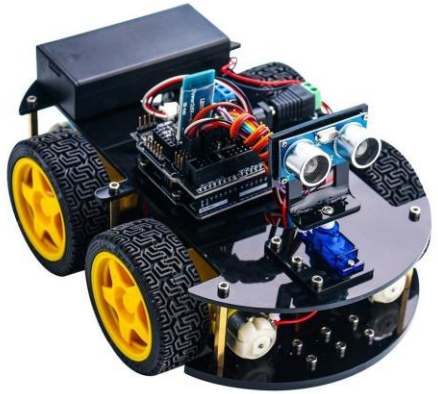
Robotics Club - Workshop 1

1. What is a Robot?

Humanoid Robot

Stationary Robot



Mobile Robot

1. What is a Robot?

Environmental

Sensor

Controller

Actuator

2. Introduction to Arduino

- **What is Arduino?**

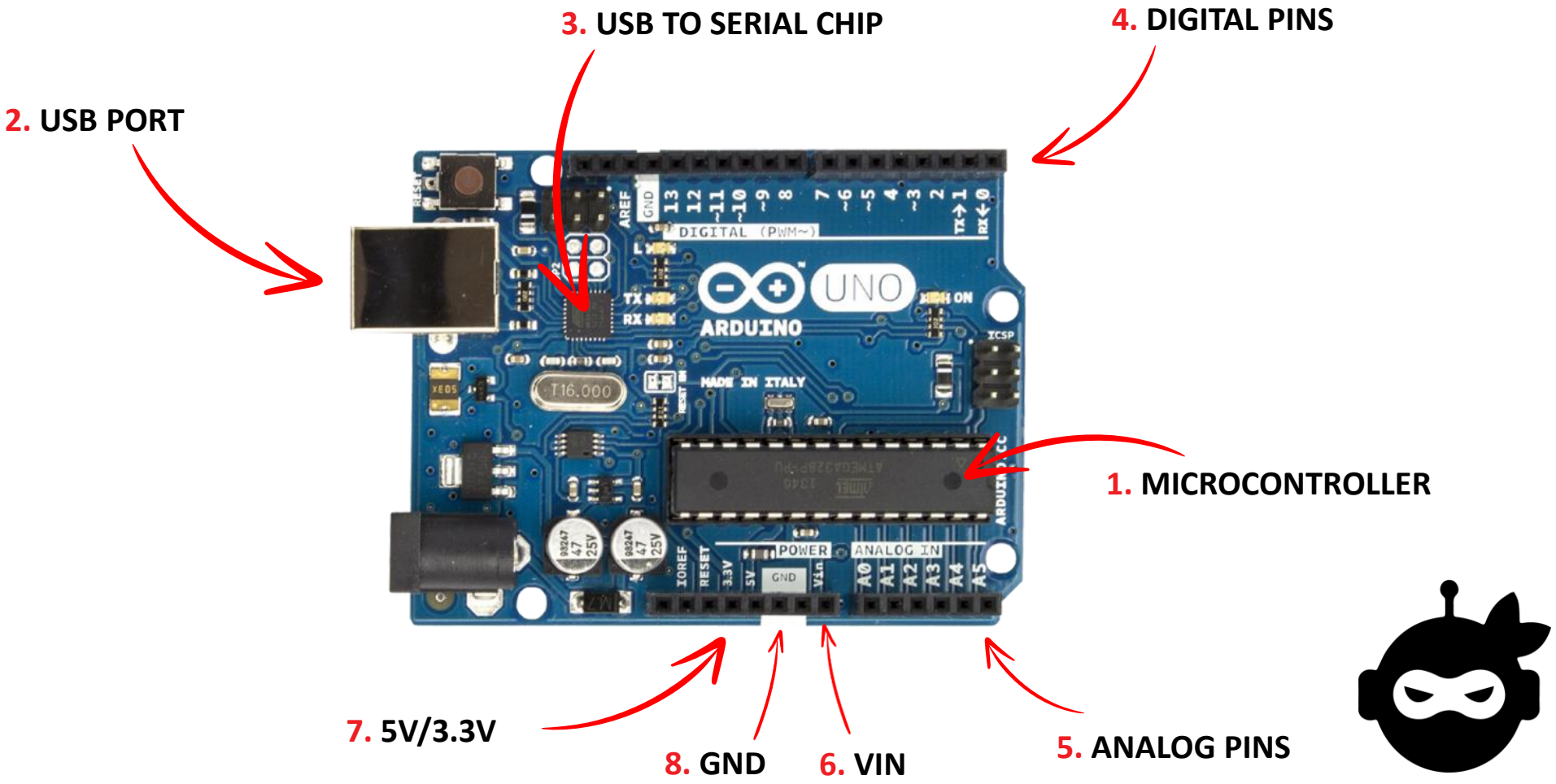
  Arduino is an open-source platform used for building electronics projects. It consists of both a programmable circuit board (microcontroller) and software (Arduino IDE) to program it.

3. Digital vs Analog

Digital Signal

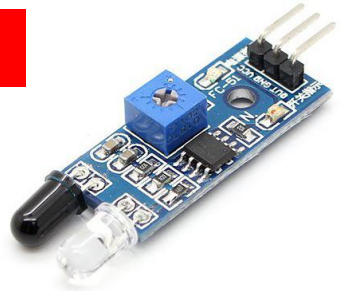
Analog Signal

4. Components of Arduino



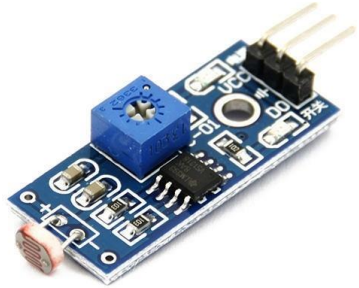
5. Sensors and Actuators

1



IR (InfraRed) Sensor

2



LDR (Light Dependent Resistor) Sensor

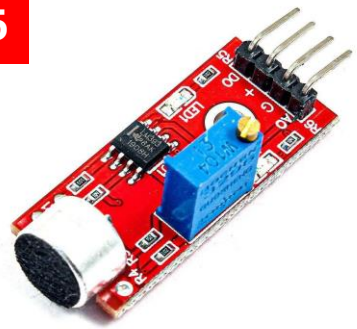
3

Touch Sensor

4

Ultrasonic Sensor

5



Sound Sensor

6

Joystick Module

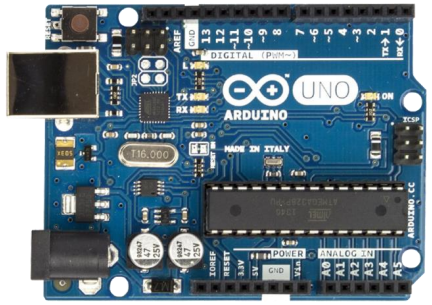
6. Setting Up First Project

- **Step 1:** Understanding the Components
- **Step 2:** Circuit Setup
- **Step 3:** Code
- **Step 4:** Upload the Code

