CHAPTER 1

INTRODUCTION

The project is designed to develop a Robotic Rover vehicle with a soft holding gripper. It can be used for pick and place of an object. It can sense whether the object picked is metallic or non-metallic. It can also detect the rover is in gaseous surrounding or not (LPG, I-Butane, Methane, Hydrogen, Alcohol, smoke). It can also tell the temperature and humidity level. The robotic vehicle is controlled by an android application for remote operation.

At the transmitting end using an Android application device, commands are sent to the receiver to control the movement of the robot to move forward, backward, and left or right. The android application device transmitted acts as a remote control that has the advantage of a certain range, while the receiver end is fed to the micro controller to drive DC motors via motor driver IC for necessary work. Remote operation is achieved by any smart-phone/Tablet, etc. The main advantage of this robot is its holding arm, which is designed to avoid extra pressure on the suspected object for safety reasons. A Rover is the one which is used to pick up an object and place it in the desired location. It is an articulated Robotic Rover, which contains a fixed robot with 3 vertical axes and rotary arms.

Manipulator is the main body of the vehicle which consisting of several joints and links.

CHAPTER 2

PROECT BRIEF

AIM

To design and build a Robotic Rover.

OBJECTIVES

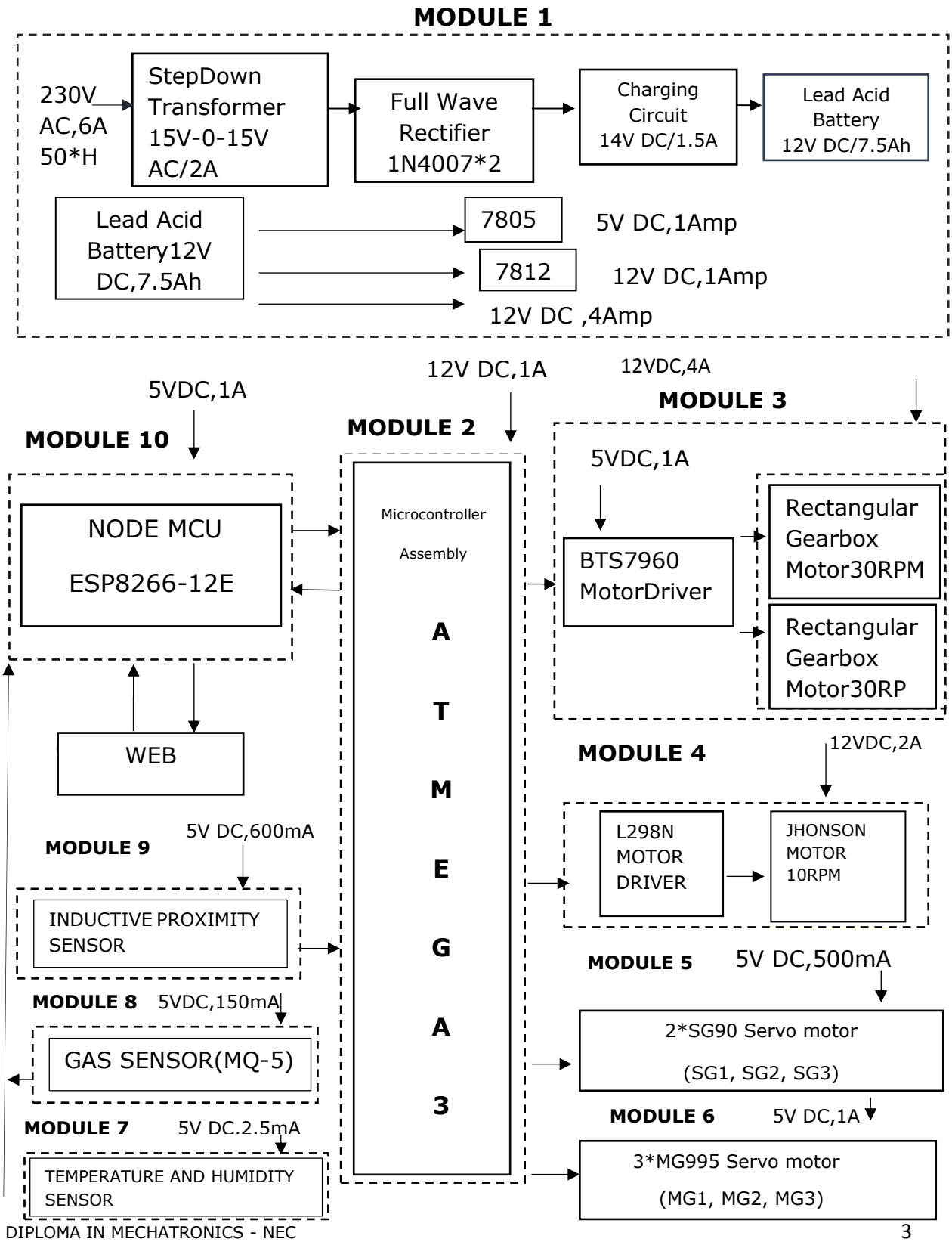
- To design a speed control system for the Robotic Rover
- Pick and place the objects using manipulator
- To implement wireless android application to control the Robotic Rover
- To detect gases in surrounding (LPG, I-Butane, Methane, Hydro gen, Alcohol)
- To display temperature and humidity level
- To sense whether the object is metallic or non-metallic

PROJECT TARGET

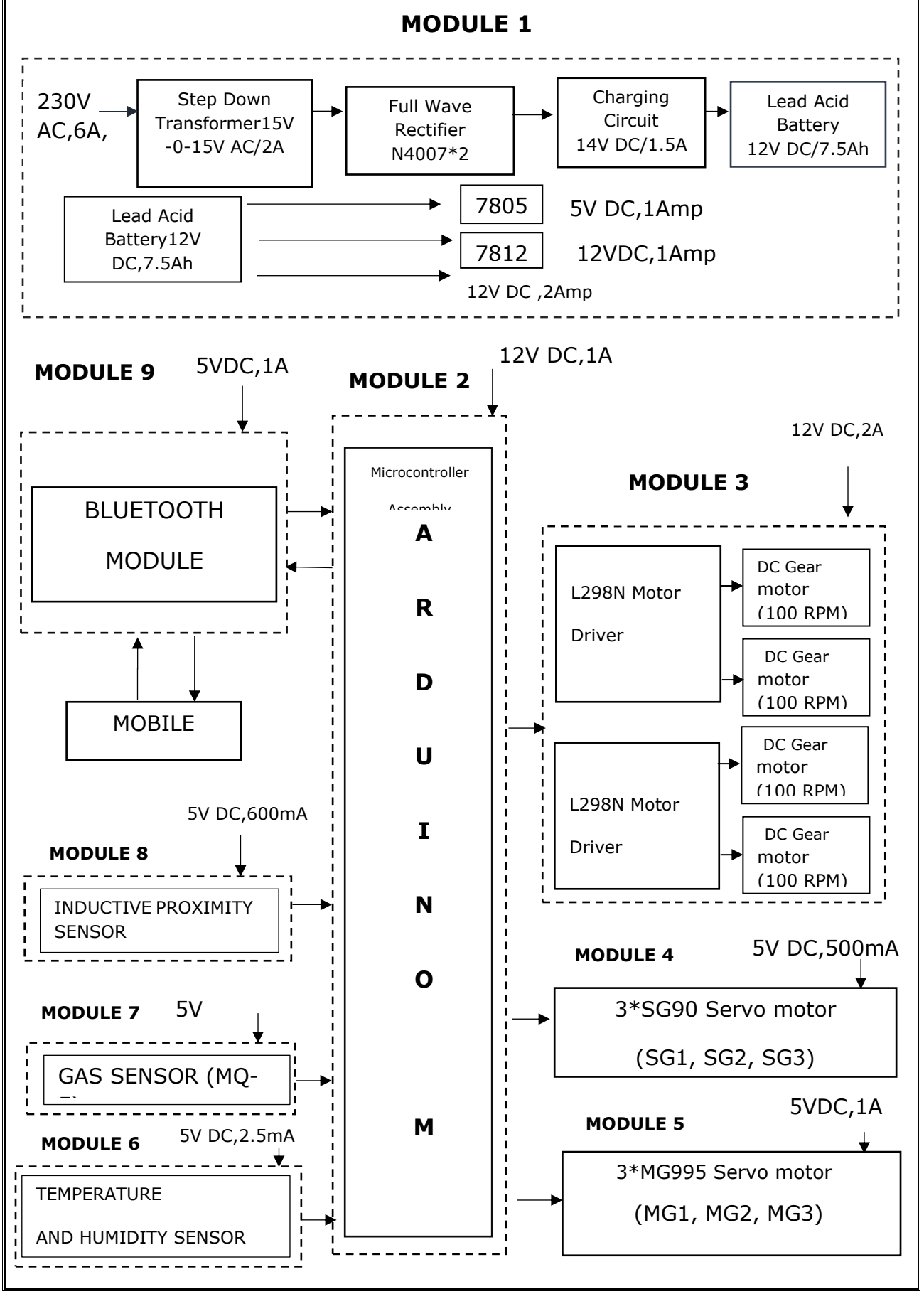
To create a wireless based Robotic Rover which can move an object from one place to another place and also to an unsustainable condition or environment.

CHAPTER 3

EXISTING BLOCK DIAGRAM



IMPROVISED BLOCK DIAGRAM



CHAPTER 4

COMPARISION OF EXISTING AND IMPROVISED

BLOCK DIAGRAM

EXISTING	IMPROVISED
1)In this we are using Node-MCU to communicate with the Arduino uno. The main disadvantage is, it required internet to connect to client.	1)In this we are using Bluetooth Module to communicate with the Arduino MEGA. The main advantage is, it required a mobile application to connect without internet
2)In this we are using BTS7960 motor Driver to drive the motor. The main Disadvantage is, it required more ports to drive a motor.	2) In this we are using L298N motor driver to drive the DC Gear motor. The main advantage is, it required less ports to drive a DC Gear motor.
3)In this we are using chain drive mechanism to move the rover. The main Disadvantage is, it will take more radius and angle while taking directions.	3)In this we are using Wheels. The main Advantage is, it has no limitation like chain drive mechanism.

CHAPTER 5

BLOCK DIAGRAM DESCRIPTION

MODULE 1: POWER SUPPLY & CHARGING CIRCUIT 12V DC/1A ,12V DC/4A & 5V DC/1A:

- In Robotic Rover 12V & 5V DC power supply is used to supply power to equipment's where 12V power is required for motor drivers and motors and 5V power is required for sensors, microcontroller and Servo motor.
- It supplies power to motor driver, Arduino microcontroller module, Sensors, Node MCU.

MODULE 2: ARDUINO MEGA 2560:

- The Arduino MEGA 2560 is designed for projects that require m ore I/O lines, more sketch memory and more RAM.
- With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects.
- The Arduino Mega 2560 is programmed using the software (IDE) our Integrated Development Environment common to all our boards and running both online and offline.

MODULE 3: JOHNSON MOTOR WITH L298N MOTOR DRIVER

- It is a simple DC motor featuring metal gearbox for driving the shaft of the motor.

- It is a mechanically commutated electric motor which is powered from DC supply. The Johnson Geared Motors are known for their compact size and massive torque-speed characteristic.
- The motor will run smoothly between the voltage range 6V to 18V DC and give you 10 RPM at 12V supply. It provides the massive torque of 12.5 kg-cm at 10 RPM.

L298N MOTOR DRIVER:

- This dual bidirectional motor driver, is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit.
- The circuit will allow you to easily and independently control two motors of up to 2A each in both directions.

MODULE 4: SG-90 SERVO MOTOR:

- The TowerPro SG90 9g Mini Servo is 180° rotation servo.
- It is a Digital Servo Motor which receives and processes PWM signal faster and better.
- It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external forces.

MODULE 5: MG995 SERVO MOTOR:

- The MG995 is a high torque, digital metal geared servo.
- It comes in a standard size and its metal gears mean when the motor is in a jam, the gears aren’t likely to strip.
- This servo will rotate up to 90 degrees.

MODULE 6: DHT11 (TEMPERATURE AND HUMIDITY SENSOR):

- DHT11 Temperature and Humidity Sensor.
- This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability.
- It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability.

MODULE 7: MQ-5 (GAS SENSOR):

- The MQ5 Gas Sensor module is useful for gas leakage detecting.
- It can detect LPG, i-butane, methane, alcohol, Hydrogen, CO2.
- The sensitivity can be adjusted using the on-board potentiometer, and you'd use this sensor by reading the analog pin to which it is connected.

MODULE 8: INDUCTIVE PROXIMITY SENSOR:

- An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects.
- An inductor develops a magnetic field when a current flow through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes.
- This effect can be used to detect metallic objects that interact with a magnetic field.
- Non-metallic substances such as liquids or some kinds of dirt do not interact with the magnetic field.

