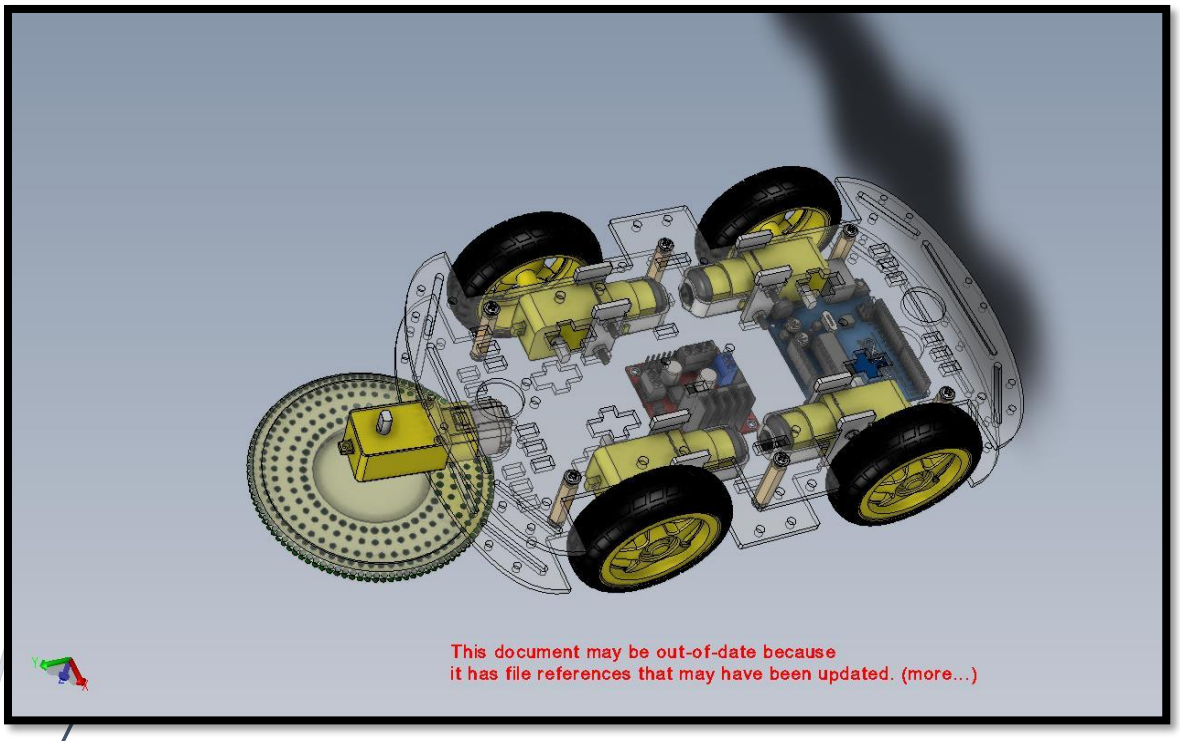
Smart Floor Cleaner using Arduino Controller

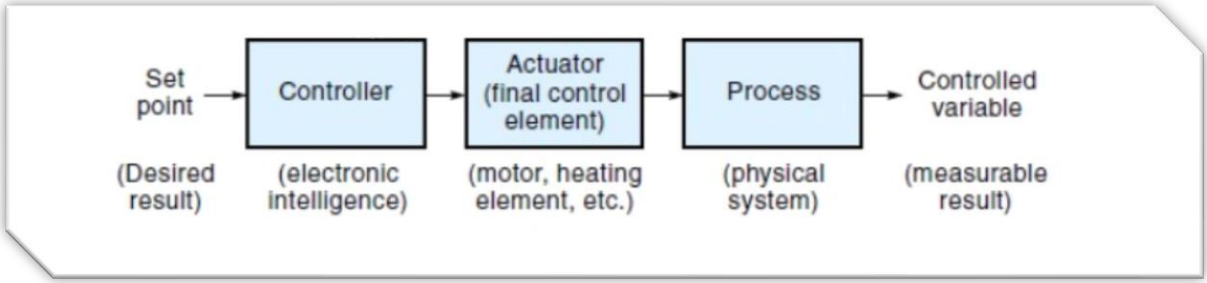


AUBAI ALKHABBAZ

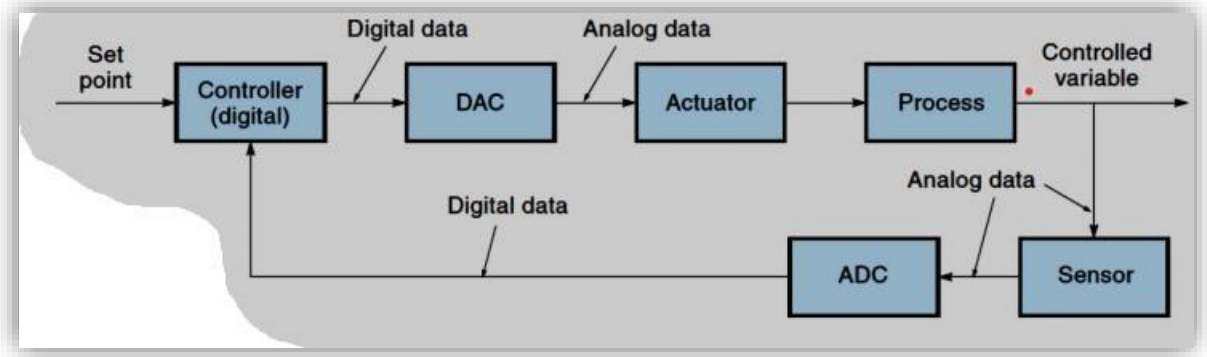
-The robots are has been used for various cleaning purposes. Robots have various cleaning expertise like mopping, picking up the waste, wet floor cleaning and dry vacuum cleaning etc,. Depending on the cleaning mechanism, these robots may have some advantages and disadvantages. Smart floor cleaning (SFC) robot has been designed for home and office environments. This robot on receiving the commands from the android device cleans an area using a cleaning pad on the floor.

The proposed system is a manual system because it is controlled by android application which is operated by human and functioning is entirely depended on the commands that are received from the android application.

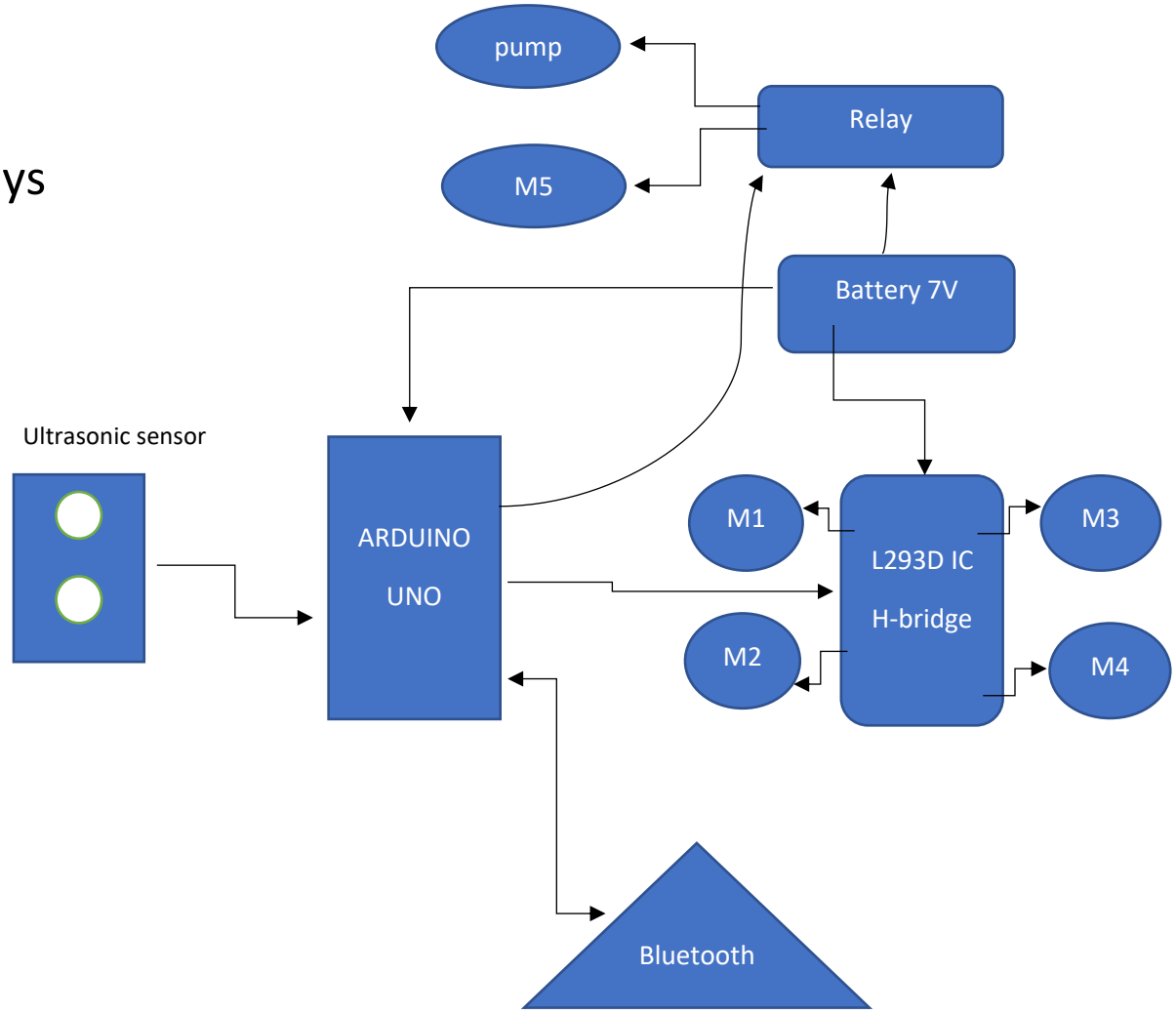
Control sys



Closed-loop sys



Robot sys



an autonomous robot for floor cleaning application is proposed. It is capable of performing mopping, cleaning tasks. The proposed model “Design and Implementation of Smart Floor Cleaning Robot using Android App” shows fig 2 for better understanding of the proposed work. This block diagram consists of 12v DC motor, L293D IC, Bluetooth module, cleaning mechanism and Arduino UNO. The power supply is given to the Arduino UNO as well as to relay. The robotic arm used here consists of 5 dc motors where 4 dc motor is used for moving robotic Forward Reverse, left, right and last dc motor is used to rotate arm completely for cleaning. Here we use L239D drivers for driving dc motors to move in forward and backward direction , for water pump, for cleaner. Relays have been used to drive the water pump and cleaner motor . Bluetooth module is used to control the robot using mobile phone application within a range .

a transmitter application that runs on an android mobile app which allows the robot to follow commands given by the user through the transmitter app. The proposed robot consists of Arduino UNO controller which has fourteen digital input/output pins, robotic arm with cleaning pad for efficient cleaning. The

Arduino UNO, on receiving the commands from android device through Bluetooth receiver, decodes the given commands and controls the motors to achieve the desired path and direction. This smart cleaner module is leads to make clean and healthy society in our country.

