“BackCare: *Development of a Mobile Health Awareness Application for Back Pain Patients’”*

By

Muhammad Zharfan b Mohd Khalis 16181

A dissertation submitted to the
Information and Communication Technology Program
Universiti Teknologi PETRONAS
In partial fulfillment of the requirement for the
BACHELOR (Hons) OF TECHNOLOGY
(INFORMATION & COMMUNICATION TECHNOLOGY)

Universiti Teknologi PETRONAS

Bandar Seri Iskandar

32610 Tronoh

Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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Approved by,

_____
(Assoc. Prof. Dr. Dayang Rohaya bt. Awang Rambli)

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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.

_____

MUHAMMAD ZHARFAN B MOHD KHALIS

ABSTRACT

Back pain is one of the most neglected pains 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 prospective on how to improve the state of back pain patients through mobile technology. The main objective of this project is to explore the use of mobile 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 Android Studio software, the author would develop a mobile application for Android named BackCare. BackCare is a mobile application that motivates the users to perform stretching through exercises provided. The Rapid Application Development (RAD) methodology is used for the development of this project. Surveys and interviews are the sources of data collection to gauge acceptance and opinions 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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CHAPTER 1

INTRODUCTION

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, 8 out of 10 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 while 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. Back pains can be long lasting pain and can lead to disable if not taken care of at early stages. The research aims to explore 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.

In the era of globalization, technology replaced many traditional aspects of our lives. It changed the methods of communication, altered the phenomenon of mobility and had a great impact on improving our lives in this emerging world. The major advantages associated with mobile phones are the affordability, portability and interactivity.

1.2 Problem Statement

The problem statements of this project are:

- Lack of awareness the importance to take care of back health.
- There is huge gap of knowledge on back pain between the back pain patients to take care and improve their back health.

Thus, as a solution to counter these problems, BackCare will be developed. As it is difficult in taking care of back due to busy schedule, BackCare is designed in attracting with alarm and ease to use. In this case, smartphone application is the most suitable approach to be used as a platform for creating health awareness. BackCare is an innovative mobile application that enables the user to manage their back pain. It acts as the companion which reminds and gives the right guidance to improve their health state on back pain.

1.3 Objectives

- To explore the use of mobile technology for creating back care awareness among back pain patients.
- To design and develop a mobile application on the Android operating system to accommodate back pain patients to have a companion which reminds and gives the right guidance to improve their health state on back pain.
- To evaluate the efficacy of a mobile-Web intervention called “BackCare” to help users implement self-tailored strategies to manage and prevent back pain occurrences.

1.4 Scope of Study

The scope of study for Android is 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 (Design Infographics, 2015).

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. A total 115 million unit number of Google's Android shipped on 60 million Smartphones in year 2011 (Design Infographics, 2015).

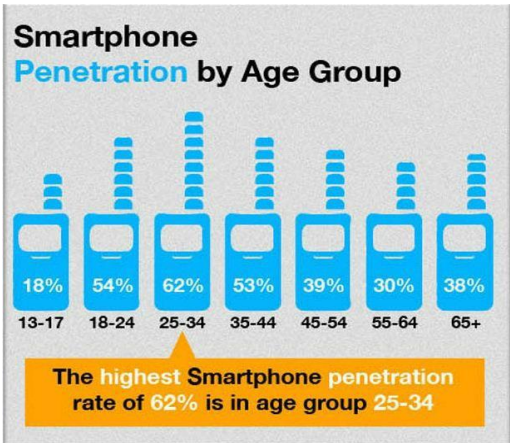


Figure 1: Smart phone penetration according to age group

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% while 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.

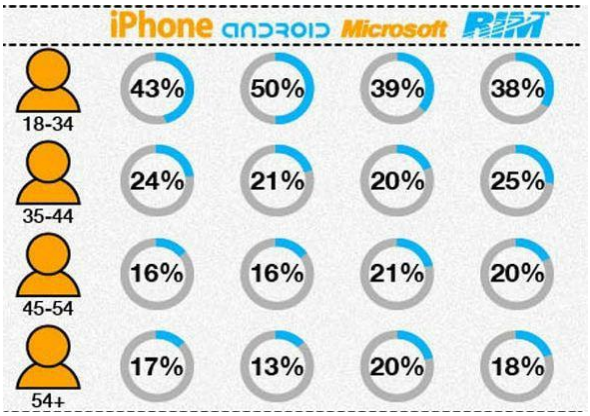


Figure 2: Smartphone user based on age and types of OS

CHAPTER 2

LITERATURE REVIEW

2.1 Understanding Back Pain

2.1.1 Definition

Figure 3: Back Pain

The back is a well-designed structure made up of muscles, bones, 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 is a complex structure that provides support for your legs, pelvis, ribcage, arms and skull (http://www.betterhealth.vic.gov.au, 2013). The spine is made up of bones called vertebrae that are stacked together to form a loose 'S'- shaped column. The intervertebral discs have a flat structure with a jelly-like centre and cushioning each vertebra.

Vertebrae are joined by pairs of small joints called as 'facet' joints. A mesh of connective tissue known as ligaments holds the spine together. Layers of muscle provide structural support and allow movement. The spinal cord connects the brain to the rest of the body and runs through the centre of the vertebral stack.

According to the NHS (National Health Service, n.d.), back pain is the largest cause of work-related absence in the United Kingdom. Although back pain may be painful and uncomfortable, it is not usually serious. Back pain can make it hard to focus on your job whether it's dull and achy or sharp and stabbing.

2.1.2 Types of Back Pain

There are two different types of back pain. An important step in managing back pain is to understand some of the basics about the different types of back pain and to identify which type you are experiencing.

- **Upper back pain versus lower back pain**

Back pain may originate from either the upper back or the lower back. Upper back pain is felt in the top half of the back and in the shoulders and neck. Ligaments and tendons that have been overstretched may be a direct result of injury and caused upper back pain, as an example during a vehicle accident. According to the (Tucker Chiropractic and Wellness Center, 2014), obesity, poor posture and weak abdominal muscles often affect spinal balance then caused the neck to bend forward. Stress can also cause muscles to tighten and contract. Bad posture can contribute to chronic pain in the neck, upper back and the arms (GlaxoSmithKline, 2012).

While for lower back pain, it is felt at the base of the back. Lower back pain may occur from overstretching the lower back muscles, lifting something too heavy, or from direct injury or trauma. Sprain or strain in the lower back can contribute to pain and sometimes muscle pain. Excessive weight and stress may also lead to lower back pain.

- **Acute versus chronic back pain**

Based on how long the pain lasts, back pain is further classified as either acute or chronic. Upper or lower back pain can be either acute or chronic in nature. Acute back pain usually could last from a few days to a few weeks. Most acute back pain is the result of trauma to the back or from a condition like arthritis. Acute pain symptoms range from shooting or stabbing pain to muscle aches and inability to stand up straight (GlaxoSmithKline, 2012).
It is considered chronic back pain if back pain lasts for 3 months or more. Chronic back pain can get worse over time and often progressive. The symptoms of chronic pain can be hard to determine and usually requires treatment from a medical professional.

2.1.3 Causes of Back Pain

There are several causes of back pain that has been identified by the medial researchers. According to National Institute of Neurological Disorders and Stroke (2015), few of these causes are described below:

- Postural Stress

Bad posture due to standing, sitting and lying with the adoption of incorrect body postures could stresses spine. The soft tissue will overstretch and joints and nerves may put under pressure.

- Muscle Strains

Minor back muscle strains usually will quickly recover by themselves but more severe strains will need physiotherapy treatment to relieve pain and promote healing.

- Disc Injuries

Discs are the shock absorbers of the spine and are anchored to the vertebrae, above and below, so they cannot slip out of place (Canadian Physiotherapy Association, n.d.). The disc has a soft (jelly-like) interior that can herniate or even rupture in response to such mechanical stresses as twisting or lifting.

- Arthritis

Inflammation within the joint and the growth of bony spurs on the edges of the vertebrae can cause vertebral joints that affected by degenerative arthritis. The pain may be limited to the back or it can radiate to the lower abdomen, leg, foot or groin. The seriousness of the injury can be indicates by measuring the distance the pain travels.

2.1.4 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 (National Center for Biotechnology Information, 2015).

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 could help 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

People who remain active are likely to recover more quickly than being inactive for long periods. Activity can range from exercising, walking and doing routine jobs.

- 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 and it has been shown to help reduce low back pain (National Institute for Health and Care Excellence, 2009).

- Surgery

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

2.1.5 Prevention of Back Pain

More than 70 per cent of back problems begin during routine daily activities. Accidents and other forms of trauma account for only 30 per cent of back problems (Canadian Physiotherapy Association, n.d.).

Recent studies indicate that the most important factor in preventing back injury may be your general physical conditioning (Healthy Canada, 2011). This includes regular aerobic exercise that may provide the conditioning a back needs to stay healthy. Nonetheless, a specific exercise program to strengthen the spine can also be effective in preventing a recurrence of back pain. Strong back and stomach muscles are important to support your spine properly and also physiotherapist can provide guidance on the appropriate exercises to strengthen these muscles.

