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Development of Electrical Appliance Controller using Kinect V2 and Arduino Uno

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Abstract

Nowadays, robotics technologies have been grown rapidly in most countries where it been used to replace humans in doing tasks or work, especially in an unsafe or hazardous environment. This paper will be based on these robotic concepts and concentrate on the patient that disable to move. The development of this patient electrical appliances controller will help the patient to self-control the appliances without having to move a lot — this controller operated by using a wireless controller and movement of human gestures. The method is implemented by using the Kinect sensor technology that interfaces with Arduino Uno and relay. The Kinect sensor recognises the skeleton frame from the patient and reads the gesture that already programs in the system. The data from the Kinect sensor sent to the microcontroller unit to be processed and matched with the human selected button display. The Arduino Uno which embedded with the microcontroller that acts as an interface between the Kinect sensor and the relay perform the process to take out the output. This controller will improve the current safety and health system of a patient in a hospital bedroom and even at home.

Keywords; *Arduino project, Kinect V2, wireless, motion sensor*

I. INTRODUCTION

According to the Journal of Medical Engineering [1], Microsoft Kinect already uses and give an impact on physical therapy and rehabilitation. A patient at a hospital during their rehabilitation session using Microsoft Kinect as their tool. Thus, this journal covers the studies on the patient with various types of neurological disorders as well as elderly patients. Moreover, in an International Conference on Biomedical Engineering Microsoft Kinect sensor is a well-known measurement tool due to its high capability to provide length, volume, and motion measurement in biomedical application [2]. Thus nowadays, Microsoft Kinect is applied and use in various sector in the world. Microsoft Kinect is a multifunctional technology than still can be upgraded.

There is several research being carried out previously on the technology based on Microsoft Kinect sensor such as Shi H. Lim et al.,[3] indicates that using Microsoft Kinect for tracking respiratory motion. The system work by records the 3D motion data and researchers make analytical data for consistency of the respiratory motion. B. Bonneechere et al.,[4] research compare the Microsoft Kinect sensor to conventional clinical, functional and rehabilitation stereophotogrammetry.

Next, Aravind. B et al., [5] finding from this study shown controlling domestic electrical appliance by a simple human gesture using Microsoft Kinect in a class or hall. Clark et al. [6] indicate to specify if instrumenting a gait assessment using the Kinectsensor is more efficient than the standard treatment. Lui et al. [7] shown that the Microsoft

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Kinect sensor provides an excellent result for mental stress relaxation tools. Mobini et al. [8] the results from this research strongly recommend designing and developing home-based rehabilitation devices using the Kinect sensor. Sommool et al. [9] researchers find an easy to understand and easy to setup tool for a teacher to engage with their student in a classroom environment using the Microsoft Kinect sensor. Therefore, this development of the Microsoft Kinect sensor project is illustrated in Figure 1.

The remainder of this paper is organised as follows; Section II provides a thorough description of the material and method used, Section III provides an analysis based on the hardware prototype and accuracy check. The paper will end with a set of the conclusion that summarises the key findings of this research and provides directions for future work the Windows device Kinect, the camera's range be shorter, from 40 cm to 3 m.

ii. Arduino IDE

Arduino language/compiler is used C and C++ make it simple to write the code for this project. Arduino works the same as other compilers such as Keil compiler and Dev C++ But the only problem in Arduino IDE is that the software does not have a simulation that compatible with Arduino IDE. Which means that, in order to project to fully functioning based on the expectation, the project must be finished construct before the code is applied. Figure 2.12 illustrates the main page of the Arduino IDE software.

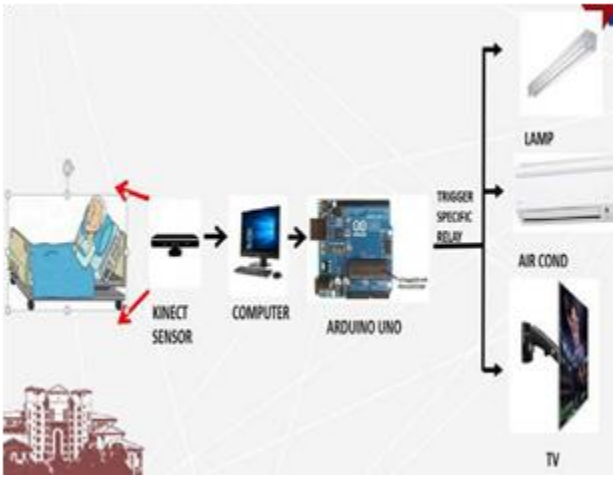

Figure 1: Design of the project

II. MATERIALS AND METHODS

To develop the electrical appliance controller, the hardware needed areKinect V2, Arduino Uno and relay. Using KinectV2, is one of the best option to control the robot using gesture or to scan the environment.

