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CONTROL OF ROBOTIC ARM USING COMPUTER VISION

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Abstract - Robots have become an integrated part of human life. The motive of this project is to provide a relationship between man and machine through the interaction of the human hand and the robotic arm. The arm consists of five degrees of freedom (DOF) and an end effector to allow interaction with the real world. Now the duty of the controller appears and is solved with the exploration of the jump motion sensor. As before, the arm is controlled by a keyboard or joystick, and it takes a lot of practice and calculation to maneuver the arm into the desired position. Gestures can be explicitly captured and set points provided with a jump motion.

***Key Words*:** robotic arm, computer vision, arm control,

I. INTRODUCTION

A robotic arm is a programmable robotic hand that consists of linear and rotating joints to achieve controlled movement. In the military, articulated robotic arms are used in demining robots, saving countless lives. The robot is remote-controlled by deminers from a safe distance to scan for explosive devices without putting themselves in danger. Therefore, the robot is usually equipped with a camera as the "eye" of the robot, providing a view of the surrounding situation, so that the operator can control the robotic arm through the camera to check and eliminate the explosive device. Today, most human-computer interactions (HCI) rely on mechanical devices such as keyboards, mice, gamepads, or joysticks. In recent years, there has been growing interest in a class of computational vision-based methods to recognize human gestures in a natural way. The main purpose of this algorithm is to measure the configuration of the hand at each instant. To facilitate this process, many gesture recognition apps use uniquely coloured gloves or markers on the hands or fingers. Additionally, different hands can be located efficiently and even in real time using a controlled background. Both of these conditions place restrictions on user and interface configuration. Due to the initial requirements of our application, we specifically avoided solutions requiring gloves or coloured markers and controlled backgrounds. It should work for different people without adding anything to them, and in unpredictable contexts.

II. LITERATURE SURVEY

[1] Love Aggarwal, Varnika Gaur, Puneet Verma presented a method to control a arm using accelerometers connected to each joints. Apart from the gestures, speech can also be other mode of interaction because of which this system can form part of a so called Perceptual User Interface (PUI). The system could be used for Virtual Reality or Augmented Reality systems.

[2] Reduanur Rahman, Md Sajid Rahman, Jillor Rahman Bhuiyan designed a robot that is wirelessly operated by the user and capable of selecting and placing many items. Using joystick, commands are sent to the receiver at the transmitting end to either regulate the robot's motion to move forward, backward, left, or right, etc.

[3] Hussein Mohammed Ali, Yasir Hashim, Ghadah Alaadden Al-Sakk presented a six degree of freedom robotic arm has been designed and implemented for the purpose of this research. The design controlled by the Arduino platform receives orders from the user's mobile application through wireless controlling signals, that is Bluetooth. The arm is made up of five rotary joints and an end effector, where rotary motion is provided by the servomotor.

III. METHODOLOGY

The following introduces the design and implementation of using computer vision to control the robotic arm with Arduino through the gesture mechanism, including the characteristics of the robotic arm, extension, direction and speed of the arm. To understand the geometry of the robot arm, its orientation angle must be calculated. It is important to know the length of each link and where the arm starts and ends in the work area, then reference the bottom of the robot arm or another point. This movement is described by a kinematics, which is of two types, forwards and backwards. If the robot's origin is in three-dimensional space (0,0) and cannot reach the origin, it is called a singularity.The robotic arm's extension must reach objects beyond its base to use it to locate and control the position of its wrist. This prototype robot arm has 6 degrees of freedom. For the first 3 joints, waist, shoulder and elbow, MG945 servo motors were used. While for the other 3 joints, wrist roll and wrist suture and clamps, smaller MG90S micro servos are used. The movement of the pruning motor is based on the rotation range of the servo motor, which rotates the whole robot arm on its basis of 0 degree and 180 degree angle θ1. The shoulder movement requires the most strength in the robotic arm because it supports the weight of the entire arm. It goes up and down according to the angle θ2. The movement of the elbow motor is the type of movement that the robotic arm is most comfortable to handle. The movement of the central scroll motor consists of rotating the arm on its axis through an angle θ4 between 0 and 180 degrees. The driving force behind the waist wheel is the up and down movement of this joint. The movement of the gripper motor is the end effector of the arm that interacts with the environment; he only has the ability to grab an object and move it just to open and close.