6. Setting Up First Project

- **Step 1:** **Understanding the Components**

1

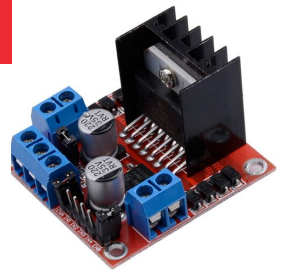


Arduino board

2

DC Motor

3



L298N Motor Driver Module

4

Jumper wires

5

USB cable

6

Mobile Robot Chassis Kit

7

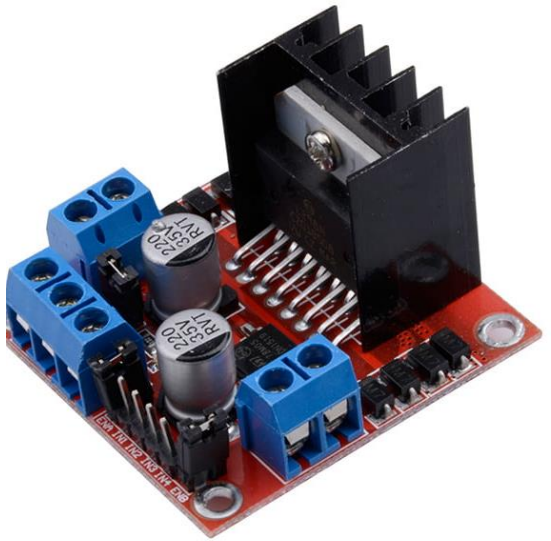
Battery

6. Setting Up First Project

- **Step 1: Understanding the Components**

1. Why Motor Driver Module?

A **Motor Driver** is an electronic component that controls the operation of DC motors, allowing you to **control the speed and direction** of the motors using a low-power microcontroller, like an Arduino.



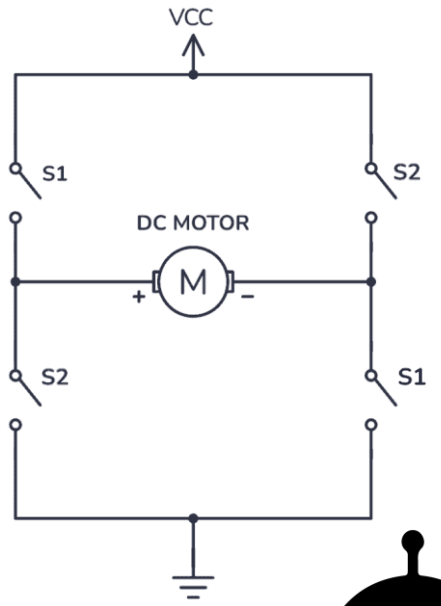
The **L298N** is a dual **H-Bridge motor driver.**
An H-Bridge is a circuit that allows you to control the direction of a DC motor.

6. Setting Up First Project

- **Step 1: Understanding the Components**

H-Bridge DC Motor Control

For controlling the rotation direction, we just need to inverse the direction of the current flow through the motor, and the most common method of doing that is by using an H-Bridge. An H-Bridge circuit contains four switching elements, transistors or MOSFETs, with the motor at the center forming an H-like configuration. By activating two particular switches at the same time we can change the direction of the current flow, thus change the rotation direction of the motor.



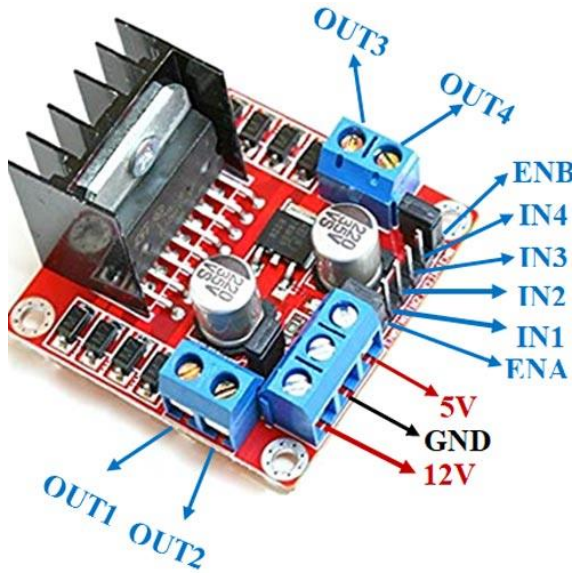
6. Setting Up First Project

- **Step 1: Understanding the Components**

2. Pins and Connections of L298N

[1] Input Control Pins:

[A] IN1 and IN2 (for Motor 1)
[B] IN3 and IN4 (for Motor 2)



Role: Control the direction of Motor 1 / Motor 2 (forward/reverse).

Depending on the HIGH/LOW combination of IN1, IN2, IN3 and IN4 , Motor 1/ Motor 2 can move forward or backward.

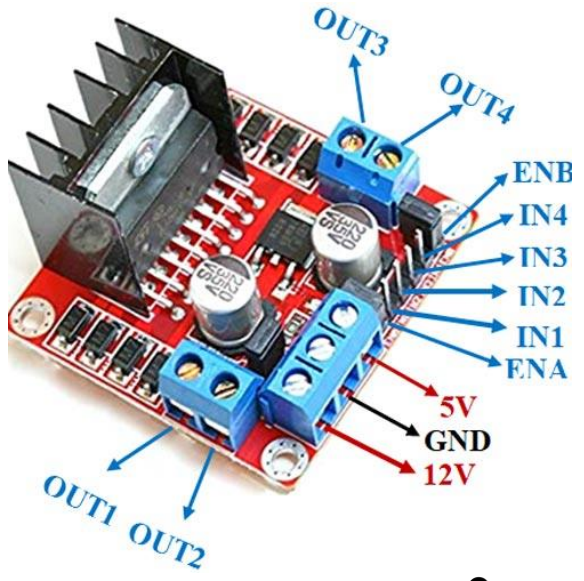
6. Setting Up First Project

- **Step 1: Understanding the Components**

2. Pins and Connections of L298N

[2] Enable Pins (Speed Control):

These pins control the speed of the motors using **PWM signals** from the Arduino.



[A] ENA (Enable A): This pin enables or disables Motor 1. By connecting it to a PWM pin on the Arduino and using **analogWrite()**, you can control the speed of Motor 1.

[B] ENB (Enable B): This pin enables or disables Motor 2. It can also be connected to a PWM pin to control Motor 2's speed.

