

Computer Vision and Sensor Based Hand Gesture Recognition for Servo Control

OBJECTIVE:

1. Human-Robot Interaction: Enable a robot to interact with humans in a more natural and intuitive way, using hand gestures and movements as a means of control.
2. Gesture-Based Control: Create a gesture-based control system for a robot, allowing users to control its movements and actions using hand gestures rather than traditional remote controls or programming interfaces.
3. Robotics Education: Use this project as an educational tool to teach robotics and computer vision concepts, allowing students to understand and experiment with image processing, servo control, and real-world applications.
4. Assistive Technology: Develop a robot that can assist individuals with physical disabilities by responding to hand gestures, making it easier for them to interact with and control the robot for various tasks.

EQUIPMENTS:

- For Image Processing based:
 1. PC
 2. Arduino
 3. Servo Motor
 4. Power Supply
 5. OpenCV
- For Gyroscope Sensor based:
 1. Arduino
 2. Servo Motor
 3. Power Supply

CIRCUIT DIAGRAM:

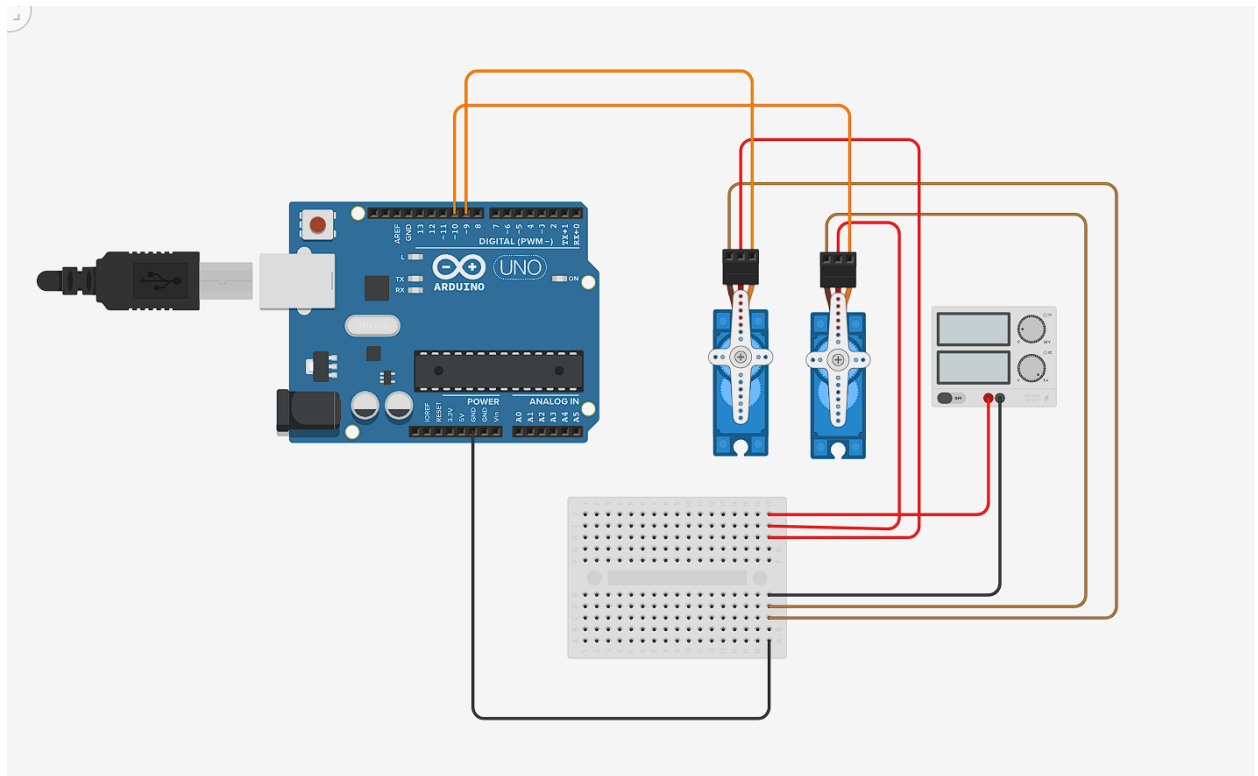


Figure 1: Circuit Diagram of Image Processing based Robotic Hand

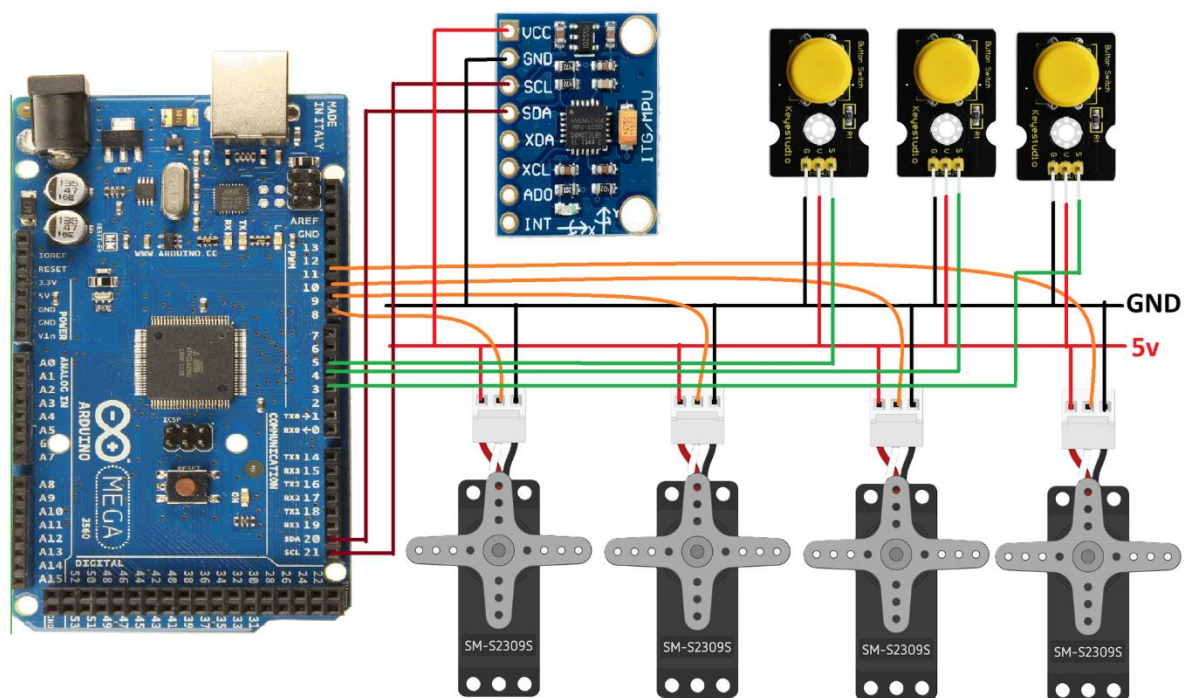


Figure 2: Circuit Diagram of Gyroscope Sensor based Robotic Hand

FLOWCHART:

