DESIGN AND IMPLEMENTATION OF 6 DEGREE OF FREEDOM ROBOTIC ARM

A
Thesis
By

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DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY (SU)

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of
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ABBREVIATIONS

SMPS	Switched Mode Power Supply
DOF	Degree of Freedom
IDE	Integrated Development Environment

Acknowledgement

At first of all, I am grateful to almighty God. Then I would like to express my heartfelt thanks to the Honorable Vice chancellor **Prof. Shamim Ara Hassan** of SU for his guidance and Leadership. Secondly, we sincerely acknowledge the contributions Head of the Department of Mechanical Engineering, **Prof. Md. Mostofa Hossain.** Finally special thanks to our project thesis supervisor **Nuruzzaman Rakib**, Assistant Professor, Department of Mechanical Engineering, SonargaonUniversity (SU). He was so dedicated and supportive. He has inspired us and given us the right direction to complete the project. We have completed this project with his necessary advice and help. Also, we would like to thank the members of our group. They share their knowledge and help make this project a success. We thank our teachers and faculty members. They are like our family. We would like to express our deep love and gratitude to them for their great support. They encourage us in university life.

Abstract

The aim of this project is to make a 6 Degree of Freedom robotic arm which is work with the instruction of anybody using Blynk app. In this system there have 6 servo motor is used to control the arm. Each servo has their personal duty at his position. Here We have used here Node MCU to control this arm using Arduino program. Arduino program is designed by Arduino IDE software.

The Robotic arms are mechanical products that are manufactured and marketed the world at a very high rate. There are thousands of types of arms are available on the market developed by different companies. Industrial use robot arm cannot be used at this time even more than the domestic robot can do the job. It is always using specific objectives and some conditions in the industry where humans cannot work at high temperature, polluted air region, weightlifting and so on. Robot arms are also used for high accurate places where local error is allowed. Robot arm set one tasks, and accurate implementation in a variety of environments. A robotic arm means a group of rigidly connected bodies that can be taken different configurations, and move between these configurations with speed and speed restrictions. Industrial robot arms vary in size and some are fixed body, type of joints, joint sequence.

CHAPTER 1
INTRODUCTION

1.1 Background

A 6 DOF robotic arm refers to a robotic arm with six different joints, allowing it to move in six different directions or axes. Node MCU is a low-cost open-source IoT platform based on the ESP8266 WIFI module. MG995 is a popular high-torque servo motor.

The first usage of the term 'robot' was in a 1921 Czech science fiction play - 'Rossum's Universal Robots' - by Karel Capek. The robots were artificial people or androids and the word was derived from the word 'Robata', a Czech word for slave (Corke, 2011).

A question of perpetual interest is to define a robot. Since the beginning of the study of robotics, there has been some controversy in the definition of a robot. So long as the evolution of robotics continues, the definition of the robot will change from time to time, depending on the technological advances in its sensory capability and level of intelligence (Deb, 2010).

However, the most widely accepted definition of a robot was given by the Robotic Institute of America (RIA) in 1979. RIA defines a robot as a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks."

Manufacturing and Assembly: Robotic arms are widely used in manufacturing and assembly lines for tasks such as picking, placing, and assembling components. They can perform repetitive tasks with high precision and efficiency.

Material Handling: 6 DOF robotic arms are employed for material handling tasks, including sorting, palletizing, and packaging. They can move objects from one location to another with precision and speed.

Welding and Metal Fabrication: Robotic arms with six degrees of freedom are used in welding applications. They can perform complex welding tasks with accuracy, speed, and consistency. This is particularly useful in industries like automotive and aerospace.

3D Printing: In 3D printing, especially in additive manufacturing, robotic arms with multiple degrees of freedom are used to manipulate the printing toolhead or the printing bed. This allows for greater flexibility in creating complex geometries.

Medical Surgery: Robotic arms are utilized in minimally invasive surgeries, allowing surgeons to perform precise movements with reduced invasiveness. The 6 DOF design enables a wide range of motion for delicate surgical procedures.

Research and Development: Robotic arms are employed in research environments to test and prototype various applications. Their flexibility makes them suitable for testing different scenarios and collecting data in controlled settings.

Space Exploration: Robotic arms are used in space missions for tasks such as deploying and repairing satellites, collecting samples from celestial bodies, and assisting astronauts during spacewalks. The ability to move in multiple directions is crucial in the microgravity environment of space.

Education and Training: 6 DOF robotic arms are used in educational settings to teach robotics and automation concepts. They provide hands-on experience for students in programming, control systems, and mechanics.

Agriculture: In agriculture, robotic arms are used for tasks such as planting, harvesting, and sorting crops. The precision and flexibility of these arms contribute to increased efficiency in farming operations.

These applications highlight the versatility of 6 DOF robotic arms in performing tasks that require precision, flexibility, and automation across various industries. The continued advancements in robotics technology are likely to expand the range of applications for these robotic arms in the future.

1.2 Objectives

- To design and control 6 DOF robotic arm.
- To check the performance test of 6 DOF robotic arm.
- To make the 6 DOF robotic arm in a cost-effective way.
- To develop a human machine interface used for control robot arm.

CHAPTER 2

LITERATURE REVIEW

2.0 Literature Review

A survey on Arduino Controlled Robotic Arm by Ankur Bhargava. In this paper a 5 Degree of Freedom (DOF) robotic arm have been developed. It is controlled by an Arduino Uno microcontroller which accepts input signals from a user by means of a set of potentiometers. The arm is made from four rotary joints and end effector also, where rotary motion is provided by a servomotor. Each link has been first designed using Solid works Sheet Metal Working Toolbox and then fabricated using a 2mm thick Aluminum sheet. The servomotors and links thus produced assembled with fasteners produced the final shape of the arm. The Arduino has been programmed to provide rotation to each servo motor corresponding to the amount of rotation of the potentiometer shaft. A robot can be defined according to the nature of the relative movements between the links that constitute it.