6. Setting Up First Project

- **Step 1:** **Understanding the Components**

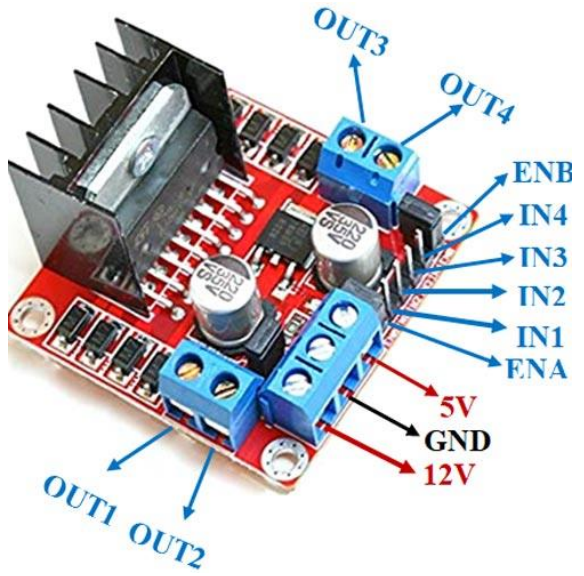
2. Pins and Connections of L298N

[3] Power Pins:

[A] 12V
[B] GND (Ground)
[C] 5V

[4] Motor Control Pins:

[A] OUT1 and OUT2
[B] OUT3 and OUT4



6. Setting Up First Project

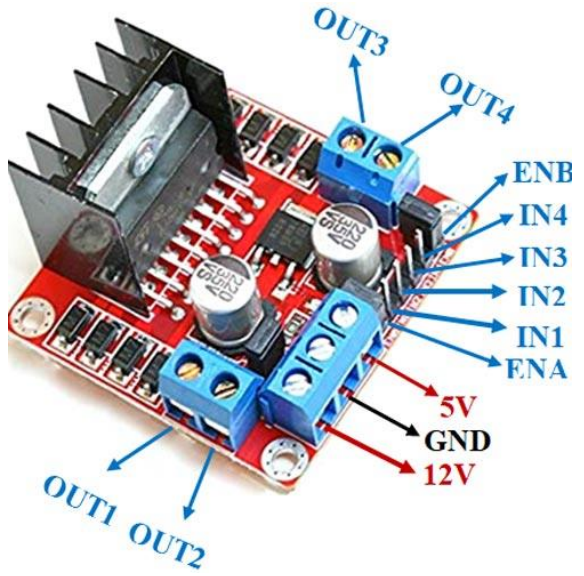
- **Step 1: Understanding the Components**

3. How the L298N Works

Motor Direction

Each motor has two input pins (e.g., IN1/IN2 for Motor 1).
By setting one pin HIGH and the other LOW,
you control the direction in which the motor spins.
For example:

IN1 HIGH, IN2 LOW → Motor moves forward.
IN1 LOW, IN2 HIGH → Motor moves backward.



Motor Speed

The ENA and ENB pins are used to control the speed of the motors using **PWM**.
By applying a PWM signal (with a value between 0 and 255) to these pins,
you can vary the motor speed. A value of 0 turns the motor off, and 255 runs it at full speed.

6. Setting Up First Project

- **Step 2: Circuit Setup**

Right Motor (Motor 1)

•IN1 (Motor 1) ← Arduino Pin 3
•IN2 (Motor 1) ← Arduino Pin 4
•ENA (Motor 1) ← Arduino Pin 2 (PWM Pin)
•OUT1 and OUT2 ← Motor 1 Pin 1-2

Left Motor (Motor 2)

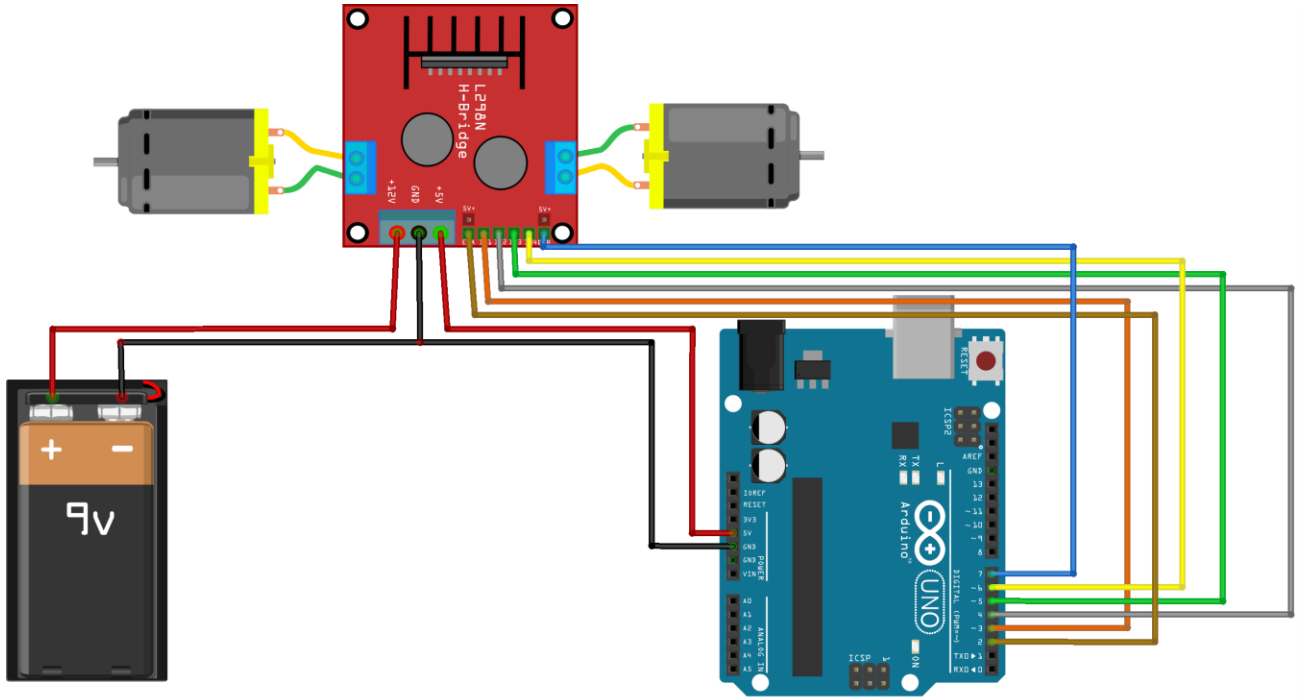
•IN3 (Motor 2) ← Arduino Pin 5
•IN4 (Motor 2) ← Arduino Pin 6
•ENB (Motor 2) ← Arduino Pin 7 (PWM Pin)
•OUT3 and OUT4 ← Motor 2 Pin 1-2

Battery

•The positive terminal ← 12V pin on the L298N.
•The negative terminal ← GND pin on the L298N and Arduino.
•5V terminal ← Arduino Pin 5V/VIN

6. Setting Up First Project

- **Step 2:** **Circuit Setup**



6. Setting Up First Project

- **Step 4: Upload the Code**
  - **Open the Arduino IDE**.
  - **Connect the Arduino board**.
  - **Select the correct board and port**:
  - Go to **Tools > Board** and select the correct Arduino model.
  - Go to **Tools > Port** and select the COM port.
  - **Copy and paste the code** into the Arduino IDE.
  - Click the **Upload button**.

