



Effects of the Physical Therapy Application for Elderly

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Abstract. Currently, the number of elderly is continuously increasing and by 2020 in Thailand, the population of 60 years is one in six of the total population. Therefore, encouraging the elderly to take care of themselves will help make them live longer and have a good quality of life. Physical therapy is a method of treating the abnormal movement of the body and it must be performed regularly in order for the body to be continuously refreshed. Often, the elderly do not receive proper physical therapy due to travel difficulties and high cost of treatment. Hence, this research studied the possibility of using Kinect technology in the physical therapy program to help the physiotherapist properly. This study was quasi-experimental research using simple random sampling. All participants were interviewed for their demographic information and examined according to the five-arm muscle exercises. The results of the motion detection experiment using the Kinect camera and the experimental physical therapy program using the Kinect device show that Kinect can detect the movement very well and physiotherapy programs with Kinect devices help users perform more accurate physiotherapy compared to doing physical therapy. The data were analyzed by the mean, standard deviation. The results meant that physical therapy Application based on Kinect for Elderly could improve physical fitness and they have a positive effect on balance and thus on the quality of life.

Keywords: Physical therapy · Application · Elderly · Kinect · Effects

1 Introduction

Currently, the number of elderly people is increasing and by 2020, there will be a large population aged 60 years, which is 1 in 6 of the total Thai population. Therefore, encouraging the elderly to take care of themselves will help make them live longer and reduce the burden of expenses in caring for illness. The physical and health changes with aging causing the body to lose physical performance like loss of muscle velocity, balance, and agility strength. The elder face problems in many aspects of their lives. Low mobility results in pathologic aging changes to organs in various systems more easily, such as joint pain, osteoarthritis, bone decay, respiratory disease due to impaired lung function coronary artery disease Stroke and high blood pressure.

Rehabilitation of the elderly by exercising is an activity that can prevent, care, treat the elderly, and reduce health care expenses. Physical Therapy is a science that restores health by exercising and using special equipment to treat patients to return to normal movement as much as possible and physical therapy in the prevention, treatment, and management of abnormal movement caused by the condition of the disease that can occur at any age especially the elderly. Furthermore, Physical therapy will help strengthen the body and prevent injury, which causes the body to become impaired in movement.

Information technology is progressing and growing rapidly and the development of tools and equipment for motion capture are tools that are widely used. Kinect is a line of motion sensing input devices [1] and it is an accessory to the Xbox 360 game console. Kinect can detect players' bodies and be able to classify the position of various joints of the player's body. Therefore, this research applied the ability of Kinect used in the exercise of the elderly.

2 System Development

This project is an experimental study to test the program with the elderly by focusing on the efficiency of the developed system and the detection accuracy of the user gestures. Hence, it needs to study information from various sources and related research to apply in the Physical therapy application with Kinect equipment. The literature review revealed the significant findings of using Kinect in elderly care as follows. Lange et al. [2] proposed the game for practicing neurological balance by using Kinect to detect patient movements and used the detection data movement that had to control the cartoon characters in the game and the results demonstrated the game helped to develop the balance of patients with pleasure and the patients were very satisfied. Using the Kinect sensor, the system captured limb node data and detected incorrect postures with DTW algorithm and the result was 95.20% [3]. Liu et al. [4] have proposed methods for detecting motion-free marking at various locations on the body of user motion detection. This research could separate the layout of two users by using the Image Segmentation method to perform surface estimation and create a three-dimensional model. To determine the position on the detection area, a global coordinate system (GCS) was used to identify the vector coordinates (x , y , and z) of the Kinect cameras from the point of direction. The experiment was performed with the participants standing at a distance of 2 meters to detect the physical therapy as shown in Fig. 1.

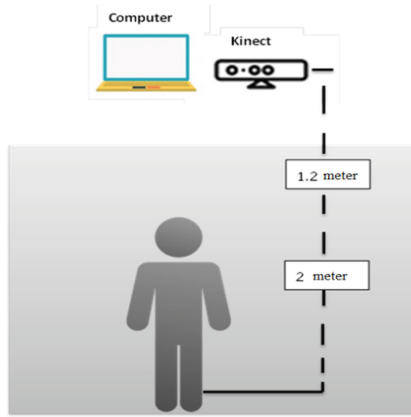


Fig. 1. The location of the motion detector

From studies and interviews with experts, the researchers gather requirements, design, and scope of work, as shown in Fig. 2. Figure 2 was described the system's operation, which consists of 3 parts: how to play, play and score and statistics. Users can choose physical poses and when finished, the system keeps score and the times of doing exercises. Users can check previous scores from the statistics menu. Figure 3 was displayed the user interface and example of the application.