MODULE 9: BLUETOOTH MODULE (HC-05):

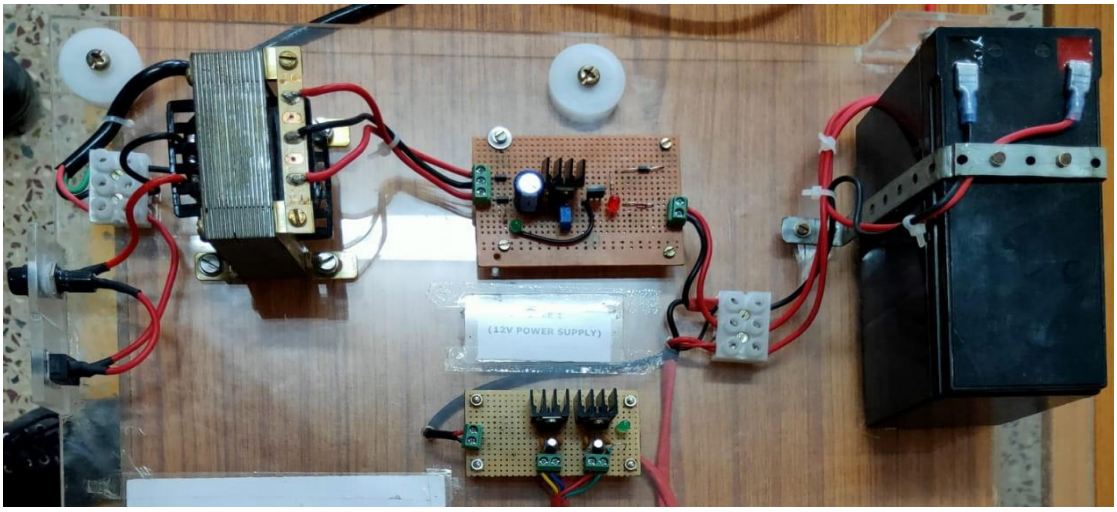
- The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed.
- We can operate the device in either of these two modes by using the key pin as explained in the pin description.
- It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP).
- Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU

MODULE 01

POWER SUPPLY & CHARGING CIRCUIT

(DC 12V/2A & DC 5V/1A)

CONTENTS



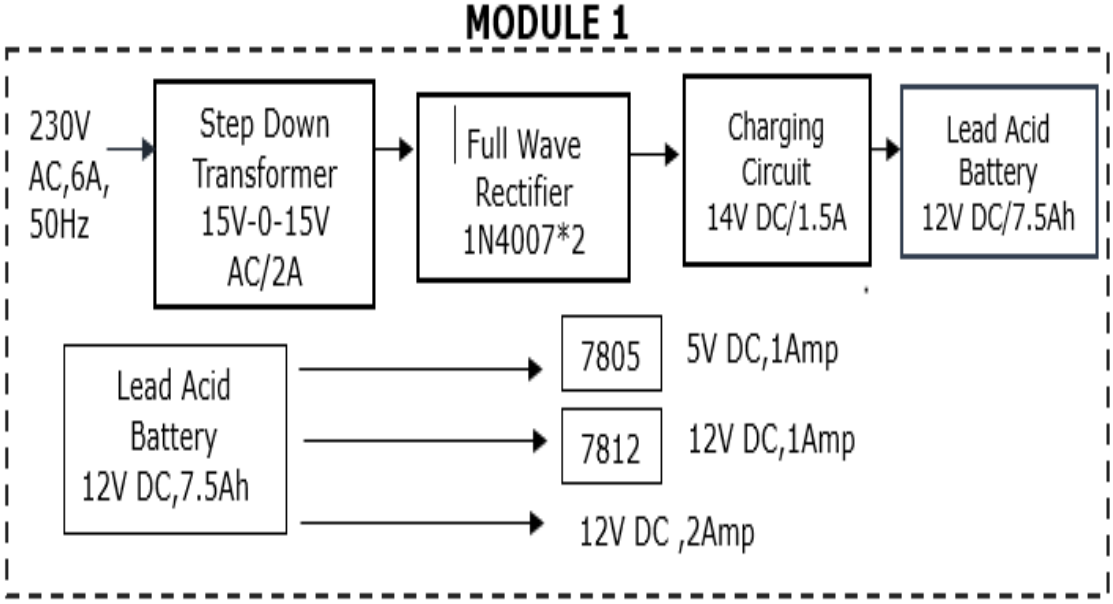
CHAPTER 6

6.0 POWER SUPPLY & CHARGING CIRCUIT

6.1 DESCRIPTION

Step down transformer gives 15V-0-15V/2A AC to the center tap full wave rectifier formed by diodes D1, D2. Rectifier will convert 30V AC to 19V DC. Capacitor C1 is introduced to filter the ripples of converted DC, so it used as filter as well as backup capacitor. To remove the ripple voltage. The Rectifier is connected to the capacitors 1000uf,50V and they are connected to regulator LM317 for regulating the voltage to 13.5v for charging the battery and a freewheeling is used to stop the back current from the battery to protect the circuit. In this circuit we are used auto cutoff system to overcome the problem of overcharging.

6.2 BLOCK DIAGRAM



BLOCK DIGRAM DESCRIPTION

INPUT

The input 230V/50Hz is given to the transformer.

STEPDOWN TRNSFORMER

A Step-Down Transformer is a device which converts high primary voltage to a low secondary voltage. In a Step-Down Transformer, the primary winding of a coil has more turns than the secondary winding.

CENTER-TAP FULL WAVE RECTIFIER

A Full Wave Rectifier is a circuit, which converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other conducts during the other half cycle of the applied ac voltage.

FILTER

The pulsating output of the rectifiers has an average DC value and an AC portion that is called ripple voltage. Filter capacitors reduce the amount of ripple voltage to a level that is acceptable.

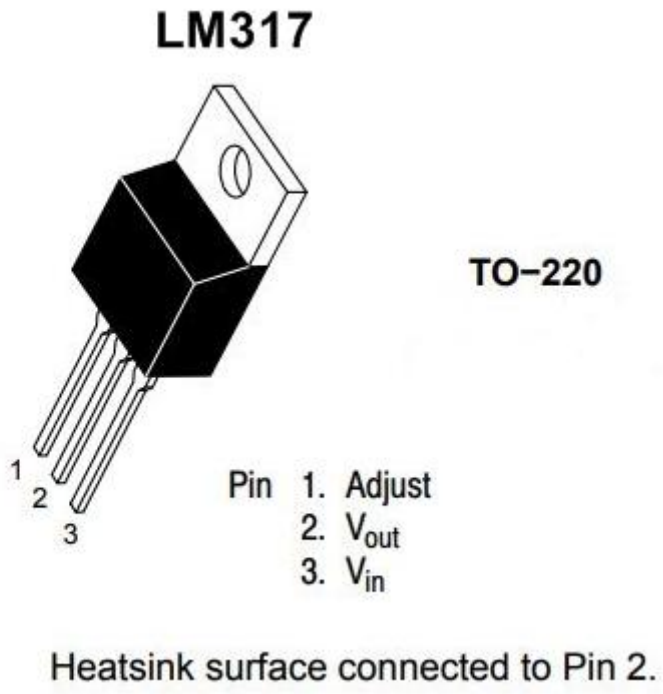
REGULATOR

We are using regulator ICs to maintain a constant output voltage in a power supply circuit. We are using regulator IC LM317 for getting 13V respectively through variable resistor to this we are connected to the battery.

For 12V,1Amp supply we are using 7812 for getting 12V respectively, and for 5V,1Amp supply we are using 7805 for getting 5V respectively.

LM317:

The LM317 is an adjustable 3−terminal positive voltage regulator capable of supplying in excess of 1.5 A over an output voltage range of 1.2 V to 37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage.



Features

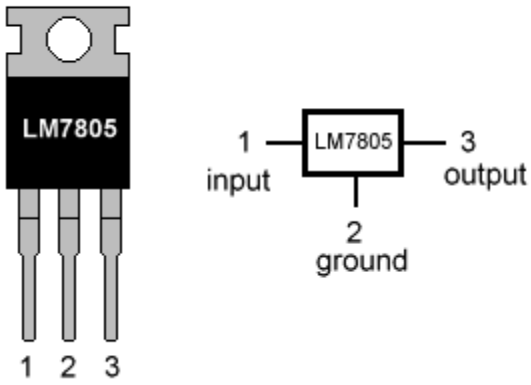
- Output Voltage Range Adjustable From 1.25 V to 37 V
- Output Current Greater Than 1.5 A
- Internal Short-Circuit Current Limiting
- Thermal Overload Protection

- Output Safe-Area Compensation

LM7805:

7805 is a 5V fixed three terminal positive voltage regulator IC. The IC has features such as safe operating area protection, thermal shut down, internal current limiting which makes the IC very rugged. Output currents up to 1A can be drawn from the IC provided that there is a proper heat sink.

LM7805 PINOUT DIAGRAM

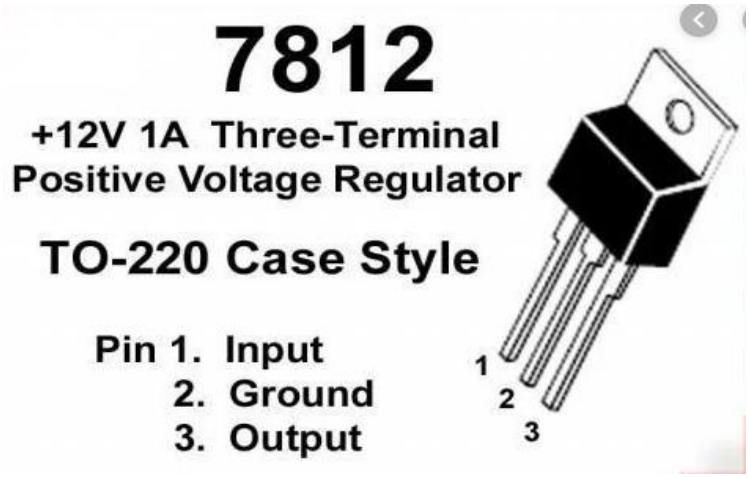


Features

- 5V Positive Voltage Regulator
- Minimum Input Voltage is 7V
- Maximum Input Voltage is 25V
- Operating current (I_Q) is 5mA
- Internal Thermal Overload and Short circuit current limiting protection is available.
- Junction Temperature maximum 125 degree Celsius
- Available in TO-220 and KTE package

LM7812:

7812 is a 12V fixed three terminal positive voltage regulator IC. The IC has features such as safe operating area protection, thermal shut down, internal current limiting which makes the IC very rugged. Output currents up to 1A can be drawn from the IC provided that there is a proper heat sink.



Features

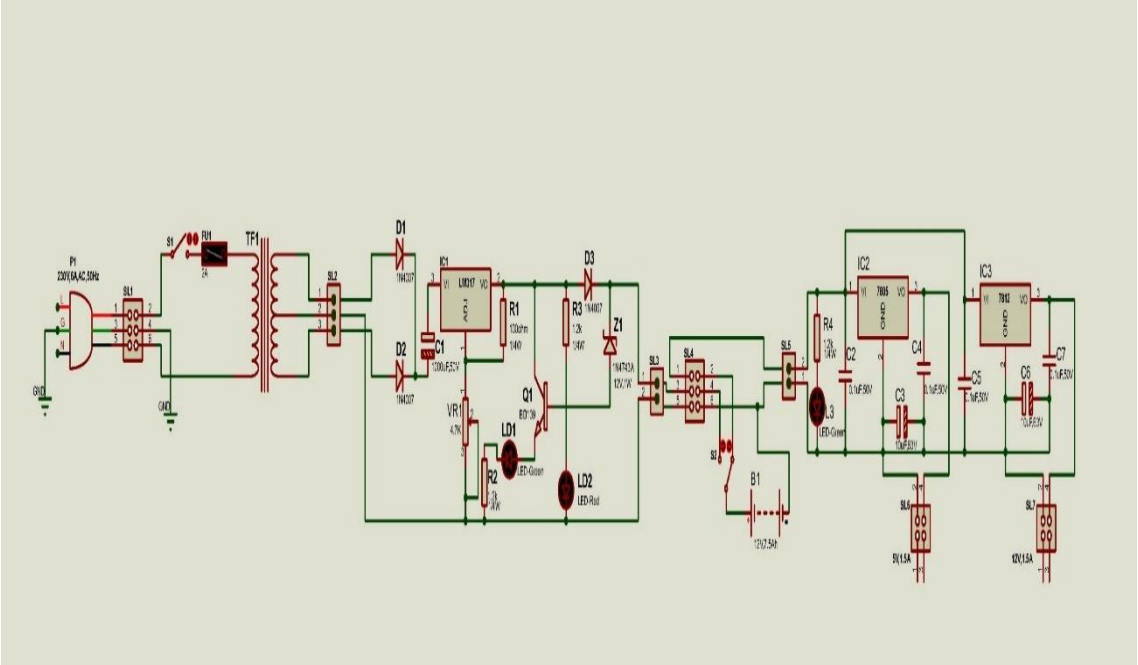
- Fixed voltage linear regulator
- 14-35V input voltage range
- 12V fixed output voltage
- 1A continuous current
- TO-220 package

Output:

The output of power supply is 12VDC/1A.

The output of power supply is 5 VDC/1A.

6.3 SCHEMATIC DIAGRAM



6.4 DESIGN

CHARGING CIRCUIT REQUIREMENTS:

Voltage = 15V DC

Current = 1A

TRANSFORMER SPECFICATION:

Voltage =15V-0-15V AC

Current =2A

For Center Tap Full Wave Rectifier:

VDC = Pulsating DC Voltage (Volts)

Vmax = V peak Voltage (Volts)

VDC = 2xVmax/ϖ

VDC =0.636xVmax

VDC =0.636x30

VDC=19.108V

As per the data sheet the Diode is 1N4007

Iout = Output Current (Amp)

Iout = 1A

In center tap full wave rectifier the frequency gets double

F=2 x F

Value of the capacitor:

C = Iout/F x Vripple

Vripple =20% of VDC

C = 1Amp/100HzX0.95

C = 950 µf

C =~ 1000 µf

Working Voltage of Capacitor:

V1 = Operating /Working Voltage

V1 =DC Voltage +25% (extra 25% for reduce the ripple voltage)

= 19+4.75

= 23.75

= 24V

Capacitor standard Voltage we are consider 50V

V1=50V

VOLTAGE REGULATOR LM317:

Consider:

Vin = 19V

Vout = Output Voltage(Volts)

R1=100 Ω

R2=70 Ω

Vout = 1.25 (R1/R1+R2) Vin

= 1.25(100Ω/100 Ω +70 Ω) Vin

= 1.25(100Ω/100 Ω +70 Ω) X19V

= 1.25 X 11,1764

= 13.97V

Vout=~14V

For R2, R3, R4 (Ohm's Law)

R = V/I

R = 14/20mA

R = 0.7 X 1000

R = 700 Ω

Power Rating for Resistor:

I = 20mA

V = 14V

P = V x I

= 14(20mA)

= 280 x 10^-3

= 0.28 W

P =~0.25W

For Heatsink:

PD = (Vin-Vout) X I out

PD = power dissipation (Watt)

Vin = Input voltage (Volts)

Vout = output voltage (Volts)

Iout = output current (Amp)

PD = (19-14V) X 1Amp

= 5W

θJA = Total junction to ambient thermal resistance (°C/W)

TJ =Junction temperature (°C)

TA = Ambient temperature (°C)

