

Animal Robot Assisted-therapy for Rehabilitation of Patient with Post-Stroke Depression

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Abstract. Recently, the utilization of therapeutic animal robots has expanded. This research aims to explore robotics application for mental healthcare in Malaysia through human-robot interaction (HRI). PARO, the robotic seal PARO was developed to give psychological effects on humans. Major Depressive Disorder (MDD) is a common but severe mood disorder. This study focuses on the interaction protocol between PARO and patients with MDD. Initially, twelve rehabilitation patients gave subjective evaluation on their first interaction with PARO. Next, therapeutic interaction environment was set-up with PARO in it to act as an augmentation strategy with other psychological interventions for post-stroke depression. Patient was exposed to PARO for 20 minutes. The results of behavioural analysis complemented with information from HRI survey question. The analysis also observed that the individual interactors engaged with the robot in diverse ways based on their needs. Results show positive reaction toward the acceptance of an animal robot. Next, therapeutic interaction is set-up for PARO to contribute as an augmentation strategy with other psychological interventions for post-stroke depression. The outcome is to reduce the stress level among patients through facilitated therapy session with PARO.

1. Introduction

World Health Organization (WHO) has classified depression as common illness worldwide, with an estimated 350 million people affected. In Malaysia, the prevalence is estimated between 8-10% of the population [1]. Strong range of emotions on sadness and bereavement are often related to Clinical Depression or technically referred to as Major Depressive Disorder (MDD). MDD may disturb physiological functions due to high level of stress and low mood. Potential consequences are increased blood pressure and change in emotion [2]. Therefore, it is important to have interventions that can reduce the consequences. Animal therapy is proven to have positive effects to relieve depression and anxiety.

Early studies showed that animals are capable of decreasing stress, reduce heart and respiratory rate, and show positive changes in hormone level as well mood elevation [3]. However, the use of animals has a number of drawbacks. In many therapy institutes, an animal is not always available to the patients because of the usage within scheduled event. Animal therapy is also discouraged due to the fear of diseases, bites, or allergies. Robot therapy, specifically in mental health care through interactions with robot has been studied by many researchers. Therapy through robotic animals is expected to have physiological effects similar to animal therapy. This research aims to use a therapeutic seal robot PARO (Figure 1) which focuses on human-robot



interaction (HRI) with PARO as a social companion.



Figure 1. Therapeutic animal robot PARO

2. Subjective Evaluation

To investigate the acceptance of Malaysians to an animal robot, subjective evaluation was done with animal robot PARO for twelve rehabilitation patients at SOCSO Rehabilitation Centre Melaka. The questions aim to investigate the opinions, impressions and acceptance level of PARO.

The evaluation period was done during a weekly group therapy session. All patients gave consent to participate. During the session, researcher explained about PARO's functionality followed by a demonstration for about 8 minutes. After that, the patients were given a chance to interact with PARO. Each patient got the chance to personally touch, stroke, hug and talk to PARO. A questionnaire of 10 questions was given to the patients after the interaction. The question topics are shown in Table 1. The first two questions asked about previous experiences with animals. Question 3 until Question 10 covers the patient's opinion and feelings related to PARO, the robotic animal. Survey responses were tabulated in a graph (Figure 2).

Table 1. Question for Subjective Evaluation

Evaluation Topics	
1. Ever own pets?	6. PARO looks alive
2. Do you like animals?	7. Feel calm with PARO
3. PARO is cute	8. Want to meet PARO again
4. Like to touch PARO	9. Want to own PARO
5. Happy with PARO	10. PARO is a robot

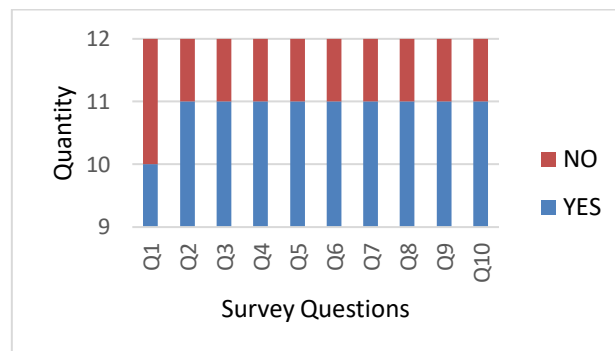


Figure 2. First interaction survey question

Overall result shows positive reaction toward the acceptance of animal robot (in this case; PARO) among rehabilitation patients. Following this, a full experiment involving therapeutic interaction between PARO and post-stroke depression patients was planned to further investigate the benefit of PARO in therapy.

3. Methodology

The experimental procedure serves as platform to investigate changes in stress level of patients with post-stroke depression before and after interacting with PARO. The experiment flow based on flow chart (Figure 3). The proposal was submitted and gain approval from UTeM Research Ethics before conducting the study. Selected of patients based on certain criteria of depression with insomnia and ability to converse in Malay and English. Only two respondent can undergo therapy in one day. A short session with psychologist was conducted to explain about the experiment flow. PARO robot was socializing with patients and assisted by a psychologist. There is certain condition where the procedures are aborted, whereby patients feel restless, abnormal behavior, unable to interact, scare of animal robot or robot perform irregular action protocol and makes patients request to abort. The interaction content is to introduce the robot to patients. The patients will familiarize and encouraged to interact under psychologist supervision, in addition some topics brought up for conversation throughout the session. The interaction also involve interviewing and video recording. The session will be recorded by video recorder (Figure 4).

