"EDUCATION OF HUMAN POWER FOR TECHNOLOGICAL EXCELLENCE"

SHRI GURU GOBIND SINGHJI INSTITUTE OF ENGINEERING AND TECHNOLOGY

"VOICE CONTROL ROBOTIC ARM"

For the MINI PROJECT-II

In

Electrical Engineering Department

Project Report

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(2023-2024)

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CERTIFICATION

This is to certify that the project entitled "Voice Controlled Robotic Arm" in the partial fulfilment of the "Mini Project-II, 3rd year" for Shri Guru Gobind Singhji Institute of Engineering and Technology, Vishnupuri, Nanded. This bonfire work carried and completed under guidance and supervision of our guide Prof. C.W. Jadhao during academic schedule 2023-2024.

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DECLARATION

We hereby declare that we have formed, completed, and written the Report entitled **"Voice Controlled Robotic Arm"** It has not previously submitted for the basis of the Mini Project-I for 3rd year course.

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Thank you!

ABSTRACT

In today’s world Robots are becoming fascinating topic of study. This is because it reduces Human effort and perform tasks with ease and precision. The existing Robotic technology in Industries works on a hard code and the robot works in a loop. To change the working of the robot we must change the entire system Function. We've seen huge improvements in robotic arms and AI. These new robotic arms can do lots of different tasks well. Some of them even listen to our voice commands, making it super easy to use them. This means we can work with them without needing to touch anything. They understand what we say and do what we ask quickly and accurately. It's like having a helpful assistant that understands us perfectly. These voice-controlled robotic arms are a big deal because they make work easier, faster, and more enjoyable. And as technology gets better, they're likely to change many industries and how we work with machines.

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CHAPTER 1: INTRODUCTION

1.1Overview

In recent years, advancements in robotics and artificial intelligence have led to the development of sophisticated and versatile robotic arms capable of performing various tasks with precision and efficiency. Robotic arms equipped with voice control technology enable seamless interaction between humans and machines, ushering in a new era of intuitive user experience and enhanced productivity. These systems use fancy technology called natural language processing and machine learning. They understand what you say and turn it into actions for the robot. So, you can control the robot without touching anything, just by talking to it.

Robotic arms with voice control represent a groundbreaking advancement in the field of robotics, offering unprecedented levels of precision, efficiency, and user-friendliness. As technology continues to evolve, these innovative machines hold the potential to revolutionize various industries and redefine the way humans interact with automation.

Need and significance of the project:

1. Accessibility Voice control helps more people, especially those with disabilities, to use robotic arms easily. Instead of struggling with buttons or joysticks, they can just talk to the robot and get things done.

2. Intuitive Interaction: Talking to the robot feels natural and doesn't need special training. You can just speak, and the robot understands, making it easy for anyone to use.

3. Hands-Free Operation: You don't need to touch anything to control the robotic arm. This is really helpful in places like factories or during surgeries where touching controls might not be safe or practical.

4. Increased Productivity: Voice control makes communication with the robot smooth, so work gets done faster. Workers can do tasks more efficiently, saving time and getting more done. Plus, you can control multiple arms at once, which is great for speeding up work.

5. Safety and Ergonomics: Voice control means less manual handling of heavy or dangerous stuff, keeping workers safe. They can control the robot from a safe distance, avoiding accidents.

6. Adaptability and Flexibility: Voice control makes it easy to change how the robot works for different tasks or places. You can quickly switch commands, so the robot can adapt to new needs easily.

CHAPTER 2: LITERATURE REVIEW

Making robotic arms move smoothly and efficiently is important. One way to do this is by using a smart method called a genetic algorithm, which figures out the best path for the arm to take, considering things like how far the joints can move and avoiding obstacles. Another cool idea is using reinforcement learning to find the best path for the arm.

To control the arm precisely, we need to understand how it moves. Some smart people have studied different ways to do this, like Zhang and Li in 2018, who looked at lots of different models and strategies. Nguyen and others in 2021 came up with a way to understand the arm's movement in real-time using a method called Recursive Least Squares.

