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Omni-Bot Pick and Place Robotic Arm: A Review

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Abstract: ***This project describes the design and implementation of a mobile robotic arm controlled through a wireless Bluetooth system. In this setup, an HC-05 Bluetooth module is connected to the Raspberry Pi to create communication between an Android mobile application and the robotic unit. The communication is carried out using UART serial protocol, which allows reliable transmission of control commands. The robotic arm is built with four degrees of freedom (4-DOF), enabling flexible movement such as base rotation, arm lifting, gripping, and object placement. The arm can rotate up to 270 degrees to cover a wider working area. Servo motors are used to achieve accurate positioning and smooth motion control. In addition to the arm mechanism, wheels are attached to the base so that the system can move from one location to another. In many small-scale industries, warehouses, and manufacturing units, pick-and-place work is still done manually. Workers have to lift, move, and place objects continuously, which increases physical effort and causes tiredness. In some cases, it can be unsafe, especially when the materials are heavy or hazardous .Most industrial robotic systems available in the market are costly and cannot be easily afforded by small industries or educational institutions. The proposed system aims to reduce human effort, improve productivity, and provide a practical automation solution at an affordable cost.***

Keywords: Pick and Place Robot, Robotic Arm ,Industrial Automation ,Raspberry Pia4,Servo Motor, Object Detection

I. INTRODUCTION

In the current situation, the field of robotics is rapidly advancing. Robotics is an automated system and robotic arms are widely used in industries, medicine, and education. They can perform repetitive tasks multiple times without errors and also handle complex tasks similar to humans.

We designed a robotic arm to reduce human labor and effort. It can perform complex tasks efficiently. In this system, we use a Raspberry Pi as the computing platform. Raspberry Pi is a small, single-board computer used to control the movement of the robotic arm. It act as a the central control unit, making the system more flexible and compatible.

A robotic arm is a combination of mechanical motion, electrical control, and software integration. The features embedded in the robotic arm include object detection, line – following capability , pick-and-place operations, and process automation. The main components used in system are sensors, servo motors, and an ultrasonic sensor.

The robotic arm is movable and can rotate up to 270 degrees . With the help of an ultrasonic sensor, it can detect objects and follow a predefined path using line-following algorithms. This robotic arm is used in industries for process automation, improving product quality and quantity, increasing accuracy, and reducing human effort.

II. LITERATURE REVIEW

The paper titled ” AUTOMATED ROBOTIC ARM” was published by Durdona Bekimetova and Timur Khudaybergenov .The project focuses on reducing the cost of robotic system so that they can be robotic system so, that they can be widely used in Education, Industries, Healthcare, Automation. The authors developed a robotic arm using a Raspberry Pi ,servo motor , programming using Python . the system integrates both hardware and software components along with mechanical assembly .[1]

The paper titled ” Rose Harvesting Robot ” was published by Dr. Swetha Ranil, Umamah G R, Dharaneshwari S. , Divyashree D.L. , Kammara Pavani Priya .This robot was designed to reduce labor cost and improve efficiency in agricultural and floricultural harvesting tasks . the system uses advanced deep learning to pluck different types of roses without damaging the plants . The robot is implemented using a Raspberry Pi, camera ,and DC motors to control movement during flower plucking .[2]

The paper titled “Automated Robotic Arm ” was published by Prof .Bhoir N .V. ,Mr. Nightie Sachin, and Mr. Raut Prajwal .The primary objective of this project is to reduces human intervention and improve productivity in pick-and- place operation . the system uses five servo motors and a Raspberry Pi for controlling movement and positioning . the design enhances process efficiency in automated material handling task.[3]

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The paper titled "Industrial Robotic Arm" was published by Rupali Dasarwar ,Nayan Thakre ,Kundan Tikale , Adarsh Pholke, and Tejas Randive.The robotic arm is designed to perform pick -and -place operation with object detection and precise manipulation in industrial environment .the system uses a Raspberry Pi along with MG995 and MG905 servo motors providing six degrees of freedom (6 DOF) . A PCA9685 SERVO MOTORS . The system also incorporates a Pi camera module and OpenCV for object detection and image processing. The methods used in the system include : Kinetic modelling, inverse kinematics solvers, PID controllers, computer vision algorithms, Robotic arm using IOT and raspberry pi.[4]

Paper titles "Real -Time Images Processing Based Robotic Arm Control Using Raspberry Pi" was published by Dr. A Brintha Therese and Pashini Gupta . This research describes the design and implementation of a robotic arm that detect and sorts objects based on their colour using real - time image processing. The system uses a Raspberry pi and a camera to capture images . Python-based image processing is used to detect colours such as red, green, and blue, and the robotic arm moves accordingly .The aim of the develop a low-cost and efficient color -sorting robotic arm move for industrial applications .[5]

