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Hand Gesture Controlled Robotic Arm

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Abstract: Robots play an important role in making our lives easier and better. This paper presents the hand gesture recognition system using leap motion controller to control the robotic arm. Iages of hand gestures are taken by camera which is in-built provided by motion sensor. Based on that pixel values, the corresponding gesture is identified and specific command is given to the Robotic system, which helps to increase human robot interaction.

Index terms: *Robotic arm, Hand gesture reognition, leap motion controller, servo motors*

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I. INTRODUCTION

Now a days, robots became a helping hand for human being as robot can perform any task which is very difficult to complete for human being in very less time such as medical surgeries, in industries for mass production as well as to pick and place heavy parts, in agricultural field, in different hazardous conditions, in land mine detection, in vaccum chambers, etc., according to the instruction of human being. In this paper we suggested such a robotic arm which is helpful to perform above suggested task. This robotic arm is controlled with hand gestures. Human robot interaction is an active area in robotic research. Research in robotics results in the development of two fields: Robotic manipulation and the input feeding system. In the in-situ standoff control, human gestures are given as input. Gesture recognition is mainly achieved using the camera and methodologies such as Grey scale conversion, Inverse algorithm, thresholding model. The aim is to make the robotic arm to understand the human body language thereby building a bridge between human and the robot. This system consists of a mechanical based robotic arm. Their movements such as forward, backward, left, right, rotate are controlled by using hand gestures. The range for robotic arm and human hands is 100 meters as both are spatially separated.

II) IMPLEMENTATION DETAILS

A) *Leap Motion Controller:*

The Leap Motion controller is a little USB fringe gadget which is intended to be put on a physical desktop, confronting upward. Utilizing two monochromatic IR cameras and three infrared LEDs, the gadget watches a generally hemispherical range, to a separation of around 1 meter. The LEDs create design less IR light and the cameras produce just about 300 casings for each second of reflected information, which is then sent through a USB link to the host PC.

The jump movement controller is just a shadow identifier. In jump movement controller, there are 2 IR cameras and 3 infrared LED's are utilized. Absolute 3 hub (x, y and z) are utilized as a part of controller. Z pivot is opposite to the surface and x hub is 30 degrees separated from z hub. Correspondingly y hub is likewise 30 degrees separated from z pivot. As hand signals are ponder controller that time 3 infrared LED's emanates light of 850nm. cameras catch our hand motion and give the sign to the microchip or PC.

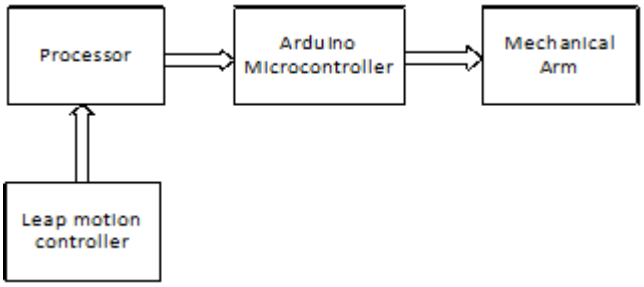

Fig. 1 Block Diagram of hand gesture controlled robotic arm

B) *Processor or Computer*:

The leap motion controller is connected two the processor which shows the recognition of the gestures which is then connected to the arduino.

C) *Arduino:*

Arduino programs may be written in any programming language with a compiler that produces binary machine code.[7] Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. Here python is used as a programming language.[6].

D) *Mechanical Arm:*

Fig. 2 shows a mechanical arm which consist of four servo motors (One standard and three micro servo motors). When our hand gesture is captured by leap motion controller then accordingly to gesture position this mechanical arm is move

with the help of four servo motors. The servo motors which are used to moving the arm are as follows:

i) Azimuth motor:- Rotate in 180º connected to the pin number 2 of arduino.
ii) Altitude motor:- Rotate in 90º connected to the pin number 3 of arduino.
iii) Wrist motor:- Rotate in 90º connected to pin number 4 of arduino.
iv) Claw motor:- Rotate in 0-85º connected to pin number 5 of arduin

Fig.2 Mechanical Arm

Servo motors:

A servo engine is fundamentally a DC motor(in some exceptional cases it is AC engine) alongside some other unique reason segments that make a DC engine a servo. In a servo unit, you will locate a little DC engine, a potentiometer, gear game plan and a savvy hardware. The insightful hardware alongside the potentiometer makes the servo to pivot as indicated by our desires. As we probably am aware, a little DC engine will turn with rapid however the torque produced by its revolution won't be sufficient to move even a light load. This is the place the rigging framework inside a servo component comes into picture. The apparatus instrument will take high information velocity of the engine (quick) and at the yield, we will get a yield rate which is slower than unique info speed however more pragmatic and generally relevant.

III. DETAILED WORKING

The leap motion controller is composed of 3 infrared LED's that emit around 850 nanometers and it has 2 infrared cameras to capture motion. The light from the IR LED's reflect off our hands and gets captured by the two IR cameras on the device. The device then steams the data if captured to the leap motion tracking software on computer i.e. processor as shown in the block diagram. The Mechanical arm is interfaced with arduino microcontroller and this whole system is connected with processor. The arm will operate using the commands come from the processor to arduino microcontroller. The tracking software probably uses parallax effect and other algorithms to reconstruct a 3D representation of the orientation and position of the hands and fingers after the algorithm determines to the best of its ability where yours hand is, the data is exported to the APT which is ready for you to interface with and pull data from.

