An Interactive 3D Acupressure Model for Self Treatment in Reducing Pain

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Graphical abstract
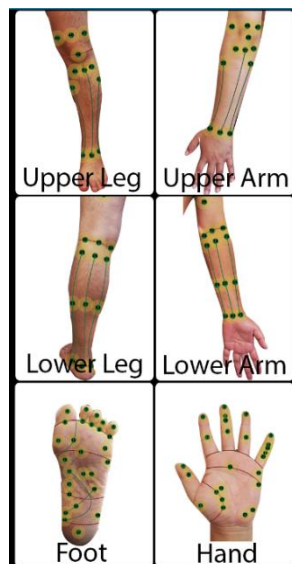
Abstract

There are many pressure points on a human body. The pressure points are specific sensitive areas on the surface of the human body going into deep tissue where the pain concentrate and accumulate on. Acupressure is an alternative way to relieve pain. This method is applied by using fingers. On medication, an effort to relieve pain by taking painkillers will cause many side effects to a human body. The objectives of this paper is to show acupressure points and its set of interconnection point in an interactive 3D visual model. This model will recommend a set of self-acupressure points for a natural self-curative therapy to relieve pain. The self-acupressure visual model has been embedded in a mobile application. This interactive 3D visual model provides an alternative way to relieve pain. It is an effective aid to help a user learn and apply self-acupressure treatment.

Keywords: Acupressure points, an interactive 3D visual model

1.0 INTRODUCTION

Historically, the knowledge on pressure points are well established since ancient time. In recent years, scientists have begun to document the existence and benefits of pressure point therapy. Research has demonstrated that a flow of electrical current along the pathways the ancient text labelled as the meridians [1] for which its conductivity has been found greater at just those keys point traditionally designated as the pressure points. Substantial evidence now exists that pressure point therapy can be instrumental in regulating the nervous system and blood circulatory system [2].

A pressure point is a specific location on human body where the intersection of vessels, nerves or muscular structures are concentrated for particular sensitivity. Pressure points in the human body can be massaged and stimulated used to help relieve a pain.

Nowadays, many people suffer from a serious pain on their body parts and most of them opt to take painkillers to relieve the pain. Painkillers can relieve pain effectively. However, it only relieves the pain temporarily and it will cause side effects to our body.

While acupuncture is widely used to manage a chronic pain [3], acupressure is more practical and cost effective in reducing pain. Acupressure is also an effective alternative way to relieve pain in a variety of conditions. At the same time, acupressure is easy to learn and can be self-practice.

This paper introduces an interactive 3D visual model in mobile application for self-acupressure treatment. It is developed for the purpose of

encouraging people to do self-treatment using acupressure to relieve pain. Thus, a self-treatment based on acupressure can be practical.

There are many visual mobile on acupressure points. However, most of the mobile applications do not support interactive 3D visual model and hardly focus on the interconnect pressure point of acupressure to relieve pain. In addition, most of the people do not know about the self-treatment using acupressure point.

For this research project, an interactive 3D visual model mobile application for self-treatment using acupressure is developed. This application includes an interactive 3D visual model, which contains all the acupressure points and its interconnection points to relieve pain. Thus, users can check the acupressure points for each part of the body and its interconnection points using this application. Therefore, it is more convenient for the users to learn about the self-treatment using acupressure. This application can be installed on the Smartphone and can use anytime and anywhere

There are few mobile applications about acupressure, but most of them using 2D image for acupressure points representation where the interactive between users and the model. Moreover, a user may find it difficult to identify the actual part of the acupressure points on their body.

Most of visual models does not focus on the interconnect pressure points to relieve pain. Interconnecting pressure points are the points to apply pressure to relieve the pain which are not located anywhere near the area in pain. The current application does not show the interconnect pressure points of acupressure points, users need to find out the point by searching it.

This interactive application is mainly focused on self-treatment acupressure points and its interconnecting acupressure points to relieve pain for self-treatment. It provides an easy to learn interaction on ancient technique of self-healing.

