A

MINI PROJECT REPORT

ON

PICK AND PLACE ROBOTIC ARM

Submitted By

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DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

NMVPM's and PCET's

NUTAN MAHARASHTRA INSTITUTE OF ENGINEERING &

TECHNOLOGY

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PICK AND PLACE ROBOTIC ARM

A Mini Project Report Submitted

In Partial Fulfillment of the Requirements

For the Degree of

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in

Electronics & Telecommunication Engineering

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CERTIFICATE

This is to certify that the mini project entitled ”Pick and Place Robotic Arm” Has been carried out by Asharani Biradar, Jithendra Chikhale, Yash Belavalekar under my guidance in partial fulfillment of the degree of Bachelor of Engineering in Electronics and Telecommunication Engineering of Nutan Maharashtra Institute Of Engineering & Technology affiliated to Savitribai Phule Pune University, Pune, during the academic year 2023-2024. To the best of my knowledge and belief this work has not been submitted elsewhere for the award of any other degree.

Prof. M. G. Chinchole	Dr. S. V. Joshi	Dr. V. V. Deotare
Mini-Project Guide	HOD E&TC	Principal

Prof._____

External Examiner

Date: Place: Talegaon Dabhade, Pune-410507

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Yash Belavalekar

ABSTRACT

To design and implement WiFi controlled pick and place robotic arm used in industrial purpose that can operate manually by a phone application. The system includes ESP3266. The robot's actions are controlled by an Android application that works on the Blynk platform, enabling users to provide instructions to the robot via their phone. The robot can follow the instructions given by the user through the Android Blynk App, allowing for easy and convenient control of the robot's movements and actions. The system's processor makes the solution for industrial automation tasks, which can be performed by the robot. the system aims to automate various tasks and eliminate human error and to increase the work efficiency.

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CHAPTER 1: INTRODUCTION

Robots are used in various environment ranging from homes to industries to provide assistant to human for a range of purpose such as operation in hazardous situations or operation in manufacturing sector. The design of a robot can be varied depending on its function, application and the environment. Robotic arm is most commonly used in industry such as manufacturing and assembling. The use of robotic arm is to overcome human inefficiency in performing repetitive task such as pick and place operation. Robotic arm is a reprogrammable and multifunctional manipulator design to assist human in various surroundings. Robotic arm is able to overcome human inefficiency in performing repetitive task such as pick and place. Thus, industry such as assembly and manufacturing have widely integrated robotic arm into their assembling line to overcome the problem of human inefficiency. Internet of things (IoT) allow data to be exchange between devices through the connection of many devices. Internet connection has fundamentally changed the arrangements for monitoring and control and the use of open or public standards and personal computer systems (PCs, tablets, smart phones) bring significant benefits to their users and producers. The capabilities and the functionality of a robot depends largely on the needs and its environment. Robot will then be varied accordingly to suit the needs. For example, robotic arm has been widely integrated into industry or factory to assist human in performing repetitive task. The used of robotic arm in industry promotes better product quality, productivity and increase efficiency. Most of the time, robotic arm is required to be train or teach before it can come into action. The training or teaching process are normally carried out through teach pendant in a certain distance within the factory. The training or teaching process on the robotic arm will pose a great challenge in the absence of the relevant person in charge or engineer. This is due to the fact that the training process on a robotic arm requires

an in-depth knowledge not only on the robotic arm but also on the surrounding environment and material that the robotic arm will be handling. The wifi controlled robotic arm allows smart industry to be realized.

Robotics deals with the design of robots their manufacture and applications. Robotics gained more importance in the modern era since it require less cost to operate than a human labour to do the same task, also once programmed robot will perform better than an experienced human labour. Now a days industry is turning towards computer based monitoring of tasks mainly due to the need for the increased productivity and delivary of the final products with maximum quality. Due to the inflexibility and generally high cost of hard computerization systems lead to the use of industrial robots. The soft catching gripper used here handle objects safely. An android based smart phone which has blue control application is used for the movement of robot. Thus based on the user commands the robot moves and pick and place the objects. The robotic arm used here is similar to a human arm which is programmed to perform the pick and place functions.

