

**ANDROID APP CAR WITH METAL
DETECTOR**

A THESIS REPORT

Paper Code:

PR891

SUBMITTED BY

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**Under the guidance of
Dr. Bansari Deb Majumder**

In

**Electronics and Instrumentation Engineering
NARULA INSTITUTE OF TECHNOLOGY
81, Nilgunj Road, Agarpara, Kolkata 700109**

May 2023

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CERTIFICATE OF APPROVAL

This is to certify that the students mentioned below have submitted this thesis report on "ANDROID APP CAR WITH METAL DETECTOR" for project evolution in Eighth semester PR891 in Electronics & Instrumentation Engineering in the year 2023 under my supervision.

This report is ready for evolution:

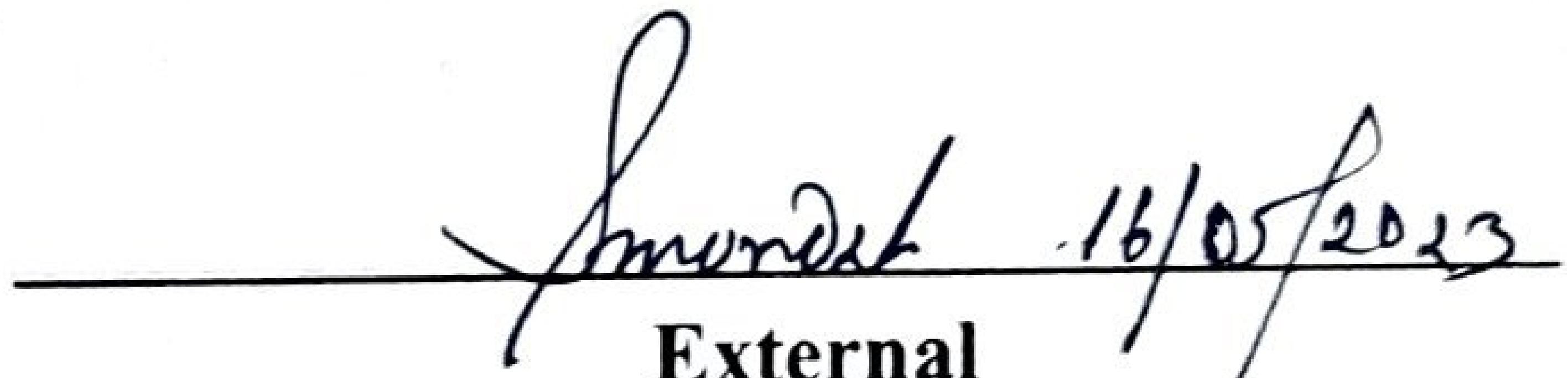
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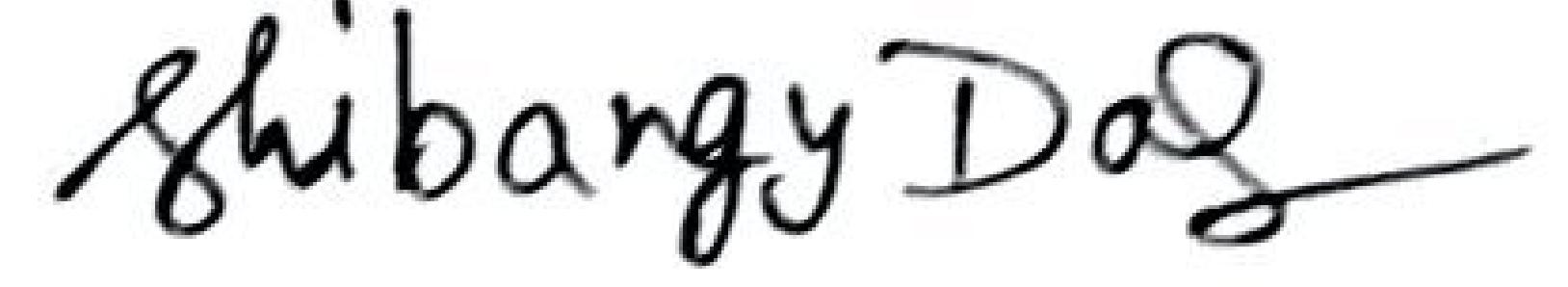
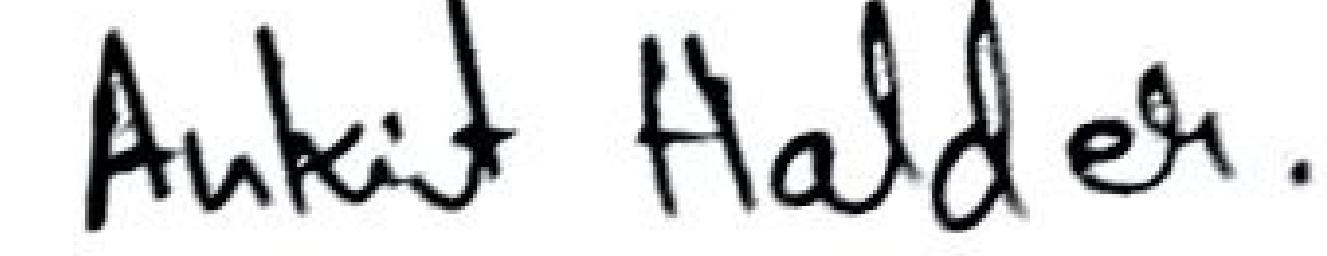


External

Examiner

ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. Bansari Deb Majumder, Assistant professor of Electronics & Instrumentation Department, Narula Institute of Technology for valuable guidance which helps us a lot in due course of project work, who extended all the facilities of Department for the project work.

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Chapter - 1

INTRODUCTION:

ANDROID APP CAR

A robot is an electromechanical machine that is controlled by computer program to perform various operations. Industrial robots have designed to reduce human effort and time to improve productivity and to reduce manufacturing cost. Today human-machine interaction is moving away from mouse and pen and becoming much more pervasive and much more compatible with the physical world. Android app can control the robot motion from a long distance using Bluetooth communication to interface controller and android. Microcontroller ATMEGA328P-PU can be interfaced to the Bluetooth module though UART protocol and code is written in embedded C language. As per the commands received from android app the robot motion can be controlled. The output motion of a robotic vehicle is accurate and repeatable. The purpose of this work is to design and implement an Android Controlled Bluetooth Robot which is used for Surveillance, home automation, wheelchairs, military and hostages Rescue applications.

METAL DETECTOR

Metal detector is a very common device that is used for checking persons, luggage or bags in shopping malls, hotels, cinema halls, etc. to ensure that person is not carrying any metals or illegal things like guns, bombs etc. Metal Detectors detect the presence of metals. There are different types of metal detectors like hand held metal detectors, walk through metal detectors and ground search metal detectors. In this project, we have designed a simple type metal detector circuit using very simple components that can be used in our homes.

Chapter – 2

MOTIVATION FACTOR BEHIND THE PROJECT:

The motivation behind this project is Insecurity of people. Many people are struggling to perform their duty which causes much death while on a mission and the circumstance related to each incident.

The official's security in trouble. They put themselves on dangerous situation to protect us. At present world moves towards to use technology.

Our project "**Android App Car With Metal Detector**" which is smart system for finding Land mines.

This is a fully automated machine.

Chapter – 3

PROJECT OVERVIEW:

Basically, robotics is used in such place where human cannot execute the work in a harmonic way. In our day-to-day life we can observe such scenario were human face trouble to keep with the pace troubles to keep with the pace. Such scene is accidents to finding metals.

In case accidents have become that make it hard for the people to protect our life. In such case a landmine detector robot can be highly useful to guard human lives wealth. So, concerning about the facts we have to design a fully automated metal detector which can help to find landmines.

To do so, we have implemented a software based “**Automated Landmine Detector**”

with the help of Proteus Professional and Arduino IDE Software. It is designed to sense any kind of metal.

As it is fully automated robot and its responses to the find metals.

Finally, this robot is much helpful and beneficial for our society and modern life as it can keep up with humans.

Chapter – 4

PROJECT OBJECTIVE:

- To detect presence of Metal.
- Find Metal location.
- Send a signal to operator that Metal is find in any place.
- It also finds any object made by Iron.

Chapter – 5

HARDWARE USED IN THE PROJECT:

Hardware Requirements For Android App Car

1. Arduino NANO

Arduino is an Integrated Development Environment based upon Processing. It has made very easy several things namely these are embedded system, physical computing, robotics, automation and other electronics based things.

Every Arduino has the same functionality (more or less) and the same features except the number of pins and size. Arduino Nano is a small chip board based on ATmega 328p.

Pin Description:

No.	Pin Number	Pin Description
1	D0 – D13	Digital Input / Output Pins
2	A0 – A7	Analog Input / Output Pins.
3	Pin # 3, 5, 6, 9, 11	Pulse Width Modulation (PWM) Pins.
4	Pin # 0 (RX) , Pin # 1 (TX)	Serial Communication Pins.
5	Pin # 10, 11, 12, 13	SPI Communication Pins.
6	Pin # A4, A5	I2C Communication Pins.
7	Pin # 13	Built-In LED for Testing.
8	D2 & D3	External Interrupt Pins.

Arduino Nano is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p (Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x). It comes with exactly the same functionality as in Arduino UNO but quite in small size.

It comes with an operating voltage of 5V; however, the input voltage can vary from 7 to 12V.

Arduino Nano Pinout contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins.

Each of these Digital & Analog Pins is assigned with multiple functions but their main function is to be configured as input or output.

They are acted as input pins when they are interfaced with sensors, but if you are driving some load then use them as output.

Functions like pin Mode() and digital Write() are used to control the operations of digital pins while analog Read() is used to control analog pins.

The analog pins come with a total resolution of 10bits which measure the value from zero to 5V.

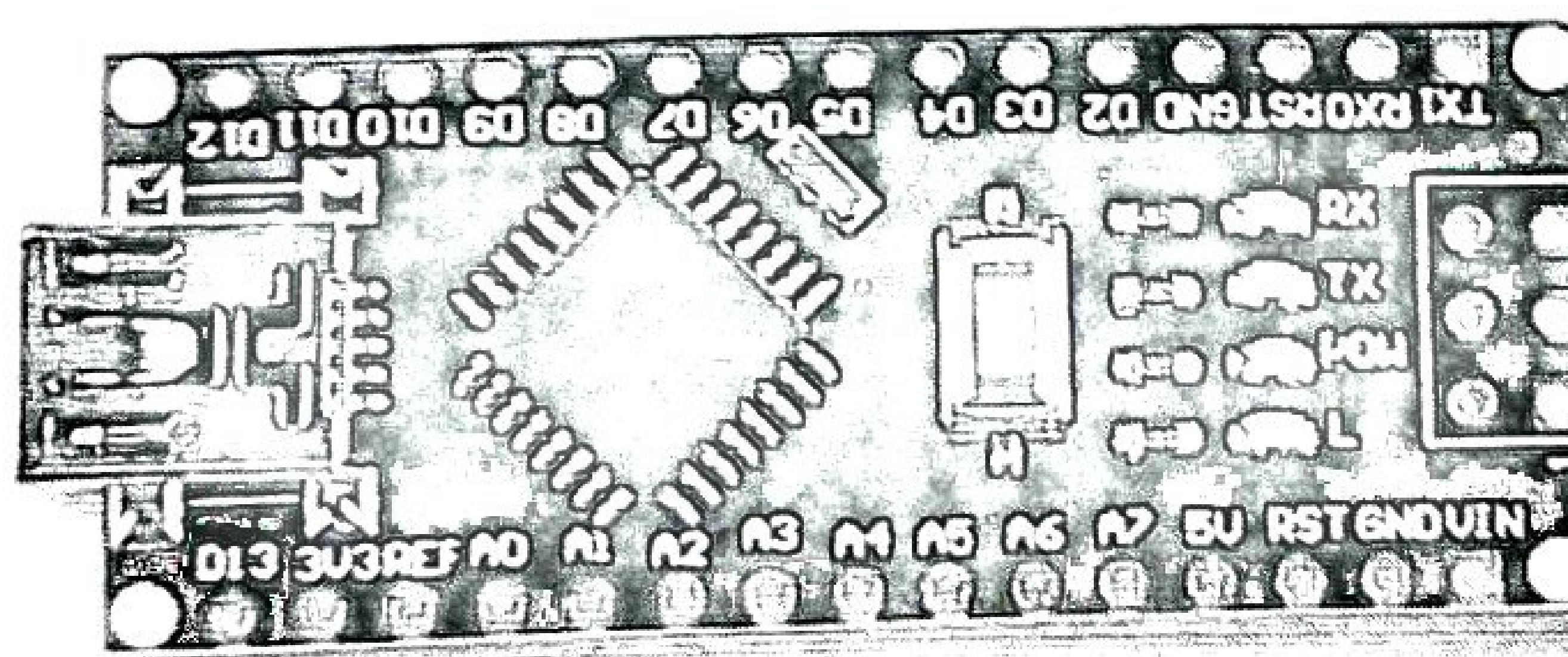
Arduino Nano comes with a crystal oscillator of frequency 16 MHz . It is used to produce a clock of precise frequency using constant voltage.