θJA (total) = TJ-TA/PD

= 125°C -23 °C/5W

= 102/5W

θJA=20.4 °C/W

6.5 BILL OF MATERIALS

MODULES

Sl.no	Item description	Symbol	Qty	Price(☐)
Module 1 (Power Supply & Charging Circuit)	(i) 3 core patch chord 230V AC,6A,50Hz	P1	1	50
	(ii) Connector 6 pin Poly carbonate,10A	SL1, SL4	2	12
	(iii) Connector 3 pin Poly carbonate,10A	SL2	1	3
	(iv) Connector 2 pin Poly carbonate,5A	SL3, SL5, SL6, SL7	4	8
	(v) Switch (Rocker SPST) 230V AC,6A	S1	1	20
	(vi)Fuse & Fuse holder (Glass Catridge Fuse 2A, Fuse holder round screw,6A, AC)	FU1	1	50

	(vii) Transformer Center Tap (15-0-15)V AC,2A	TF1	1	250
	(viii) Diode: 1N4007 Axial Type	D1, D2, D3	3	9
	(ix)Electrolytic Capacitor (50V,1000uf) Radial Type	C1	1	8
	(x) Carbon film Resistor (10k,1/4W CFR, ±5%)	R1, R2, R3, R4	4	4
	(xi) Trimpot (10k,1/2W)	VR1	1	10
	(xii)LM317	IC1	1	15
	(xiii) Heat sink: E3A-T220-25E	-	3	45
	(xiv) NPN Transistor: BD139	Q1	1	10
	(xv) Zener Diode: 1N4742 Axial Type	Z1	1	2
	(xvi) LED 5mm radial type (3V,20mA)	LD1, LD2, LD3	3	10

	(xvii) Lead Acid Battery (12V,7.5Ah)	B1	1	700
	(xviii)Ceramic Capacitor (104) Radial Type (50V,0.1uf)	C2, C4, C5, C7	4	4
	(xix) Electrolytic Capacitor (63V,10uf) Radial Type	C3, C6	2	12
	(xx) DC +ve Regulator 7805,1A	IC2	1	10
	(xxi) DC +ve Regulator 7812,1A	IC3	1	10
	(xxii) Toggle switch: SPDT, SDT-106D-0-1(6A,125VAC)	S2	1	30
	TOTAL			1282

MODULE 02

ARDUINO MEGA 2560

CONTENTS

CHAPTER 7

MICROCONTROLLER ASSEMBLY MODULE

7.0 ARDUINO MEGA 2560

7.1 DESCRIPTION

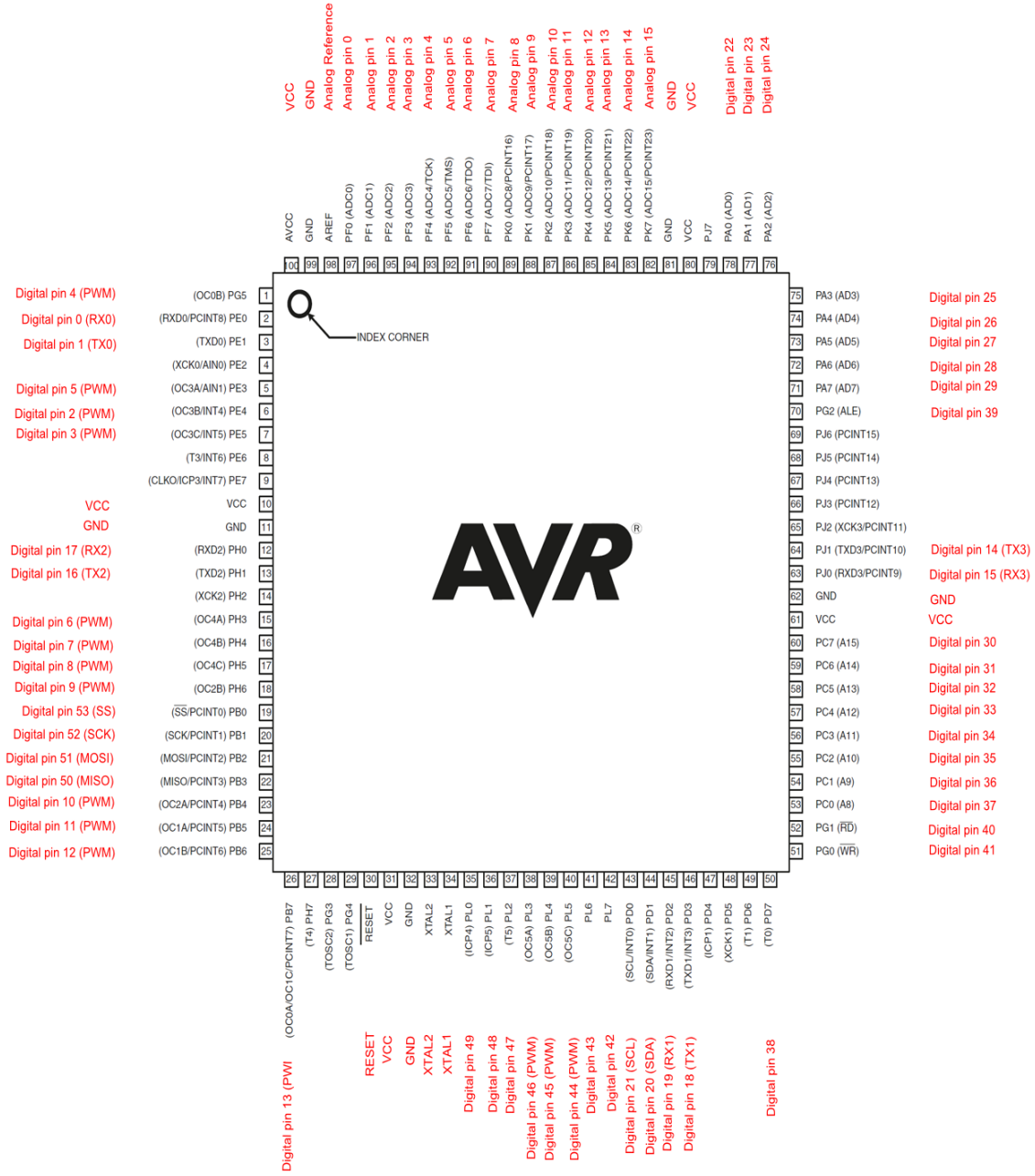
The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. The Arduino Mega 2560 is programmed using the software (IDE) our Integrated Development Environment common to all our boards and running both online and offline.

7.2 FEATURES OF ARDUINO MEGA 2560

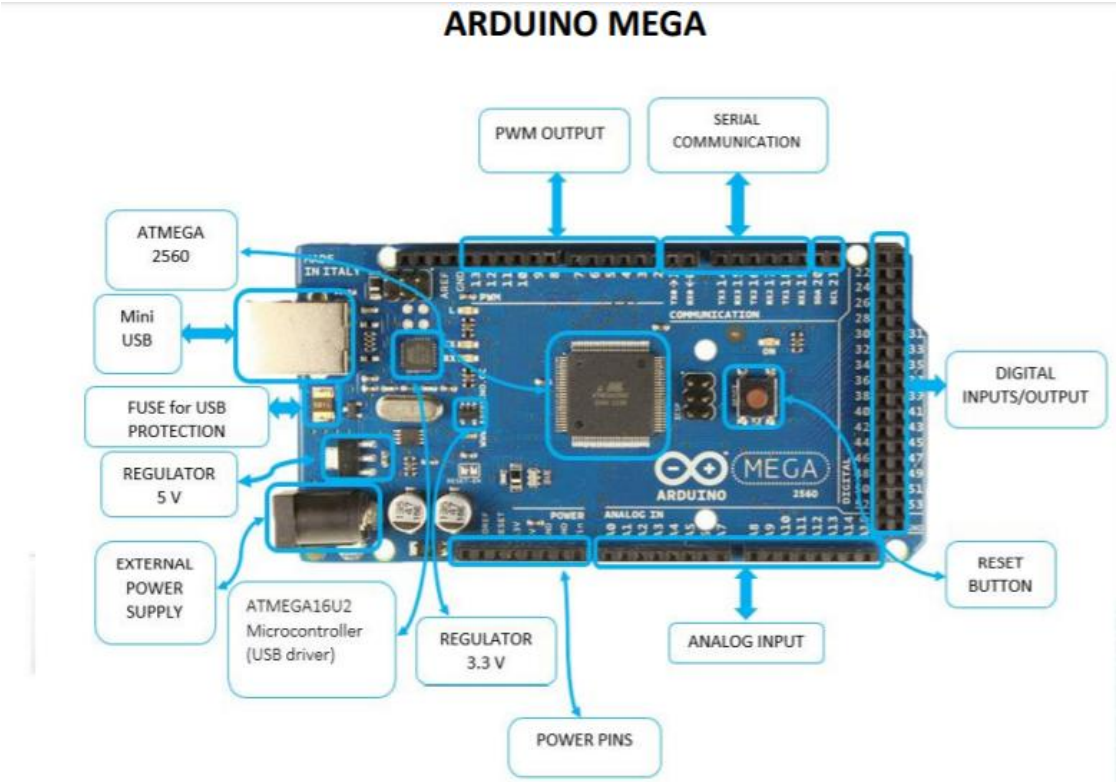
- The ATmega2560 is a Microcontroller
- The operating voltage of this microcontroller is 5volts
- The recommended Input Voltage will range from 7volts to 12volts
- The input voltage will range from 6volts to 20volts
- The digital input/output pins are 54 where 15 of these pins will supply PWM o/p.
- Analog Input Pins are 16
- DC Current for each input/output pin is 40 mA
- DC Current used for 3.3V Pin is 50 mA
- Flash Memory like 256 KB where 8 KB of flash memory is used with the help of bootloader
- The static random access memory (SRAM) is 8 KB

- The electrically erasable programmable read-only memory (EEPROM) is 4 KB
- The clock (CLK) speed is 16 MHz
- The USB host chip used in this is MAX3421E

PIN CONFIGURATION:



PIN DESCRIPTION:



PIN DIAGRAM EXPANATION:

VIN:

The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V:

The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

3V3:

A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND:

Ground pins.

The ATmega2560 has 256 KB of flash memory for storing code (of which 8 KB is used for the bootloader), 8 KB of SRAM and 4 KB of EEPROM (which can be read and written with the EEPROM library).

Each of the 54 digital pins on the Mega can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50k Ohms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX):

Used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts:

2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2). These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM:

0 to 13. Provide 8-bit PWM output with the analog Write () function.

SPI:

50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language. The SPI pins are also broken out on the ICSP header, which is physically compatible with the Demilanove and Diecimila.

LED:

13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

I2C:

20 (SDA) and 21 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website). Note that these pins are not in the same location as the I2C pins on the Duemilanove.

AREF:

Reference voltage for the analog inputs. Used with analog Reference ().

Reset:

Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

PIN MAPPIMG TABLE:

Pin Number	Pin Name	Mapped Pin Name
1	PG5 (OC0B)	Digital pin 4 (PWM)
2	PE0 (RXD0/PCINT8)	Digital pin 0 (RX0)
3	PE1 (TXD0)	Digital pin 1 (TX0)
4	PE2 (XCK0/AIN0)	
5	PE3 (OC3A/AIN1)	Digital pin 5 (PWM)

6	PE4 (OC3B/INT4)	Digital pin 2 (PWM)
7	PE5 (OC3C/INT5)	Digital pin 3 (PWM)
8	PE6 (T3/INT6)	
9	PE7 (CLKO/ICP3/INT7)	
10	VCC	VCC
11	GND	GND
12	PH0 (RXD2)	Digital pin 17 (RX2)
13	PH1 (TXD2)	Digital pin 16 (TX2)
14	PH2 (XCK2)	
15	PH3 (OC4A)	Digital pin 6 (PWM)
16	PH4 (OC4B)	Digital pin 7 (PWM)
17	PH5 (OC4C)	Digital pin 8 (PWM)
18	PH6 (OC2B)	Digital pin 9 (PWM)
19	PB0 (SS/PCINT0)	Digital pin 53 (SS)
20	PB1 (SCK/PCINT1)	Digital pin 52 (SCK)
21	PB2 (MOSI/PCINT2)	Digital pin 51 (MOSI)
22	PB3 (MISO/PCINT3)	Digital pin 50 (MISO)
23	PB4 (OC2A/PCINT4)	Digital pin 10 (PWM)
24	PB5 (OC1A/PCINT5)	Digital pin 11 (PWM)
25	PB6 (OC1B/PCINT6)	Digital pin 12 (PWM)