These are the following tips to help prevent back pain:

- Lifting

Figure 4: Lifting posture

Lift with legs, not back. Think of the spine as one unit. Keep its neutral alignment when lifting object or bending down. Avoid twisting and lifting, this increases the likelihood of injury. Keep the spine in its neutral alignment even with reaching to pick something light up off the floor.

- Standing

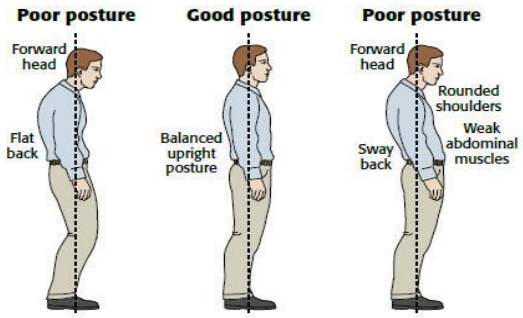


Figure 5: Correct Standing Posture

Back musculature is able to maintain a neutral posture when standing with a neutral spine. The back muscles fatigue more quickly in a neutral spine as compared to more chest and abdominal muscles. Hence, most people stand in a more forward flexed position due to fatigue of the back musculature. This forward flexed position continuously could lead to muscles imbalances.

- Sitting

Figure 6: Correct Sitting Posture

Don’t sit for long periods of time. Try to stand up, stretch and walk around after a while of sitting. Use a back support in chair if necessary but make sure it fits your back.

- Exercise

A healthy body-weight puts less strain on back. Physiotherapist can show how to keep your back flexible and strong with correct back and stomach exercises.

- Driving

Position car seat correctly so your back is supported and your legs are relaxed and slightly bent. Use a lumbar roll or a rolled-up towel to give extra lower back support.

- Sleeping

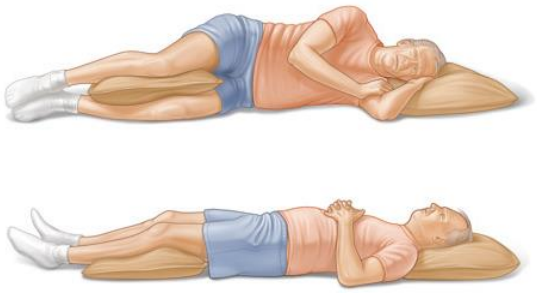
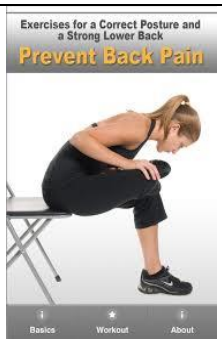
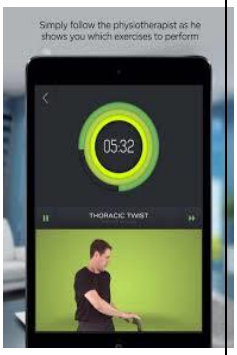


Figure 7: Correct Sleeping Posture

Your mattress should be firm enough to support your spine in a neutral position. Try to consider adding a layer of foam for added support.

2.2 Technology Comparative Study

Name	Image of the Product	Description	Advantage	Disadvantage
Upper & Lower Back Pain Relief (Gabriel N., 2014)		Apps that provide articles on back pain	• User could get some information about back pain	• Nothing about managing pain or prevention at all
WebMD Pain Coach (WebMD, LLC, 2014)		Apps that help you through daily health and wellness choices so you can better manage your chronic pain	• Able to track your pain • Provide articles on some chronic pain • Provide exercise tips	• Does not specific to back pain • Does not provide video or tutorial on exercises
Prevent Lower Back Pain (iGlimpse Limited, 2013)		App that provides exercises for a correct posture and a strong lower back	• Includes various types of exercises for back pain	• There is no video or tutorial for exercises • Nothing about managing pain or prevention at all
Backache (Infin8, 2015)		Integrate short micro breaks into your day to speed up the recovery time for your back pain.	• Send regular notifications when to take a micro break throughout the day. • Includes exercises that target all areas of the body including back, neck, legs, chest, feet, arms and hands	• There is no tips on back pain • Nothing about managing pain or prevention at all

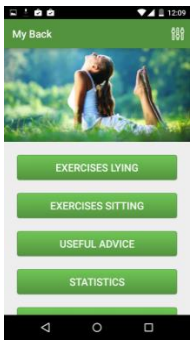
Name	Image of the Product	Description	Advantage	Disadvantage
Audio Book - Back Pain (Twayesh Projects, 2014)		Apps that provide articles on back pain with an audio This audio book is in English and requires internet connection.	• User could get some information about back pain • More interesting learning using audio	• Nothing about managing pain or prevention at all • Requires internet connection to enable the audio.
My Back (nicemir.com, 2015)		Apps that has a range of exercises to strengthen the muscle corset back and spine.	• Has useful advice to take care of your back. • Video on each exercise. • Customization of the exercise time. • Can track user's progress on exercise in a day.	• There is no reminder system

Table 1: Summary of Existing Applications

CHAPTER 3

METHODOLOGY

3.1 Research Method

In order to develop BackCare mobile application, several research methodologies have been carried out to map out the work plan by following the research procedures, strategies and conducting several approaches to the required knowledge.

A qualitative and quantitative approach has been taken at the beginning stage of the research which is helpful and relevant in assessment of the response percentage regarding people's opinion, experiences and behavior. Survey questions technique of this approach has been applied to analyze the different methods of travelling that most people use and plan before traveling to their desired destinations. Broader elaboration of the result will be discussed further in the following sections of the paper.

3.2 System Development Approach

Rapid Application Development (RAD) is selected for successful designing and completion of this project. This approach is preferred over the others due to its applicability for developing highly interactive system with clearly identified user groups and does not involve computational complexity as in our case. Due to time constraints to finish the project which is almost 6 months, the use of Rapid Application Development (RAD) methodology helps to

focus on building the Application in a short period of time, by overlooking additional features and concentrating only on main system functionality.

3.3 System Development Stages

The conceptual framework comprises two main stages. The first stage is the early analysis, which consists of problem identification and objective determination. Figure 14 shows the second stage in the application development which involves Rapid Application Development. Prototype will be tested to the real users to see the result and feedback from them.

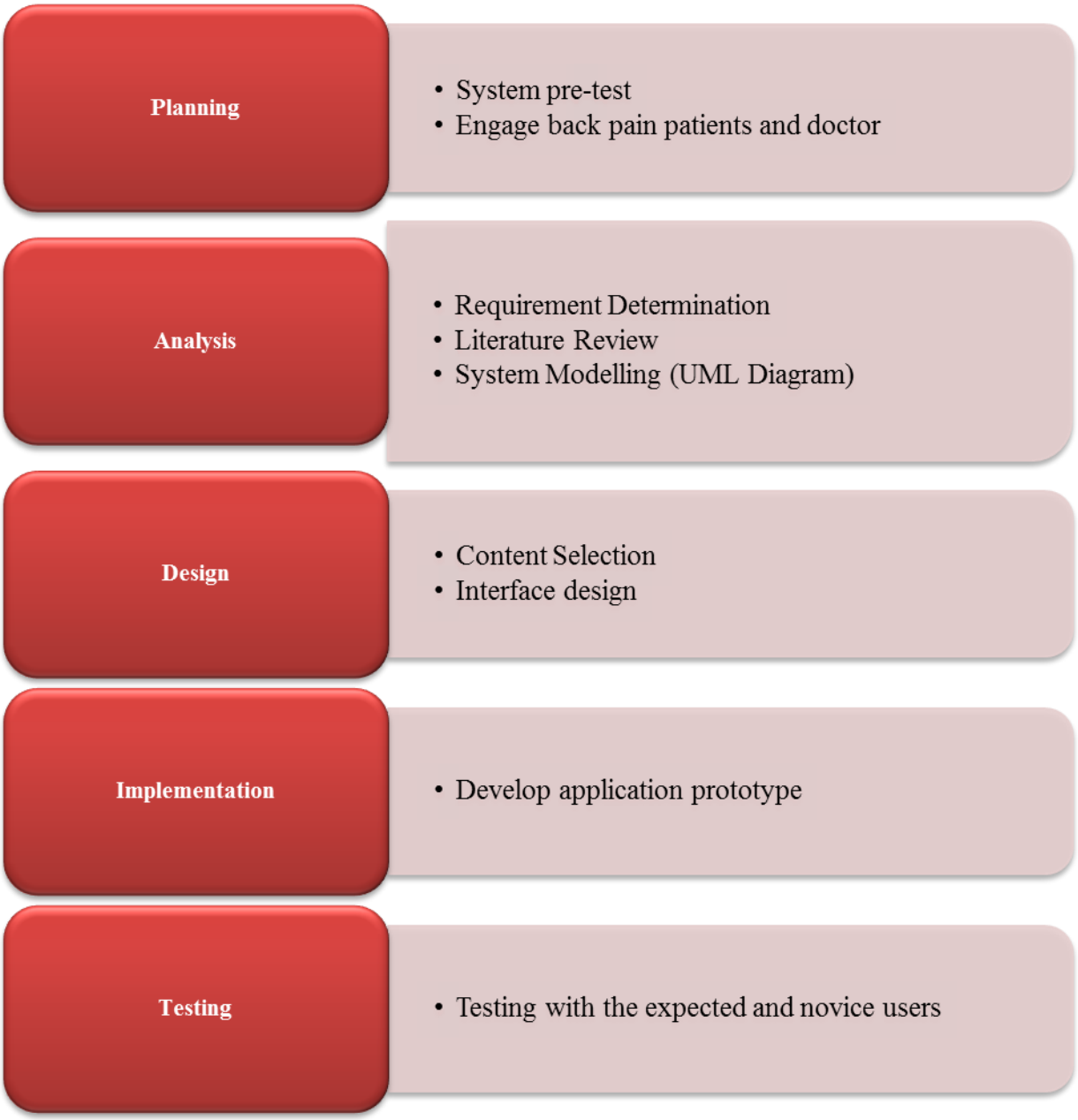


Figure 8: Rapid Application Development of BackCare Mobile Application

3.3.1 Planning Stage

This phase establishes a high-level view of intended project and determines the goal of the project. The aim of this phase is to perform preliminary investigation on the current and effective Android Application system design and the analysis on the method of generating user information.in order to achieve this aim, a requirement gathering method were selected such as:

Survey: Doctor and also people who frequently experience back pain need to answer the questionnaire. This survey being conducted to gather all information needed.