IV. CIRCUIT DIAGRAM

The LM393 comparator has four pins which are A0 (analog pin), ground, VCC (can be 3.3v/5v depending on module) and D0 (digital output pin). According to the pin configuration, the pins are connected to the aforementioned Arduino Nano. The servo has three pins VCC, GND and Signal, VCC and Ground are connected to their respective pins, and the signal pin is connected to pin D5 of the Nano board. The LM393 comparator sensing block is connected by wires as power and ground pins to measure the strength of the current flowing through the sensing block and send the information to the comparator.

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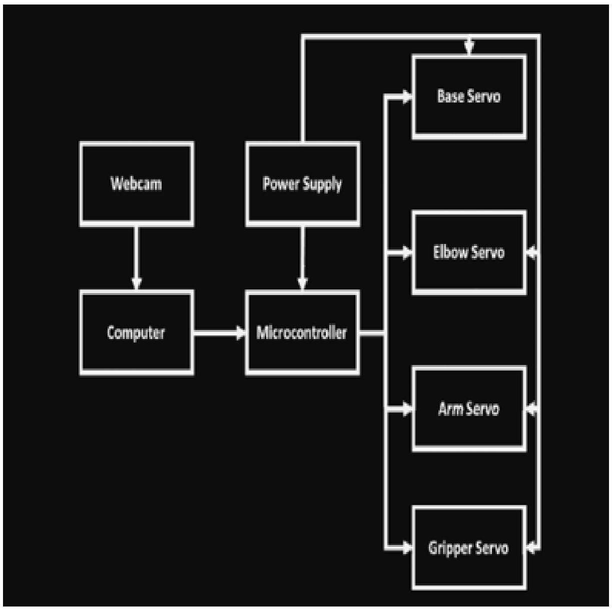
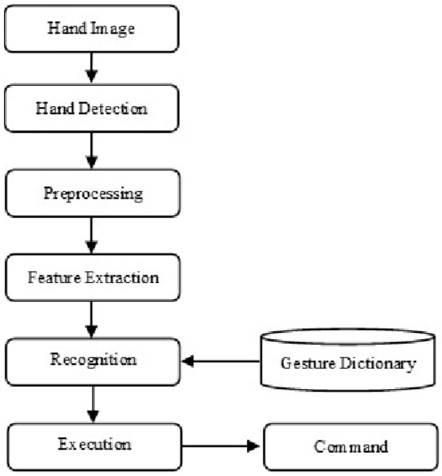


V. BLOCK DIAGRAM



VI. SCOPE OF THE PROJECT

To achieve reliable recognition, it is very important to detect features extracted from the images that are being captured, even with changes in image scale, noise, and illumination. These points are usually located in high contrast areas of the image, such as the edges of objects. Gesture recognition is initially performed by independently matching each keypoint to a database of keypoints extracted from the training images. Many of these initial matches will be incorrect due to blurry features or features caused by background clutter. Therefore, clusters of certain features that match the object and its pose are first identified, as these clusters have a higher probability of being correct than a single feature match. Each image is then processed and examined by performing a detailed fit to the model and using the results to control the Arm.