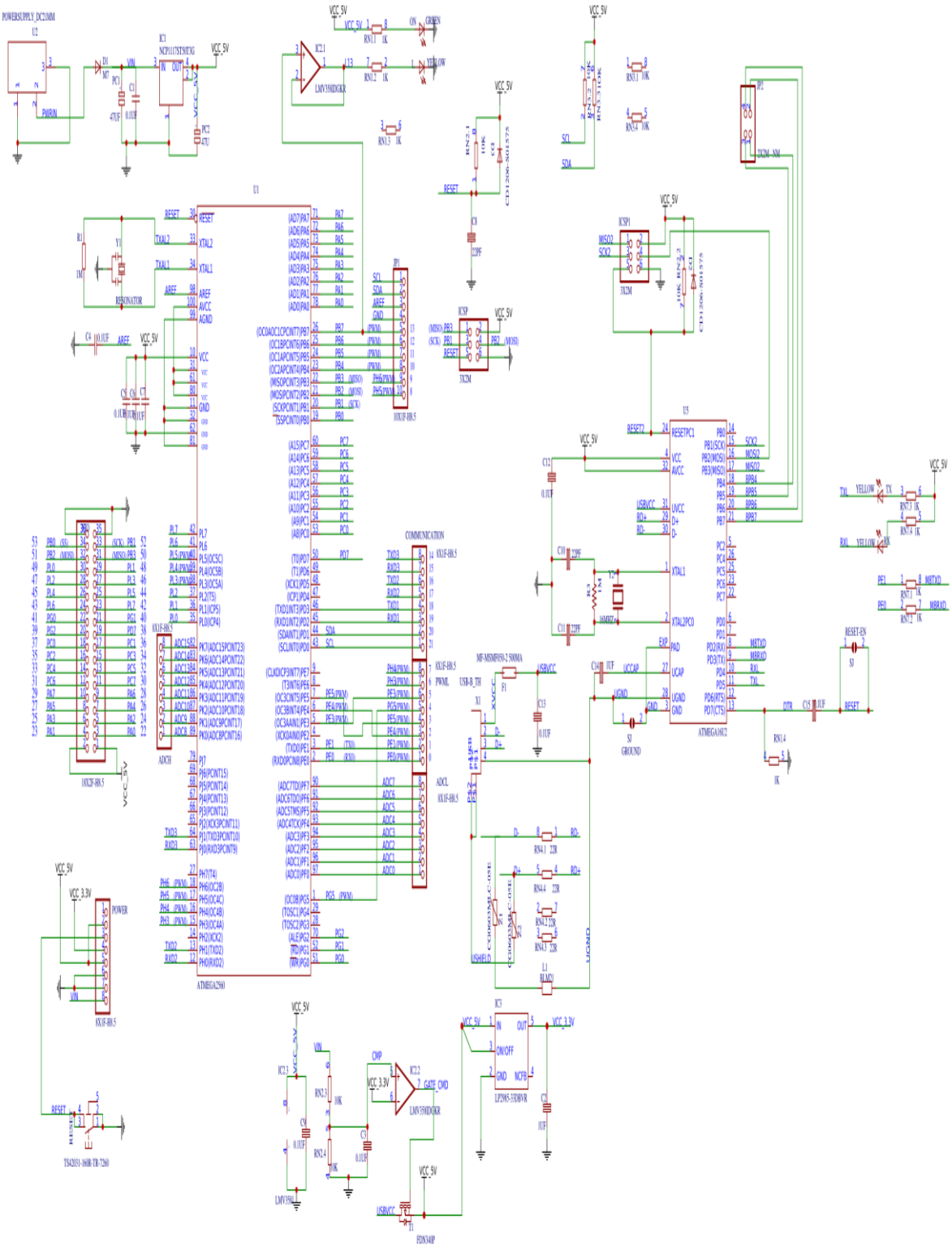
26	PB7 (OC0A/OC1C/PCINT7)	Digital pin 13 (PWM)
27	PH7 (T4)	
28	PG3 (TOSC2)	
29	PG4 (TOSC1)	
30	RESET	RESET
31	VCC	VCC
32	GND	GND
33	XTAL2	XTAL2
34	XTAL1	XTAL1
35	PL0 (ICP4)	Digital pin 49
36	PL1 (ICP5)	Digital pin 48
37	PL2 (T5)	Digital pin 47
38	PL3 (OC5A)	Digital pin 46 (PWM)
39	PL4 (OC5B)	Digital pin 45 (PWM)
40	PL5 (OC5C)	Digital pin 44 (PWM)
41	PL6	Digital pin 43
42	PL7	Digital pin 42
43	PD0 (SCL/INT0)	Digital pin 21 (SCL)
44	PD1 (SDA/INT1)	Digital pin 20 (SDA)
45	PD2 (RXDI/INT2)	Digital pin 19 (RX1)
46	PD3 (TXD1/INT3)	Digital pin 18 (TX1)

47	PD4 (ICP1)	
48	PD5 (XCK1)	
49	PD6 (T1)	
50	PD7 (T0)	Digital pin 38
51	PG0 (WR)	Digital pin 41
52	PG1 (RD)	Digital pin 40
53	PC0 (A8)	Digital pin 37
54	PC1 (A9)	Digital pin 36
55	PC2 (A10)	Digital pin 35
56	PC3 (A11)	Digital pin 34
57	PC4 (A12)	Digital pin 33
58	PC5 (A13)	Digital pin 32
59	PC6 (A14)	Digital pin 31
60	PC7 (A15)	Digital pin 30
61	VCC	VCC
62	GND	GND
63	PJ0 (RXD3/PCINT9)	Digital pin 15 (RX3)
64	PJ1 (TXD3/PCINT10)	Digital pin 14 (TX3)
65	PJ2 (XCK3/PCINT11)	
66	PJ3 PCINT12)	
67	PJ4 (PCINT13)	

68	PJ5 (PCINT14)	
69	PJ6 (PCINT 15)	
70	PG2 ALE)	Digital pin 39
71	PA7 (AD7)	Digital pin 29
72	PA6 (AD6)	Digital pin 28
73	PA5 (AD5)	Digital pin 27
74	PA4 (AD4)	Digital pin 26
75	PA3 (AD3)	Digital pin 25
76	PA2 (AD2)	Digital pin 24
77	PA1 (AD1)	Digital pin 23
78	PA0 (AD0)	Digital pin 22
79	PJ7	
80	VCC	VCC
81	GND	GND
82	PK7 (ADC15/PCINT23)	Analog pin 15
83	PK6 (ADC14/PCINT22)	Analog pin 14
84	PK5 (ADC13/PCINT21)	Analog pin 13
85	PK4 (ADC12/PCINT20)	Analog pin 12
86	PK3 (ADC11/PCINT19)	Analog pin 11
87	PK2 (ADC10/PCINT18)	Analog pin 10
88	PK1 (ADC9/PCINT17)	Analog pin 9

89	PK0 (ADC8/PCINT16)	Analog pin 8
90	PF7 (ADC7/TDI)	Analog pin 7
91	PF6 (ADC6/TDO)	Analog pin 6
92	PF5 (ADC5/TMS)	Analog pin 5
93	PF4 (ADC4/TCK)	Analog pin 4
94	PF3 (ADC3)	Analog pin 3
95	PF2 (ADC2)	Analog pin 2
96	PF1 (ADC1)	Analog pin 1
97	PF0 (ADC0)	Analog pin 0
98	AREF	Analog Reference
99	GND	GND
100	AVCC	VCC

7.3 SCHEMATIC DIAGRAM:



7.4 BILL OF MATERIAL

SL NO	Item description	symbol	Qty	Price(□)
1	ATMEGA2560	U1	1	27
2	POWERSUPPLY_DC21MM	U2	1	19
	47UF	PC1	1	3
4	0.1UF	C1, C4, C5, C6, C7, C3, C9, C12, C13, C15	10	7
5	RESONATOR	Y1	1	5
6	NCP1117ST50T3G	IC1	1	6
7	1M	R1, R3	2	3
8	M7	D1	1	6
9	18X2F-H8.5	XIO	1	6
10	8X1F-H8.5	POWER, ADCH, COMMUNICATION, PWML, ADCL	5	20
11	TS42031-160R-TR-7260	RESET	1	5
12	10X1F-H8.5	JP1	1	6

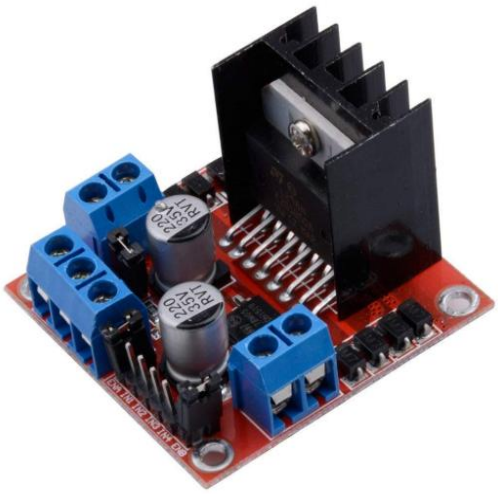
13	CD1206-S01575	D3, D2	2	8
14	22PF	C8, C10, C11	3	3
15	3X2M	ICSP, ICSP1	2	8
16	1UF	C2, C14	2	2
17	LP2985-33DBVR	IC3	1	9
18	FDN340P	T1	1	50
19	2X2M – NM	JP2	1	33
20	16MHZ	Y2	1	19
21	USB-B_TH	X1	1	80
22	MF-MSMF050-2 500MA	F1	1	
23	CG0603MLC-05E	Z1, Z2	2	49
24	BLM21	L1	1	12
25	SJ	GROUND, RESET-EN	2	30
26	ATMEGA16U2	U5	1	16
27	47U	PC2	1	17

28	GREEN	ON	1	2
29	YELLOW	L, TX, RX	3	2
30	1u	C16, C18	2	1
31	1u	C17, C19	2	2
32	1N4448	D4, D5	2	8
33	1k	R2, R4	2	2
34	Оптопара	U3, U4	2	26
35	BC847AWT1G	Q1, Q2	2	50
36	LMV358IDGKR	IC2	1	69
37	1K	RN1, RN7	2	12
38	10K	RN2, RN3	2	12
39	22R	RN4	1	12
TOTAL			700	

MODULE 03

JOHNSON MOTOR WITH L298N MOTOR DRIVER

CONTENTS



CHAPTER 8

8.0 JOHNSON MOTOR WITH L298N MOTOR DRIVER

8.1 DESCRIPTION

L298N MOTOR DRIVER

This dual bidirectional motor driver, is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, TTL logic gates, relays, etc. This board equipped with power LED indicators, on-board +5V regulator and protection diodes.

FEATURES

- Input Voltage: 3.2V~40Vdc. Brief Data:
- Driver: L298N Dual H Bridge DC Motor Driver
- Power Supply: DC 5 V - 35 V
- Peak current: 2 Amp
- Operating current range: 0 ~ 36mA
- Low: -0.3V ≤ Vin ≤ 1.5V.
- High: 2.3V ≤ Vin ≤ Vss.
- Maximum power consumption: 20W (when the temperature T = 75 ℃).

JOHNSON MOTOR:

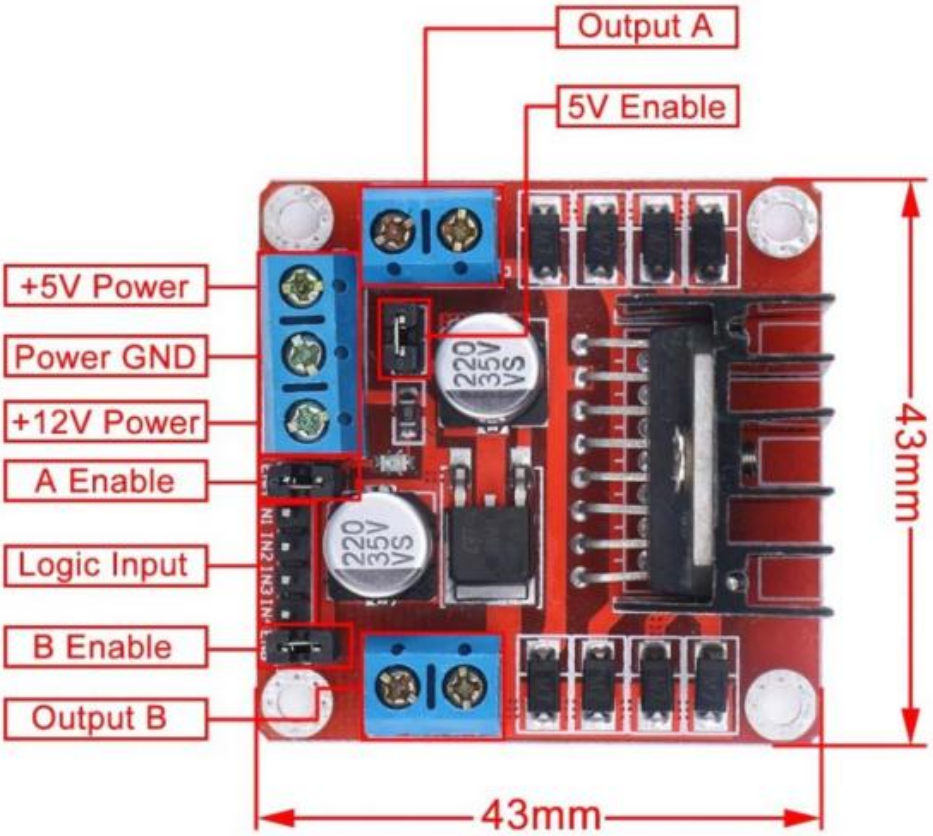
It is a simple DC motor featuring metal gearbox for driving the shaft of the motor, so it is a mechanically commutated electric motor which is powered from DC supply. The Johnson Geared Motors are known for their compact size and massive torque-speed characteristic.

The Johnson Motor comes with side shaft also known as an off-centered shaft and six M3 mounting holes. The shaft of the motor equips metal bushes which makes these DC gear motors Shaft wear resistant. The shaft of the motor has a hole for better coupling.

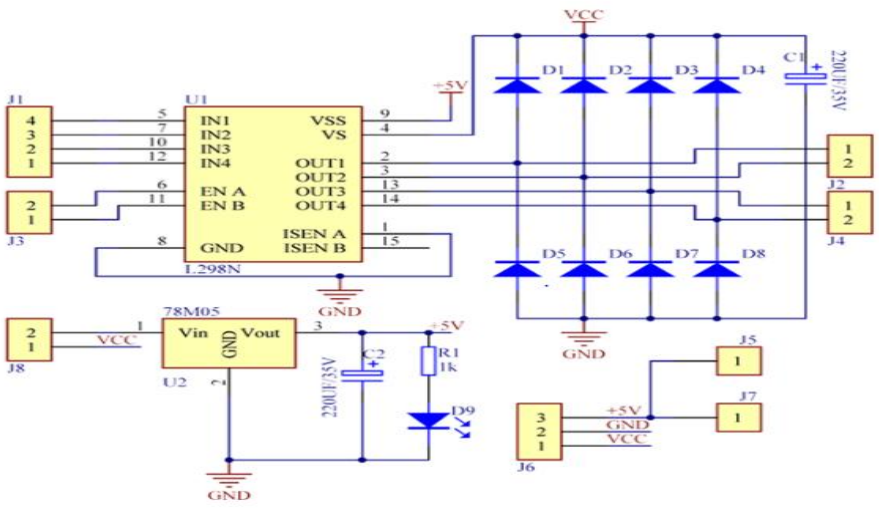
FEATURES:

- 10RPM 12V DC motors with Metal Gearbox and Metal Gears
- 18000 RPM base motor
- 6mm Dia shaft with M3 thread hole
- Gearbox diameter 37 mm.
- Motor Diameter 28.5 mm
- Length 63 mm without shaft
- Shaft length 30mm
- 180gm weight
- 120kgcm Holding Torque
- No-load current = 800 mA, Load current = upto 7.5 A(Max)
- Recommended to be used with DC Motor Driver 20A or Dual DC Motor Driver 20A

8.2 PIN DIAGRAM:



8.3 SCHEMATIC DIAGRAM:



8.4 BILL OF MATERIALS:

SL.NO	Item Description	Symbol	Qty	Price (☐)
1	L298	U2	1	20
2	L297DIL20-1	U1	1	5
3	KF301-5.0 2P	J3, J4, J5, J6, J7, J8	5	20
4	LM7805EE	U3	1	50
5	470uf	C1	1	2
6	220uf	C2	1	2
7	PIN 3	J1, J2	2	10
8	10k	R1, R2	2	2
9	CAP 0805	C4, C3	2	8
10	22uf	C5	1	2
11	1N4007	D1, D2, D3, D4, D5, D6, D7, D8	8	15
12	1 Ohm	R4, R10	2	3
13	22k	R5, R7	2	3
14	332 uf	C7	1	3
15	5kOhm	R6	1	2
TOTAL				147

TOTAL BILL OF MATERIALS:

SL.NO	Item Description	Symbol	Qty	Price (□)
1	Motor Driver (L298N)	L1	1	147
2	Johnson Motor	M1	1	150
TOTAL				297

MODULE 04

SG-90 SERVO MOTOR DRIVER

CONTENTS

CHAPTER 9

9.0 SG-90 SERVO MOTOR

9.1 DESCRIPTION

The TowerPro SG90 9g Mini Servo is 180° rotation servo. It is a Digital Servo Motor which receives and processes PWM signal faster and better. It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external forces.