There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack, means you cannot supply external power source through a battery.

This board doesn't use standard USB for connection with a computer; instead, it comes with Mini USB support.

Tiny size and breadboard friendly nature make this device an ideal choice for most of the applications where sizes of the electronic components are of great concern.

Flash memory is 16KB or 32KB that all depends on the Atmega board i.e Atmega168 comes with 16KB of flash memory while Atmega328 comes with a flash memory of 32KB. Flash memory is used for storing code. The 2KB of memory out of total flash memory is used for a bootloader.



The SRAM can vary from 1KB or 2KB and EEPROM is 512 bytes or 1KB for Atmega168 and Atmega328 respectively.

This board is quite similar to other Arduino boards available in the market, but

the small size makes this board stand out from others.

Following figure shows the specifications of Arduino Nano Board.

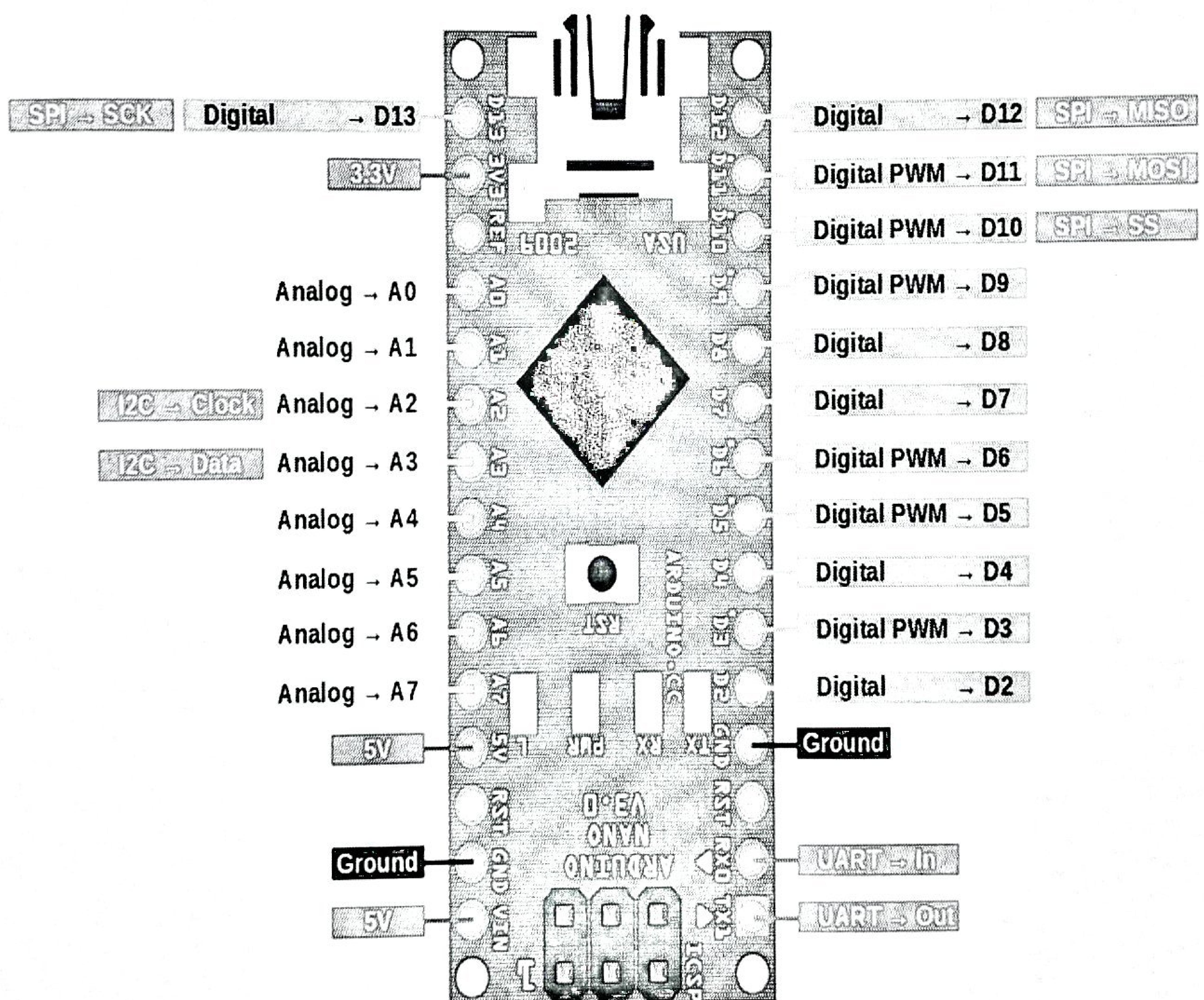
Microcontroller	Atmega328p/Atmega 168
Operating Voltage	5V
Input Voltage	7 – 12 V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512bytes or 1KB
USART	Yes

It is programmed using Arduino IDE which is an Integrated Development Environment that runs both offline and online.

No prior arrangements are required to run the board. All you need is board, mini USB cable and Arduino IDE software installed on the computer. USB cable is used to transfer the program from computer to the board.

No separate burner is required to compile and burn the program as this board comes with a built-in boot-loader.

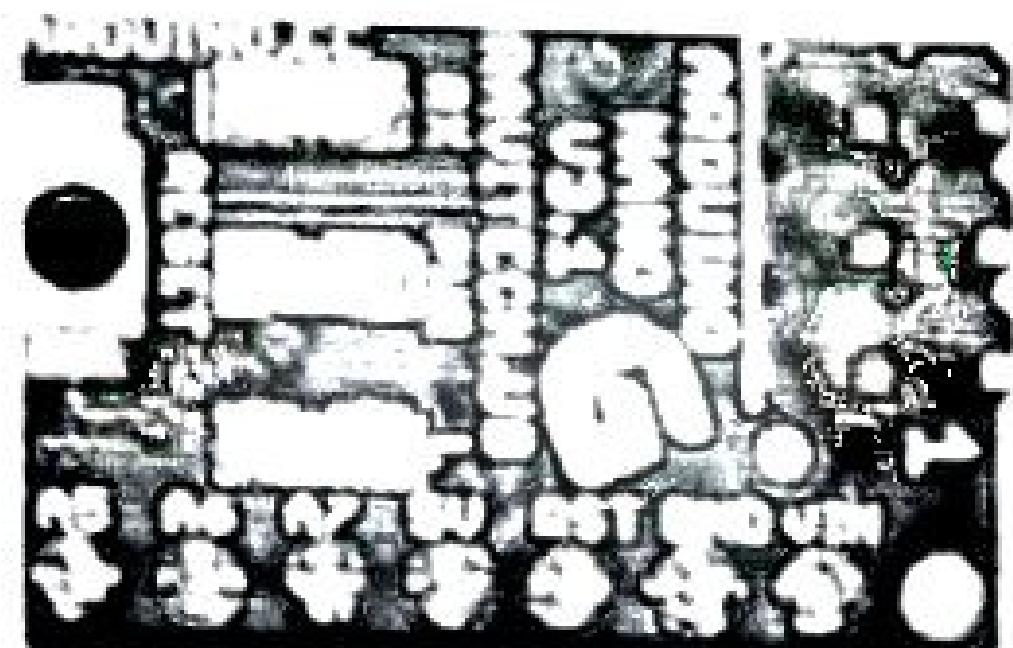
Following figure shows the pinout of Arduino Nano Board.



Each pin on the Nano board comes with a specific function associated with it. We can see the analog pins that can be used as an analog to digital converter where A4 and A5 pins can also be used for I2C communication. Similarly, there are 14 digital pins, out of which 6 pins are used for generating PWM.

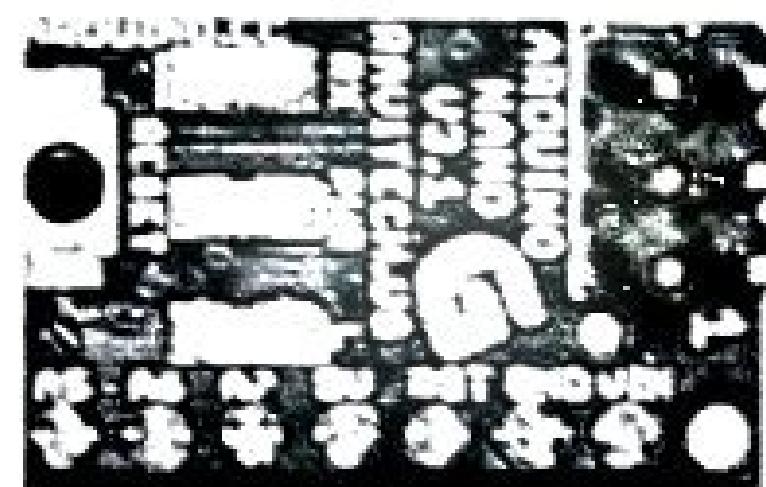
PIN Description

Vin. It is input power supply voltage to the board when using an external power source of 7 to 12 V.



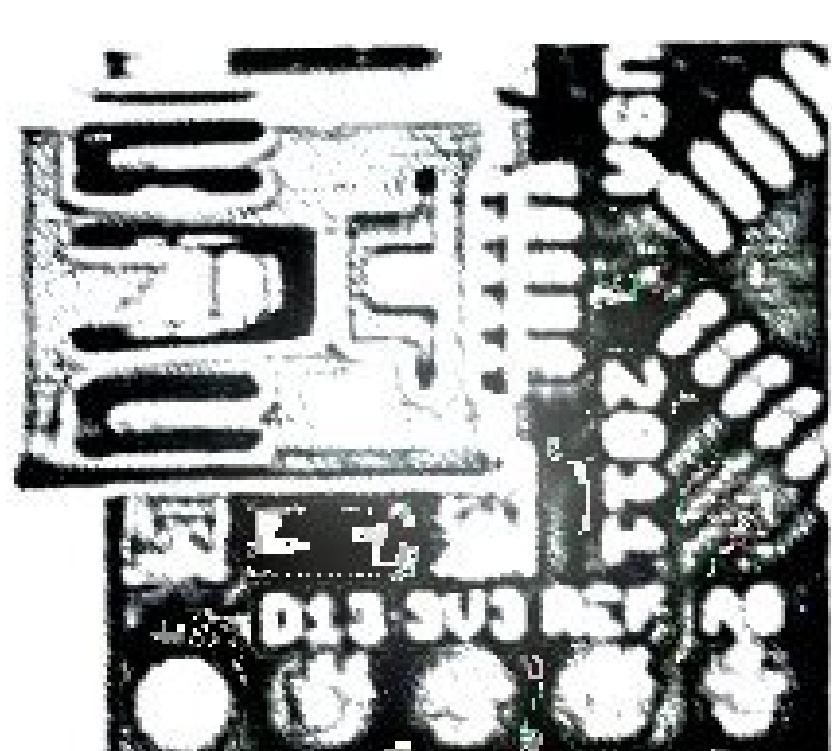
↑
Vin

5V. it is a regulated power supply voltage of the board that is used to power the controller and other components placed on the board.



