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ENGINEERING THE HUMAN TOUCH: MIMICKING THE ART OF THAI MASSAGE

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ABSTRACT

Objective: Massage has been used for several thousand years, both for therapeutic and relaxation purposes. Massage is known to be effective in relieving pain, stress, anxiety, and therefore improving health for both patients and ordinary people. Access to massage is still very limited at present. One way to improve the access is via the use of massage chairs. Several types of massage chairs have been developed but customers still feel that their performances are too mechanical, unlike the massage performed by human masseurs. The objective of this work is to design a massage chair that can mimic or perform massage activities similar to human masseurs as much as possible.

Design and results: The work was performed in 3 phases; study phase, in which Thai massage was studied in some detail, massage chair design phase, and prototype and test phase. It was found that Thai massage could be characterized by 3 key actions; pull, press, pin or 3Ps for short. A massage chair was designed in such a way that it could perform back massage according to the 3P actions similar to human masseurs. A test of the prototype was carried out with 40 potential customers in Bangkok. The test results showed that the chair performed satisfactorily and the massage performed was more 'human-like' than those performed by existing roller-type massage chairs. A number of improvements were suggested by those participated in the test, however.

Conclusions: This study indicates that design and development of more 'human-like' massage chairs is possible and, if successful, would improve access to massage for many. Such wider access to 'human-like' massage chairs would help improve health and quality of life both patients and general public.

Keywords; Thai massage; massage chair; human mimicking

1. INTRODUCTION

Massage, believed to be originated in ancient China some 5,000 years ago,¹ is widely used all over the world both for relaxation and therapeutic purposes. The use of massage for therapeutic purposes, called massage therapy, has been extensively studied. Lund concluded from several previous studies that massage was quite effective as a pain relieving method.² Both traditional

Thai massage and Swedish massage were found to be effective in reducing back pain intensity and anxiety of patients.³ Cardiovascular surgical patients were found to benefit from massage in reducing pain, anxiety, and tension.⁴ A pilot longitudinal study in Taiwan on the effect of full body massage on pain intensity and anxiety found that massage yielded beneficial effect both in short-term and long-term.⁵ Swedish massage treatment was found to result in a minor decrease in blood pressure.⁶ Massage was found to be more likely to result in pain relief compared with static touch.⁷ A study on Japanese female workers in their 50s found that traditional Japanese massage (or Anma therapy) significantly reduced muscle stiffness and anxiety.⁸ The use of chair massage was found to benefit both the patients and the cores such as nurses.^{9,10}

It is evident from the above and other studies that massage is beneficial to human health both physically and psychologically. The use of massage therapy is on the rise and the use of massage for relaxation and pleasure is also increasing. To obtain a massage service, one has to go to a massage parlor or a particular place that provides massage service. This is inconvenient and expensive for many, and in many locations of the world massage service is simply just not available. There have been many attempts therefore to design and manufacture massage chairs which try to mimic the activities performed by human masseurs or massage therapists. Massage chairs would enable people to have massages in the comfort of their homes, and at anytime they want. There is no need to travel, sometimes a very long distance, no need to wait, and the cost is much lower compared with the services by human masseurs. Massage chairs would make massage services, and their associated benefits, more accessible to wider populace as people can receive the services more conveniently and more affordably.

There are several types of massage chairs on the market nowadays. The designs of existing massage chairs are based on a few design concepts, however. The first concept, perhaps the most widely employed concept for massage chair design, is based on the rolling contact between the rolling elements of the massaging machine and the body of the person receiving the massage.¹¹ The rolling elements, assembled together as a set and placed in the backrest of a massage chair, move up and down against the back of the user. The contact pressure can be adjusted by the users by simply adjusting the degree of pressing against the backrest (Fig 1).

Figure 1: The roller-type massaging mechanism showing key components of the mechanism and the area of the back of the user over which the rollers move.

