Development of a mobile wellness application for back pain patients using persuasive technology (Stretch)

Zeffree Kan bin Zainal Kan
Department of Computer and Information Sciences,
Universiti Teknologi PETRONAS
Bandar Seri Iskandar, Tronoh Perak, Malaysia
zeffree@live.com

***Abstract* — Back pain is a common problem among adults and exercising is one of the best way to get better in the long run for back pain patients. In this project, the author explore the potentials on how to improve the state of low back pain patients through technology as well as looking into persuasive techniques suitable to persuade low back patients to exercise. The main objectives of this project is to design and develop a mobile wellness application and implement these persuasive techniques. Additionally, the objective is to evaluate user's perception on the developed application. Using MIT App Inventor for Android, the author has created a mobile application for Android named Stretch. Stretch is a mobile application that encourages the users to exercise through several persuasion strategies. From the prototype created, a sample group of users were taken to test and evaluate the application in terms of technology as well as its effectiveness. From the findings at the end of the project, more people prefer applications that use persuasive**

Keywords – Persuasive Technology; Android, Mobile Wellness; Mobile Application; Back Pain

I. INTRODUCTION

Back pain (also known as dorsalgia) is pain felt in the back that usually originates from the muscles, nerves, bones, joints or other structures in the spine.

Approximately 9 out of 10 adults will be afflicted by back pain at some point in their life. [1]. A typical response to experiencing back pain is to take it easy and rest. While this approach is understandable for short term, when done for more than a day or two it can actually undermine healing. Instead, active forms of back exercises are necessary to rehabilitate the spine and help alleviate back pain. [2]

Assoc Prof Dr Dayang Rohaya
Department of Computer and Information Sciences,
Universiti Teknologi PETRONAS
Bandar Seri Iskandar, Tronoh Perak, Malaysia
roharam@petronas.com.my

There has been growing research in incorporating technology to improve general health and cure illness. One of the cost cutting technologies is using persuasive technology. Persuasive technology is broadly defined as technology that is designed to change attitudes or behaviors of the users through persuasion and social influence, but not through coercion. [3]
This project aims to look into how mobile technology and persuasive technology can help in assisting back pain patients in improving their state of health through exercising.

Currently, back pain, as most medical condition, require a proper treatment and the right information on the postural training and back care so that the patient can get better. The technology advances, especially in mobile technologies and persuasion techniques has not been fully utilize in this domain to help back pain patients in getting better. The two questions that will be raised in this project is:

- How can we improve the state of low back pain patients through mobile technologies and persuasive techniques?
- What are the persuasive techniques suitable to persuade low back patients to exercise?

II. PERSUASIVE TECHNOLOGY IN MEDICINE

There have been many implementations of using persuasive design in medicine. In the case of dementia patients, [4] studied on behavior pattern detection for persuasive design in nursing homes. The study presents a behavior pattern detection architecture based on the Ambient Assisted Living paradigm and Workflow Mining technology to enable re-learning mechanisms in dementia

processes via providing tools to automate the conduct disorder detection.

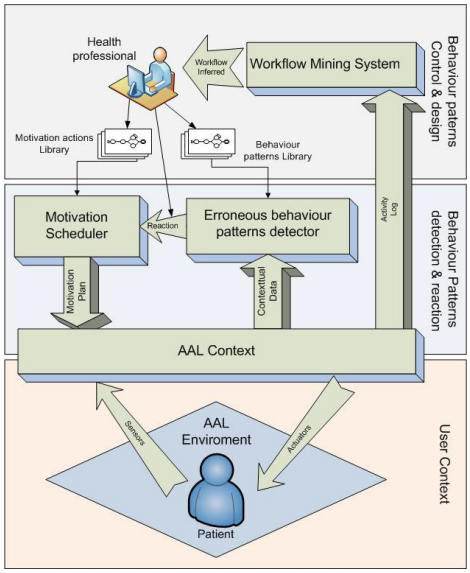


Figure 2: Architecture to detect behavior patterns of subjects in Nursing Homes to allow the application of persuasive technologies to correct conduct diseases.