2.0 ACUPRESSURE POINTS

Human muscle accounts for about 50 percent of body weight but 85 percent of human pain complaints [4]. Human muscles are covering nearly every other tissue or structure in the body. A pressure point of pain on human muscle associated to pain is commonly referred to as an acupressure point.

In general, each muscle receives one artery to bring nutrients via blood supply into it but several veins to take away metabolic waste products surrendered by the muscle into the blood. The nerve

supply to a muscle, however, also enters at the same place as the blood supply. Each skeletal muscle fibre is supplied by a single nerve ending. The nerve entering the muscle usually contains roughly equal proportions of sensory and motor nerve fibres [5].

Acupressure points are practically hard points in the myofascia that hurt to the touch and render pain. Fascia is the semiflexible fibrous membrane of connective tissue that binds together the various components of the body. The myofascia is the fascia relating to the muscles. It covers individual muscle fibers, bundles them together and covers the whole muscles [6]. Acupressure points can be felt as hard knots in our muscles. And they hurt when pressed. Acupressure points arise at predictable places in the muscle and cause predictable patterns of referred pain.

Acupuncture and acupressure point are the same points on a human body. While an acupuncture treatment uses thin hair needles to stimulate the points, an acupressure treatment will just use hands to stimulate and press on the intended points.

Acupressure is easy to learn and can be self-treatment. Self-treatment acupressure is applied using the thumb or finger to specific interconnecting pressure points of the acupressure point in pain. Acupressure points place on the body skin. It is sensitive to bio-electrical impulses in the body. There are 14 long meridians around our body. There are more than 360 acupressure points along the meridians [7].

These acupressure points have its interconnection points. The interconnection points are the point to apply pressure on it to relieve pain of its acupressure points. The pressure is applied gently and is often increased for about 30 seconds. Next, hold 30 seconds to 2 minutes and decreased the pressure for 30 seconds. The steps need to repeat for 3 to 5 times when applying self-treatment acupressure, a mental attitude of calmness and concentration is important. Loose and thin clothing is recommended when giving acupressure [7].

Acupressure self-treatment is cost-free since it does not have to depend neither to any specific tools nor any earlier appointment with anyone. The only equipment needed is only acupressure mobile application in a smartphone and fingers. This mobile based application therapy can be practiced at anytime, anywhere. It empowers not only curative abilities but also the body's wisdom and expressions. Furthermore, it increases the awareness and morale of the practitioner since they have to determine how much the pressure and which approach is most beneficial [8].

Figure 1 shows the arm and leg potential point of pain and the interconnection acupressure point as the treatment and vice versa

Pressure point therapy is one of the most intriguing and fastest-growing bodywork styles in the world. Medical doctors, chiropractors, physical therapists and massage therapists are all beginning to use this technique to relieve formerly undiagnosable muscle and joint pain [9]. The stimulation of the point causes an increase in the oxygen level in the area and produces instant relief. The current therapy is simply applying on series of pressure points a gentle but firm finger pressure. Here, we are proposing the concept of symmetrical pressure points. Currently, the pressure points are mapped in most pressure point reference chart as static with minimal inter-connection across body symmetry.

3.0 AN INTERCONNECTION AMONG SETS OF ACUPRESSURE POINTS

In general, every acupressure points on human is highly inter-related to each other. For every pressure point on the hand, there will be another at the equivalent respective location on the opposite leg. Suppose a person suffers from a strong pain on his leg, a well-trained therapist can apply a medium stimulating touch on his respective pressure point on his hand to ease the pain. In this case, the patient will

not feel the painful stress of massage pressure since the hand is not in pain.

Figure 1 shows the acupressure points on the arm and respective set of interconnecting acupressure points on the leg. These sets of interconnecting points have been collected from a traditional pressure point therapist in Melaka Malaysia. Even though the knowledge on the interconnection is traditionally known among the experienced therapist, it is not explicitly written in any modern literatures.

Figure 2 A therapist is locating a pressure point on a patient ankle the interconnection acupressure point as the treatment and vice versa

Figure 3 A therapist is applying a pressure on the interconnecting point on the hand

Suppose a person suffers from a strong pain on his leg, a well-trained therapist can apply a medium stimulating touch on his respective pressure point on his hand to ease the pain. In this case, the patient will not feel the painful stress of massage pressure since the hand is not in pain.