VII. RESULTS

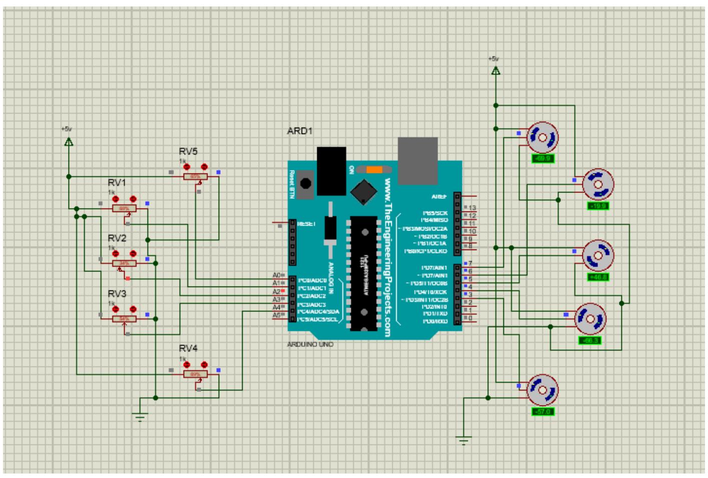


Figure 1: Simulation of each component

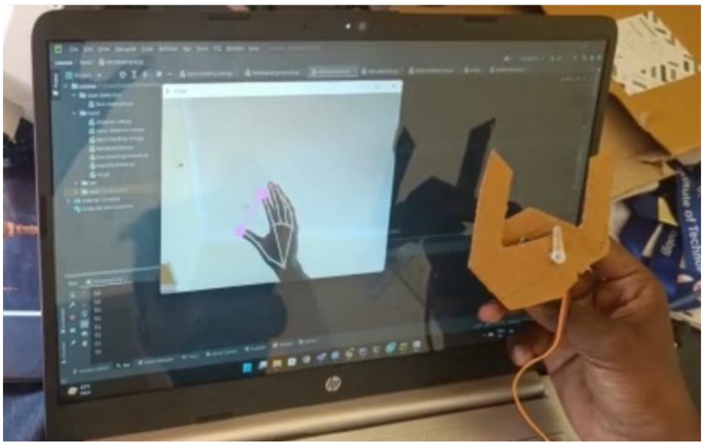


Figure 2: Arm gripper controlled using computer vision

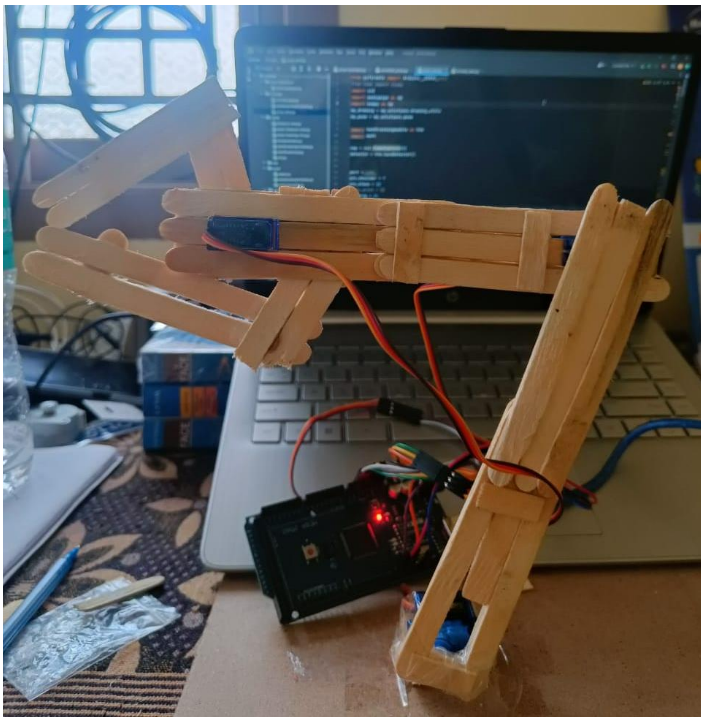


Figure 3: Complete Arm controlled using computer vision

VIII. CONCLUSION

A low-cost computer vision system that can run on a general-purpose computer equipped with a low-power USB webcam is one of the main goals of our work and has been successfully implemented. We experimented with around 30 gesture images and got higher average accuracy. The best grading rate of 97% is achieved under different lighting conditions. But the downside of this method is that the hand must be positioned correctly relative to the webcam for the entire hand area to be captured. If the hands are not positioned correctly, gestures cannot be recognized correctly. The gestures performed in this method involve only one hand, which reduces the number of gestures that can be performed with both hands. Real-time control of robots via hand gestures is a novel approach with countless applications.

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