A

MINI PORJECT REPORT

ON

"4 DOF Mobile Controlled Robotic arm using NODE MCU8266"

FOR PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
MINI PROJECT
OF T.E. E&TC – 2019 COURSE, SPPU, PUNE

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CERTIFICATE

This is to certify that the Mini Project Report entitled
4 DOF MOBILE CONTROLLED ROBOTIC
ARM USING NODE MCU 8266
Has been successfully completed by

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Is a bonafide work carried out by them under the supervision of Ms.S.M.Hosamani and it is approved for the partial fulfillment of the requirements for the Mini project report of T.E. E&TC – 2019 Course of the Savitribai Phule Pune University, Pune.

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HOD,E&TC Dept.

Place: Pune
Date:

ACKNOWLEDGEMENT

We express our deep gratitude towards our project guide Ms.S.M.Hosamani .It is because of her valuable guidance, analytical approach and encouragement we could learn, work and complete this project. We will always cherish the great experience to work under her enthusiastic guidance.

We are also grateful to our beloved HOD ,teaching and nonteaching staff, friends and well-wishers who directly or indirectly contributed for the success of our project.

Finally, how can we forget out parents whose loving support and faith in us remains our prime source of inspiration.

THANK YOU !!!

ABSTRACT

As we are living in 21st century, where industries are using "Industry 4.0" revolution, automation is one of the important part of industry. The pick and place robotic arm is one of the technologies in manufacturing industries which is designed to perform pick and place operations. The system is so designed that it eliminates the human error and human intervention to get more precise work. Literature suggests that the pick and place robots are designed, implemented in various fields such as; in bottle filling industry, packing industry, used in surveillance to detect and destroy the bombs etc. The project deals with implementing of an pick and place robotic arm using Arduino and NodeMCU microcontroller. The main focus of this project was to design and develop the mechanism for robotic arm for lifting. The robotic arm was designed with four degree of freedom and programmed to accomplish accurately simple light material lifting task to assist in the production line in any industry. The robotic arm is equipped with 4 servo motors to link the parts and bring arm movement. It is controlled by an NodeMCU microcontroller which accepts input signals from a user through Blynk app which is installed in user's mobile phone.

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CHAPTER 1
Introduction

1.1 BACK GROUND AND CONTEXT

In the industry, automation is one of the most important part. It avails to reduce the need for humans by creating additional help systems that can increase efficiency and productivity of the work. One of the most widely used components of automation systems is robots, and the most common type in the market is the robotic arm which is commonly used in industrial purposes.

A robotic arm is a mechanical arm, usually programmable, with similar functions that a human arm do. It is connected by joints allowing either rotational motion or linear displacement. Akin to the purpose of a human arm, robotic arms are designed to fulfill tasks determined in a controlled environment in accordance with predetermined commands (by O giving programming).

Robotic arm has wide application in industries, it can be used for many functions in industry as they can be used for welding, product inspection, material handling, packaging, etc. Also in computer related industries, robotic arm plays an important role as placing small parts as it becomes very difficult when we use manual method.

In the project, firstly we determine what should be the main function of our robotic arm and also we decided what materials will be suitable for this purpose, according we have design our robotic arm. It is controlled by an Node MCU microcontroller which accepts input signals or instructions given by us through Blynk app. The servomotors and links thus produced assembled with fasteners produced the final shape of the arm. Arduino IDE software is used to programmed this microcontroller using C language. We have design, developed and implement of robot arm which has the ability to perform simple tasks, such as light material

1.2 RELEVANCE

The Automated Robotic Arm works as pick and place robotic arm which is being implemented to ease the process of assembly complicated components, process of moving heavy materials etc. Usually the transfer process of the materials is being carried out, using man power and if the transfer process is repeated for a period of time, it can cause injuries to the operator. By using the particular robotic arm, the operator will no longer have to bent and lift up heavy loads thus preventing injuries and increasing the efficiency of the work. Operator will make mistakes whether small or big in a while. In the industries, as we know that the industry cannot afford to take any kind of mistakes, as every mistake in industry will be very costly whether in terms of money, time and material.

1.3 LITERATURE SURVEY

Supriyono et. al. uses Arduino mega 2560 EEPROM which show result that it can record data for duration of 682000 ms. The potentiometer of 10 k2 has non-linearity of 0.37% and proper mapping is 0-1023 to 0-258 by shifting the initial angle of 20°. They have used MG995 servomotor which has non-linearity of 0.05%. The system established can record the movement and applied to the robot arm accurately.xzwhen the system is recording a movement manually, its controller will read analog input from the pins where potentiometers are attached. In this case, potentiometer represents manual input to have manual angular ilovement. The mapping results will be the reference for servo motors to have angular motion. At the same time mapping result will be saved in Arduino Mega EEPROM. Later the saving data can be retrieved to have automatic angular movement of servo motor. [1]

Shalini Pukella et. al. has designed a pick and place robotic arm for transfer of parts from a station to another and this was achieved with the help of Electro pneumatics. They observe that by using electronic components and pneumatics arrangements instead of servo controlled robot has made the system simple and low cost. Automation of the pick and place process reduces the cycle time which increases productivity thereby reduction in the material handling cost. [2]

Dr. Ignatius Antony Herman et. al. have created effectively mechanical structure of the automated arm and interfaced with the aurdino processor. They have created G-codes for different figures and effectively meant regulator recognizable language. In this manner by consolidating the exceptionally adaptable automated arm structure with 3D printing innovation it can expand the printing territory also, can print little bends without any problem.