Initille [5] did a research on persuasive technology to motivate healthy aging based on the problem of the increase in the number of elder population and the costs of medical procedures in United States. In his research, he looked into healthier lifestyle decisions related to diet, exercise, dental care, stress management and maintaining social relationships to positively impact the overall quality of life and long-term health by using technology to motivate these areas.

The research explains the advantages of Just-In-Time Messaging and Behavior Change Motivation in delivering the necessary information to the user on the right time in order to have impact on behavior. By using sensors such as accelerometers worn on the body, we can infer posture, ambulation, and various household activities that involve physical activity and these activity detection algorithms will run on mobile phones and acquire sensor data from the wearable sensors. [5]

III. MOBILE WELLNESS APPLICATION

Mobile wellness applications can motivate people to exercise more because of their ubiquitous presence and suitable technological possibilities. Wellness application utilizes several factors that can increase physical activity level of users, for example data tracking, social sharing and playfulness. [6].

An example of popular off-the-shelf application is the collaboration between Apple and Nike, Nike + iPod. Nike uses a sensor in their the built-in pocket beneath the insole of the Nike+ shoes which can then be paired wirelessly to iPod and iPhone devices. These devices will then have the Nike + iPod application which will then be able to provide the user with features such as a tracker for their time/distance/pace of running and calories burned. Additionally, the application can also send the user's workout data to nikeplus.com which the user can then see all of his/her completed runs and share motivation with runners across the world. [7]

Figure 4: Nike + iPod application

IV. SIMILAR WORKS

In 2010, the BackCare team from United Kingdom created a free mobile application for iOS which provides information on all aspects of back care in order to help people with back pain. Users of the BackCare app are given basic facts about caring for their backs and how to avoid injuring them, illustrated with exercises shown on screen and videos showing the correct way to do them. The application also helps users in UK to find a practitioner close to them using location based tracking. Additionally, there is a feature called "Me and My Back" which allows people to keep a diary of their back pain, showing the areas affected and the level of pain. The data is saved and can be sent

to the user's email address or sent to a practitioner of their choice prior to an appointment.

Figure 6: Some of the features available in the BackCare application.

In 2012, Focus Medica created an Animated Quick Reference guide for Low Back Pain. 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. Each title in the series addresses health concerns with authoritative content on a given condition and is supported by relevant images and lifelike animation videos besides a glossary of related terms and their meanings, and a section for maintaining the patient's record. This handy reference is designed for easy navigation between the content, glossary, images and videos that play independent of the internet once downloaded.

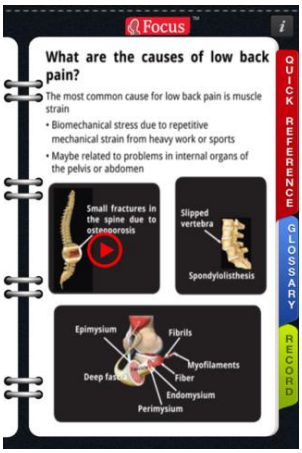


Figure 7: Animated Quick Reference application

A more recent persuasive technology in medicine and mobile, specifically in the area of back pain itself is the latest LumoBack, a mobile solution for creating a perfect posture. The whole solution consist of a device, which is LumoBack's wearable sensor patch that is worn on the waist or lower back and connects wirelessly to an iPhone 4s or the new iPad. 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. Over time, the app can process trend data to determine whether user's posture is steadily improving over time. [8]

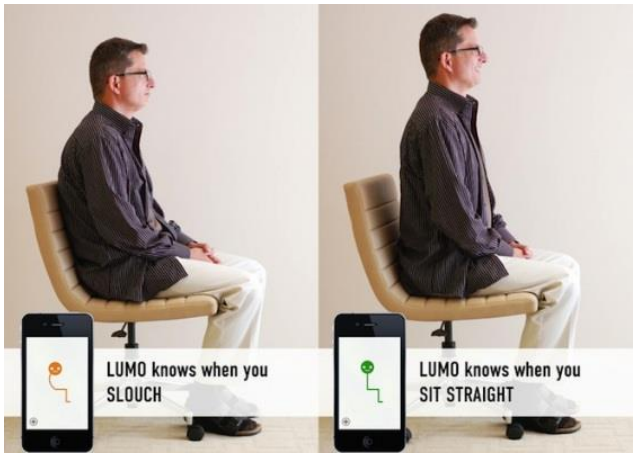


Figure 8: LumoBack wearable sensor patch and the LumoBack application.

