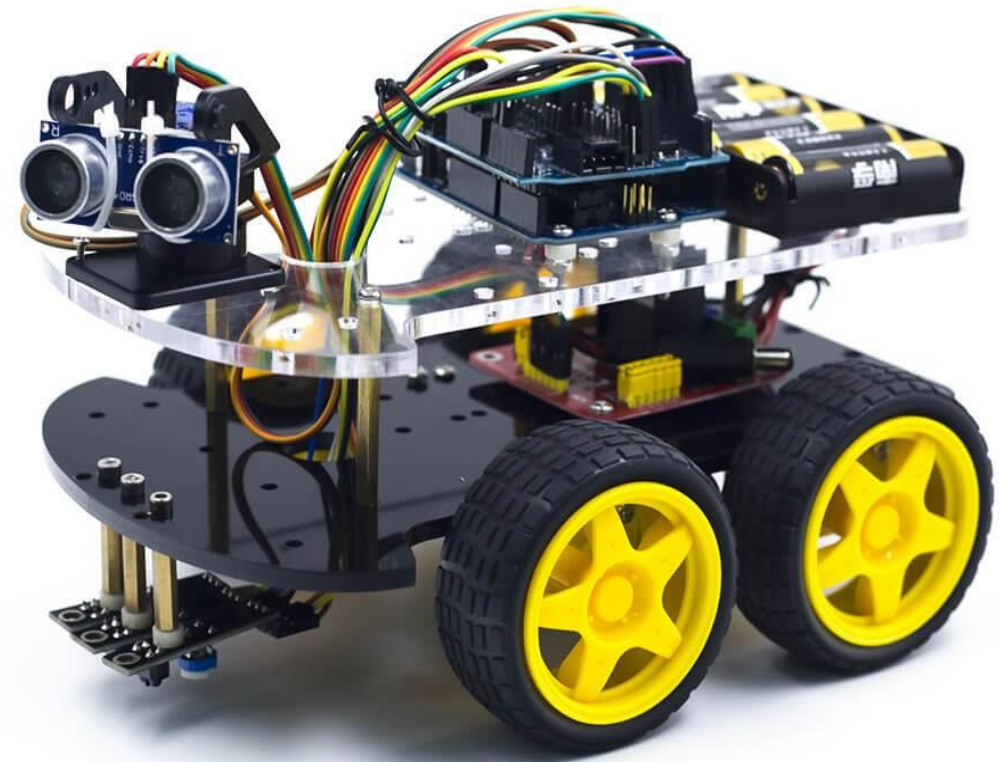
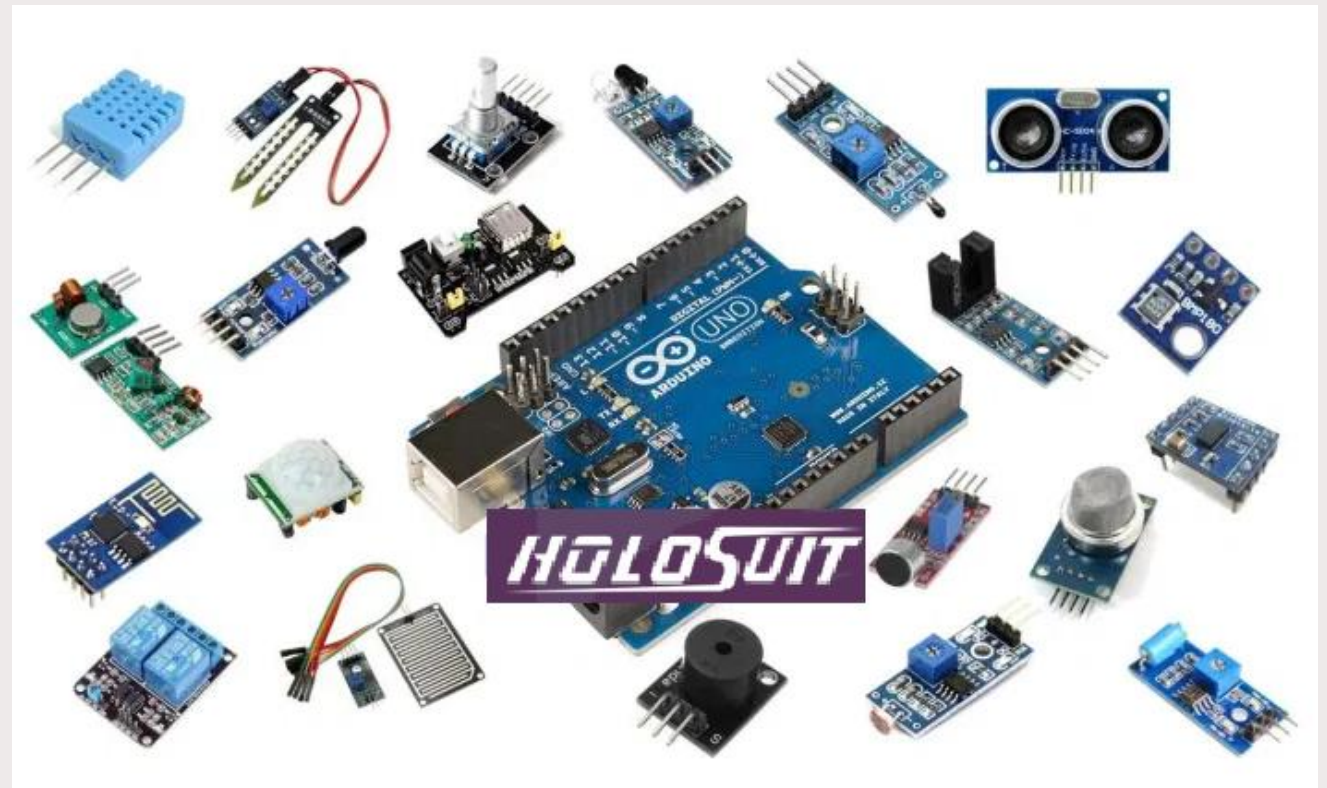