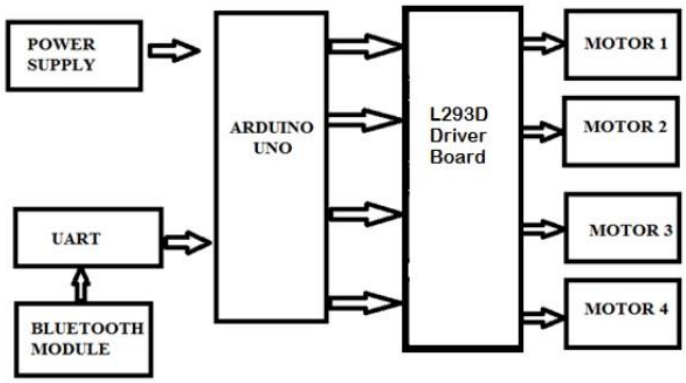


Fig.1. Block diagram of proposed Smart Foor Cleaner

Fig.2.Transmitter

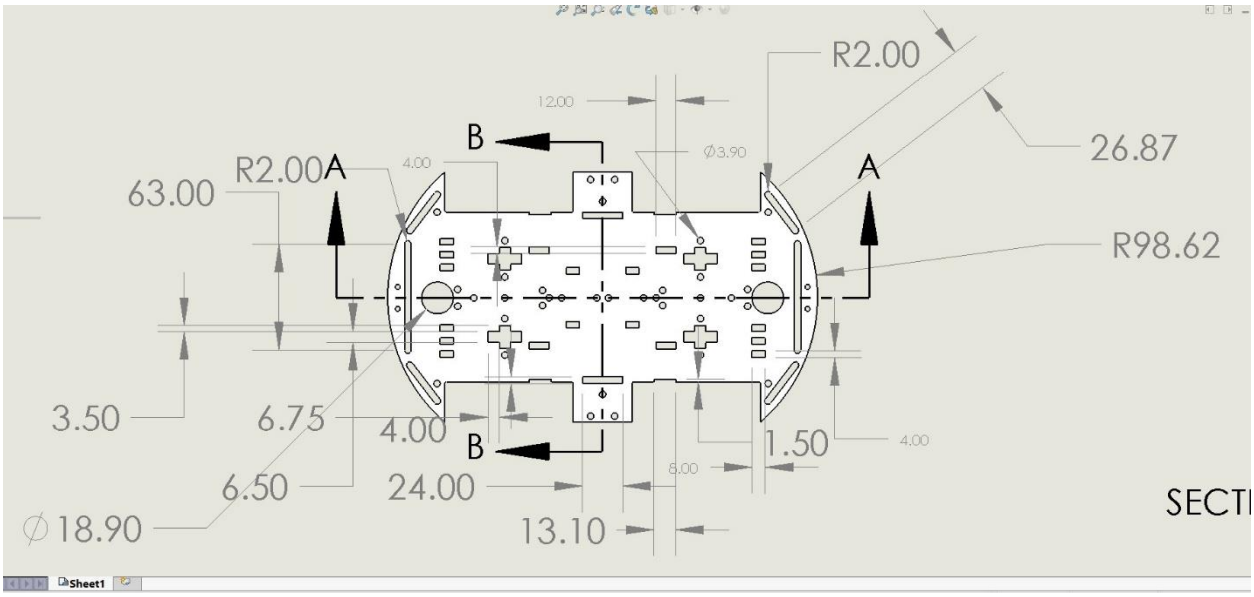
1-chassis robot:

Acrylic

Acrylic sheet, generally known as Plexiglas is a great material for building robot bodies which allows you to see-through your robots. An alternative for glass as they are shatter resistant (to a certain extent) and lighter, Plexiglas is available in different sizes and shapes. You can use superglue or hot glue to stick them together. Cutting, drilling and shaping Plexiglas is always a pain; you either crack it, or even worse as your cut the sheets, it melts and sticks back together. You can cut them *slowly* and carefully with a hacksaw. There are a few saw blades specially designed to cut acrylic glass; use them or purchase an expensive laser cutter.

Mechanical Properties	Metric	English	Comments
Hardness, Barcol	49 - 50	49 - 50	Average value: 49.9 Grade Count:9
Hardness, Rockwell M	94 - 105	94 - 105	Average value: 98.2 Grade Count:14
Ball Indentation Hardness	175 MPa	25400 psi	Average value: 175 MPa Grade Count:3
Tensile Strength, Ultimate	62.0 - 83.0 MPa	8990 - 12000 psi	Average value: 74.4 MPa Grade Count:18
	40.0 - 110 MPa @Temperature -40.0 - 70.0 °C	5800 - 16000 psi @Temperature -40.0 - 158 °F	Average value: 75.0 MPa Grade Count:3
Tensile Strength, Yield	64.8 - 83.4 MPa	9400 - 12100 psi	Average value: 75.4 MPa Grade Count:14
Elongation at Break	3.0 - 6.4 %	3.0 - 6.4 %	Average value: 5.16 % Grade Count:23
Modulus of Elasticity	2.76 - 3.30 GPa	400 - 479 ksi	Average value: 3.10 GPa Grade Count:21
Flexural Yield Strength	98.0 - 125 MPa	14200 - 18100 psi	Average value: 109 MPa Grade Count:20
Flexural Modulus	2.96 - 3.30 GPa	429 - 479 ksi	Average value: 3.22 GPa Grade Count:12
Compressive Yield Strength	110 - 124 MPa	16000 - 18000 psi	Average value: 120 MPa Grade Count:13
Compressive Modulus	2.76 - 3.03 GPa	400 - 440 ksi	Average value: 2.96 GPa Grade Count:11
Poissons Ratio	0.37	0.37	Average value: 0.370 Grade Count:3
Shear Modulus	1.70 GPa	247 ksi	Average value: 1.70 GPa Grade Count:3
Shear Strength	25.5 - 62.1 MPa	3700 - 9000 psi	Average value: 55.2 MPa Grade Count:11
Izod Impact, Notched	0.160 - 0.220 J/cm	0.300 - 0.412 ft-lb/in	Average value: 0.199 J/cm Grade Count:8
Izod Impact, Notched (ISO)	1.60 kJ/m²	0.761 ft-lb/in²	Average value: 1.60 kJ/m² Grade Count:3
Charpy Impact Unnotched	1.20 - 2.17 J/cm²	5.71 - 10.3 ft-lb/in²	Average value: 1.55 J/cm² Grade Count:7
Coefficient of Friction	0.45 - 0.80	0.45 - 0.80	Average value: 0.583 Grade Count:3
Compression Set	0.75 %	0.75 %	Average value: 0.750 % Grade Count:8

Overview of materials for Acrylic, Cast (matweb.com)



Punching operations on platform:

$$\tau = \frac{F}{A}$$

where

- τ shear stress [Pa]
- F applied force [N]
- A cross-sectional area [m^2]

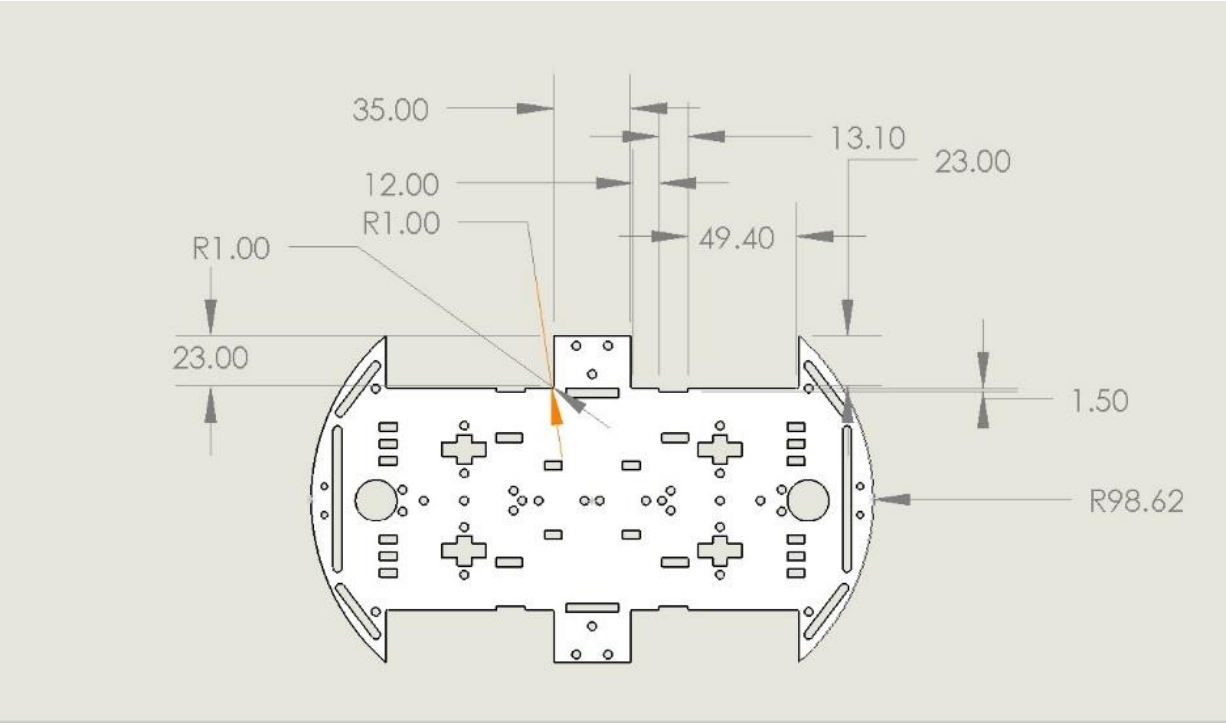
T= 62.1 MPA MN/M^2 = N/mm^2 from table.

Thick of platform = 3 mm

F=T*A N

A= punched out

Platform without holes :



L Arc length:

L=2*pi*r*(Θ/360)

L=2*3.14*98.62132*(98.12324/360) = 168.8106

s Arc length:

L=2*pi*r*(Θ/360)

L=2*3.14*1*(45/360) =0.758

Platform = 2*168.8106 +
23*8+0.758*8+49.90*4+1.50*8+13.10*4+12*4+35*2=909.684mm=0.909684m

A=909.684*3=2729.052mm^2

F=T*A (N)

F=62.1*2729.052 = 169474.1292 N=169.4741292 KN

holes:

S circle:
A= punched out

Diameter =3.90mm

A= Pi*D*thick =3.14*3.90*3=36.0738 mm^2

F=T*A N

F=62.1*36.0738=2281.4298 N=2.2814298 KN

L circle:
A= punched out

Diameter =18.90mm

A= Pi*D*thick =3.14*18.90*3=178.038 mm^2

F=T*A N

F=11056.1598N=11.0561598 KN

S rectangle:

A=(2*a+2*b)*thick =(2*4+2*8)*3=72 mm^2

F=T*A N

F=4471.2N=4.4712 KN

m rectangle:

A=(2*a+2*b)*thick =(2*4+2*12)*3=96 mm^2

F=T*A N

F=5961.6N=5.9616KN

L rectangle:

A=(2*a+2*b)*thick =(2*4+2*24)*3=168 mm^2

F=T*A N

F=10432.8N=10.4328KN

Cross rectangles

A=(area)*thick = (4*3.50+4*6.75+4*3.50)*3=165 mm^2

F=T*A N

F=10246.5N=10.2465KN

S slot:

A= ((pi*4)+(2*4+26.84*2))*3=222.72 mm^2

F=T*A N

F=13830.912N=13.830912KN

L slot:

A= ((pi*4)+(2*4+63*2))*3=439.68 mm^2

F=T*A N

F=27304.128N=27.304128KN

Thermal Stress :

Acrylic has a coefficient of thermal expansion at 7.7 x 10-5

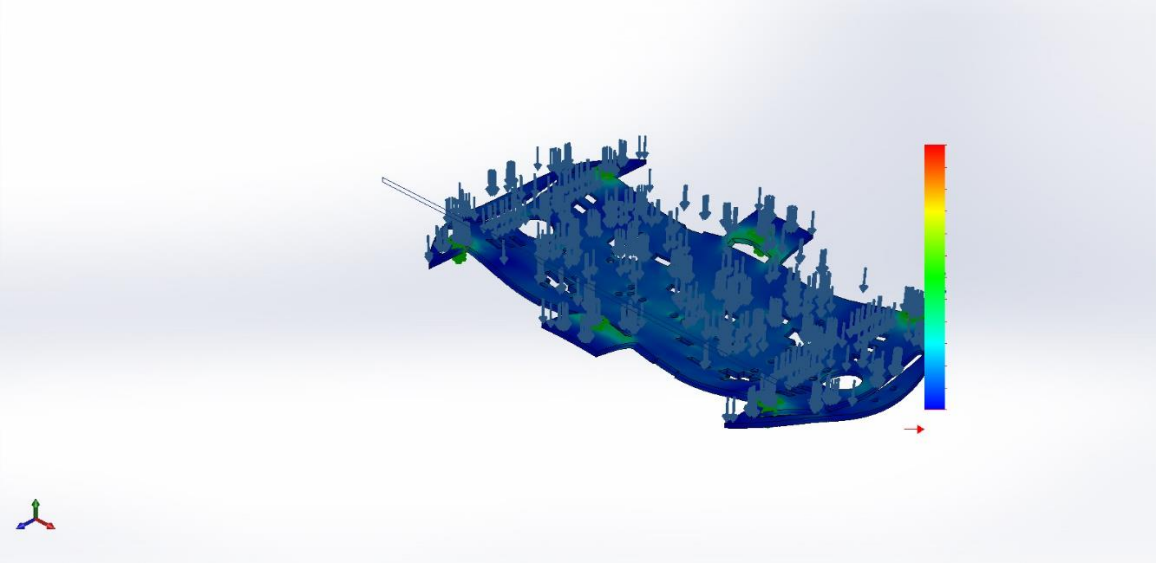
L flatform = 260mm , standard Ambient temperature and pressure = 25C

(Delta L) = α L (Delta T)