V. DESIGN STRATEGIES

The design strategy for persuasion that will be implemented in this system is the following:

1. Tailored information

   The exercise activities and program will be tailored to user's profile after a session of profiling during user's first run of the application. From there, only certain exercises that are suitable will be chosen for the user.

2. Expert's Recommendation

   The exercise activities will follow a strict expert's choice and only relevant exercises that has been recommended by experts for back pain patients.

3. Emotion expression

   The user's profile will be displayed in an avatar, in which the facial expression of the 'user' will change based on the

performance of the user on his/her exercise plans.

4. Reward for consistency

   The system will emphasize on consistency of the user with the exercise plans, and the effect will be shown on the user's avatar.

5. User Interface Design

   The design of the user interface will be customized to fit the target user group likings and preferences.

VI. TOOLS AND EQUIPMENTS

The hardware used in the project is divided into two which is the development machine, and the target machine. The development machine was a desktop computer running Windows operating system and the target machine was a Samsung Galaxy SII with Android operating system.

The software required during the development was a web browser with internet connectivity to MIT App Inventor, a web based application which allows anyone to create applications for the Android operating system.

VII. SYSTEM METHODOLOGY

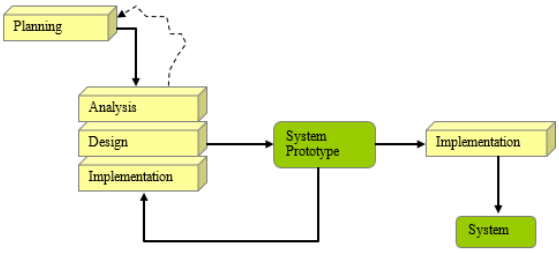


Figure 9: The Prototyping Model

In this project, the prototyping model is used for the software development. This methodology is usually used when the process is likely to be changed as the project proceeds or when the stakeholder has little idea of what system to be built. All the Analysis, Design, and Implementation phases performed at the same time and on each cycle in producing a *system prototype*. The cycle repeated continually based on the comments until the system prototype successfully meets the requirements.

VIII. SYSTEM ARCHITECTURE

From the design strategies, several elements have been designed. For example, in the emotion expression strategy, the relevant character model has been designed. The character model has 4 different expressions to show different progress states to the user.

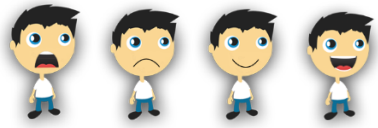


Figure 20: Different expression states to represent the emotion relevant to the user state of exercising.

In the Reward for Consistency strategy, the method of giving 'Star' level is used. The user will be ranked from 0 to 4 stars. If the user consistently uses the system and follows the instructions, the user will have a higher star ranking, with a maximum of four out of four stars.

Figure 21: The graphic used to designate the star points user have. Golden stars represent a star, black to represent no star.

Framework

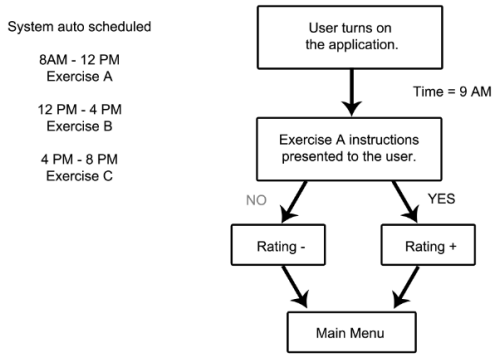


Figure 23: Core flowchart of the user exercise feature

When the user turns on the application, the system looks for the time and date of the phone and searches from the user database for the exercise that has been scheduled for the time period. This exercise schedules were previously scheduled through the profiling done at the beginning of the

application and is kept in a database. The exercise activity recommended will then be displayed to the user. This exercise activity is taken from expert's recommendations. For the purpose of the prototype, the exercise move was taken from SpineUniverse (www.spineuniverse.com) to demonstrate to the user how the moves should be done.