9.2 PIN DIAGRAM:

9.3 FEATURES

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm

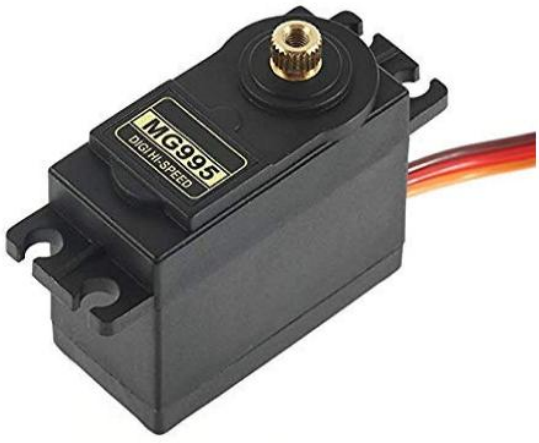
9.4 BILL OF MATERIALS

SL.NO	Item Description	Symbol	Qty	Price (☐)
1	Servo Motor (SG-90)	SM1, SM2	2	150X2
TOTAL				300

MODULE 05

MG995 SERVO MOTOR DRIVER

CONTENTS



CHAPTER 10

10.0 MG995 SERVO MOTOR

10.1 DESCRIPTION

The high-speed standard servo can rotate approximately 120 degrees (60 in each direction). We can use any servo code, hardware or library to control these servos, so gear box, especially since it will fit in small places. It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external forces.

10.2 PIN DIAGRAM

PIN CONFIGURATION

MG995 has three terminals as mentioned in pin diagram and the function of each pin is given below.

Pin	Name	Function
1	Signal pin (Orange pin)	The PWM signal which states the axis position is given through this pin.

2	VCC (Red pin)	Positive power supply for servo motor is given to this pin.
3	Ground (Brown pin)	This pin is connected to ground of circuit or power supply.

10.3 FEATURES:

- Weight: 55g
- Dimension: 40.7 × 19.7 × 42.9 mm
- Operating Speed (4.8V no load): 20sec / 60 deg
- Operating Speed (6.0V no load): 16sec / 60 deg (no load)
- Stall Torque (4.8V): 10kg/cm
- Stall Torque (6.0V): 12kg/cm
- Operation Voltage: 4.8 - 7.2Volts
- Gear Type: All Metal Gears
- Stable and shock proof double ball bearing design
- Dead band width: 5 μs
- Temperature range: 0 ºC – 55 ºC.

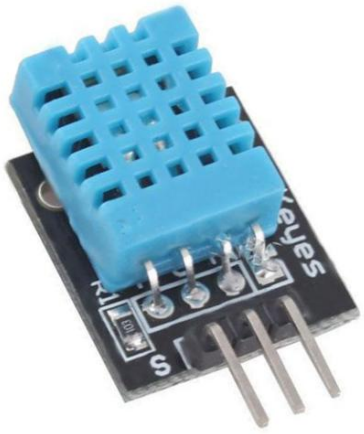
10.4 BILL OF MATERIALS

SL.NO	Item Description	Symbol	Qty	Price (☐)
1	Servo Motor (MG-995)	SM3, SM4, SM5	3	200X3
TOTAL				600

MODULE 06

DHT-11 (TEMPERATURE AND HUMIDITY SENSOR)

CONTENTS



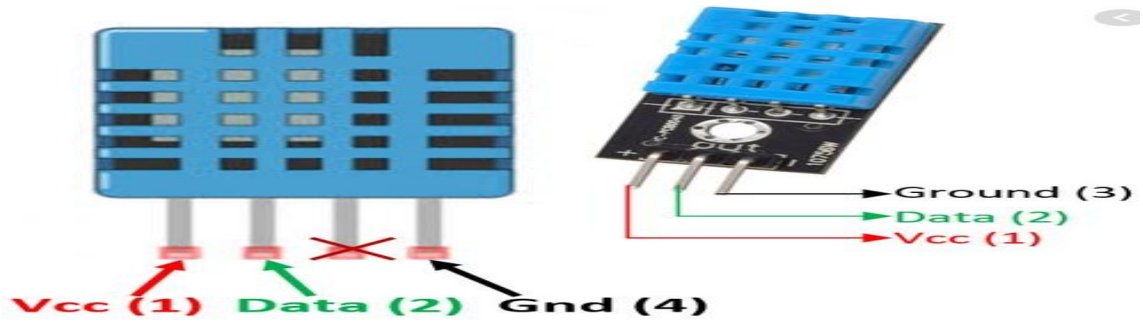
CHAPTER 11

11.0 DHT11 (TEMPERATURE AND HUMIDITY SENSOR)

11.1 DESCRIPTION:

It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. The only real downside of this sensor is you can only get new data from it once every 2 Sec. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and upto 20-meter signal transmission making it the best choice for various applications, including those most demanding ones.

11.2 PIN DIAGRAM:



PIN DISCRIPTION

Pin 1 is the VDD power supply 3.5～5.5V DC

Pin 2 is for DATA serial data, a single bus

Pin 2 NC, empty pin

Pin 4 GND ground, the negative power

11.3 FEATURES

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

11.4 BILL OF MATERIALS

SL.NO	Item Description	Symbol	Qty	Price (☐)
1	DHT-11	TS1	1	85
TOTAL				85

MODULE 07

MQ-5 (GAS SENSOR)

CONTENTS

CHAPTER 12

12.0 MQ-5 (GAS SENSOR)

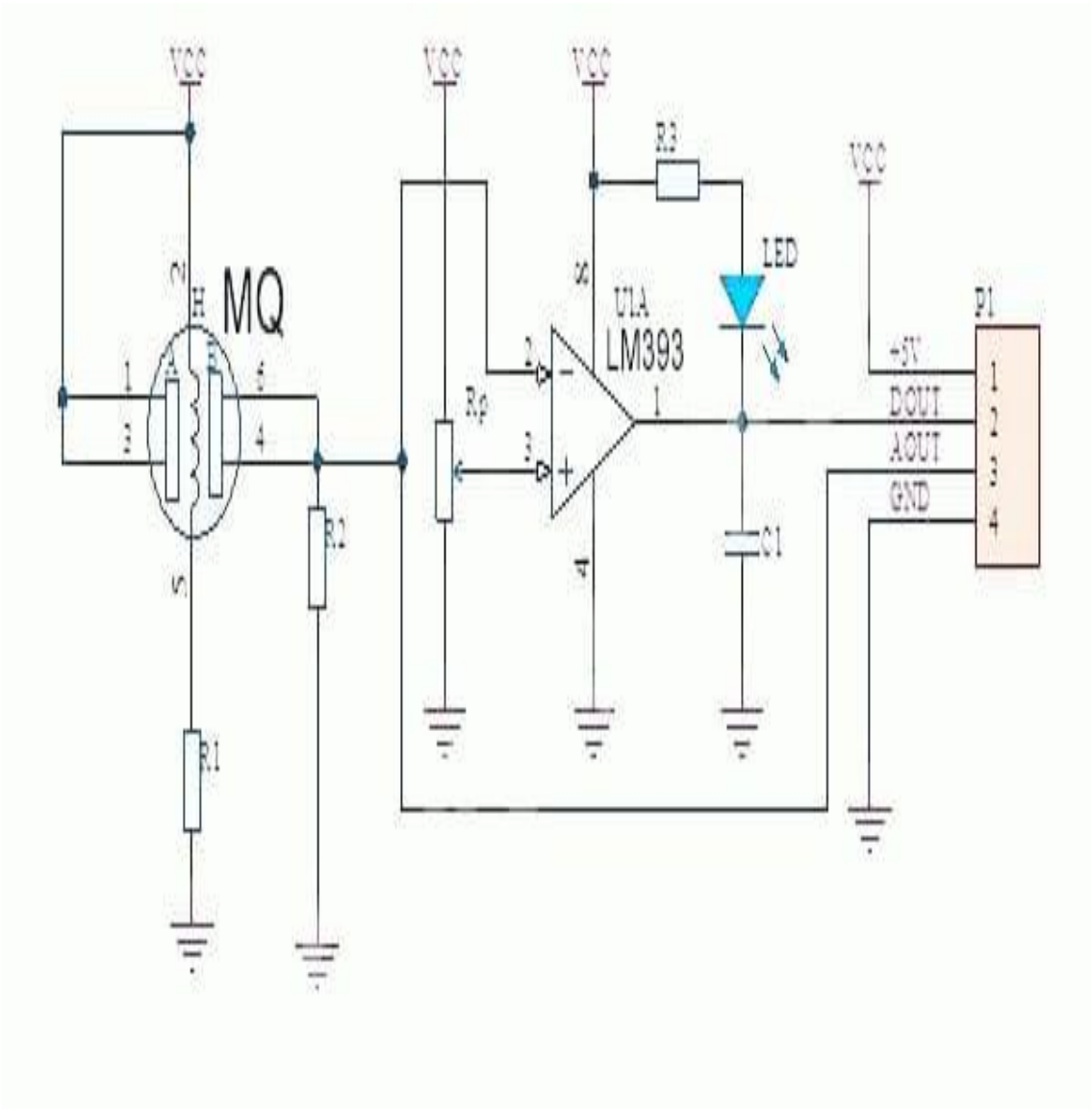
12.1 DESCRIPTION

The MQ5 Gas Sensor module is useful for gas leakage detecting. It can detect LPG, i-butane, methane, alcohol, Hydrogen, CO2. The sensitivity can be adjusted using the on-board potentiometer, and you'd use this sensor by reading the analog pin to which it is connected.

12.2 PIN DIAGRAM

Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

12.3 SCHEMATIC DIAGRAM:



12.4 BILL OF MATERIALS

SL.NO	Item Description	Symbol	Qty	Price (□)
1	LM393, Boost Converter	U1	1	10
2	2.7M ohm	R1	1	2
3	910K ohm	R2	1	2
4	10uH	L1	1	13
5	100uf	C1	1	2
6	100uf	C2	1	2
7	100nf	C3	1	2
8	1N5819, LED	D1	1	5
9	HDR2X3	P1	1	5
10	LM393	U2	1	40
11	LED	D2, D3	2	3
12	1uf	C4	1	3
13	1k ohm	R3, R4	2	3
14	SIP4	P2	1	2
15	4.7k ohm	R5	1	2
16	5R1 ohm	R6	1	2
17	100k ohm	R7	1	2
TOTAL				100

MODULE 08

INDUCTIVE PROXIMITY SENSOR

CONTENTS

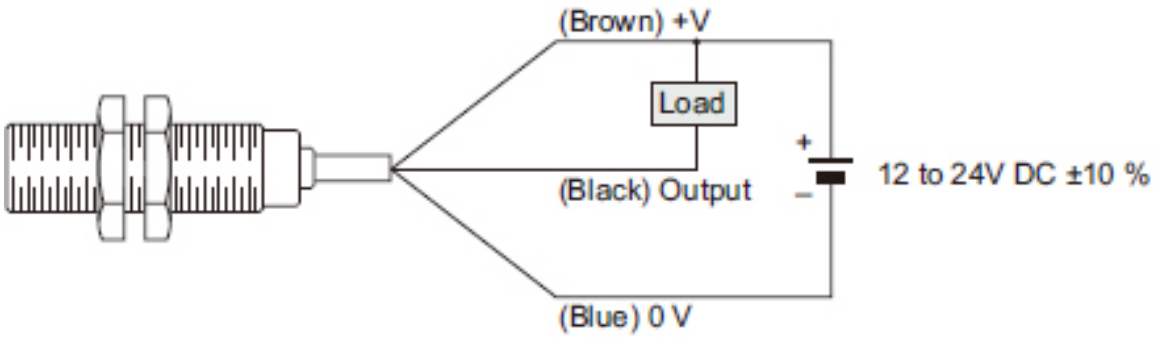
CHAPTER 13

13.0 INDUCTIVE PROXIMITY SENSOR

13.1 DESCRIPTION

An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects. An inductor develops a magnetic field when a current flow through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes. This effect can be used to detect metallic objects that interact with a magnetic field. Non-metallic substances such as liquids or some kinds of dirt do not interact with the magnetic field.