The project titled "Robotic Arm Using Raspberry Pi and IoT" was presented by Hiranmayee Panchagam. This paper describes the design and implementation of a low-cost robotic arm system that can be controlled through the Internet of Things (IoT). The system uses a Raspberry Pi as the main controller, Python programming for system operation, and an online dashboard for remote monitoring and control. The primary objective of this project is to develop a robotic arm capable of picking and placing hazardous objects while keeping humans at a safe distance. This system is particularly useful in environments where direct human interaction may be unsafe, such as chemical industries, fire-affected areas, or other hazardous locations. The robotic arm operates using Wi-Fi connectivity and the MQTT protocol for communication between the hardware and the IoT platform. The main components used in this system include a Raspberry Pi, servo motors, an IoT platform, a Wi-Fi module, a power supply unit, and the mechanical structure of the robotic arm .[6]

The paper was "Design and Implementation of Pick – and -Place Robotic Arm". The paper was published by Amit Shelke, Saurabh Sapkale, Subhansh Kakkade , Ravikumar Mourya, Manoj Borse. The robot is a 4-degree – of - freedom (4-DOF) articulated arm used to grip, lift, move, and place objects automatically . it uses four servo motors for movement and Is controlled using an ATmega16 microcontroller with a serial servo control circuit . the main objective of this project is to reduce human efforts , increase operational speed ,and minimize errors in industrial application . robot are widely used to perform repetitive and complex tasks such as material transfer , machining , welding, processing ,assembly , and inspection. compared to humans , robotic system provide greater precision , repeatability , and efficiency. The proposed robotic arm is capable of transferring object with a diameter of up 6 cm and a weight of up to 150 grams over a distance of 50 cm. the system component include a Raspberry Pi , servo motors , an IoT platform , a power supply unit , and the robotic ASM structure.[7]

The paper titled "Robotic Arm for Automated Pick and Place" was published by Megha Amsha, Anadhita Rao, G. Ume Maheswari, D. Prakash, and Jutika Aggarwal. The robotic arm identifies, grips, lifts, and places objects from one position to another. The system uses an ESP8266 Wi-Fi module for wireless control. An ESP8266 Node MCU is used as the main controller. The system is suitable for small-scale automation and material handling applications. It operates on battery power and provides stable performance during object handling.[8]

The paper titled "Real-Time Image Processing Based Robotic Arm Control System Using Raspberry Pi" presents a system that utilizes a camera and OpenCV techniques to detect and track predefined objects. Once an object is detected, the robotic arm automatically performs pick-and-place operations. The system is based on a Raspberry Pi running on a Linux (Debian-based) operating system and integrates both hardware and software components. The hardware setup includes a Raspberry Pi board, a camera module, a relay module, a power supply unit, and the robotic arm structure. This system is suitable for applications in surveillance and industrial automation.[9]

The paper titled "Design and Implementation of a Pick and Place Robotic Arm for Flexible Manufacturing System" was published by P. Hemalatha, C. K. Hemalatha, Dr. S. R. K. Jilani, Jaongez K. Terzoo, and Olatu Adny F. Otengye. The project focuses on designing a robotic arm for flexible manufacturing. It reduces human labor, improves speed and accuracy, and increases productivity. The system includes a microcontroller, motor drivers, stepper motors, and a power supply. The microcontroller controls the motors through motor drivers.[10]

III. SYSTEM METHODOLOGY: NEW APPROACH

Fig.1 represents the functional structure of the robotic arm system. Multiple components work together to perform pick-and-place operations efficiently .

A. Main Blocks

1) Microprocessor (Raspberry Pi)
2) IR Sensor
3) Power Supply
4) Motor Drive
5) Motor
6) Robotic arm And Gripper

The microprocessor is the brain of the brain of the system .It receives input signal from joystick and IR sensors and processes them to control the movement of the robotic arm . The Joystick is use for manual control of robotic arm's movement ,including speed of direction . It allow movement in up ,down, left, and right directions . The joystick is especially useful during critical condition when the system cannot be controlled wirelessly . The IR sensor is use for object detection and line - following operation . The motor driver act an interface between microprocessor and the motors. It control motor speed and direction based on signal received from the microprocessor .

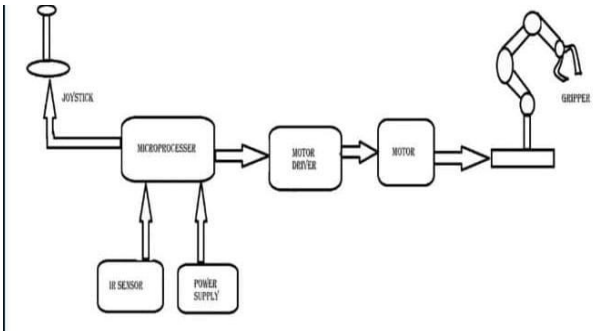


Fig.1Basic Block Diagram Of System

The motor drive the robotic arm and enable movement , while the gripper perform the pick – and – place operation . the power supply provides the necessary electrical energy to all Component of the system . the power supply provides the necessary electrical energy to all component of the system. The power supply is the most important block in the system . Without a power supply ,the robotic arm cannot operate . it provides electrical power to all required components such as the microprocessor, motor drive, and motor . two types of motor are used in the system : MG90S servo motors and DC motors. Servo motors convert electrical signal into mechanical motion and are connected to the joints of the robotic arm for movement control . To drive the motor, an L293D motor drive is use . the motor driver act as an interface between microprocessor and the motors. Since motors require high current, the microprocessor cannot drive them directly therefore ,the motor driver amplifies the current and control motors direction and speed . the robotic arm and gripper from the final output unit of the system . The gripper is attached to end of arm and is use for pick – and – place operations , holding and releasing objects.