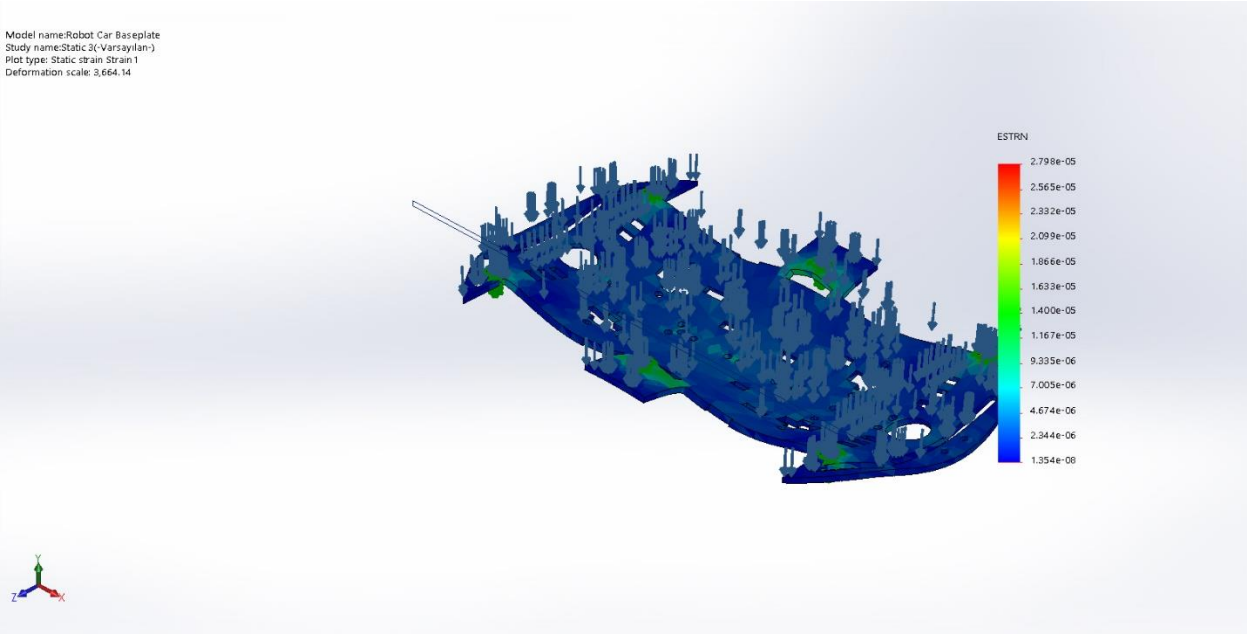
Delta L = 7.7 x 10-5 * 260 * (37-25) = 0.24024

0.0932%

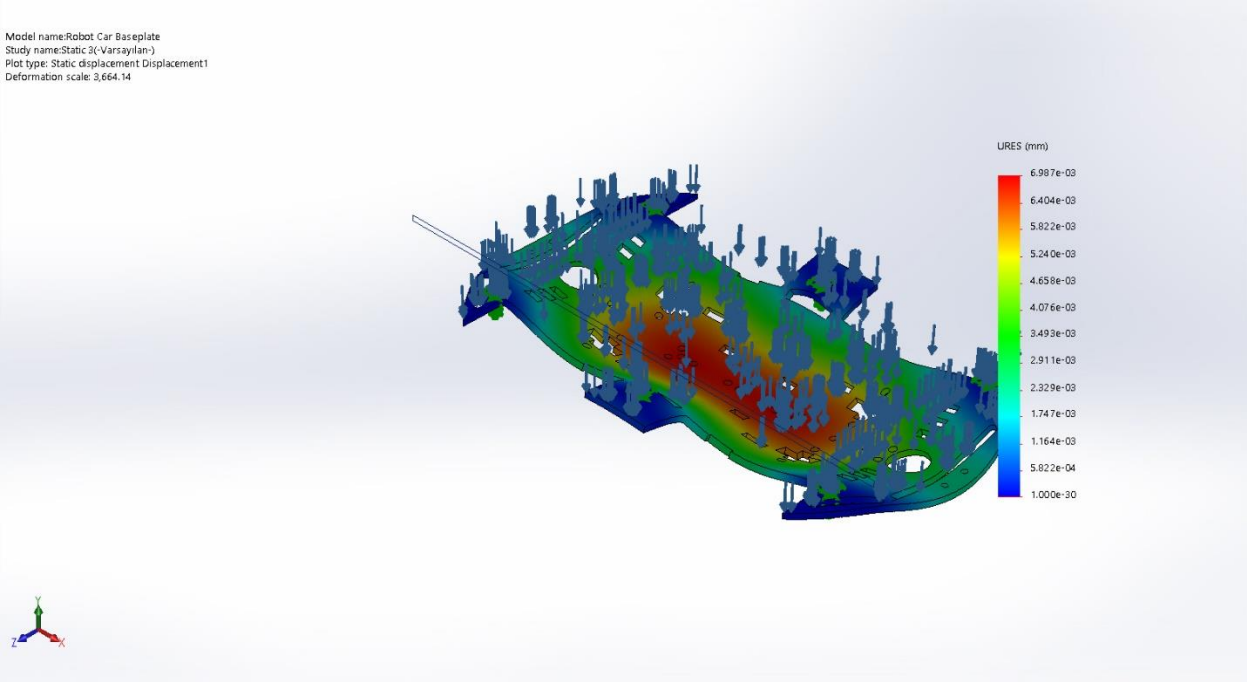
Robot Car Baseplate-Static 3-Stress-Stress اجهاد 1N load



Robot Car Baseplate-Static 3-Strain-Strain انفعال 1N load



Robot Car Baseplate-Static 3-Displacement-Displacement

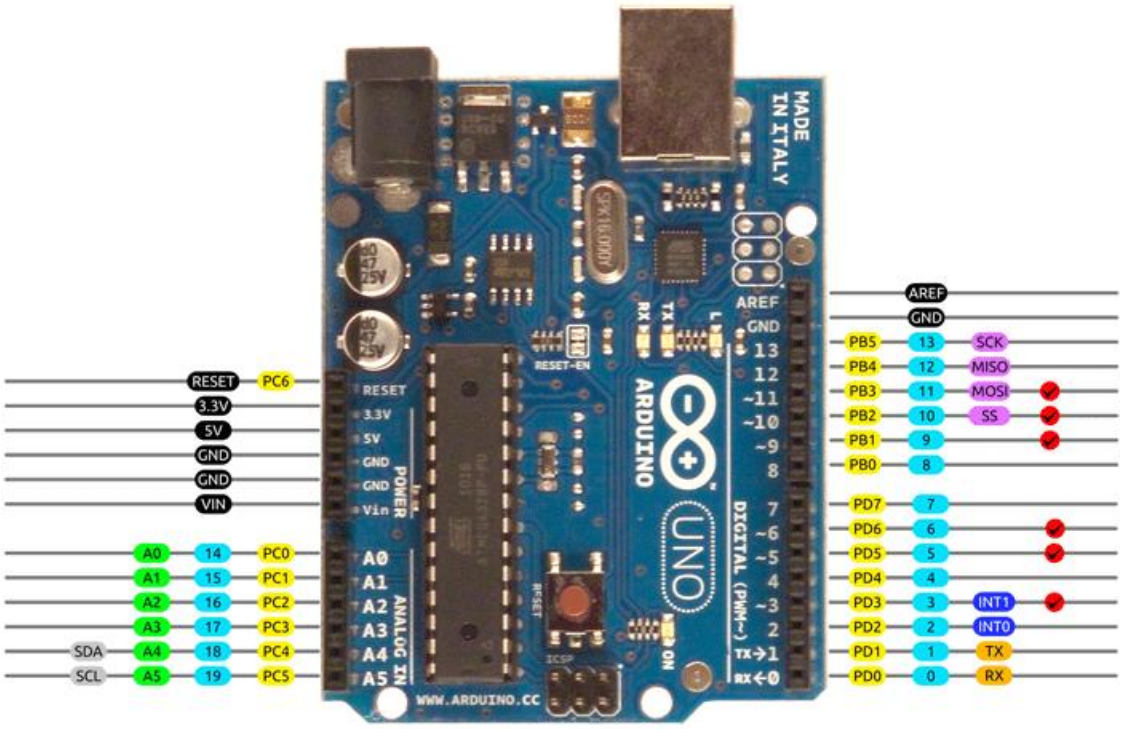


2-Arduino Uno

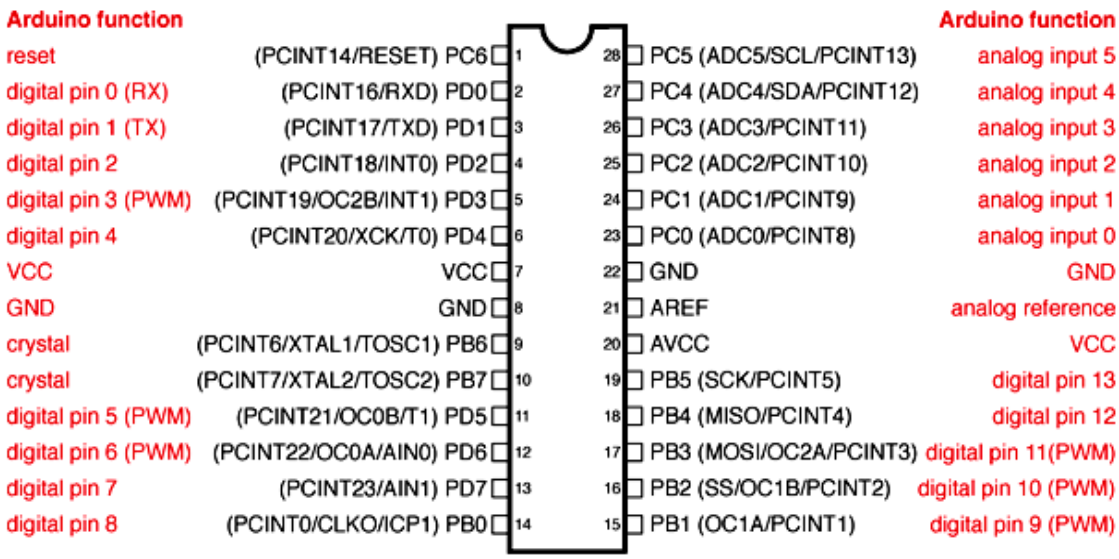
Arduino Uno In our project Arduino controller is used to control the motor and pumps to drive the car and clean the floor. The spray system of water also controlled by controller.

The Arduino Uno R3 is a microcontroller is used in our project to integrate and control the functions of all equipment's like LCD, Bluetooth. The Arduino Uno R3 is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz



AVR DIGITAL ANALOG POWER SERIAL SPI I2C PWM INTERRUPT



3-Sensors

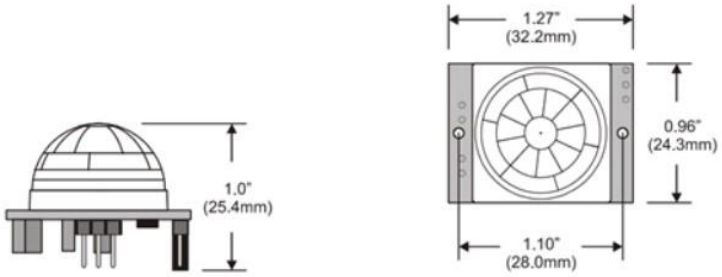
In our project we were designed fully automated floor cleaner system with bluetooth setup. For this automated system we used multiple sensors, one is PIR sensor another one is Ultrasonic sensor. Which are used to sense the

object or human near the cleaner path and stop the motors of wheels the after clear the object cleaner moves ahead.

A PIR (Passive Infrared) sensor is a motion detector which detects the heat (infrared) emitted naturally by humans and animals. When a person in the field of vision of the sensor moves, the sensor detects a sudden change in infrared energy and the sensor is triggered (activated). They are commonly used in security lighting and alarm systems in an indoor environment. The PIR sensors have a range of approximately 6 meters, depending on conditions.

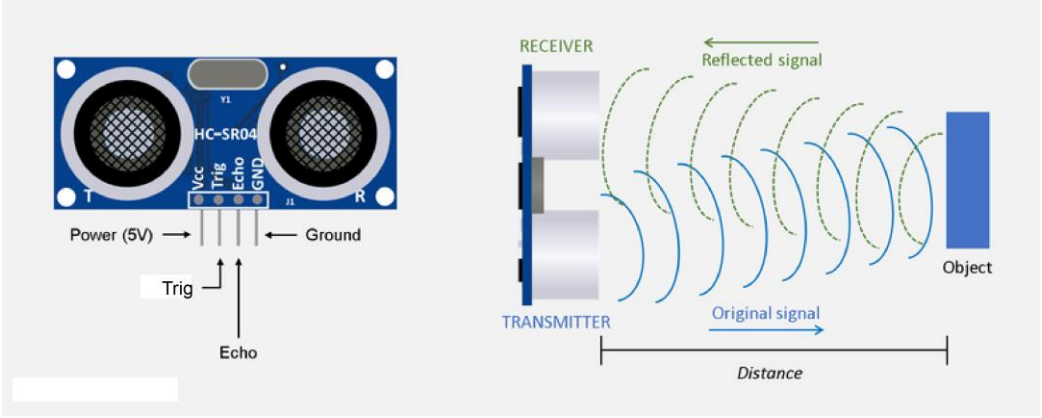
The sensor adjusts to slowly changing conditions that occur normally within the environment but shows a high-output response when a sudden change takes place.