Review on development of industrial robotic arm by Rahul Gautam This selective operation robotic control method is need to be overcome the problem such as placing or picking object that at distant from the worker. The robotic arm has been developed successfully as the movement of the robot can be controls precisely. It is expensive to change the cable and therefore the designing to reduce the friction on table, is crucial to increase time between maintenance. [04]

Survey on Design and Development of competitive low-cost Robot Arm with Four Degrees of Freedom by Ashraf Eashanye in this paper the representation of the design, development and implementation of robot arm is done, which has the ability to perform simple tasks, such as light material handling. The robotic arm is designed and made from acrylic material where servo motors are used to perform links between arms. The servo motors consist of encoder so that no need to use controller. However, the rotation range of the motor is less than 180º span, which greatly decreases the region reached by the arm and the possible positions. The design of the robot arm was for four degrees of freedom. The end effector is not considered while designing because a readily available gripper is used as it is much easier and economical to use a commercial.

Kurt E. C, Shang Y, A Geometric approach for the robotic arm kinematics with hardware design, Electrical design and implementation, Journal of robotics, 2010, Volume 10. Rahman A, Khan A. H, Dr. Ahmed T, Md Sajjad M, Design analysis and Implementation of Robotic arm – The Animator, American Journal of Engineering Research, 2013, Volume 2, Issue 10. [3] Gautam R, Gedam A, Zade A, Mahawadiwar A, Review on Development of Industrial robotic arm, IRJET, March 2017, Volume 4, Issue 3. [4] Omijeh B. O, Uhunmwangho R, Ehikhamenle M, Design analysis of a remote controlled "Pick and Place" Robotic vehicle, International Journal of Engineering Research and Development, 2014, Volume 10, Issue 5. [5] Katal G, Gupta S, Kakkar K, Design and Operation of Synchronized Robotic Arm, IJRET, Aug 2013, Volume 2, Issue 8. [6] Gunasekaran K, Design and analysis of articulated inspection arm of a robot, international journals for trends in Engineering and Technology, May 2015, Volume 5, Issue 1. [7]

CHAPTER 3

METHODOLOGY

3.1 Introduction

The components here used are Arduino uno board, capacitors, servo SG90,10k pot variable resistor. Now talking about servo motors, they are excessively used when there is a need for an accurate shaft movement or position. These are not proposed for a high sped application. Servo motors are proposed for low speed, medium torque and accurate position application. So, they are best for designing robotic arm. Servo motor is available at different shapes and sizes. We are going to use small servo motors (four) a servo motor will have mainly three wires positive voltage another is for ground and the last one is for position setting. The RED Wire is connected to power, the brown wire is grounded and the orange wire is for signal.

1. The arm has been built with cardboards and the individual parts have been locked to servo motors. Arduino Uno is programmed to control servo motors. Servos motors are acting as joints of Robotic arm here. This setup looks a like degrees (90 in each direction), these are excessively used when there is a need for accurate shaft movement or position. These are not proposed for high-speed applications. They are proposed for low speed, medium torque and accurate position application. The voltage across variable resistors is not linear; it will be bit noisy one. So, to filter out this noise, capacitors of micro are placed across each resistor a Robotic Crane or we can convert it into a Crane by easy ways.

2. This Robotic Arm is controlled by four Potentiometer with which we attach each with potentiometer that is used to control each servo. We can move these servos by rotating the potentiometer to pick some object, with some practice we can easily pick and move the object from one place to another. Here we use low torque servos here but we can use more powerful servos to pick heavy object.

3. Program done using Arduino 1.6.10.

4. We connect the circuit according to circuit diagram.

5. Now the voltage provided by this variable resistor voltage which represents position control into ADC channels of Arduino.

6. We are going to use four ADC channels of UNO from A0 to A3. After the ADC initialization, we will have digital value of pots representing the position needed by user.

7. We will take this value and match it with servo position.

8. The robotic arms take a perfect scaling that is cardboard, foam board is cut using measuring a servo are fitted according so that position of one servo motor does not affect the position of other servo motor.

9. As we rotate the 10K pot the value changes accordingly and we get rotation in the output of servo motor.

10. The voltage across variable resistors is not completely linear; it will be a noisy one. So, to filter out this noise, capacitors are placed across each resistor.

3.2 Block Diagram of the system

In this the robotic arm works on the principle of electrical input energy to perform some mechanical works effectively with the help of some automation and program-based operations. The pick and place robotic arm consist of major hardware components such as strips & motors and arm gripper, switches, battery, piece of metal, and other discrete mechanical and electrical components. This project is designed for developing a pick and place robotic arm with a soft catching gripper. This soft catching gripper is used for safely handling an object carefully while catching and placing. The robotic arm consists of servo motor which is used for angular rotations of the arm for catching items (to hold items, to release, to rotate, to place). This servomotor used is works on the principle of Fleming's left-hand rule and is controlled using Arduino circuit board.