Currently this type is the most popular type among many types of massage chairs. The second concept might be called the press and move concept whereby the ‘fingers’ of the massaging mechanism, attached to the backrest of a massage chair, ‘press’ against the shoulder of the user and ‘move’ around the shoulder region (Fig 2).¹²

Figure 2: The press and move concept for massaging mechanism design showing key components of the mechanism and the areas of the back of the user where the ‘fingers’ press and move.

The third concept is based on vibration.¹³ In this concept, two vibration creating devices are placed in the backrest of the massage chair. When activated the user will feel the vibration, and certain parts, corresponding to the locations of the device, of the back of the user are massaged (Fig 3).

Figure 3: The vibration-based massage chair design. Two vibration devices are placed at the backrest of a chair and corresponding areas of the back of the user are massaged

The fourth concept, called hydro-massage, is based on warm water jet impacting the back of the user. The device which generates warm water jet is placed at the backrest of the massage chair Fig 4.¹⁴

Figure 4: Schematic diagram of the hydro-massage design concept showing key components of the massaging device and the areas of the back of the user that are impacted by warm water jets.

Despite much effort in the design and development of massage chairs, the capability of massage chairs in general is still far removed from human masseurs. Mimicking human, the most intelligent creature on earth, is no easy task. Preliminary interviews with massage chair users in Thailand by the authors revealed that existing massage chair would be much more useful and better appreciated if they were more ‘human-like’, i.e., could perform massage more like a human masseurs than they do now. The objective of this work is to design and develop a massage chair that could mimic human masseurs in performing Thai massage, at least to some degree.

METHODOLOGY

This work was performed in 3 stages. The first stage was the ‘study phase’ which involved the study of Thai massage in some detail in order to obtain a clear insight and the ‘feel’ of the art. The second stage was the ‘design and development phase’ which involved the design of the massage chair with mechanisms that could best mimic the art of Thai massage. A prototype was constructed and improved in accordance with massage knowledge and design. The third stage was the ‘test phase’ which involved the testing of the prototype massage chair to see whether it performed as intended and to gather preliminary responses from potential customers.

In the study phase, the authors received several massage services delivered by experienced professional masseurs. The aim here was to get the ‘feel’ of authentic Thai massage, and to really understand how it is delivered. Several observations of the massage during actual deliveries of massage services were made. Experts on Thai massage were interviewed in order to get better knowledge and understanding about the art. Relevant literature on Thai massage was also consulted.

In the design phase, we employed the insight and salient features of Thai massage that resulted from the study phase as key design inputs. Design work started with the design of a mechanism that could perform massaging similarly to a hand. Other parts of the chair were then designed to house the mechanism. The prototype of the massage chair was then constructed and tested. Several refinements were made to the prototype. The detail of the design is explained in the section that follows.

The final prototype was tested with 40 participants, 20 male and 20 female in Bangkok. The test was conducted in a room with a relaxed atmosphere specially prepared for the test. The participants were asked to sit in the massage chair and received massage for ten minutes, one by one, of course. After receiving massage, each participant was asked to give scores on two questions. The first question was ‘To what extent did you feel the massage like being massaged by human hands?’ The second was ‘What was your overall satisfaction with the massage chair?’ The participants were also interviewed about general feeling after receiving the massage and possible improvements that could be made in order to make the massage chair better.

THE ART OF THAI MASSAGE

Thai massage is an ancient art which has been used for relieving muscle stress and healing for a long time. In the old days, Thai massage was an important branch of medicine and was widely employed to cure many types of illnesses. At present, Thai massage is still considered a branch of Thai traditional medicine and a lot of Thai people do believe that massage treatment is effective in curing certain illnesses. To be a qualified masseur, one needs to be properly trained in a certified massage school by experienced teachers. A qualified masseur has working knowledge about anatomy, particularly the muscle and skeleton systems, and the knowledge of the illnesses to be treated. Both theoretical and practical training are given in massage schools.