2D model of the sensor



Ultrasonic sensors are devices that use electrical–mechanical energy transformation to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a sequence of compressions and rarefactions along the direction of wave propagation through the medium. Apart from distance measurement, they are also used in ultrasonic material testing (to detect cracks, air bubbles, and other flaws in the products), Object detection, position detection, ultrasonic mouse, etc.

For measuring the distance:
Distance= ½ (speed of sound (340M/S) * time taken)

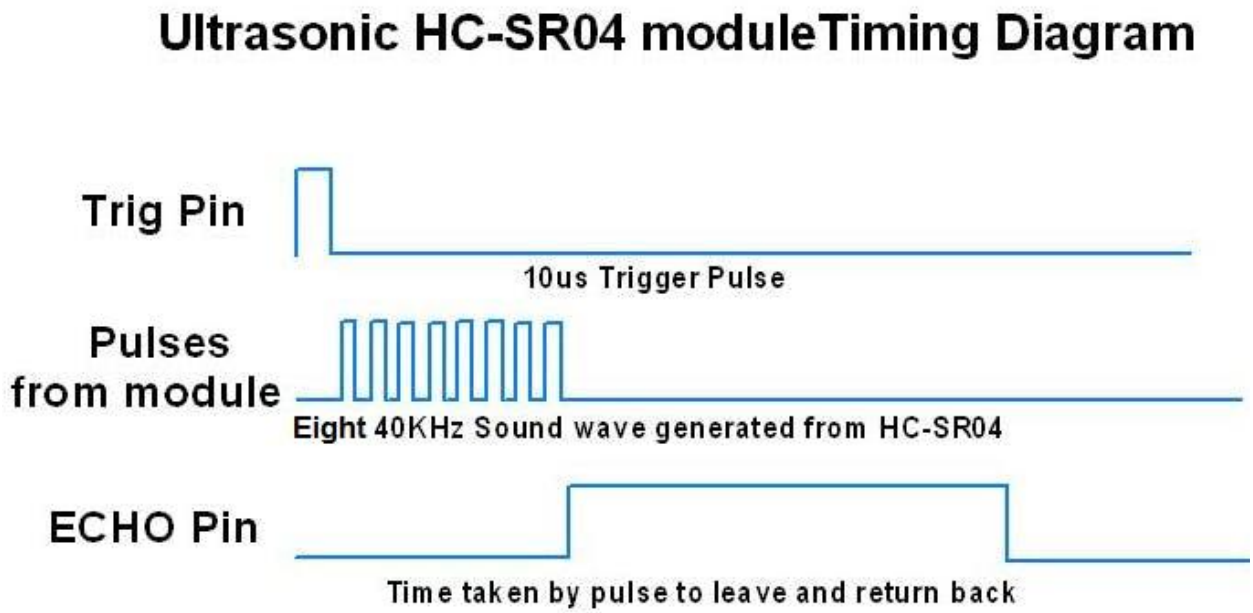


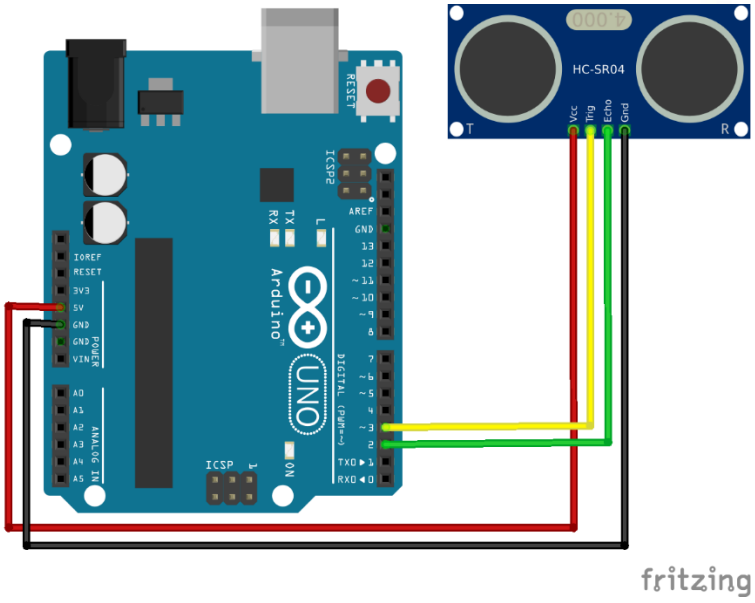
Electric Parameter

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**

It has 4 pins TRIG, ECHO, GND & VCC. It emits the ultrasonic waves through the trig pin and receives the waves through echo pin when the waves get Reflected back from the target.

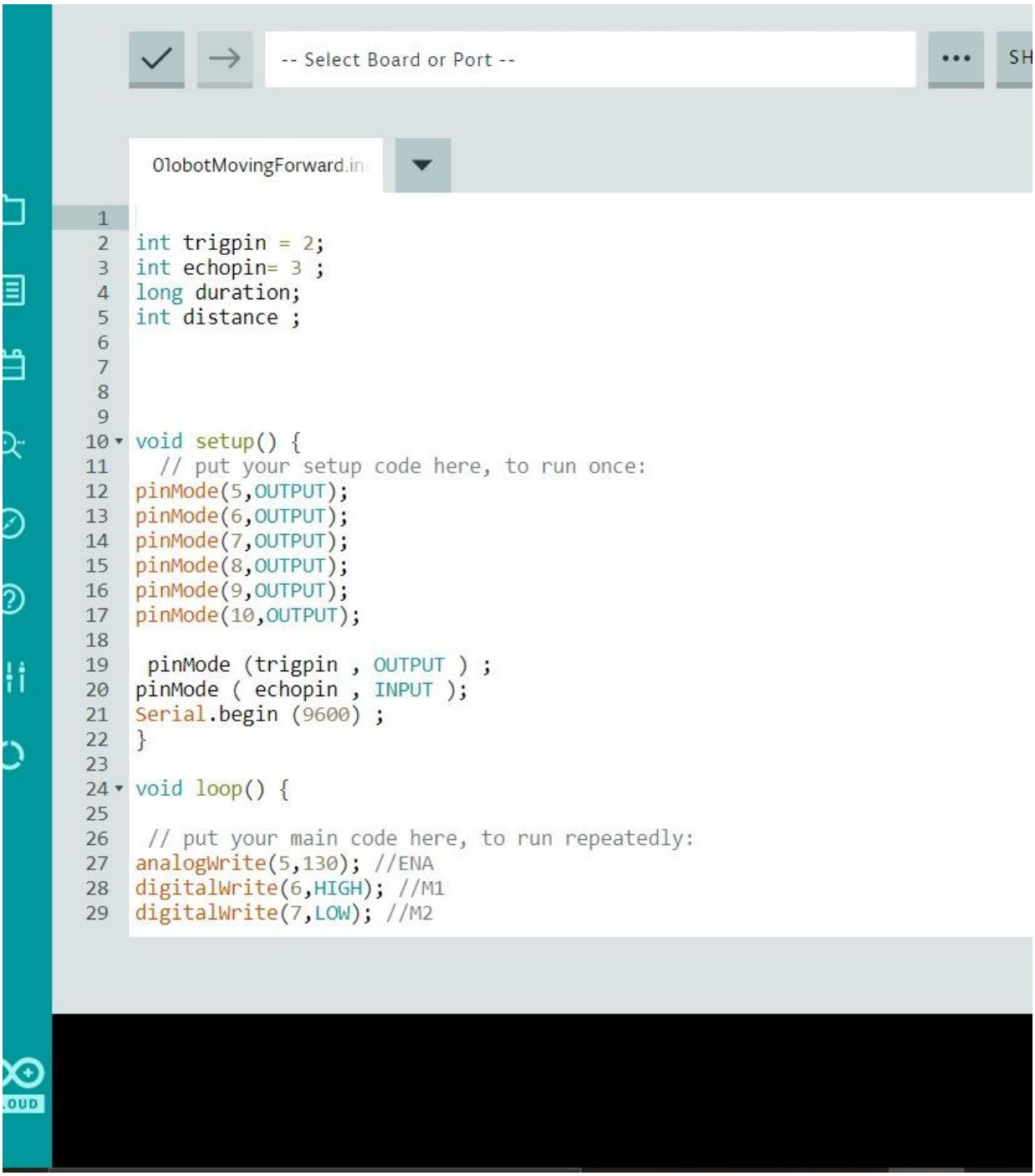
In order to generate the ultrasound we need to set the Trigger Pin on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo Pin. The Echo Pin will output the time in microseconds the sound wave traveled.





Ultrasonic Sensor HC-SR04 with Arduino Code for Ranging Test

C/C++



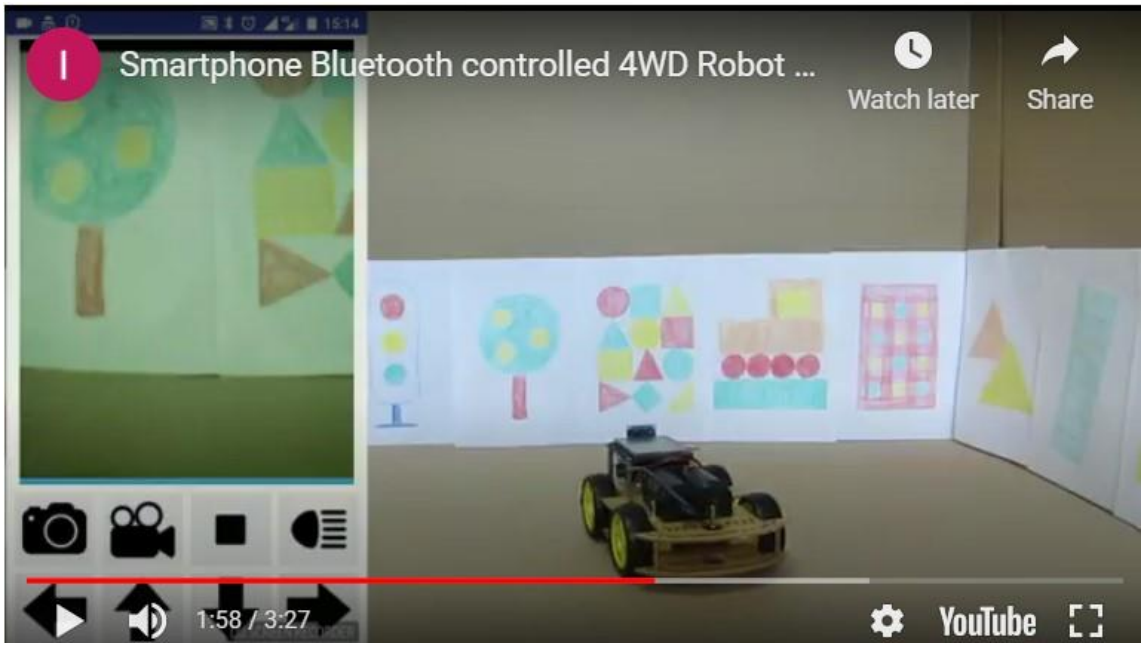

-- Select Board or Port --
OlobotMovingForward.in
digitalWrite(7,LOW); //M2
analogWrite(10,130); //ENB
digitalWrite(8,HIGH); //M3
digitalWrite(9,LOW); //M4
//Serial.println("MOVE!");
digitalWrite (trigpin , LOW) ;
delayMicroseconds (2) ;
digitalWrite (trigpin , HIGH);
delayMicroseconds (10) ;
digitalWrite (trigpin , LOW);
duration = pulseIn (echopin , HIGH);
distance = duration * 0.034 /2 ;
Serial.print("distance :");
Serial.println (distance);
if (distance <= 20)
{
analogWrite(5,0); //ENA
digitalWrite(6,LOW); //M1
digitalWrite(7,LOW); //M2
analogWrite(10,0); //ENB
digitalWrite(8,LOW); //M3
digitalWrite(9,LOW); //M4
//Serial.println("STOP!");
}
}

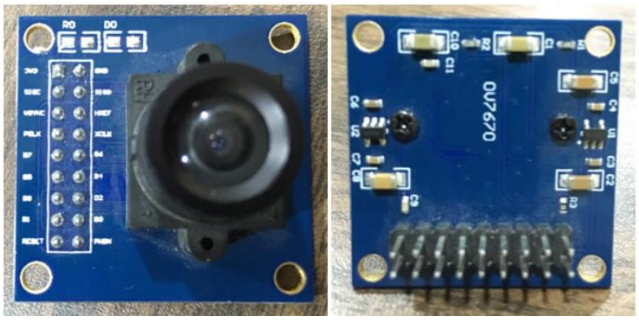
We can add extra sensor to our project like “Camera Module “

OV7670 Camera Module is a FIFO camera Module available from different Manufacturers with different pin Configurations. TheOV7670 provides full frame, windowed 8-bit images in a wide range of formats. The image array is capable of operating at up to 30 frames per second (fps) in VGA. The OV7670 includes

- Image Sensor Array(of about 656 x 488 pixels)
- Timing Generator
- Analog Signal Processor
- A/D Converters
- Test Pattern Generator
- Digital Signal Processor(DSP)
- Image Scaler
- Digital Video Port
- LED and Strobe Flash Control Output

The OV7670 image sensor is controlled using Serial Camera Control Bus (SCCB) which is an I2C interface (SIOC, SIOD) with a maximum clock frequency of 400KHz.