Right after all data are collected, the interface of BackCare application will be developed. This will include the processes of understanding the characteristic and behavior of the data and what are the method of collection and the process of the data.

3.3.2 Analysis Stage

Throughout the analysis stage the points that were clearly stated earlier in the planning stage should be analyzed with the help of user. Furthermore, in this stage literature of the researches, published papers and journals that were done previously will be carefully studied according to each related scope which will help the development of this project and also the previous techniques that can be integrated with the project development.

In addition the similar products that are in the market can act as a guide or standard on where to start and how to improve the existing product that will help on taking care of back.

However, the possible problems the project might encounter should also be predicted during this stage to develop solution framework that might help solve the problem occurred. Analyzing the difficulties that might occur is the most important aid that helps to accomplish the objective of the project. The use case is developed to visualize the interaction of the system with users this will require data input, process and also the output. Additionally a class diagram will be used to illustrate the structure of the application by showing the application's classes, their attribute and methods.

Finally based on the data collected through pre-survey questionnaires, the information has then be further analyzed the majority feedbacks in the concepts used in "BackCare" and the criteria that should be included for better efficient usage. On the other hand, literature survey has also been carried out on the use of android application for back pain guideline to prove the validity of the concept to be used during the exercise tutorial.

3.3.3 Design Stage

This stage considered the longest stage because it includes designing the whole system features throughout the prototype development cycle.

When the analysis phase has been completed, a quick design on the system interface of "BackCare" is developed to determine the system flow and have a clearer view and structures on the system model and also the system flow.

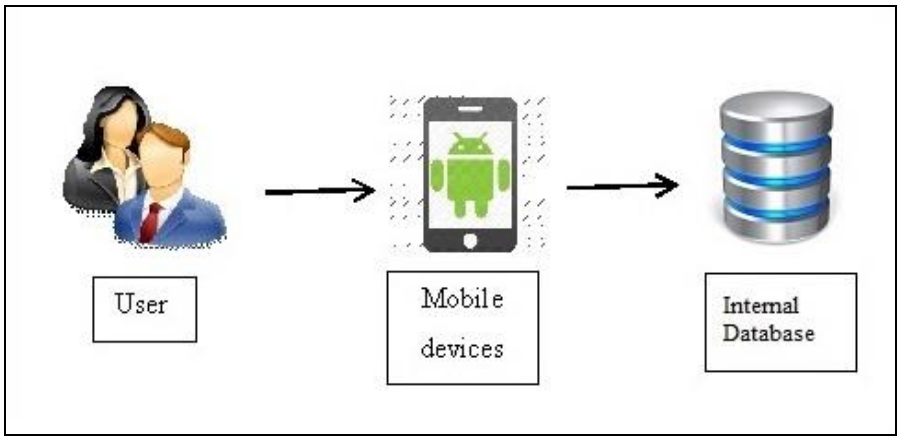


Figure 9 The Proposed System Architecture

The internal database will include information such as name, age, occupation, email, password and exercise record daily.

The user will input their preferences they desire by using the system's interface according to those preferences they will get the output.

Development of prototype

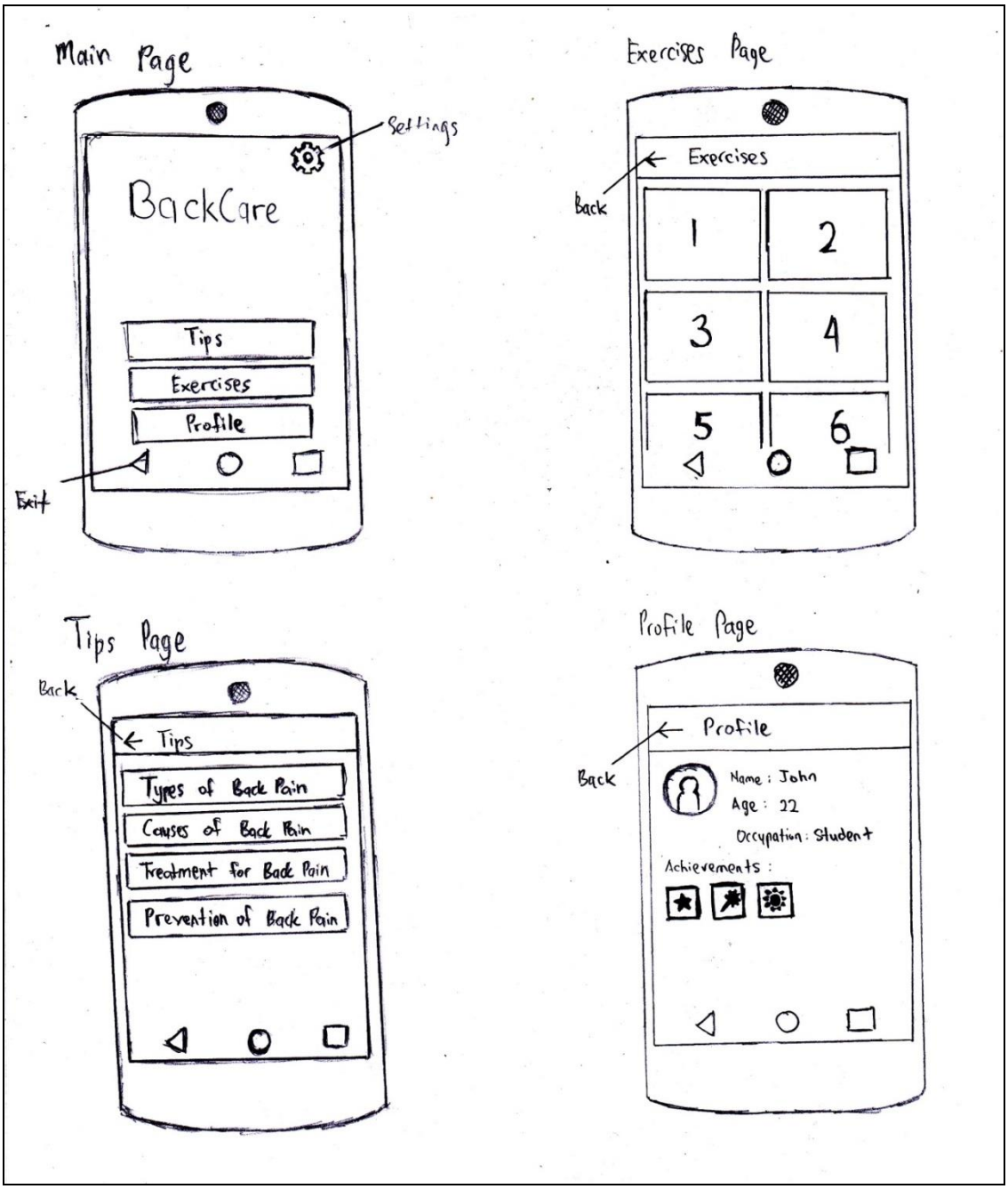


Figure 10: Early Design of BackCare Apps

The prototype of BackCare is begun with initial interface and functionalities. In order to develop BackCare app, certain tools were used. To ensure that the features are working, the testing will be performed once each feature is completely built. This is to avoid the overload of debugging work during the overall features integration process.

3.3.4 Implementation Stage

During implementation stage we have to make sure that all the prototype functionality are working successfully according our plan.

3.3.5 Testing Stage

When the features required have been developed, a complete prototype will be implemented to the users to perform the overall system testing. The purpose of conducting system testing is to examine the functionality and usability of BackCare app form the user's perspective.

The user's feedbacks will be collected to further improve the existing design of BackCare until the amendment meets the requirement and desired model for the users.

