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EFFECTIVENESS OF OCCUPATIONAL THERAPY USING ROBOT MANIPULATOR FOR ELDERLY

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ABSTRACT

Physical activity is one part of occupational therapy, especially in the activity of the knee joint, where the knee joint is an important part of the movement of the human body. The movement of the knee joint gets weaker as people age, this is experienced by the elderly. Elderly are elderly people who often experience knee joints, in addition to the age factor of the knee joint, it is also influenced by post-accidents, strokes and so on which results in weak knee joint function. To restore and function the knee joint, a tool that controls the function of the knee joint is needed, namely a robot manipulator. This robot is a tool that works automatically the same as the function of the leg which can move the knee joint without any effort from human power but can be controlled via an Android-based smartphone. This robot manipulator tool works and functions with instructions via Android in the form of button control facilities that are on Android and also uses voice commands to control the robot. This manipulator robot consists of several main supporting components, namely the controller, manipulator, power supply unit, sensor and actutor. This Robot Manipulator provides a speed setting mode on the tool, so that the user can adjust the speed of the tool according to its capacity. Also, the movement of this tool can provide convenience and reduce the risk of weak knee joints. Testing and implementing robot manipulators for the elderly certainly needs to be analyzed for their achievements by analyzing using the Wilcoxon Rank test, where this test applies the pretest, namely the initial safeguards before the use of robots and posttest, namely the action after using the manipulator robot.

Keywords: Robot Manipulator, Occupational Therapy, Android, Rank Wilcoxon

INTRODUCTION

The development of technology towards the 4.0 industrial revolution directs all elements of science to integrate into technology to be able to develop in accordance with the 4.0 industrial revolution. Researchers are also involved in the direction of this revolution in any research that will be made including robot-based research. Advances in robot technology are increasingly advanced and the need for robot technology touches all fields of science, including human health. The development of human health, especially the elderly, is very sad in terms of physical activity, namely the movement of the knee joint which is of course influenced by the age factor. Obstacles to movement of the knee joint is not only a factor of age, but also other factors such as post-accident, stroke, blood flow, and so on, which are related to the weakness of motion of the knee joint, especially the elderly. This research is focused on the elderly at the KhusnulKhotimah

Nursing Home as the object of this research. The number of elderly in the orphanage is 20 people ranging in age from 60 to 90 years. Most of the elderly have difficulty walking with the constraint of weakness in the knee joint. The previous actions have not been significant in assisting recovery and reducing the impaired motion of the knee joint. The provision of occupational therapy measures is still manual and conventional, which is still assisted by a supervisor such as still being assisted in terms of footwork and walking in the nursing home.

Occupational therapy is a form of health services for the community or the elderly who experience physical and or mental disorders by using exercises or activities to work on selected targets to increase individual independence in the area of daily life activities, productivity and utilization of free time in order to improve the degree of public health (Cardona Reyes & Muñoz Arteaga, 2016). Seeing the obstacles that exist in the nursing home, this research appears to provide solutions in terms of reducing risks and helping in terms of physical activity for knee joint motion and making it easier for counselors to carry out occupational actions for the elderly. The tool designed and created is a robot manipulator tool which functions as an automatic tool such as leg movement and this manipulator robot consists of several main supporting components, namely controllers, manipulators, power supply units, sensors and actutors. This manipulator robot is controlled by using a smartphone with an Android application as a medium of instruction. The instructions are carried out with the button and voice facilities in the Android application to control the manipulator robot. To find out and analyze from the testing and implementation of manipulator robots to the elderly, of course, its achievements need to be analyzed by analyzing using the Wilcoxon Rank test, where this test applies the pretest, which is the initial observation before the use of robots and posttest, namely the action after using the manipulator robot.

THEORETICAL FRAMEWORK

A. Definition of Occupational Therapy

Occupational therapy is a science and art to direct one's participation in carrying out a selected task that has been found, with the aim of facilitating learning the functions and skills needed in the process of adapting to the environment. The thing that needs to be emphasized in occupational therapy is that the work or activities carried out by the client are not just keeping the client busy, but the activities or work carried out can channel the client's talents and emotions, lead to a useful job according to abilities and talents, and increase prokdutivitas (Olaoye, Emechete, Onigbinde, &Mbada, 2016).

Occupational therapy comes from the word Occupational Therapy. Occupational means a job, therapy means treatment. So, Occupational Therapy is a combination of art and science to direct sufferers to selective activities, so that health can be improved and maintained, and prevent disability through activities and busy work for people with mental and physical disabilities. (American Occupational Therapist Association). The purpose of occupational therapy training itself is to restore the function of the sufferer as much as possible, from abnormal to normal conditions that are deployed to physical and mental disabilities, by providing planned activities with attention to the patient's condition so that the patient is expected to be independent in the family and community (Bar &Ratzon, 2016)

B. Function and Purpose of Occupational Therapy

The function and purpose of occupational therapy. Occupational therapy is directed medical application for the elderly physically and mentally by using activities as a medium of therapy in order to restore a person's function so that he can be as independent as possible. These activities are various kinds of activities that are planned and tailored to the goals of therapy. The elderly who are sent by a doctor to get occupational therapy are with the following intentions.