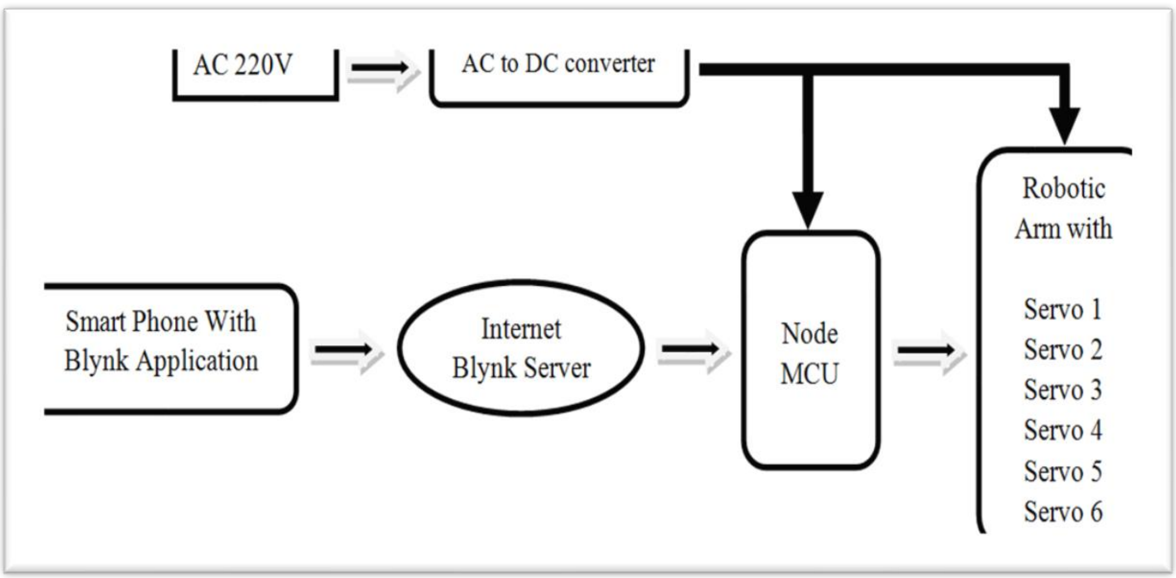

Figure 3.1: Block Diagram

In this system we try to make an internet based robotic arm and show the system control using a smart phone with node MCU. To connect the robotic arm with the smart phone we use here Blynk app which is works on an Arduino IDE software program. We used hare mobile hotspot to supply the wi-fi signal to run the system on time. Node MCU is a smart IoT programed device which is most used module in IoT platform.

3.3 Frame Design and Fabrication

The following material properties were put into consideration during the material selection process:

- Strength
- Lightness
- Availability
- Ease of cutting.

The material should possess sufficient strength so as to ensure that each link of the arm is able to bear the load imposed on it by motors, other attached links and the payload. Lightness of the material reduces the torque requirement of the robot actuators, thereby minimizing cost. The material also had to be readily available and easy to cut because the fabrication of some parts of the robotic arm involved the cutting of intricate shapes.

Perspex (polymethyl methacrylate or PMPA plastic) satisfies all the above criteria and was thus selected for the project. Perspex can be easily cut with readily available hand tools such as a fret saw. In addition to this, it offers outstanding strength and stiffness (Polymech, 2012) which made it suitable for the project.

It is also cheap and readily available. With a density of 1.18g/cm3 (Boedeker.com, 2013), its lightness is a key advantage for any demonstrative or educational robotics project, because it reduces the torque requirement of the robot actuators.

3.4 Implementation Plan

The entire implementation plan of the robotic arm from start to finish is represented by a block flow diagram shown in Figure

