JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Pick and Drop Robotic Arm using Hand Gesture

[1]Malhar Bhosale, [2]Manthan More, [3]Onkar Chapekar, [4]Pratiksha Potghan, [5]Prof. Digamber Shelke

[1] Department of Artificial Intelligence & Data Science,
[1]Suman Ramesh Tulsiani Technical Campus Faculty of Engineering, Pune, India.

Abstract : This project presents the development of an intelligent robotic arm system capable of performing pick-and-place operations through hand gesture recognition. The gesture-controlled robotic arm offers significant benefits, including increased productivity, safety, and accessibility, with the potential to transform workflows across various industries. The arm executes pick-and-drop actions based on the user's gestures, ensuring precise and efficient object handling. The project demonstrates how human-robot interaction can be improved using smart, gesture-based control mechanisms, making robotics more accessible, intuitive, and user-friendly. The robotic arm is powered by servo motors and controlled via a microcontroller (e.g., Arduino or Raspberry Pi), which interprets gesture inputs into mechanical motions. These gestures are then mapped to corresponding robotic arm actions like grip, release, and directional movement. This technology has applications in automation, healthcare, and hazardous environments where touchless control is advantageous.

Index Terms **- Robotic Arm, Pick and Place, Machine Learning, Gesture Recognition, Arduino, Hand Tracking, Real time Control, Human Machine Interaction.**

1) INTRODUCTION

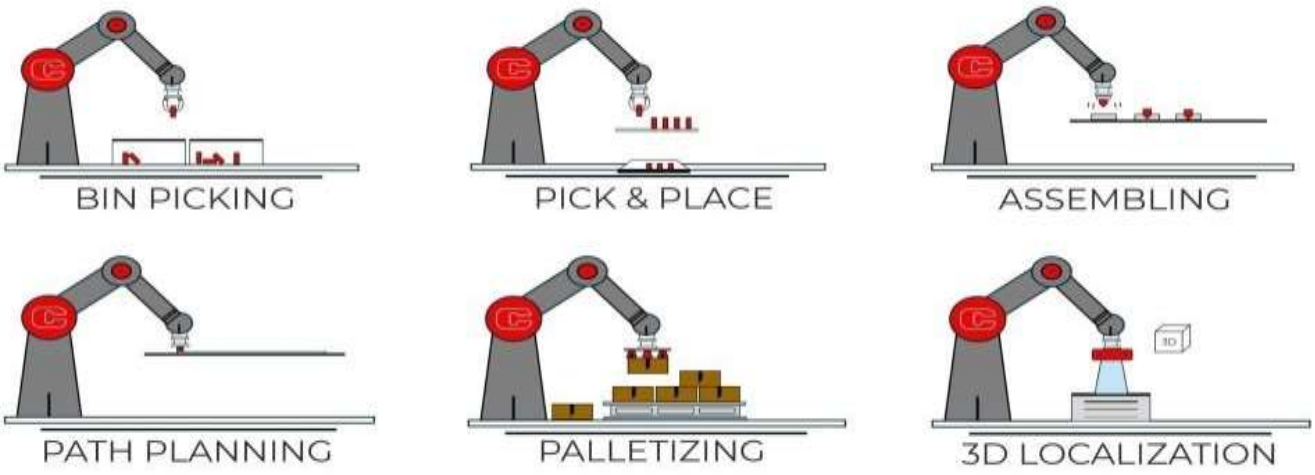
Imagine being able to control a robotic arm with just the movement of our hand. This project is an attempt to achieve we are taking a challenge of building an ARUDINO powered robotic arm designed to follow hand gesture in real time whether its rotating gripping objects or performing complex tasks. This robotic arm can be programmed to carry out task with precision all through the natural momentums of our hands. This robotic arm can be used for automobile companies, manufacturing, packing, medical studies, etc. There are many robotic arm which are controlled my manual controller but we are trying to go advanced in our project by controlling it with our hand gesture and software application which can be easily handled and easy to use and also very much precise when manual controlled. Traditional robotic arm requires or physical controllers which can be complex. This movements are programmed by microcontrollers [ARUDINO or ESP 32].