1. Special therapy for the mental or mental elderly.
   a. Creating a certain condition so that the elderly can develop their ability to be able to relate to other people's dates and the surrounding community.
   b. Helps in releasing emotional movements naturally and productively
   c. Help find work abilities that match their talents and circumstances
   d. Assist in data collection in order to establish diagnosis and other therapeutic assignments
2. Special therapy to restore physical function, increase joint space, muscle strength, and movementcoordination.
3. Teaching activities of daily life such as eating, dressing, learning to use public facilities (telephone,television, etc.), both with and without tools, clean bathing, and so on.
4. Helping the elderly to adjust to their routine work at home, and providing suggestions on thesimplification (silification) of the room and the location of daily necessities.
5. Increase work tolerance, maintain, and increase the remaining capabilities.
6. Provide various kinds of activities for the elderly to explore as a step in pre-cocational training. Based on this activity, it will be possible to know the mental and physical abilities, work habits,ocialization, interests, potentials and others of the elderly in directing them to the right job in work training.
7. Helping sufferers to accept reality and use the time during the treatment period in a useful way.
8. Directing interests and hobbies so that they can be used after returning to the family.

The occupational therapy program is a part of medical services for the total rehabilitation of an elderly person through collaboration with other hospital staff. In the implementation of occupational therapy, it seems that there will be a lot of overlapping with other therapies so that a coordinated and integrated collaboration is needed (Kang, 2017).

C. Knee Joint

The knee joint is part of the inferior extremity that connects the upper leg (thigh) to the lower leg (Holsgaard-Larsen et al., 2017). The function of the knee joint is to regulate the movement of the leg. And to move these legs are also needed, among others:

1. The muscles that help move the joints,
2. Joint capsules that serve to protect the jointed bone so that it does not come off when moving,
3. There is a bone surface with a certain shape that regulates the extent of movement,
4. The presence of fluid in the joint cavity which functions to reduce friction between the bones on the joint surface.

5. The ligaments around the knee joint which connect the two bones are jointed so that the bones become strong for body movements.

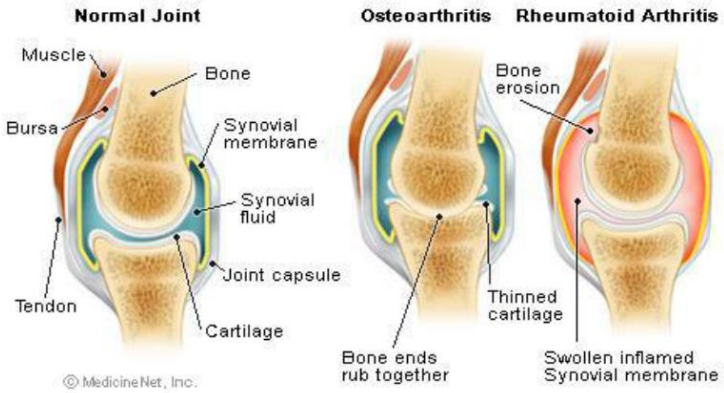

Figure 1. Knee Joint

The knee joint is formed by the distal epiphysis of the femur, the proximal epiphysis, the tibia and the patella, and has several joints that are formed from related bones, namely between the femur and patella called articulatio patella femoral, between the tibia bone and the femur is called articulatiotibio femoral and between the tibia and the proximal fibula called the proximal tibio fibular articulation (Meyer et al., 2017).

Cartilage (cartilage) is the connective tissue that makes up the movement system of cartilage tissue which is composed of cartilage cells. Cartilage cells secrete a matrix called chondrin. The matrix causes cartilage to be flexible, smooth and strong. Cartilage has an extracellular matrix which is rich in glycosaminoglycans and proteoglycans. It is a special connective tissue in which the extracellular matrix is densely concentrated, so that this cartilage has a elastic strength that allows this tissue to withstand mechanical stress without experiencing distortion. Another function of cartilage is to support soft tissue. Because the surface is slippery and resilient, cartilage is a shock absorbing area and a friction surface for joints (Castiblanco&Shareef, 2017).

D. Robot Manipulator

Robot feet or many applications in the industrial world, especially used as a large-scale moving goods with heavy goods, the control can be either automatic or manual. Automatic robots are robots that can move according to their motion system without having to interfere with human feet, while manual robots are robots that move according to their motion system with the help of operators as controllers (Vijay & Jena, 2016).

Robot feet generally consist of shoulders, legs and feet which can be a gripper or feet that have fingers like human feet as object grabbers. The leg part of the robot is known as the leg manipulator, which is a system of motion that functions to manipulate (hold, take, lift, move, process) objects. To take the object, the robot's leg is equipped with a gripper (holder) in the form of fingers like human fingers.

E. Rank Wilcoxon

The Wilcoxon cascade test introduced by Frank Wilcoxon in 1945 is a refinement of the "Sign Test", that is, in addition to paying attention to positive and negative signs, the magnitude of the difference is also considered. This test is used to test conditions (variables) in paired samples with minimal ordinal scale data scores or also for research with pre and post data. The presumption required in the use of the Wilcoxon signed test is that the data pairs are taken randomly and each difference between the score pairs (di) (population distribution) is symmetric (Perolat, Couso, Loquin, & Strauss, 2015).