The introduction highlights the transition in robotics from human-operated to wireless-controlled systems, leveraging advancements in wireless technologies like WiFi for remote robot operation. It introduces the development of a WiFi controlled robotic arm that can be wirelessly operated through an Android app coupled with a microcontroller, enabling users to control the robot's movements using buttons on the app. The robotic arm's functionality is enabled by two DC servo motors connected to a microcontroller on the receiving end.

1.1 OVERVIEW:

In today's time of advanced computing, robots are far more reliable than humans when it comes to doing hazardous jobs. Earlier iterations of robotics required human interaction, but recent advancements in wireless technology have made it possible to operate robots wirelessly, via WiFi, Bluetooth. The robot can be operated wirelessly through Blynk app using WiFi. An android app coupled with a ESP3266 performs the necessary functions. WiFi is used to establish a link between the smartphone app and the robot. The user operates the robot using buttons on the app. Using the sliders in the app we can manually control the movement of each servo or axis of the robot arm. With the same button we can pause the automatic operation as well as reset or delete all steps so that we can record new ones. The servo motors that are linked to a microcontroller on the receiving end. The purpose of this project is to develop and deploy a low-priced, adaptable, and secure WiFi controlled robotic arm capable of carrying out the user's specified tasks. WiFi has several benefits as an interface medium. To begin, you won't need any special instruction to use this technology. Second, if services were simplified, more people would use them, and those with a wider range of impairments would be able to use the same tools as everyone else.

1.2 PROBLEM STATEMENT :

The aim is to design and implement adaptable, secure WiFi-controlled robotic arm for pick and place tasks, utilizing wireless technology advancements to enhance remote operation capabilities and human work.

1.3 NEED OF PROJECT:

Creating a robotic arm for picking and placing that integrates. the ESP8266 and Blynk IoT meets essential needs in several industries. to learn various types of control methods for the pick and place robotic arm for educational purpose uses. The arm's capacity to perform repetitive activities makes automation possible, which is necessary for efficiency and cost savings. distant control characteristics make it possible for distant operation, which is essential for continuity and safety. Integration of IoT improves data logging, predictive maintenance, and monitoring. Flexibility and creativity are encouraged by the project's scalability, which guarantees adaptability to a variety of applications and situations. Robotics, Internet of Things, and automation technology breakthroughs are facilitated by the platform. it offers for study and cooperation. All things considered, this project tackles the critical demand in today's industrial scene for effective, linked, and flexible automation solutions.

1.4 AIM OF PROJECT

The aim of the project is to design and implement a pick and place robotic arm system utilizing ESP8266 for connectivity and control via a Blynk app over WiFi, enabling users to remotely operate the robotic arm for various tasks like sorting, assembly, or automation.

1.5 OBJECTIVES

1) Development of a wireless pick and place robotic hand for industrial applications: The main objective of the project is to design and implement a robotic hand equipped with wireless communication technology that can autonomously pick up objects from one location and place them in another within industrial settings
2) Enhancing efficiency and safety in industrial operations: The project aims to reduce manual labor, minimize risks associated with hazardous industrial tasks, and improve overall efficiency by automating pick and place operations using the robotic hand
3) Integration of IoT and robotics technologies: By combining Internet of Things (IoT) concepts with robotics, the project seeks to explore the synergies between these technologies to achieve enhanced functionality, connectivity, and automation capabilities in industrial environments
4) Cost-effective and high-performance design: The project focuses on developing a low-cost yet highly efficient robotic hand that can handle various objects, navigate cluttered spaces, and collaborate with other machines or systems to perform tasks effectively

CHAPTER 2: LITURATURE REVIEW

"Arduino Based Pick and Place Robot with Robotic Arm for Industrial Use"

Shazia Afroze1, Md. Jubair Hossain2 Md. Istiak Hossain Paran3

The project focuses on developing an Arduino-based pick and place robotic system for industrial use, integrating a microcontroller (Arduino Mega 2560) and a robotic arm. The system aims to automate tasks in various industries like bottle filling, packaging, and bomb disposal, reducing human error.