NSDC – Junior Skills Championship Mobile robotics

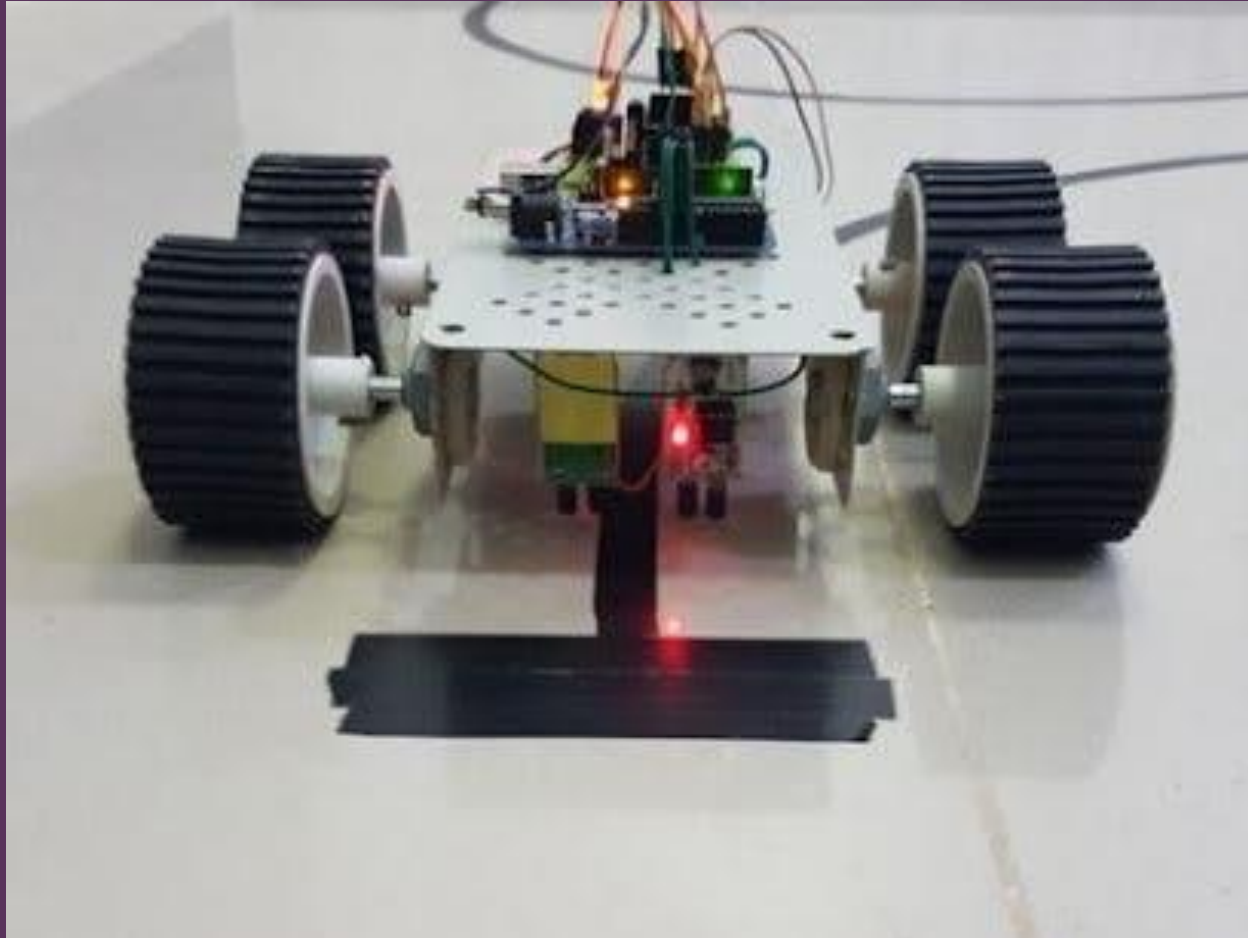


Agenda - Day 3

- Line tracing robot – experiment 1
 - What's a line following robot
 - Working principle
 - Components
 - Schematic and connections
 - Let's code!!
- Obstacle avoiding robot – experiment 2
 - What's an obstacle avoidance robot
 - Working principle
 - Components
 - Schematic and connections
 - Let's code!!

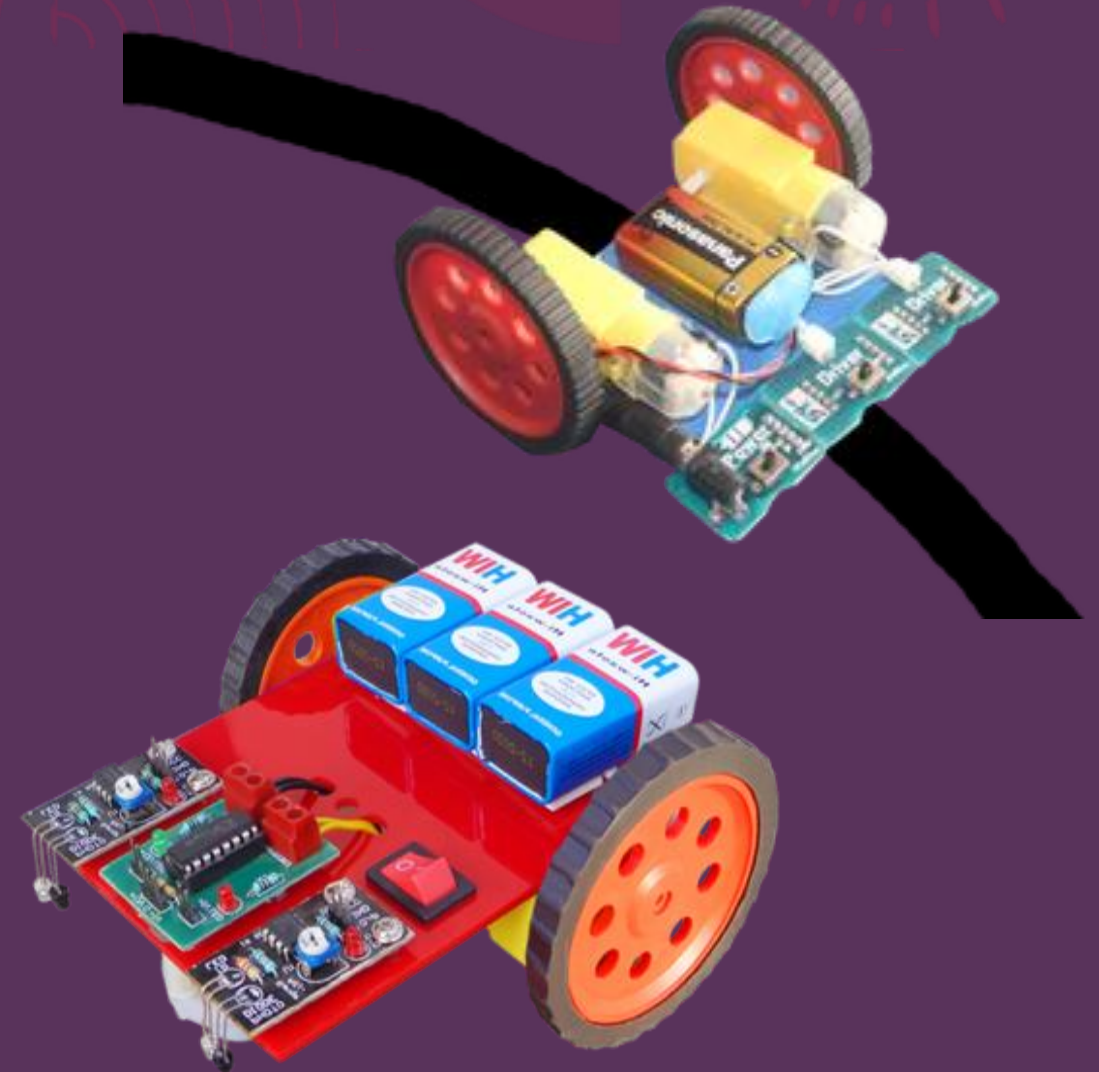


Arduino Line following robot



Line Tracing/following Robot

- Line Tracing is a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa) or it can be invisible like a magnetic field
- Sensing a line and maneuvering the robot to stay on course, While Constantly correcting using feedback mechanism forms a simple yet effective closed loop system



Line Tracing Robot

Mobile robots commonly used in most of applications

- Two Wheeled
- Three Wheeled
- Four Wheeled
- Six Wheeled
- Tank treads



Line Tracing Robot

IR Transmitter & Receiver

IR transmitter (Emitting Diode)

- The IR LED emitting infrared light is put on in the transmitting unit. IR or Visible light is emitted from the emitter
- This emitted light strikes the surface and gets reflected. If the surface is white, more intensity of light gets reflected and for black surface very less intensity of light is reflected

IR Receiver (Photo Detector)

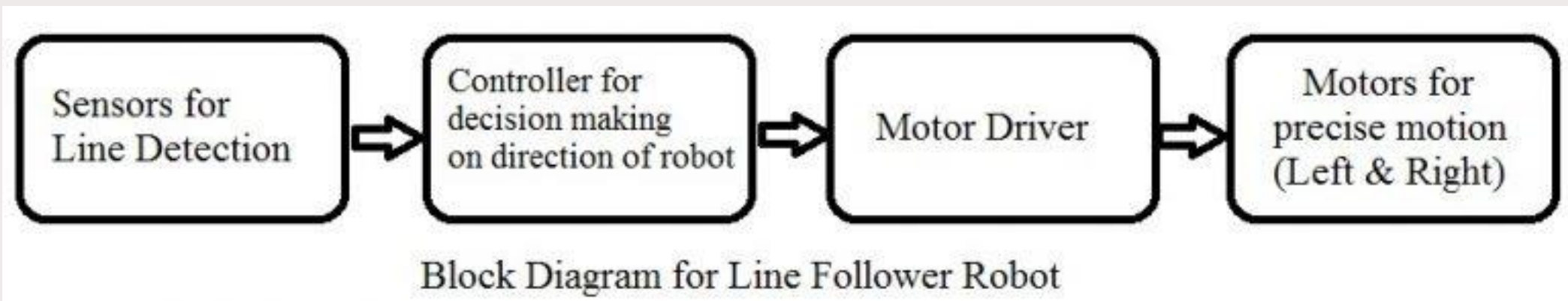
- Used to detect the intensity of light reflected.
- The corresponding Analog voltage is included based on the intensity of reflected light, which further compared by comparator and output send as 0 or 1