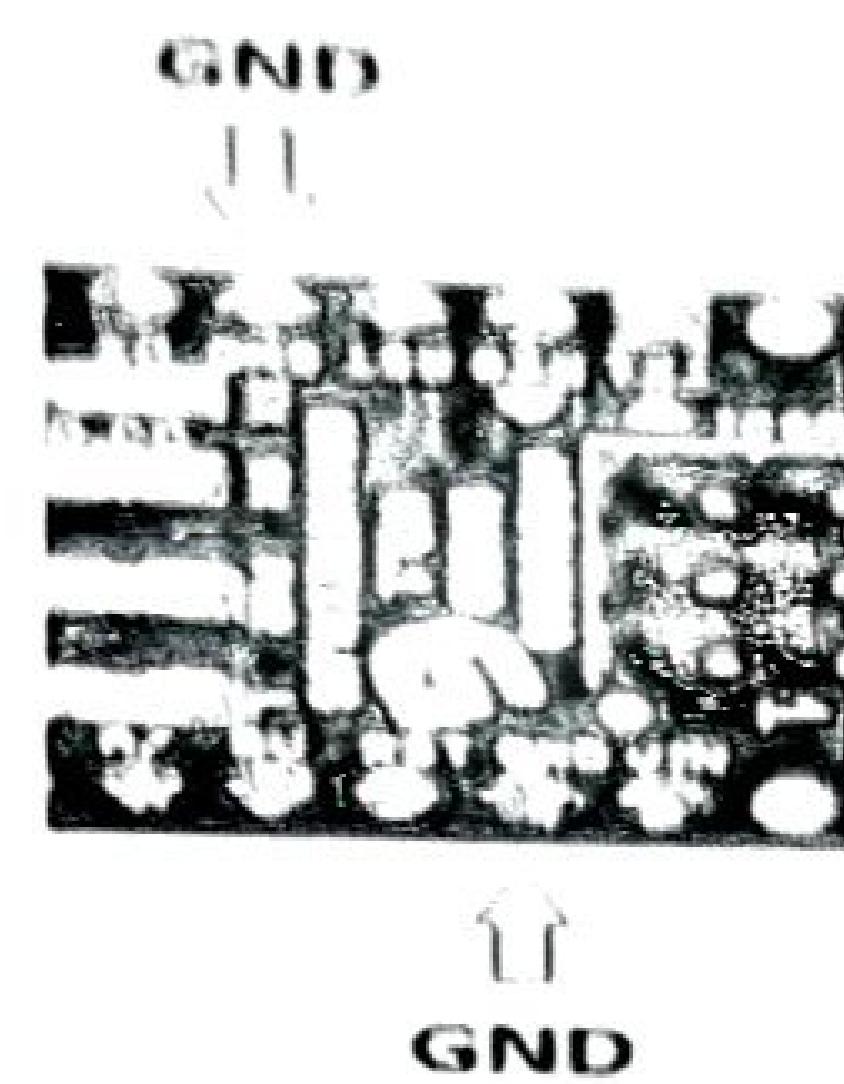
↑
5V

3.3V. this is a minimum voltage generated by the voltage regulator on the board.

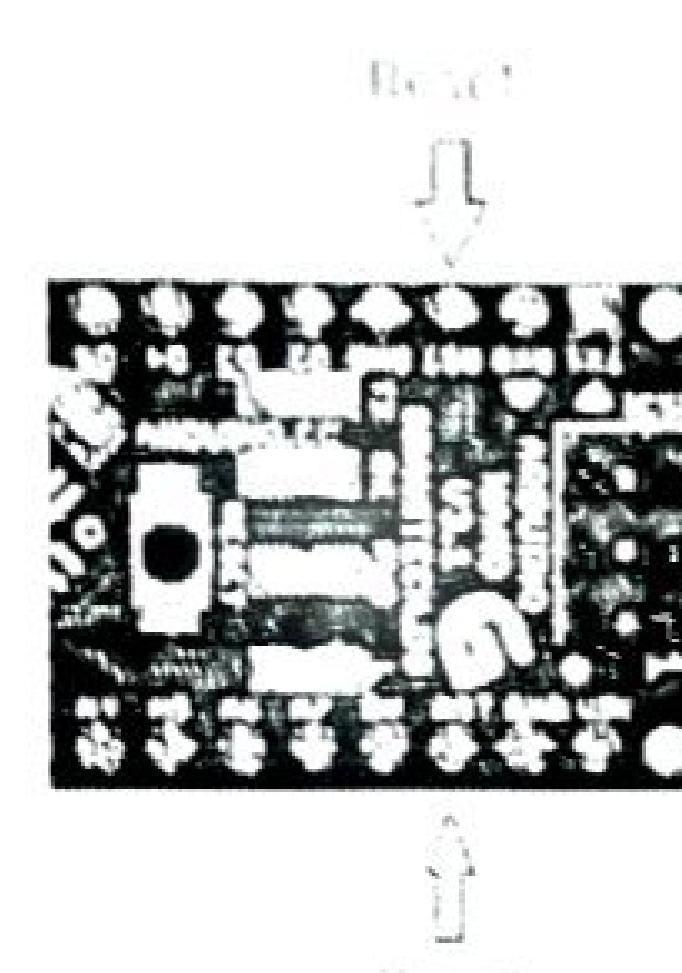


↑
3V3

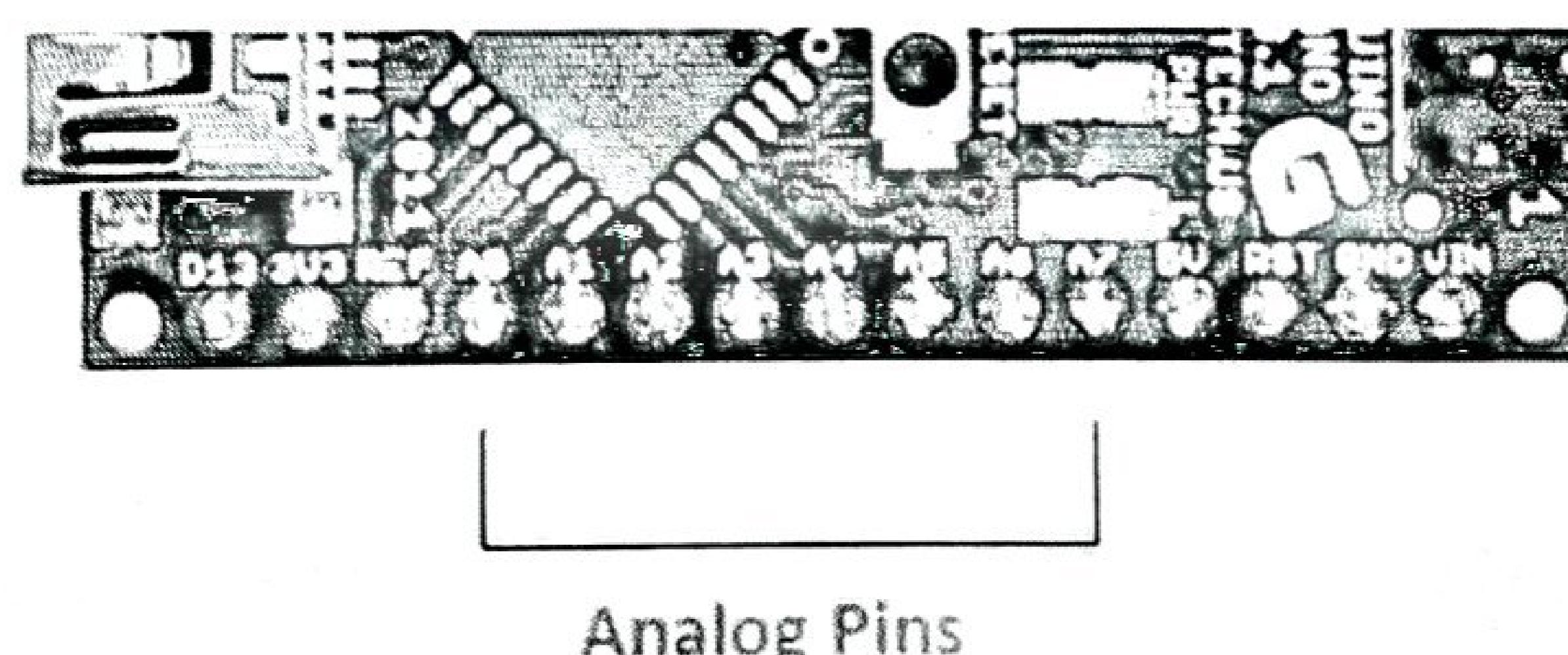
GND. These are the ground pins on the board. There are multiple ground pins on the board that can be interfaced accordingly when more than one ground pin is required.



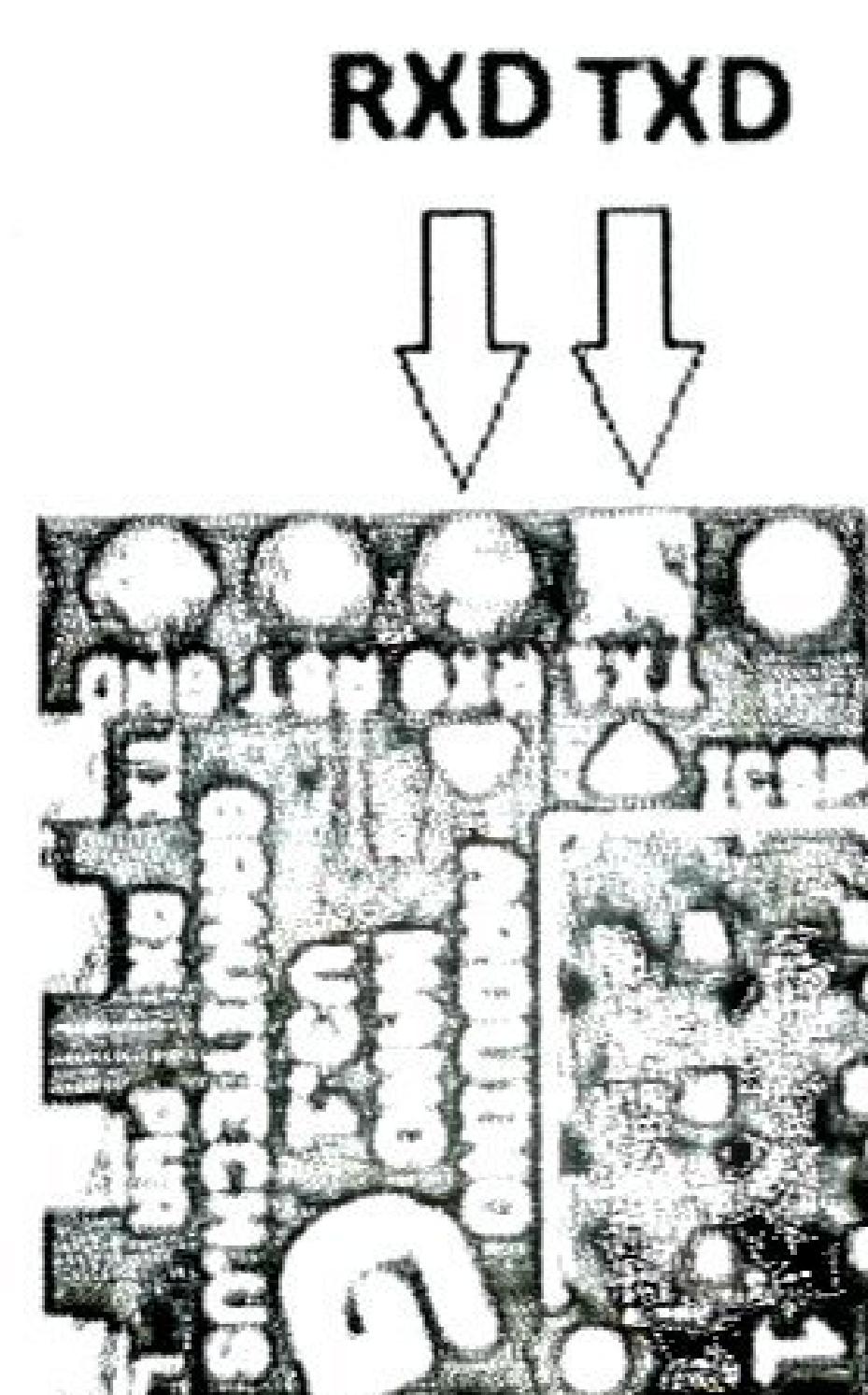
Reset. Reset pin is added on the board that resets the board. It is very helpful when running program goes too complex and hangs up the board. LOW value to the reset pin will reset the controller.