Key components of the system include an Arduino Mega 2560 microcontroller, 6 DOF metal mechanical arm, 4WD smart chassis kit, L298N H-Bridge dual motor driver, MG996R servo motor, PCA9685 servo driver, and more

The robotic arm offers two degrees of freedom and features functionalities like line following, wall detection, obstacle avoidance, and sensor integration.[1]

"Wireless Pick and Place Robotic Hand for Industrial Applications"

Mr. Najeemullah1, Shoaib Khan2, Md. Shahed hussain3, Abu Bakar4

Disabled people always need a person to take care of them and be with them to do their works. It is impossible that a person can be

available for someone all the time. Pick and Place robot can assist a disabled person so that they can give instructions to the robot

and get their works done. This pick and place robot can pick the objects from one place to another place. Robots are meant for

making the tasks easy and safer. Robots can replace the presence of a human and can do dangerous operations.[2]

"Robotic Arm Control using Internet of Things (IoT)"

Amirah 'Aisha Badrul Hisham1,3, Low Zi Han1, Mohamad Hafis Izran Ishak2* and Nurul Hawani Idris2

Robotic arms are versatile manipulators designed to aid humans in various tasks, particularly in repetitive operations like pick and place tasks

The integration of Internet of Things (IoT) with robotic arms enables the realization of smart industries, where data exchange between devices is facilitated through interconnected networks.

MATLAB R2013a is utilized in the study to visualize the movement of the robotic arm in a three-dimensional space, displaying the number of positions during operation.[3]

"Pick and Place Robotic Arm Using Android Device"

From this paper we have found the possibility to control a robot using any android device. The robotic vehicle is golem application controlled for remote operation. All the transmitting end using golem application device, commands are sent to the receiver to manage the movement of the golem either to maneuver forward, backward and left or right etc. At the receiving end four motors are interfaced to the microcontroller where two are for the body movement. The golem application device transmitter acts as a far flung management that has the advantages of adequate vary, while the receiver end Bluetooth device is fed to the microcontroller to drive DC motors via

motor driver IC for necessary work. Remote operation is achieved by Associate in Nursing sensible phone or Tablet etc., with golem

OS; upon a GUI (Graphical User Interface) based bit screen operation. The main advantage of this golem is its soft catching arm that is designed to avoid additional pressure on the suspected object for safety reasons. Any the project are going to be augmented by interfacing it with a wireless camera so as that the person dominant it'll browse operation of the arm and gripper remotely [4]

CHAPTER 3: METHODOLOGY 1

3.1 HARDWARE COMPONENTS

- MG996R Servo Motor
- SG90 Micro Servo Motor
- HC-05 Bluetooth Module
- ESP8266 Board
- 5V 2A DC Power Supply

3.2 SOFTWARE APP

- Arduino ide app
- Blynk app

CHAPTER 4: SYSTEM IMPLEMENTATION

4.1 DESCRIPTION OF HARDWARE COMPONENTS

ESP8266

Wireless Control: The robotic arm can be controlled wirelessly by connecting it to a computer or mobile device via the ESP8266. This eliminates the need for physical connections and allows for remote operation of the arm. Sensor Integration: To give feedback to the controller of the robotic arm, the ESP8266 can connect with sensors like gyroscopes, accelerometers, and distance sensors. Among other things, this data can be utilised for collision detection and positioning.

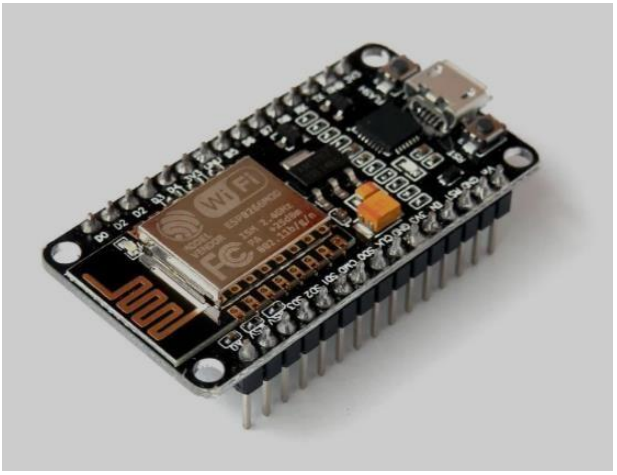

FIG1.1

Data Logging and Analysis: The ESP8266 can transmit sensor data and other telemetry to a distant server or cloud platform for storage and analysis because to its integrated TCP/IP stack. This makes it possible to track the robotic arm's performance over time and spot trends or abnormalities. Web-Based Interface: A graphical user interface for controlling the robotic arm can be accessed through a web server that can be hosted by the ESP8266. Through the use of a web browser, users may communicate with the arm and access functions including preset movements, manual control, and configuration settings.