To make sure the arm does what we want, even when things aren't perfect, some researchers like Wu and their team in 2019 made a clever control system using something called adaptive neural networks. Liang and others in 2022 had another neat idea, combining different ways to control the arm for the best results.

Adding sensors to the arm helps it understand its surroundings better. Zhao and their team in 2020 found that using cameras to see objects helps the arm recognize and pick up things.

All these improvements in planning, understanding how the arm moves, controlling it better, and adding sensors make robotic arms better and better.

CHAPTER 3: DESIGN SPECIFICATIONS

As mentioned earlier, the project is designed in MATLAB. Figure 2 shows the full circuit of our project. This circuit is divided into a few parts for the ease of explanation. The parts are:

- ➢ Arduino Mega
- ➢ Servo Motors
- ➢ Servo Driver
- ➢ Bluetooth Module
- ➢ Wire and Cable

2.1 Arduino Mega

Description:
The Arduino Mega 2560 is a small but powerful computer board. It's like the brain of a project that you can control. It has lots of pins you can use to connect things to it—54 pins for digital stuff (like turning things on and off) and 16 pins for analogue stuff (like reading sensors). It also has special ports for connecting other devices, like a USB port to talk to your computer and a power jack to give it electricity. There's even a reset button to start over if something goes wrong.
Specifications:

- Operating Voltage = 5V
- Input Voltage = 7-12V
- Digital I/O Pins = 54 (of which 15 provide PWM output)
- Analog Input Pins = 16
- DC Current per I/O Pin = 20 mA
- DC Current for 3.3V Pin = 50 mA
- Flash Memory = 256 KB of which 8 KB used by bootloader
- SRAM = 8 KB
- EEPROM = 4 KB

2.2 Servo Motor:

1. Servo Motor MG995:

Description:

The MG995 servo motor is like a strong and reliable worker that can move precisely within a certain range. It's often used in making robotic arms because these arms need motors that can handle a lot of movement without breaking down. The MG995's metal gears make it tough and long-lasting, perfect for robotic arms that have to work hard. With this motor, engineers can build robotic arms that move accurately and can keep going for a long time, making them useful in factories and other places where machines do repetitive tasks.

Specification:

- High speed rotation for quick response
- Constant torque throughout the servo travel range
- Weight: 55 g
- Operating voltage range: 4.8 V to 7.2 V
- Operating speed: 0.2 s/60º (4.8 V), 0.16 s/60º (6 V)
- Rotational degree: 180º
- Current draw at idle: 10mA
- Current at maximum load: 1200mA

2. TowerPro SG90 mini servo motor

Description:

The TowerPro SG90 mini servo is a really good quality and super-fast servo motor. It's made to work with almost any radio control system, which means you can use it for things like remote control helicopters, planes, cars, boats, and trucks. What's special about it is that it's really lightweight, which is great for small machines like these. Instead of heavy metal gears, it uses carbon fibre gears, which makes it even lighter. This is important because heavy motors can slow things down or make them harder to control.

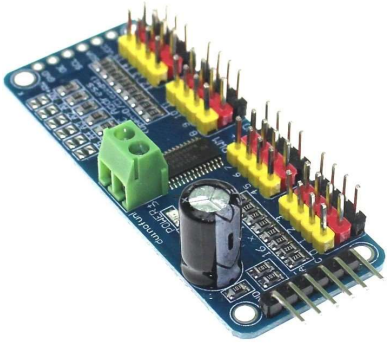
This servo motor can rotate up to 180 degrees, which is quite a lot for its size. It's also a digital servo motor, which means it can understand and react to signals really quickly. Inside, it has clever electronics that give it good power and speed, so it can hold things in place well and respond fast to changes.