This project demonstrates how human robot interaction can be improved by smart techniques. Making robotics more user friendly. The pick and drop robotic arm using hand gesture aims to overcome these challenges by introducing a more user-friendly approach to robotics control. The arm is very flexible and can be made suitable in places where the environment is not safe for humans. Our project can be more impactful because till now no one has able to bring these many features in a robotic industry. Our motive is to make more human friendly more précised more efficient and less costly and effortless.

2) HOW IT WORKS ?

We are sending a signal (over Bluetooth) from the robotic gloves to the servo motors when a signal has been received the servo drivers will send signal to move the robotic arm. Robotic arm has series of servo motors connect with each other to perform a function that has been commanded by robotic gloves. ARDUINO is used to communicate with the sensors which has been connected to both robotic arm and robotic gloves. Which sends the signal to servo and stepper motors to move left to right and up to down and pick and drop. The flex sensor which we are using in robotic glove to analyse the movement of our hand and to give the command to robotic arm. The robotic arm is controlled by servo motors VIA Bluetooth and make the robotic arm come to life. The robotic arm code makes use of the HCPCA9685 libraries for the servo driver this way we can power servo motors all connected by an ARUDINO.

We are using both ARUDINO UNO and ARUDINO NANO. ARUDINO UNO is used to give command to robotic arm and ARUDINO NANO is used to give command to robotic gloves. Stepper motor is used for 360 movement of robotic arm. We are using two battery backup 24 volt for robotic arm and 11 for robotic glove. Which is used to power all the sensors and motors used for this project.



3) PROJECT SCOPE

The Pick and Drop Robotic Arm with Hand Movement Control using Arduino project aims to develop an interactive and intuitive robotic arm capable of performing pick-and-place tasks by responding to the operator's hand gestures. This system will use an Arduino microcontroller integrated with hand-tracking sensors to allow the user to control the arm in real-time through simple hand movements.