IX. EVALUATION

The system that 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 on the application.

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

The question asked are as following :

1. Do you think that the application is easy to install?
2. Do you think that the application is easy to use?
3. How would you rate the design of the application (scale 1 to 5, 5 highest)
4. Do you think that the application is innovative?
5. Do you think that the application is useful?
6. Do you like the following feature applied in the application
    a. Tailored information (Y/N)
    b. Expert's Recommendation (Y/N)
    c. Emotion expression (Y/N)
    d. Reward for consistency (Y/N)
    e. User Interface Design (Y/N)
7. Do you think this application will help you should you have back pain in the future?
8. Do you think that using application similar like this is better than using an application that just displays you information about back pain?
9. Will you run the application again in the future?

X. RESULT AND DISCUSSION

The result from the study was that most user agree :

1) It was easy to install the application

2) The application is easy to use and understand

3) The design of the application was great, with average score of 4.1/5

4) The application is innovative and useful.

5) They like application with persuasive techniques applied in, compared to normal information display application.

According to ranking, the users liked the Expert recommendation, followed by user interface design and tailored information second, reward for consistency forth and finally emotion expression.

XI. CONCLUSION AND FUTURE WORK

Persuasive technology is an interesting field of research to study as it offers insights on how human behavior reacts to different approaches or strategies in winning their attention. Evidently, persuasive technology has been seen applied everywhere today, from consumer applications to healthcare. Similarly, mobile technology has been a booming technology especially with the rise of smartphones and Google's operating system, Android. More and more people can afford a smartphone today, and technology is touching more peoples life today more than ever before. By looking into both these fields, more and more problems in health care can be tackled and improved for the betterment of society.

This project has highlighted how a common general health issue, can be improved and made interesting to the public through the implementation of simple, generic persuasive strategies applied through a mobile application designed to help them get better.

From this project, we have managed to make several conclusion:

- Persuasive technology can be applied to make applications more engaging and interesting to users, consequently increasing effectiveness.

- Mobile technology can be used to assist patients in healthcare, specifically low back pain
- This application has demonstrated how having persuasive technology is better than not having persuasive strategies in getting users to use the application

XII. REFERENCES

[1] T. P. Atul and A. Abna, "American Academy of Family Physicians," 15 March 2000. [Online]. Available: http://www.aafp.org/afp/2000/0315/p1779.html. [Accessed 3 5 2012].

[2] U. F. Peter, "Exercise and Back Pain," 8 September 1999. [Online]. Available: http://www.spine-health.com/wellness/exercise/exercise-and-back-pain. [Accessed 7 July 2012].

[3] B. J. Fogg, Persuasive Technology: Using Computers to Change What We Think and Do, Morgan Kaufmann, 2002.

[4] J. M. G.-G. J. V. J. C. N. M. R. J. M. B. a. V. T. Carlos Fern´andez-Llatas, "Behaviour patterns detection for persuasive design in Nursing Homes to help dementia patients," *33rd Annual International Conference of the IEEE EMBS*, 2011.

[5] S. S. Initille, "A New Research Challenge: Persuasive Technology to Motivate Healthy Aging," *IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE,*, 2004.

[6] A. Ahtinen, P. Huuskonen and J. Häkkilä, "Let's All Get Up and Walk to the North Pole: Design and Evaluation of a Mobile Wellness Application," *Proceedings: NordiCHI*, 2010.

[7] Apple, "Nike+iPod," [Online]. Available: http://www.apple.com/ipod/nike/run.html. [Accessed 10 7 2012].

[8] C. Farr, "LumoBack," 3 July 2012. [Online]. Available: http://venturebeat.com/2012/07/03/lumoback-perfect-posture/. [Accessed 10 July 2012].