Analog Pins. There are 8 analog pins on the board marked as A0 – A7. These pins are used to measure the analog voltage ranging between 0 to 5V.



Rx, Tx. These pins are used for serial communication where Tx represents the transmission of data while Rx represents the data receiver.



13. This pin is used to turn on the built-in LED.

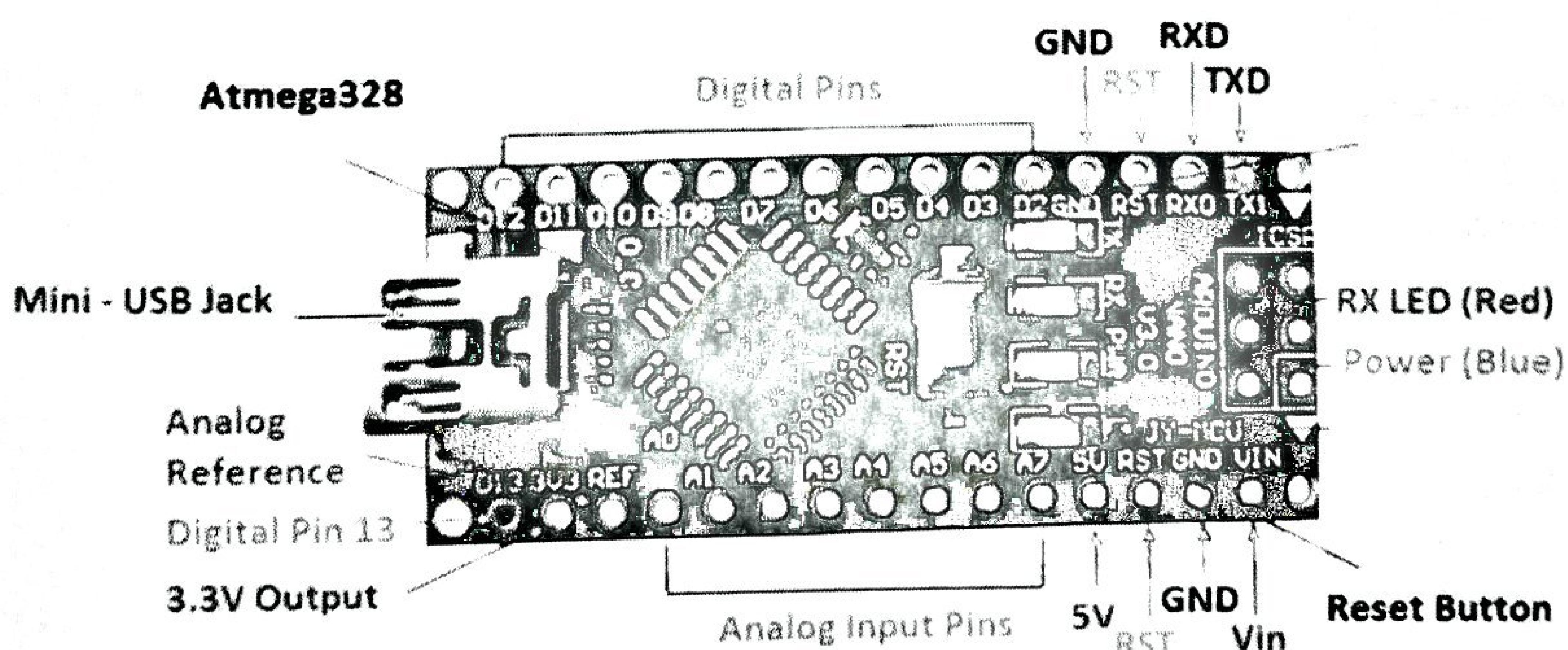
AREF. This pin is used as a reference voltage for the input voltage.

PWM. Six pins 3,5,6,9,10, 11 can be used for providing 8-bit PWM (Pulse Width Modulation) output. It is a method used for getting analog results with digital sources.

SPI. Four pins 10(SS),11(MOSI),12(MISO),13(SCK) are used for SPI (Serial Peripheral Interface). SPI is an interface bus and mainly used to transfer data between microcontrollers and other peripherals like sensors, registers, and SD card.

External Interrupts. Pin 2 and 3 are used as external interrupts which are used in case of emergency when we need to stop the main program and call important instructions at that point. The main program resumes once interrupt instruction is called and executed.

I2C. I2C communication is developed using A4 and A5 pins where A4 represents the serial data line (SDA) which carries the data and A5 represents the serial clock line (SCL) which is a clock signal, generated by the master device, used for data synchronization between the devices on an I2C bus.



Communication and Programming

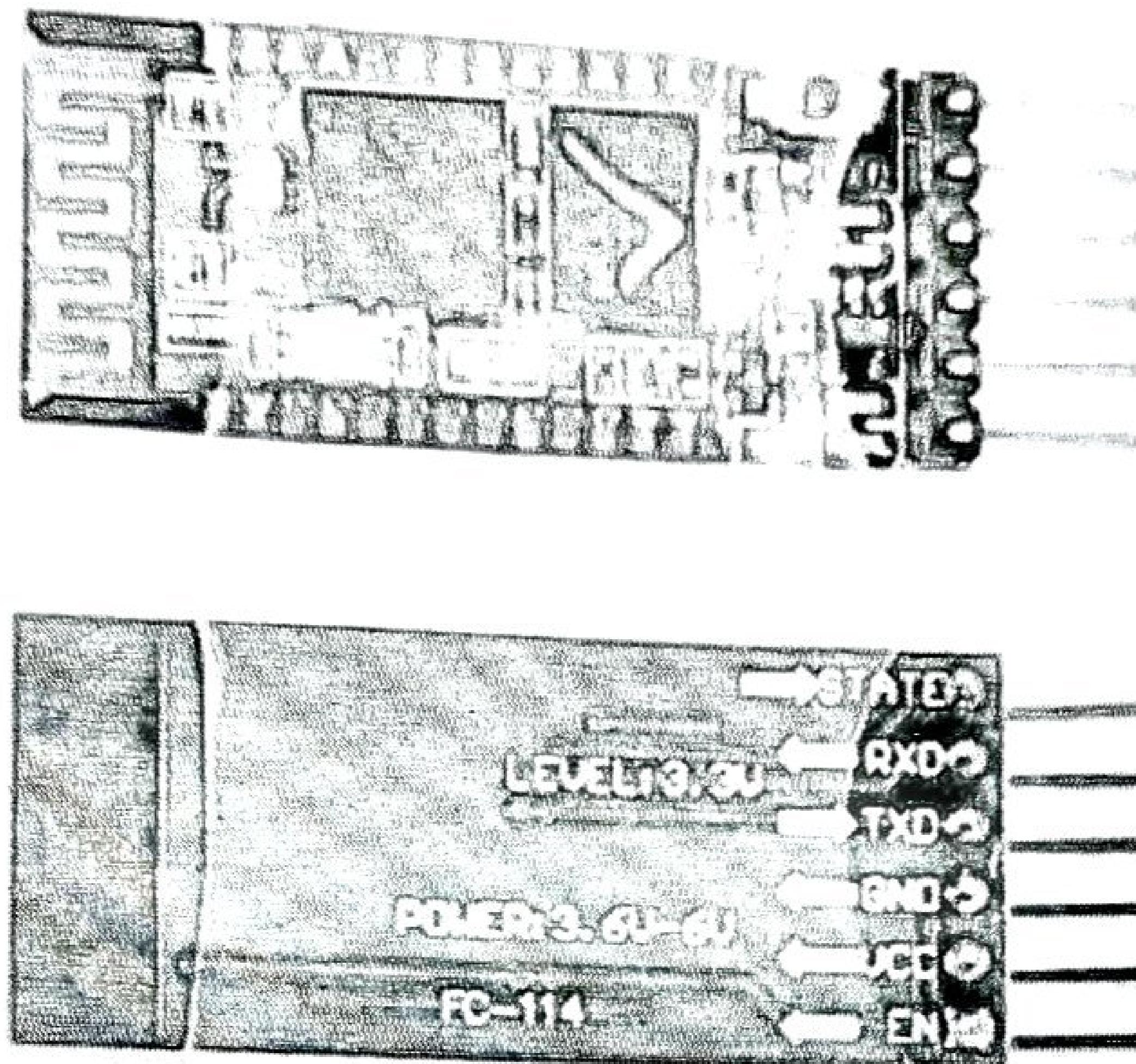
- The Nano device comes with an ability to set up a communication with other controllers and computers. The serial communication is carried out by the digital pins like pin 0 (Rx) and pin 1 (Tx) where Rx is used for receiving data and Tx is used for the transmission of data. The serial monitor is added on the Arduino Software which is used to transmit textual data to or from the board. FTDI drivers are also included in the software.

- which behaves as a virtual com port to the software.
- The Tx and Rx pins come with an LED which blinks as the data is transmitted between FTDI and USB connection to the computer.
 - Arduino Software Serial Library is used for carrying out a serial communication between the board and the computer.
 - Apart from serial communication the Nano boards also support I2C and SPI communication. The Wire Library inside the Arduino Software is accessed to use the I2C bus.
 - The Arduino Nano is programmed by Arduino Software called IDE which is a common software used for almost all types of board available. Simply download the software and select the board you are using. There are two options to program the controller i.e either by the bootloader that is added in the software which sets you free from the use of external burner to compile and burn the program into the controller and another option is by using ICSP (In-circuit serial programming header).
 - Arduino board software is equally compatible with Windows, Linux or MAC, however, Windows are preferred to use.

2. Bluetooth Module HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.



Hardware Features

Typical -80dBm sensitivity.
Up to +4dBm RF transmits power.
3.3 to 5 V I/O.
PIO (Programmable Input/Output) control.
UART interface with programmable baud rate.
With integrated antenna.
With edge connector.

Software Features

Slave default Baud rate: 9600, Data bits: 8, Stop bit: 1, Parity: No parity.
Auto-connect to the last device on power as default.
Permit pairing device to connect as default.
Auto-pairing PINCODE:"1234" as default.

Pin Description:

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate. When enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

Vcc:

Supply Voltage 3.3V to 5V

GND:
Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

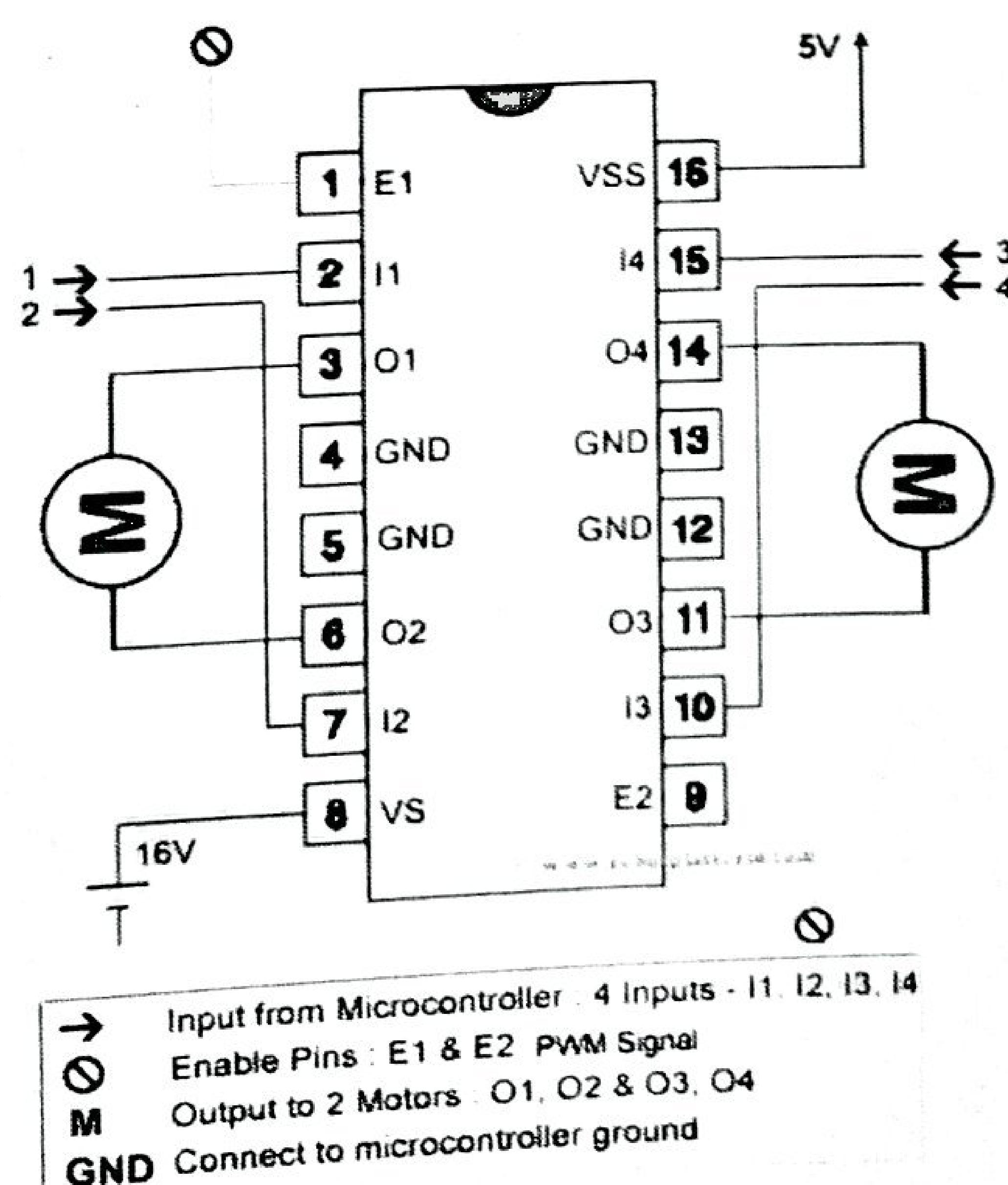
STATE:

