

IoT Based Bluetooth Control Industrial Robotic Arm Gripper

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Abstract: Robotic arms are extensively used in industrial automation to perform repetitive and accurate operations such as picking, placing, and assembling components. However, traditional robotic systems are generally expensive, complex to operate, and require specialized infrastructure. This project focuses on the design and development of a low-cost robotic arm fabricated using 3D printing technology and controlled through a mobile device. The system utilizes an ESP32 microcontroller as the central controller, which communicates with a mobile application through Bluetooth or Wi-Fi to control the movements of the robotic arm.

Keywords: Thermoelectric Generator (TEG), Waste Heat Recovery, Seebeck Effect, IoT Monitoring, ESP32, DC–DC Boost Converter, Energy Efficiency

I. INTRODUCTION

The term robot is derived from the Czech word “*robota*”, which means forced labor. This meaning appropriately describes the role of many robots that are designed to perform heavy, repetitive, or hazardous tasks that are difficult for human beings. Robots are widely used in industries to handle operations that may be dangerous, boring, or require high precision. Among the various types of robots, the robotic arm is one of the most commonly used robotic systems in industrial automation.

II. LITERATURE REVIEW

1. IoT in Robotics

Many studies highlight that the integration of the Internet of Things in robotics enables remote monitoring, control, and automation of industrial processes. IoT-based robotic systems allow real-time data exchange, improving efficiency and reducing human intervention in hazardous environments. Thermoelectric Generator Principle

2. Bluetooth Based Wireless Control System

Researchers have explored wireless communication technologies like Bluetooth for short-range control of robotic arms. Bluetooth enables low-cost, efficient, and user-friendly control of robots through mobile devices, making it suitable for industrial and prototype robotic applications.

III. SYSTEM DESIGN AND COMPONENTS

An IoT-based Bluetooth controlled industrial robotic arm gripper is an advanced automation system used to perform tasks such as picking, placing, and handling objects in industrial environments. This system uses wireless communication to control the robotic arm through a mobile device, reducing human effort and increasing efficiency.

The integration of IoT enhances monitoring, control, and flexibility in industrial operations.

- Microcontroller ESP32
- Servo Motors (mg995)
- Servo motors (sg90)
- Connecting wires
- ESP32 pcb
- Robotic arm 3D printing parts

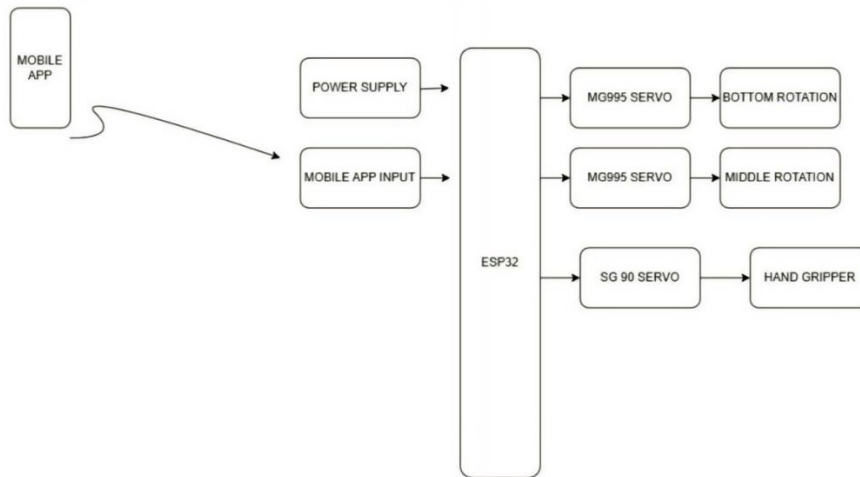


Fig 1. Block Diagram

The mobile device sends control commands through Bluetooth or Wi-Fi. These commands are received by the ESP32 microcontroller, which processes them and controls the servo motors to move the robotic arm accordingly.

IV. WORKING

The system works based on wireless communication using Bluetooth technology. A mobile application sends control commands to the Bluetooth module connected to the microcontroller. The microcontroller processes these commands and controls the movement of motors attached to the robotic arm. The arm moves in different directions, and the gripper opens or closes to pick or release objects. IoT features allow monitoring and future expansion for remote access and automation

The working of the IoT-based Bluetooth controlled industrial robotic arm gripper is based on wireless communication and motor control. The system starts when the power supply is provided to all components including the microcontroller, Bluetooth module, and motors.

A mobile application is used to send control commands through the Bluetooth module (such as HC-05). These commands are transmitted wirelessly and received by the Bluetooth module connected to the microcontroller. The microcontroller (Arduino) reads the incoming data and processes it.