Being an ancient art, it is inevitable that several branches or techniques of Thai massage have evolved. The so called royal Thai massage, reserved for members of the royal family and high-ranking officials in the old days, employs precise massaging techniques. Only hands (fingers and palms) are allowed in giving the massage. This is opposed the commoner Thai massage, massage for the general public, which any parts of the body; hands, forearms, elbows, feet, knees etc, are allowed. In the point or special area Thai massage, the masseur presses at certain points or areas of the person’s body for a certain period of time then releases. In practice, however, it is difficult to perform Thai massage

strictly according to any one type and the boundary between different types is rather blurred. When actually giving massage, the masseur normally communicates with the client so that the ‘delivery’ suits the specific needs of the client. Contemporary Thai massage is therefore a mixture of the different massage techniques mentioned above.

For the purpose of designing a massage chair, Thai massage consists essentially of 3 steps; pull, press, pin. In the ‘pull’ step, the masseur uses his or her fingers to simultaneously ‘pull’ the muscle of the client in the area to be massaged using relatively light forces. The masseur then gradually applies heavier forces using palms and fingers which constitutes the ‘press’ step. In the pin step, the masseur presses the muscle in the massage area to a required level and keeps still for a certain period of time. The pressure level and the time for keeping still depend on the needs of the client. The three steps are then repeated in different areas or something in the same area of the client’s body. The actions of these three steps of Thai massage are used as key inputs in the design of the massage chair in this work.

MESSAGE CHAIR DESIGN

The key design requirement of the massage chair is that the chair must be able to perform back massage function. The massage performed by the massage chair should be as similar to the massage delivered by professional Thai masseurs as possible. The client receiving the chair massage must feel as though he or she is receiving a human massage. In other words, the massage chair should be able to mimic human masseurs at least to a certain extent.

In order to mimic Thai massage properly, the chair must be able to perform the 3P’s of Thai massage; the pull, press, and pin actions, which are common to many types of Thai massage. This is considered to be the key functional requirement for the design of the massage chair. The next requirement is that the massage actions could be performed anywhere over the back of the user as he or she wishes. This means that the massaging mechanism must be able to move up and down over the back of the user, and such movement can be controlled by the user.

Typically it takes around 15 seconds to complete a cycle of Thai massage. A cycle of the massage comprises all three; the pull, press, and pin actions. Of the 15 seconds, about 6 seconds is used for the pull action, 6 seconds for the press action, and 3 seconds for the pin. The forces applied in the three massage actions are also different. For the pull action, only a light force of approximately 4.5 – 7 kgf is applied. A medium force of about 19-22.5 kgf is used in the press action. For the pin action, a relatively high force of 24.5 – 28.9 kgf is required.

For the massage chair to perform various massage actions at all, there must be a device or a subsystem placed at the backrest of the chair that performs the massage function. Such a device should contain a mechanism that could exert pressure on the back of the user and

could be moved up and down so that the massage could be performed over the area of the back of the user. We shall call this device “massage device”

The solution principles to be employed for the massage mechanism are described as follows. The mechanism consists of 3 major components; two ‘mechanical hands’, a rocking mechanism, and a frame. The mechanical hands are mounted onto the rocking mechanism and then assembled on the frame in such a way that they can be moved up and down by an electric motor.

The working principle selected for the mechanical hand can be described as follows. The hand consists of 4 ‘fingers’ one at the center and three at the peripheral of the hand. The center finger can rotate and exert pressure on the back of the user. The peripheral fingers can move back and forth in a manner similar to human fingers. The movements of the fingers are achieved through a camshaft and springs as shown in Fig 5.

Figure 5: Rendering and sketches showing the working principle of the mechanical hand

The camshaft is driven by an electric motor. The rendering of assembled massage device is shown in Fig 6.