3.4 Flowchart

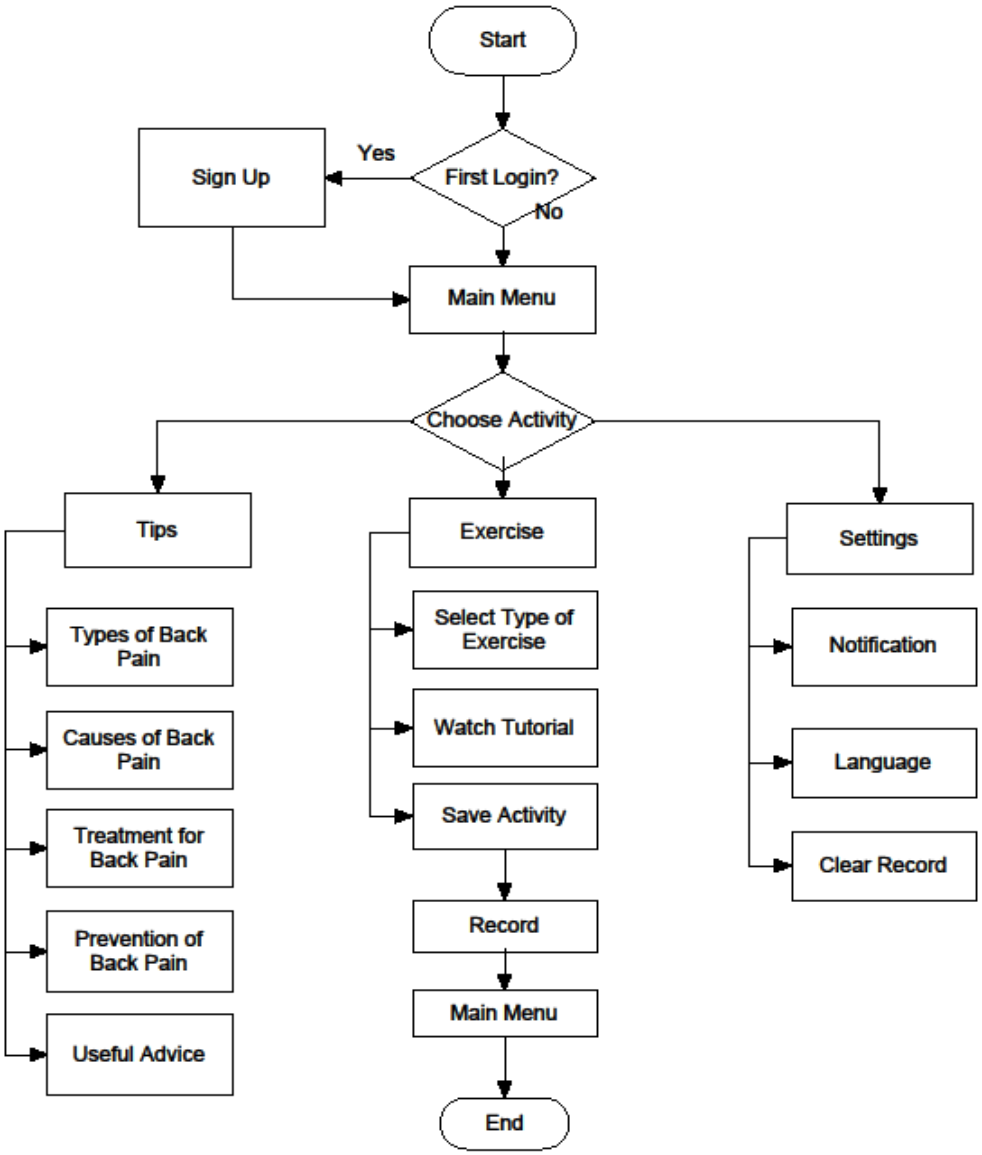


Figure 11 Flow chart for BackCare App

3.5 Gantt Chart

Task	Duration	Weeks																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Requirement Planning Phase																													
Identification of Problem	1																												
Study on Project Background	1																												
Define Objective	1																												
Define scope and limitation	1																												
Preliminary Research	2																												
Literature Review	2																												
Collecting survey	2																												
Selection of tools	1																												
Prototyping Phase																													
Construct flowchart	1																												
Designing the architecture of the apps	1																												
Define the requirements	1																												
Submission of Interim Report	1																												
Proposal Defense	1																												
Build the apps	4																												
Testing Phase																													
Field Testing	2																												
Progress Report Submission	2																												
Improvement of the prototype	3																												
Pre Sedex	1																												
Deployment Phase																													
Viva	1																												
Project Disertation/Submission	1																												

Table 2: Gantt chart for FYP 1 and FYP 2

3.6 Tools

To develop this project, there are several tools and requirements needs to be filling to run the system. The most fundamental one is personal computers with Windows platform, 1 GB RAM (minimum), 80 GB hard-disk space, including 115 MB of available space on the hard disk that contains the operating system. Other minimum requirement and tools required also being stated as follows:

Research for suitable database program	Google Chrome and books
Presentation of the implementation plan and ideas / presentation	Microsoft Power Point 2010
Gantts Chart for project planning	Microsoft Power Point 2010 Database
Development and Interface Design	MySQL, Adobe Photoshop CS5, Android Studio
Programming Language	PHP, JavaScript, HTML and CSS
Documentation and report writing	Microsoft Word 2010

CHAPTER 4

RESULTS AND DISCUSSION

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.
- One of the main reasons is that people do neglect their back pain because of lack of information about back pain.
- Thus, implementation of mobile application could be an effective way to guide and 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 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 on back pain.

4.2 Results 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 42 participants. Most of the participants were young adults from the age of 21 to 30. 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.

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.

Section A: This section is to gather participant's background information.

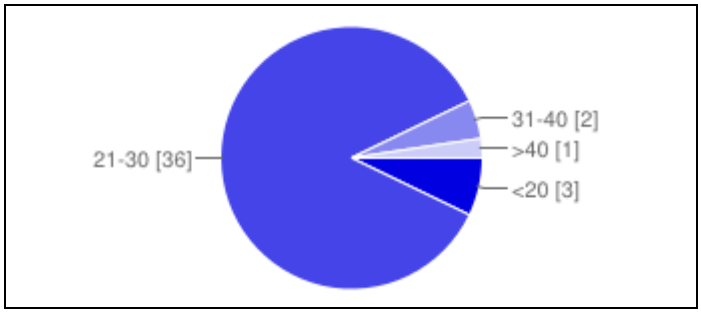


Figure 12: What is your age?

Analysis: Apparently, most of the respondents belong to the age group between 21 and 30 years old.

Auditor
lecturer
student
own business
diploma
Student
Teacher

Figure 13: What is your occupation?

Analysis: Apparently, most of the respondents were students because the questionnaire was given through email and social network.

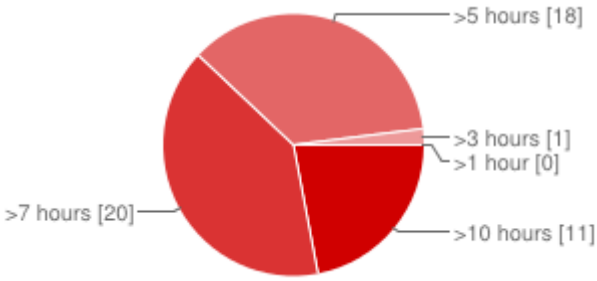


Figure 14: How many hours on average do you sit at your desk in a day?

Analysis: Apparently, most of the respondents spend their time more than 7 hours sitting at their desk in a day.

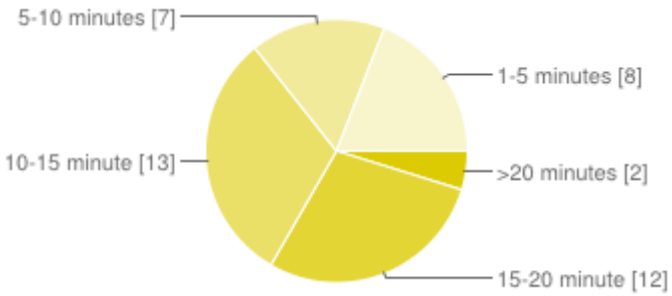


Figure 15: How many hours on average do you take a break from sitting?

Analysis: According to the grapevine, most of the respondents will have their break 10-15 minutes each time from sitting.

Basically, this section can conclude that most of the respondents are students, belong to 21-30 years old and they spend their time more than 7 hours sitting at their desk in a day and also take their break 10-15 minutes from sitting.

Section B - This section is to collect participant's back pain experience.

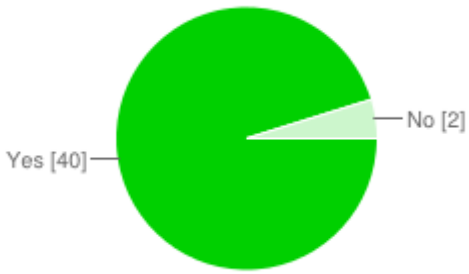


Figure 16: Have you experienced back pain?

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

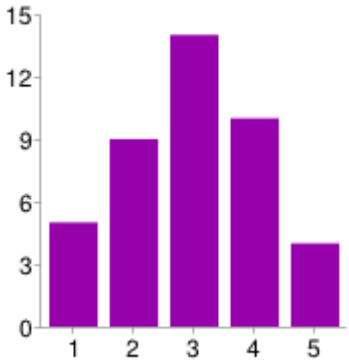


Figure 17: How often do you experience back pain in a day?

Analysis: Most respondents experience back pain 3 times in a day. The contributing factors could be incorrect sleeping posture, sitting posture and etc.