Specification:

- Model: SG90
- Weight: 9 gm
- Operating voltage: 3.0V~ 7.2V
- Servo Plug: JR
- Stall torque @4.8V: 1.2kg-cm
- Stall torque @6.6V: 1.6kg-cm

2.3 Servo Driver

16-Channel 12-bit PWM/Servo Driver I2C interface PCA9685



Description:

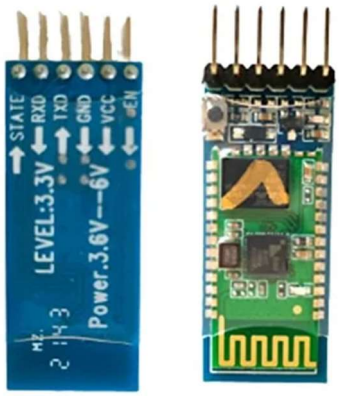
If you're building a robot with lots of moving parts or controlling many LEDs with PWM outputs, a 16-Channel 12-Bit PWM/Servo Driver is the solution. It helps manage numerous PWM signals without overwhelming your microcontroller, acting like a central hub for smooth operation and expanded project capabilities..

Specifications:

- Driver IC = PCA9685
- Length(mm) = 62
- Width(mm) = 25
- Height(mm) = 15
- Weight (gm) = 1

2.4 Bluetooth Module

REES52 Hc 05 Ttl Bluetooth Transceiver Module



Description:

The HC-05 Bluetooth module is like a little wireless helper that you can use with any microcontroller. It's perfect for sending and receiving data without the hassle of wires, using something called the UART protocol.

Now, there's another module called HC-06. This one can only be a follower, or what we call a slave device. It's like a good listener that can connect to most phones and computers using Bluetooth. But here's the catch: it can't connect to other devices that are also only followers, like keyboards or other HC-06 modules.

To connect with these kinds of devices, you'd need a master module, and that's where the HC-05 comes in. It can be both a master and a follower, so it's like a more versatile team player. With HC-05, you can connect to all sorts of devices, making it a better choice for more complex setups where you need to connect to different kinds of Bluetooth gadgets.

Specification:

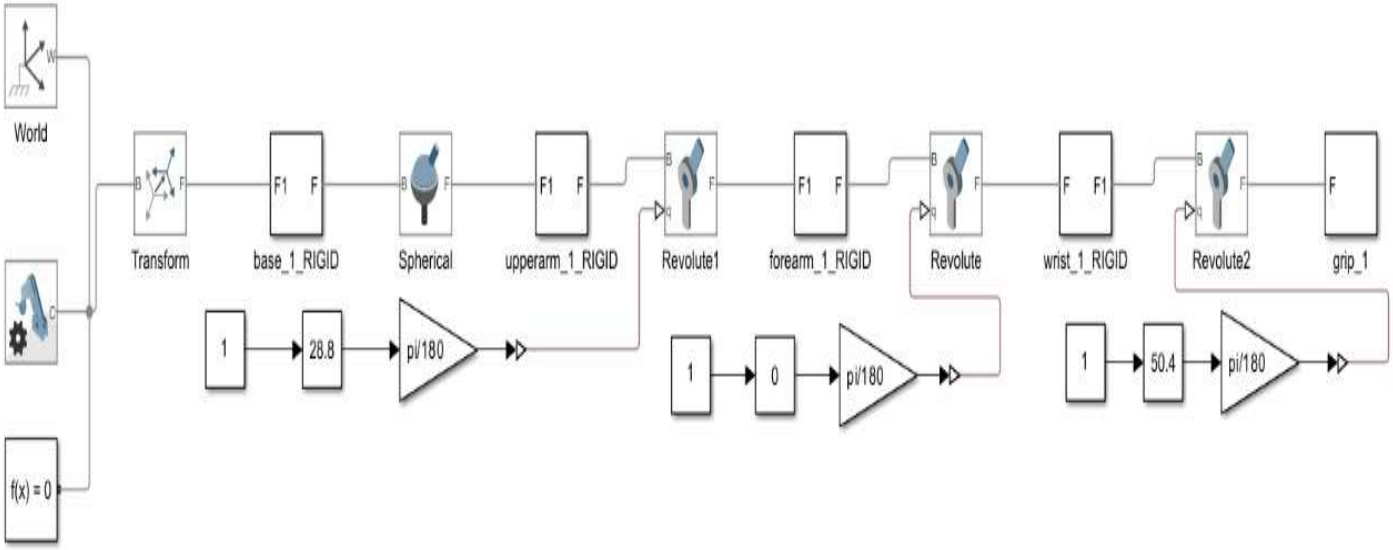
- Input Supply voltage = 3.6 ~6v
- Input current = 50 mA
- Maximum Operating Range = 10m
- Operating Frequency = 2.4GHz ISM band