i) Microsoft KinectV2

The Microsoft Kinect sensor that has been used to detect and read the patient skeleton is the Microsoft Kinect V2. Figure 2.1 illustrates the Microsoft Kinect V2 structure. This instrument has been created to perform in 12V from output socket and 5V to the serial port of a computer. With a minimum interface, it is set to connect with Arduino UNO circuit through a processing software to communicate with each other.

Figure 2.1: Microsoft Kinect V2

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Furthermore, in this project, Arduino Uno is a software that can make the Microsoft Kinect sensor communicate with the processing software to control the microcontroller. Thus, the microcontroller can trigger the relay according to the data received from the Microsoft Kinect sensor.

Figure 2.2: Arduino IDE software

2.1 Block Diagram

Furthermore, the optimum range of the Kinect ranges from 1.2 m to 3.5 m. If objects are in front of or too near to the sensor, it not be scanned and only appear as black spots if they are too far away, the scanning accuracy be too small to make them appear as flat objects. By using

Figure 2.3 shows a system of a block diagram for the "Development of patient electrical appliance controller using Kinect V2 and Arduino Uno". The main methods which are consist of Microsoft Kinect sensor that detects or read patient gesture, Arduino Uno as a microcontroller, processing software and relay. The centre of this block diagram is Arduino Uno as the microcontroller, which is the main controller of this system. Arduino Uno board and relay are connected to the power supply in order to turn on the system. The microcontroller sends the data of on or off with the selected command from the user that is processing software communicate with the gesture from Microsoft Kinect. It acts as or controls the input and output of the system.electrical appliance can be turned on and off without moving from the hospital bed.