It acts as a status indicator. When the module is not connected to / paired with any other Bluetoothdevice, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with other device. When this module is connected to/paired with any other blue toothdevice, the signal goes High. At this high state, the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

3. L293D motor Driver module

L293D is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction we can control speed of each dc motor by giving PWM to enable pin .L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

As we can see in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). If we want to control speed enable pin is connected to the PWM pin of microcontroller. We have connected only one motor and used the enable pin to control the speed of dc motor.



L293D Logic Table:

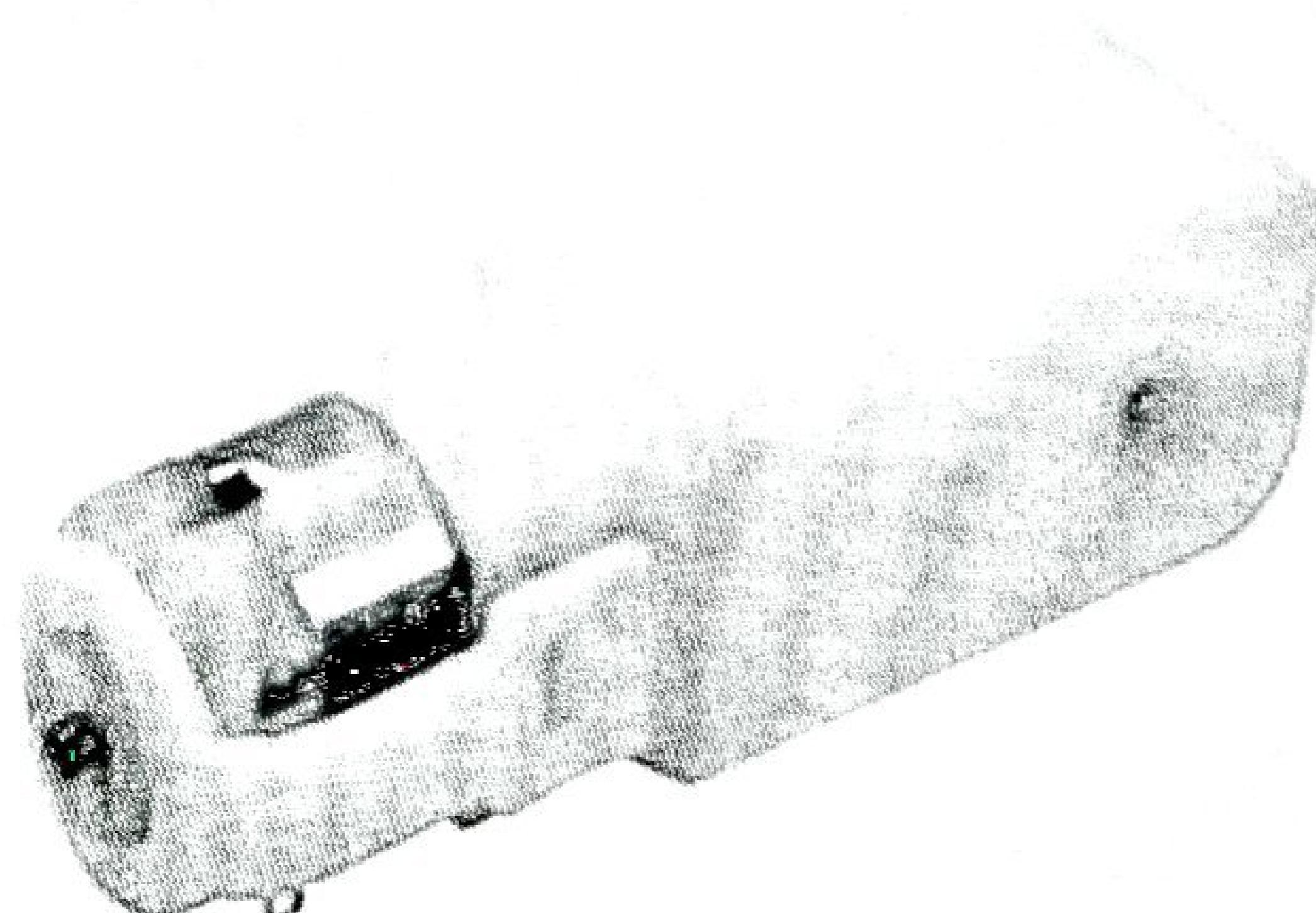
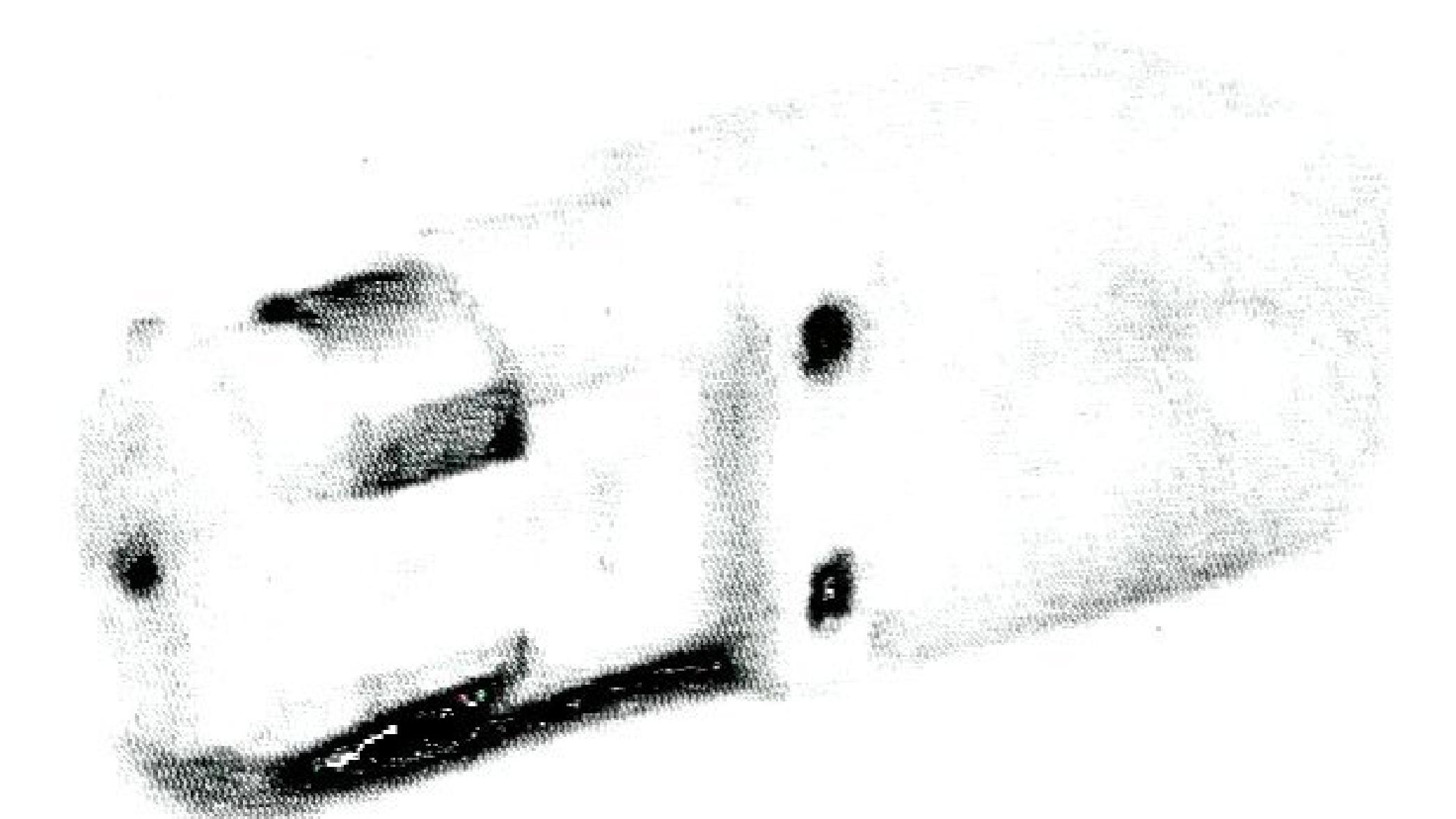
Let's consider a Motor connected on left side output pins (pin 3, 6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

- Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi-Impedance state]
- Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

In a very similar way the motor can also operate across input pin 15, 10 for motor on the right hand side.

4. DC Gear Motor

Dc motor converts electrical energy into mechanical energy. The concept is gears reduce the speed of the vehicle but increase its torque is known as gear reduction. In DC motor is assembled with multiple gear setups. Speed of motor is counted in terms of rotations per minute is called RPM. RPM means Revolution per Minute. The setups assemble helps to increasing the torque and reduce the motor speed. All micro-controller based Robots this type of DC motor can be used.