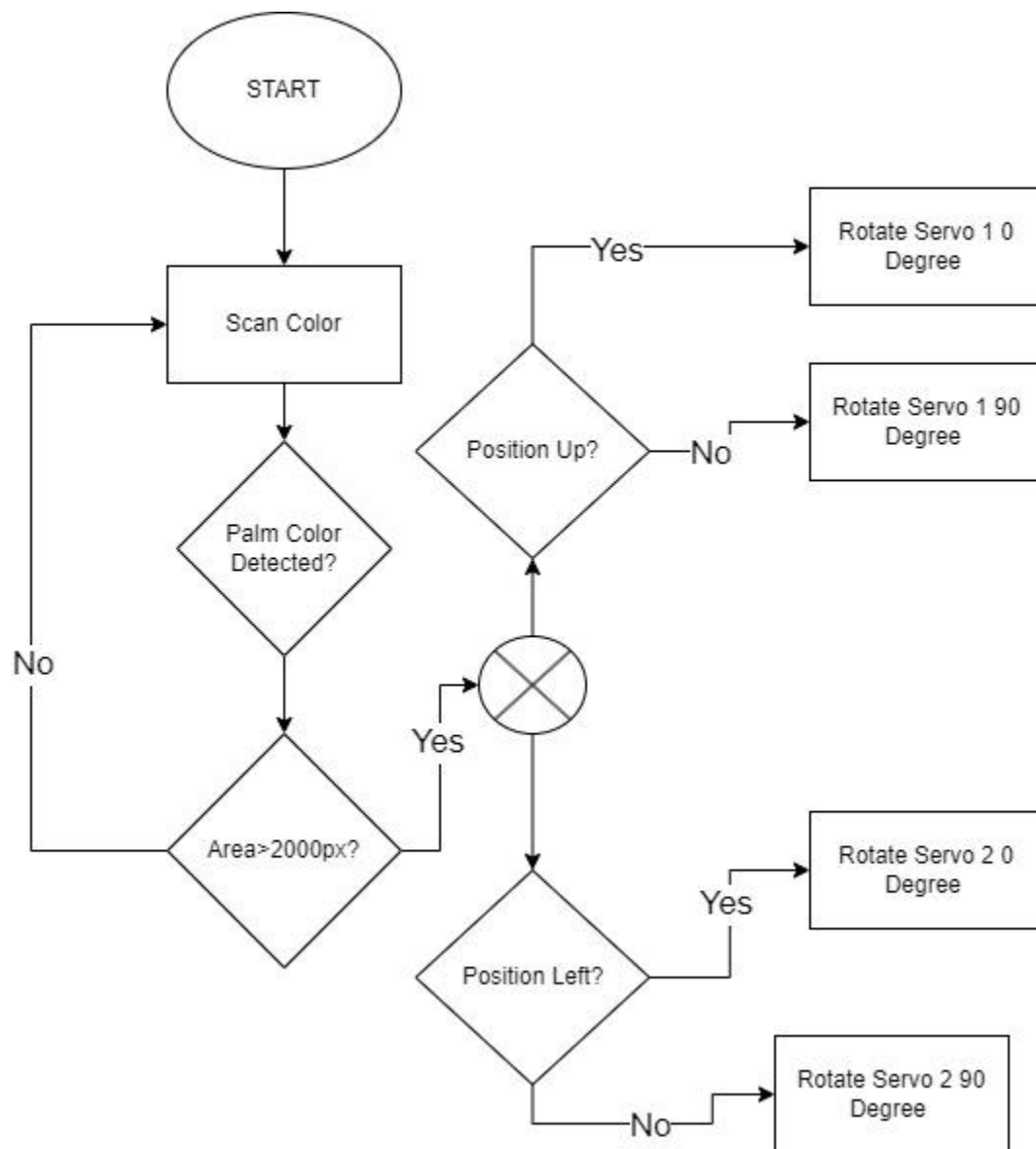


Figure 3: Functional Flowchart of Image Processing based Robotic Hand

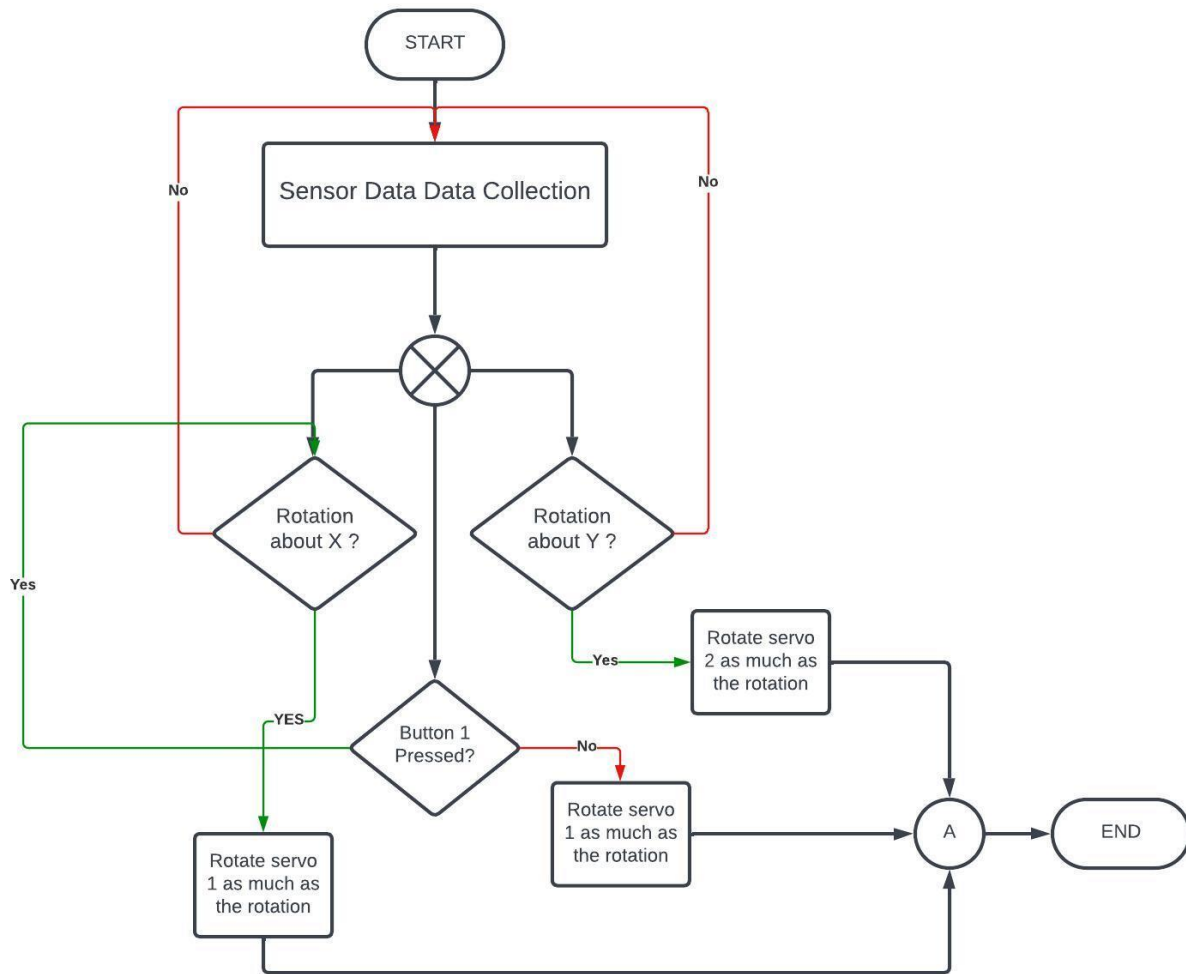


Figure 4: Functional Flowchart of Gyroscope Sensor based Robotic Hand

WORKING PROCEDURE:

For Image Processing based:

1. Initialization: Set up robot hardware and initialize variables and flags, such as "Hand Detected" flag and servo positions.
2. Color Detection: Capture an image or video frame from the camera. Process the image to detect the color associated with the palm of the hand.

3. Hand Detection and Servo Control: Determine the position of the hand (up, down, left, or right) based on the hand's movement or position within the frame and assists to rotate the servo according to the flowchart.
4. Control and Feedback: Implement control logic to ensure smooth and accurate movement of the robot based on the detected hand position.
5. Continue looping to continually monitor the hand position and control the robot's movement.

For Gyroscope Sensor based:

1. Create a design for the robotic hand, considering the number and arrangement of fingers, joints, and actuators (servos or motors) needed for each finger and the wrist.
2. Choose an appropriate gyroscope sensor that can provide reliable data on hand orientation and movements.
3. Mount and secure the gyroscope sensor to the hand structure in a way that ensures accurate data collection.
4. Connect the actuators to the hand's mechanical structure, ensuring that they can produce the required movements.
5. Interface the gyroscopic sensor with a microcontroller or microprocessor (e.g., Arduino, Raspberry Pi) to receive orientation data.
6. Implement logic for hand gestures, such as opening and closing the hand, rotating the wrist, or performing specific finger movements.
7. Test the robotic hand extensively to ensure its reliability and performance.
Evaluate the hand's ability to carry out specific tasks or applications.

