



Fabrication of Gesture Controlled Robotic Arm

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ABSTRACT: Now-a-days robotic arm is used in various areas such as military, defence, medical surgeries, pick and place function in industrial automation applications. Based on the gesture of human hands the robotic arm moves and performs the task and this system replicates the actions of human hands. The arm is very flexible and can be made suitable in places where the environment is not safe for humans like firework manufacturing industry, bomb diffusing etc. There are various techniques for controlling the robotic arm. This paper deals with the accelerometer based gesture recognition for controlling the movements of the robotic arm through wireless control by using zig bee protocol.

KEYWORDS: Coding for accelerometer, Coding for Robotic arm, LEAP Motion device,

I. INTRODUCTION

A robotic arm is a type of mechanical arm usually programmable with similar functions to a human arm. The arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion or translational motion.

The links of the manipulator can be considered to form a kinematic chain. It is analogous to the human hand. There are wide variety of applications for robotic arm in various fields such as in military for disposing the deadly bombs, in space exploration for collecting and analysing different samples from outer space, in industries for group production of different materials. These robotic arm helps to do various jobs at a higher precision and consumes only less time when compared to manual or any other mean. Hence, they have become the backbone for the production industries of the Multi-National Companies (MNC's).

II. RELATED WORK

The concept of parabolic dish solar cooker get from Muhammad Nomana [1]. The design and focal point c is calculated using the paper by Berryman [3]. And the construction of parabolic dish, the concept taken from the paper by Jorge Alexander Alarcon [5]. The heat storage system design concept get from the paper Asfaw Haileselassie [2]. The main component used to make the heat storage system is clay/mud. The idea about Heat Transfer Characteristics of soil thermal storage in the non-heating get from the paper Cang Tong [4].

III. METHODOLOGY

The objective of this study is to develop an articulated robotic arm prototype with implementing the gesture recognition control strategy through Leap motion sensor which focus on detection of hand gesture. This kind of control techniques in robotics introduce a complement in obligatory basic teachings in education which can provide a more entertaining and fun form, showing that there are always with additional motivation to the students when they develop and control robotic elements remotely or locally. The robotic arm is made with obsolete materials such as some shafts and gears from the old printer, some are 3D printed out in order to stay the cost low. The relationship between the user and the robotic arm is enhanced by the incorporated gesture control through Leap motion sensor since it has a better control ability. This robotic arm prototype is capable to simulate the human forearm which can

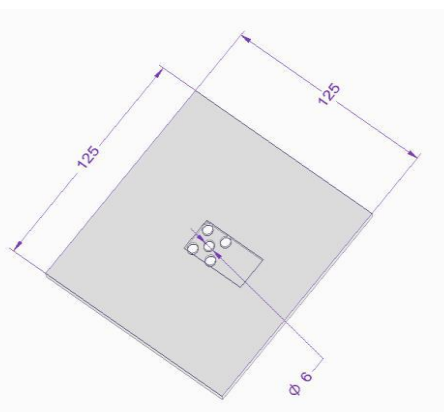


operate in 3D that follows the degree of freedom of human forearm. The reason to adopt gesture control is applications can be generated in a very intuitive way, this is the most effective gestures since the software adapts to human, not human adapts to the software. Human moves by instinct, without the need of thinking in most cases. Thus the best is computer understands human, that would make our life better. 8 The entire control system is integrated with several systems and new technology such as Leap motion device, implementation of hardware constituted by microcontroller and 3D printing technology. The control is performed by an Arduino controller that receives commands from the computer via serial communication to transmit the data to drives servo motors.

Arduino is a platform that interface between the computer and the robotic arm, that translate the gestures into motion of the robotic arm. In this study, several kinds of motion sensor such as Microsoft Kinect, Asus Xtion sensor, Wii remote, MYO and Leap motion are discussed and compared. These motion devices mostly used in video games to enrich the gaming experience. However, in this study shows that those devices can also be used in robotic development. Leap motion sensor is chosen due to its highest accuracy compared to other devices, which has the accuracy of 0.2mm and capturing frame can reach up to 200 frames per second, high portability with small size, easy to use and low cost. The SDK of the Leap transform the data captured into intuitive vectors such as position of fingers and hands and gestures like pinching and touching that facilitates the programmer works. There are application programming interfaces (APIs) inside the Leap, data of hands and fingers can be sent to the program that designed by programmer through the software. A few microcontroller boards are compared, the most important aspects to be considered is the connectivity, versatility and accessibility. For instance, the GPIO, the board has a large number output ports that will increase the accessibility of it since different types of peripherals can be accessed to. The Arduino Uno board is chosen because it met the necessary requirements and properties.

The objective of this study is to design and construct the control system for the robotic arm with Leap motion controller. The principle of Leap motion sensor and servo 9 motors control adapted in this research. Leap motion sensor again is used in this research due to its specification is better than other motion device in this application. Basically the design of the control system is composed by three parts which is detection, data processing and signal control using microcontroller Arduino UNO R3 and robotic arm with a mini gripper.