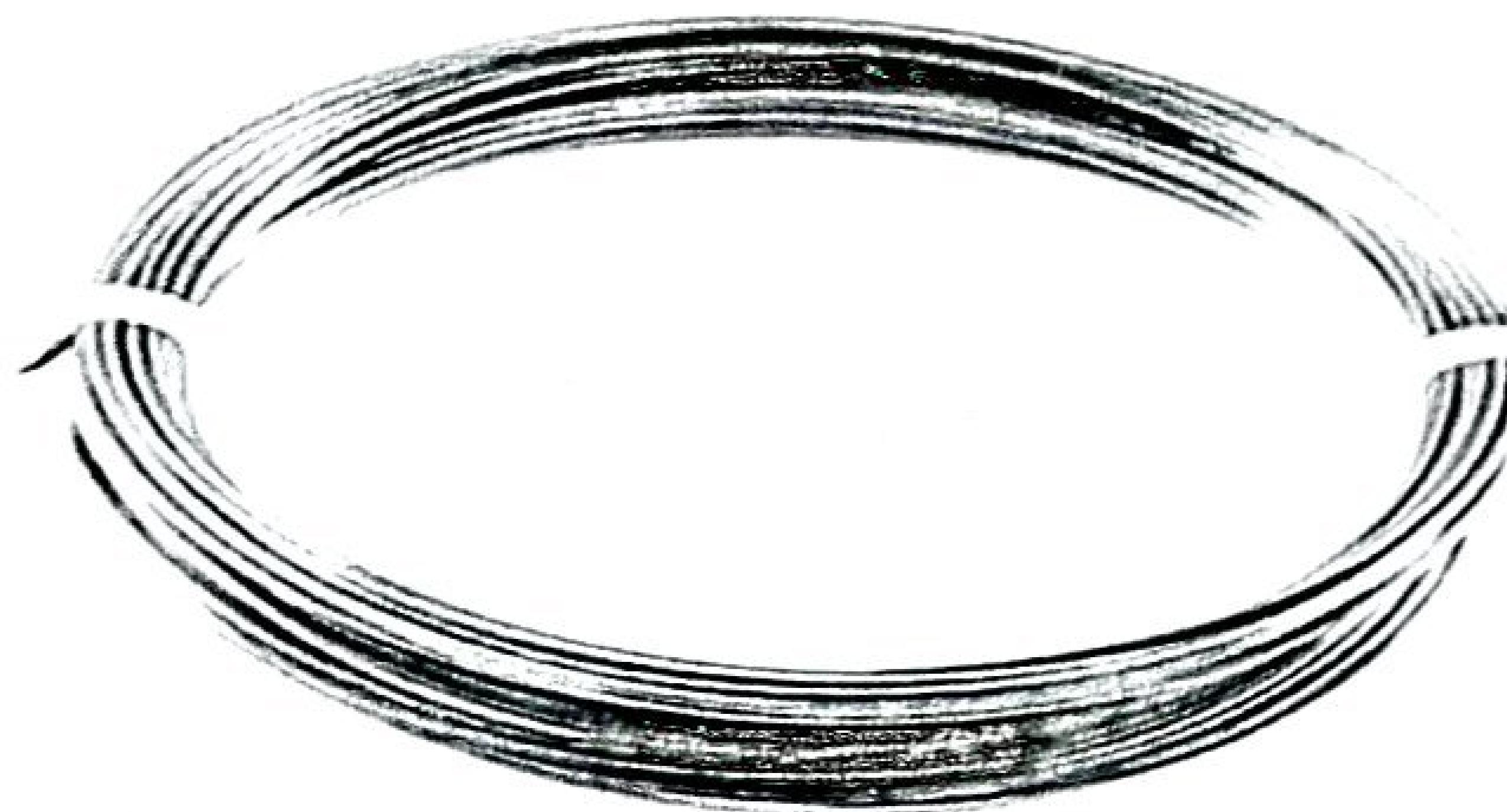


- 5. Small Vero board**
- 6. Robot chassis with motors and wheels**
- 7. Battery 18650 Li-On**
- 8. Connecting wires**
- 9. Adaptor 9V**
- 10. Battery Holder**

Hardware Requirements For Metal Detector

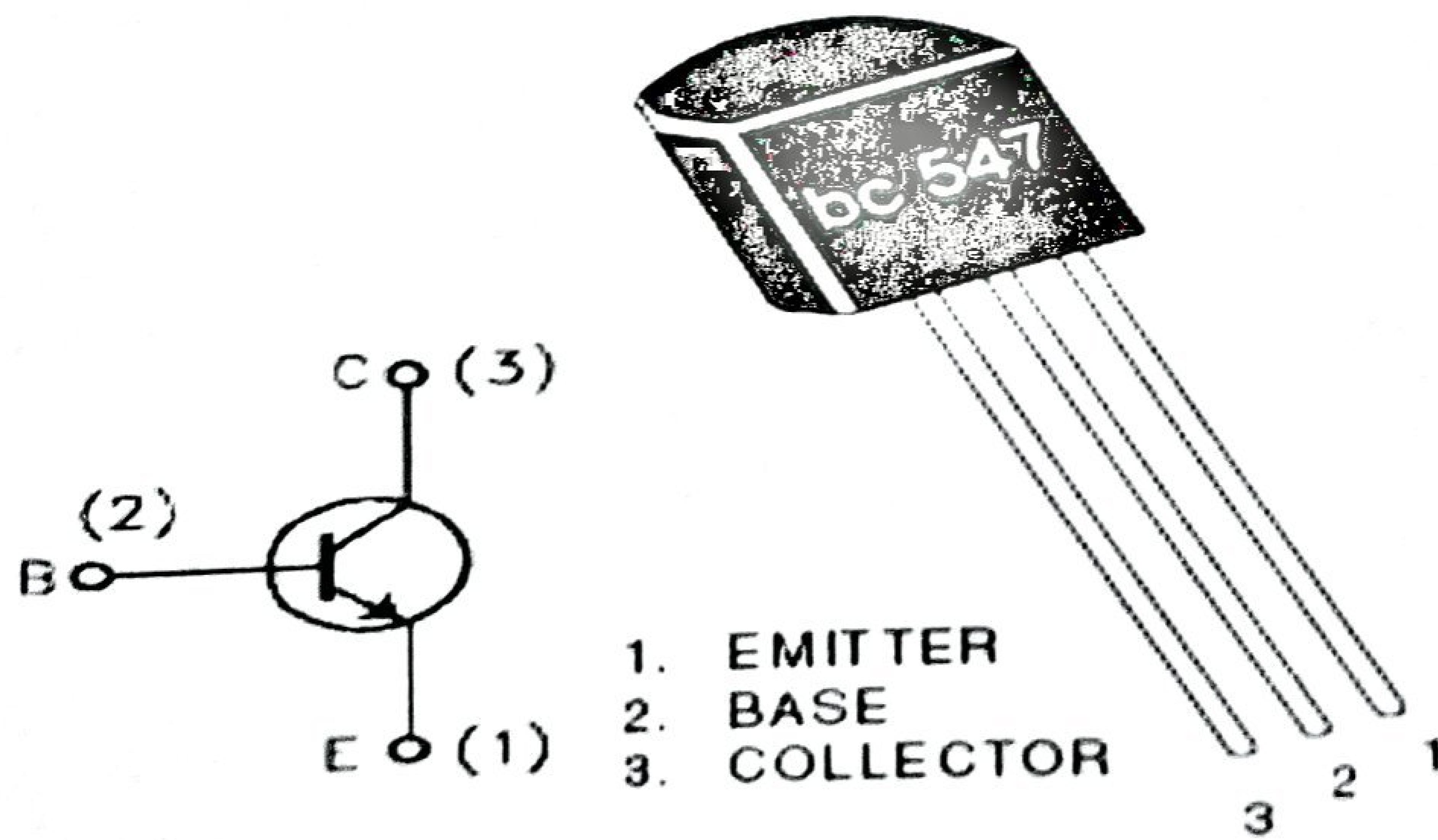
1. Copper Coil

(copper wire of 36 AWG is taken and it is wound in to a coil of diameter 5 – 6 cm and 100 turns)



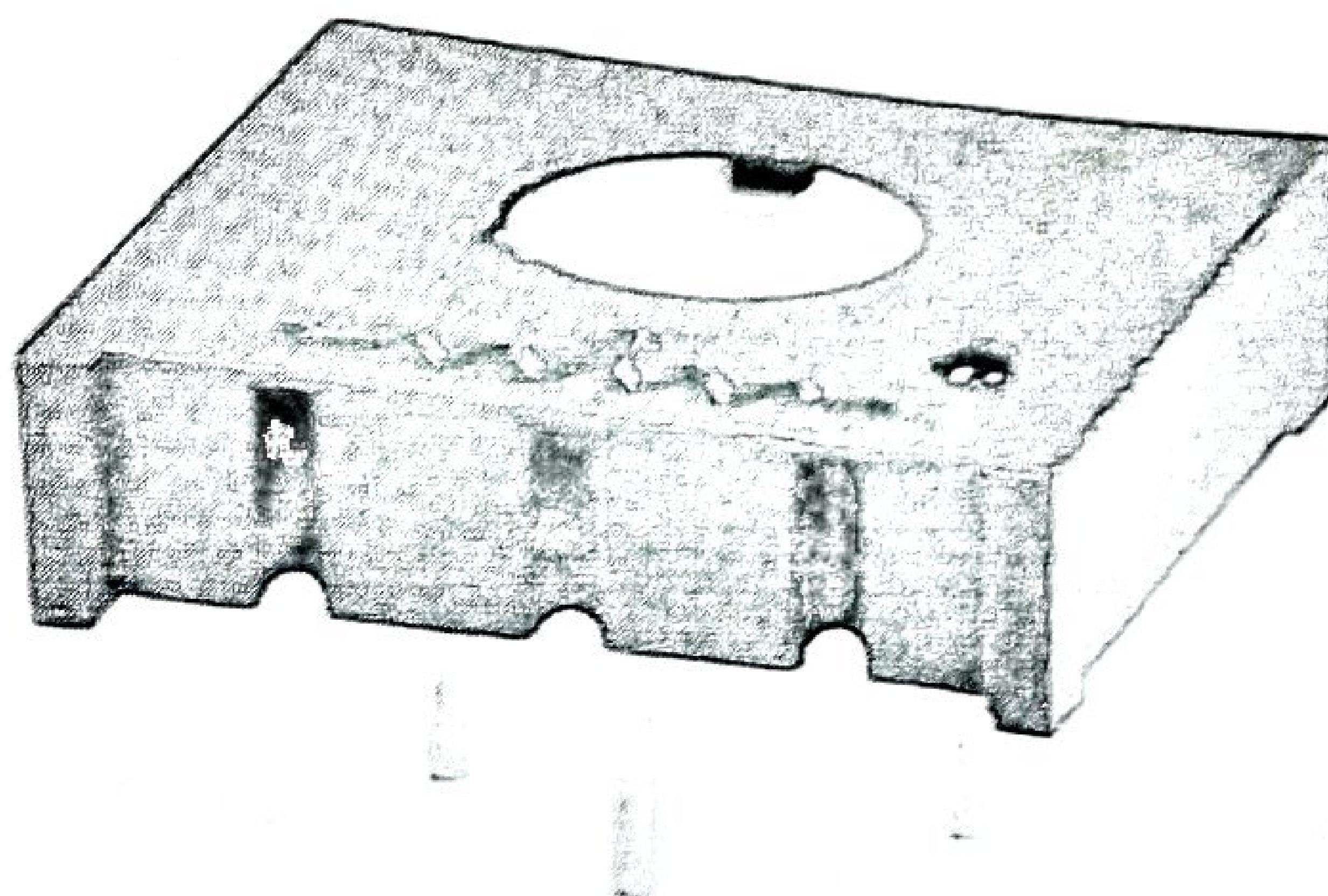
2. BC547 Transistor

BC547 is a bipolar junction transistor (BJT). It is kind of an NPN transistor. It has three terminals: Emitter, Collector and Base. The maximum current gain of BC547 is 800A. The Collector-Emitter Voltage is 65V.



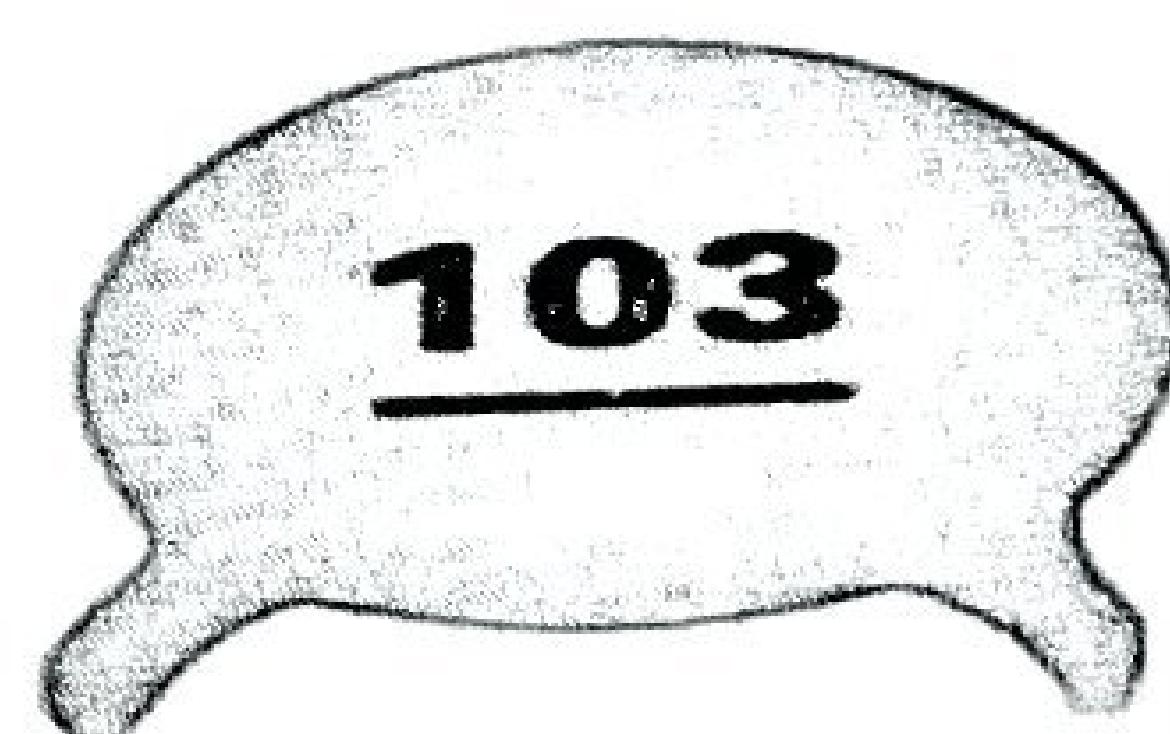
3. 50k pot

50K ohm Variable Trim pots are also known as preset potentiometers used for adjustment, calibration, and tuning purposes in circuits. They are easily mountable on PCB boards and adjusted by a screwdriver. The resistive track is made up of carbon composition or cermet.