Integration with IoT Ecosystems: The robotic arm may take part in more extensive automation workflows or communicate with smart home systems thanks to the ESP8266's ability to communicate with other IoT platforms and devices.

software Updates Over-the-Air (OTA): The ESP8266 has support for OTA updates, which makes it simple to upgrade the robotic arm's software without requiring physical access. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

MG 996R SERVO MOTOR

This Continuous Rotation MG996R has the ability to rotate continuously in 360 degrees. It makes this servo motor perfect for robotics or even the rotation of camera sliders. The MG996R servo motor is a high-performance motor known for its exceptional torque and precise control. Designed for robotics, automation, and other projects requiring reliable motor movement, the MG996R delivers impressive performance and versatility.

With its robust construction and metal gear design, the MG996R servo motor offers excellent durability and longevity. It can generate a torque of up to 11 kg/cm, allowing it to handle demanding tasks with ease. Whether you're building a robotic arm, a hexapod robot, or any other project that requires strong and precise motion control, the MG996R is up to the challenge.

FIG 1.2

SERVO MOTOR

Servo motors typically consist of output shafts that can be used to position the shaft at a particular angle using the coded signal transmitted by the servo. Servo motors are very useful in everyday life and are used in many devices. Servo motors are very efficient and economical. Servo motors are small and can be placed on the device to perform the desired action more effectively. Servo motors are very efficient and energy saving motors. These servo motors are controlled by pulse width modulation. Pulse width modulation uses a control wire to send an electrical pulse. The minimum, maximum pulse and repetition rate are three types of pulse width modulation. The total amount of movement of the servo motor is 180 °, and it rotates 90 ° in each direction. Servo motors rotate both clockwise and counterclockwise.

FIG 1.3

5V 2A DC Power Supply

A 5V 2A power supply can supply up to 2 amps (or 2000 milliamps) of current to a device, while a 5V 1A power supply can supply up to 1 amp (or 1000 milliamps) of current. In practical terms, this means that a 5V/2A power supply can provide more power to a device than a 5V 1A power supply.

FIG 1.4

Arduino Robot Arm 3D Model

To begin with, I designed the Robot Arm using Solidwork 3D modeling software. The arm has 5 degrees of freedom.

For the first 3 axis, the waist, the shoulder and the elbow, I used the MG996R servos, and for the other 2 axis, the wrist roll and wrist pitch, as well as the gripper I used the smaller SG90 micro servos.

FIG 1.5

4.2 Assembling the Robot Arm

So at this point we are ready to assemble the robot arm. I started with the base on which I attached the first servo motor using the screws included in its package. Then on the output shaft of the servo I secured a round horn a bolt and on top of it I placed the upper part and secured it using two screws. Here again first goes servo, then the round horn onto the next part, and then they are secured to each other using the bolt on the output shaft.

FIG 1.6

We can notice here that at the shoulder axis it is good idea to include some kind of spring or in my case I used a rubber band to give some help to the servo because this servo carries the whole weight of the rest of the arm as well as the payload. In similar way I continued to assemble the rest of the robot arm. As for the gripper mechanism I used some 4 millimeters bolts and nuts to assembly it. Finally I attached the gripper mechanism onto the last servo and the Arduino robot arm was completed

4.3 CIRCUIT DIAGRAM

The next stage is connecting the electronics. The circuit diagram of this project is actually quite simple. We just need an Arduino board and a HC-05 Bluetooth module for communication with the smartphone. The control pins of the six servo motors are connected to six digital pins of the Arduino board.

For powering the servo we need 5V, but this must come from an external power source because the Arduino is not able to handle the amount of current that all of them can draw. The power source must be able to handle at least 2A of current. So once we have connected everything together we can move on to programing the Arduino and make the Android app.