Kaustubh Ghadege et. al. has developed a novel robotic arm which is robust and light with four degree of freedom and can be reprogrammed for various applications. This arm uses NodeMCU controller which is especially developed for pick and place application. The purpose is to design and build a more compact, usable and cheaper pick and place robotic arm. A android application ha been developed as a input device will send signal to nade MCU, the NodeMCU will make a response accordingly.

Vaibhav Pawar et. al. in their paper they design and build the robotic arm from aircraft grade aluminium material where servo motors used to perform arm movements. They design the robotic arm limited to the four degree of freedom. Firstly a prototype was build 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 workspace. Complex and complicated duties would be achieved faster and more accurately with this.

Ashly Baby et. al. in their paper a robotic arm is implemented using Arduino to pick and place object more safely without incurring much damage. The robotic arm used here contain a O soft catching gripper which safely handle the object. In the modern era time and man power are major constraints for the completion of a task. The use of soft catching gripper and low power wireless communication technique like Bluetooth makes the system more effective when compared to other system. The propsed system is capable of lifting only small weights. by introducing high torque providing motor large weights can be picked.

1.4 MOTIVATION

Robotic and automation is employed in order to replace human to perform those tasks that are routine, dangerous, dull and in a hazardous area. In a world of advanced technology, today, automation greatly increases production capability, improve product quality and lower production cost.

A pick and place robotic arm plays an important role in industry. After going through various research papers and other material, we came to know that IOT is an important parts of automation. We can operate robotic arm from anywhere just by connecting to our internet. This factor was not consider by others, so we prepare our robotic arm based on IOT. We used Node MCU microcontroller to control our arm which is connected with WIFI. WIFI gives an advantages that it can be operated from any place. Now-a-days almost all industries are using automations and smart things, and our project is advanced of all previous robotic arm which was control by Bluetooth module. To overcome the problem of range of operating which was only 10 meters in case of robotic arm operate by Bluetooth, we use WIFI module so it is efficient also and it is majorly used in industries for pick and place operation.

1.5 AIM OF THE PROJECT

To create a Robotic arm with 4 DOF using NODE MCU. Robotic and automation is employed in order to replace human to perform those tasks that are routine, dangerous, dull and in a hazardous area.

1.6 SCOPE AND OBJECTIVES

1. To develop a versatile and low cost robotic arm which can be utilized for Pick and Place operation.
2 To design, Modelling, Programming and Simulation of Pick and Place Mechanism.
3. To implement a robotic arm with four degree of freedom and which is not too bulky and also compatible to use
4. To control the displacement and movement of robotic arm using Node MCU through WIFI.
5. To control robotic arm from any corner of world using Blynk application.

CHAPTER 2

Description of Project

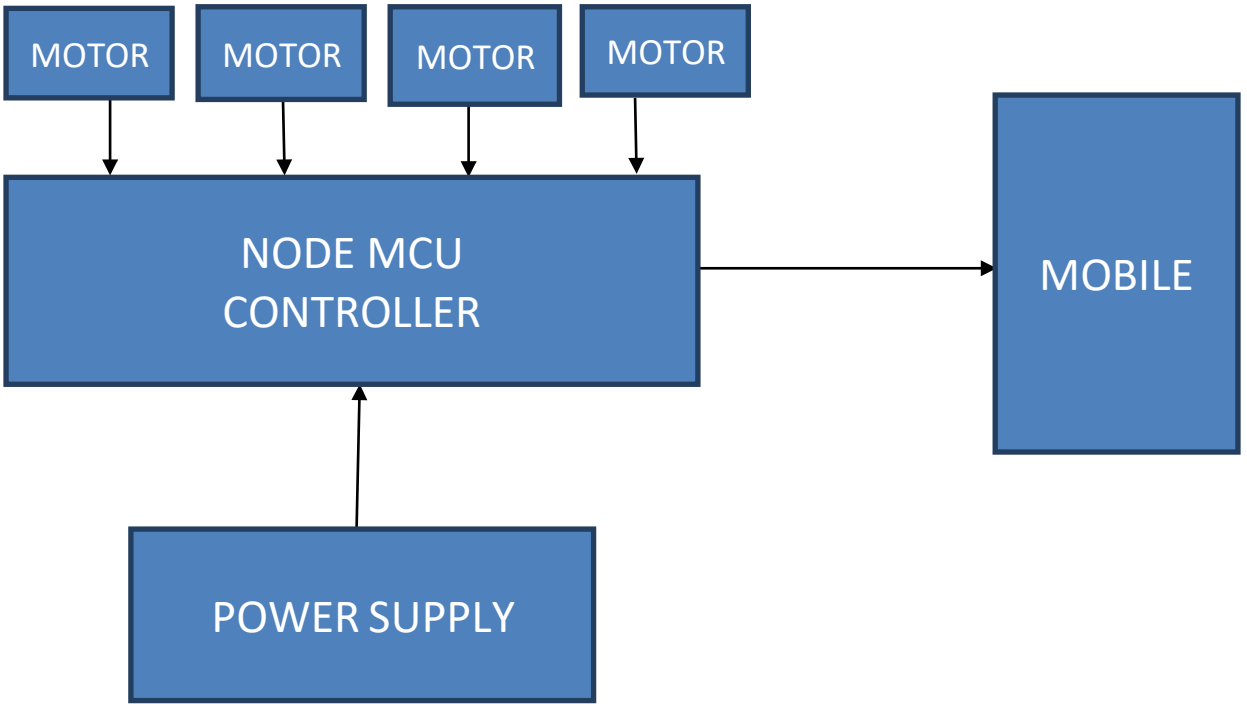
2.1 Technical Approach:

The novel idea behind Health line is to provide quality health service to one and all. The idea is driven by the vision of a cable free biomedical monitoring system. On body sensors monitor the vital parameters (blood pressure, ECG, temperature and heart beat rate). Periodic health monitoring (or preventative care) allows people to discover and treat health problems early, before they have consequences. Especially for risk patients and long term applications, such a technology offers more freedom, comfort, and opportunities in clinical monitoring.

So,We are proposing a innovative project to dodge such sudden death rates by using Patient Health Monitoring that uses sensor technology and communicate to the loved ones in case of problems. This system uses Temperature and heartbeat sensor for tracking patient's health. Both the sensors are connected to the Arduino-uno. To track the patient health micro-controller is in turn interfaced to a LCD display.

2.2 Block Diagram

Fig2.1_block diagram.



1. Servo Motor : (Metallic Gear)

The unit comes complete with 30cm wire and 3 pin 'S' type female header connector that fits most receivers, including Futaba, JR, GWS, Cirrus, Blue Bird, Blue Arrow, Corona, Berg.Spektrum and Hitec.

This high-speed standard servo can rotate approximately 120 degrees (60 degree in each direction). We can use any servo code, hardware or library to control these servos. The MG995 Metal
Gear Servo also comes with a selection of arms and hardware to get you set up nice and fast!

2. NODE MCU : (ESP8266)

NodeMCU is an open-source Lua based firmware and development board specially targeted for IOT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use.

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency, NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi Bluetooth and Deep Sleep Operating features make it ideal for IOT projects.

3. PCB:

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. Printed circuit boards are used in nearly all electronic products and in some electrical products, such as passive switch box

4. Power supply (Battery):

The **nine-volt battery**, or **9-volt battery**, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top.
The battery has both terminals in a snap connector on one end. The smaller circular (male) terminal is positive, and the larger hexagonal or octagonal (female) terminal is the negative contact. The connectors on the battery are the same as on the load device; the smaller one connects to the larger one and vice versa. The same snap-style connector is used on other battery types in the Power Pack (PP) series.

2.4 Hardware /Software resources:

a) Hardware resources:

2.4.1 :-Servo Motors:

A **servomotor** is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor, although the term *servomotor* is often used to refer to a motor suitable for use in a closed-loop control system.

2.4.1 :- Servo Motor

Size [mm×mm×mm]	61.1×40.2×41
Torque [Kgcm]	64 (18V)
Speed [sec / 60deg]	0.162
Weight [g]	116
Voltage [V]	18
Operation current [A]	1.2 (Max)
Operation angle range [deg]	300/ Endless turn
Communication speed [bps]	1Mbps
Manufacturer	Robotis

Fig.2.a:- Servo Motor Specification

2.4.2 Printed Circuit Board:

A **printed circuit board** (**PCB**) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate.[1] Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. Printed circuit boards are used in nearly all electronic products and in some electrical products, such as passive switch boxes.

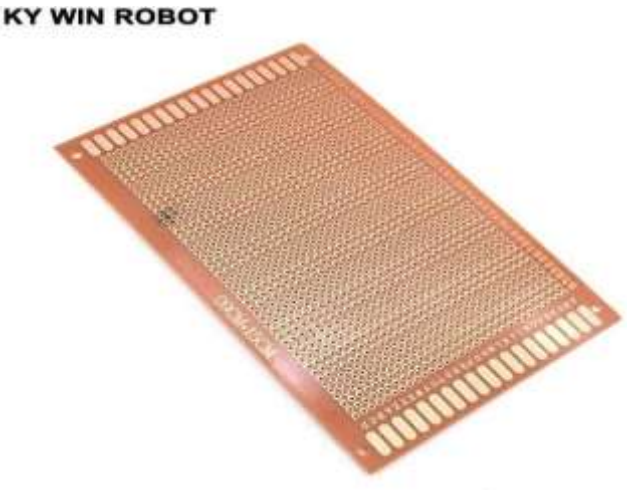


Fig 2.4.2 :-PCB

2.4.3 NODE MCU:

NodeMCU is an open-source Lua based firmware and development board specially targeted for loT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use.