13.2 PIN DIAGRAM



13.3 FEATURES

- Red LED checks the state of the proximity sensor
- High repeated positioning accuracy
- High switching frequency
- Wide voltage range

- Outer (Thread) Diameter: M12
- Antivibration, dust, water and oil prevention

13.4 BILL OF MATERIALS

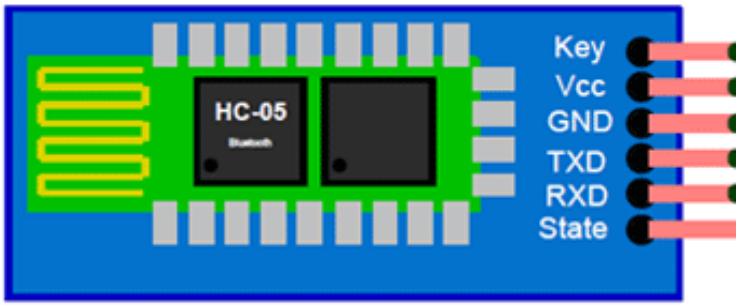
SL.NO	Item Description	Symbol	Qty	Price (☐)
1	Inductive Proximity Sensor	IP1	1	200
TOTAL				200

MODULE 9

BLUETOOTH MODULE(HC-05)

CONTENTS

- DESCRIPTION
- PIN DIAGRAM
- FEATURES
- BILL OF MATERIALS



CHAPTER 14

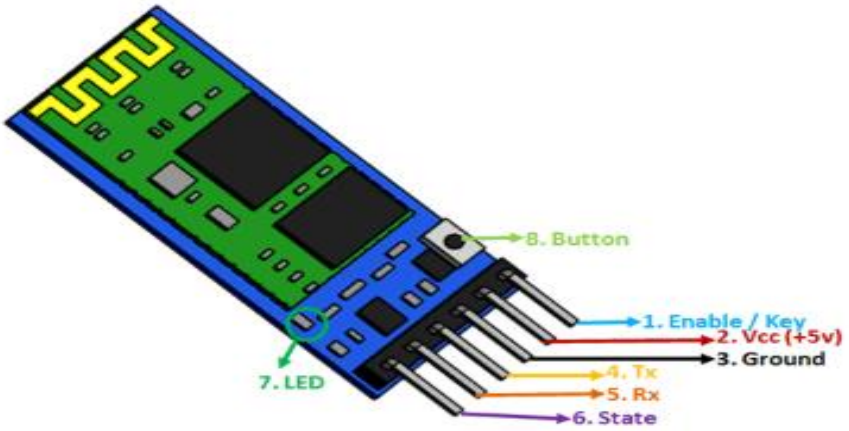
14.0 BLUETOOTH MODULE(HC-05)

14.1 DESCRIPTION

The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin as explained in the pin description.

It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU as shown in the figure below

14.2 PIN DIAGRAM



14.3 FEATURES

- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)

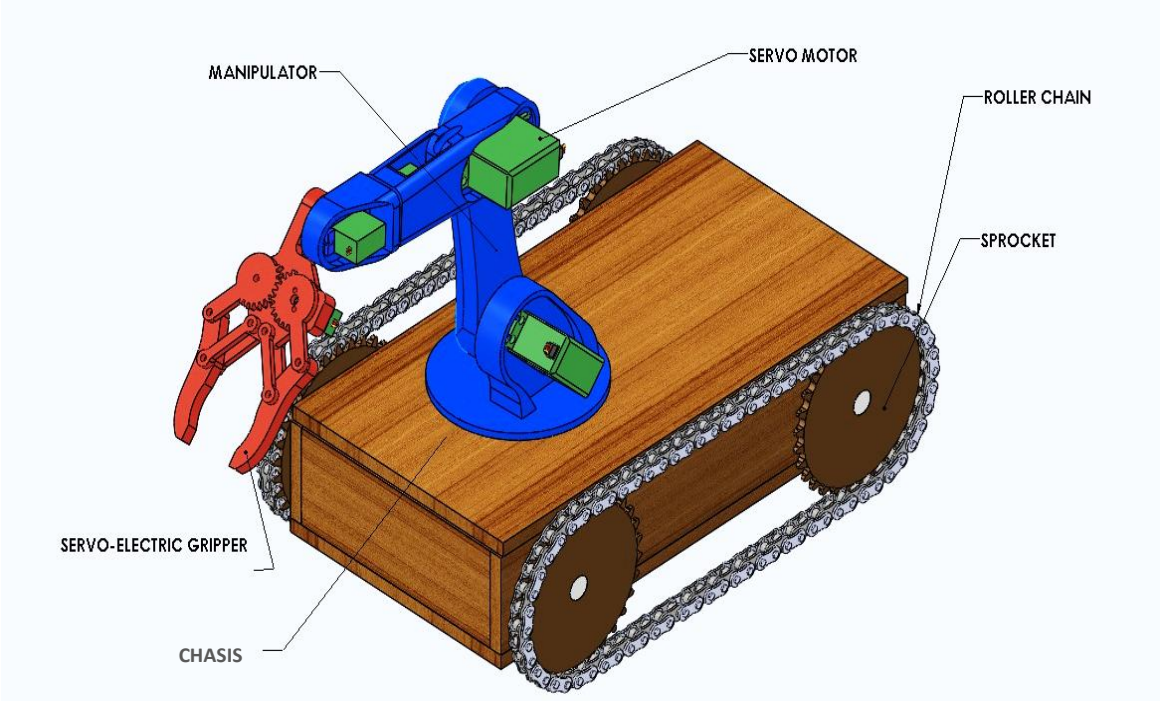
14.4 BILL OF MATERIALS

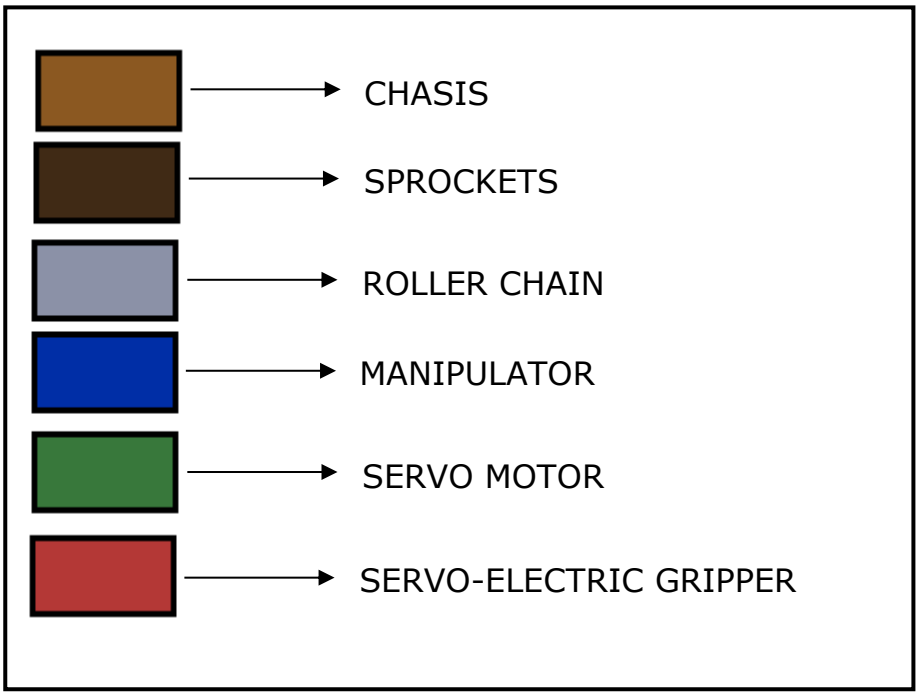
SL.NO	Item Description	Symbol	Qty	Price (☐)
1	BLUETOOTH MODULE	BL1	1	250
TOTAL				250