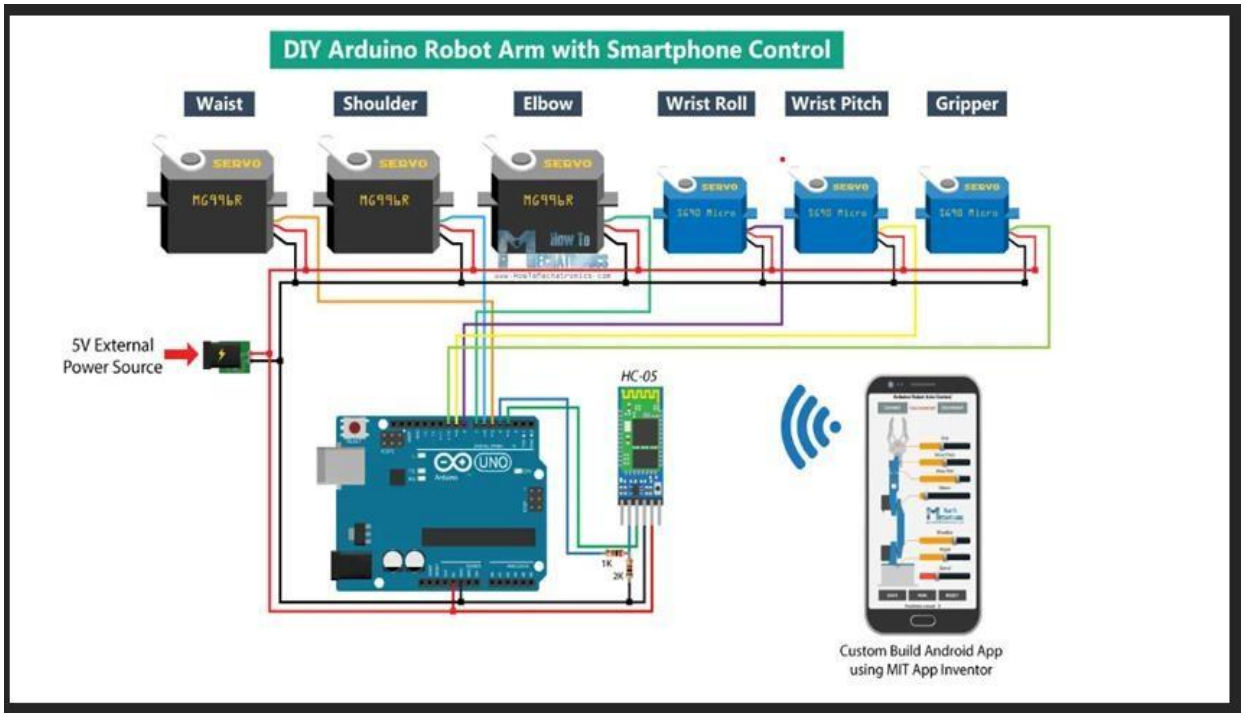

FIG 1.7

4.4 Control Android App

Let’s take a look at the Android app now and see what kind of data it is actually sending to the Arduino.

- A Smartphone
- Android OS version 5+
- iOS version 14.1+

Blynk doesn't run on Windows Phones, Blackberries and other dead platforms.

Sorry. You can also run Blynk on emulators

Blynk can run on over 400 hardware modules. The most popular are:

- ESP32
- ESP8266
- Node MCU
- Arduino (any model)
- Raspberry Pi (any model)
- Particle (any model)

Blynk Library is an extension that runs on your hardware. It handles connectivity, device authentication in the cloud, and commands processing between Blynk app, Cloud, and hardware. It's highly flexible whether you are starting from scratch, or integrating Blynk into existing project.

Blynk App: Blynk is a platform that allows you to control hardware remotely using a smartphone or tablet. It provides a user-friendly interface for interacting with IoT (Internet of Things) devices.

Installation: Users need to download the Blynk app from the App Store or Google Play Store and create an account.

Project Setup: Once the app is installed, users will need to set up a project within the Blynk app. This involves selecting the type of hardware they're using (in this case, the robotic arm) and configuring the interface.

Interface Design: Users can design a custom interface within the Blynk app to control the robotic arm. This might include buttons, sliders, or other widgets to send commands to the arm.

Connection: The Blynk app communicates with the robotic arm over the internet via Wi-Fi or cellular data. The robotic arm must be connected to the internet and linked to the user's Blynk account.

Control: Once everything is set up, users can use the Blynk app to send commands to the robotic arm. For example, they might use buttons to move the arm left or right, up or down, or to grab and release objects.