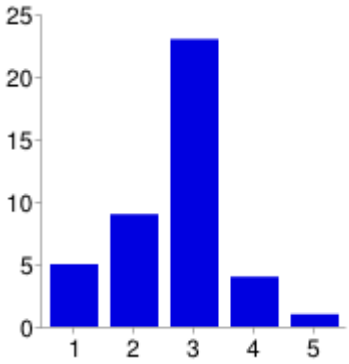


Figure 18: What is the severity of your back pain?

Analysis: Most respondents experienced level 3 which is medium for the severity of their back pain.

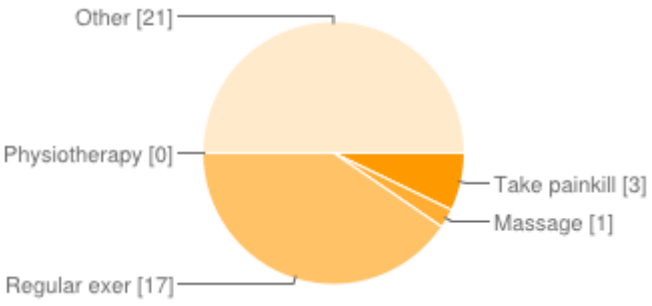


Figure 19: How do you overcome the pain?

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 do exercise and relax then assume that the pain will be relieved.

According to this section, most participants have experienced in back pain which support the relevancy of this project and they also will prefer to do some exercises to overcome the pain.

Section C - This section is to gather information about participant's experience on mobile back pain experience.

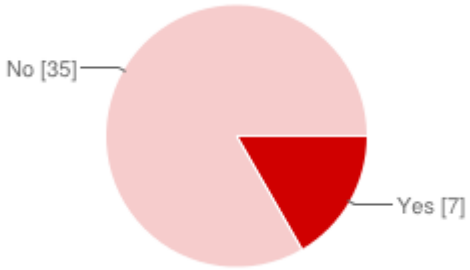


Figure 20: Have you used any mobile health application(s) for back pain? (If yes, please proceed to the next question and if no, please skip to question 13)

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.

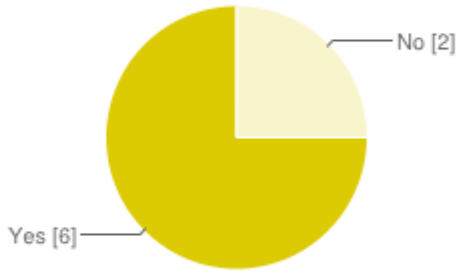


Figure 21: Does the previous mobile application helps you to take care of your back?

Analysis: Apparently, most of participants that have used mobile health application for back pain agreed that the previous mobile application does help them to take care of their back.

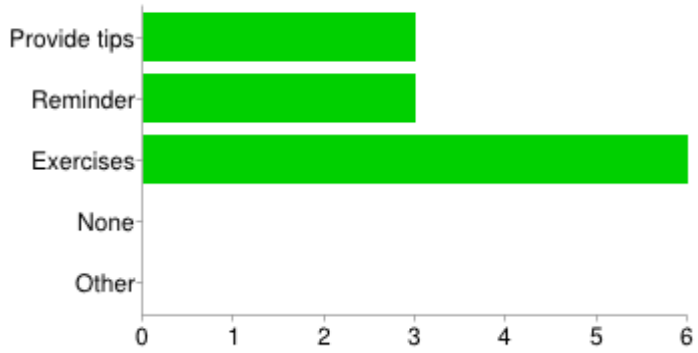


Figure 22: Which features in the previous mobile applications do you like most? (You may choose more than one)

Analysis: Most participants agreed that exercise function is the most favourable in a mobile health application for back pain.

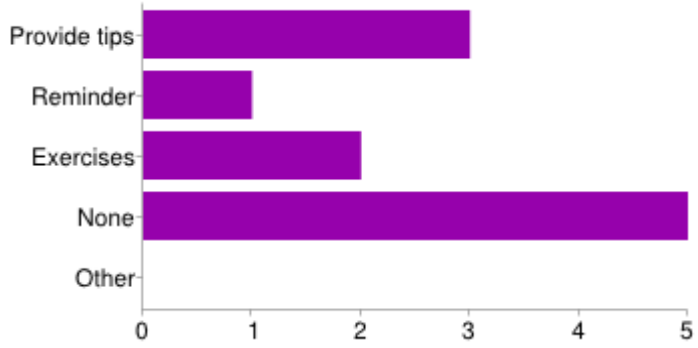


Figure 23: Which features in the previous mobile applications do you dislike most? (You may choose more than one)

Analysis: Based on the graph, most respondents agreed that none of the functions in the previous mobile health applications are non-favourable to them. Hence, provide tips, reminder and exercise functions that must have in a mobile health application.

Yes because to help me to take care of my back.
Yes because it can help improve my back health
Yes because i hope this mobile application can help to take care of my back
Yes because it is good
Yes because it is a good apps for me.
Yes because it can help my back
Yes

Figure 24: Would you like to use a mobile health application for back pain? Justify. (Optional)

Analysis: Respondents will skip to this question if they choose no on Question 10. 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.

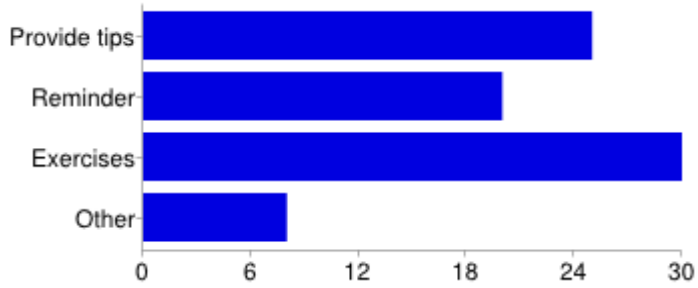


Figure 25: What features would you want to have in your mobile health application for back pain? (You may choose more than one)

Analysis: Based on the graph, participants respond that provide tips, reminder, and exercise should be features in mobile health applications. They also added some other functions which are track their daily exercise, rewards and also share their achievements to social media.

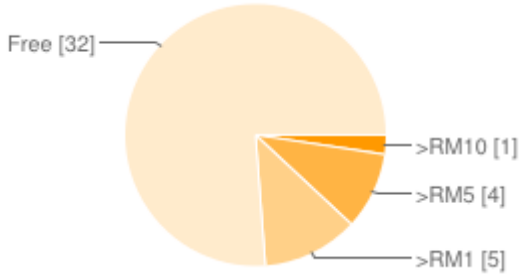


Figure 26: If there is any mobile health application to help you to take care of your back, how much are you willing to pay?

Analysis: Most respondents would like to install a free mobile health application.

According to this section, 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. Then, participants respond that provide tips, reminder, and exercise should be features in mobile health applications. They also

added some other functions which are track their daily exercise, rewards and also share their achievements to social media and they also prefer to install it for free.

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

4.3 Application Screenshot

There are two options that user might select in home page, Figure 27 which is login and register. The first choice will navigate user to the login page, Figure 28 whereby user requires entering email and password while second choice will navigate user to

register by entering their information such as name, age, occupation, email and password.

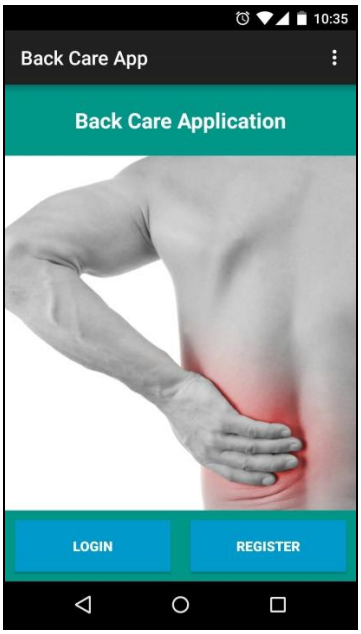


Figure 27 Home Page

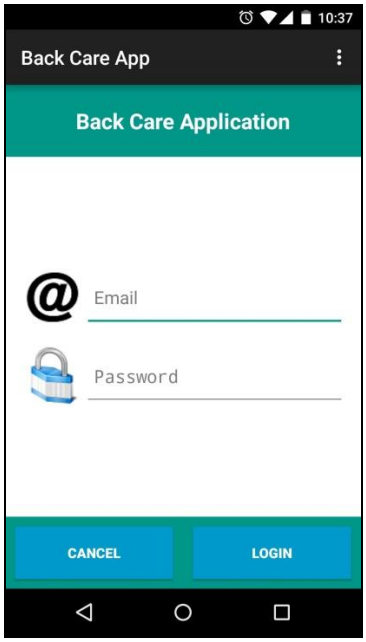


Figure 28 Login Page

Figure 29 shows the main page of BackCare Application .The user has to select one of those functionalities according to their desire. Figure 30 shows the read tips page; user has to select which information they would like to read on managing their back

pain. There are types of back pain, causes of back pain, treatment for back pain, prevention of back pain and useful advice.