Line Tracing Robot

Working of Arduino Line Follower Robot

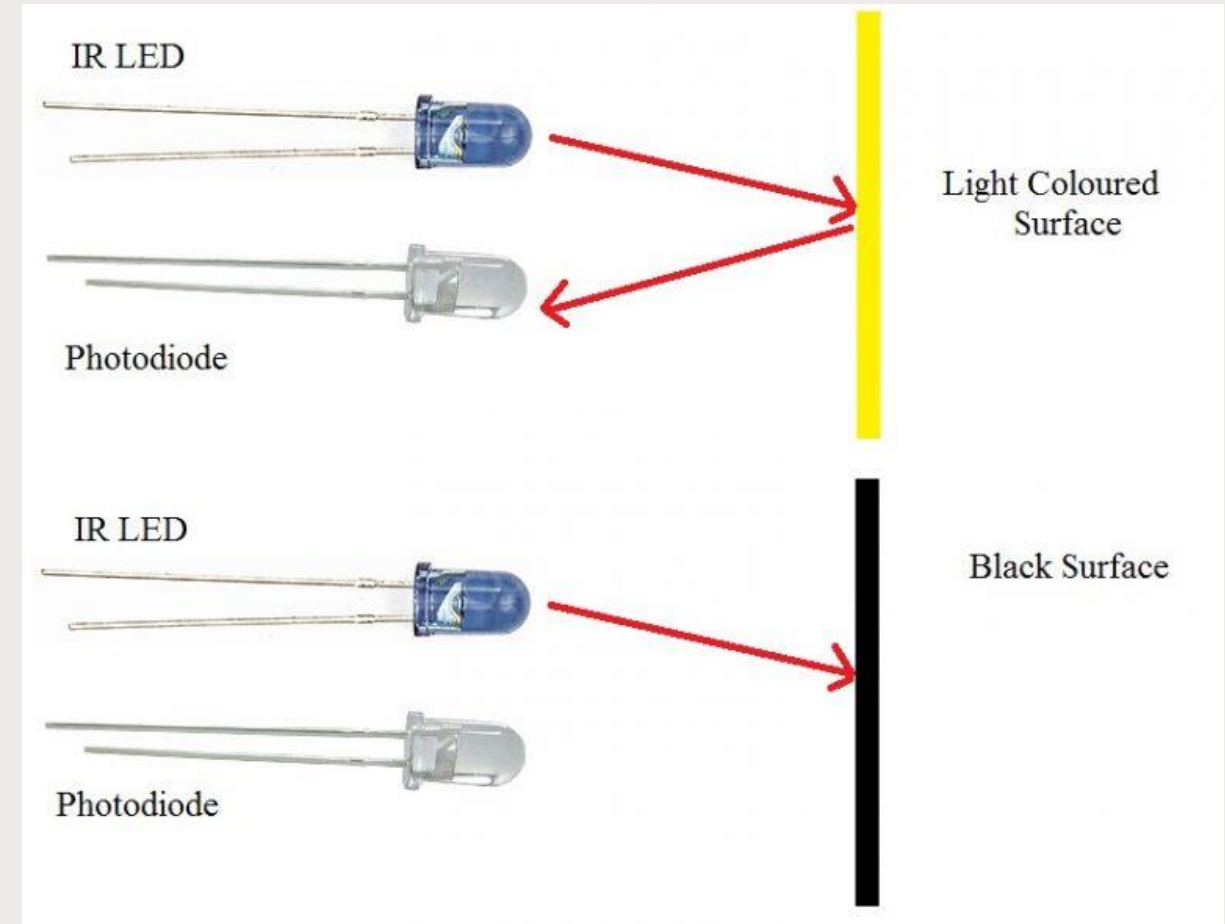
- The working of the project is pretty simple: detect the black line on the surface and move along that line
- The line follower robot built is divided in to 4 blocks
- We need sensors to detect the line. For line detection logic, we used two IR Sensors, which consists of IR LED and Photodiode
- They are placed in a reflective way i.e. side – by – side so that whenever they come into proximity of a reflective surface, the light emitted by IR LED will be detected by Photo diode.



Line Tracing Robot

Working of Arduino Line Follower Robot

- The image shows the working of a typical IR Sensor (IR LED – Photodiode pair) in front of a light-coloured surface and a black surface.
- As the reflectance of the light-coloured surface is high, the infrared light emitted by IR LED will be maximum reflected and will be detected by the Photodiode.
- In case of black surface, which has a low reflectance, the light gets completely absorbed by the black surface and doesn't reach the photodiode.



Line Tracing Robot

Working of Arduino Line Follower Robot

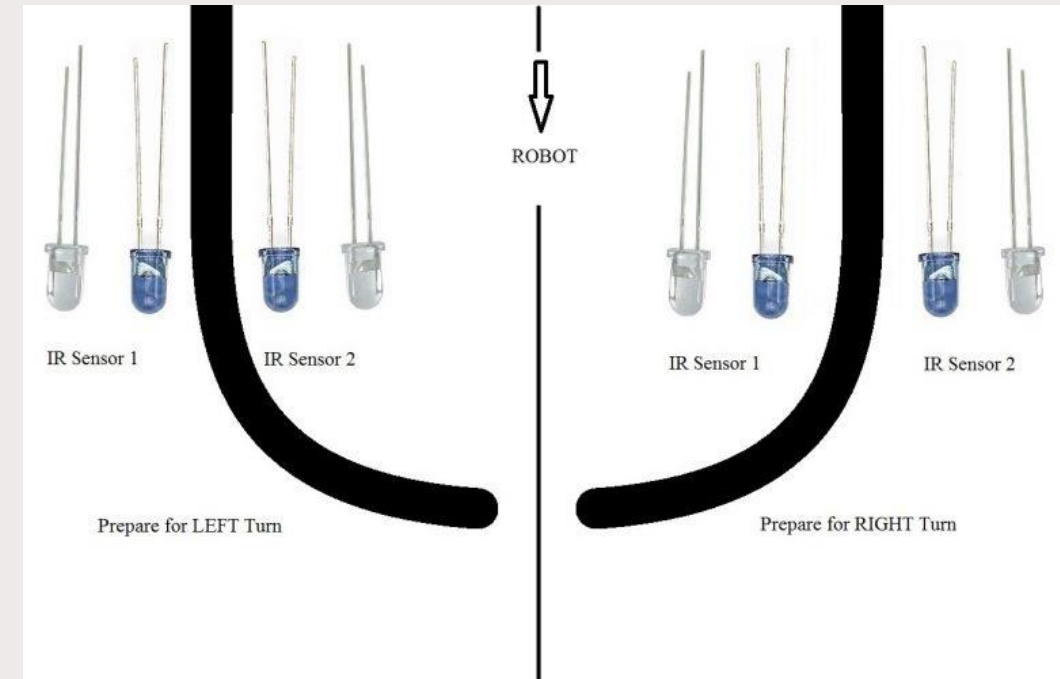
- Using the same principle, we will setup the IR Sensors on the Line Follower Robot such that the two IR Sensors are on the either side of the black line on the floor
- When the robot moves forward, both the sensors wait for the line to be detected. For example, if the IR Sensor 1 in the above image detects the black line, it means that there is a right curve (or turn) ahead



Line Tracing Robot

Working of Arduino Line Follower Robot

- Arduino UNO detects this change and sends signal to motor driver
- In order to turn right, the motor on the right side of the robot is slowed down using PWM, while the motor on the left side is run at normal speed
- Similarly, when the IR Sensor2 detects the black line first, it means that there is a left curve ahead and the robot must turn left
- For the robot to turn left, the motor on the left side of the robot is slowed down (or can be stopped completely or can be rotated in opposite direction) and the motor on the right side is run at normal speed.