The system is tested and successfully function as it can control the robotic arm movements. The program is written in JavaScript, leaps and Johnny-five package these two libraries need to be installed in computer in order to get raw data from Leap motion controller and send to microcontroller to execute. The coordinates of the hand model inside Leap data have to map with the real coordinates of the robotic arm, the angle of the servo motors at each joint have to calculated with the captured X, Y and Z axes data. The X-axis is for the base rotation of the robotic arm, two fingers for the end-effector gripper, and the Y and Z axes are for the rest of the joint between base and gripper. Inverse kinematics equations are used in calculation for the servo motors angle between base and gripper. The robotic arm is 3D printed, the prototype is first designed by using CAT software. The results are satisfactory as the distance between hand and Leap motion versus angle of servo motor are similar for all the three axes, meaning that the robotic arm with this system that using inverse kinematics calculation can mimic the user's hand movement with high accuracy. The only limitation for this robotic arm is it cannot mimic the human hand movements completely as it only had 4 degree of freedoms (DOF), a higher DOF robotic arm have a better dexterity.



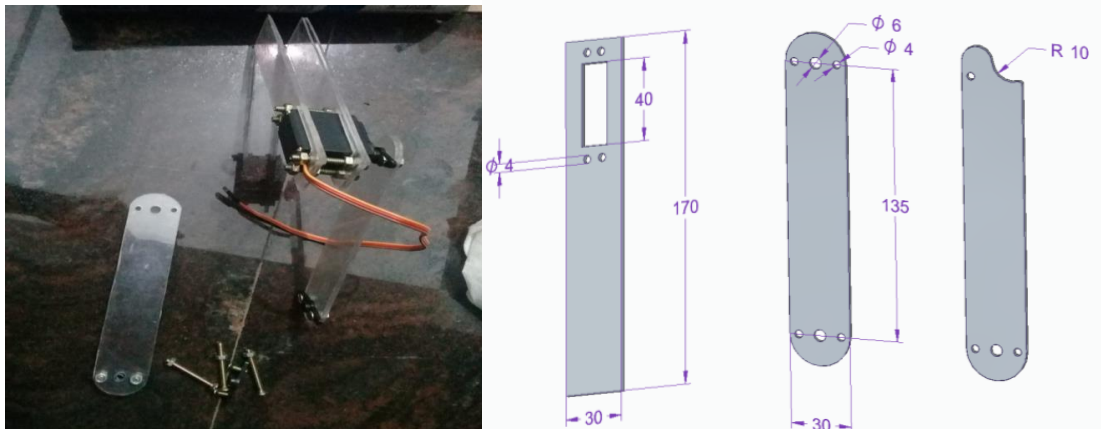


Fig.1. & Fig.2 Base, Fig.3, Fig.4 & Fig.5. Link-1 and Link-2, Fig.6. Links

IV. EXPERIMENTAL RESULT

The designing of the prototype of the robotic arm was successfully completed with the help of trial and error method. The designing and fabrication of a robotic arm was completed. The robotic arm was able to follow the hand gestures such as grip, move right, move left, pitch-up and pitch-down. All these movements can be done simultaneously.

The robotic arm was built with five servo motors, links and a gripper. It is powered by power bank with 5 volts. The sensing glove needs a controller to process all the data from the accelerometer. The Arduino UNO board is used for this function.

The arm can do basic pick and place functions with the help of accelerometer and by changing the gripper to another tool its functionality can be changed to like welding, spraying, painting and drilling. Muscle sensor was first selected for the controlling of the arm then it was found out that the muscle sensor was difficult to use and was costlier so the control mechanism was changed into an accelerometer since it provides the same function for our project. Thus the gestures of the human hand were able to be replicated in an easier and cost-effective method.

Sheet metal was replaced by acrylic because sheet metal needs a lot of high grade power tools and due to its unavailability we selected acrylic sheet as the fabrication material of our project. We also learned and understood the basic of computer languages like C# and Python.



V. CONCLUSION

Robotic arm has a wide scope of development. Thus this approach provides a better way to control a robotic arm using accelerometer which is more intuitive and easy to work, besides offering the possibility to control a robot by other wireless means. Also, many applications which require precise control and work like human beings can be implemented using this method and it provides more flexible control mechanism.

In the future the arms could be developed as such it will be able to perform every task that a human can do in a much better way. In our project we were able to study the movement of the arm with the help of programming languages such as C# and Python. Thus we were able to acquire knowledge about programming languages. Therefore, the project was really useful to us.

BCI (Brain Control Interface), which is an emerging field can be employed to acquire signals from the human brain to control the arm. Robotic arms are versatile and have enormous ways of implementation.

The robotic arms speed can be increased by using a custom made control module which is often faster than an Arduino.

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