4-Geared DC motors :

Types of Motors

Remember when you are selecting motors that current is proportional to torque, and speed is proportional to voltage.

Type	Image	Pros	Cons
DC Brushed		Cheaper then many other categories, rugged, and easy to control. Will often have 2 wires.	Brushes can wear away.
DC Brushless		Higher efficiency then brushed motors (better power and mass ratios). Can be sealed to minimize dirt getting into the motor. Reduced sparking and electrical noise so good for hazardous environments. Will often have 3 wires.	More complex to control and can be more expensive

Type	Image	Pros	Cons
Stepper Motor		Has similar characteristics to a brushless motor (because it is one) however you can command it in "steps" so you can do position control with no external feedback.	The primary advantage is also the disadvantage. In many high torque and operations where things change (like in a robot) it can skip steps leading to position error. Whenever possible you should still have position feedback.Also since a stepper motor needs to use power to hold its position (even with minimal load) the standby power consumption can be similar to the full load power before it starts skipping.
RC Servo		Small easy to control motors that can be given position commands.	By default they have about 100 degrees of movement (every brand if different). They need to be modified (you can purchase them modified) for continuous rotation. Only for small torque operations.

Inclined surface : سطح مائل

$(Torque)$

$$T = \frac{(\text{Acceleration} + \text{Gravity} * \sin(\text{slope angle}) * \text{mass} * \text{Wheel radius})}{number\ of\ wheels} * efficiency * saftey\ factor$$

$Efficiency$مقدار الضياع في طاقة

Accelerationمعدل التسارع

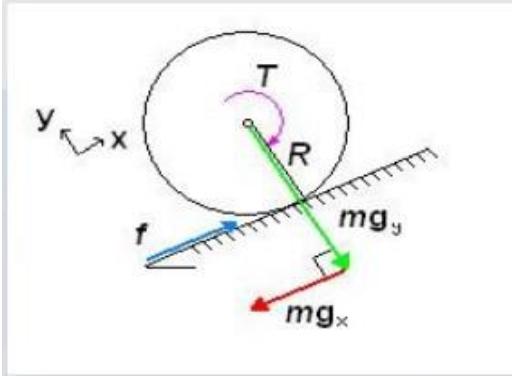
sin(slope angle) زاوية

mass = الكتلة كاملة لروبوت

Wheel radiusنصف قطر العجلة

Gravity = 9.8

saftey factor معامل الأمان للحمولة



Total efficiency = 85%

Wheel radius = 0.066 m

Supply voltage = 12V

Desired operating time= 10min

Follow the link = [Drive Motor Sizing Tool | RobotShop Community]

Flat surface أملس

$$T = \frac{\text{mass} * \text{Wheel radius}}{number\ of\ wheels} * efficiency * saftey\ factor$$

Final Torque = Torque motor *Gear Ratio * Gear efficiency

Power = Torque *speed

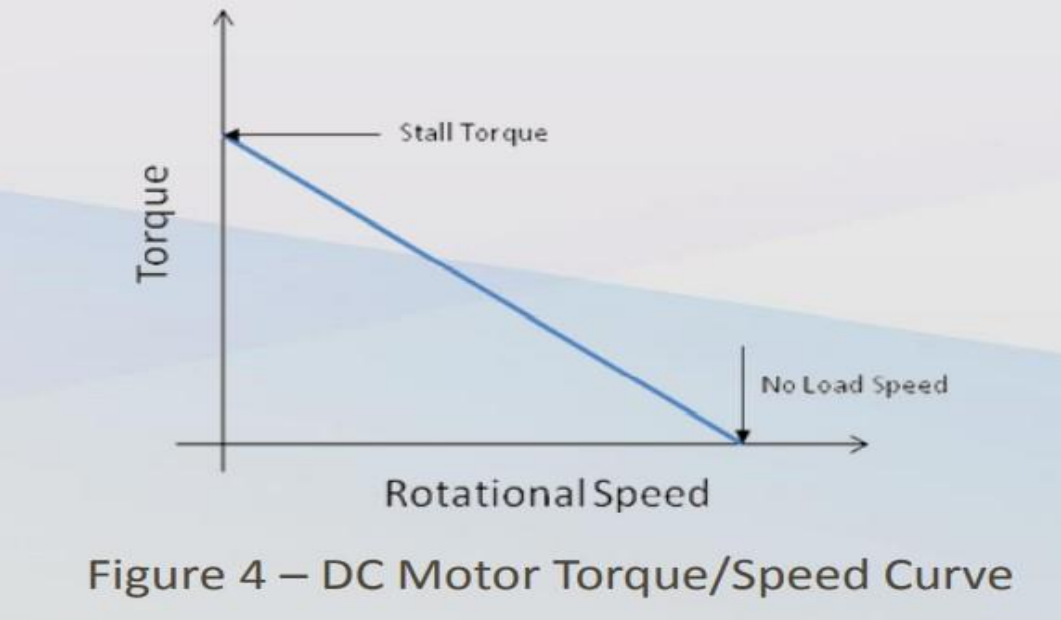
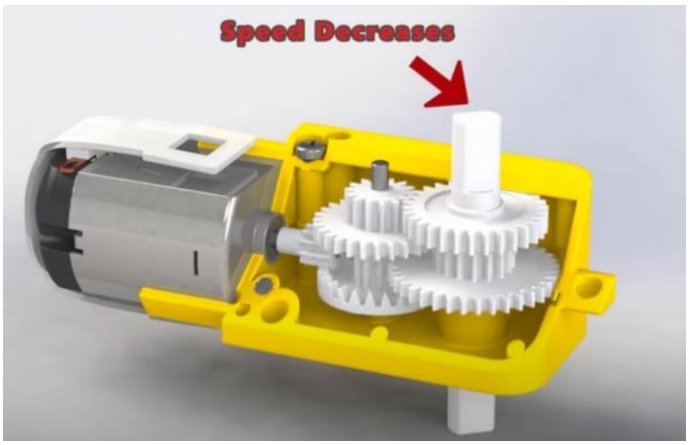
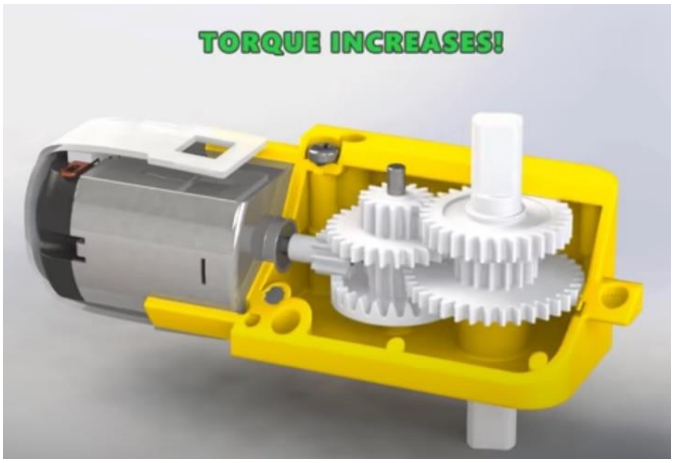