WORKSHOP 1

SESSION 4

LIGHT DEPENDENT RESISTOR (LDR)

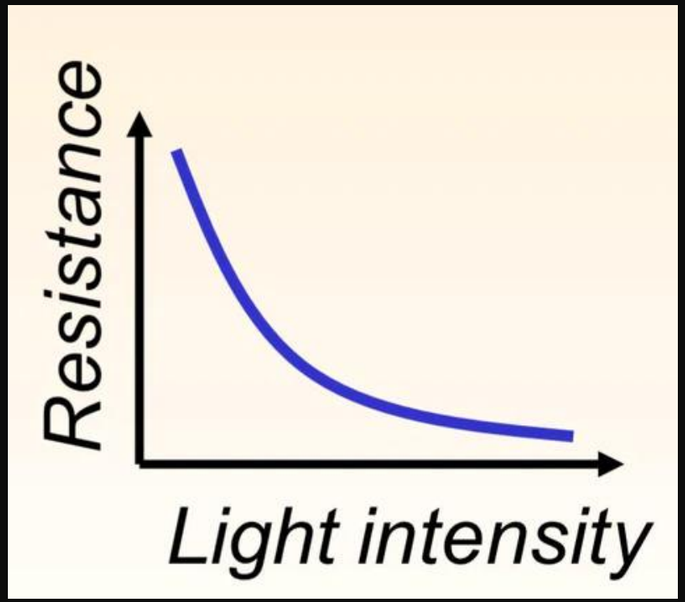
Kareem Yasser

What is an LDR Sensor?

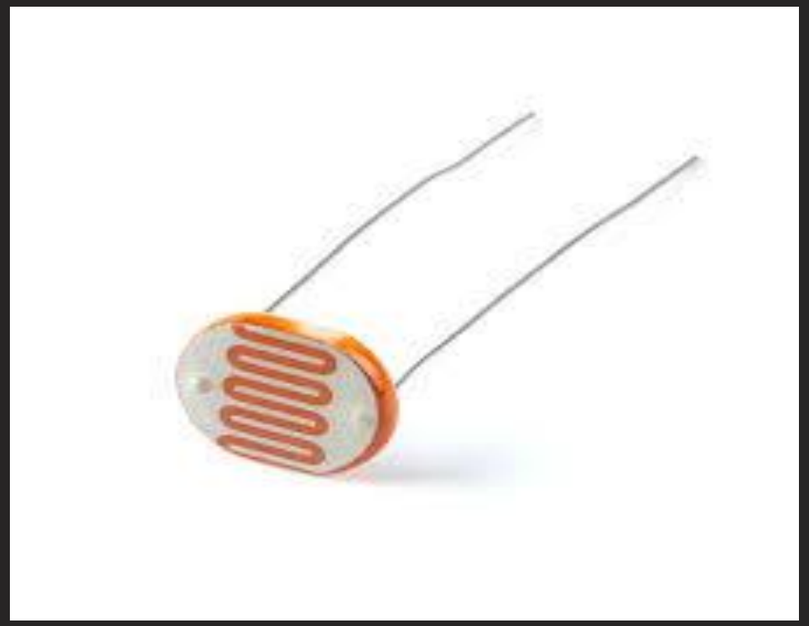
An LDR sensor is a passive electronic component that changes its resistance based on the intensity of light. The sensor is made of a semiconductor material that exhibits the photoconductive effect.

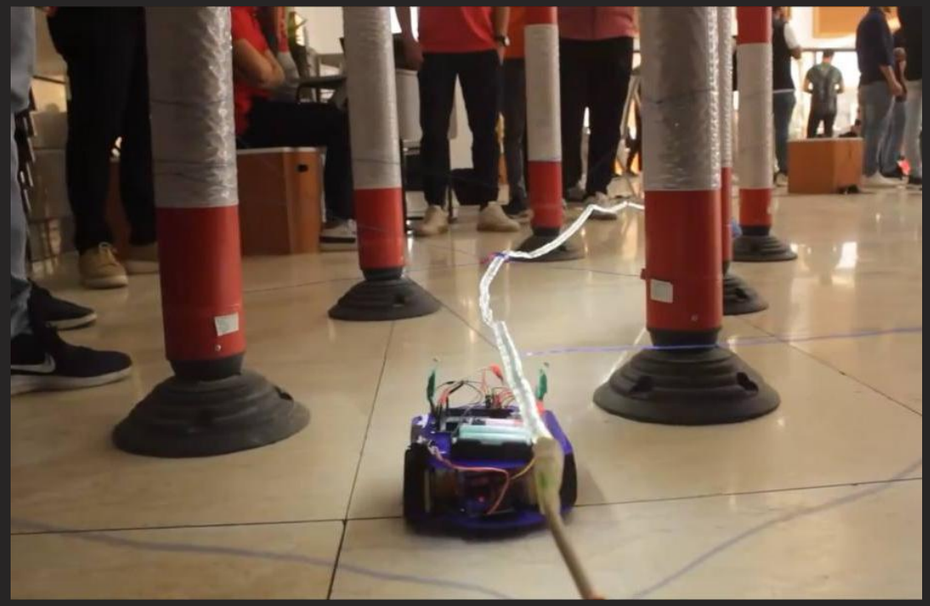
How does an LDR Sensor work?

When exposed to light, the resistance of an LDR sensor decreases, allowing more current to flow through it. In darkness, the resistance increases, limiting the current.