4) SYSTEM ARCHITECTURE

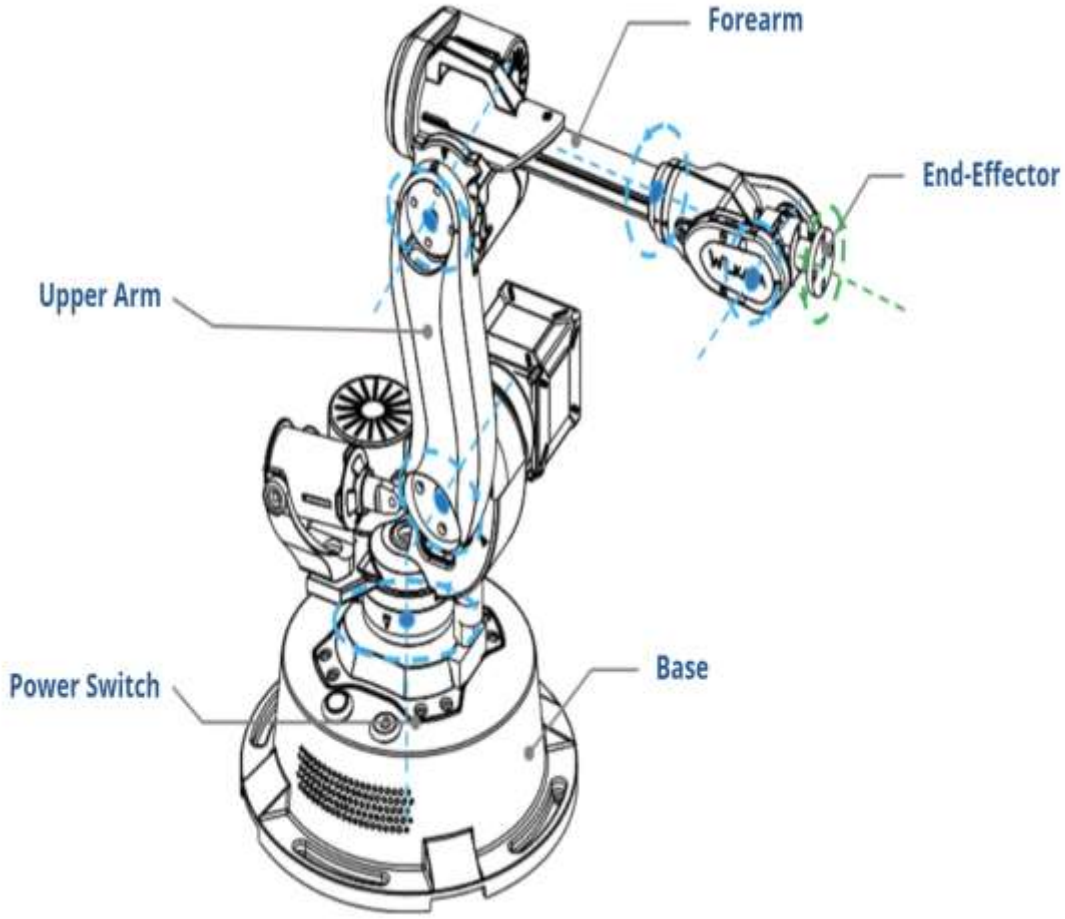
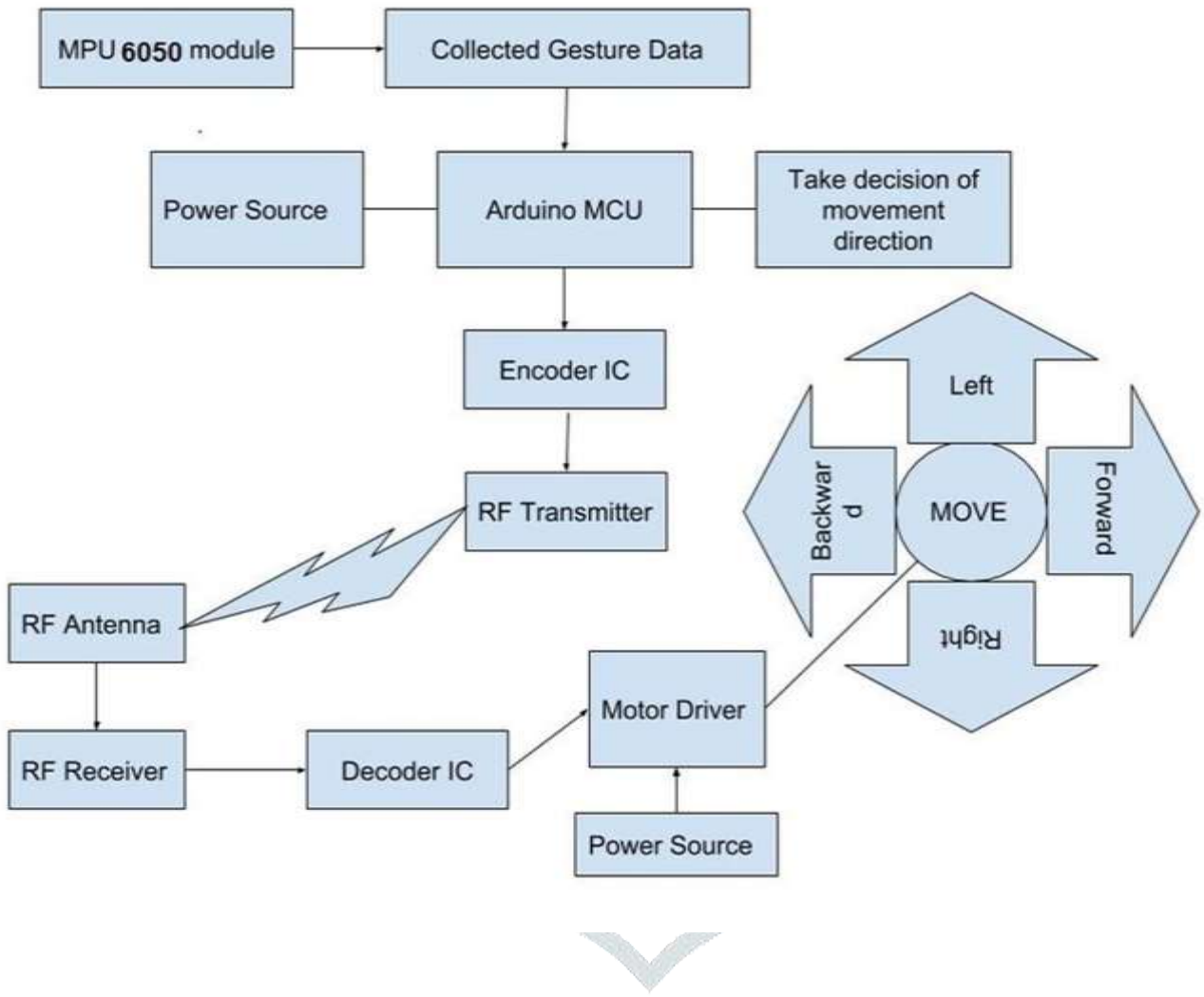