A human body is internally governed by the combination of interconnecting pathway of energy channels, also often called meridian lines. When an acupressure point is stimulated, it has been observed that the patient will often experience a change in seconds and this change frequently occurs at the opposite end and contralateral side of the body from the point stimulated. The exact mechanism of this action is not yet fully understood, although certain

aspects appear to be based on established neurophysiologic concepts [10].

The pain will be checked by applying pressure on the point and it will be relieved by rubbing on the interconnect acupressure point and vice versa. Figure 2 shows pressure was applied to the subject where the pain is located at the ankle joint meanwhile Figure 3 shows the interconnection points on the wrist joint has been rubbed as the acupressure treatment to relieve the pain.

In computer science, the visual representation of the pressure point shall be more like an expert system. It shall convey the knowledge of traditional measurements used by experts in this field. It may be used as an aid to locate a set of pressure points on the body. Typically, pain in one part of the body is a result of a blockage in a channel in another part of the body It shall guide a novice practitioner where to apply pressure.

The depth of the points listed on the visual can be different and requires different amounts of pressure. Typically, basic learning process on how to apply pressure for both surface and deep pressure points takes several years to acquire. This research shall not only try to preserve the knowledge but also to speed up the learning process of pressure points in reflexology massage therapy.

4.0 RESULT SURVEY ON INTERCONNECTING ACUPRESSURE POINT TECHNIQUE

A pain assessment test and pain relief assessment test has been conducted to 10 street soccer players immediately after a soccer match. The result through an interview with patient after the technique on interconnection acupressure points has been applied is depicted in Table 1.

Table 1 Pain Assessment show an improvement after pressure point treatment

Player	Pain Area	No Pain (0)	Mild (1,2,3)	Moderate (4,5,6)	Severe (7,8,9)
1	Ankle				
2	Knee				
3	Knee				
4	Knee				
5	Heel				
6	Thigh				
7	Thigh				
8	Calf				
9	Calf				
10	Dorsal				

Using zero to ten Numeric Rating Scale (NRS). Brief Pain Inventory (BPI) asks a patient to rate his/her present pain intensity [11]. Zero indicates no pain, 5 is moderate pain and 10 is worst possible pain. The score 1-3 is considered, the score from 4-6 is moderate and 7-10 is severe. This is a practical quantitative measure of pain. Visual Analog Scale (VAS) rates pain on 10 continuum numbers from 0 to 10, that reflects 0 as no pain and 10 reflects pain at its worst.
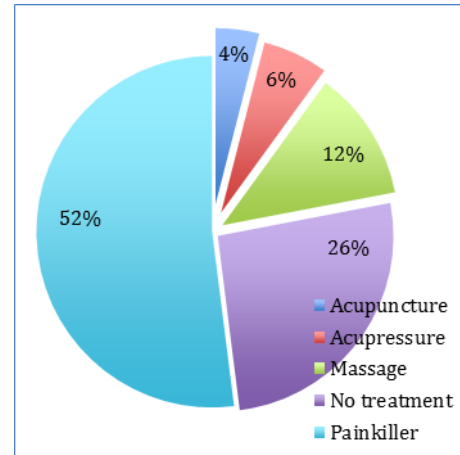

Figure 4 The distribution treatment by patient suffering a serious pain

5.0 USER BACKGROUND SURVEY

A preliminary survey has been conducted prior to the development of this mobile application. The subjects have been selected among the patients of a reflexology service centre in Melaka, Malaysia.

There are 37 female (74%) and 13 male respondents (26%). Among the respondents, there are different age groups. The respondents are mainly around 21-30 years old (91%). There are 3 respondents (6%) are more than 55 years old and 1 respondent(2%) respondent is 31-40 years old. On the respondent background, 40 respondents (80%) or their family members have suffered from serious pain during their lifetime.