2.5 Wire and Cables

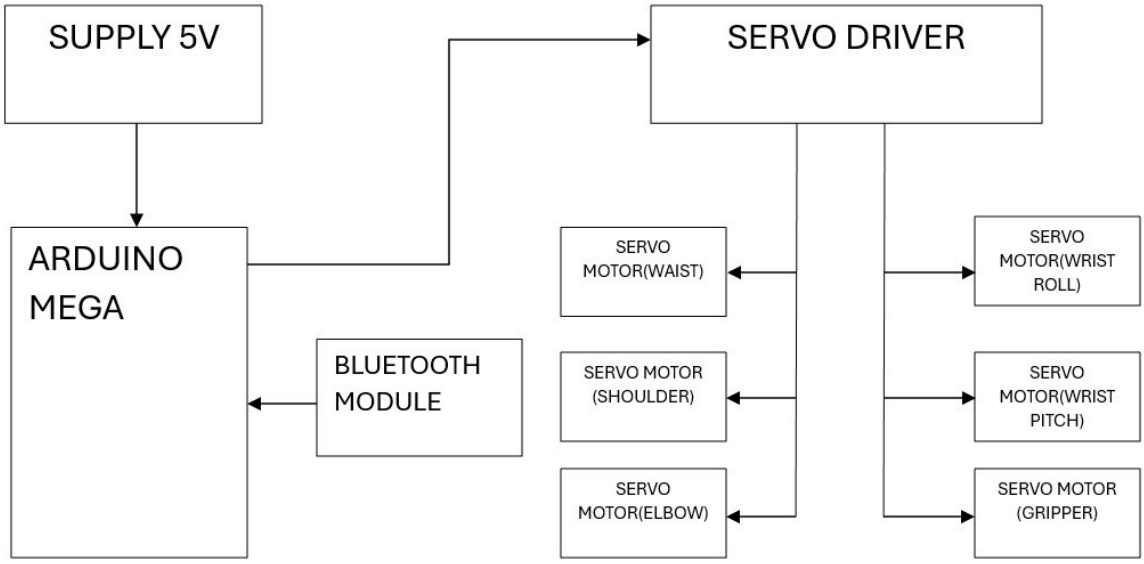
A jump wire (also known as jumper, jumper cable) is an electrical wire, with a connector or pin at each end which is normally used to interconnect the components of a breadboard or other test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their end connectors into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

2.6 Cad Model

2.7 Simulation:



CHAPTER 4: BLOCK DIAGRAM



CHAPTER 6: FUTURE PROSPECTS

1. Dual Command Operating Robotic Arm Control Systems: Control the robotic arm using two methods, like voice and gestures or voice and haptic feedback, for better user control and precision.

2. Image Processing Robotic Arm Control Systems: Equip the arm with a camera to recognize objects and adjust its movements, accordingly, enabling it to work more independently and efficiently.

CONCLUSION

In simple terms, our project with the voice-controlled robotic arm is a big step forward in how robots and people work together. We showed that by using our voices, we can make the robot move exactly how we want it to. This is great because it can make robots easier to use in many different areas, like factories or helping people who need extra support.

Building the robot arm also taught us a lot about how to design and make things, and it helped us work together as a team to solve problems. Now that we've finished this project, we have a good starting point to make even better voice-controlled robots in the future. We can make them understand us better, do more tasks, and even learn new things by themselves.

Overall, our project isn't just about making a cool robot; it's about showing how technology can make life better for everyone. It's like saying, "Look what we can do with a bit of creativity and hard work!" So, it's not just a success in building a robot; it's also a reminder of how amazing innovation can be.

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