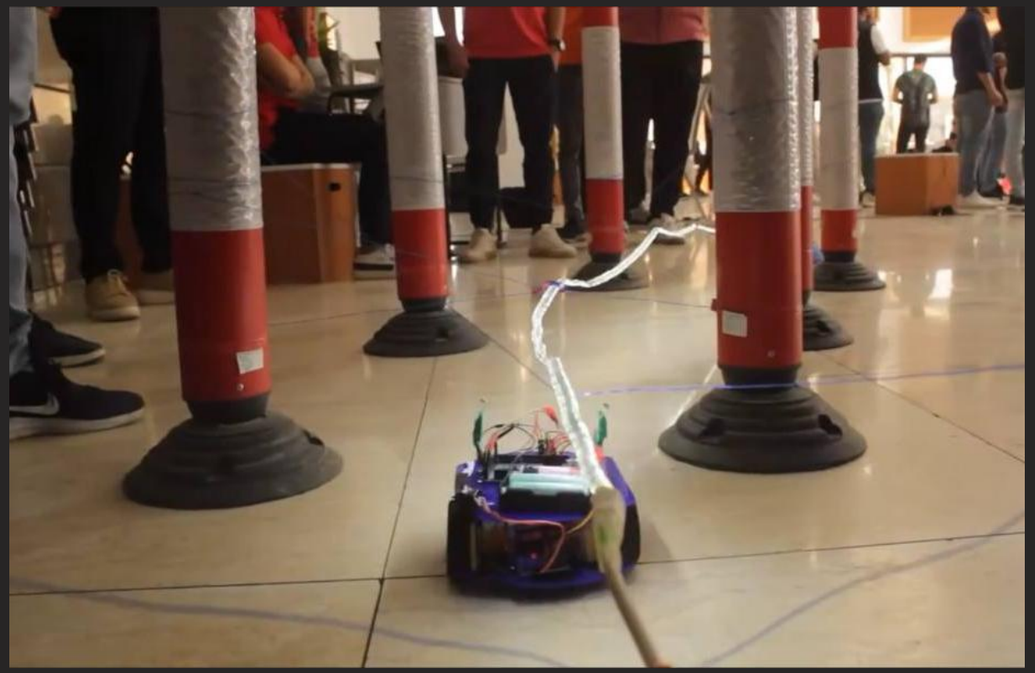
Very famous applications





LDR Sensor and Light Follower

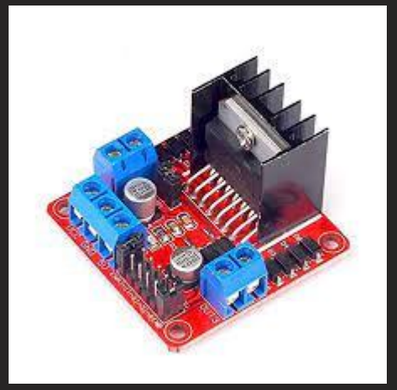
An LDR sensor, or Light Dependent Resistor, detects light intensity. A light follower is a device that uses an LDR sensor to follow light sources autonomously.



Introduction to Light Follower

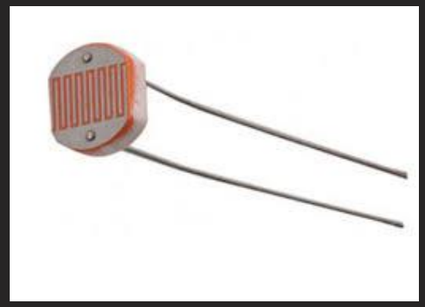
A light follower is a fascinating device that uses an LDR sensor to detect and track the brightest light source in its vicinity. It imitates the behavior of sunflowers, which always follow the sun.

Components of Light Follower



1 LDR Sensor and resistor

Senses light intensity and triggers the movement of the light follower and the resistor to divide the voltage.

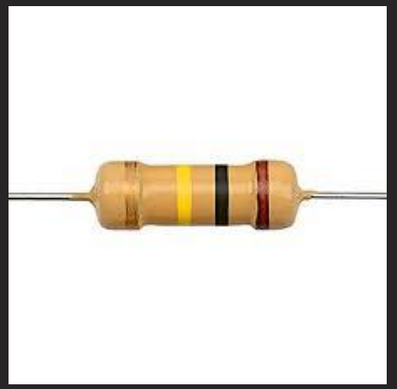


2 Motor and Motor Driver

Rotates the light follower towards the brightest light source detected by the LDR sensor.

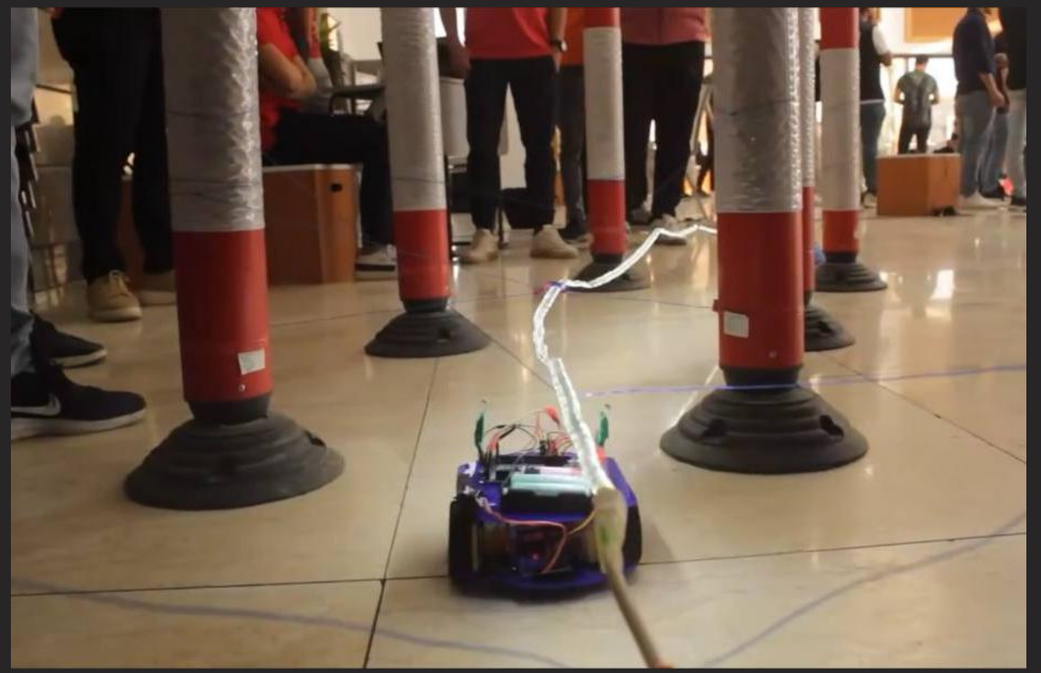
3 Arduino Uno and the Kit

Receives input from the LDR sensor and controls the motor to align the device with the light source.



How does a Light Follower work?

A light follower continuously adjusts its position by using the LDR sensor to compare light intensities from different directions. The motor then rotates the device to face the brightest light source detected.