Figure 4 – DC Motor Torque/Speed Curve





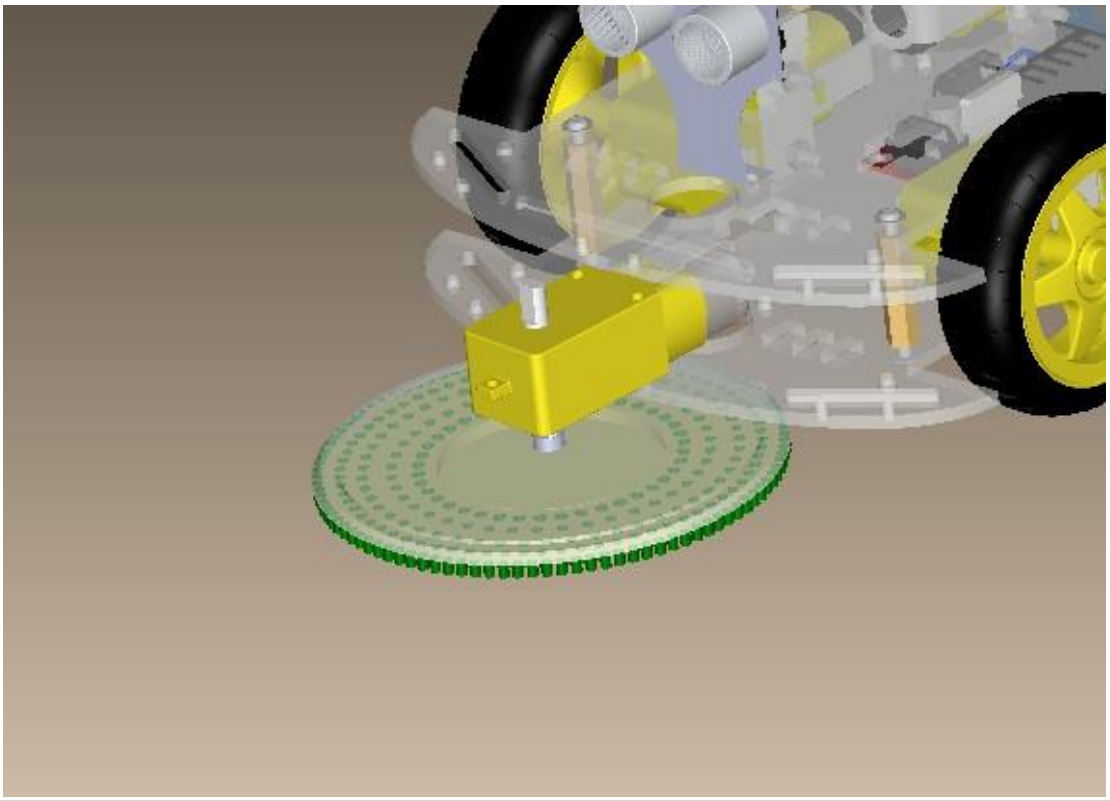
TT Gearmotor

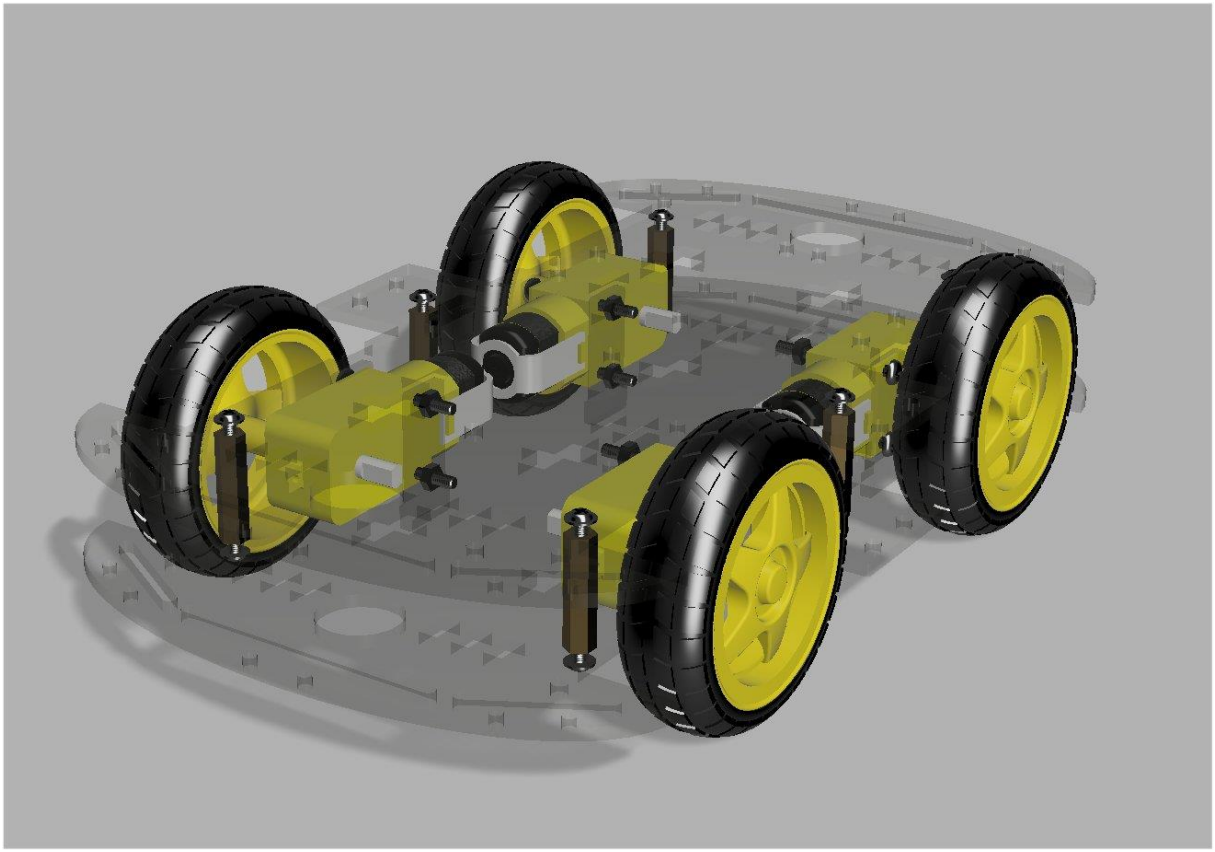
- Operating Voltage: 3 - 12 V DC (Recommended 6 - 8 V DC)
- The Load Current: 70 mA (250 mA Max) (3V)
- Gear Ratio: 1:48

17000 RPM / 48 = 354 RPM
Speed Decreases to around
6 Rotations per Second

DC Brushed Motor

- Operating Voltage: 3 - 12 V DC (Recommended 6 - 8 V DC)
- Rated Current: 0.17 A
- Rotational Speed: 6 V = 17000 RPM
- **Torque Not Specified**





4WD Smart Robot Car Chassis Kit Specifications are as follows Chassis Dimensions: L 26 Cm X W 16 Cm

Working Voltage	DC 3V	DC 5V	DC 6V
Working Current	100ma	100ma	120ma
Reduction Ratio	48:1		
No-load(with wheel)	100 RPM	190 RPM	240 RPM
Wheel Diameter	6.6cm		
Speed(no-load)	20m/min	39m/min	48m/min
Weight	50g		
Size	70mm*22mm*18mm		
Noise	<65db		

Torque = 800 gm.cm / Motor

Total Torque = 800 x 4 = 3200 gm.cm

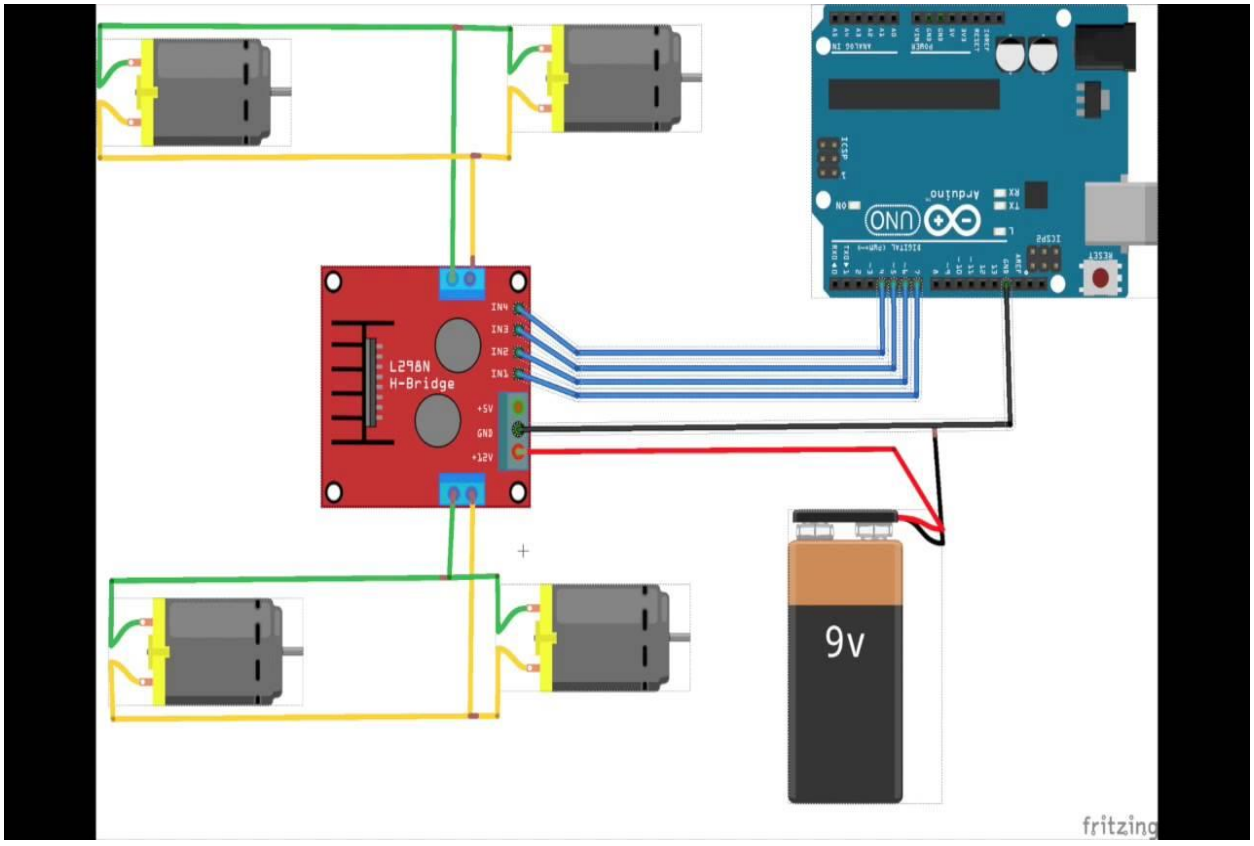
From flat surface torque equation (Max Weight carried)= 2.5 K.g

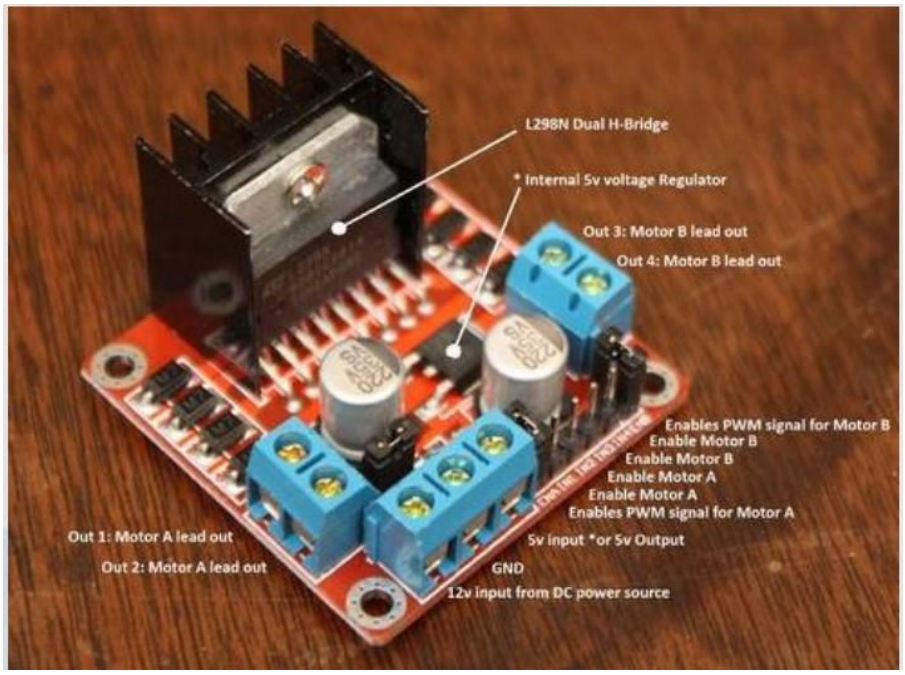
5-Motor Driver

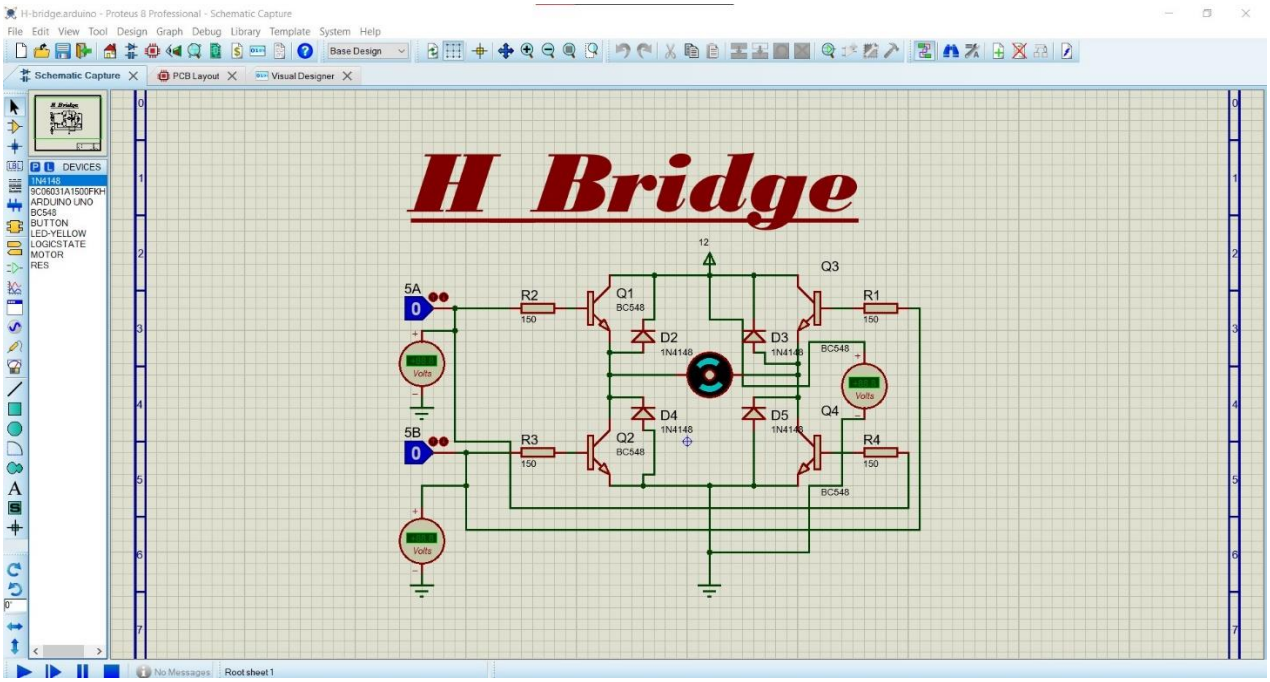
H-Bridge : is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