4. 0.01uF Capacitor

This is a 0.01uF - (103) Ceramic Capacitor Use this capacitor for power decoupling, having a smooth power in your circuit, timing circuits etc. It is always a good idea to put one of these next to the power pins of a microcontroller.



5. 22pf Capacitor

This 22pF Ceramic Capacitor designed as a non-polarized, linear disc-shaped capacitor. This ceramic capacitor widely used for power decoupling, having smooth power in your circuit, timing circuits, etc.



6. Buzzer

7. Battery- 9Volt

8. Vero Board

9. Solder Wire

10. Soldering Iron

11. Cello Tape

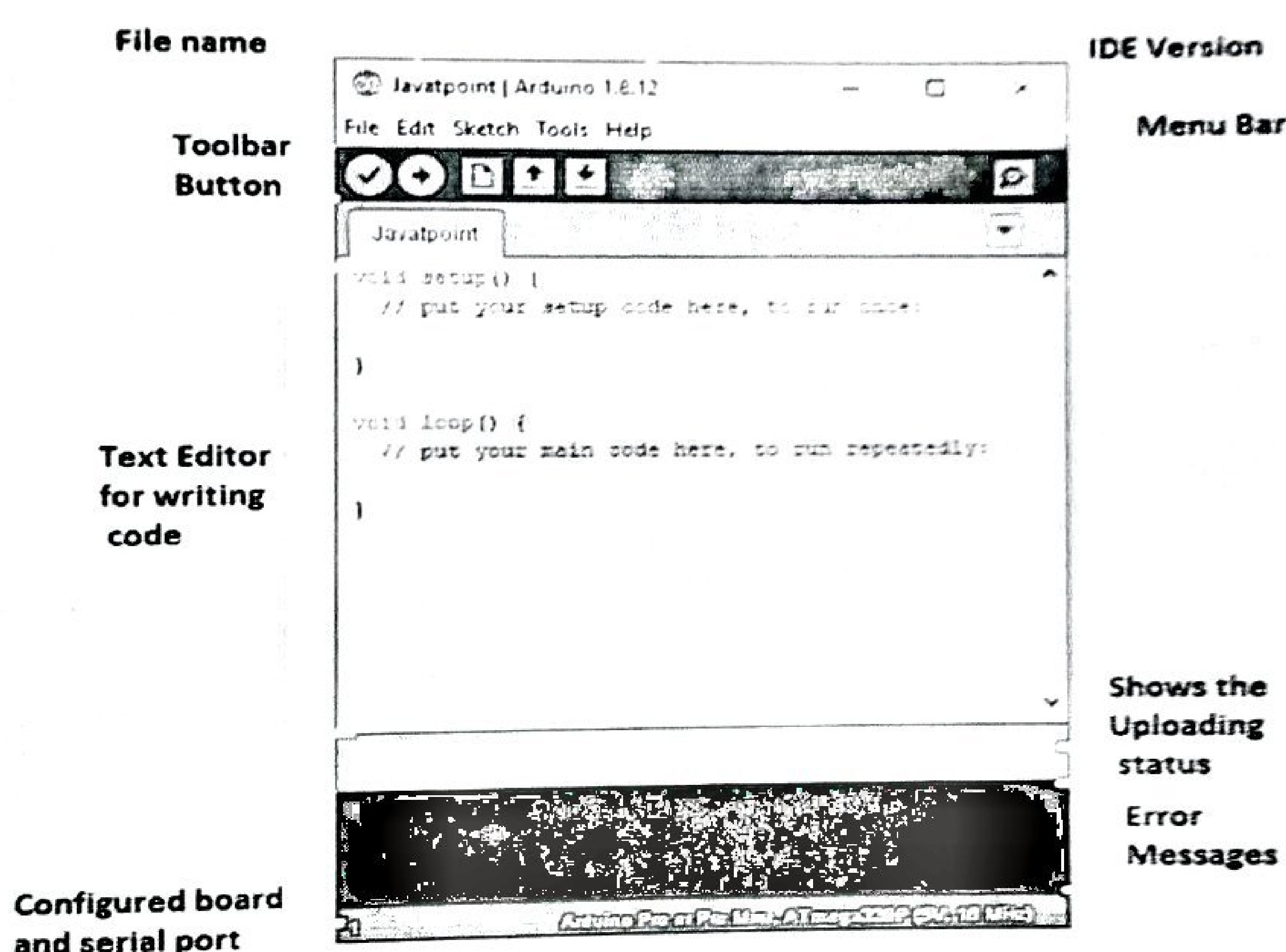
12. PVC Board 6MM

Chapter – 6

SOFTWARE USED IN THE PROJECT:

For programming, the Arduino software provides an integrated development environment (Arduino IDE) and core libraries. The Arduino IDE program is a software program written in Java language and based on the Processing. The Arduino IDE is basically a framework built on top of C and C++ and compiled using avr-gcc and AVR Libc.

The open-source Arduino IDE makes it easy to write code and upload it to the Arduino Nano for execution. It is available for all major desktop platforms i.e., Windows, Mac OS and Linux.



Picture : Arduino IDE

Chaqpter – 7

PROJECT DESCRIPTION:

Android App Car

This is a simple Micro-controller based car. The Micro-Controller is connected in the car. The Arduino is doing all this job. For receiving data wirelessly we are using the HC-05 Bluetooth module.

At first, We have to connect/ pair the Bluetooth module with the phone (Android) you want to control. Now, we are doing different operations such as when we press the forward button then the Phone sends a data value to the Bluetooth module.

Next, we have to code in a way that if Arduino Gets a Certain Data (Suppose 'F' for forwarding) we have to make a certain condition for running the car in a certain direction. So, basically, there are many switch cases in the Arduino code. For a known condition or a switch case, the car will perform the added functions in the code.

In the Same way, F, B, L, R, are used for moving the car Forward, Backward, Left, Right movements.

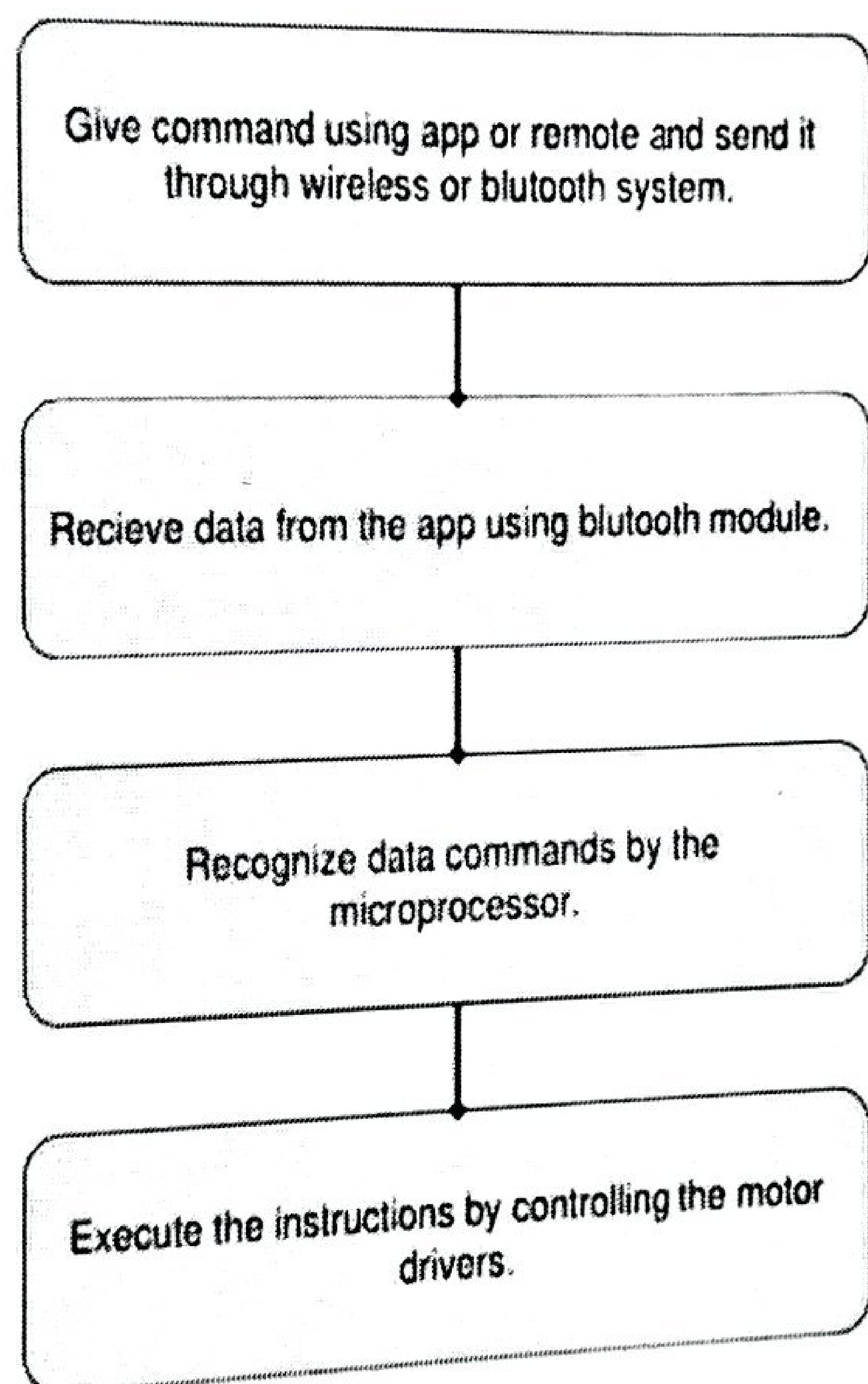
METAL DETECTOR

A metal detector is an electronic device that comprises of an oscillator which generates an AC current that passes via a coil generating an alternating magnetic field. When a part of the metal is nearby to the coil, eddy current will be induced in the metal object & this generates a magnetic field of its own. This system is developed using several electrical and electronic principles. The principle of electromagnetism is a major principle applied. When the coil which serves as the sensor is placed over a metal and the system is switched ON, the electric current passing through the coil makes it magnetic and being placed over a metal, the metal generates a very small voltage (in micro volts) in form of eddy currents. This generated eddy current is received by the sensors and thus it causes a disturbance to the main current flow. The buzzer makes a sound as it moves the metal part near the copper coil in this circuit.

MMMMMM B, L, R are used for moving the car Forward, Backward, Left, Right movements.