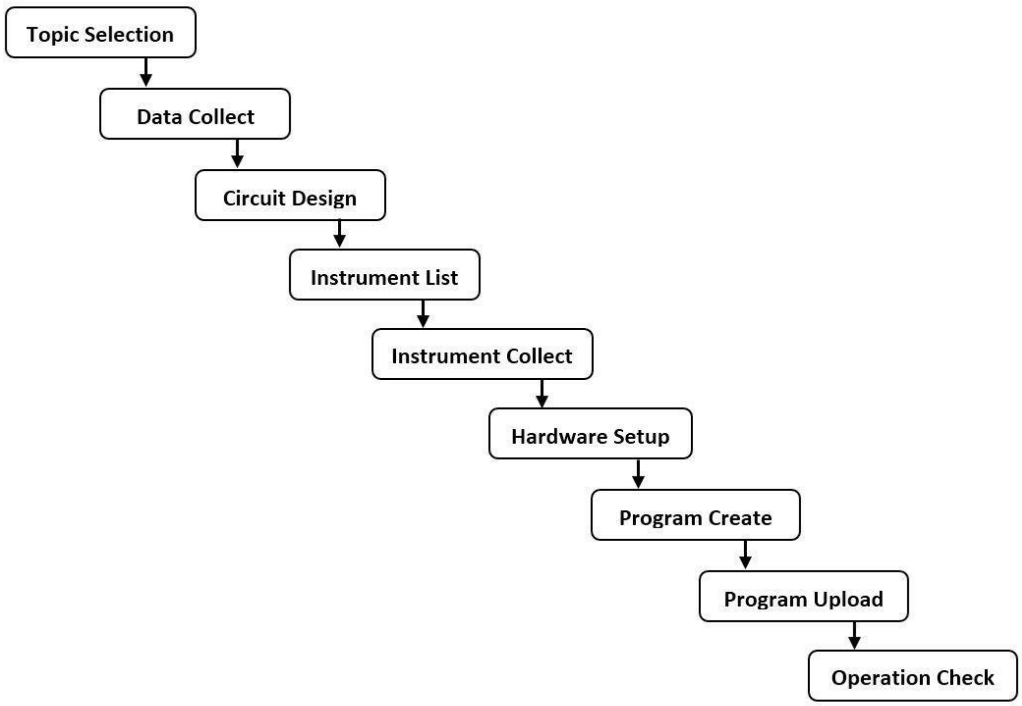

Figure 3.2: Implementation Schedule

3.5 Circuit Diagram

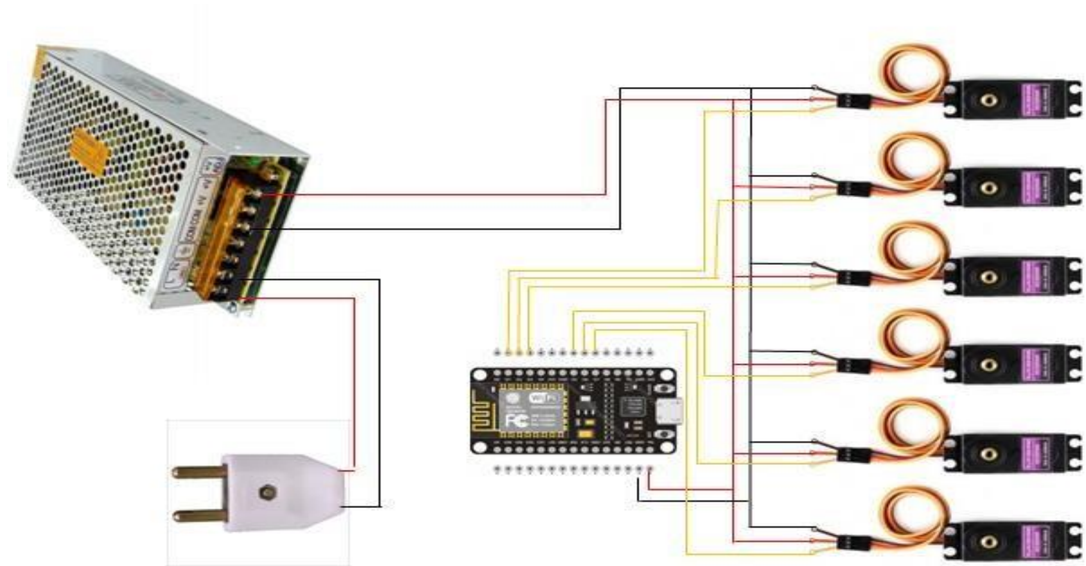

Figure 3.3: Circuit Diagram

As shown above we will need a total of 4 servo motor to operate our robotic arm, sincethese motors do not consume much power, they are being driven directly by the 5V dc supply from our 1A adapter. I have used the breadboard to make the above connections; once the connections are done my set-up looks something like this.

3.6 Robotic Arm Design

The main benefits of teleportation are that homo-sapiens are versatile and thus compliant with unstructured conditions. This project went through a range of design stages from the very first design which mainly focused on the necessary DOF, to the point that the design achieved its optimum stage and fulfilled all the criteria of the project based on complex assessments. In particular, we started by deciding the lengths of the arms connections to establish a practical configuration of six DOF and the ability to reach distances of 1 foot and the ability to fold the arm within the UGV surface dimension. The template ofthree connections was chosen because in conjunction with the revolving base and gripper it results in six DOF. The original lengths of the ties have been calculated from the 2-meter extension requirement. The design process may involve using computer-aided design (CAD) software to create 2D models of the robot and its components. The following was the stage of determining the form of each link. The subsequent approach concentrated more on the usability of trying to maximize each joint with the available rotating angle. In addition, the length and stroke were chosen in order to meet the loading criterion for each linear actuator. This stage of development led to a change of the proportions of relations, which involved a compromise to achieve the best movement. Eventually, the gripper was applied to the design, and the connecting dimensions improved, which reduced the connecting measurements in particular to a smaller arm.

3.7 Drive Circuit

After the design of the robotic arm is complete, a moving circuit must be applied. The linear actuators are the robotic arm components to be operated. Essentially such actuators are DC motors which are operated by adjusting the polarity on the terminals in the direction of rotation. The linear actuators were powered by H-bridges consisting of relays. In particular, for practicality, pre-welded relay modules have been used since they enable the control of engines using a microcontroller directly.

3.8 Remote Controller

The Arduino Mega microcontroller has been chosen because its own C-based programming language is easy to program. The code includes the library which enables the Arduino Mega to be interfaced with a Bluetooth dongle that can then be linked to a PlayStation wireless controller to wirelessly monitor relays with the PS3 controller. The relays control the current direction in which the DC motors of the linear actuators flow, which controls the extension and retraction of each connection of the robotic arm. The servo motors mounted on a base rotation and a gripper were controlled by analog buttons on the PS3 controller.

3.9 Mechanical Analysis

The efficiency of the robotic arm has to be evaluated, so the measurements below are carried out to ensure that the mechanical configuration satisfies the standard specifications.

3.10 Robotic Arm Parameters

Enlisting the industrial robotic arms parameter:

1. Number of axes: 6
2. Degree of freedom: 6
3. Working Freedom: The region of space a robot can reach
4. Carrying capacity or pay load: How much weight a robot can lift.
5. Speed: How fast the robot can position the end of its arm, angular linear speed of each axis or as a compound speed.
6. Acceleration: How quickly an axis can accelerate.
7. Accuracy: How closely a robot can reach a commanded position.
8. Repeatability: How well the robot will return to a programmed position.
9. Power source: 5V
10. Drive: Some robots connect electric motors to the joints via gears, others connect to the motor to joint directly.
11. Compliance

3.11 Robotic Arm Types

i. **Cartesian robot:** Used for pick and place work, handling machine tools and arc welding application in various purposes like in assembly operations.

ii. **Cylindrical robot:** It is mostly used for assembly purpose operations, handling of machine tools, spot welding. It is a robot which has axes form of a cylindrical coordinate system.

iii. **Spherical robot:** Used for handling machine tools, spot welding, fettling machines, gas welding and arc welding. It is a robot which has axes as form a polar coordinate system.

iv. **Articulated robot**

v. **Parallel robot**

vi. **SCARA robot**

vii. **Anthropomorphic robot:** It is shaped in a way that resembles a human hand, i.e. with independent fingers and thumbs.