CHAPTER 15

EXISTING MECHANICAL DESIGN

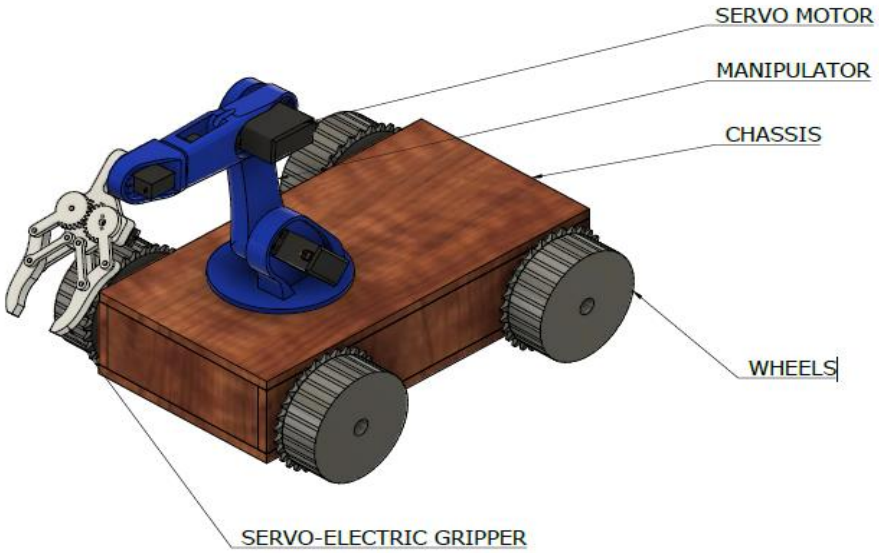
OVERALL ISOMETRIC VIEW

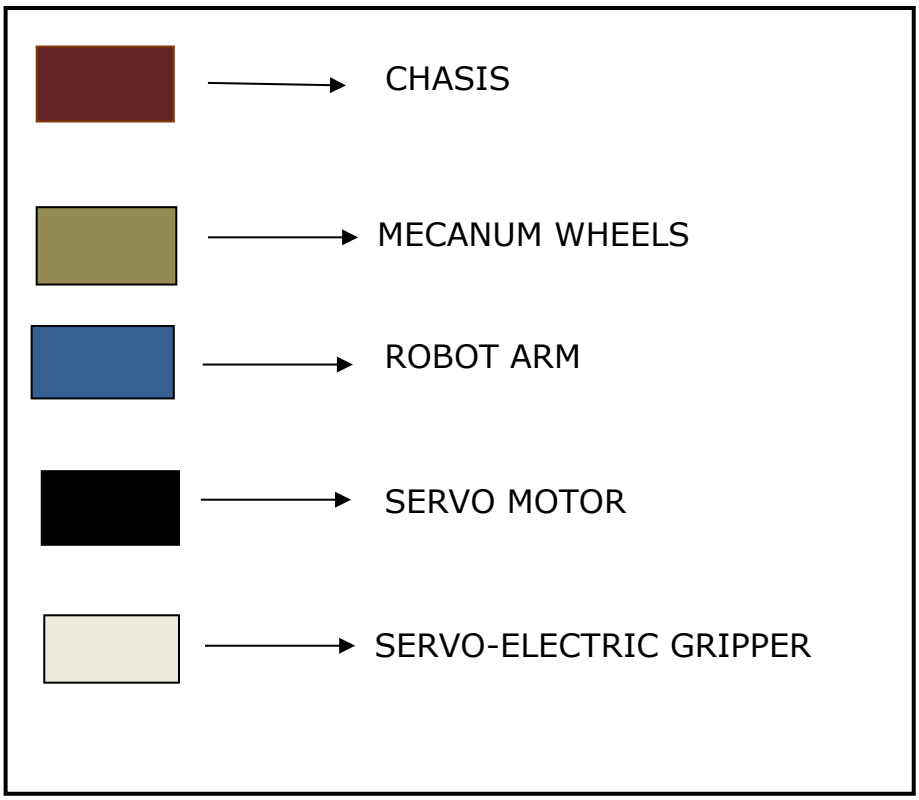




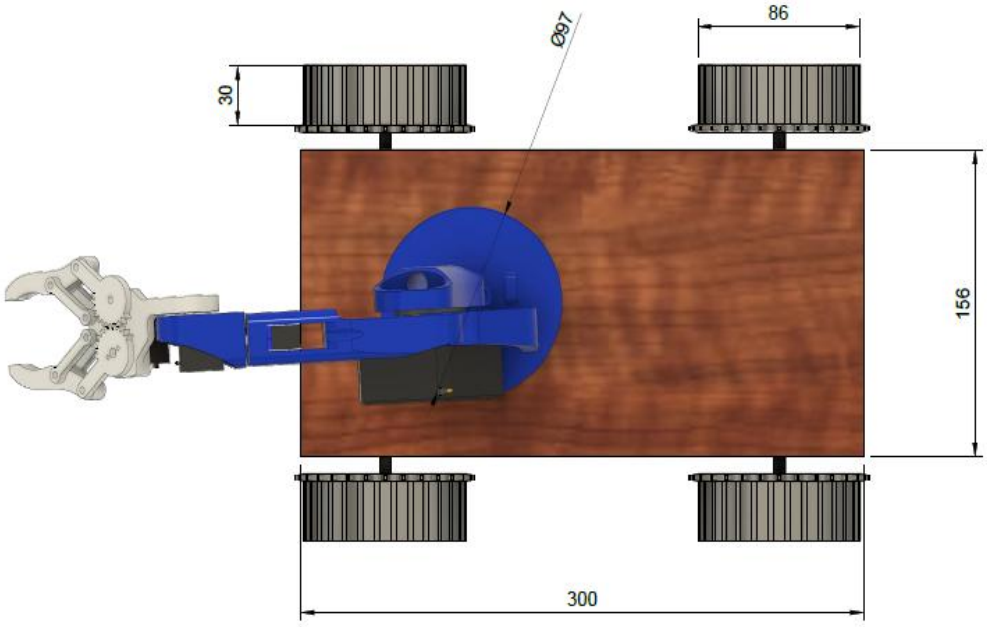
IMPROVISED MECHANICAL DESIGN

OVERALL ISOMETRIC VIEW



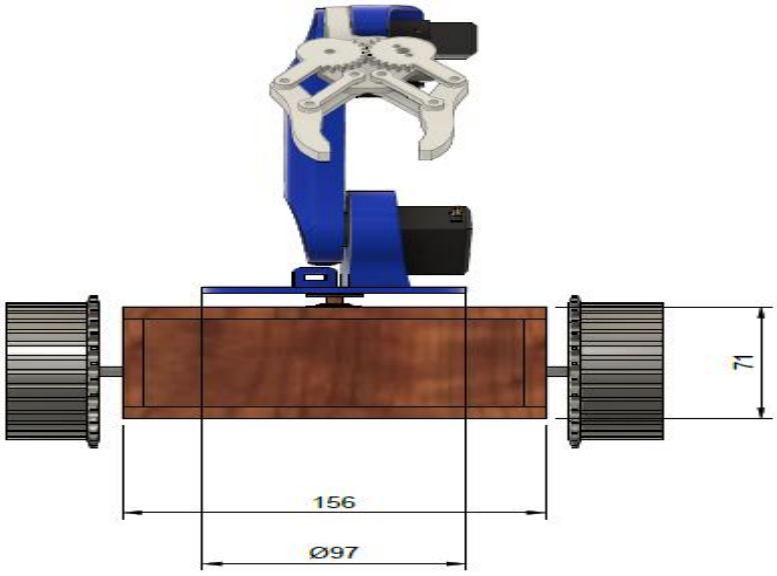


TOP VIEW



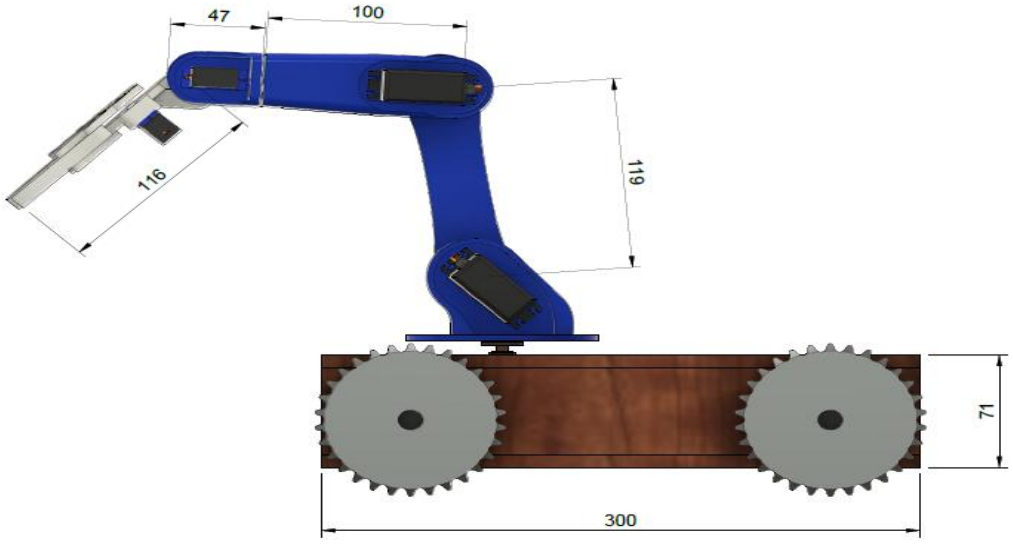
ALL DIMENSIONS ARE IN mm

SIDE VIEW



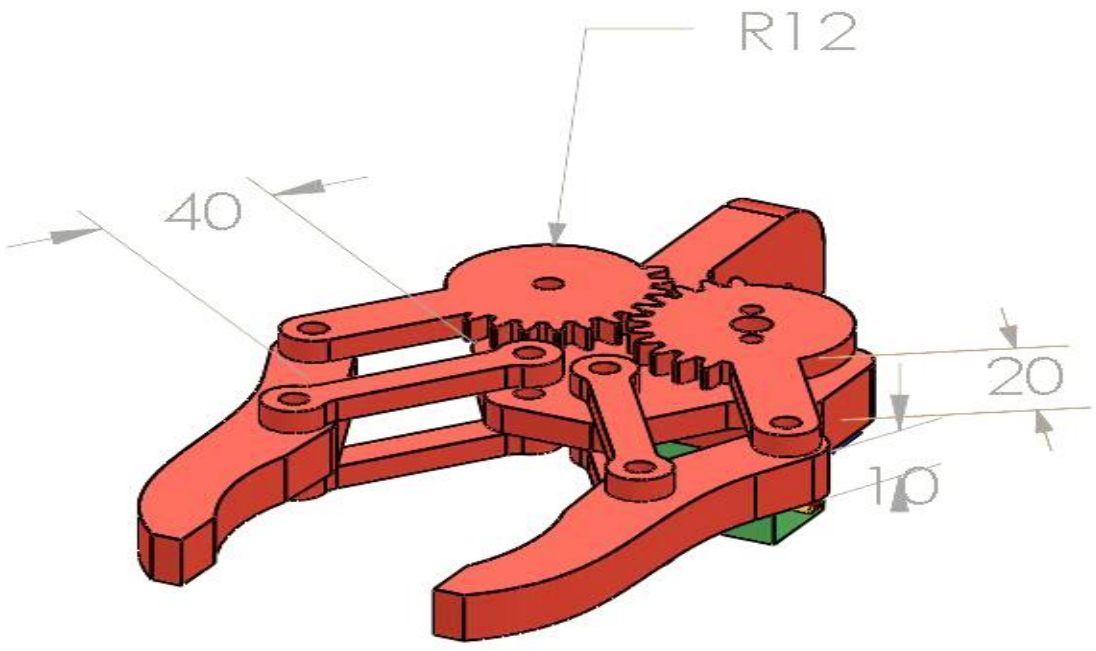
ALL DIMENSIONS ARE IN mm

FRONT VIEW



ALL DIMENSIONS ARE IN mm

SERVO ELECTRIC-GRIPPER



ALL DIMENSIONS ARE IN mm

CHAPTER 16

16.0 BILL OF MATERIAL

16.1 MODULES

Sl.no	Modules	Individual Price (□)	Qty	Total Price (□)
1	Module1: Charging Circuit	1280	1	1280
2	Module2: Arduino Mega 2560	700	1	700
3	Module3: L298N with DC Gear motor	400	4	1300
4	Module4:SG-90	100	3	300
5	Module6:MG-995	250	3	750
6	Module7:DHT11	85	1	85
7	Module8:MQ-5	100	1	100
8	Module9: Inductive Proximity Sensor	200	1	200
9	Module10: Bluetooth module (HC-05)	250	1	250
TOTAL				4,965

16.2 MECHANICAL COMPONENTS

Sl.no	Mechanical components	Specification	Qty	Price (□)
1	Screw Nut Spacers	M3*15mm M3.5*0.6mm M3*10mm, M3*35mm	200g 150g 500g	200
2	L-clamps	20 mm x 20 mm	20 pieces	50
3	plywood	IS 303 Grade (5mm x 500mm X 400mm)	1 sheet	200
4	wheels	100 mm (R50)	4	500
Total				950

16.3 ELECTRICAL COMPONENTS

Sl.no	Item Description	Specification	Quantity	Price (□)
1	Insulation tape	10.5mm*10m	1	30

2	Sleeves	Ø1mm Ø3mm Ø6mm	2m 2m 2m	30 40 40
3	Connecting Wires	Multi Stranded (24 AWG, 10 AWG)	10m	150
Total				290

16.4 MISCELLANEOUS

Sl.no	Item description	Specifications	Quantity	Price (☐)
1	Anabond	202 (Cyanoacrylate Adhesive)	20ml	100
2	Nylon Bush	25mm	8	40
3	Plastic loop Lock Pin Tag	3”	75g	30
Total				170

16.5 OVERALL BILL OF MATERIAL

SL NO:	Items	price (□)
1	Mechanical Components	950
2	Electrical Components	290
3	Modules	4,965
4	Miscellaneous	170
5	3D Parts for Robotic Arm	3,200
	Total	9,575