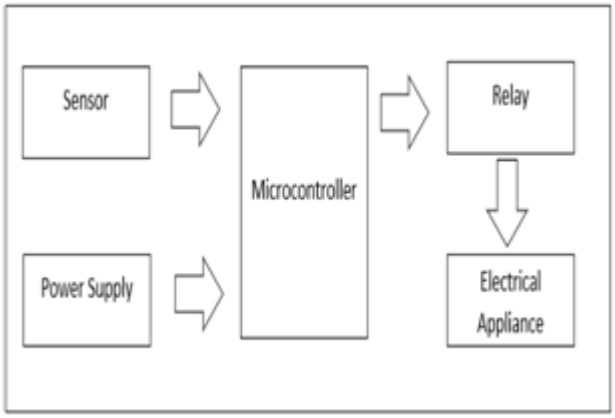

Figure 2.3: Block diagram of the project

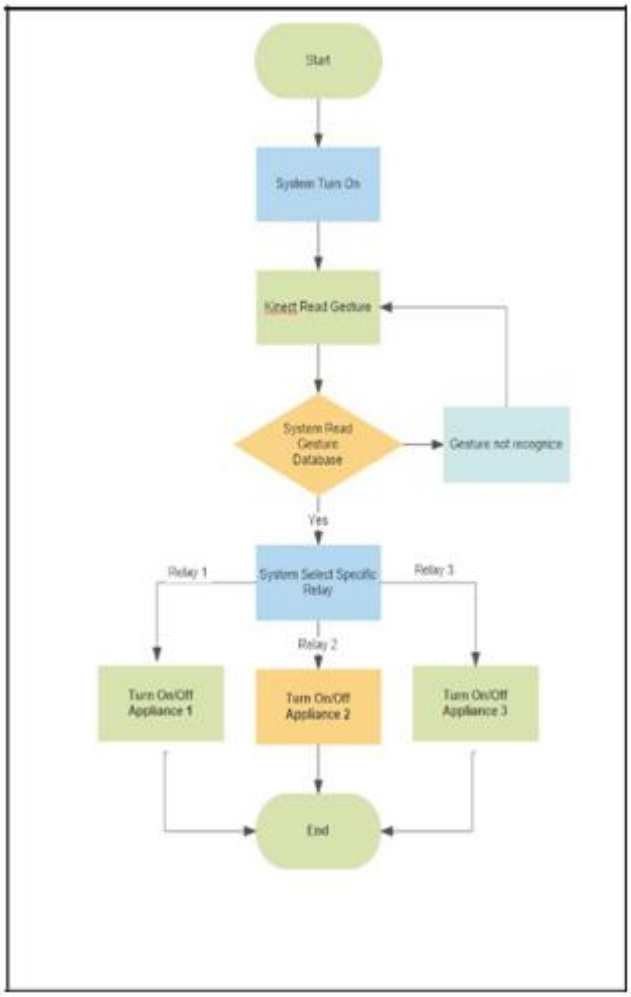

Figure 2.4: The process of project

2.2 Flow Chart

Figure 2.4 represents the flowchart of the development of the patient electrical appliance

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controller using Kinect V2 and Arduino Uno. It shows the flow of the system from where the system is turned on, how the Kinect read the gesture and store in database and until the relay trigger by the command from the Arduino microcontroller. The system managed to trigger up to three appliances before the cycle completed.

III. RESULTS AND ANALYSIS

i. Project Development Result

The final product (hardware) of the development of patient electrical appliance controller using Kinect V2 and Arduino Uno is well constructed, as shown in Figure 3.1. The Arduino Uno is put together with all the relay to minimise the wire usage and easy to communicate with the port on Arduino Uno through the serial port on the computer. The Arduino Uno microcontroller process the data from the processing software input on the serial port to allow the output system to operate the selected relay. Furthermore, Microsoft Kinect is connected to the computer and programmed by Microsoft Visual Studio. The Kinect detect and read the patient movement on the hospital bed when all the sensor is turned on. Next, the cursor software, as illustrated in Figure 3.3 that build and programmed from the Microsoft Visual Studio, is moving and following the human movement or gesture. The processing software, as illustrated in Figure 3.2 that display selected electrical appliance controller that needs to turn on or off, is ready to send the data to the microcontroller, when the selected data that been select by the patient on the hospital bed, the specific relay that connected to the

ii.Result Testing and Analysis of Accuracy

This test scenario is carried out by recording the number of commands that have been detected and classified by the system from 20 experiments that have been carried out on the parameters of distance. The experiment consisted of 5 times the cursor software detected the patient movement to select each of the electrical controller button display that is a lamp on, fan on, lamp off, fan off and all off. 5 Attempts at each of these instructions depict both frequently and arbitrarily the different positions and motions of the patient. The following Figure 3.4 shows the outcomes of the experiment with range parameters.