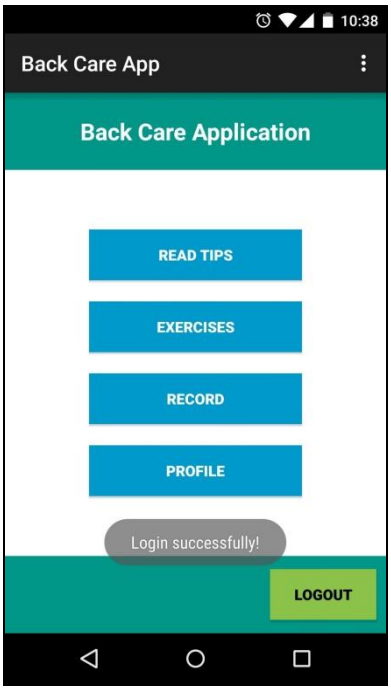


Figure 29 Main Page

Figure 30 Read Tips Page

Figure 31 shows the main page of BackCare Application .The user has to select one of category of exercises which are lying and sitting. Figure 32 shows one of the exercises from lying category where the user could click the “play video” button then “marked as done” button after the user done the exercise in order to save the record.

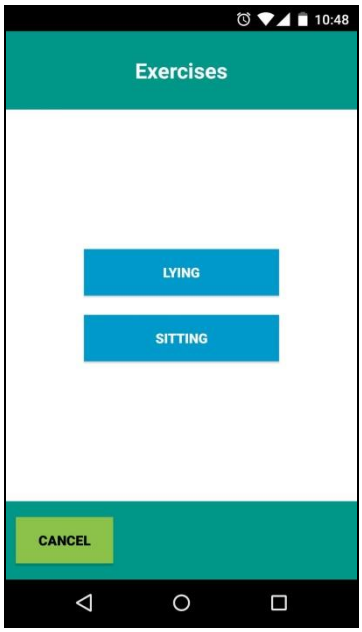


Figure 31 Exercise Page

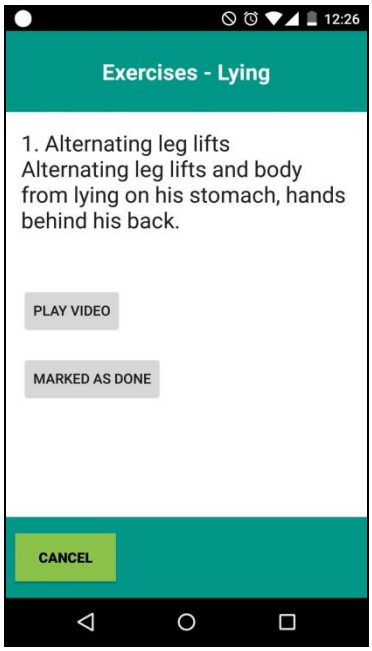


Figure 32 Alternating Leg Lifts Page

Figure 33 shows the record page of BackCare Application .After the user clicked “marked as done” from the exercises pages, the data will be stored in the database. From this page, user could monitor and track their progress daily. Figure 34 shows the profile page where the user could see their information when they registered previously.

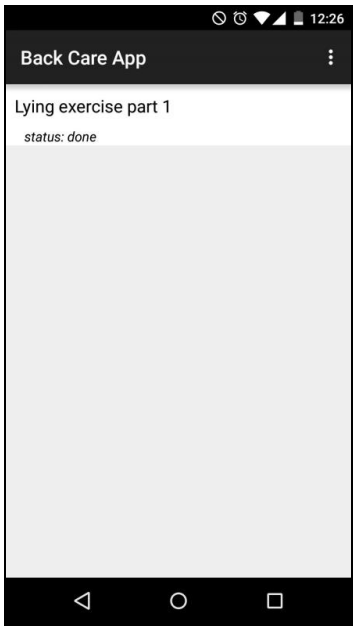


Figure 33 Record Page

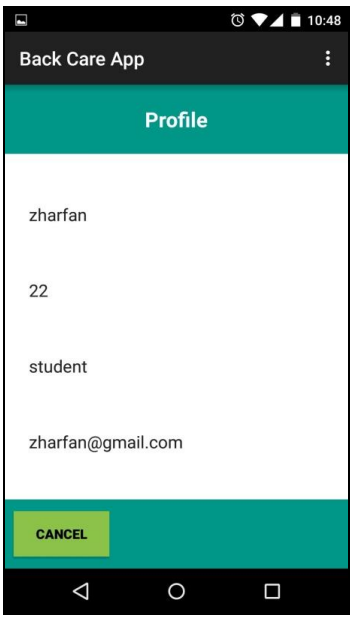


Figure 34 Profile Page

4.4 User Acceptance Testing

The aim of conducting user acceptance testing is to allow the targeted users to evaluate and examine the prototype of “BackCare” Application based on self-perception. This user Acceptance testing will be targeting 20 users both male and female who are all smartphone users and familiar with using mobile applications and experiencing back pain. The users’ evaluation will be based on 3 categories. The categories include social factors, technological factors and customer satisfaction.

4.4.1 Social Factors

In this section, the respondents are required to examine the statements based on the criteria’s on BackCare App user friendliness, BackCare’s usefulness and the BackCare’s usability.

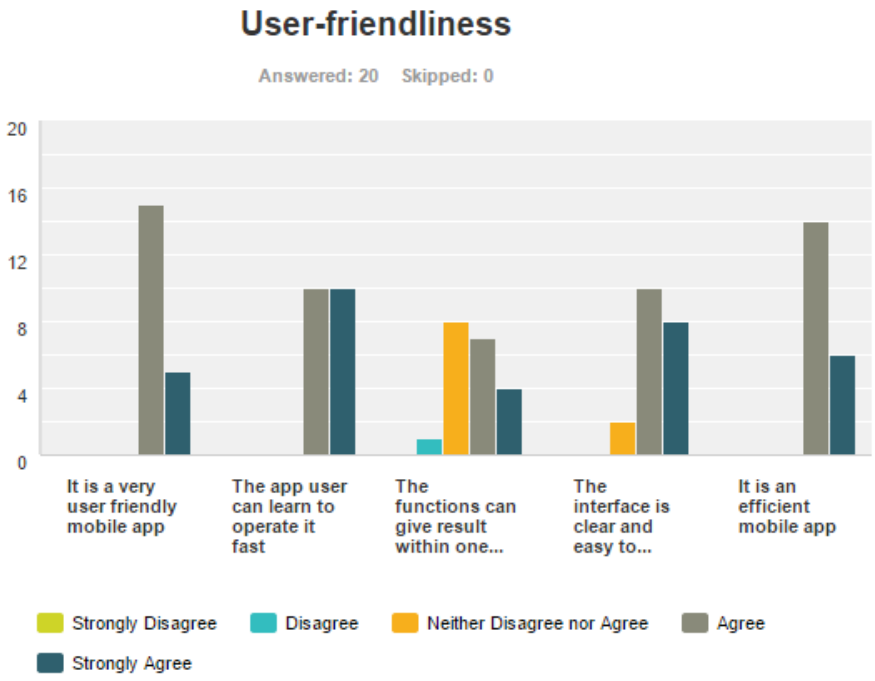


Figure 35: The UAT on BackCare's user-friendliness

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
It is a very user friendly mobile app	0.00% 0	0.00% 0	0.00% 0	75.00% 15	25.00% 5	20
The app user can learn to operate it fast	0.00% 0	0.00% 0	0.00% 0	50.00% 10	50.00% 10	20
The functions can give result within one click	0.00% 0	5.00% 1	40.00% 8	35.00% 7	20.00% 4	20
The interface is clear and easy to understand	0.00% 0	0.00% 0	10.00% 2	50.00% 10	40.00% 8	20
It is an efficient mobile app	0.00% 0	0.00% 0	0.00% 0	70.00% 14	30.00% 6	20

Table 3 The UAT on BackCare's user -friendliness data

In the criterion on BackCare user friendliness, the result shows the respondents had given high rating and it proves that the user felt that BackCare is a user- friendly and efficient app and easy to operate it and thus, the user can operate it in a short time.