L298 Dual H-Bridge Module

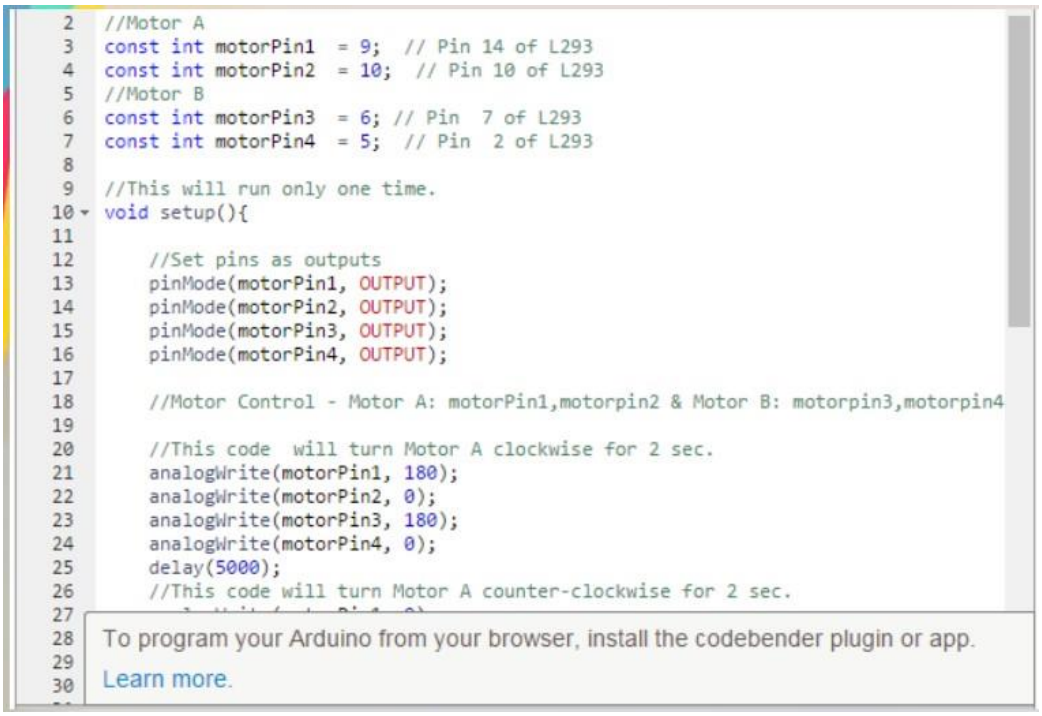
This module is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring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




L298N Dual H-Bridge
* Internal 5v voltage Regulator
Out 3: Motor B lead out
Out 4: Motor B lead out
Enables PWM signal for Motor B
Enable Motor B
Enable Motor B
Enable Motor A
Enable Motor A
Enables PWM signal for Motor A
5v input *or 5v Output
GND
12v input from DC power source
Out 1: Motor A lead out
Out 2: Motor A lead out


H-bridge.arduino - Proteus 8 Professional - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Schematic Capture
PCB Layout
Visual Designer
DEVICES
1N4148
9C06031A1500FKH
ARDUINO UNO
BC548
BUTTON
LED-YELLOW
LOGICSTATE
MOTOR
RES
H Bridge
12
5A
5B
R1
R2
R3
R4
150
Q1
Q2
Q3
Q4
BC548
D2
D3
D4
D5
1N4148
Volts
No Messages
Root sheet 1

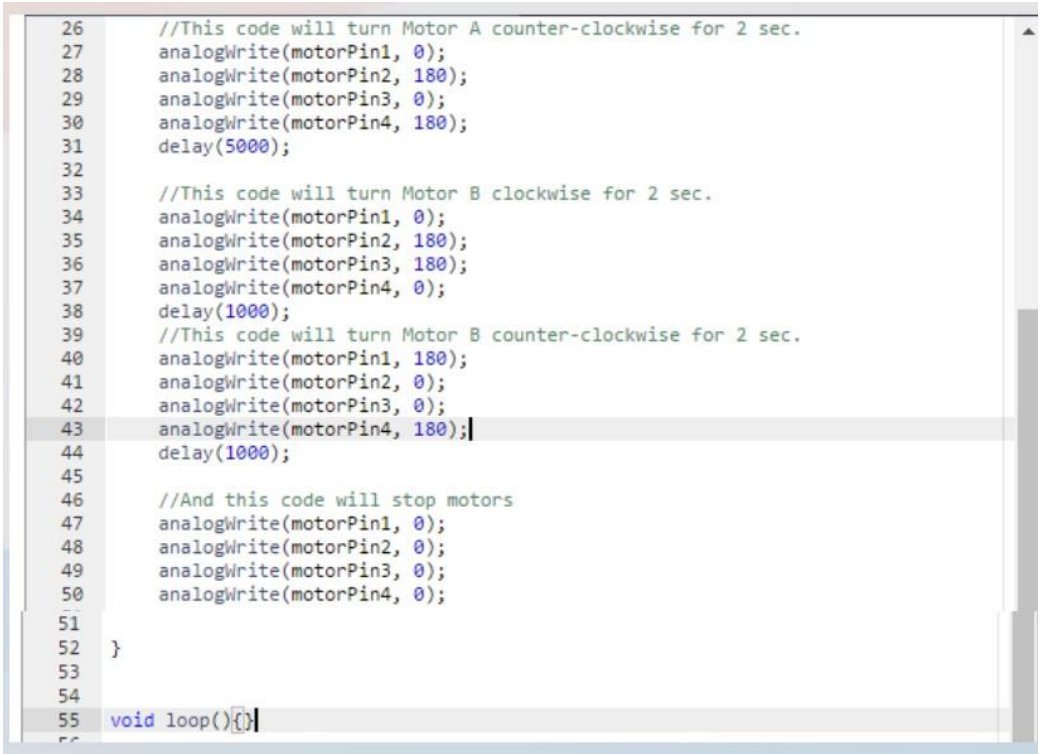
Arduino Sketch for L298 Dual H -Bridge



```
//Motor A
const int motorPin1  = 9;  // Pin 14 of L293
const int motorPin2  = 10;  // Pin 10 of L293
//Motor B
const int motorPin3  = 6; // Pin  7 of L293
const int motorPin4  = 5;  // Pin  2 of L293

//This will run only one time.
void setup(){

    //Set pins as outputs
    pinMode(motorPin1, OUTPUT);
    pinMode(motorPin2, OUTPUT);
    pinMode(motorPin3, OUTPUT);
    pinMode(motorPin4, OUTPUT);

    //Motor Control - Motor A: motorPin1,motorpin2 & Motor B: motorpin3,motorpin4

    //This code  will turn Motor A clockwise for 2 sec.
    analogWrite(motorPin1, 180);
    analogWrite(motorPin2, 0);
    analogWrite(motorPin3, 180);
    analogWrite(motorPin4, 0);
    delay(5000);
    //This code will turn Motor A counter-clockwise for 2 sec.
```

To program your Arduino from your browser, install the codebender plugin or app.

Learn more.



```
    //This code will turn Motor A counter-clockwise for 2 sec.
    analogWrite(motorPin1, 0);
    analogWrite(motorPin2, 180);
    analogWrite(motorPin3, 0);
    analogWrite(motorPin4, 180);
    delay(5000);

    //This code will turn Motor B clockwise for 2 sec.
    analogWrite(motorPin1, 0);
    analogWrite(motorPin2, 180);
    analogWrite(motorPin3, 180);
    analogWrite(motorPin4, 0);
    delay(1000);
    //This code will turn Motor B counter-clockwise for 2 sec.
    analogWrite(motorPin1, 180);
    analogWrite(motorPin2, 0);
    analogWrite(motorPin3, 0);
    analogWrite(motorPin4, 180);
    delay(1000);

    //And this code will stop motors
    analogWrite(motorPin1, 0);
    analogWrite(motorPin2, 0);
    analogWrite(motorPin3, 0);
    analogWrite(motorPin4, 0);

}


void loop(){}
```

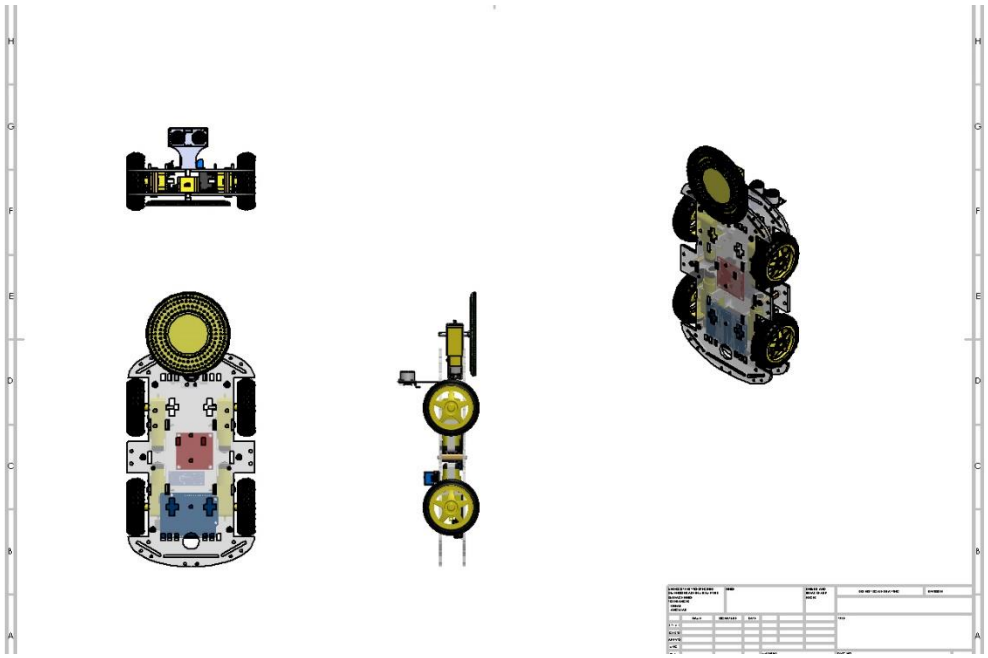
6-Power Source

You may choose between several different energy sources as you want and your capabilities.

We prefer to choose 18650 battery Pack.

7-Wheels

A wheel is a circular component that is intended to rotate. The wheels are controlled forward and reverse by Arduino programming and Bluetooth module with the help of driver circuit.



We chose this type of robot (4 Wheels)

Advantages

– Usually, low-cost

– Simple design and construction

– Near infinite different dimensions cater to your specific project

– Six wheels can replace a track system

– Diameter, width, material, weight, tread etc. can all be custom to your needs

– Excellent choice for beginners

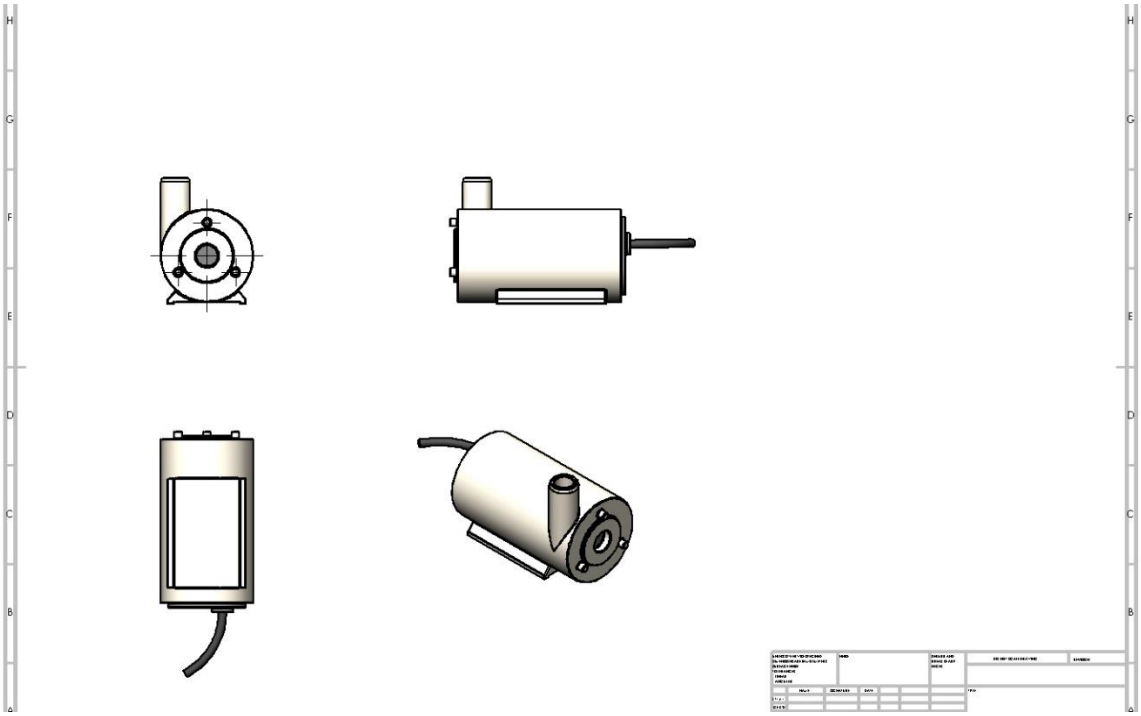
Disadvantages

– May lose traction (slip)

– Small contact area (small rectangle or line)

8-Pump

Water Pumps DC 3-6V



Specification:

DC Voltage:2.5-6V
Maximum lift:40-110cm / 15.75"-43.4"
Flow rate:80-120L/H
Outside diameter of water outlet: 7.5mm / 0.3"
Inside diameter of water outlet: 4.7mm / 0.18"

Diameter: Approx. 24mm / 0.95"
Length: Approx. 45mm / 1.8"
Height: Approx. 33mm / 1.30"
Material: plastic
Driving mode: brushless dc design, magnetic driving
Continuous working life of 500 hours

9-Relay:

About Relay

A relay is a programmable electrical switch, which can be controlled by Arduino or any micro-controller. It is used to programmatically control on/off the devices, which use the high voltage and/or high current.