Out of those who have suffered serious pain, half of them take painkillers to relieve pain. There are 26 respondents (52%) who have taken painkillers to relieve pain. While, 13 respondents (26%) state that they do not take any treatment for the pain. There are 2 respondents (4%) use acupuncture to relieve pain and 3 respondents (6%) only try to relieve pain by acupressure treatment. The rest of the respondents (12 %) relieve their pain problem by taking massage treatment. The choice of treatments in dealing with a serious pain is depicted in the Figure 4.

In general, a pain killer is still a popular medication in dealing with serious pain while an acupressure treatment is lagging behind. Even though, most of the respondents (92%) know the painkillers will cause some kind of side effect to the body. And only 4

respondents (8%) do not know that the pain killers will cause long term side effects to the body.

Among the respondents, there are 30 respondents (60%) who do not know acupressure is an alternative way to relieve pain. There are 20 respondents (40%) know acupressure can relieve pain.
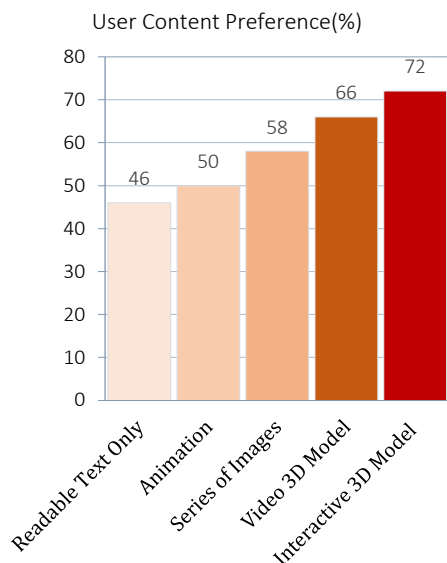

Figure 5 The content preferences chosen by the user is in favour of an interactive 3D Model

Majority of respondents (48/50) have a smartphone while only 2 respondents do not own a smartphone. When asked about their willingness to try and use mobile application on acupressure for relieving pain, 39 respondents (78%) state that they are willing to try while there are 11 respondents (22%) will not use such applications.

On the content preference in the self-treatment acupressure application, 36 respondents (72%) choose an interactive 3D model followed by a video 33 respondents (66%). There are 29 respondents (58%) state that they also prefer to view images in the application followed by an animation 25 respondents (50%) and text only 23 respondents (46%). These preference ratings are depicted in the Figure 5.

6.0 AN INTERACTIVE 3D MODEL ON ACUPRESSURE POINTS IN SMARTPHONE

An interactive 3D model in mobile application is processed by the graphical processing unit (GPU) of a mobile unit. An open graphic library (OpenGL) embedded system (ES) is a cross-platform application programming interface (API) for 3D graphics.

It handles 2D and 3D graphics on embedded devices. An OpenGL ES removes any redundancies to create an API that suitable for various devices. The compatibility of OpenGL is maintained to prevent loss of functionality.

In OpenGL ES, it only consists of vertex array to specify the geometry. The 3D model in android is drawn from the vertex array in OpenGL ES. All the coordinates are determined in the vertex array. OpenGL ES also can use to texture the model to make the model look more realistic.

A 3D model can be implemented the touch events to response for the users touch on the screen. The 3D model can let users to rotate, zoom, drag and point to specific coordinates by implement the touch event to provide interactivity to the users.

There are several applications on acupressure application available in the market. The current existing system does not fully meet the requirement of user. Most of the applications provide less information about the acupressure point to relieve pain and are more focus to acupressure point for symptoms.

There are many people taking painkillers to relieve pain. However, painkillers will cause many side effects to our body. This interactive application has been developed to encourage people to relieve pain in an efficient way. This application mainly focuses on self-acupressure to relieve pain.

By developing this application, user can check the interconnect pressure point to relieve point. Thus, this project will enable users to learn self-treatment acupressure. There are many applications about acupressure, but mostly focus on acupressure for symptoms. Users may not have any more information about the self-treatment acupressure point to relieve pain.

This project is developing an application for Android smartphone. Nowadays most of the people have Smartphone, thus the user can use this application in anywhere and anytime. The system does not only provide the location of the acupressure points but also its interconnection pressure point in a 3D model.