3.12 Drawing: 6 DoF Robotic arms of 2D Drawing

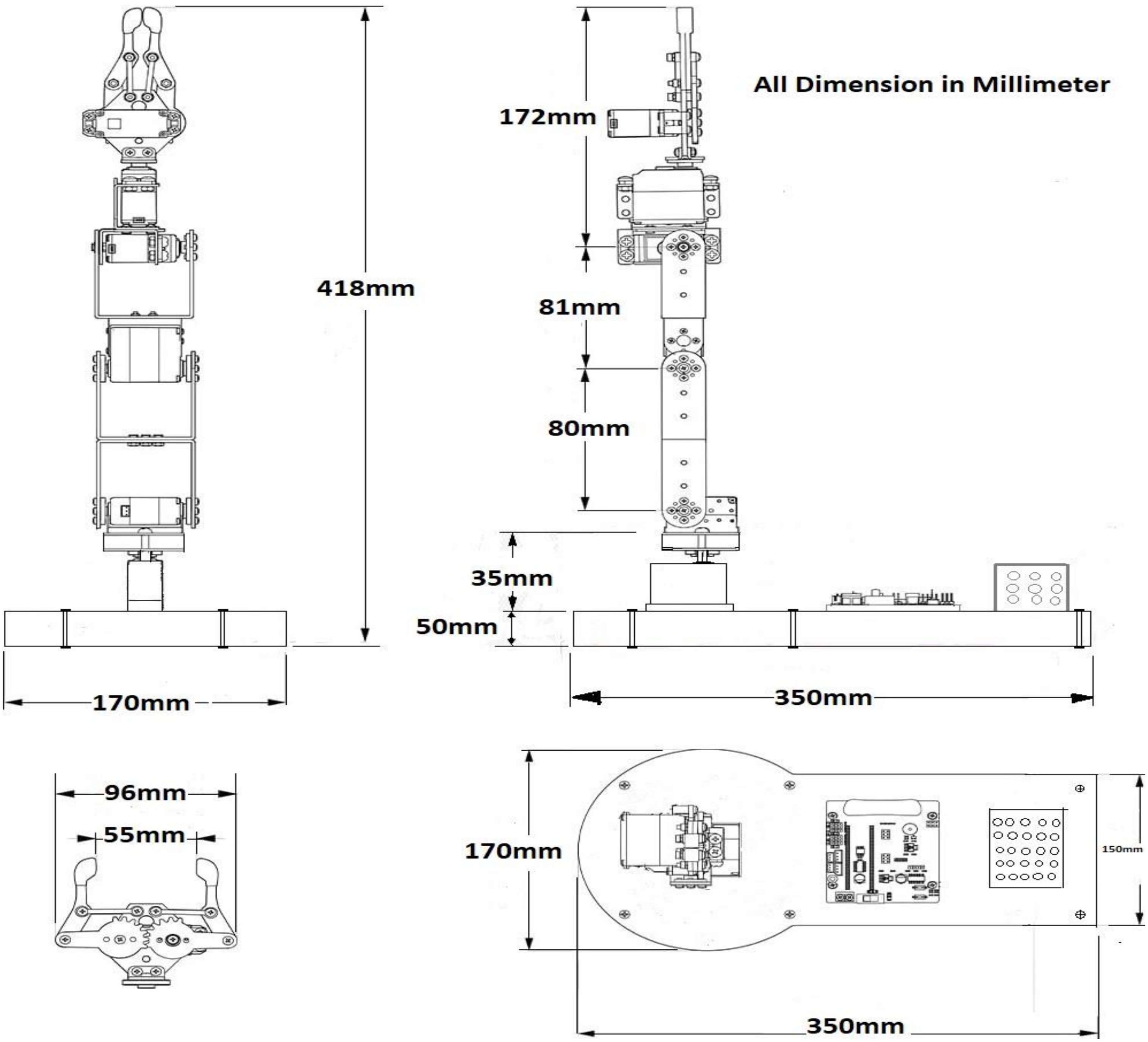

Figure 3.4: 2D Drawing of 6 DoF Robotic Arm

CHAPTER 4

Different Components

4.1 Introduction

In this chapter, we will discuss the materials, components, devices, and tools utilized to construct the machine. As it is a synergistic combination of mechanical, electrical, and control systems, all three types of components are used in this project.

4.2 Materials and Instruments

Instruments used in this project can be classified into two categories which are

a. Hardware and materials

b. Control tools and software

4.3 Hardware

Table 4.1: Hardware Components

S/L	Components Name	Quantity
01	Node MCU	1 Nos
02	5V SMPS	1 Nos
03	Servo Motor	6 Nos
04	Metal Frame & Gripper	1 Set
06	PCB Board	1 Nos
07	Wire	1 Meters
08	Jumper Wire	6 Nos

4.3.1 Power Supply (SMPS)

Switched-mode power supplies are electronic supplies that incorporate switching regulators to convert electrical power efficiently. They are widely used in a range of modern applications thanks to characteristics like efficiency, low cost, and adaptability.

