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Robotic Arm Controlled By Hand Gesture Using Leap Motion

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Abstract: The designing and developing of robotic arm has been a common practice among developers. Some designs are based on industrial levels, some are low level industries. It is common to see it. When robotic arm is designed the man aim is towards control and industrial automation. There are several persons in this world which are handicapped and researches are being carried and several projects are being designed in order to help them. In this paper we intend to propose and design a robotic arm which will be using a new controller which is known as Leap Motion Controller. This hardware is totally focused on helping the persons who cannot walk and are handicapped persons. Leap Motion Controller is used here because it has the capabilities which are much needed to design this hardware setup. Leap Motion controller is based on 3D control and this is the main highlight of our robotic arm. We aim to develop robotic arm that may help those persons which cannot move their legs (paralyzed) so by using their hands and just guiding the Leap Motion the robotic arm performs its operation.

Keywords: Leap Motion Controller, Robotic Arm, Arduino

I. INTRODUCTION

There have been vast technological advancements in science and technology in almost every field of life especially in information technology [1], education [2], health sector [3, 4], and so on which are focusing towards the betterment of mankind. Components are being designed to assist humans in one way or another like sensors which are able to observe the parameters and are able to communicate this data to outside world for further processing. Smart machines or also called sensors are being designed so that they are able to simply perform the function by just understanding the gestures of the humans.

Researchers have worked hard on development of small and efficient machines known as Micro Electro Mechanical Systems) and Nano Electro Mechanical Systems (NEMS). This is one of the greatest advancements.

Robotic arm is basically a mechanical type of arm. This arm is programmed to work like human arm. Humans get tired of repeated functions. They are designed to assist human in areas which humans may not be able to work. Traditional types of robotic arms are designed in such a way that they are controlled by the use of mouse, controller, and keyboard or may be preprogrammed.

The proposed method of controlling robotic arm is through hand gestures. This can be an alternative method of controlling robotic arm without the need of any external component. The proposed system will use Leap Motion Controller as the main ingredient. This is a hand gesture motion sensor which senses the motion and movement of hand and then communicates to the robotic arm for further necessary action.

II. METHODOLOGY

In this section we present the methodology of the proposed project. First step is to power ON the system and let the system initialize. After initialization is completed then the system is ready and mow Leap Motion is turned ON to get it ready. Now the Leap Motion Controller Sensor is ready to detect any motion that occurs near it.



Figure 1: Proposed Methodology

As it detects any movement of hand the Leap Motion Controller observes this signal and communicates with the robotic arm. The arm has been attached with Arduino which collects the signal from Leap Motion Controller and then communicates with motors to perform the operation. The proposed methodology is shown in figure 1.

III. HARDWARE

As intention of the research is to help the handicapped persons so the main component is the hardware and its design structure. In the hardware new components have been utilized in order to show state of the art of available options.

A. Leap Motion Controller

The Leap Motion Controller comprises of three light emitting diodes (LEDs) and two cameras. These components are used for tracking infrared light of wavelength 810 nanometers (nm). This light is outside visible light spectrum. It gathers hand gesture movements and sends them using Bluetooth signals for further operation.

We have used leap motion which is a new technology and it works on a three dimensional (3D) methodology. It is a sensor which understands motion from the human hand. Whatever the movement of the hand will be it first reads the signals and after analyzing this in real time it compiles the movement and sends it back to the controller for further necessary actions. It reacts as per the action and movement of the hand like moving the hand in a way that if he is trying to hold anything then it will understand the movements and then send it to the system for further processing.

The Leap Motion Controller and its three dimensional coordinates are shown n figure 2 and also how it understands the hand gestures using these dimensions is also illustrated in figure 2.