Relay has two groups of pins: low voltage group and high voltage group.

- Pins in the low voltage group are connected to Arduino, including three pins:
  - GND pin: needs to be connected to **GND** (0V)
  - VCC pin: needs to be connected to **VCC** (5V)
  - IN pin: receives the control signal from Arduino
- Pins in the high voltage group are connected to high voltage a device, including three pins (usually in screw terminal):
  - COM pin: is the common pin. It is used in both normally open mode and normally closed mode
  - NO pin: is normally open pin. It is used in the normally open mode
  - NC pin: is normally closed pin. It is used in the normally closed mode

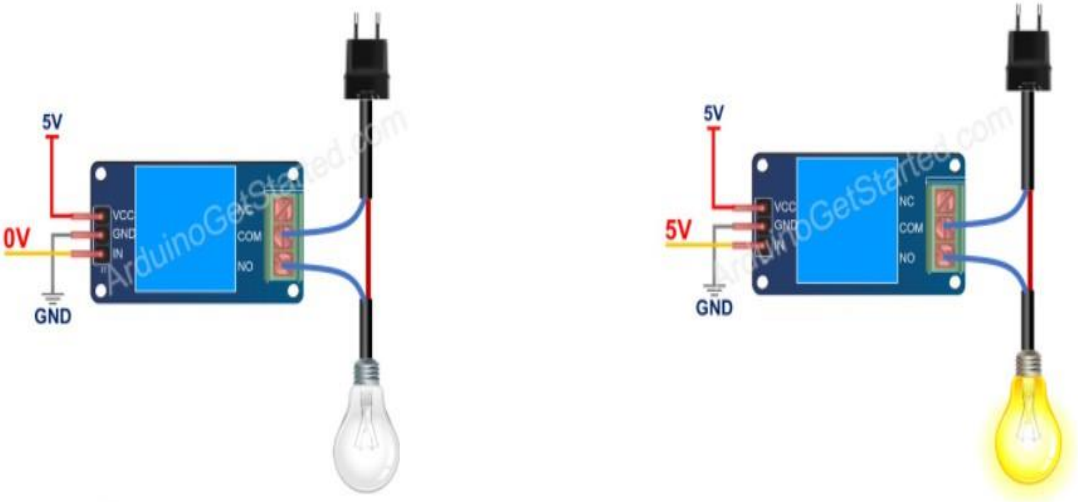
In practice, we usually do NOT use all of the pins in the high voltage group. We use only two of them:

- We use only COM pin and NO pin if we use normally open mode.
- We use only COM pin and NC pin if we use normally closed mode.

Normally Open Mode

To use this mode, we need to connect the high voltage device to the COM pin and NO pin.

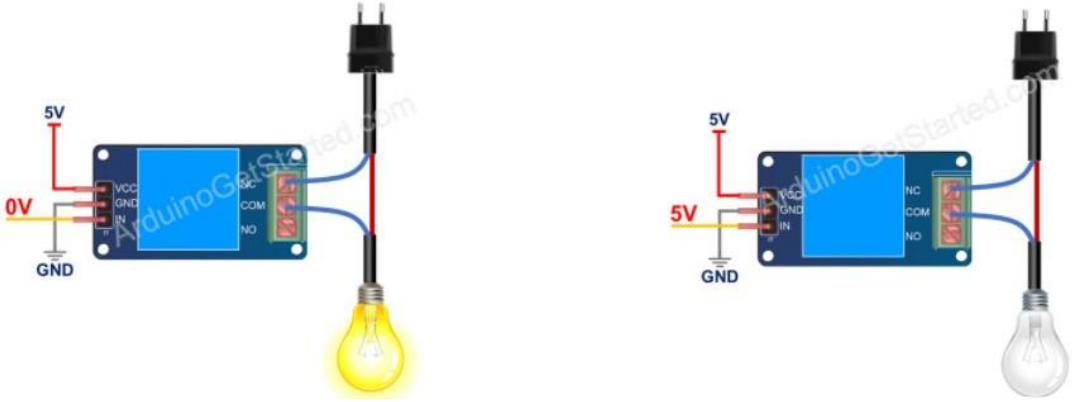
- If the IN pin is connected to **LOW** (0V), the switch is open. The device is **OFF** (or inactive).
- If the IN pin is connected to **HIGH** (5V), the switch is closed. The device is **ON** (or active).



Normally Closed Mode

To use this mode, we need to connect the high voltage device to the COM pin and NC pin.

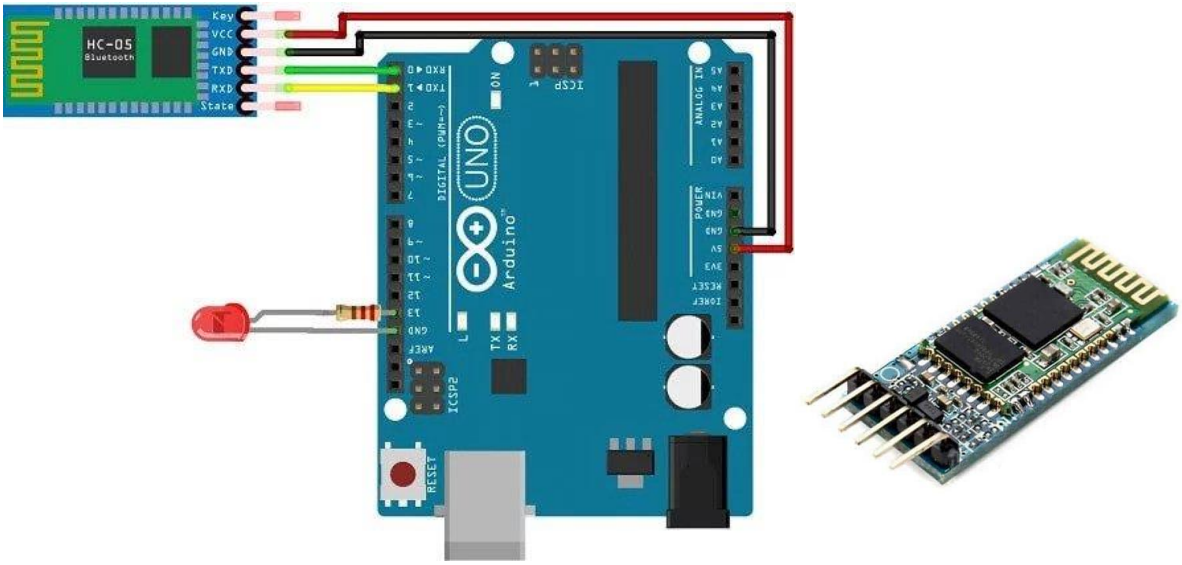
- If the IN pin is connected to **LOW** (0V), the switch is closed. The device is **ON** (or active).
- If the IN pin is connected to **HIGH** (5V), the switch is open. The device is **OFF** (or inactive).



10-HC-05 Bluetooth Module

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.

Bluetooth module can communicate in two way. Which means, It is full-duplex. We can use it with most micro controllers. Because it operates Serial Port Protocol (SSP). The module communicate with the help of USART (Universal Synchronous/Asynchronous Receiver/Transmitter) at the baud rate of 9600. and it also support other baud rate. So we can interface this module with any microcontroller which supports USART. The HC-05 can operate in two modes. One is Data mode and other is AT command mode. When the enable pin is "LOW" the HC-05 is in Data Mode. If that pin set as "HIGH" the module is in AT command mode.

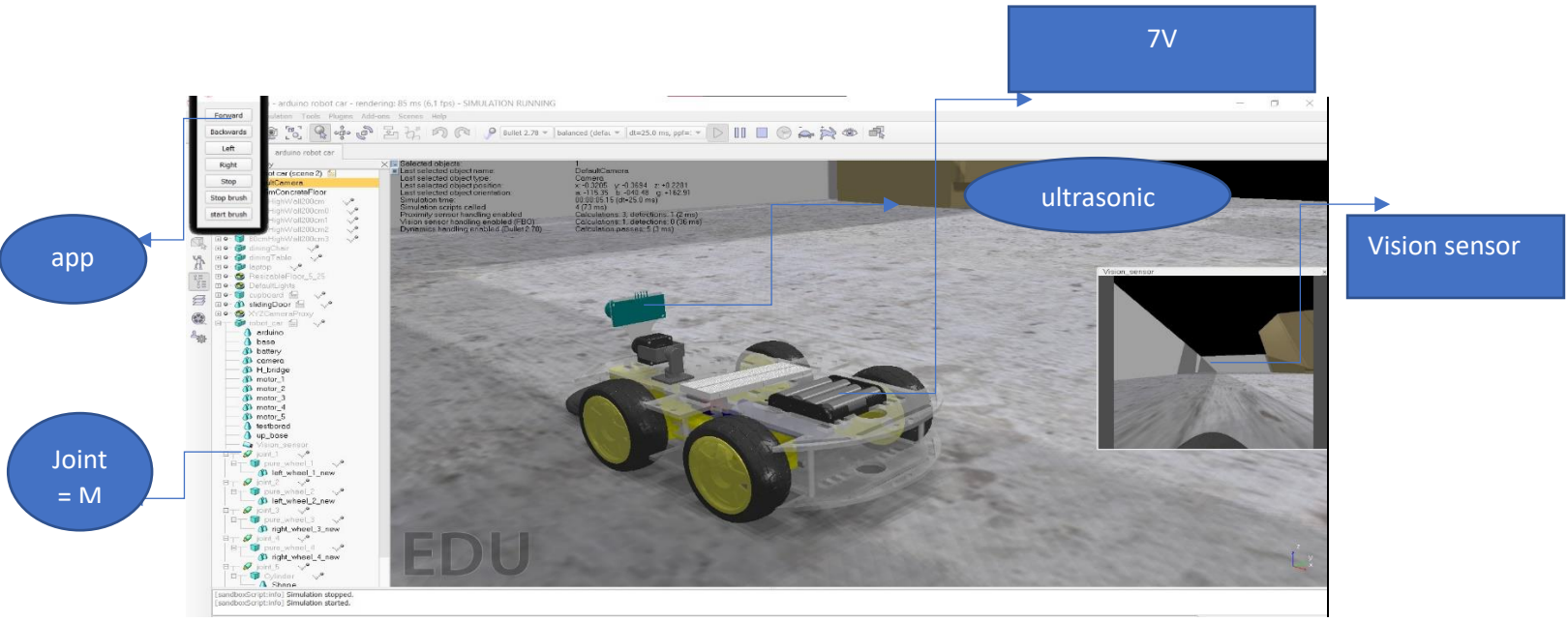


11-Application Software

The Android app is generally developed using JAVA language. The app controlling this vacuum robot can be built without having the knowledge in java language. It is called as “VBot211” developed by MIT App Inventor. Shown below is a diagram which shows the interface of the app. The app shown below has 5 buttons and all the button gives 5 different bytes in the output that is to be fed to the microcontroller to further process. For e.g. if we press Up! Button, the Bluetooth module will give 1 byte at its output.

The app invented by these searches for the Bluetooth devices along with their MAC addresses. The user just
needs to select a particular MAC Address. When a particular MAC is selected, the status shown on the screen is “connected”.

12-Sim V-rep



Lua app

[CustomUI Plugin - UI XML Syntax (coppeliarobotics.com)]

```
ui=simUI.create('<ui enabled="true" modal="false" title="arduino robot car" closeable="true" layout="vbox" placement="relative" p
'<button enabled="true" text="Forward" on-click="moveForward"></button>' ..
'<button enabled="true" text="Backwards" on-click="moveBackwards"></button>' ..
'<button enabled="true" text="Left" on-click="turnLeft"></button>' ..
'<button enabled="true" text="Right" on-click="turnRight"></button>' ..
'<button enabled="true" text="Stop" on-click="stop"></button>' ..
'<button enabled="true" text="Stop brush" on-click="stop2"></button>' ..
'<button enabled="true" text="start brush" on-click="start"></button>' ..
'</ui>')
```

References:

(PDF) Floor Cleaning Robot with Mobile-App or Autonomous (researchgate.net)

How to Use OV7670 Camera Module with Arduino Uno (circuitdigest.com)

Floor Cleaning Robot - Arduino Project Hub

Arduino Based Floor Cleaning Robot using Ultrasonic Sensor (circuitdigest.com)

Journal of Critical Reviews (jcreview.com)

Lecturing robotic courses at te Universitat Politècnica de València.

(572) Introduction to CoppeliaSim Course | CoppeliaSim (V-REP) - YouTube