CHAPTER 17

ADVANTAGES & DISADVANTAGES

ADVANTAGES

- Reducing Man Power
- Fast Production
- Time Management

DISADVANTAGES

- Less Payload Capacity
- Full Manual Controlled
- Limited Operating Range

APPLICATIONS

- Pick & Place
- Industrial Usage
- Component Handling

18.PROGRAM

```
#include <SoftwareSerial.h>

#include <AccelStepper.h>

#include <Servo.h>


Servo servo01;

Servo servo02;

Servo servo03;

Servo servo04;

Servo servo05;

Servo servo06;


SoftwareSerial Bluetooth(A8,36); // Arduino(RX, TX) - HC-05 Bluetooth (TX, RX)


// Define the stepper motors and the pins the will use

AccelStepper LeftBackWheel(1, 42, 43);   // (Type:driver, STEP, DIR) - Stepper1

AccelStepper LeftFrontWheel(1, 40, 41);  // Stepper2

AccelStepper RightBackWheel(1, 44, 45);  // Stepper3

AccelStepper RightFrontWheel(1, 46, 47); // Stepper4
```

```
#define led 14


int wheelSpeed = 1500;


int lbw[50], lfw[50], rbw[50], rfw[50]; // arrays for storing positions/steps


int servo1Pos, servo2Pos, servo3Pos, servo4Pos, servo5Pos, servo6Pos; // current position

int servo1PPos, servo2PPos, servo3PPos, servo4PPos, servo5PPos, servo6PPos; // previous position

int servo01SP[50], servo02SP[50], servo03SP[50], servo04SP[50], servo05SP[50], servo06SP[50]; // for storing positions/steps

int speedDelay = 20;

int index = 0;

int dataIn;

int m = 0;


void setup() {

  // Set initial seed values for the steppers
```

```
  LeftFrontWheel.setMaxSpeed(3000);
  LeftBackWheel.setMaxSpeed(3000);
  RightFrontWheel.setMaxSpeed(3000);
  RightBackWheel.setMaxSpeed(3000);
  pinMode(led, OUTPUT);
  servo01.attach(5);
  servo02.attach(6);
  servo03.attach(7);
  servo04.attach(8);
  servo05.attach(9);
  servo06.attach(10);
  Bluetooth.begin(4800); // Default baud rate of the Bluetooth
module
  Bluetooth.setTimeout(5);
  delay(20);
  Serial.begin(9600);
  // Move robot arm to initial position
  servo1PPos = 90;
  servo01.write(servo1PPos);
  servo2PPos = 100;
  servo02.write(servo2PPos);
```

```
  servo3PPos = 120;
  servo03.write(servo3PPos);
  servo4PPos = 95;
  servo04.write(servo4PPos);
  servo5PPos = 60;
  servo05.write(servo5PPos);
  servo6PPos = 110;
  servo06.write(servo6PPos);
}

void loop() {
  // Check for incoming data
  if (Bluetooth.available() > 0) {
    dataIn = Bluetooth.read();  // Read the data
Serial.println(m ="");
    if (dataIn == 0) {
      m = 0;
    }
    if (dataIn == 1) {
      m = 1;
```

```
}
if (dataIn == 2) {
  m = 2;
}
if (dataIn == 3) {
  m = 3;
}
if (dataIn == 4) {
  m = 4;
}
if (dataIn == 5) {
  m = 5;
}
if (dataIn == 6) {
  m = 6;
}
if (dataIn == 7) {
  m = 7;
}
if (dataIn == 8) {
```

```
  m = 8;
}
if (dataIn == 9) {
  m = 9;
}
if (dataIn == 10) {
  m = 10;
}
if (dataIn == 11) {
  m = 11;
}
if (dataIn == 12) {
  m = 12;
}
if (dataIn == 14) {
  m = 14;
}
if (dataIn == 16) {
  m = 16;
}
```

```
if (dataIn == 17) {
  m = 17;
}
if (dataIn == 18) {
  m = 18;
}
if (dataIn == 19) {
  m = 19;
}
if (dataIn == 20) {
  m = 20;
}
if (dataIn == 21) {
  m = 21;
}
if (dataIn == 22) {
  m = 22;
}
if (dataIn == 23) {
  m = 23;
```

```
}
if (dataIn == 24) {
  m = 24;
}
if (dataIn == 25) {
  m = 25;
}
if (dataIn == 26) {
  m = 26;
}
if (dataIn == 27) {
  m = 27;
}

// Move the Mecanum wheels platform
if (m == 4) {
  moveSidewaysLeft();
}
if (m == 5) {
  moveSidewaysRight();
```

```
}
if (m == 2) {
  moveForward();
}
if (m == 7) {
  moveBackward();
}
if (m == 3) {
  moveRightForward();
}
if (m == 1) {
  moveLeftForward();
}
if (m == 8) {
  moveRightBackward();
}
if (m == 6) {
  moveLeftBackward();
}
if (m == 9) {
```

```
  rotateLeft();
}
if (m == 10) {
  rotateRight();
}

if (m == 0) {
  stopMoving();
}

// Mecanum wheels speed
if (dataIn > 30 & dataIn < 100) {
  wheelSpeed = dataIn * 20;
}

// Move robot arm
// Move servo 1 in positive direction
while (m == 16) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
```

```
  }
  servo01.write(servo1PPos);
  servo1PPos++;
  delay(speedDelay);
 }
 // Move servo 1 in negative direction
 while (m == 17) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo01.write(servo1PPos);
  servo1PPos--;
  delay(speedDelay);
 }
 // Move servo 2
 while (m == 19) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo02.write(servo2PPos);
```

```
  servo2PPos++;
  delay(speedDelay);
 }
 while (m == 18) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo02.write(servo2PPos);
  servo2PPos--;
  delay(speedDelay);
 }
 // Move servo 3
 while (m == 20) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo03.write(servo3PPos);
  servo3PPos++;
  delay(speedDelay);
 }
```

```
while (m == 21) {
 if (Bluetooth.available() > 0) {
  m = Bluetooth.read();
 }
 servo03.write(servo3PPos);
 servo3PPos--;
 delay(speedDelay);
}
// Move servo 4
while (m == 23) {
 if (Bluetooth.available() > 0) {
  m = Bluetooth.read();
 }
 servo04.write(servo4PPos);
 servo4PPos++;
 delay(speedDelay);
}
while (m == 22) {
 if (Bluetooth.available() > 0) {
  m = Bluetooth.read();
```

```
  }
  servo04.write(servo4PPos);
  servo4PPos--;
  delay(speedDelay);
 }
 // Move servo 5
 while (m == 25) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo05.write(servo5PPos);
  servo5PPos++;
  delay(speedDelay);
 }
 while (m == 24) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo05.write(servo5PPos);
  servo5PPos--;
```

```
  delay(speedDelay);
}
// Move servo 6
while (m == 26) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo06.write(servo6PPos);
  servo6PPos++;
  delay(speedDelay);
}
while (m == 27) {
  if (Bluetooth.available() > 0) {
    m = Bluetooth.read();
  }
  servo06.write(servo6PPos);
  servo6PPos--;
  delay(speedDelay);
}
```

```
    // If arm speed slider is changed
    if (dataIn > 101 & dataIn < 250) {
      speedDelay = dataIn / 10; // Change servo speed (delay
time)
    }


    // If button "SAVE" is pressed
    if (m == 12) {
      //if it's initial save, set the steppers position to 0
      if (index == 0) {
        LeftBackWheel.setCurrentPosition(0);
        LeftFrontWheel.setCurrentPosition(0);
        RightBackWheel.setCurrentPosition(0);
        RightFrontWheel.setCurrentPosition(0);
      }
      lbw[index] = LeftBackWheel.currentPosition();  // save
position into the array
      lfw[index] = LeftFrontWheel.currentPosition();
      rbw[index] = RightBackWheel.currentPosition();
      rfw[index] = RightFrontWheel.currentPosition();
```

```
    servo01SP[index] = servo1PPos;  // save position into the
array
    servo02SP[index] = servo2PPos;
    servo03SP[index] = servo3PPos;
    servo04SP[index] = servo4PPos;
    servo05SP[index] = servo5PPos;
    servo06SP[index] = servo6PPos;
    index++;                    // Increase the array index
    m = 0;
   }

   // If button "RUN" is pressed
   if (m == 14) {
    runSteps();

    // If button "RESET" is pressed
    if (dataIn != 14) {
     stopMoving();
     memset(lbw, 0, sizeof(lbw)); // Clear the array data to 0
     memset(lfw, 0, sizeof(lfw));
     memset(rbw, 0, sizeof(rbw));
```

```
      memset(rfw, 0, sizeof(rfw));
      memset(servo01SP, 0, sizeof(servo01SP)); // Clear the
array data to 0
      memset(servo02SP, 0, sizeof(servo02SP));
      memset(servo03SP, 0, sizeof(servo03SP));
      memset(servo04SP, 0, sizeof(servo04SP));
      memset(servo05SP, 0, sizeof(servo05SP));
      memset(servo06SP, 0, sizeof(servo06SP));
      index = 0;  // Index to 0
    }
   }
  }
  LeftFrontWheel.runSpeed();
  LeftBackWheel.runSpeed();
  RightFrontWheel.runSpeed();
  RightBackWheel.runSpeed();

  // Monitor the battery voltage
  int sensorValue = analogRead(A0);
  float voltage = sensorValue * (5.0 / 1023.00) * 3; //
Convert the reading values from 5v to suitable 12V i
```

```
  //Serial.println(voltage);
  // If voltage is below 11V turn on the LED
  if (voltage < 11) {
    digitalWrite(led, HIGH);
  }
  else {
    digitalWrite(led, LOW);
  }
}
void moveForward() {
  LeftFrontWheel.setSpeed(wheelSpeed);
  LeftBackWheel.setSpeed(wheelSpeed);
  RightFrontWheel.setSpeed(wheelSpeed);
  RightBackWheel.setSpeed(wheelSpeed);
}
void moveBackward() {
  LeftFrontWheel.setSpeed(-wheelSpeed);
  LeftBackWheel.setSpeed(-wheelSpeed);
  RightFrontWheel.setSpeed(-wheelSpeed);
  RightBackWheel.setSpeed(-wheelSpeed);
```

```
}
void moveSidewaysRight() {
  LeftFrontWheel.setSpeed(wheelSpeed);
  LeftBackWheel.setSpeed(-wheelSpeed);
  RightFrontWheel.setSpeed(-wheelSpeed);
  RightBackWheel.setSpeed(wheelSpeed);
}
void moveSidewaysLeft() {
  LeftFrontWheel.setSpeed(-wheelSpeed);
  LeftBackWheel.setSpeed(wheelSpeed);
  RightFrontWheel.setSpeed(wheelSpeed);
  RightBackWheel.setSpeed(-wheelSpeed);
}
void rotateLeft() {
  LeftFrontWheel.setSpeed(-wheelSpeed);
  LeftBackWheel.setSpeed(-wheelSpeed);
  RightFrontWheel.setSpeed(wheelSpeed);
  RightBackWheel.setSpeed(wheelSpeed);
}
void rotateRight() {
```

```
  LeftFrontWheel.setSpeed(wheelSpeed);
  LeftBackWheel.setSpeed(wheelSpeed);
  RightFrontWheel.setSpeed(-wheelSpeed);
  RightBackWheel.setSpeed(-wheelSpeed);
}
void moveRightForward() {
  LeftFrontWheel.setSpeed(wheelSpeed);
  LeftBackWheel.setSpeed(0);
  RightFrontWheel.setSpeed(0);
  RightBackWheel.setSpeed(wheelSpeed);
}
void moveRightBackward() {
  LeftFrontWheel.setSpeed(0);
  LeftBackWheel.setSpeed(-wheelSpeed);
  RightFrontWheel.setSpeed(-wheelSpeed);
  RightBackWheel.setSpeed(0);
}
void moveLeftForward() {
  LeftFrontWheel.setSpeed(0);
  LeftBackWheel.setSpeed(wheelSpeed);
```

```
  RightFrontWheel.setSpeed(wheelSpeed);
  RightBackWheel.setSpeed(0);
}
void moveLeftBackward() {
  LeftFrontWheel.setSpeed(-wheelSpeed);
  LeftBackWheel.setSpeed(0);
  RightFrontWheel.setSpeed(0);
  RightBackWheel.setSpeed(-wheelSpeed);
}
void stopMoving() {
  LeftFrontWheel.setSpeed(0);
  LeftBackWheel.setSpeed(0);
  RightFrontWheel.setSpeed(0);
  RightBackWheel.setSpeed(0);
}

// Automatic mode custom function - run the saved steps
void runSteps() {
  while (dataIn != 13) {   // Run the steps over and over again
until "RESET" button is pressed
```

```
   for (int i = 0; i <= index - 2; i++) {  // Run through all
steps(index)
    if (Bluetooth.available() > 0) {      // Check for incomding
data
      dataIn = Bluetooth.read();
      if ( dataIn == 15) {          // If button "PAUSE" is
pressed
        while (dataIn != 14) {        // Wait until "RUN" is
pressed again
          if (Bluetooth.available() > 0) {
            dataIn = Bluetooth.read();
            if ( dataIn == 13) {
              break;
            }
          }
        }
      }
      // If speed slider is changed
      if (dataIn > 100 & dataIn < 150) {
        speedDelay = dataIn / 10; // Change servo speed
(delay time)
      }
```

```
      // Mecanum wheels speed
      if (dataIn > 30 & dataIn < 100) {
        wheelSpeed = dataIn * 10;
        dataIn = 14;
      }
    }
    LeftFrontWheel.moveTo(lfw[i]);
    LeftFrontWheel.setSpeed(wheelSpeed);
    LeftBackWheel.moveTo(lbw[i]);
    LeftBackWheel.setSpeed(wheelSpeed);
    RightFrontWheel.moveTo(rfw[i]);
    RightFrontWheel.setSpeed(wheelSpeed);
    RightBackWheel.moveTo(rbw[i]);
    RightBackWheel.setSpeed(wheelSpeed);

    while (LeftBackWheel.currentPosition() != lbw[i] &
LeftFrontWheel.currentPosition() != lfw[i] &
RightFrontWheel.currentPosition() != rfw[i] &
RightBackWheel.currentPosition() != rbw[i]) {
      LeftFrontWheel.runSpeedToPosition();
      LeftBackWheel.runSpeedToPosition();
```

```
  RightFrontWheel.runSpeedToPosition();
  RightBackWheel.runSpeedToPosition();
}
// Servo 1
if (servo01SP[i] == servo01SP[i + 1]) {
}
if (servo01SP[i] > servo01SP[i + 1]) {
  for ( int j = servo01SP[i]; j >= servo01SP[i + 1]; j--) {
    servo01.write(j);
    delay(speedDelay);
  }
}
if (servo01SP[i] < servo01SP[i + 1]) {
  for ( int j = servo01SP[i]; j <= servo01SP[i + 1]; j++) {
    servo01.write(j);
    delay(speedDelay);
  }
}

// Servo 2
```

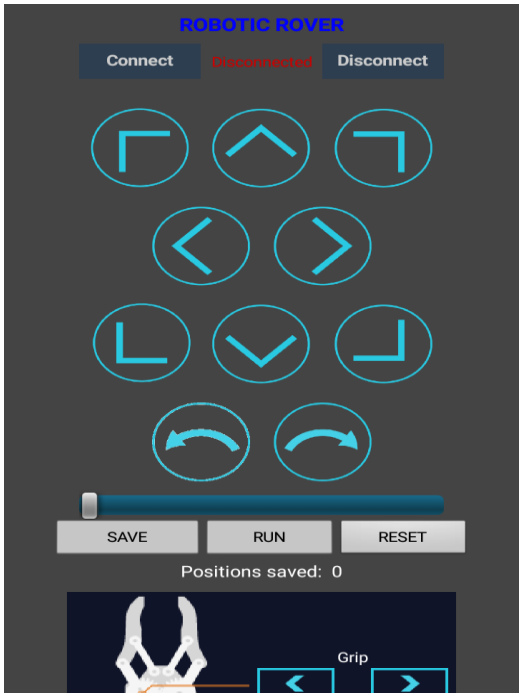
```
if (servo02SP[i] == servo02SP[i + 1]) {
}
if (servo02SP[i] > servo02SP[i + 1]) {
  for ( int j = servo02SP[i]; j >= servo02SP[i + 1]; j--) {
    servo02.write(j);
    delay(speedDelay);
  }
}
if (servo02SP[i] < servo02SP[i + 1]) {
  for ( int j = servo02SP[i]; j <= servo02SP[i + 1]; j++) {
    servo02.write(j);
    delay(speedDelay);
  }
}

// Servo 3
if (servo03SP[i] == servo03SP[i + 1]) {
}
if (servo03SP[i] > servo03SP[i + 1]) {
  for ( int j = servo03SP[i]; j >= servo03SP[i + 1]; j--) {
```

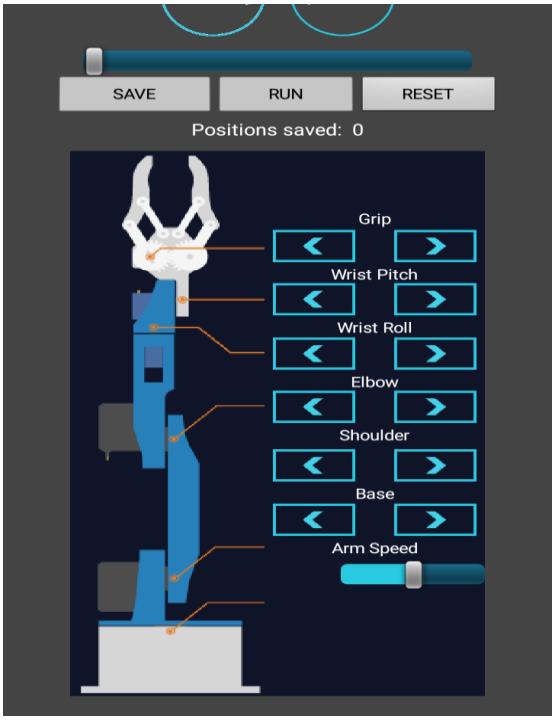
```
    servo03.write(j);
    delay(speedDelay);
  }
 }
 if (servo03SP[i] < servo03SP[i + 1]) {
  for ( int j = servo03SP[i]; j <= servo03SP[i + 1]; j++) {
    servo03.write(j);
    delay(speedDelay);
  }
 }

 // Servo 4
 if (servo04SP[i] == servo04SP[i + 1]) {
 }
 if (servo04SP[i] > servo04SP[i + 1]) {
  for ( int j = servo04SP[i]; j >= servo04SP[i + 1]; j--) {
    servo04.write(j);
    delay(speedDelay);
  }
 }
```

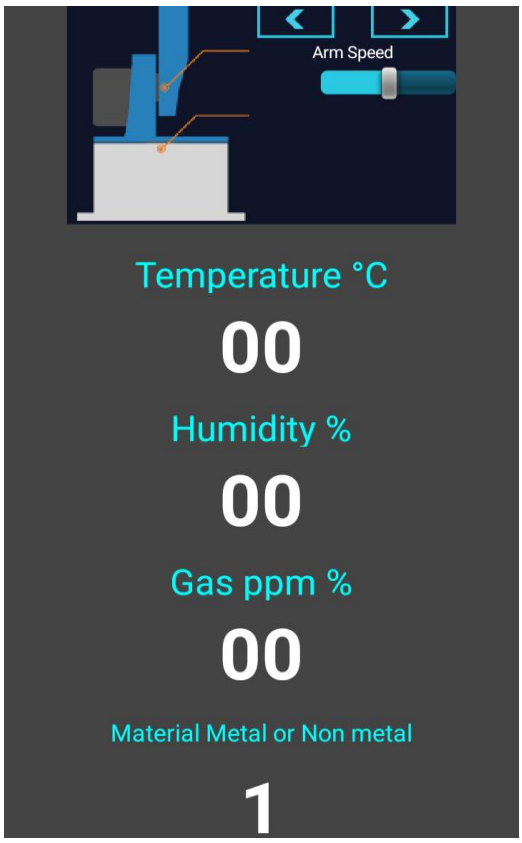
```
if (servo04SP[i] < servo04SP[i + 1]) {
 for ( int j = servo04SP[i]; j <= servo04SP[i + 1]; j++) {
  servo04.write(j);
  delay(speedDelay);
 }
}

// Servo 5
if (servo05SP[i] == servo05SP[i + 1]) {
}
if (servo05SP[i] > servo05SP[i + 1]) {
 for ( int j = servo05SP[i]; j >= servo05SP[i + 1]; j--) {
  servo05.write(j);
  delay(speedDelay);
 }
}
if (servo05SP[i] < servo05SP[i + 1]) {
 for ( int j = servo05SP[i]; j <= servo05SP[i + 1]; j++) {
  servo05.write(j);
  delay(speedDelay);
```

```
    }
   }

   // Servo 6
   if (servo06SP[i] == servo06SP[i + 1]) {
   }
   if (servo06SP[i] > servo06SP[i + 1]) {
    for ( int j = servo06SP[i]; j >= servo06SP[i + 1]; j--) {
     servo06.write(j);
     delay(speedDelay);
    }
   }
   if (servo06SP[i] < servo06SP[i + 1]) {
    for ( int j = servo06SP[i]; j <= servo06SP[i + 1]; j++) {
     servo06.write(j);
     delay(speedDelay);
    }
   }
  }
 }
```

19. CONTROLLER APP







CONCLUSION

Thus, the robotic rover can help for gripping up harmful objects and place them safely and these robots are used in manufacturing industries to move objects.