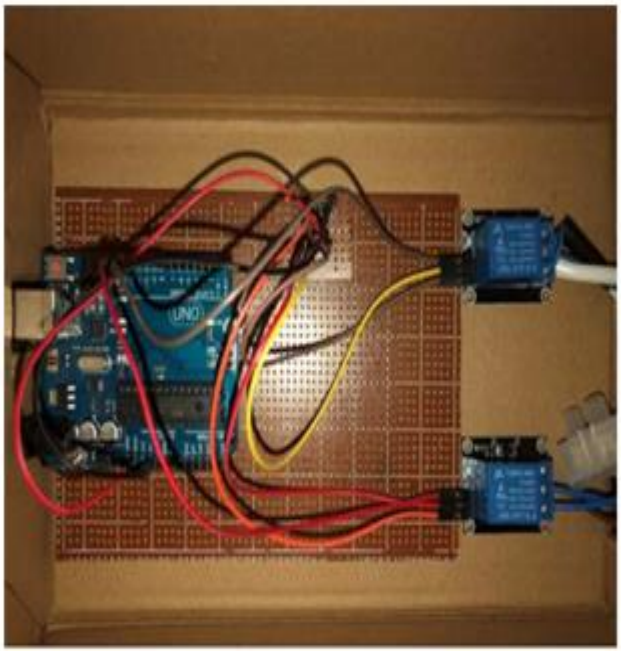

Figure 3.1: Arduino Uno connected to the relay

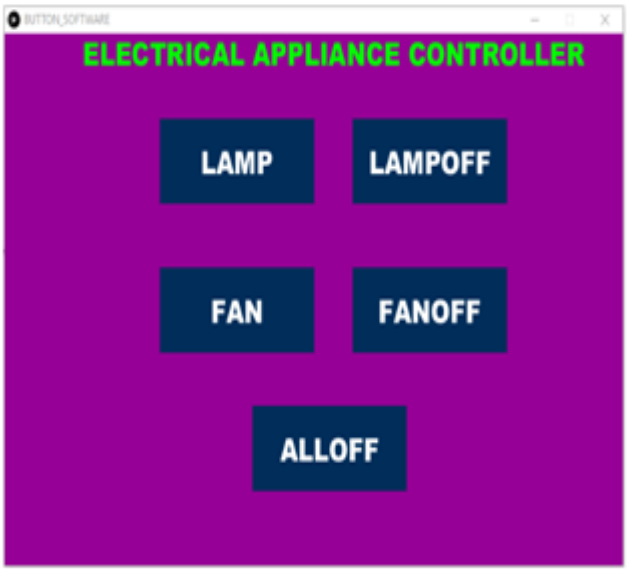

Figure 3.2: Electrical appliance controller software

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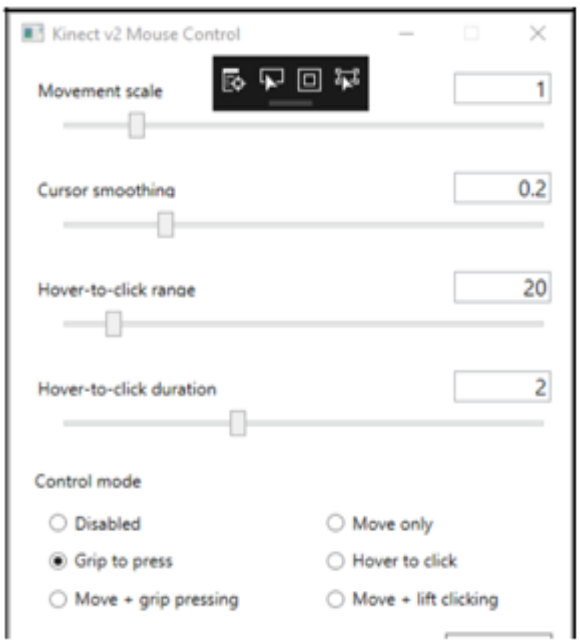

Figure 3.3: Cursor controller software

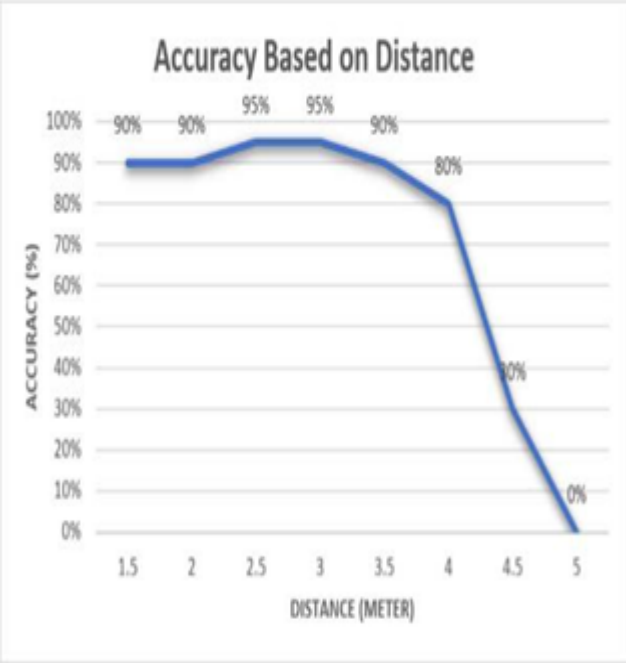

Figure 3.4: Accuracy test graph based on distance

IV. CONCLUSION

This paper has successfully achieved its objective – detect the small gesture of a patient by using the sensor in Microsoft Kinect, integrate it with the microcontroller (Arduino Uno) and able to trigger the ON and OFF of the electrical appliances.

This project can be further developed in the future to store more data about the patient for medication monitoring and purposes.

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