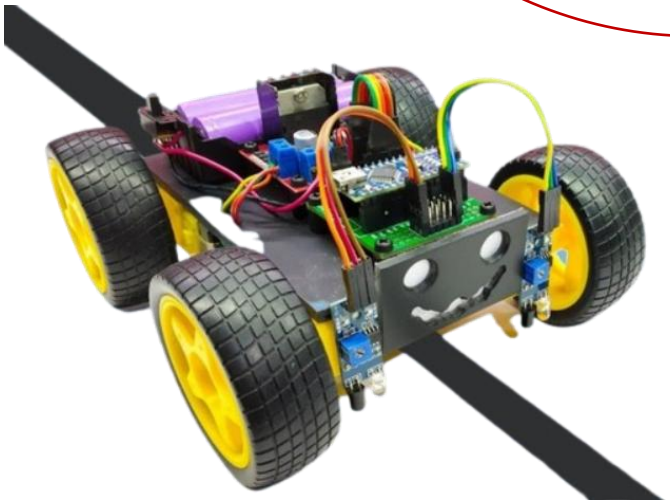
Robotics Club

Line Follower Robot

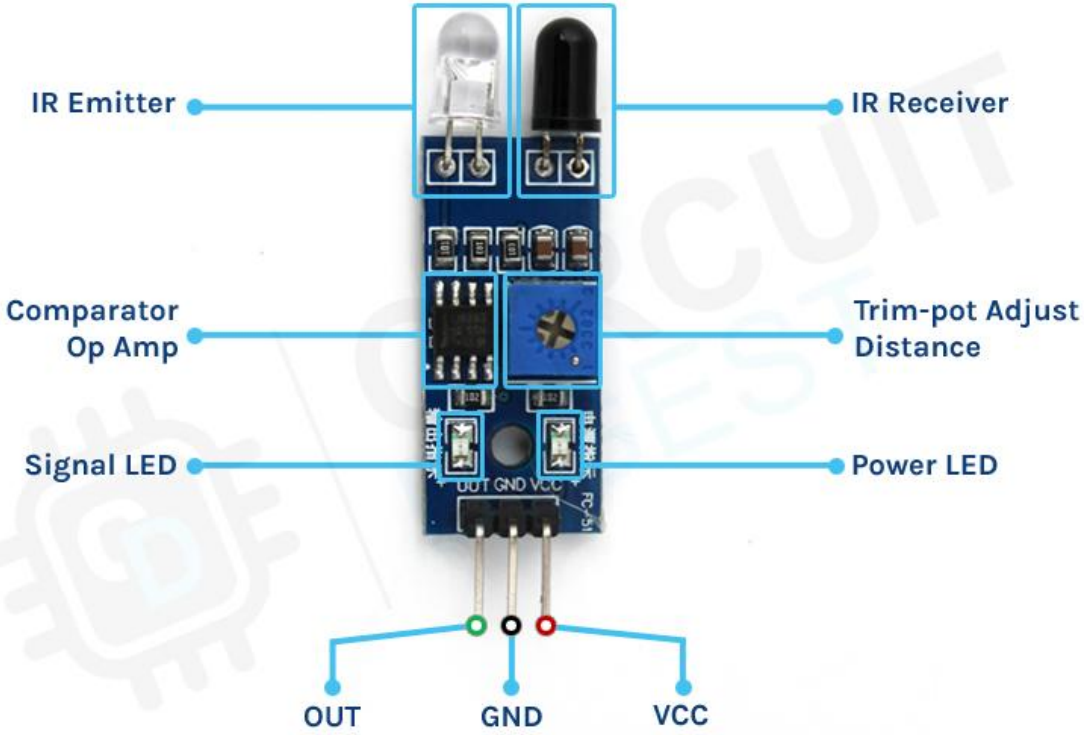
A project brought to you by E-JUST Robotics Club