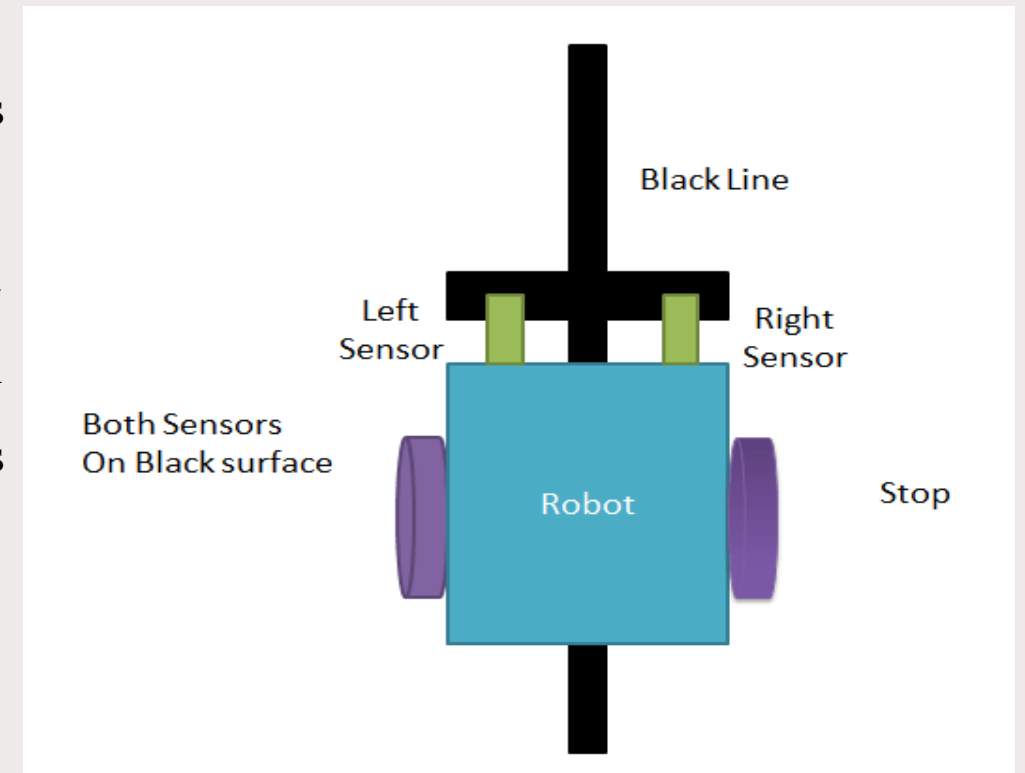


Line Tracing Robot

Working of Arduino Line Follower Robot

We are using two IR sensor modules namely the left sensor and the right sensor.

- When both left and right sensor senses white then the robot moves forward
- If the left sensor comes on a black line, then the robot turn the left side
- If the right sensor sense black line, then robot turn right side until both sensors comes at the white surface. When the white surface comes robot starts moving on forward again.
- If both sensors come on the black line, the robot stops.

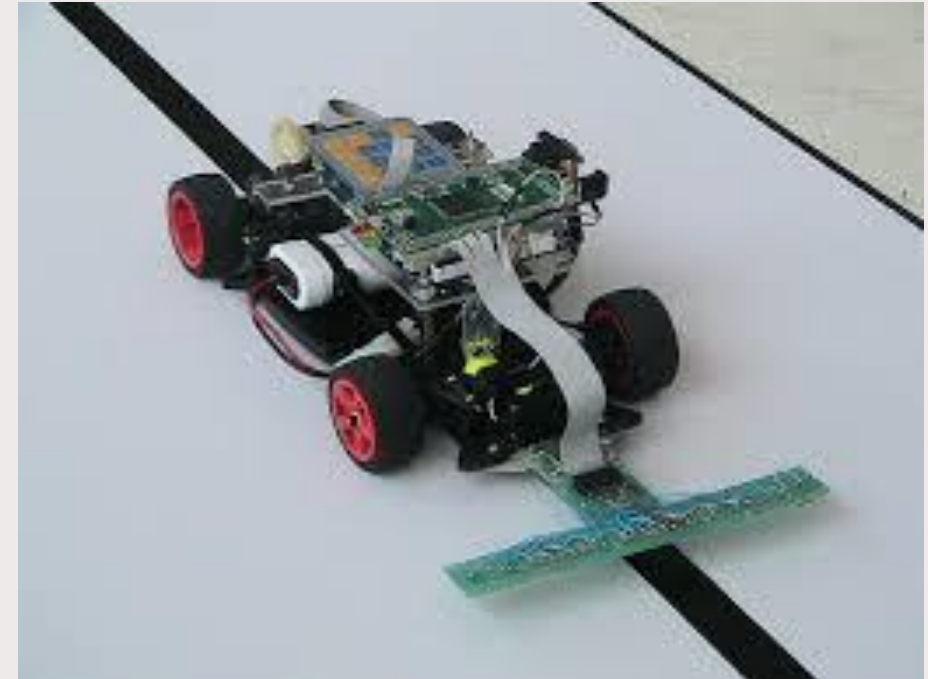


Line Tracing Robot

Working of Arduino Line Follower Robot

Arduino UNO continuously monitors the data from both the sensors and turns the robot as per the line detected by them

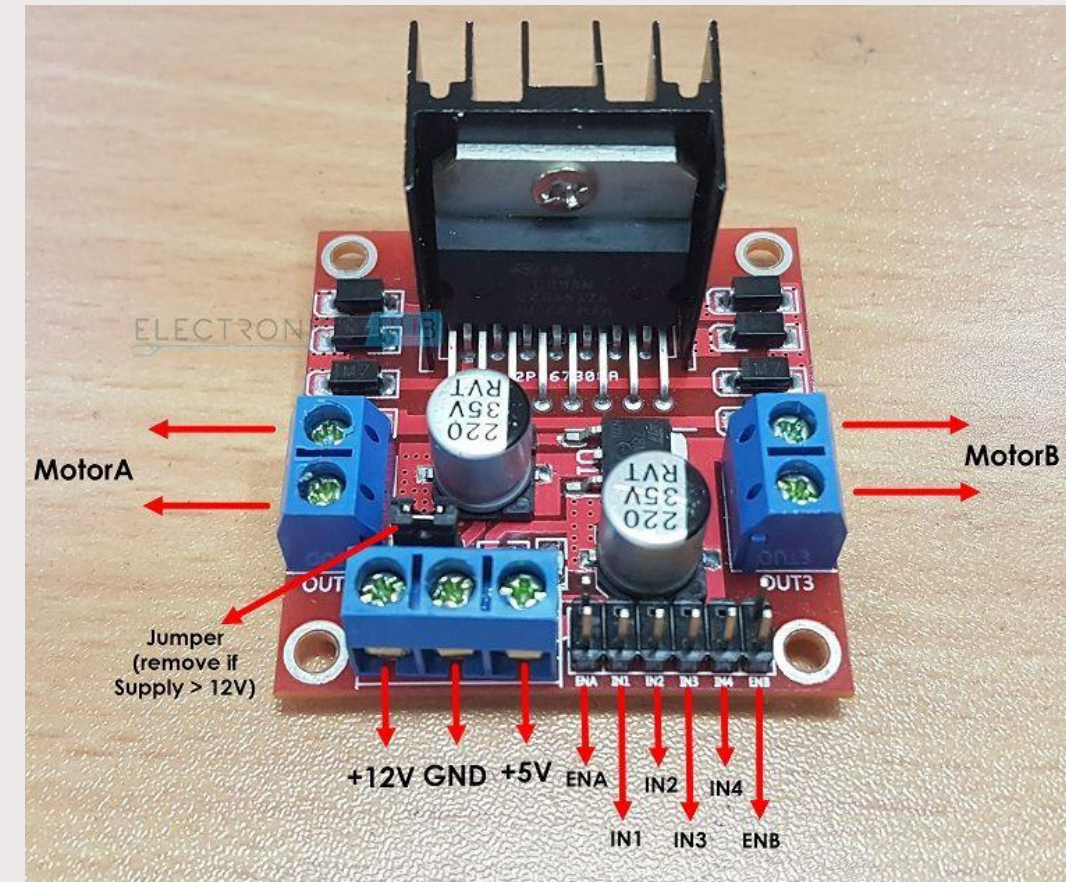
- In order to increase the efficiency of black line detection, number of sensors can be increased
- An array of sensors will be more accurate than just two sensors.
- In this example (where two sensors are used), the positioning of the sensors is very important
- The width of the black line plays a major role in the placement of the sensors.