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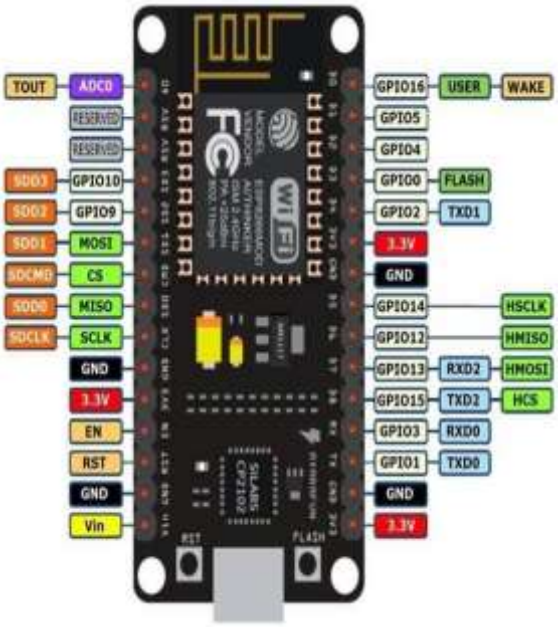


Fig.2.4.3 :- NODE MCU

Parameters	Specification
Microcontroller	ESP8266
Memory	32 bit
Processor	TenSilica L 106
Processor Clock	80MHz-160MHz
RAM	¡ 36Kb
Storage	16 Mb
Built-in WiFi	2.4GHz supports 802.11 b/g/n
ADC Pin	1(10bit Resolution)
GPIO pins	10
Operating Voltage	3.0V 3.6V
Operating Current	80mA(Average)
Operating Temperature Range	-40oC - 125 oC

Fig.2.b:- NODE MCU Specification

2.4.4 Power supply (Battery):

The **nine-volt battery**, or **9-volt battery**, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top.

The battery has both terminals in a snap connector on one end. The smaller circular (male) terminal is positive, and the larger hexagonal or octagonal (female) terminal is the negative contact. The connectors on the battery are the same as on the load device; the smaller one connects to the larger one and vice versa. The same snap-style connector is used on other battery types in the Power Pack (PP) series. Battery polarization is normally obvious, since mechanical connection is usually only possible in one configuration. The most common type of nine-volt battery is often called a 9 volts, although there are less common nine-volt batteries of different sizes.

Parameters	Specifications
Voltage	9W
Brand	Hi-Watt
Battery Type	Lithium-ion
Capacity	600mAh
Colour	White, Blue

Fig.2.c:- Battery Specification

Fig.2.4.4 battery

b) Software Resources:

1. Arduino IDE:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics.

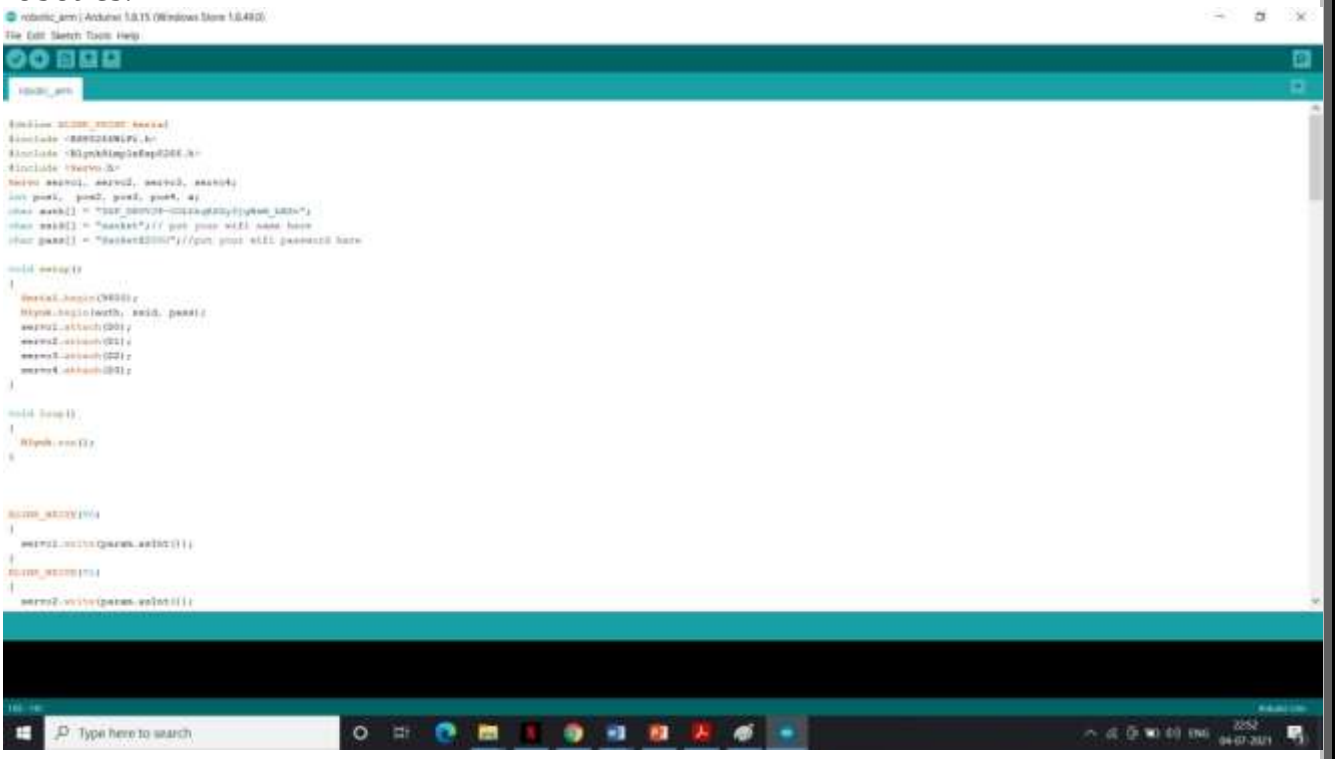


Fig.2.4.5:- Ardiuno IDE Window

2 . BLYNK application:

Blynk is an IOT platform, where we will rapidly build projects for commanding and keep track of the information
making use of mobile phones like Android and IOS gadgets. There's another advantage of making the project
dashboard and widgets like button, display, sliders, etc naming them as Grippers, Left and right turn, Up and downshift
for governing microcontrollers, and other superficial. we are able to control the machine and may track the sensor data
on the phone screen by making use of these widgets.

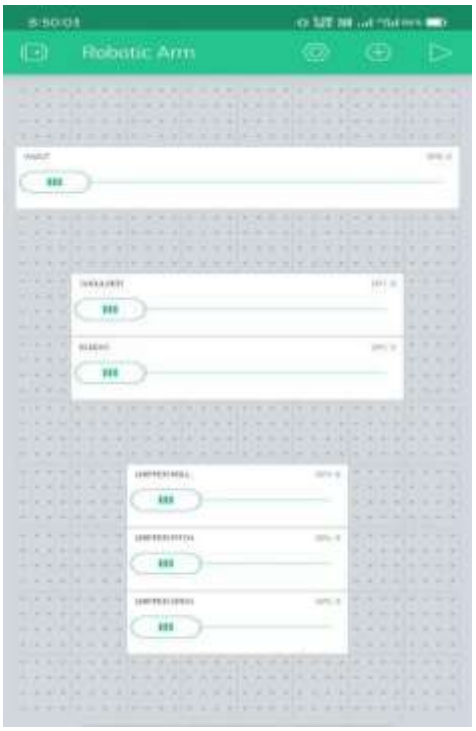


Fig.2.4.6:- Blynk App Window

CHAPTER 3

System Design

3.1 Circuit Diagram:

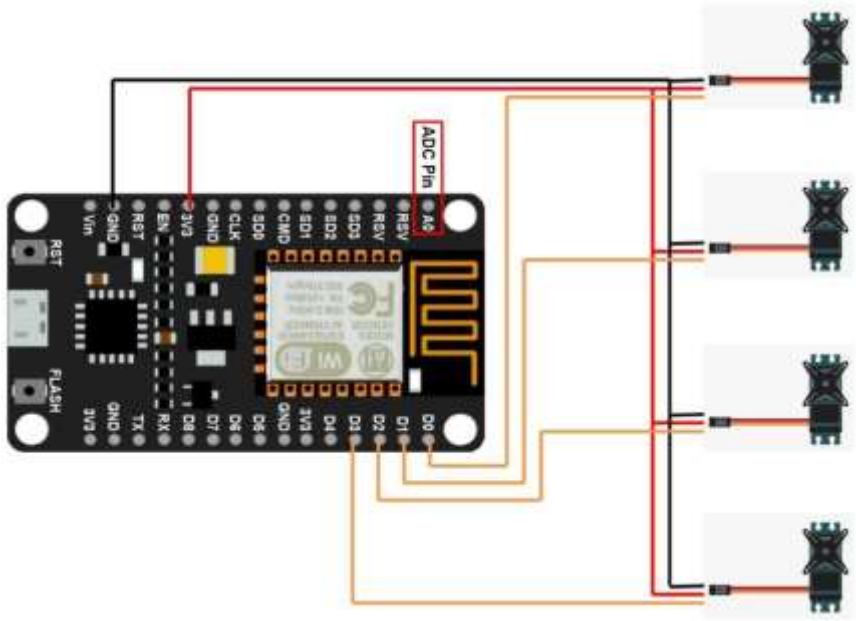


Fig 3.1 circuit diagram

About Circuit and connection:

- Figure shows the circuit diagram of our proposed project 4 DOF ROBOTIC ARM using NODE MCU that uses wifi technology and communicate to the robot.
- There are 3 ports at the servo motor power,ground and control input. As shown in above circuit diagram the 3 ports of servo motor are connected w.r.t to the Microcontroller (NODE MCU).
- The NODE MCU is connected to the mobile application through WIFI connectivity .

CHAPTER 4

4.1 : Implementation:

Setting Up Blynk & NodeMCU (ESP8266) Library for Arduino IDE

The coding for this Robotic Arm project is simple. First, we need the Blynk library for Arduino IDE.