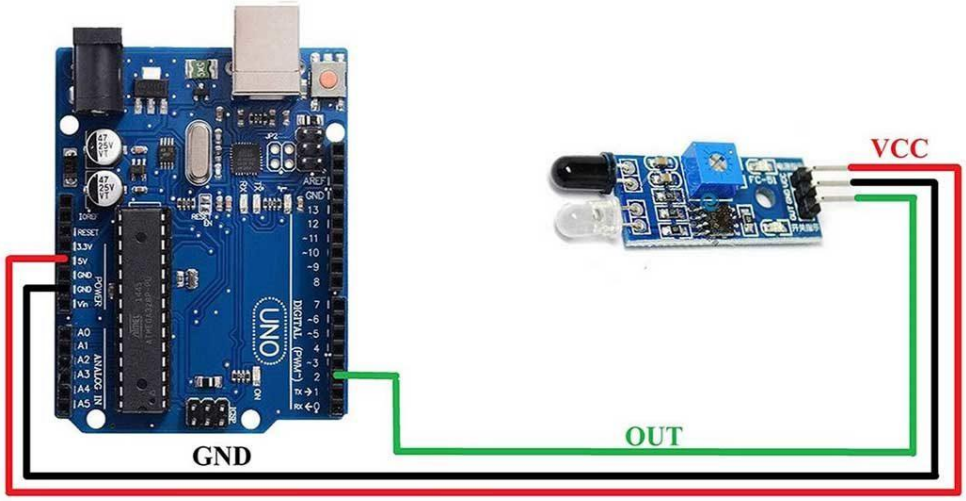
Outline

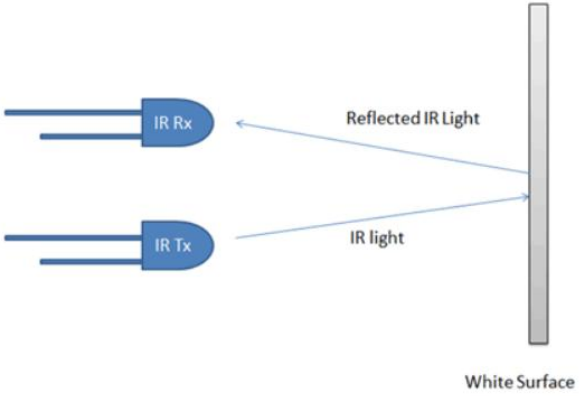
1. IR
2. Algorithm
3. Code preview

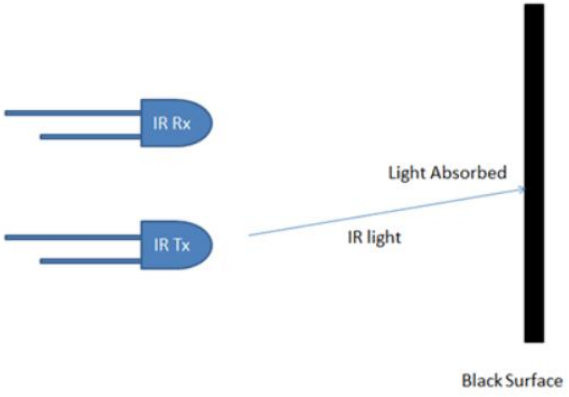


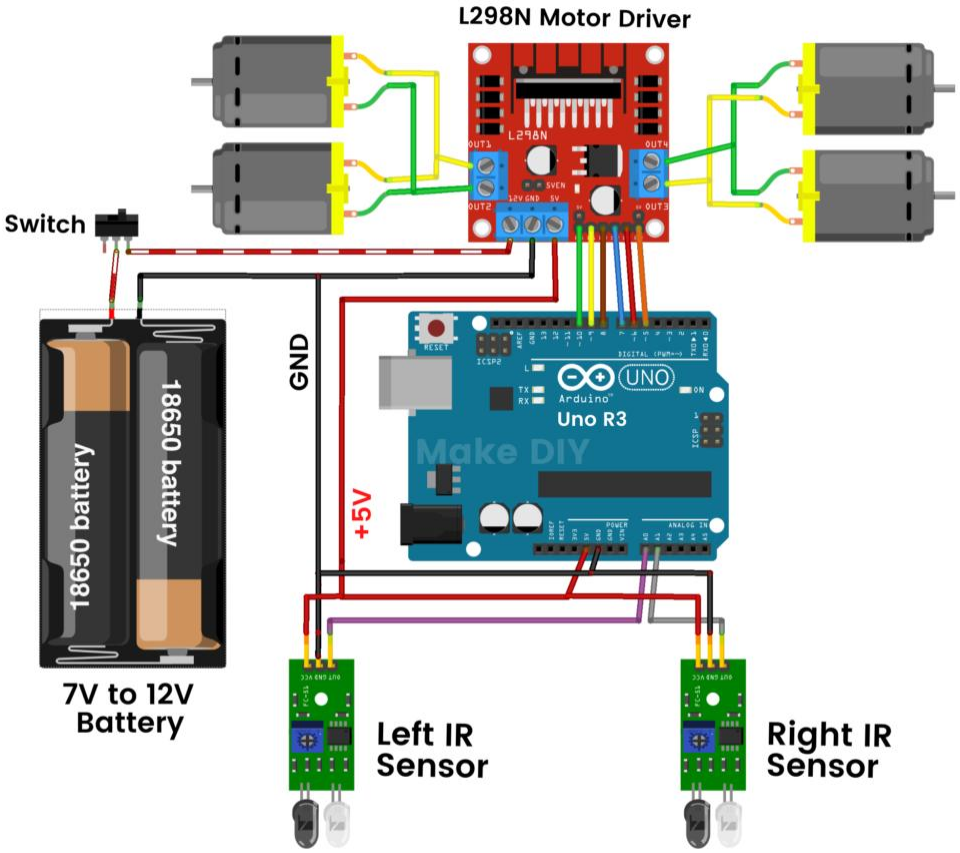
IR Sensor


IR Emitter
IR Receiver
Comparator
Op Amp
Trim-pot Adjust
Distance
Signal LED
Power LED
OUT GND VCC
OUT
GND
VCC