Chapter – 8

FLOW CHART:

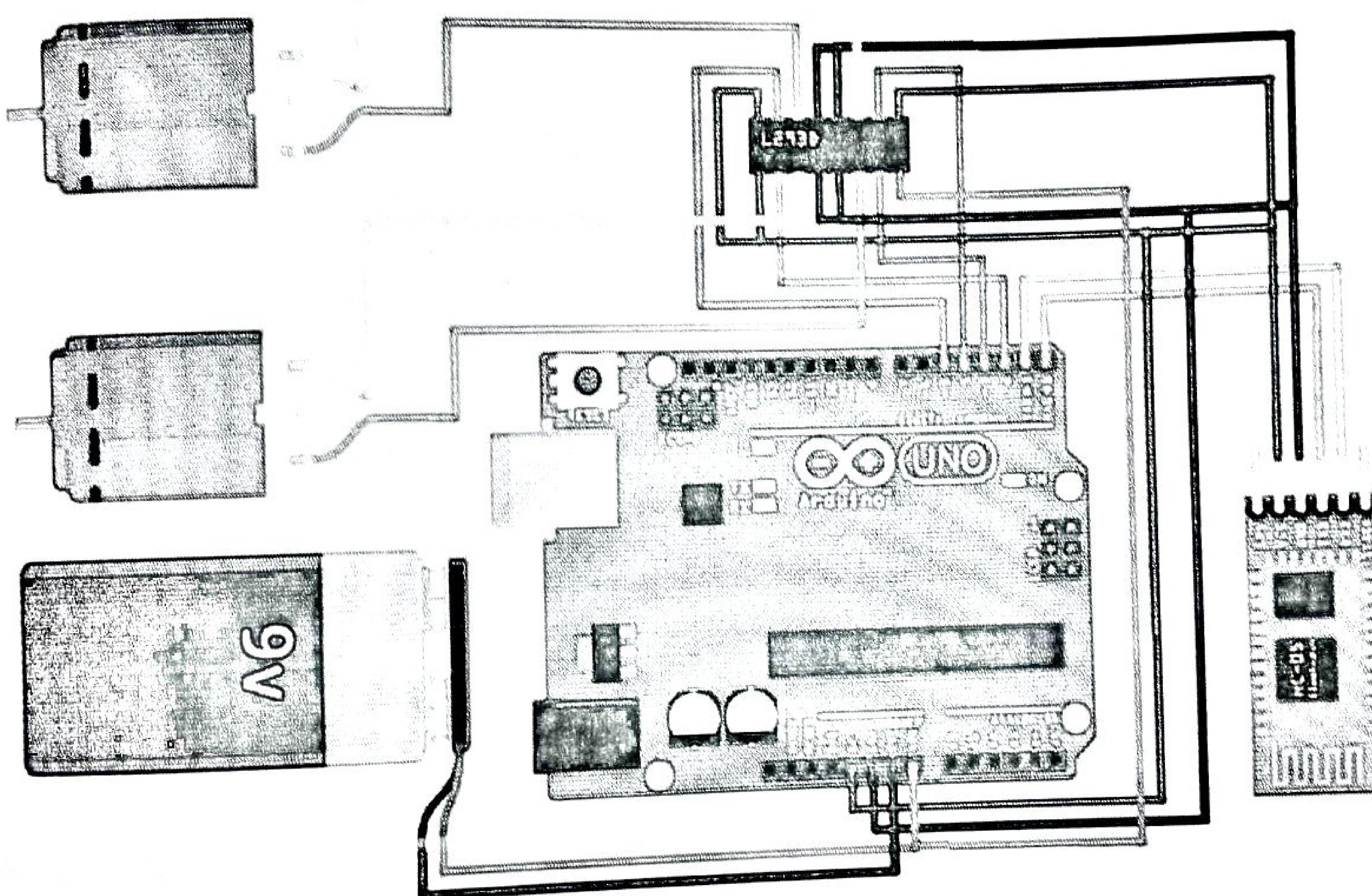


Flowchart Of Android App Car

Chapter – 9

CIRCUIT DIAGRAM:

Android App Car



Picture 1: Circuit Diagram of Bluetooth Car

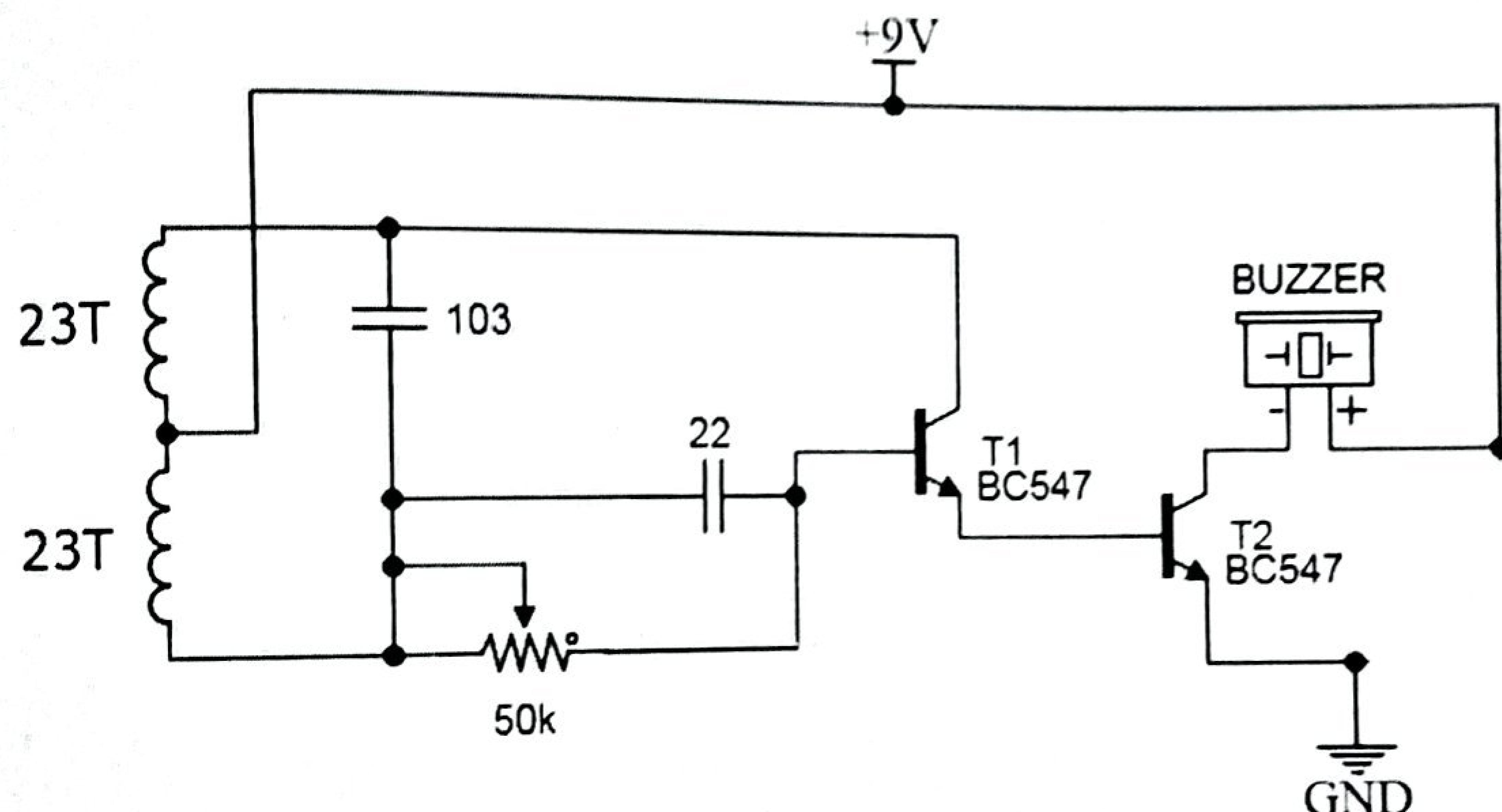
For circuit connection we need three major components which are Arduino uno, L293d motor driver and Bluetooth module hc-05. Firstly take the Arduino uno and then fix it on the middle of the car. After this take the L293d motor driver and mount it over the Arduino uno. Now the next thing is to connect the dc motors with your motor driver. Take the dc motors one by one and connect it with the motor driver.

After connecting all the motors take the Bluetooth module hc-05 and connect it with the Arduino uno. Connect the VCC pin of the Bluetooth module with the +5 Volt pin of motor driver. Then connect the ground pin of the Bluetooth module with the ground pin of motor driver. Now connect the RX pin of Bluetooth module with the TX pin of Arduino uno. Again connect the TX pin of Bluetooth module with the TX pin of Arduino uno.

module with the RX pin of Arduino uno.

Lastly we have to give the supply to the circuit. Here we use 18650 Li-On battery to provide the power supply in the circuit. Now our circuit connection is completed.

METAL DETECTOR



Picture 2: Circuit Diagram of Metal Detector

Chapter – 10

RESULTS:

In this project, an autonomous landmine finding robot has been implemented which is capable to detecting mines and find them successfully. This robot can move forward, backward, left, right etc.

The motor and Arduino code works together to control the movement of the robot. If any Iron particle is detected by its receiver, then it sends a signal to buzzer and the buzzer will start and it will be continued until the operator send stop signal to the system.

Chapter – 11

SNAPSHORT OF THE PROJECT:



Picture : Snapshot of Project

Chapter - 12

APPLICATION:

Industrial uses: Used by various industries to detect metallic objects.

Airport Security: To check peoples before allowing them to access the boarding area and the plane.

Building security: Checking peoples before entering a particular building, such as a school, office or prison.

Event security: Testing whether a person is carrying dangerous thighs while entering a sporting event, concert or other large gatherings of people.

Finding Items: To search a lost item, such as a piece of jewelry.

Archaeological exploration: To find metallic items of historical significance.

Geological research: For detecting the metallic composition of soil or rock formations.

Chapter – 13

COMPONENT INFORMATION:

SL.NO.	NAME	DETAILS
1.	Arduino Nano	1 Pic
2.	Bluetooth Module HC-05	1 Pic
3.	L293D Motor Driver Module	1 Pic
4.	DC Gear motor	4 Pics
5.	Battery	1 pic of 18650 Li-On
6.	Adapter	1Pic of 9Volt
7.	Battery Holder	1 Pic
8.	Buzzer	1 Pic
9.	Vero Board	1 Pic
10.	Copper Coil	Copper wire of 36 AWG is taken and it is wound in to a coil of diameter 5 – 6 cm and 100 turns
11.	9 Volt Battery	1 Pic
12.	Solid Wire	As per required
13.	Cello Tape	As per required
14.	PVC Board	1 Pic of 6mm
15.	Capacitor	1 Pic of 0.01 uF
16.	Solder Wire	As per required
17.	Capacitor	1 Pic of 22 pf
18.	Soldering Iron	As per required
19.	50k Pot	1 Pic
20.	BC547 Transistor	2 Pics

Chapter -14

CONCLUSION:

This project has presented a unique vision of concept which are used in this particular field. It aims to promote technology innovative to achieve a reliable and effective outcome from various instruments.

Experimental work has been carried out carefully. The result shows that higher efficiency is indeed achieved using the embedded system. With a common digitalized platform, these latest instruments will enable increase flexible in control, operations and expansion allow for embedded intelligence essentially foster the resilience of the instrument and eventually benefit the customers with improvement in services reliability and increase convenience.

This project presents the major features and functions of the various concept that could be used in detail through various categories.

Science this initial work cannot address everything's within the proposed fame work and vision more development efforts are needed to fully implement the proposed framework through a joint effort of various entities.

Chapter - 15

FUTURE SCOPE OF THE PROJECT:

1. To update the system for finding other metals.
2. Implement Anti Drone systems.
3. Implement radar.

Chapter – 16

DETAILS OF THE PROGRAM:

```
char bt='S';

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

    pinMode(5,OUTPUT);
    pinMode(4,OUTPUT);
    pinMode(3,OUTPUT);
    pinMode(2,OUTPUT);

    Stop();
}

void loop() {
    bt=Serial.read();

    if(bt=='f' || bt=='F')
    {
        forward();
    }
    if(bt=='b' || bt=='B')
    {
        backward();
    }
    if(bt=='L' || bt=='l')
    {
        left();
    }
    if(bt=='R' || bt=='r')
    {
        right();
    }
}

void forward() {

    digitalWrite(5,LOW);
    digitalWrite(4,HIGH);
    digitalWrite(3,LOW);
    digitalWrite(2,HIGH);
}
```

```
void backward() {  
    digitalWrite(5,HIGH);  
    digitalWrite(4,LOW);  
    digitalWrite(3,HIGH);  
    digitalWrite(2,LOW);  
}  
  
void left() {  
  
    digitalWrite(5,LOW);  
    digitalWrite(4,HIGH);  
    digitalWrite(3,HIGH);  
    digitalWrite(2,LOW);  
}  
  
void right() {  
  
    digitalWrite(5,HIGH);  
    digitalWrite(4,LOW);  
    digitalWrite(3,LOW);  
    digitalWrite(2,HIGH);  
}  
  
void Stop() {  
  
    digitalWrite(5,HIGH);  
    digitalWrite(4,HIGH);  
    digitalWrite(3,HIGH);  
    digitalWrite(2,HIGH);  
}
```

Chapter – 17

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