Figure 4.1: SMPS

A 5V 5A DC SMPS Power Supply is used in the setup. A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. This power supply convertor is built for such purposes. This circuit board converts 220V AC current to 12V DC output voltage. It is used in many small equipment and components such as computers, Television, Cathode ray Oscilloscope, etc. It has inbuilt over-voltage, over current, and short circuit protection. The board is perfectly designed to provide high output performance. This board has an inbuilt LED indicator.

Specification:

1. Input voltage: 220V AC
2. Output voltage: 5V DC
3. Output current: 5A
4. Frequency: 50HZ/60HZ
5. Dimension: 108mm x 54mm x 25mm
6. Inbuilt over voltage, over current, and short circuit protection

4.3.2 Mechanical Gripper

A mechanical gripper is used to grip the objects and hold it while transferring it from its location to the destination. The gripper has its inbuilt mini servo in it so it can open or close its jaws to grip the objects. The gripper is made from the acrylic by the LASER cutting operation. the shaft of the servo is fixed to the end of first jaw which meshes with the gear on the second jaw. as the motor rotates the gear rotates and this in turn rotates the gear in mesh and the jaws open or close to release or hold the objects. A gear link is attached to a servomotor which is meshes with another geared link to provide a smooth action of gripping of different objects according to their sizes the movement of both of figures of the grippers is synchronize well to hold the object.

Figure 4.2: Mechanical gripper

4.3.3 Metal Base with Frame

The base is made so strong so that it can support the whole assembly and balance the center of gravity of whole arm. the base let the arm do movements in the require directions flawlessly and the arm can cover the hemispherical volume.

4.3.4 Servo Motor

The three major servo motors are used in the robotic arm, one for the base movements and two on the side of the base plate two transmit the motion through the various links to the arm. The servo motor is bolted to the base plate it keeps it fixed and it avoids vibrations during the actual operations. A rotary actuator is consisting of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticatedcontroller, often a dedicated module designed specifically for use with servomotors.

Figure 4.3: Servo Motor

4.3.5 Controller

By sending a servo signals a servo control can be obtained, a series of repeating pulses of variable width where either the width of the pulse (most common modern hobby servos) or the duty cycle of a pulse train (less common today) determines the position to be achieved by the servo. Controller integrate the digital command signal into the analogue parameter like movement of the servo motor shaft. With the help of controller, we can upload the programmed regarding the movements of the servos.by using the controller we can control the number of servos at a time and synchronize the operation of the servo for

-operation of any servo in any sequence and

-to synchronize actuation of four servos sequentially in a loop programmed.

Figure 4.4: Node MCU

4.3.6 Connectors

The device that used to join electrical terminations and create an electrical circuit is called as an electrical connector. These are electro-mechanical devices consist of plugs called male ended and jacks called female ended. The connection may be temporary, as for portable equipment, require a tool for assembly and removal, or serve as a permanent electrical joint between two wires or device. In our project we used only the male-to-male connectors or the plugs for the connections.

4.4 Software Design

4.4.1 Coding Environment

There are numerous coding environments to take into account while designing an automatic rain shed system using a microcontroller. Here we chose Arduino Integrated Development Environment (IDE) Version 1.8.16.

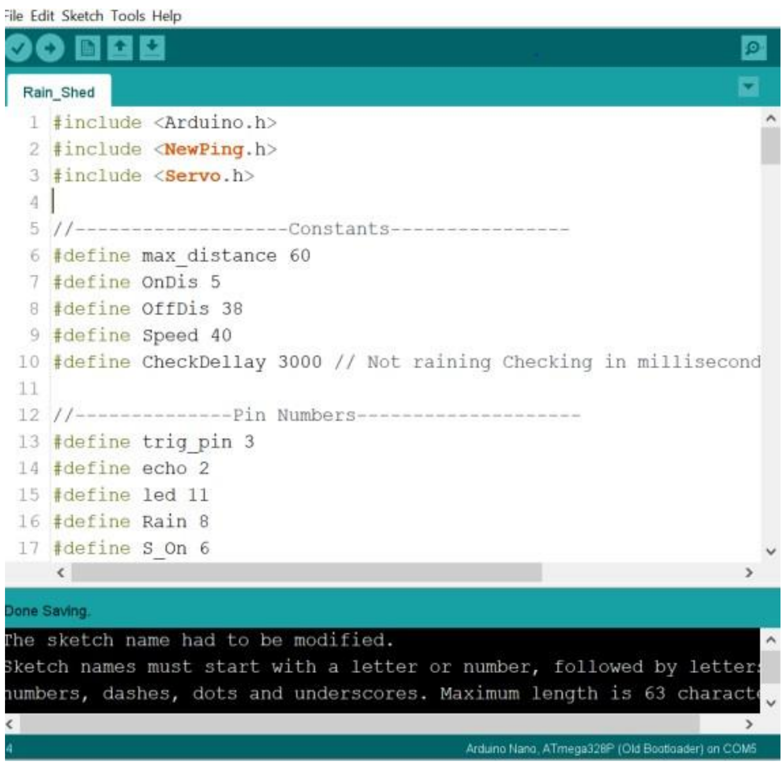

Figure 4.5: Arduino IDE

The Arduino Integrated Development Environment (IDE) offers a user-friendly environment for creating and uploading code to Arduino boards. Arduino is a popular platform for microcontroller programming. It supports a range of microcontrollers, including models like the Arduino Uno or Arduino Mega that are frequently used in steam boiler applications.