The assumptions of this test are:

a. The data for analysis consisted of n different fruits $Di = Y_i - X_i$. Each pair of measurement results (X_i, Y_i) is obtained from observations of the same subject or subjects who have been matched according to one or more variables. The pairs (X_i, Y_i) in this sample were obtained randomly.
b. Variable difference ($Y_i - X_i$) represents the results of observations on a continuous random variable.
c. The population distribution (d_i) is symmetrical.

The null hypothesis (H_0) to be tested says that the two populations are identical. If H_0 is true, it can be expected that the number of levels marked as positive will roughly be equal to the number of levels marked negative. If the two numbers of levels differ greatly from one another it can be concluded that the two populations are not identical, and thus we reject H_0. In other words, H_0 is rejected if one of the numbers of positive or negative levels is very small (Marx, Backes, Meese, Lenhof, & Keller, 2016).

METHODS

A. Problem Identification

At this stage, identifying the problems that arise is takenby conducting a survey directly at the KhusnulKhotimah Nursing Home. The survey was conducted to determine the problem that there are obstacles in health services, especially the physical activity of the elderly. The physical activity services provided are still manual and conventional in nature so that they have less impact on the occupational therapy provided. The results of observations and interviews conducted show that many elderly people experience difficulties in physical activities, especially walking. The age range identified in the nursing home was from 60 to 90 years. This research was conducted by observing and interviewing the supervisor and owner of the KhusnulKhotimah Nursing Home.

B. Formulation of Objectives

The formulation of the objectives of the problems found becomes the next step after the research theme is determined. In this study, the formulation of the resulting objectives is to create a product in the form of a Robot Manipulator and Android as a medium for occupational therapy for the elderly. The formulation of the next objective is to determine the impact and influence of this robot by using the Wilcoxon Rank to analyze before (pretest) and after (posttest).

C. Literature study

Literature study is carried out to obtain references regarding theories and methods that support research. This step is done by looking for references from several books, journals, handbooks, or articles related to the research material.

D. Field Study

The field study was conducted at the KhusnulKhotimah Nursing Home by conducting brainstorming and interviews with the owner of the Nursing Home and elderly counselors. This step is taken to identify the needs of the nursing home owner to get good methods and therapy for the elderly.

E. Variable Identification

The variables used in the study can be classified into independent variables and dependent variables.

F. System Design

At the design stage, the researcher creates a system workflow that has been obtained from the requirements gathering analysis. Then the collection of equipment and materials for making robot manipulator devices and designing smartphone applications with the Android application as a control on the device. The control that is carried out in this android application is by means of buttons and facilities that are controlled by voice commands. The following are the designs that will be carried out in this study.

DISCUSSION

A. Mechanical Design

The main material used to make this style is fiber. This material is used as a frame for a hold and a motorbike seat. The hinges are attached to the lower knee and the splinting knee so that it creates the appropriate movement of the leg. The length of the knee to the ankle of this tool is 35 cm while the measurement from the knee to the shoulder is 25 cm. The height of this tool can be adjusted high and lowaccording to the chair used by the elderly at the time of carrying out the therapy. Elevate this toolreaches 100cm.This tool uses a motor power window to move the mechanic which is loaded by the feet. Mekaik from ankle to shoulder will move left or right or up and down depending on the direction of the motorbike. The method used indetermining the mechanical length is by trial and error. Figure 8 represents a processmechanical body manufacture.

Figure 2. Mechanical Design

In the motor, a position is made so that the motor is the core driving force of this tool. The position of the motor is made of turned iron and the position of the motor is made so that the motor moves properly. The motor power window is installed according to the design, so that the motor movement is as desired. Motor power window is installed directly on the mechanical body so that when the motor rotates the mechanical body follows the motion of the motor. The mechanical body has been covered with cloth, covered with foam so that the user feels comfortable and adhesive so that the elderly's feet follow the motorbike motion.

Figure 3. Top View

B. Movement Testing

1. Mode One Movement Test

   The movement of the motor mode one is a movement that is programmed by providing a PWM value to the motor so that it can move slowly left and right. The PWM value is given three different tests to be able to find a stable motor speed when given a load. Mode one average test graph.

2. Test Mode Movement Two

   The second mode motor movement is a motor movement designed to be able to move the limbs up and down by providing PWM values in the CW and CCW directions until they match the movement expected.

3. Test Mode Movement Three

   Three mode motor movement is a motor movement designed to be able to move the limbs up and down by providing PWM values in the CW and CCW directions until they match the expected movements.

CONCLUSION

Based on the final project that has been tested and analyzed, it can be withdrawnconclusion that:

a. Setting the PWM value to get a safe movement must dolots of testing.

b. The current and voltage values will be large when the CCW motor moves against the gravitational force.
c. Motor speed is affected by the load obtained.
d. The current value will increase if the load given to the motor is getting heavier

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