- Create a Blynk account

The Quick start guide will start automatically

- Follow Quick start guide

We will walk you through the whole process

- Install Blynk apps

No iOS or Android coding required

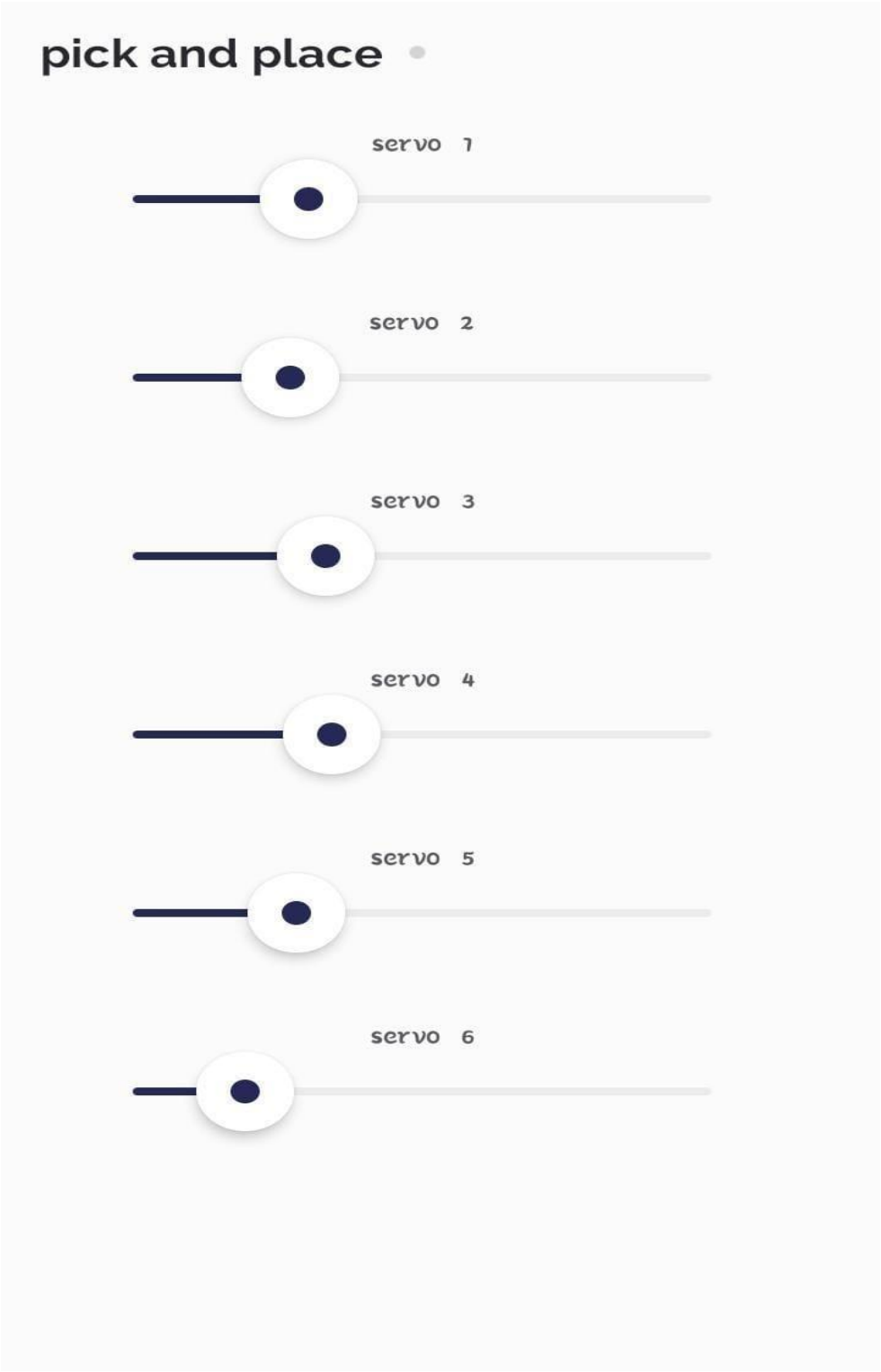

FIG 1.8

CHAPTER 5: RESULT

The pick and place robotic arm using ESP8266 with WiFi connectivity successfully demonstrated the ability to remotely control the arm's movements. through a wireless network. The arm was able to accurately pick up objects from a designated location and place them at another desired location based on the commands sent via WiFi.