IV. LEAP MOTION TECHNOLOGY

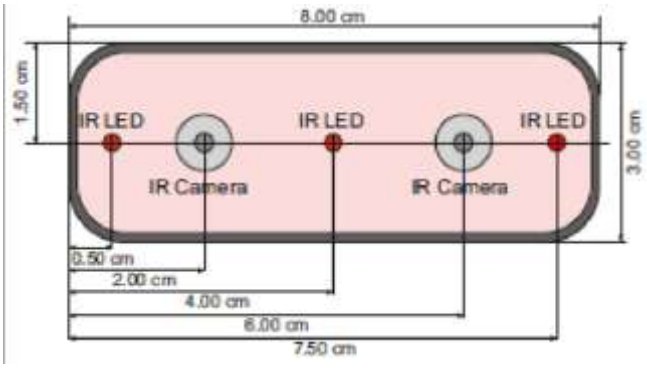

Fig. 3 Schematic view of Leap motion controller

The Leap Motion controller is a sensor device that aims to translate hand movements into computer commands. The controller itself is an eight by three centimeter unit that plugs into the USB on a computer. Placed face up on a surface, the controller senses the area above it and is sensitive to a range of approximately one metre. Strength of the Leap Motion controller is the accurate level of detail provided by the Leap Motion API.[1] The API provides access to detection data through a direct mapping to hands and fingers. Data provided by the API is determinate in that a client application does not need to interpret raw detection data to locate hands and fingers

Fig.4 Hand gesture recognition by leap motion sensor

In Fig. 4 , the API remembers one hand with five digits. The granularity of the Leap Motion controller is an advantage toward discovery of Auslan signs. The controller can reliably perceive singular digits in a hand. Having the capacity to recognize, address and measure digit and fingertip area and development is basic for precisely following of communication via gestures movements. The controller is likewise equipped for following little developments, another key limit for precise communication via gestures acknowledgment. While the specialized details for the Leap Motion controller refer to a scope of up to one meter, in our testing we found that the gadget performs precisely inside a field-of-perspective around 40cm from the front and sides of the gadget. Numerous Auslan signs rely on upon hand developments around the upper middle, and the closeness and field of perspective for the controller is an advantage for this need.

V. FEATURE EXTRACTION

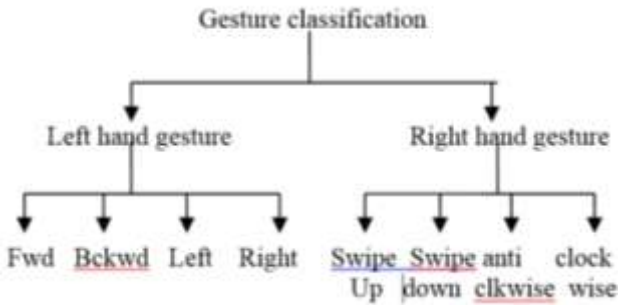

Fig. 5 Gesture recognition flow diagram

Fig. 5 indicates stream graph for hand motion acknowledgment for left hand and right hand. The Leap Motion does not give back a complete profundity outline rather just an arrangement of significant hand focuses and some hand posture highlights. Fig. 6 highlights the information gained by the Leap gadget that will be utilized as a part of the proposed motion acknowledgment framework, as underneath:

i) Position of the fingertips Fi, i = 1,… … ,N speak to the 3D positions of the distinguished fingertips. N is the quantity of perceived fingers.

ii) Palm focus C generally compares to the focal point of the palm district in the 3D space.

iii) Hand introduction in light of two unit vectors, h is indicating from the palm focus the fingers, and n is opposite to the palm plane indicating descending from the palm focus. Be that as it may, their estimation is not exceptionally precise and relies on upon the fingers course of action.

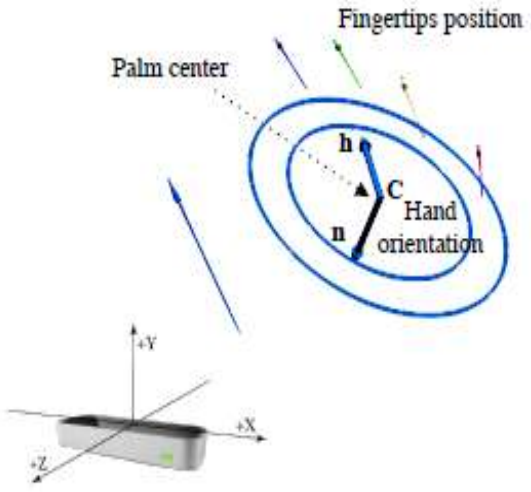

Fig. 6 Data acquired by the Leap motion

VI. CONCLUSION

We proposed the hand gesture recognition in order to control the robotic arm with the help of the web camera. By calculating the pixel values and comparing with the pre-feed database, the specific command is provided to the robotic arm which depends on the gesture given. It is cost effective and highly flexible. A system is developed to demonstrate the proposed system. Experimental result show that the system can recognize the hand gesture in the real time and perform the desired action.

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