Line Tracing Robot

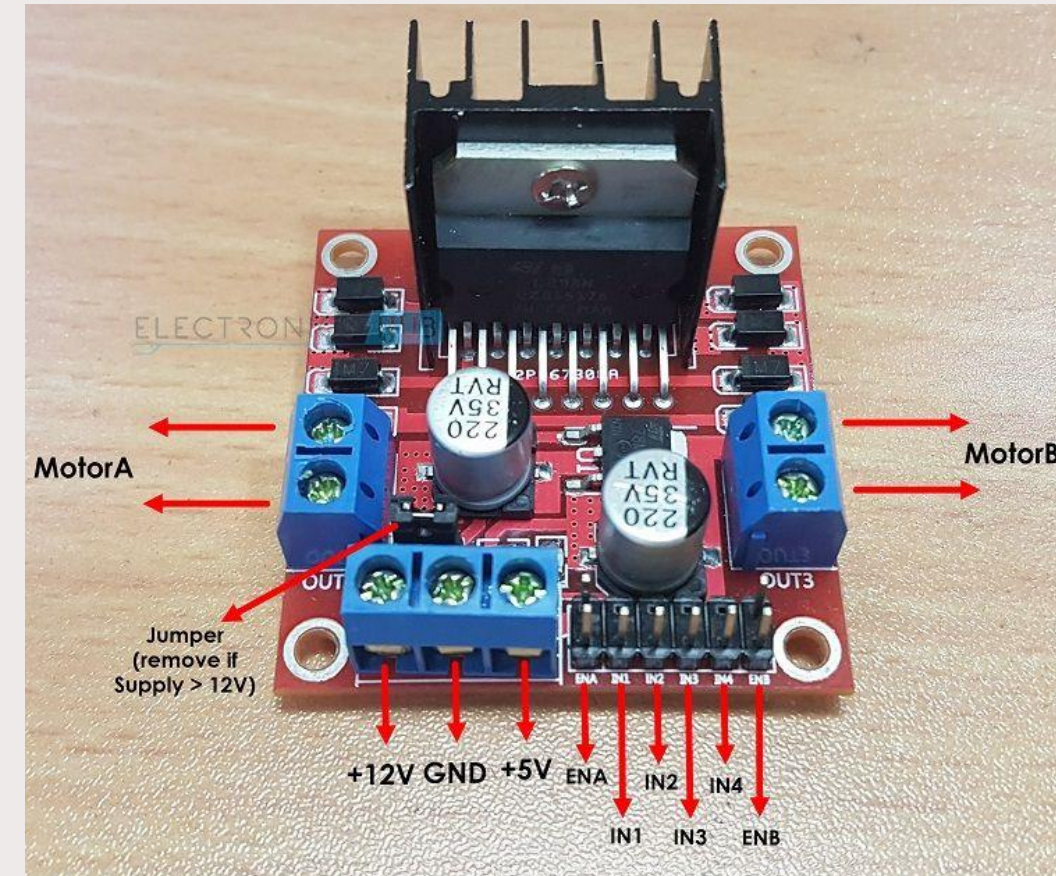
L298N H-Bridge Motor Driver for line tracing robot

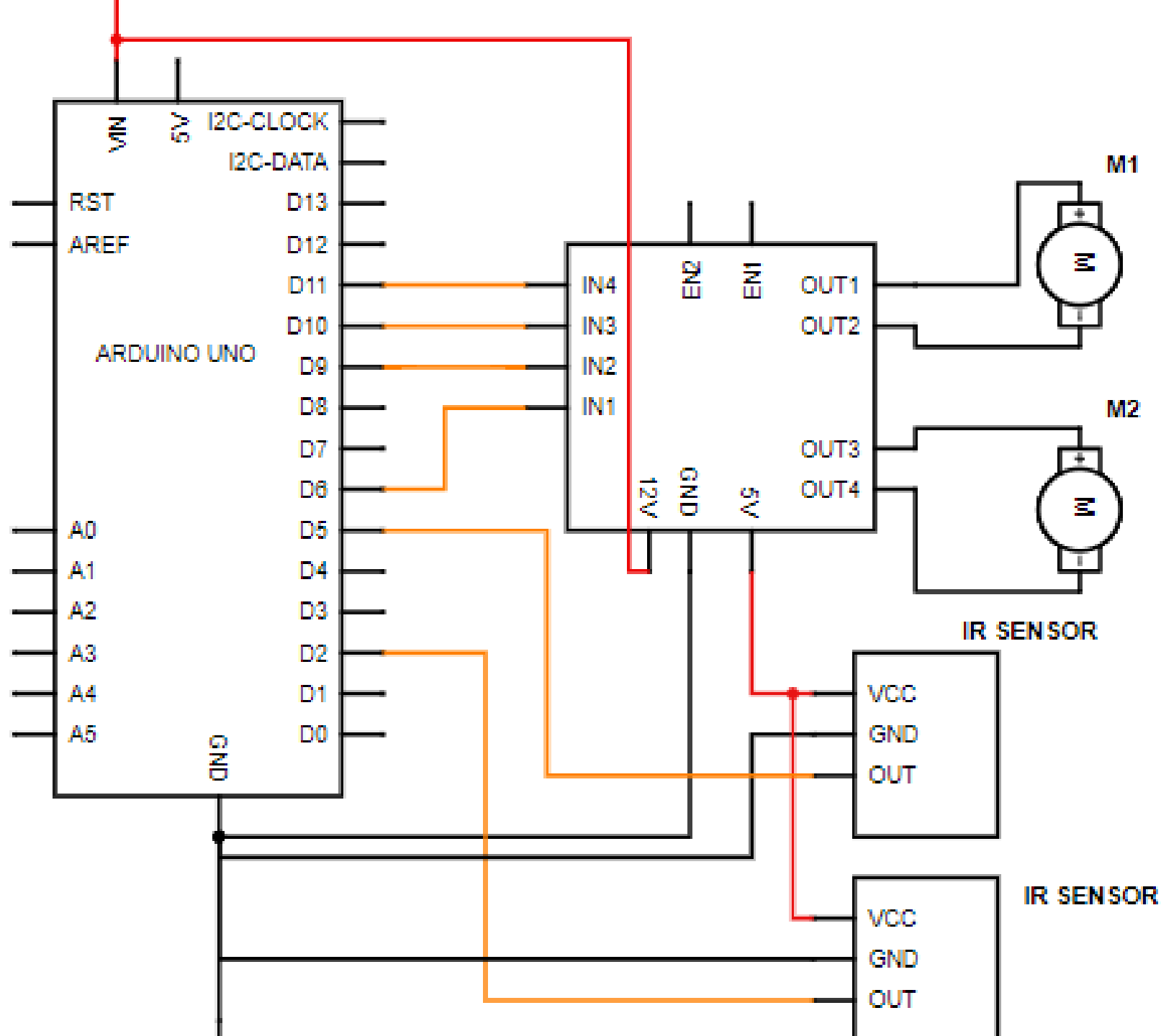
- We have Motor A and Motor B terminals are connect to the microcontroller.
- Motor A connects to terminals 1 and 2 while Motor B connects to terminals 3 and 4.
- Motor 1: To rotate forward we apply a high pulse to IN1 and a low pulse to IN2
- Motor 1: To reverse it, reverse the pulses to IN1 and IN2. The same applies to the Motor 2
- Speed control is also possible with the L298N motor driver
- All we need is feed PWM (Pulse Width Modulation) signals to the motor enable pins (EN1 & EN2)