The architectures in this application are android application, a user interface and a database. The database stores all the object information on the 3D models. The 3D model has been modelled in Autodesk Maya which is touch interactive that can rotate, zoom and drag.

7.0 SELF-CURATIVE THERAPY

A pain is a major physiological and psychological unpleasant experience of human beings. In order to identify an acupressure point in pain, physiotherapists or physicians compare a patient complaints to the pain pattern of pressure points they know and to catalogs of common pressure points and then feel around in muscles for hard knots in the likely places. They will know that they find the right spot when the patient makes a sudden reaction in agony when the knot is pressed [4].

A user will seek for remedy to ease off his/her pain. One will assess the presence and intensity of pain by applying some amount pressure to the pain area. A user may estimate the pain intensity on a scale of 1 to 10. A user can check the interconnecting pressure point from the Interactive 3D Acupressure Model to relieve point of pain.

Figure 6 The front page of the self-treatment acupressure application

The user may opt to apply sufficient pressure on the interconnecting point to relieve the pain. Thus, this project will enable users to do self-treatment acupressure. Surrounding an acupressure point, painful knots that develop in muscles and tissues are a common cause of chronic pain. Sustained self-treatment is by far the most effective acupressure point therapy.

A user is encouraged to do self-acupressure therapy. As the condition improves, he or she may forget how intense his/her symptoms were originally, and think the user is not getting any better. Typically, a user will be able to see an improvement even with an occasional setback (DeLaune, 2011).

A 3D model will be stored in database and will be query back using xml file to be displayed in an application interface on a smart phone screen as shown in Figure 6.
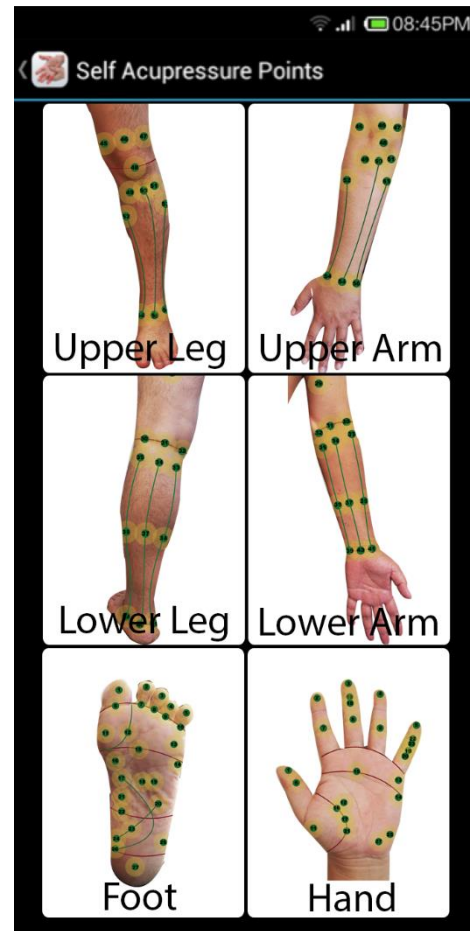

Figure 7 The main menu of the self-treatment acupressure application

The user interface in Figure 7 shows user interface of the application that contains a menu set for potential acupressure pain points. The menu then will be navigated to a screen that display selected model with points. The model can be rotated, zoomed in or out to ease user in seeking potential pain points.

A user may select any acupressure point as shown on the left of Figure 8. The system will navigate to the respective interconnecting point for the acupressure point in pain as shown on the right of Figure 8.

Figure 8 The navigation of interconnecting acupressure points during a self-treatment therapy

The main objective of this paper is to develop an interactive 3D acupressure model that can promote alternative way to relieve pain. According to DeLauni in [12], any pain on acupressure points on the body should be treated immediately and reduced in order to avoid the potential of becoming a chronic pain. A longer time taken to cure a pain may contribute to a muscle get entangled and involved in chain reaction chronic pain and dysfunction.

Table 2 Basic quantitative rating scores

Description	Rating Score
Strongly disagree	1
Disagree	2
Not sure	3
Agree	4
Strongly agree	5

8.0 A USER ACCEPTANCE TEST

A qualitative evaluation survey has been carried out based on the beta version. The user acceptance is important to evaluate the system functionality of this application. Each group of test users will get a set of questionnaire respectively. In early parts of the questionnaire, there are 5 different rates for each question. Test user need to answer required to rate the question with the rating as shown in the following Table 2.