Following are the steps to follow for doing coding

1. Download the Blynk library from the playstore.

2. After that install the Blynk Library for Arduino.

So, after setting up the Blynk library for Arduino IDE. Second, we need the NodeMCU library for Arduino IDE

To program NodeMCU with Arduino IDE go File >Perferences Settings.

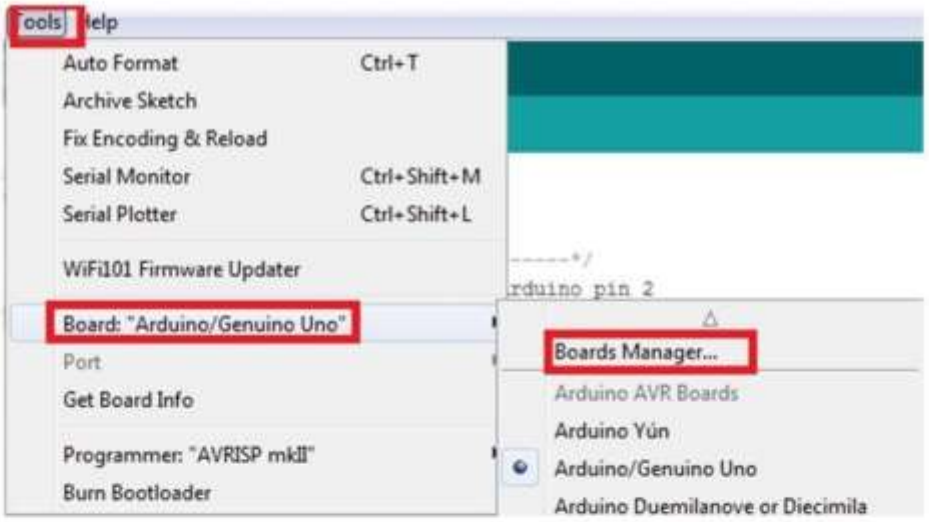


Figure 5.8 Programming steps

In Boards Manager window, Type *esp* in the search box, esp8266 will be listed there below. Now select latest version of board and click on install.