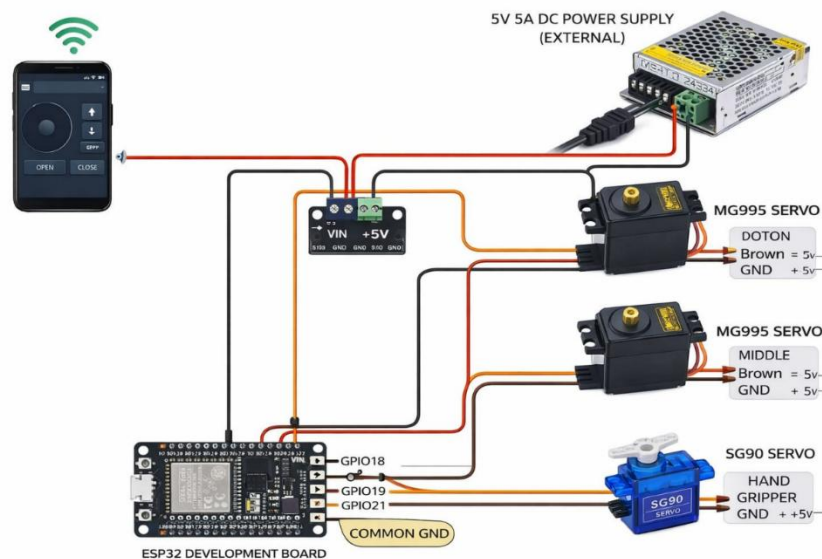


Fig. 2 Circuit Diagram

Based on the received command, the microcontroller sends appropriate signals to the motor driver and servo motors. The motors then rotate to move the robotic arm in different directions such as up, down, left, and right. Each joint of the arm is controlled independently to achieve precise movement.

The gripper, which acts as the end-effector, is controlled by a servo motor. When the user sends a command to pick an object, the gripper closes and holds the object firmly. When the release command is given, the gripper opens and releases the object.

V. RESULT

The testing results demonstrate that the IoT based Bluetooth controlled robotic arm with gripper operates successfully according to the project objectives.

The major outcomes of the system include:

- Successful wireless communication between mobile device and ESP32
- Accurate control of servo motors
- Smooth movement of robotic arm joints
- Effective pick-and-place operation using gripper mechanism

The system proved to be cost-effective, flexible, and suitable for educational and research applications.

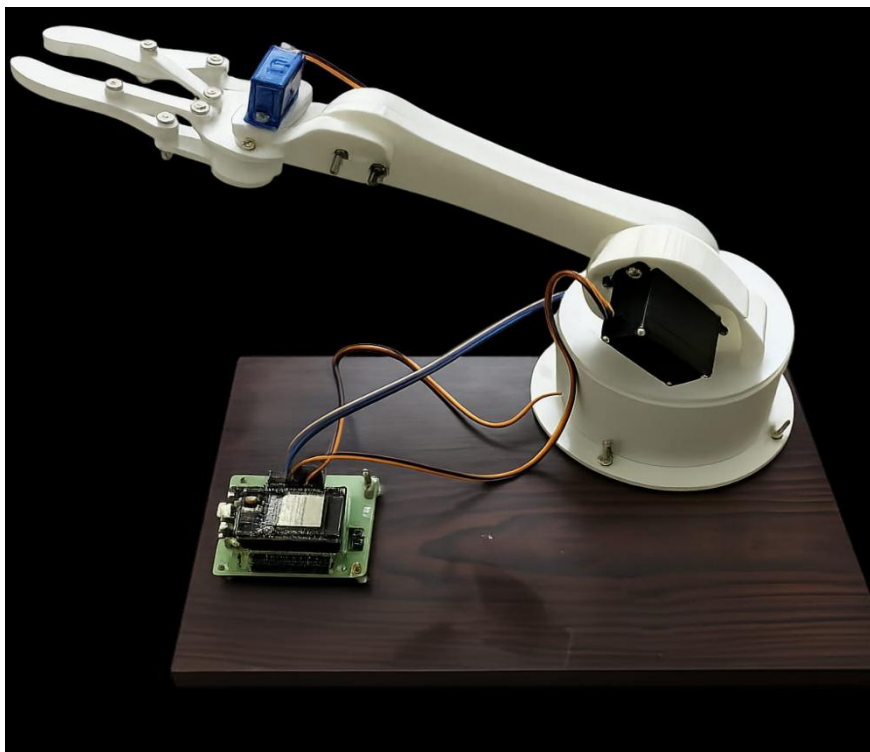


Fig. 3 Output with Hardware

VI. CONCLUSION

The project titled “IoT Based Bluetooth Controlled Robotic Arm with Gripper” was successfully designed and implemented. The main objective of this project was to develop a low-cost and efficient robotic arm system that can be controlled wirelessly using a mobile device.

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BIOGRAPHY

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