Line Tracing Robot

IN1	IN2	IN3	IN4	Direction
0	0	0	0	Stop
1	0	1	0	Forward
0	1	0	1	Reverse
1	0	0	1	Left
0	1	1	0	Right







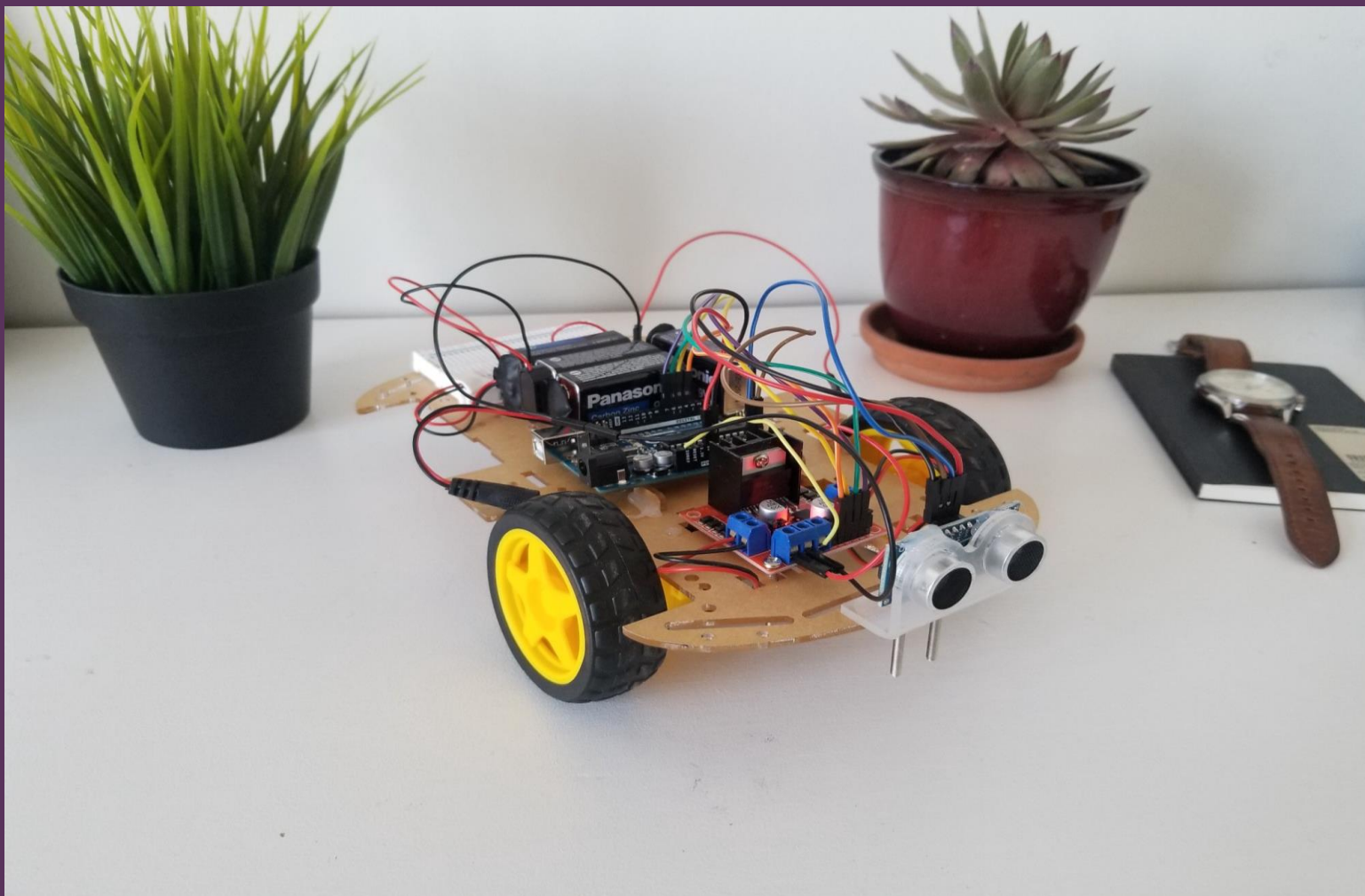
Line Tracing Robot

Applications of Line Follower Robot

- Line follower Robots are commonly used for automation process in industries, military applications and consumer applications.
- They are very useful as they can work without any supervision i.e. they work as automatic guided vehicles.
- With additional features like obstacle avoidance and other security measures, line follower robots can be used in driver less cars.



Obstacle avoidance robot



Obstacle avoidance robot

- The obstacle avoidance robot is used for detecting obstacles and avoiding the collision.
- The robot gets the information from the surrounding area through mounted sensors on the robot.
- The ultrasonic sensor is most suitable for obstacle detection and it is of low cost and has a high ranging capability.

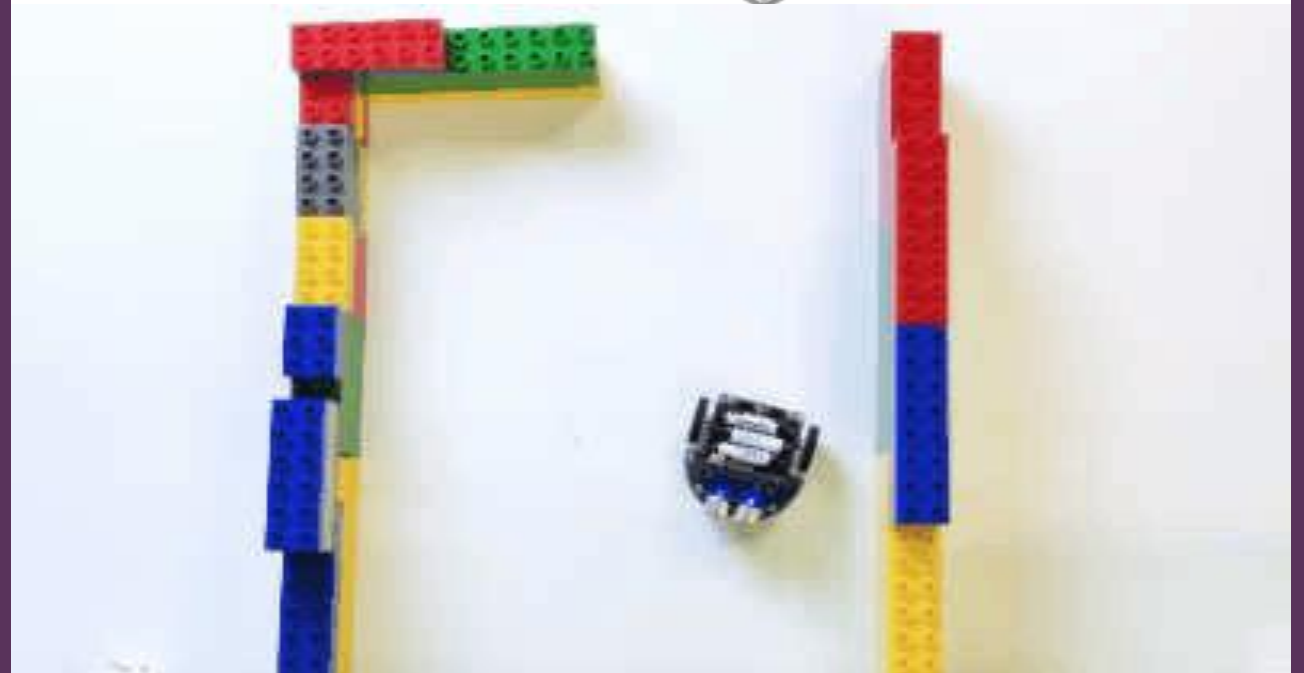
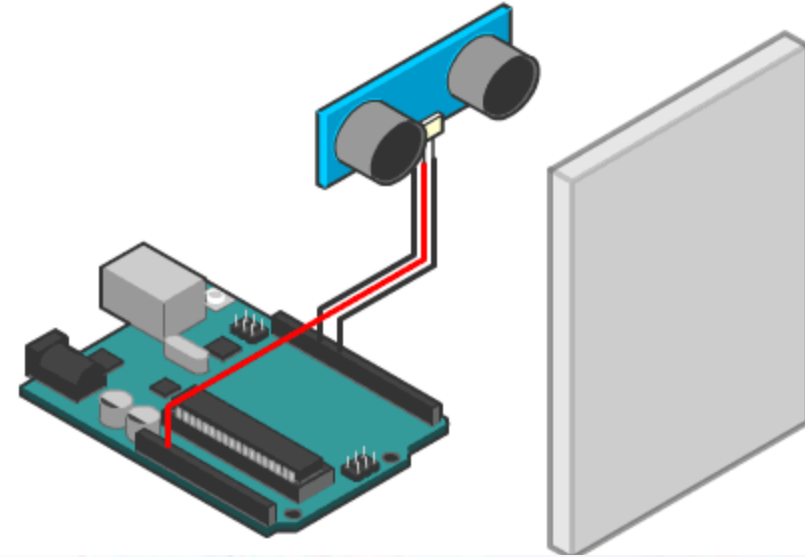