FIG: PICK AND DROP ROBOTIC ARM USING HAND GESTURE

5) BLOCK DIAGRAM



1. MPU6050 (Accelerometer + Gyroscope): The MPU6050 is a 6-axis motion tracking device that combines a 3-axis accelerometer and a 3-axis gyroscope. It is used for measuring orientation, acceleration, and angular velocity in robotics and gesture-controlled devices.
2. Flex Sensor: A Flex Sensor changes its resistance based on how much it is bent, making it ideal for detecting finger or limb movements. Commonly used in wearable electronics and robotic gloves.
3. Jumper Wires: Flexible wires used to make connections between components on a breadboard or between modules. Available in male-to-male, male-to-female, and female-to-female types.
4. Breadboard: A reusable platform for prototyping electronic circuits without soldering. It allows quick and easy component connections.
5. Arduino Nano: A compact version of the Arduino board, suitable for space-constrained projects. It has similar features to the Uno but in a smaller form factor.
6. Arduino Uno: A popular microcontroller board based on the ATmega328P, used for beginners and prototyping. It features 14 digital I/O pins and USB connectivity.
7. Servo Driver (PCA9685): A 16-channel PWM driver module that allows control of multiple servos using I2C communication. Ideal for robotics and automation projects.
8. Servo Motor (MG966R Series): A high-torque servo motor commonly used in robotics for precise angular movement. It operates based on PWM signals to control rotation angles.

6) RESULT

Robotic Arm – Pick up Object

Robotic Arm – Move the Object

7) CONCLUSION

The project in the end successful to pick up object and move the object. The robot arms can be controlled by using sensors, Arduino, and hand gestures. The sensors are employed for remote control that will enable forward, backward, left and right control movements and pick and drop depends on the hand movements. The project successfully demonstrates real-time hand gesture recognition, wireless control, and precision in object handling, making it suitable for various applications such as industrial automation, healthcare, logistics, and assistive technology.

8) ACKNOWLEDGMENT

We extend our sincere gratitude to all those who contributed to the development of this **Pick And Drop Robotic Arm Using Hand Gesture**. We deeply appreciate the support and guidance of our mentors and faculty members, whose insights and expertise played a crucial role in shaping this research.

9) REFERENCE

[1] Vikram et al., March 2023 – *Gesture Controlled Robotic Arm Using Accelerometer*: Developed a real-time control system using ADXL345 and Arduino UNO.

[2] Ankita D., Snehal B. et al., July 2022 – *Hand Gesture Controlled Robotic Arm for Pick and Place Operation*: Used flex sensors and RF for remote object handling.

[3] Pawar B., Khan A., April 2021 – *Wireless Gesture Controlled Robot with Robotic Arm*: Glove-based wireless system for robotic pick-and-place tasks.

[4] Patil M. et al., September 2021 – *Pick and Place Robot Using Gesture Control and IoT*: Enabled IoT-based gesture control using NodeMCU.

[5] Kumar R., Singh P., November 2020 – *Hand Gesture Based Control System for Pick and Place Robotic Arm*: Flex sensor-based robotic control for automation and rehabilitation.