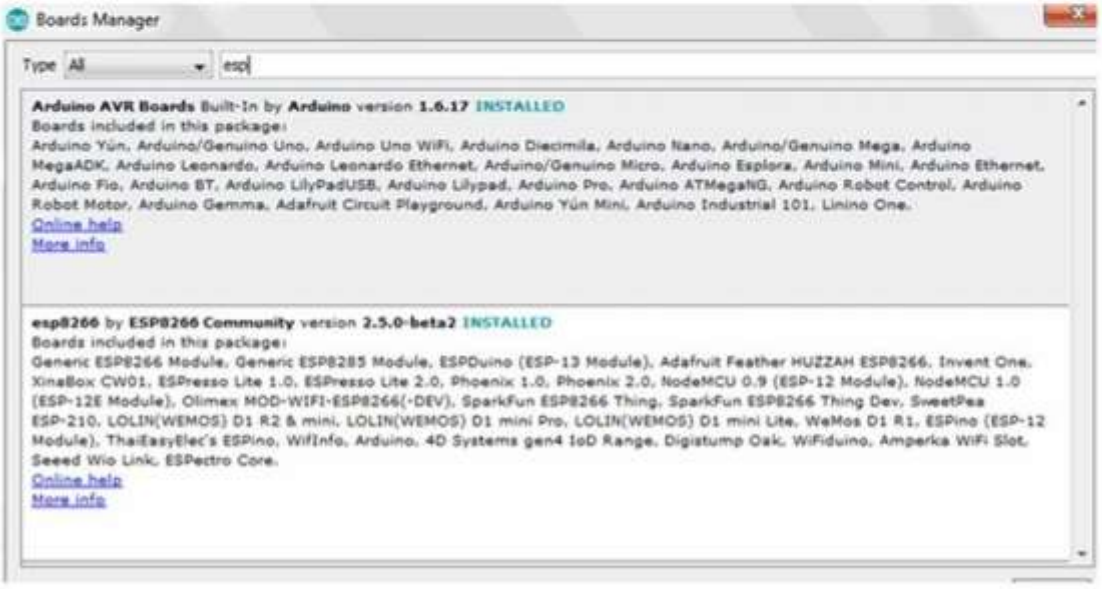


Figure 5.9 Programming steps

ARDIUNO IDE WINDOW:-

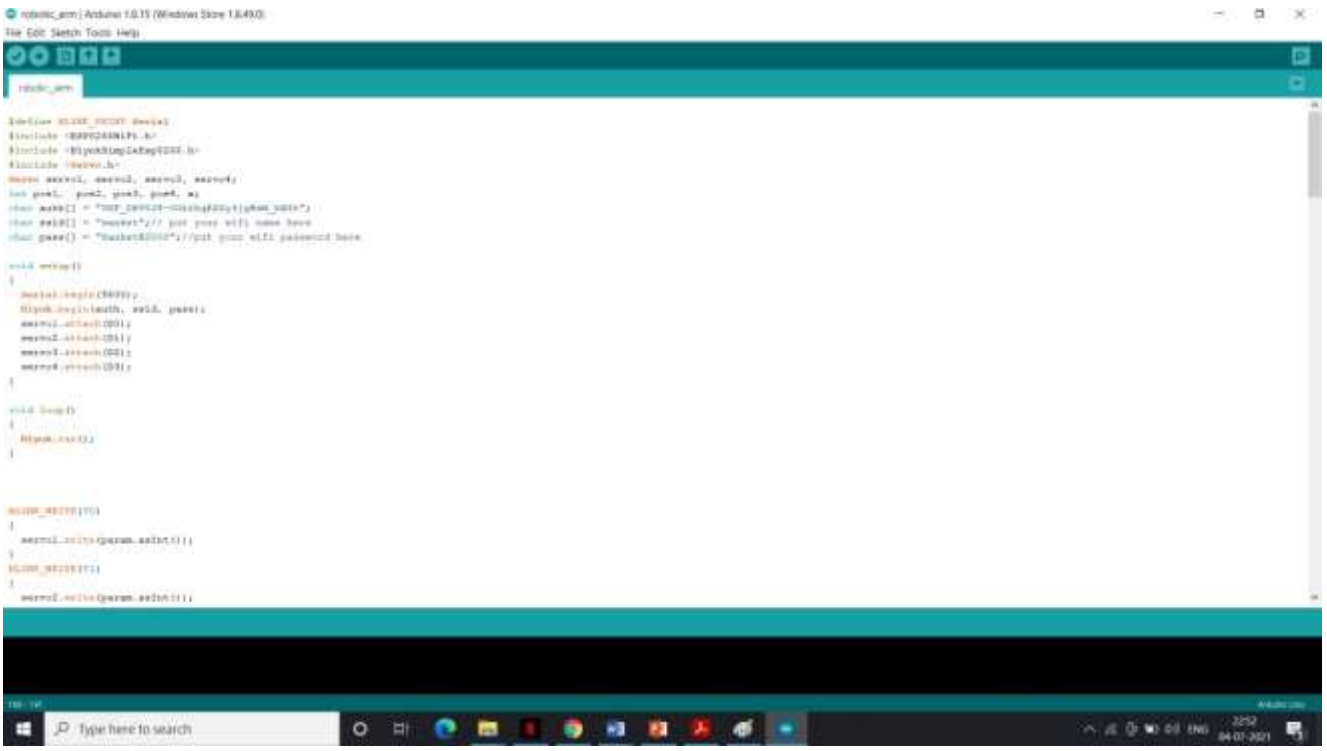


Fig 4.2_Arduino IDE window

4.1.2 Program:

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <Servo.h>
Servo servo1, servo2, servo3, servo4;
int pos1,  pos2, pos3, pos4, x;
char auth[] = "5XF_DR9VJ4-0OLthqKSZy3jgWsM_bNZt";
char ssid[] = "sanket";// put your wifi name here
char pass[] = "Sanket@2000";//put your wifi password here

void setup()
{
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  servo1.attach(D0);
  servo2.attach(D1);
  servo3.attach(D2);
  servo4.attach(D3);
}

void loop()
{
  Blynk.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)
{
  servo1.write(90);
  servo2.write(90);
  servo3.write(90);
  servo4.write(90);
}


BLYNK_WRITE(V5)
{
pos1=30;
pos2=180;
pos3=100;
pos4=30;
for (x = 0; x <= 10; x += 1)
{
  pos1+=3;
  pos2-=4;
  pos3-=4;
  pos4+=3;
  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
  servo4.write(pos4);
  delay(200);
  Serial.print(pos1);
  Serial.print("\t");
  Serial.print(pos2);
  Serial.print("\t");
  Serial.print(pos3);
  Serial.print("\t");
  Serial.println(pos4);
}
for (x = 10; x <= 20; x += 1)
{
  pos1+=3;
  pos2+=4;
```

```
  pos3+=4;
  pos4+=3;
  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
  servo4.write(pos4);
  delay(200);
  Serial.print(pos1);
  Serial.print("\t");
  Serial.print(pos2);
  Serial.print("\t");
  Serial.print(pos3);
  Serial.print("\t");
  Serial.println(pos4);
}
for (x = 20; x >= 10; x -= 1)
{
  pos1-=3;
  pos2-=4;
  pos3-=4;
  pos4-=3;
  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
  servo4.write(pos4);
  delay(200);
  Serial.print(pos1);
  Serial.print("\t");
  Serial.print(pos2);
  Serial.print("\t");
  Serial.print(pos3);
  Serial.print("\t");
  Serial.println(pos4);
}
for (x = 10; x >= 0; x -= 1)
{
  pos1-=3;
  pos2+=4;
  pos3+=4;
  pos4-=3;
  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
```

```
  servo4.write(pos4);
  delay(200);
  Serial.print(pos1);
  Serial.print("\t");
  Serial.print(pos2);
  Serial.print("\t");
  Serial.print(pos3);
  Serial.print("\t");
  Serial.println(pos4);
}
}