Obstacle avoidance robot

- The module has two eyes like projection in the front which forms the Ultrasonic transmitter and Receiver.
- The sensor works with the simple formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

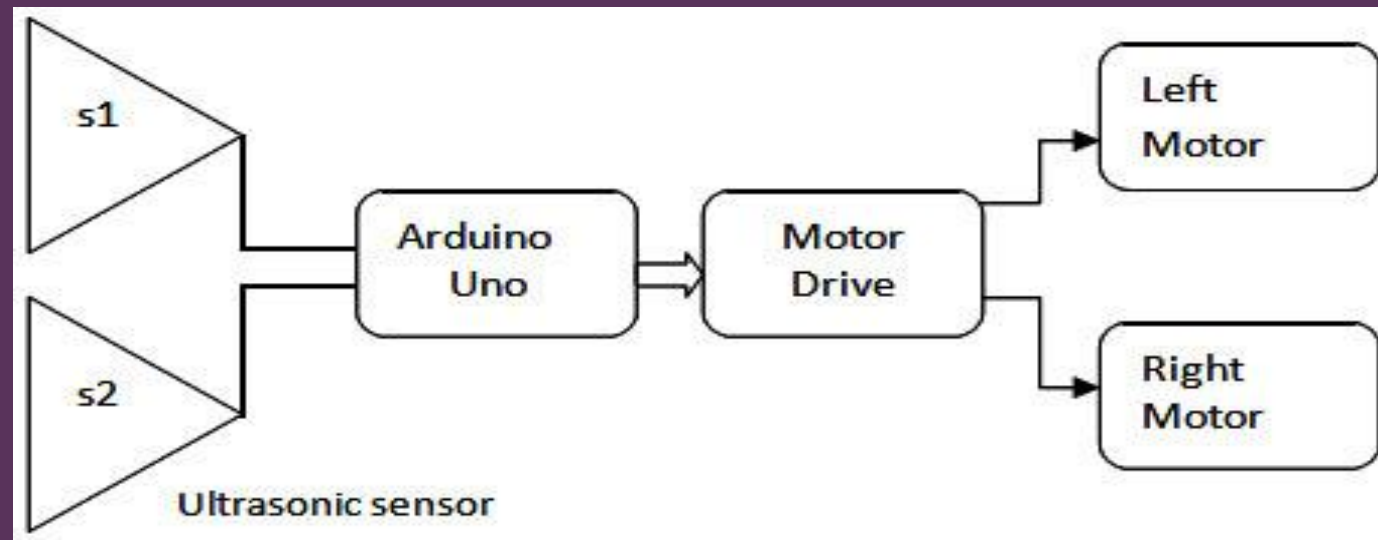
- The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver
- Since we are using the Ultrasonic wave, we know the universal speed of US wave at room conditions which is 330m/s.



Obstacle avoidance robot

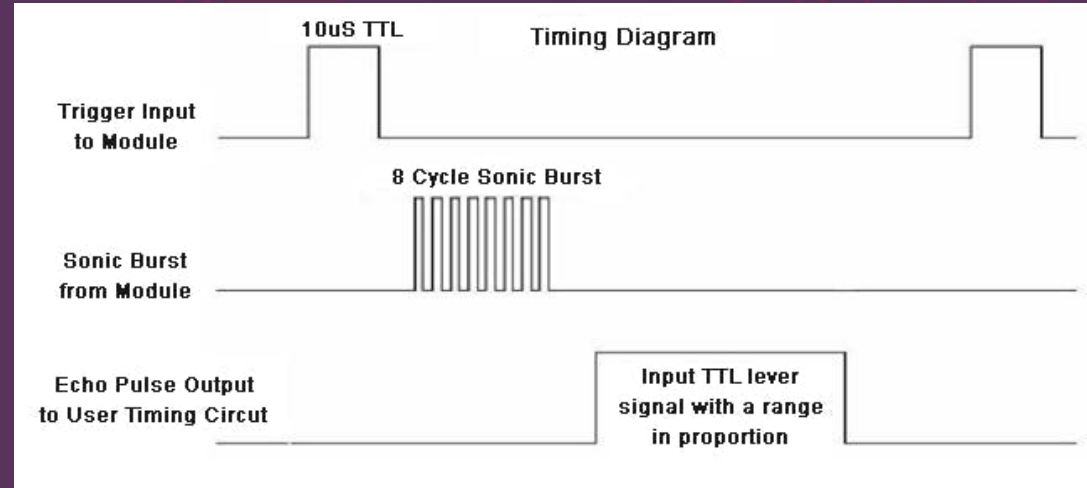
Working of obstacle avoidance robot

- When the robot is powered on, both the motors of the robot will run normally and the robot moves forward.
- During this time, the ultrasonic sensor continuously calculate the distance between the robot and the reflective surface. This information is processed by the Arduino.
- If the distance between the robot and the obstacle is less than 19cm, the Robot stops and scans in left and right directions for new distance using Servo Motor and Ultrasonic Sensor.
- If the distance towards the left side is more than that of the right side, the robot will prepare for a left turn. But first, it backs up a little bit and then activates the Left Wheel Motor in reversed in direction.
- Similarly, if the right distance is more than that of the left distance, the Robot prepares right rotation. This process continues forever and the robot keeps on moving without hitting any obstacle.