4.4.2 Blynk IoT

Blynk is an IoT platform that allows us to quickly build projects for controlling and monitoring the data using Android and iOS devices. We can create project dashboardand add widgets like button, display, sliders, etc. for controlling microcontrollers and other peripherals. Using these widgets, we can control the devices and can monitor the sensor data on the phone screen. Follow the below steps to install Blynk and create dashboard for robotic arm control.

1. In your mobile phone Install the blynk application from the Google Play Store.
2. Next sign up for the Blynk application using the email id.
3. After signing up login the Blynk application.
4. After login, click on ***New Project***.
5. Next project name is given as per required and board we use is "Node MCU" selected and connection type is given as "Wi fi"
6. After that click Create and an auth token code is sent to your mail id.
7. Copy the Auth Token Code sent to your mail ID we will use it in our "Node MCU" coding.
8. Next, we have to create our own application for our Robotic ARM Control by adding the widgets in the widgets box. As we have four servo motor control, I have added four sliders.
9. After Adding the Sliders. You can change each sliders name and Slider value and then the Slider settings. Slider 1 as GRIPPER with settings as OUTPUT V0 from 0 to 180. Slider 2 as LEFT/RIGHT with settings as OUTPUT V1 from 0 to 180. Slider 3 as UP/DOWN with settings as OUTPUT V2 from 0 to 90. Slider 4 as FORWARD/REVERSE with settings as OUTPUT V3 from 0 to 60. For ALL Sliders I have turned OFF the SEND ON RELEASE. So that we can keepa Write Delay of 100ms between the values.
10. After Adding all the sliders with above settings, the application looks like this. After that you can run the application by clicking Play Button.
11. Now our application is ready. Next thing is to make the circuit connections and upload code to the Node MCU. After that we can control our Robotic ARM using the Blynk Application.

4.5 Cost of the Project

Table 4.2: Cost of the project

S/L	Components Name	Quantity	Price (taka)
01	Node MCU	1 Nos	570
02	5V SMPS	1 Nos	270
03	Servo Motor	6 Nos	2280
04	Mechanical Frame with Gripper	1 Set	5000
05	PCB Board	1 Nos	100
06	Wire	1 Mtr	50
07	Jumper Wire	6 Nos	200
Total			8470/-

CHAPTER 5

RESULTS & DISCUSSIONS

5.1 Experimental Results

Table 4.3: Data Table

Parameter	Specification	Description
Physical	Actuation	6 DC Servo Motor
	Weight	2.5 kg
	Dimensions	Base: 350x170x50mm
		Arm Length: 380mm
Performance	Position Precision	±2mm
	Movement Time Required	6 Sec. (Depend on Internet speed)
	Payload	25, 50, 100, 150, 175 gm
	Gripping Range	15mm to 50mm
	Load Capacity	190 gm (Max)

Table 4.4: Performance Test

Degree of movement	Payload (Gram)	Status	Duration
45°	25	Pass	Depend on internet speed
	50	Pass	
	100	Pass	
	150	Pass	
	175	Pass	
	200	Fail	
90°	25	Pass	
	50	Pass	
	100	Pass	
	150	Pass	
	175	Pass	
	200	Fail	