The questionnaire has been prepared based on the system visual clarity, navigation and interactivity, functionality, content and the effectiveness of this interactive 3D acupressure model.

Technically, the respondents have given high marks on the interactivity of the system as shown in Parts A, B and C as shown in Table 3.

Table 3 Evaluation scores on the interactive 3D acupressure model

No.	Aspect / Module	Mean	Median	Mode
PART A: VISUAL CLARITY				
1	The interface is bright and clear.	4.6	5	5
2	The text for instruction is easy to read.	4.5	4.5	5
3	The menu button labelled with body part is easy to identify.	4.4	4	4
4	The use of colour on the button is meaningful.	4.8	5	5
5	The seek bar on the right of the screen is easy to see.	4.5	4.5	5
6	The use colour on the acupressure points on 3D model is easy to identify.	4.4	4	4
PART B: NAVIGATION AND INTERACTIVITY				
1	The menu button divided by body part is easy to press.	4.4	4.0	4
2	The slide button on top of screen is clear and easy to slide.	4.8	5.0	5
3	The seek bar on right of the screen is easy to use.	4.8	5.0	5
4	The button response time is fast.	4.8	5.0	5
5	The back button is easy to press.	4.3	4.0	4
6	The colour change on a selected acupressure point is easy to identify.	4.6	5.0	5

PART C: FUNCTIONALITY AND CONTENT

1	The interactive 3D model illustrates the human body clearly.	4.3	4	4
2	The use of colours on acupressure points make them easier to identify.	4.6	5	5
3	The acupressure points in smartphone presented attractively.	4.3	4	4
4	The acupressure points in smartphone is simple and clear.	4.2	4	4
5	The tutorial on bottom of the screen to apply acupressure is easy to follow.	4.8	5	5

PART D: EFFECTIVENESS

No.	Question	Answer Correctly	Answer Wrong
1	What is the name of this treatment? A. Acupuncture B. Acupressure C. Reflexology D. Massage	30	0
2	What is the inter-connecting part for upper leg? A. Lower leg B. Upper Arm C. Lower Arm D. Foot	27	3
3	What is the colour of selected point on 3D model? A. Red B. Green C. Yellow D. Blue	28	2
4	What is name of the point to apply pressure for acupressure point? A. Acupressure point B. Pressure point C. Interconnection point D. Connection point	29	1
5	How long is the total duration to apply pressure on the point? A. 30 seconds B. 1 minutes C. 2 minutes D. 3 minutes	29	1

Effectiveness in user acceptance checks on the information delivered in the application to end users. According to Part D in Table 3, most of the user gets the information delivered by the application. Among respondents, less than 4 people answer the question wrongly. Thus, it is proven that the application developed based on this interactive 3D visual model delivers the information successfully to the end users.

The results from the user acceptance test on this interactive 3D visual model proves that the application which has been developed works well and meets the objectives.

This application provides an interactive 3D model to view acupressure points and the interconnect pressure point to relieve pain. Each acupressure point is specifically labelled to prevent confusion.

In the end, the user will always have more control over his/her own therapy. The user may obtain either substantial or complete relief from pain without any additional treatment. In fact, he or she may not get more temporary relief from self-help pressure techniques than from limited period of time within a session with practitioners' treatments.

9.0 CONCLUSION

The acupressure technique proposed in this paper provides an alternative way to relieve pain effectively. Furthermore, the acupressure technique can be made for a self-treatment and easy to learn. The self-treatment acupressure is applied using the finger to apply pressure to acupressure interconnect pressure points. In addition, relieve pain by acupressure will not cause any side effect to human body system. This project has been developed to encourage people to relieve pain without using painkillers. The self-acupressure visual model has been embedded in a mobile application. This interactive 3D visual model provides an alternative way to relieve pain. It is an effective aid to help a user learn and apply self-acupressure treatment.

Acknowledgement

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