OUTPUT:

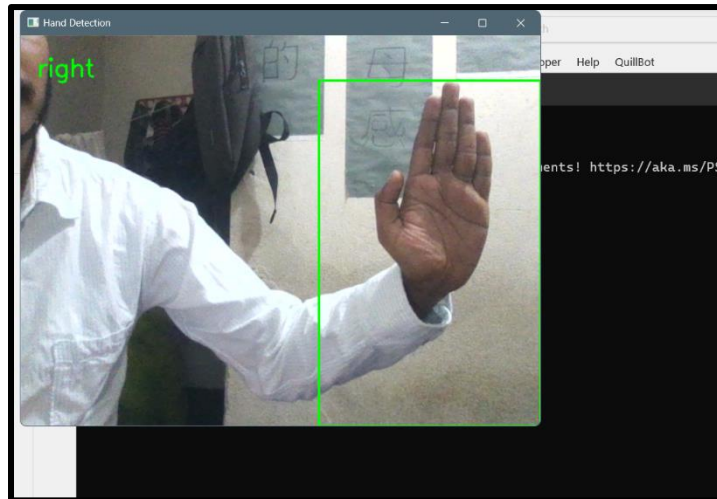
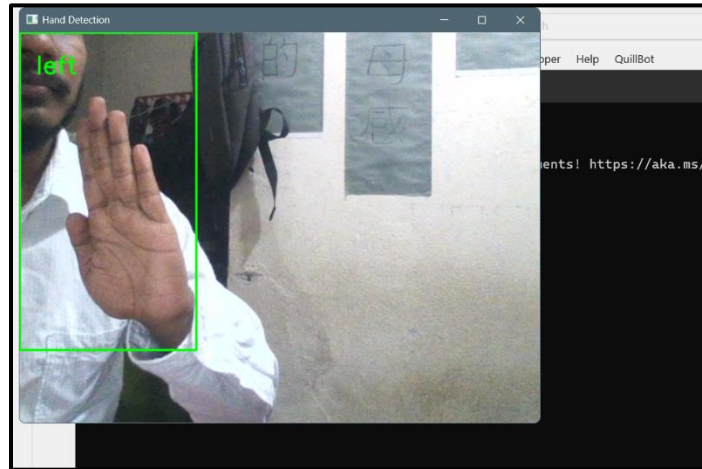
DISCUSSION & CONCLUSION: In this project, we successfully developed a robot that can detect the direction of a hand based on color respond to hand movements and also based on gyroscope sensor.

During the project, we encountered several challenges. These challenges included lighting conditions affecting color detection, calibration of servos for precise movement, and the need for real-time image processing for seamless interaction.

There are several areas in which this project could be enhanced in the future such as- Improved Color Detection, Gesture Recognition, Autonomous Navigation, Developing a user-friendly interface.

This project demonstrates the potential of gesture-controlled robots for enhancing human-robot interaction. While we achieved our primary goal, there is still room for improvement and expansion into practical applications. Gesture control opens up exciting possibilities for making robots more accessible and user-friendly in various domains.

Images:



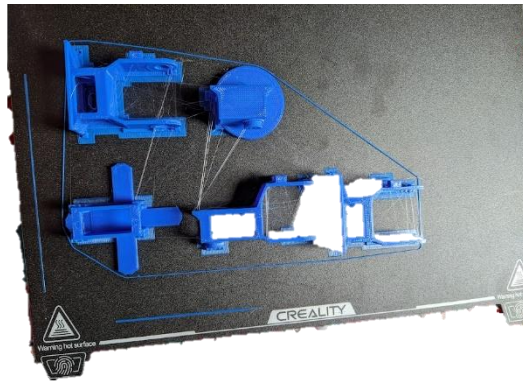


Image: 3D printed Parts

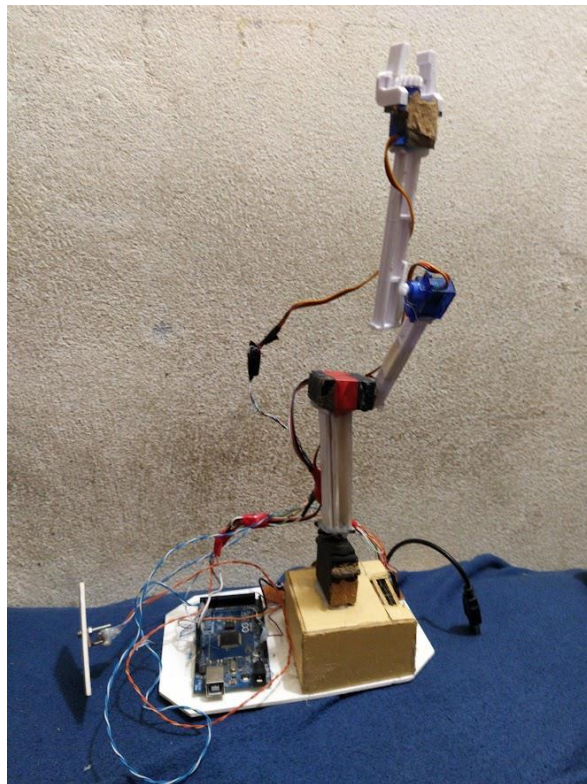


Image: Gyroscope Based Manipulator

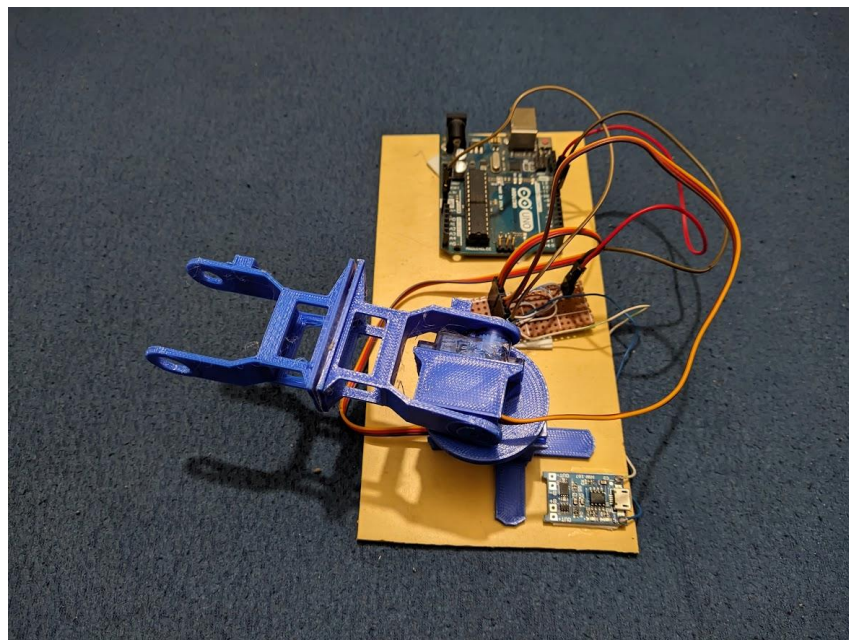
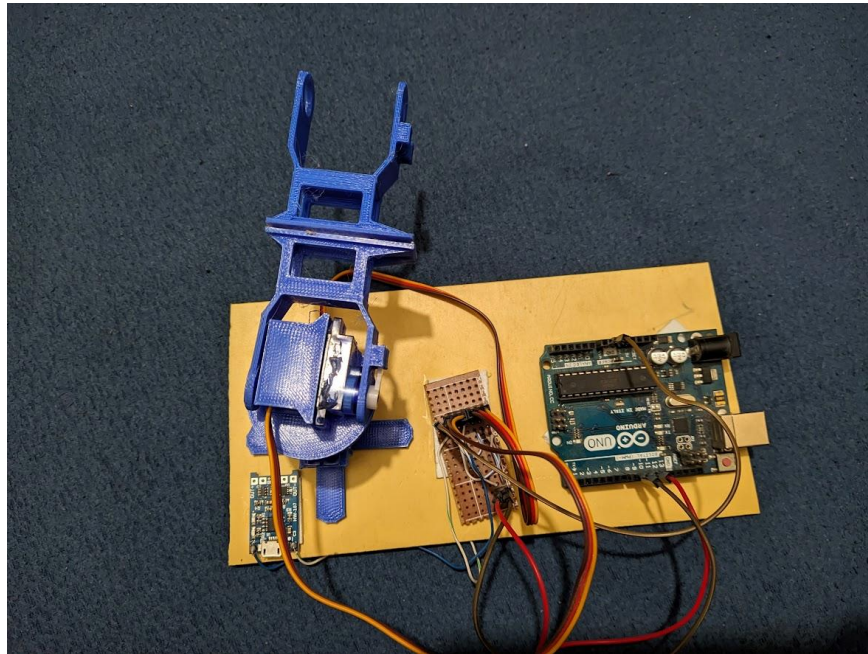


Image: Computer Vision Based Manipulator