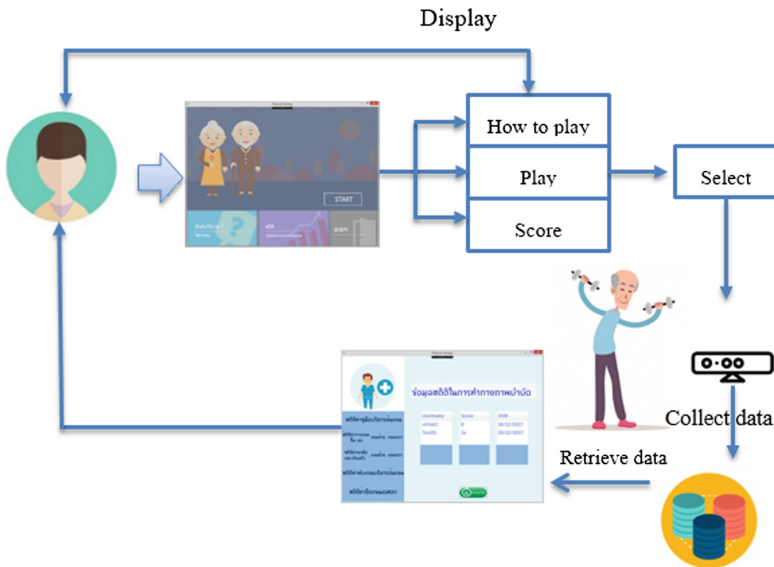


Fig. 2. System design

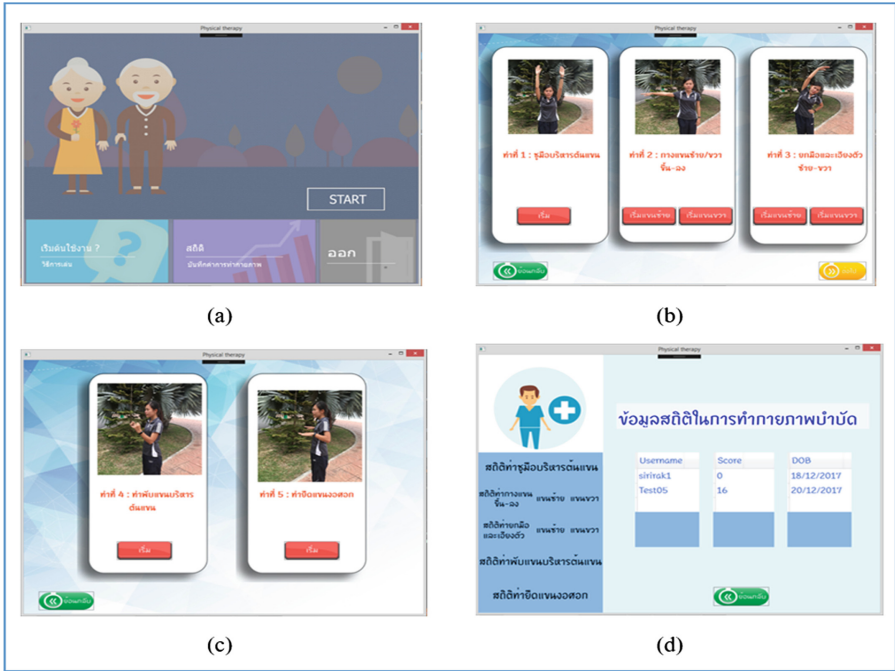


Fig. 3. The user interface design

3 Results

This section shows the results of the program experiment as the following this: Black Box testing approach was applied to evaluate this project because this technique assesses the performance of project without paying attention to how the system works and what it does but it will test only the input and output without checking how the system will process it. Black Box testing is determined the error of the project as following: functional requirement test, Function test, Usability test, Performance test and Security test [5] (Table 1).

Table 1. The results of Black Box testing approach

	Level of proficiency (n = 5)		
	\bar{X}	SD	Result
1. Assessment of the functional requirement test	4.00	0.39	Highest level
2. Assessment of the functional test	4.00	0.47	Highest level
3. Assessment of the usability test	4.01	0.61	Highest level
4. Assessment of the performance test	4.55	0.15	Highest level
5. Assessment of the security test	4.50	0.21	Highest level

In addition, the system is used to test the 10 elderly people aged between 55 and 70 years old. The Table 2 was presented the results of the motion-detecting activity in all 5 postures in physical therapy, performed all 5 postures, showed that the accuracy was high in the positions and the highest error detection was the 4th position: folded arms and upper arm management. This is caused by a mistake in specifying the joint position of the arms on both sides, as well as the movement of the body, so the position of the joints have as little changed. However, there are many factors that caused to be fewer mistakes in detection like the speed of posture, physiotherapy, and detection of joints.

Table 2. The results of the motion detection experiment in physical therapy posture

Users	The performance of the correct posture (10 times per person)				
	Posture no. 1	Posture no. 2	Posture no. 1	Posture no. 4	Posture no. 5
1	10	10	9	9	8
2	10	9	9	8	9
3	10	10	9	9	9
4	10	9	9	9	10
5	10	10	10	7	9
6	10	9	9	7	9
7	10	10	9	7	8
8	10	10	9	8	10
9	10	9	10	9	9
10	10	10	9	7	10

The results showed that the performance of the correct posture was good and users were satisfied when playing this application (Fig. 4).



Fig. 4. The example of participants playing this application

4 Conclusion

The exercise of the elderly helps to slow the deterioration of the various systems also improves the strength of muscles. Hence, the significant objective of this project has been to implement the physical therapy application based Kinect for elderly persons. From the development of the physical therapy application using Kinect, the results of this project can help elderly people in physical therapy and the system consists of five physiotherapy postures and has videos showing how to do it easily. Users were satisfied with the application at a good level however the limitation of this project found that when the subject's body is obscured by another object, the API is unable to determine the correct position of the joint position and the result may be incorrect. In addition, the quality of the coordinate data of the joints received from the API is unstable, so it is not possible to specify the location, including calculating degrees or measuring distances. In the future, researchers will focus on the constraints and the requirements to study other factors like the feasibility of using the position that affects the level of accuracy in detecting.

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