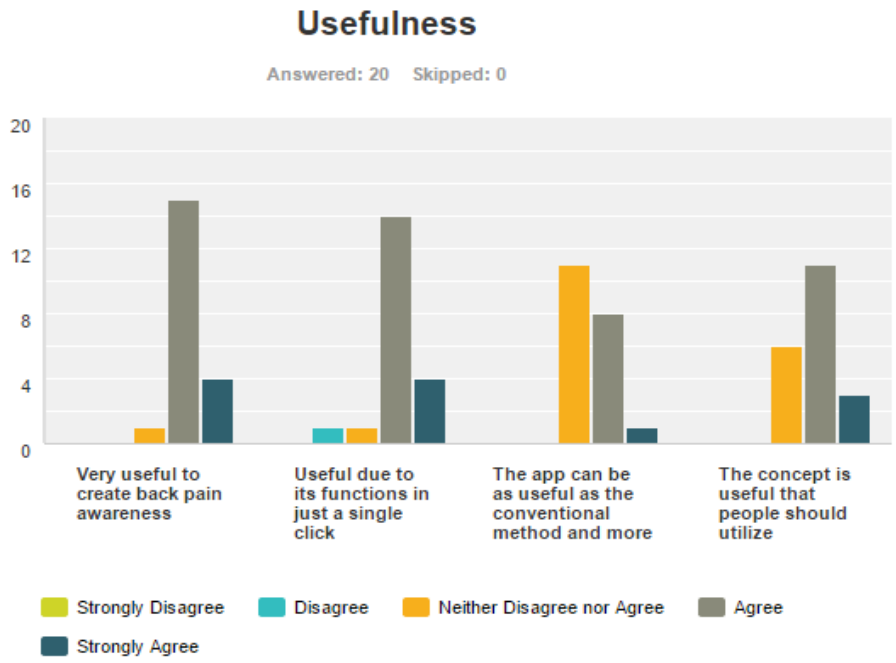


Figure 36 The UAT on BackCare's Usefulness

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
Very useful to create back pain awareness	0.00% 0	0.00% 0	5.00% 1	75.00% 15	20.00% 4	20
Useful due to its functions in just a single click	0.00% 0	5.00% 1	5.00% 1	70.00% 14	20.00% 4	20
The app can be as useful as the conventional method and more	0.00% 0	0.00% 0	55.00% 11	40.00% 8	5.00% 1	20
The concept is useful that people should utilize	0.00% 0	0.00% 0	30.00% 6	55.00% 11	15.00% 3	20

Table 4 The UAT on BackCare's usefulness data

Based on the result collected for the usefulness of BackCare, it shows that most of the 20 respondents find it very useful due to its functions and suitable to be used by people experiencing back pain.

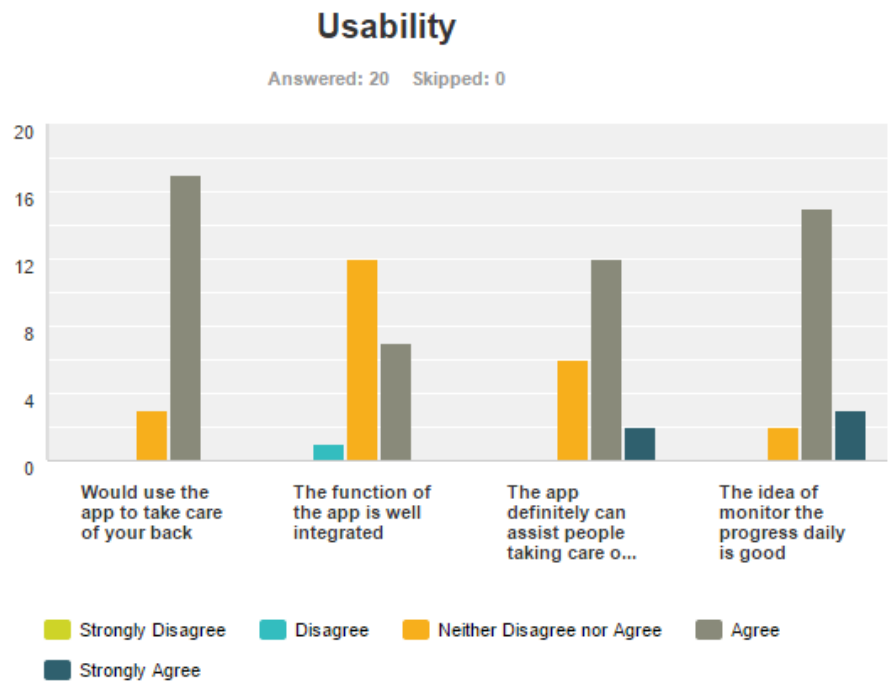


Figure 37 The UAT on BackCare's usability

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
Would use the app to take care of your back	0.00% 0	0.00% 0	15.00% 3	85.00% 17	0.00% 0	20
The function of the app is well integrated	0.00% 0	5.00% 1	60.00% 12	35.00% 7	0.00% 0	20
The app definitely can assist people taking care of their back	0.00% 0	0.00% 0	30.00% 6	60.00% 12	10.00% 2	20
The idea of monitor the progress daily is good	0.00% 0	0.00% 0	10.00% 2	75.00% 15	15.00% 3	20

Table 5 The UAT on BackCare's usability data

As for the response of BackCare's usability, 85% agreed that they will use the app to take care of their back. The 20 respondents also find the function of the app is well integrated and are usable for the respective purpose, assist people taking care of their back.

4.4.2 Technological Factors

For the technological factor, the respondents are required to examine the quality of the app based on the criteria of availability of information, the attitude of the application and the behavioral intention of the users.

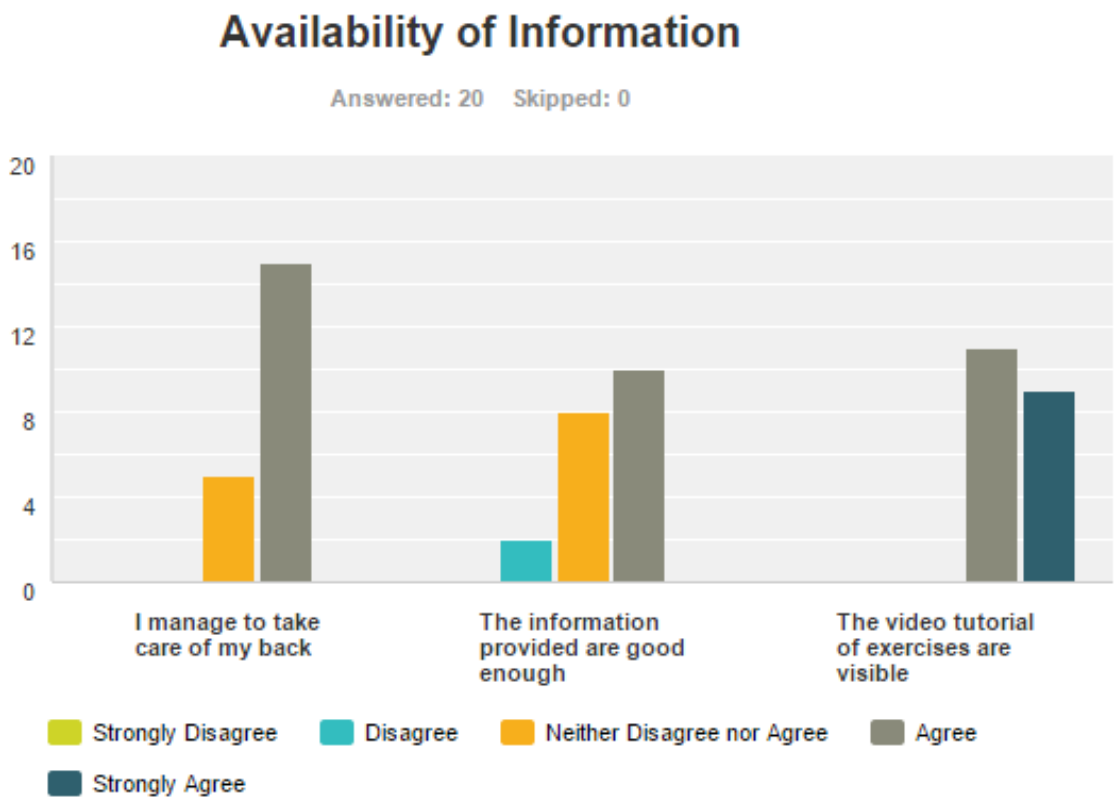


Figure 38 The UAT on Availability of information

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
I manage to take care of my back	0.00% 0	0.00% 0	25.00% 5	75.00% 15	0.00% 0	20
The information provided are good enough	0.00% 0	10.00% 2	40.00% 8	50.00% 10	0.00% 0	20
The video tutorial of exercises are visible	0.00% 0	0.00% 0	0.00% 0	55.00% 11	45.00% 9	20

Table 6 The UAT on Availability of information data

According to the 20 respondents most of them manage to take care of their back and said that the video tutorial of exercises is good enough. Besides, the information provided is good enough and can be easily accessed by BackCare app. While there were 25% respondents said that they neither disagree nor agree with BackCare could manage to take care of their back because they need more time to keep track their back pain health progress.