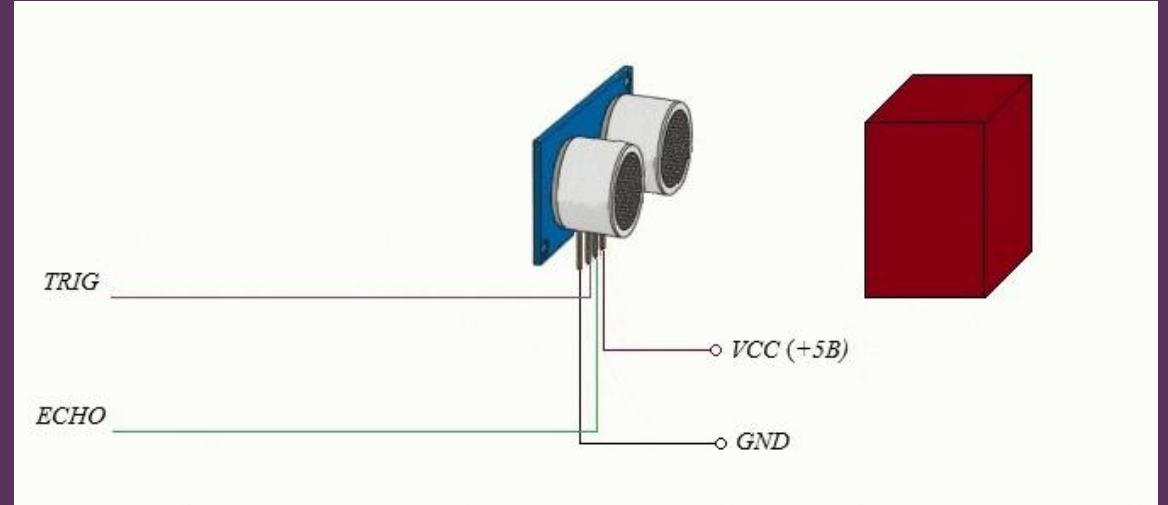
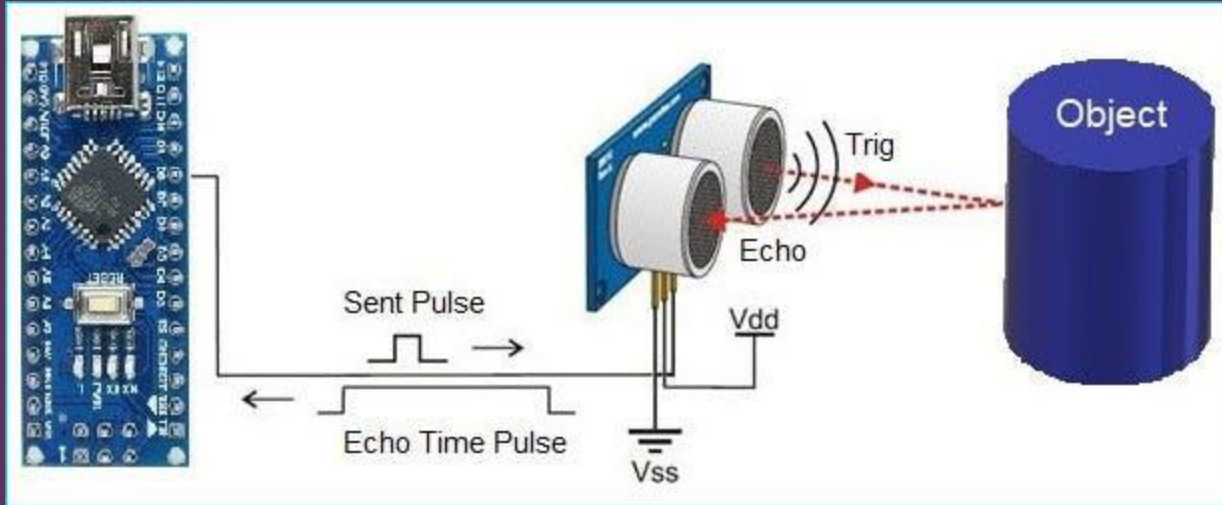


Obstacle avoidance robot

- So, the Trig pin of HC-SR04 is made high for at least 10 us. A sonic beam is transmitted with 8 pulses of 40KHz each.



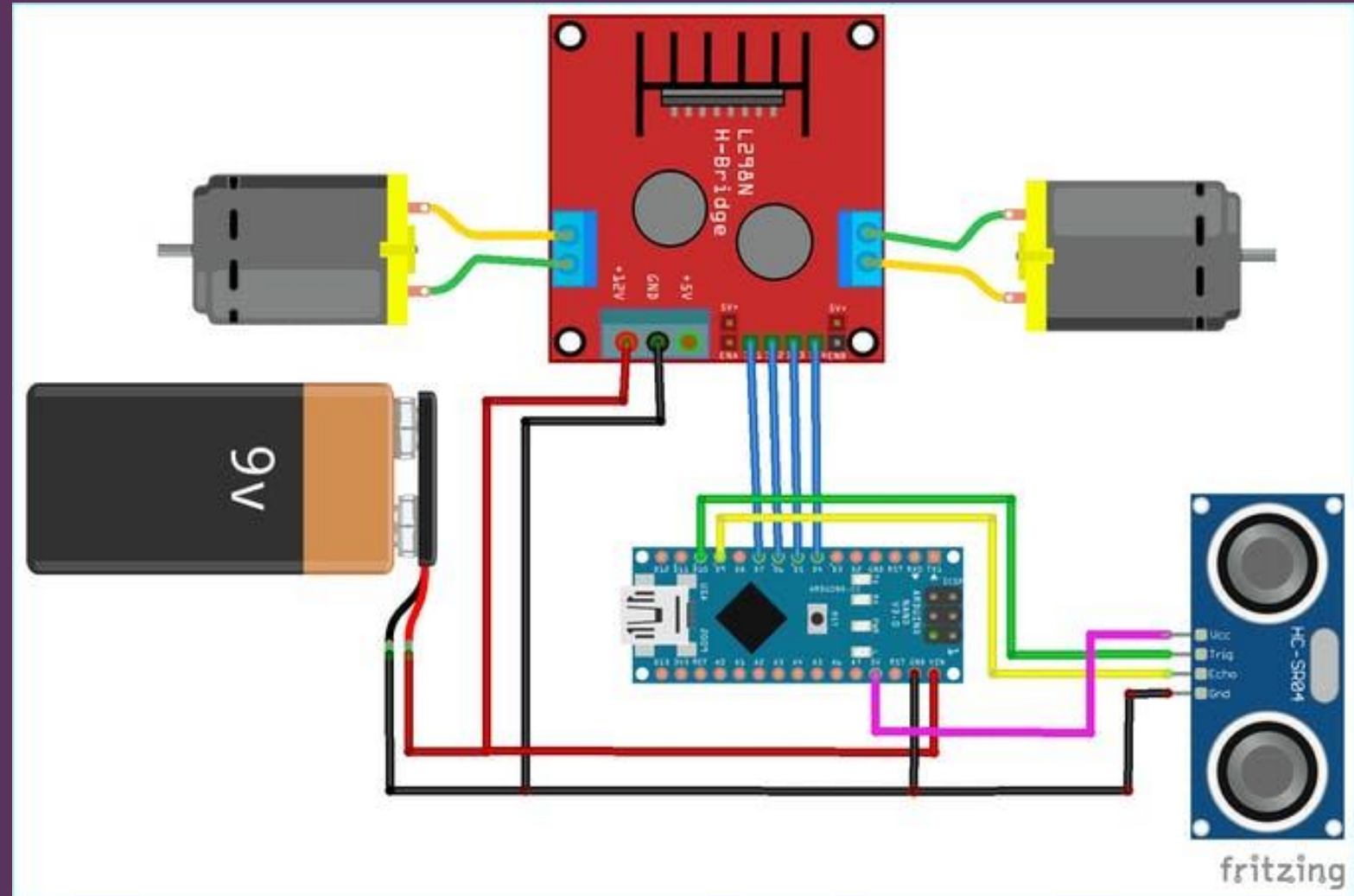
- The signal then hits the surface and return back and captured by the receiver Echo pin of HC-SR04. The Echo pin had already made high at the time sending high.



Obstacle avoidance robot

Schematic and connections

Battery positive	Arduino Vin
Battery negative	Arduino GND
Motor driver 12v pin	VCC or battery positive
Motor driver GND	Arduino GND
Motor 1 A and B	Motor driver A1 B1
Motor 2 A and B	Motor driver A2 B2
Arduino - D4 D5 D6 D7	Motor driver IN1,IN2,IN3,IN4
Ultrasonic sensor VCC	5v pin of Arduino
Ultrasonic sensor GND	Arduino GND
Ultrasonic sensor Trig	D9 of Arduino
Ultrasonic sensor Echo	D10 of Arduino



Applications of obstacle avoidance robot

- Car collision avoidance systems
- Industrial applications on autonomous movements
- Household cleaning bots