Figure 6: Rendering of assembled massage device

As for the control of the massage actions, two modes of control are selected. In the first mode, massage actions follow a predetermined program which is encoded in a control board. The users simply turn on a switch and the massage mechanism will perform the pull, press, pin actions automatically. In the second mode, the user controls the movements of the massage mechanism and the mechanical fingers by controller. This would enable the user to adjust the massage actions if the automatic program is not satisfactory.

Once the key concept of the massage device was developed, the embodiment and detail design of the device and of the chair were performed. Design activities include; specifying overall dimensions of the device and the chair, deciding on the chair architecture, selection of materials and components, specifying detailed shapes and dimensions of various parts, and deciding on standard components such as motors and screws. The chair was designed to consist essentially of 5 key components; a chair body, a massage device, two armrests, a footrest, and a control device. The massage device was fitted into the backrest of the chair and the footrest fitted to the front. The control device was designed as a separate panel electrically connected to the chair. All the parts and components, standard and nonstandard, are available or can be manufactured locally. The design is finally reviewed to minimize errors before all the parts and components are acquired, and the prototype constructed.

PROTOTYPING AND TESTING

A prototype massage chair was constructed based on the designs presented in previous section. A rendering of the massage chair showing its key components is shown in Fig 7. The finished prototype massage chair is shown in Fig 8.

Figure 7: Rendering of assembled massage chair showing its key components

Figure 8: Massage chair prototype

The prototype was tested for functionality and customer satisfaction. Potential customers, 20 men and 20 women, were invited to take part in the test. The participants were asked to rate the performance of the chair based on two key questions;

- a) To what extent does the chair perform like a human masseur?
- b) What is the overall satisfaction?

To the first question, the participants rated 3.51 out of 5 on average, and to the second, the rating was 3.59. The results indicated that the chair performs satisfactorily as intended although there is a lot of room for improvement.

The participants were also interviewed briefly after the test with the same questions and asked for suggestions for improvements. More than half of the participants felt that the chair performed more ‘human-like’ massage than other massage chairs that they have used. About 70% of the participants thought that the chair performed satisfactorily overall. Several improvements were suggested including better look, softer bionic ‘fingers’, improved ease of use and better control, addition of leg massage device.

DISCUSSION

Preliminary test results show that the prototype massage chair can perform back massage more ‘human-like’ than existing roller-typed ones. This is encouraging. It indicates that, with further improvements and refinements, massage chairs of the future might be able to perform massage very similar to human masseurs. It is interesting to compare the development of massage chair with humanoid robots. Great strides have been made in the field of humanoid robots, and present day robots can perform tasks very similar to those performed by human unimaginable decades ago. Similar progress can be made in the field of massage chairs provided that sufficient efforts, dedication, and resources are available for development.

Massage is a special kind of human activity which requires delicate and controlled movements of fingers and palms. Such movements are extremely difficult to mimic, even by humans. Development of a massage chair should aim at simple movements, at least at the beginning, that could accomplish the main purpose of Thai massage, i.e., relieving aches and pain, and relaxing.

One important limitation of this work is the study of Thai massage. We identified the 3P’s; pull, press, pin, as the key characteristics of Thai massage. Although this is generally true, different type of Thai massage has very different characteristics. Future research should study different types of Thai massage in more detail so that the massage chair could be designed accordingly for specific type of Thai massage or with the capability of performing many different types of Thai massage.

The overall response is, nonetheless, encouraging. Improvements in massage chair design are possible, and there is a lot of room for doing so. Such improvements together with widespread availability of massage chairs could help increase accessibility to massage therapy as well as massage for relaxation. Improvements in massage chair design could contribute to better health and quality of life of both patients and the public.

HIGHLIGHTS

- A new design of a massage chair that mimics Thai human massage is described
- Thai massage can be characterized by three key actions: pull, press, and pin
- Three key actions of Thai massage are used to create a program for a massage chair
- A mechanical hand is designed with the functionality to perform Thai massage
- New mechanical hand improves massage performed by existing roller-type massage chairs

CONCLUSION

This work involves the design and development of a massage chair that could perform Thai massage. A study of Thai massage was conducted and the massage chair was designed accordingly. It was found that there are several types of Thai massage and that Thai massage is extensively used in massage therapy. Numerous studies have demonstrated that massage is effective in relieving pain, stress, and anxiety of patients. We also found that the essential characteristics of Thai massage consists of three actions; pull, press, and pin or the 3Ps.