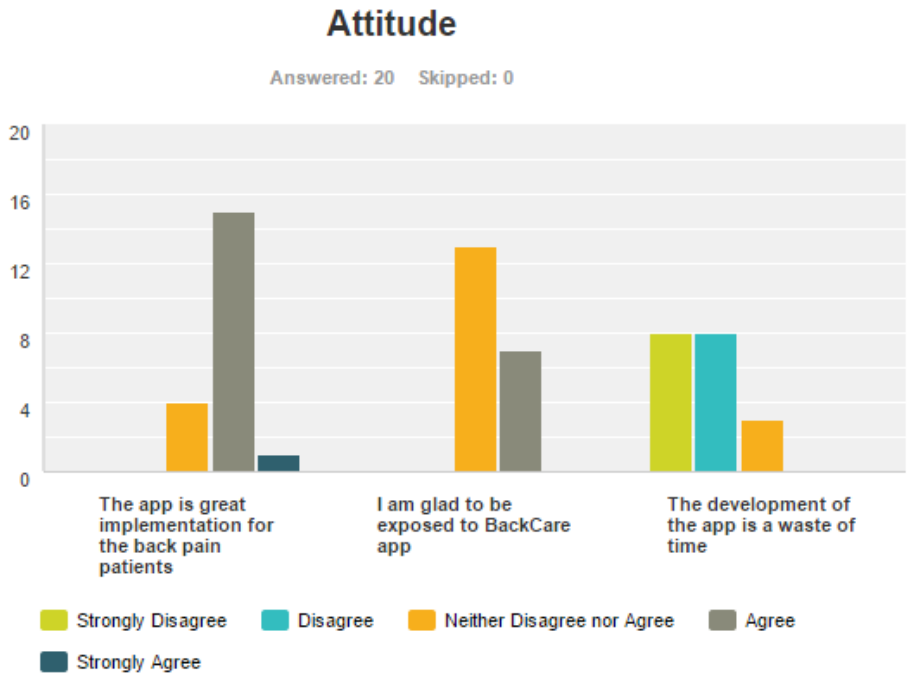


Figure 39 The UAT on Attitude

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
The app is great implementation for the back pain patients	0.00% 0	0.00% 0	20.00% 4	75.00% 15	5.00% 1	20
I am glad to be exposed to BackCare app	0.00% 0	0.00% 0	65.00% 13	35.00% 7	0.00% 0	20
The development of the app is a waste of time	42.11% 8	42.11% 8	15.79% 3	0.00% 0	0.00% 0	19

Table 7 The UAT on Attitude data

All the respondents find BackCare app is a positive platform to help users and 80% of them agree that the app is a great implementation for the back pain and the rest of them remain neutral to the statement. Besides, 35% of them are glad to be exposed to BackCare app and some of them remain neutral as well. On the other hand, most of the respondents believe that the development of BackCare app is definitely not a waste of time. Thus the result proves that BackCare app is an acceptable app for users.

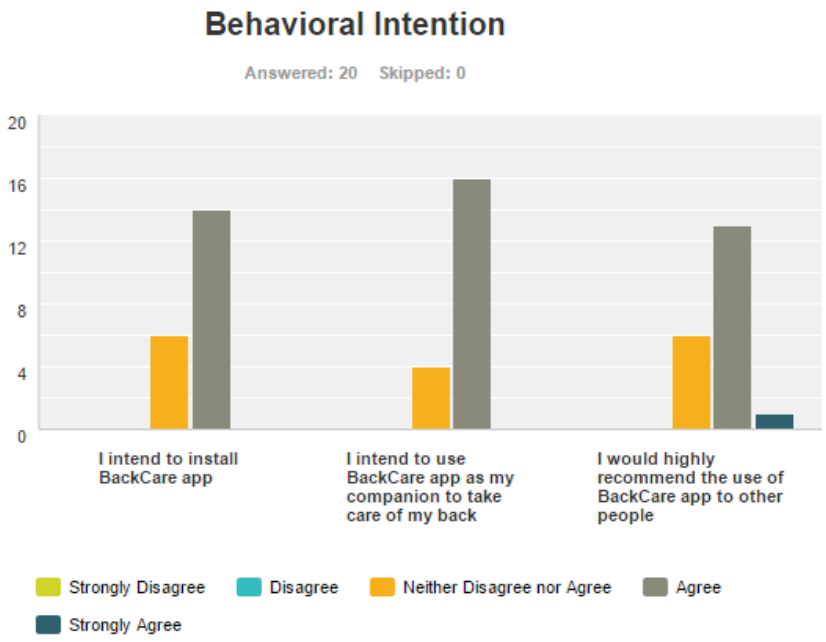


Figure 40 The UAT on Behavioral intention

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
I intend to install BackCare app	0.00% 0	0.00% 0	30.00% 6	70.00% 14	0.00% 0	20
I intend to use BackCare app as my companion to take care of my back	0.00% 0	0.00% 0	20.00% 4	80.00% 16	0.00% 0	20
I would highly recommend the use of BackCare app to other people	0.00% 0	0.00% 0	30.00% 6	65.00% 13	5.00% 1	20

Table 8 The UAT on Behavioral intention data

Based on the result above, most of the respondents agree to install BackCare app in their phone and would recommend and guide people in using it. 80% of them claim that they would utilize BackCare app as their companion to take care of their back.

4.4.3 Customer Satisfaction

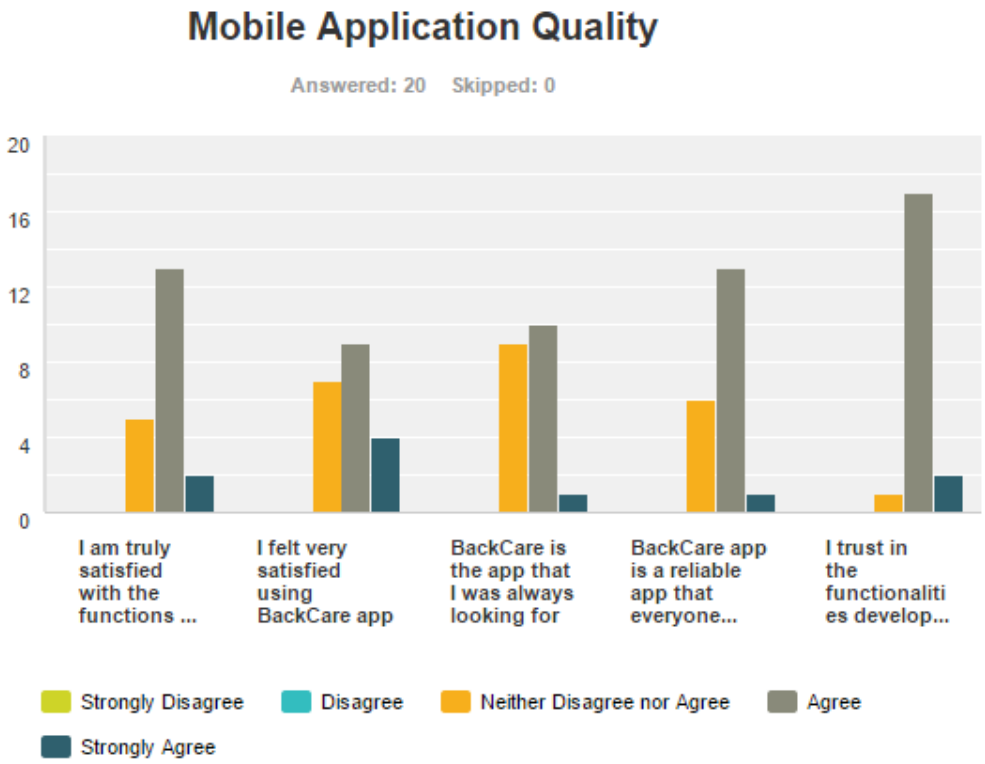


Figure 41 The UAT on Mobile Application quality

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Total
I am truly satisfied with the functions in BackCare app	0.00% 0	0.00% 0	25.00% 5	65.00% 13	10.00% 2	20
I felt very satisfied using BackCare app	0.00% 0	0.00% 0	35.00% 7	45.00% 9	20.00% 4	20
BackCare is the app that I was always looking for	0.00% 0	0.00% 0	45.00% 9	50.00% 10	5.00% 1	20
BackCare app is a reliable app that everyone should use	0.00% 0	0.00% 0	30.00% 6	65.00% 13	5.00% 1	20
I trust in the functionalities developed in BackCare app	0.00% 0	0.00% 0	5.00% 1	85.00% 17	10.00% 2	20

Table 9 The UAT on Mobile Application Quality data

Based on the testing of the mobile application quality, most of the respondents are truly satisfied in using BackCare app. They also find BackCare is reliable app and trusts the functionality in it. 50% of them strongly agree that BackCare is the app that they were always looking for, whereas the rest remain neutral on the statement because they still unsure about the efficacy of BackCare app that could help them in assisting to take care of their back pain.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Relevancy of the objectives

As stated previously, the objective of this research is to evaluated the efficacy of a mobile-Web intervention to help users implement self-tailored strategies to manage and prevent back pain occurrences.. 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. 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 BackCare. Thus, several conclusions have been made:

- It is important to raise awareness among people to prevent back pain.
- 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 exist, and the only way to stay competitive is to create a good difference in the future. Besides that, by developing specific exercises for different category of age or diseases could help to categorize different exercises for different category and increase the efficacy of mobile health application.

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APPENDICES

These are questions listed in the questionnaire:

Section A: This section is to gather participant's background information.

1. What is your age?
2. What is your occupation?
3. How many hours on average do you sit at your desk in a day?
4. How many hours on average do you take a break from sitting?

Section B - This section is to collect participant's back pain experience.

5. Have you experienced back pain?
6. How often do you experience back pain in a day?
7. What is the severity of your back pain?
8. How do you overcome the pain?

Section C - This section is to gather information about participant's experience on mobile back pain experience.

9. Have you used any mobile health application(s) for back pain? (If yes, please proceed to the next question and if no, please skip to question 13)
10. Does the previous mobile application helps you to take care of your back?
11. Which features in the previous mobile applications do you like most? (You may choose more than one)
12. Which features in the previous mobile applications do you dislike most? (You may choose more than one)
13. Would you like to use a mobile health application for back pain? Justify. (Optional)
14. What features would you want to have in your mobile health application for back pain? (You may choose more than one)
15. If there is any mobile health application to help you to take care of your back, how much are you willing to pay?