Figure 2: Leap Motion controller (Courtesy: Google Images)

B. Arduino

Arduino is a controller which is based on open-source platform. This is very much a popular controller now days because of the fact that it is simple in the sense that it uses USB cable to connect to any computer and has one simple Integrated Development Environment (IDE). Run the IDE and connect Arduino with USB Cable and start writing the code and its that simple. Previously we had an extra hardware which needed to be programmed first and then connected with the system. Programming language used in coding of an Arduino is C++. It is also simple and easy to program.

In the proposed system the Arduino is controlling the movement and dealing as an intermediate component between Leap Motion Controller and the motor. The reason that Arduino has been preferred over other controller is that it is compatible with both beginners and advance level people also. It is simple to get use for the persons who are beginners and are using it and it is flexible for advance level users.

Arduino has a variety of boards like

- Arduino UNO
- Arduino Leonardo
- LilyPad Arduino
- Arduino MEGA

Arduino MEGA has been used in this hardware and comprises of 54 pins for inputs/outputs this is why it is used in the project. Arduino MEGA is shown on figure 3.



Figure 3: Arduino MEGA (Courtesy: Google Images)

C. Motors

Servo motors are used in many applications because if their energy small size and their energy efficiency. They are very commonly found in toys like robots and cars etc. They are also used in industries, robotics and many other services also. Servo motor used in this project is MG995 as shown in figure 4. It has three terminals / Pins: as shown in figure 5.



Figure 4: MG995 Servo Motor (Courtesy: Google Images)



Figure 5: MG995 Servo Motor Pin Configuration (Courtesy:

Google Images)

Red Pin / Terminal: It is for positive supply for the motor (VCC) Orange Pin / Terminal: The PWM signal which states the axis position is demonstrated through this pin. Brown Pin / Terminal: It is used for ground

In the proposed system the motor has been attached to the control wheel with the help of gears. Now as the motor will move the connected potentiometer will change the resistance. In this way the circuit will be regulating the movement and the direction as well.

When the motor shaft is at the required position then the motor is not given power supply. If the required position is not achieved, then motor is moved to that desired position. Speed of the motor is directly proportional between the difference of the positions (i.e. required position and its actual position). When the motor is near to or is nearing desired position then the motor speed becomes slow.

IV. SOFTWARE

Application Program Interface (API) of the Leap Motion Controller provides the facility to communicate or interact with sensors in order to sense and retrieve input values. In the proposed system we have use Python for the purpose of creating API. This API is used for communication between sensor and the robotic arm. The code which we have used in order to control the manipulator develops 3D position of the hand and sends it to convert into degrees.

V. WORKING MECHANISM

A. Working Mechanism of the project

In this section we will define that what components are used here for what purposes. The final hardware layout of the project is shown in figure 6.



Figure 6: Final hardware

The main high light of the project is the leap motion. It is just like a brain of our project. It is the one component which is able to understand the motion of the human hand. It is based on Python programming. Programming is set to make it work. When a person who may be handicapped moves his or her hand and shows this to leap motion then leap motion first detects the motion of the hand and tries to visualize. After observing the movements, it sends signals to Arduino. When Arduino receives this signal then it communicates with the motors to perform the required action.

VI. CONCLUSION

In this project we have designed and developed a robotic arm for the purpose of providing assistance to the ones who are handicapped. We have used leap motion which is a new technology and it works on a three dimensional (3D) methodology. It is a sensor which understands motion from the human hand. Whatever the movement of the hand will be it frst reads the signals and after analyzing this in real time it compiles the movement and sends it back to the controller for further necessary actions. It reacts as per the action and movement of the hand like moving the hand in a way that is it moving forward or backward. Based on hand movement it will capture the motion and then move the robotic arm as said. Leap motion is a sensor which is really helpful in making help to the ones who cannot perform their daily activities due to paralyzed muscles. It is a low cost project which majorly helps people in the sense that it only needs the movement of the hand. Leap Motion is a newly developed hardware which is used to assist when the motions of hand are given to it. Arduino was used because of the fact that it is easy to program, low cost and also reprogrammable. Collectively it can be said that this project is very useful to let the helping hand to the handicapped.

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