IV. FUTURE SCOPE

1) In the future, a camera can be integrated with object detection using Raspberry Pi to enhance automation and improve accuracy in pick-and-place operations.
2) Voice command control can be added to make the system more user-friendly and enable hands-free operation.
3) An automatic charging dock can be implemented to allow the system to recharge itself, ensuring continuous and efficient operation.

V. CONCLUSION

In this project, a robotic arm system was developed to perform pick-and-place operations automatically. The system uses a Raspberry Pi, camera module, and servo motors to detect and move objects from one position to another. Image processing techniques help in identifying the object correctly, and the robotic arm performs the task without manual support. The system works properly for small-scale industrial applications and reduces human effort. This project shows how automation and image processing can be combined to improve accuracy and efficiency in practical applications.

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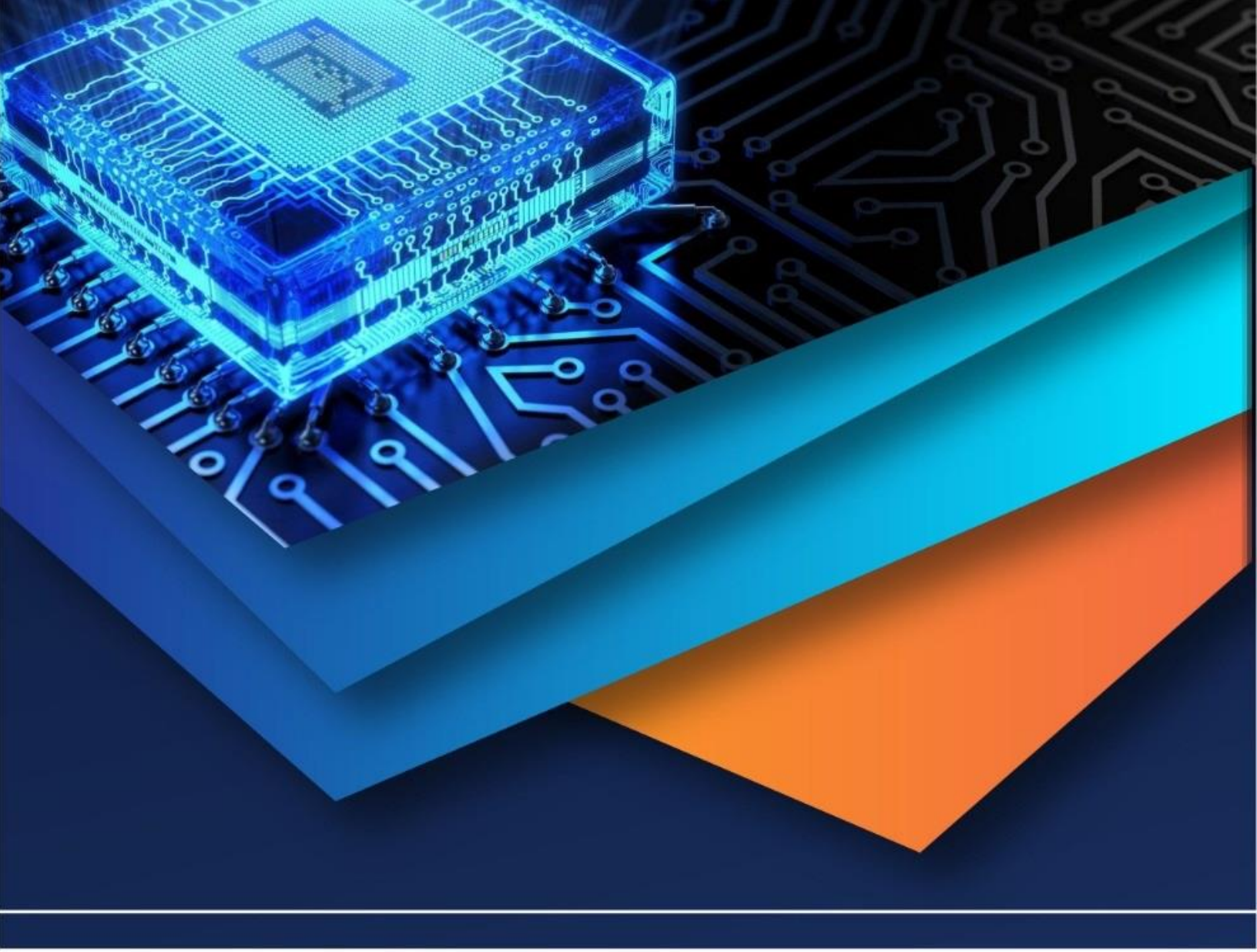
VI. ACKNOWLEDGEMENT

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