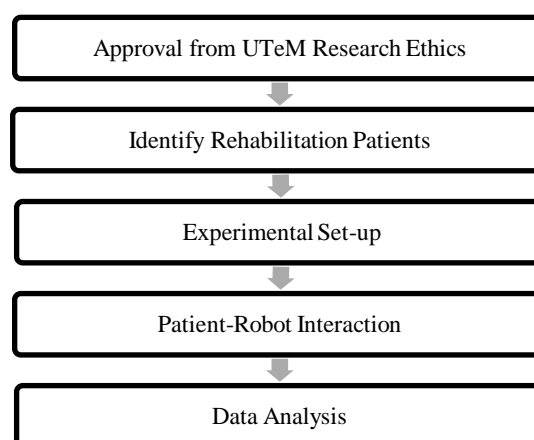


Figure 3. Flow of methodology

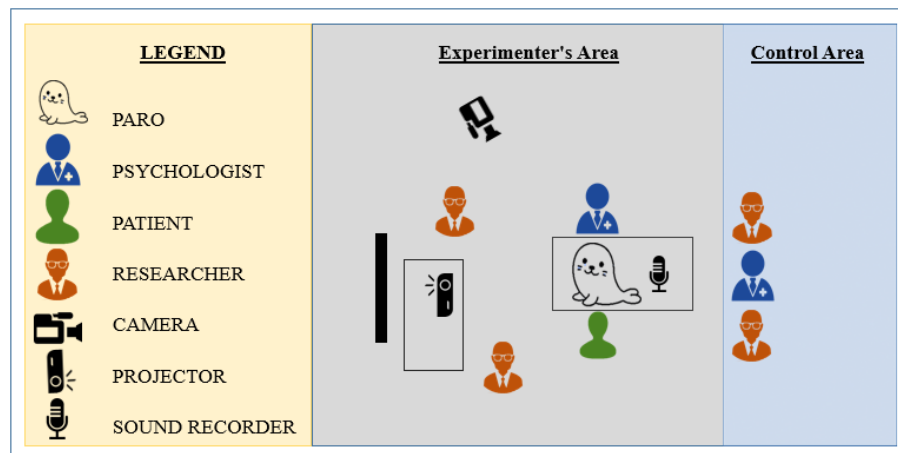


Figure 4. Proposed room layout for the experiment

The emotion gained from video camera was with analyze with OpenCV. With facial emotion detection, algorithms detect faces within video and sense micro expressions of smile by analyzing the relationship between points on the face. The number of smile was recorded and store as indication of positive emotions. There are several questionnaires that was used for the participant such as the HRI survey, Hamilton Depression Rating Scale (HAM-D), Columbia-suicide severity rating scale (C-SSRS) and Pittsburgh Sleep Quality Assessment (PSQI). HAM-D is a multiple questionnaire used to provide indication of depression, and as guide to evaluate recovery. On the other hand, C-SSRS is used to rates of suicidal ideation on a scale. It also acts as a tool for measuring behaviour in primary care. At the same time, PSQI is an instrument used to measure the quality and patterns of sleep in adults. The standardized measure designed to gather consistent information about the subjective nature of people's sleep habits.

4. HRI Survey

Robots come into contact with humans in both physical and emotional. Many potential factors motivate their social acceptance. In this study, a series questionnaire of human-robot interaction has been answered by the patient. The questionnaire divide into two section, which is before the patient meet the robot and after the patient done meeting with the robot. The questionnaires were designed to analyze the autonomy on realistic animal robot, mechanic movement of animal robot, attitude toward animal robot and human level acceptance of animal robot. During the therapy session, these animal robots were presented as therapy animal that capable to respond and comfort the patient. For autonomy on realistic animal robot, the patient was asked their opinion on the animal robot. The patient describes physical appearance of the robot. The highlighted part of the body includes the fur, limb, eyes and tail. However, the patient thought PARO was a bear instead of baby seal. The patient describes PARO fur as soft and really comfortable to touch, thus the PARO fur was created as hypoallergenic. PARO also let the patient experience it mechanic of movement, which it involves the movement of eyelashes, tail, neck and hand. During the survey, the patient mentions several times that she like the eyelashes movement. The patient was asked whether she can express the feeling toward the robot. She agrees that she can talk comfortably with PARO. The patient also expresses herself as 'mother' when she talks to PARO. PARO remind the patient's cat that she once loves. On the survey question, the patient was asked about her opinion on robot. The patient describes PARO can raise her loving experience toward animal robot.

5. Conclusion

Therapy session using animal robot PARO has huge potential to reduce depression symptom such as stress level and sleep time. PARO has an ability to calm agitated patient, feel loved, facilitate communications and lessen the need for medication. Robotic technology like PARO offers excellent opportunities to connect with individual who appears otherwise unreachable.

Acknowledgement

The authors wish to thank Ministry of Higher Education Malaysia, [FRGS/1/2016/SKK06/FKP-AMC/F00321], Universiti Teknikal Malaysia Melaka and SOCSO Rehabilitation Center Melaka for their support.

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