CHAPTER6: ADVANTAGES

- Cost-Effective Solution: The project offers a low-priced robotic arm controlled via WiFi, making it an affordable option for various applications

- Wireless Operation: Enables remote operation of the robotic arm, providing flexibility and convenience in controlling the device

- User-Friendly Interface: Utilizes WiFi technology, which is easy to use and does not require special training, enhancing accessibility for a wider user base

- Enhanced Safety: By allowing wireless operation, the project reduces the need for human intervention in hazardous tasks, improving safety in such environments

- Potential for Adaptability: The use of WiFi technology opens up possibilities for integrating additional features and functionalities to enhance the robotic arm's capabilities in the future

6.1 APPLICATIONS:

The project of pick and place robotic arm with the help of a blynk app offers several advantages, including:

1) Manufacturing Sector: Assembly, packaging, and material handling are just a few of the jobs that the IoT-based robotic arm can handle in manufacturing facilities. The production line's productivity and efficiency are increased by its remote control and automation features.
2) Logistics and Warehousing: The robotic arm can automate processes like inventory management, palletizing, and sorting in warehouses and logistics centres. Its capacity for self-operation and inventory system integration enhances warehouse operations while cutting labour expenses.
3) Healthcare Industry: IoT-enabled robotic arms can help medical personnel with patient care, rehabilitation activities, and procedures. Their accuracy and agility reduce the possibility of mistakes and enhance patient results.
4) Agriculture: IoT-based robotic arms can be utilised in agriculture for operations including crop monitoring, planting, and harvesting.
5) Automation of Smart houses: In smart houses, robotic arms can be used for housekeeping, cooking, and security. With IoT integration, they may take care of domestic tasks on their own and react to voice or mobile app commands.
6) Research and Education: IoT-based robotic arms can be useful instruments for conducting experiments, imparting robotics principles, and creating creative solutions in research labs and educational establishments. Their adaptability and variety make them the perfect platforms for experimentation and hands-on learning.
7) Environmental Monitoring: Tasks like pollution detection, tracking wildlife, and habitat restoration can be performed by robotic arms fitted with sensors. They can safely explore remote or dangerous places thanks to their mobility and remote control capabilities.

CHAPTER7: FUTURE SCOPE &CONCLUSION

7.1 FUTURE SCOPE

1) Advanced Sensing Technologies: By incorporating cutting-edge sensors like LiDAR, cameras, and 3D scanners, robotic arms can become more perceptive, which will allow them to interact with their surroundings more intelligently and carry out intricate tasks with greater accuracy.
2) AI and Machine Learning: By integrating machine learning algorithms, IoTbased robotic arms can become more adaptive to changing environments, learn from their experiences, and gradually improve their performance. This may result in robotic systems that are more effective and flexible and are able to make decisions on their own.
3) Collaborative Robotics: IoT-based robotic arms may be able to operate securely and effectively alongside human operators in the future thanks to advancements in collaborative robotics,
4) This creates new opportunities for human-robot cooperation on maintenance, assembly, and inspection jobs.
5) Implementation of more advanced control features such as obstacle avoidance and path planning algorithms to enhance the robotic arm's autonomy and efficiency
6) Integration of machine learning algorithms to enable the robotic arm to learn and adapt to different pick and place tasks, improving its versatility and adaptability
8) Exploration of incorporating sensors like proximity sensors or vision systems to enable the robotic arm to interact with its environment more intelligently and autonomously
9) Scaling up the project to develop multi-robot systems or collaborative robotic arms controlled via Bluetooth for more complex and coordinated tasks

7.2 CONCLUSION

The project successfully implemented a WiFi-controlled robotic arm for pick and place tasks, showcasing the efficacy of wireless technology in robotics.

The system offers effective solution for remote robot operation, emphasizing the accessibility and user-friendly nature of WiFi technology.

This study highlights the potential of WiFi as an interface medium for robotics, catering to a diverse user base, including individuals with impairments.

Overall, the project fulfills its objective of creating a low-priced, adaptable, and secure WiFi -controlled robotic arm.

The significance of wireless technologies in enhancing robotic functionality and usability is underscored by this project.

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