BLYNK_WRITE(V6)
{
  pos1=0;
  pos2=90;
  pos4=60;
  pos3=90;

  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
  servo4.write(pos4);
  delay(300);
  pos4=120;
  servo4.write(pos4);
  delay(300);
  pos1=0;
  pos2=90;
  pos4=60;
  pos3=90;

  servo1.write(pos1);
  servo2.write(pos2);
  servo3.write(pos3);
  servo4.write(pos4);
  delay(300);
  pos4=120;
  servo4.write(pos4);
  delay(300);
}
```

```
BLYNK_WRITE(V7)
{
  for (x = 0; x <= 180; x += 1)
  {
   pos1++;
   pos2++;
   pos3++;
   pos4++;
   servo1.write(pos1);
   servo2.write(pos2);
   servo3.write(pos3);
   servo4.write(pos4);
   delay(15);
  }
 for (x = 180; x >= 0; x -= 1)
 {
   pos1--;
   pos2--;
   pos3--;
   pos4--;
   servo1.write(pos1);
   servo2.write(pos2);
   servo3.write(pos3);
   servo4.write(pos4);
   delay(15);
 }
}
```

Important libraries:

- Arduino UNO library: ArduinoUnoTEP.dll
  ArduinoUnoTEP.idx
- Heart Beat Sensor Library: - HeartbeatSensorTEP.HEX
  -HeartbeatSensorTEP.IDX
  -HeartbeatSensorTEP.LIB
  -HeartbeatSensorTEP2.HEX
- Library used in Arduino IDE:

Liquid Crystal :- #include <LiquidCrystal.h>

4.2 Testing and debugging

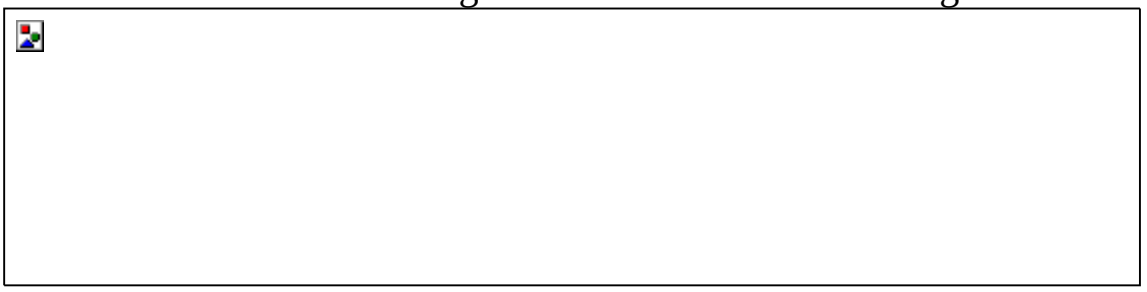
- At first we implemented the circuit in a virtual simulator and tested for any circuit malfunctions before the actual implementation in the hardware.
- We tested the simplest possible circuit at first and when the simulation was running properly we added more circuit elements to the circuit till we reach the desired model.
- We faced problems for finding particular library for the BLYNK application .

CHAPTER 5

Results and conclusion

5.1 Results

A research on possible design and basic information about the robotic arm was initially made. Using 4 ser motors, the robotic arm could move in different directions and could hold or release things with its gripper. Working model of robotic arm using NodeMCU microcontroller has been developed by us. The program code was written in C++ language which is one of the most popular and fundamental programming language. By making all correct connections of microcontroller and considering the proper design, we are able to operate the robotic arm which can be used to lift maximum weight of 700 gram. Following are the observations that we got after the successful running the robotic arm.



By the successful operating of robotic arm, we can conclude that the design and other factors that we consider during model making is correct and the arm operate and move in four axis without any problem. NodeMCU microcontroller was operated by wifi model which having advantages that it can be control by any place by connecting our mobile phone to it. All the results obtain was satisfactory.

5.2 Conclusion

Designing of Robotic Arm using NodeMCU microcontroller has been successfully completed. We provided 4-DOF ie it can move in right, left, up, and down direction with the help 4 servomotors. We use Arduino ide to program Arduino which uses C++ language and can be control by Wifi module. The experiments are conducted on the pick and place robot and the results obtained werevery satisfactory. The necessary theoretical and practical information for this purpose has been obtained and the necessary infrastructure has been established for the project. During the process of making and developing the project, a lot of theoretical knowledge has been transferred to the practice and it has been ensured that it is suitable for the purpose of the project. Despite the fact that the robotic arm made by this project is of prototype quality, it hasa quality that can be improved for more robotic systems.

5.3 Future Scope

There are several future recommendations that should be consider. Stability of our robotic arm can be increase more by using position hold system in future. By providing articulate wheels, we can move the arm according to the requirement. Accuracy can be increases by using proper sensors. Degree of freedom can also be increases by using appropriate system. Its weight lifting capacity can also be increase by using more power servo motor and by taking less weight's gripper. We can edit our programme and can add other tasks and other can give other function as a input. Instead of just pick and place operation, by doing changes in programming, we can use it for other function.

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