A massage chair was designed in accordance with the 3P characteristics of Thai massage. The prototype chair was constructed and tested. The test results showed that the chair could perform massage satisfactorily and that the massage performed was more ‘human-like’ than existing roller-type massage chairs. Several improvements were suggested by the subjects that participated in the test, however.

The results of this work indicate that improvement of massage chairs to be more ‘human-like’ is possible and that there is ample room for such improvement. Successes in developing of such massage chair would mean that quality massage would be accessible to a large number of people who currently have no or limited access to this valuable ancient art.

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REFERENCES

1. *History of Swedish Massage*, Queensland Swedish Massage Institute. [Http://www.qsmi.org.au/smhistory.html](http://www.qsmi.org.au/smhistory.html) (last accessed 16 December 2010).
2. Lund I., (2000) Massage as a pain relieving method, *Physiotherapy*, 86, 12, 638-639, 654.
3. Chatchawan U., Thinkhamrop B., Kharmwon, S., Knowles J., Eungpinichpong W. (2005) *Thai massage versus Swedish massage among patients with back pain associated with myofascial trigger points*, *Journal of Bodywork and Movement Therapies*, 9, 298-309.
4. Cutshall S., Wentworth L., Enger D., Sundt T., Kelly R., Baur B. (2010) Effect of massage therapy on pain, anxiety and tension in cardiac surgical patients: A pilot study, *Complementary Therapies in Clinical Practice*, 16, 92-95.
5. Sui-Whi J., Wilkie D., Gallucci B., Beaton R., His-Ying H. (2009) Effects of a Full-Body Massage on Pain Intensity, Anxiety, and Physiological Relaxation in Taiwanese Patients with Metastatic Bone Pain: A pilot study, *Journal of Pain and Symptom Management*, 37, 4, 754-763.
6. Aourell M., Skoog M., Carleson J. (2005) Effects of Swedish massage on blood pressure. *Complementary Therapies in Clinical Practice*, 11, 242-246.
7. Kessler, J., Marchant, P., and Johnson M. (2006) A study to compare the effects of massage and static touch on experimentally induced pain in healthy volunteers. *Physiotherapy*, 92, 225-232.
8. Donoyama, N., Munakata, T., and Shibasaki, M. (2010) Effect of Anma therapy (traditional Japanese massage) on body and mind. *Journal of Bodywork & Movement Therapies*, 14, 55-64.
9. Mackereth, P., Campbell, G., Maycok, P., Hennings, J., and Breckons, M. (2008) Chair massage for patients and carers: A pilot service in an outpatient setting of a cancer care hospital. *Complementary Therapies in Clinical Practice*, 14, 136-142.
10. Brennan, M., and DeBate, R. (2008) The effect of chair massage on stress perception of hospital bedside nurses, *Journal of Bodywork and Movement Therapies*, 10, 335-342.
11. Marcantoni, E., C.I.A.R. S.r.l. (2000) Massage Device Having a Very Simple Structure and Usable Directly or Insertable in the Back of Massage Chairs or the Like, U.S. Pat. 6,071,252.
12. Furuie, Y. and Tanimoto, Y., Sanyo Electric Co., Ltd. (2001) Massage Machine of Chair Type, U.S. Pat. 6,200,282
13. Freels, J. and Milton, D., Capitol Systems (1991) Vibrating/Massage Chair, U.S. Pat. 5,022,384.
14. Arzt, F.J., Alfred H. Koch Services Laboratory. (2000) Hydro-Massage Chair, U.S. Pat. 6,036,663

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