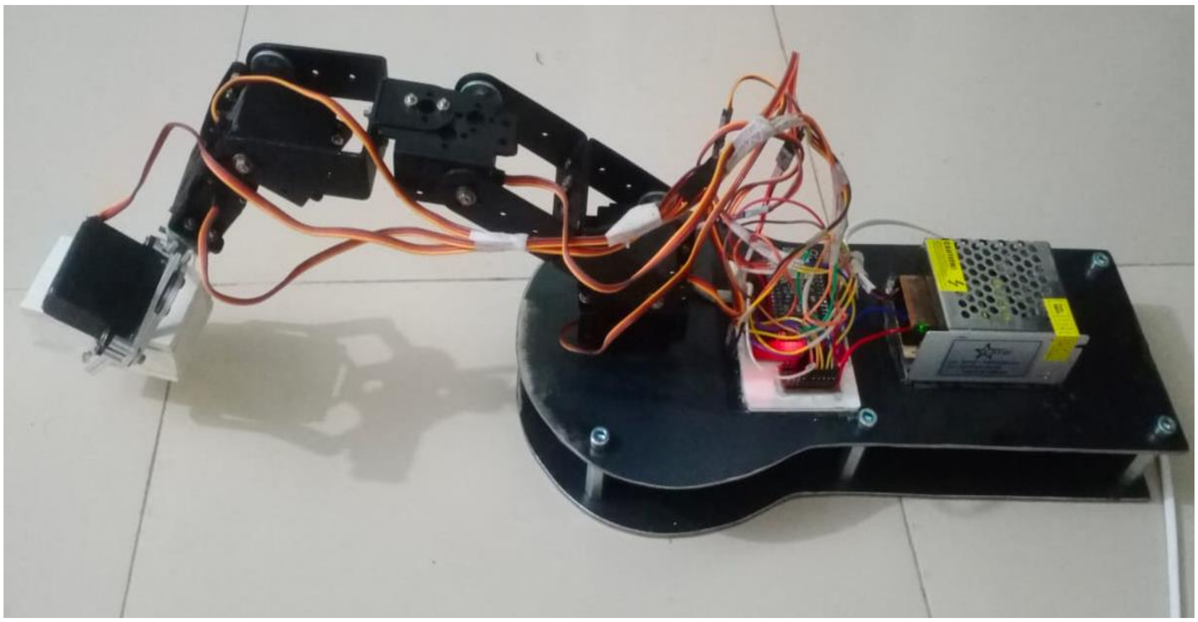

Figure 5.1: Full over view of Robotic Arm System

CHAPTER 6

CONCLUSION and RECOMMENDATION

6.1 Conclusion

This report presents the design and the development of robotic arm, which has the ability to perform simple tasks, such as light material handling. The robotic arm is designed and built from aircraft grade aluminum material where servo motors were used to perform arm movements. The design of the robotic arm limited to the four degrees of freedom The design of a Robotic arm has been complete. A prototype was built and confirmed functional. This system would make it easier for man to unrivalled the risk of handling suspicious objects which could be hazardous in its present environment and workplace. Complex and complicated duties would be achieved faster and more accurately with this design. A device that is applicable to EOD implementations with regard to the control distance and stability will effectively replace the current control system. This proposed work is an overview of how we can make use of servo motor to make joints of a robotic arm and control it using potentiometer and Arduino UNO. Also used for high loaded industrial application work. This Due to the growing demand for natural Human Machine Interfaces and automaton intuitive programming platforms, a robotic system that permits users to manage AN industrial automation using arm gestures and postures was planned. Two 3-axis accelerometers were selected to be the input devices of this system, capturing the human arms behaviors. When compared with alternative common input devices, particularly the teach pendant, this approach mistreatment accelerometer is additional intuitive and straightforward to figure, besides giving the likelihood to control a automaton by wireless suggests that. mistreatment this technique, a no expert robot applied scientist will management an automaton quickly and during a natural method. The low worth and short set-up time area unit alternative advantages of the system. still, the irresponsibleness of the system is a vital limitation to think about. The ANN′s shown to be an honest option to acknowledge gestures and postures, presenting a mean of ninety-two of correctly recognized gestures and postures. The system has a very good response time is another necessary issue. Future work can devolve on the development of the average of properly recognized gestures. One approach might be the implementation of a gyro into the system, in order to separate the acceleration because of gravity from the inertial acceleration. The employment of additional accelerometersattached to the arms is another chance. The Arduino has a very good response time and later the same system can be up graded to raspberry pi in future and the same is implemented on proteus design tool. Finally, the system was first built on a bread board and the values area calculated the same values were used in the code to see the difference in the operation of the robotic arm.

6.2 Advantages

- Grasping and holding objects and then move them to a new location, or mixing with other fluids. (Used in laboratories that trust such arms to work within a toxicenvironment and so do not endanger the researcher. Building cars.
- Retrieving suspicious objects without endangering humans.
- Dig trenches.
- A source of entertainment and education.
- An appendage of an anthropocentric robot.
- Used in surgery.
- Used in farming

6.3 Disadvantages

- This project is a small-scale production it can pick up only small and lighter objects.
- On large scale this project may become costly and its circuit complexity increases.
- On large scale may become hazardous due to uncontrollable robotic arm it can harm physically.

6.4 Recommendation

- Future enhancement can include further improvement that is by adding 360-degree rotary servo motor and making it more stable. Setup can be modified that will pick more weight compared to present model.
- Ultrasonic sensor can even be placed on the arm, so that it can detect and simultaneously pick the object and keep it on another place.

REFERENCES

1. The first usage of the term 'robot' was in a 1921 Czech science fiction play - 'Rossum's Universal Robots' - by Karel Capek. The robots were artificial people or androids and the word was derived from the word 'Robata', a Czech word for slave (Corke, 2011).

2. A question of perpetual interest is to define a robot. Since the beginning of the study of robotics, there has been some controversy in the definition of a robot. So long as the evolution of robotics continues, the definition of the robot will change from time to time, depending on the technological advances in its sensory capability and level of intelligence (Deb, 2010).

3. Rahman A, Khan A. H, Dr. Ahmed T, Md Sajjad M, Design analysis and Implementation of Robotic arm – The Animator, American Journal of Engineering Research, 2013, Volume 2, Issue 10.

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5. Omijeh B. O, Uhunmwangho R, Ehikhamenle M, Design analysis of a remote controlled "Pick and Place" Robotic vehicle, International Journal of Engineering Research and Development, 2014, Volume 10, Issue 5.

6. Katal G, Gupta S, Kakkar K, Design and Operation of Synchronized Robotic Arm, IJRET, Aug 2013, Volume 2, Issue 8.

7. Gunasekaran K, Design and analysis of articulated inspection arm of a robot, international journals for trends in Engineering and Technology, May 2015, Volume 5, Issue 1.

Appendix

Programing Code:

```
#define BLYNK_TEMPLATE_ID "TMPLy2aoXZPZ"
#define BLYNK_DEVICE_NAME "6 DOF Robotic ARM"

#define BLYNK_FIRMWARE_VERSION        "0.1.0"

#define BLYNK_PRINT Serial
#define USE_NODE_MCU_BOARD

#include "BlynkEdgent.h"
#include<Servo.h>
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;

void setup()
{
  Serial.begin(9600);

  servo1.attach(D1);
  servo2.attach(D2);
  servo3.attach(D3);
  servo4.attach(D5);
  servo5.attach(D6);
  servo6.attach(D7);

  BlynkEdgent.begin();
  delay(2000);
}

void loop()
{
  BlynkEdgent.run();
```

```
}
BLYNK_WRITE(V0)

{
  servo1.write(param.asInt());
}
BLYNK_WRITE(V1)

{

  servo2.write(param.asInt());
}
BLYNK_WRITE(V2)

{
  servo3.write(param.asInt());
}
BLYNK_WRITE(V3)

{
  servo4.write(param.asInt());
}
BLYNK_WRITE(V4)

{
  servo5.write(param.asInt());
}
BLYNK_WRITE(V5)

{
  servo6.write(param.asInt());
```