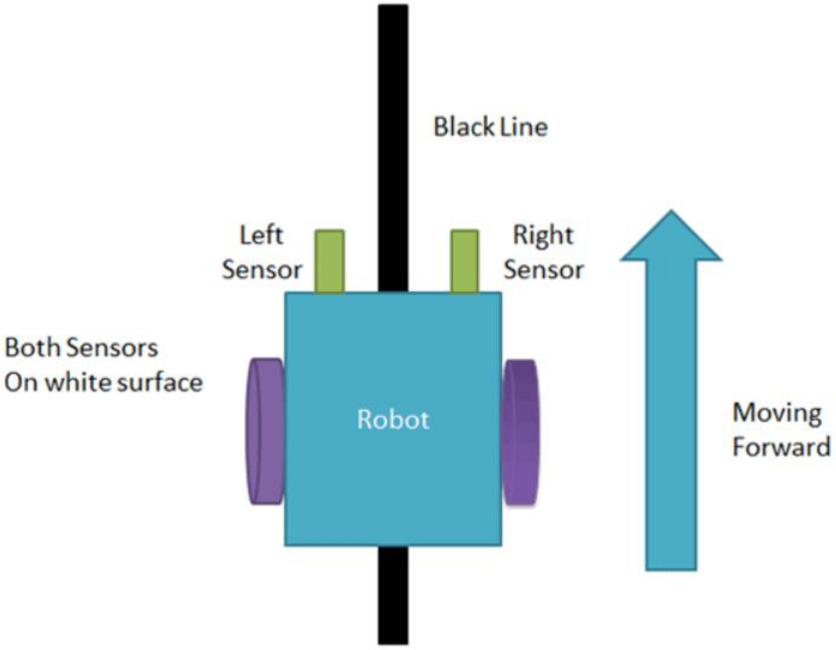

VCC
OUT
GND

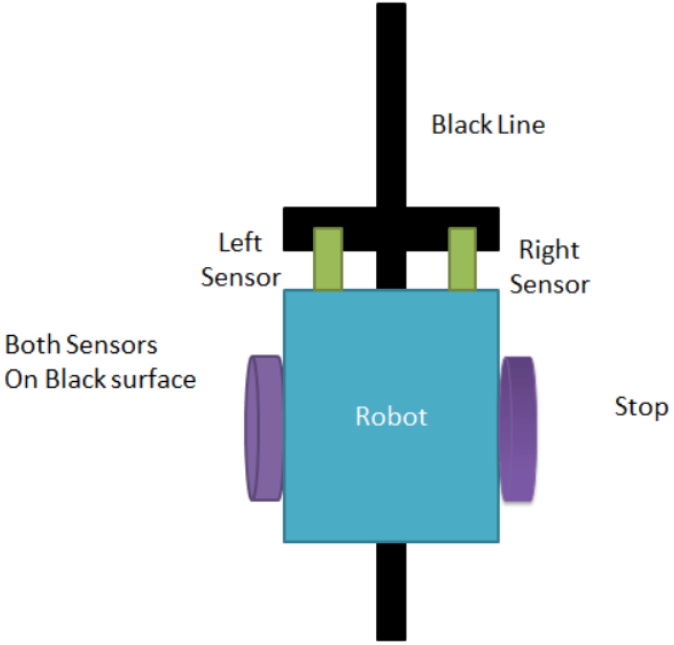

IR Rx
Reflected IR Light
IR Tx
IR light
White Surface

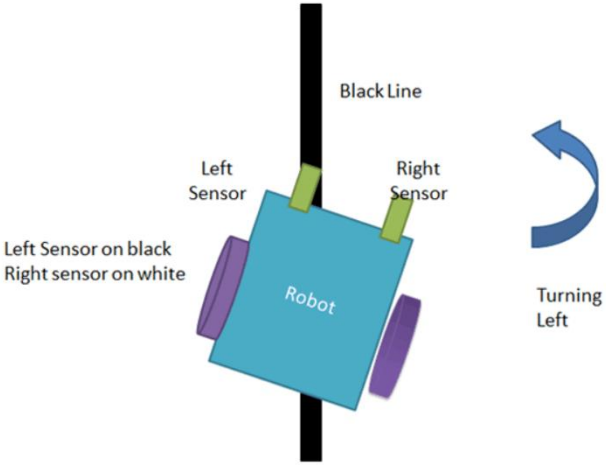

IR Rx
Light Absorbed
IR Tx
IR light
Black Surface

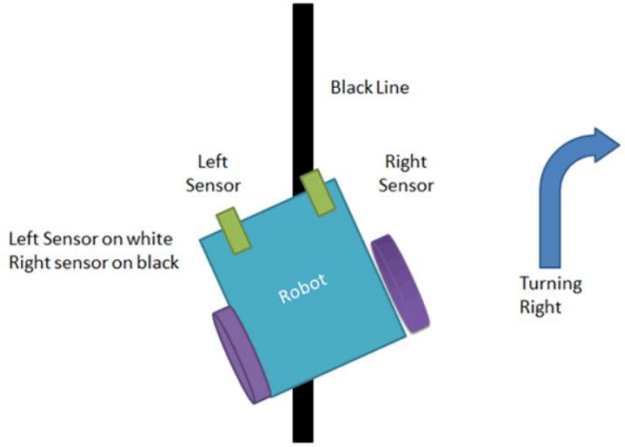

L298N Motor Driver
Switch
GND
+5V
18650 battery
18650 battery
7V to 12V
Battery
Arduino
Uno R3
Make DIY
Left IR
Sensor
Right IR
Sensor

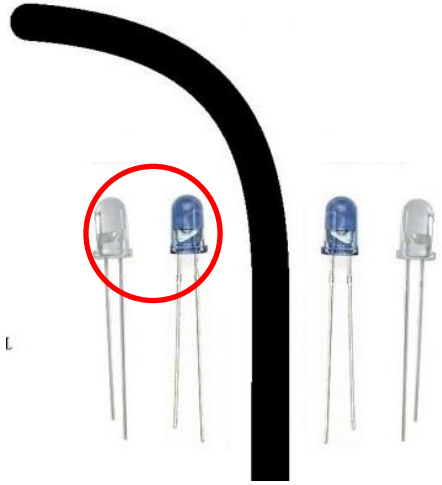
void loop()

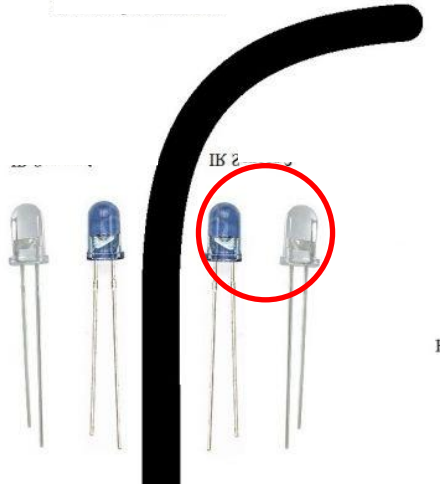

Black Line
Left Sensor
Right Sensor
Both Sensors On white surface
Robot
Moving Forward

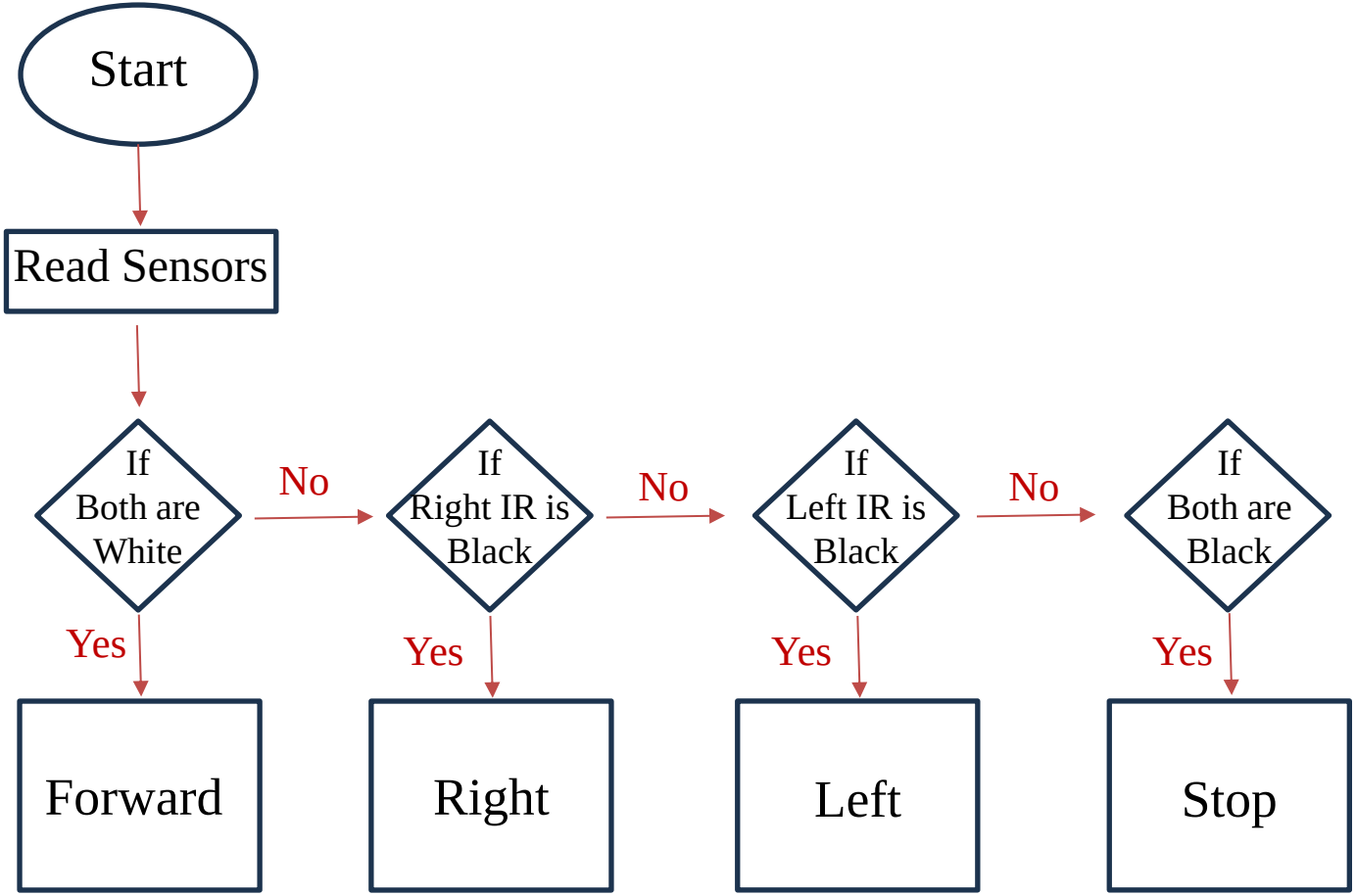

Black Line
Left Sensor
Right Sensor
Both Sensors On Black surface
Robot
Stop

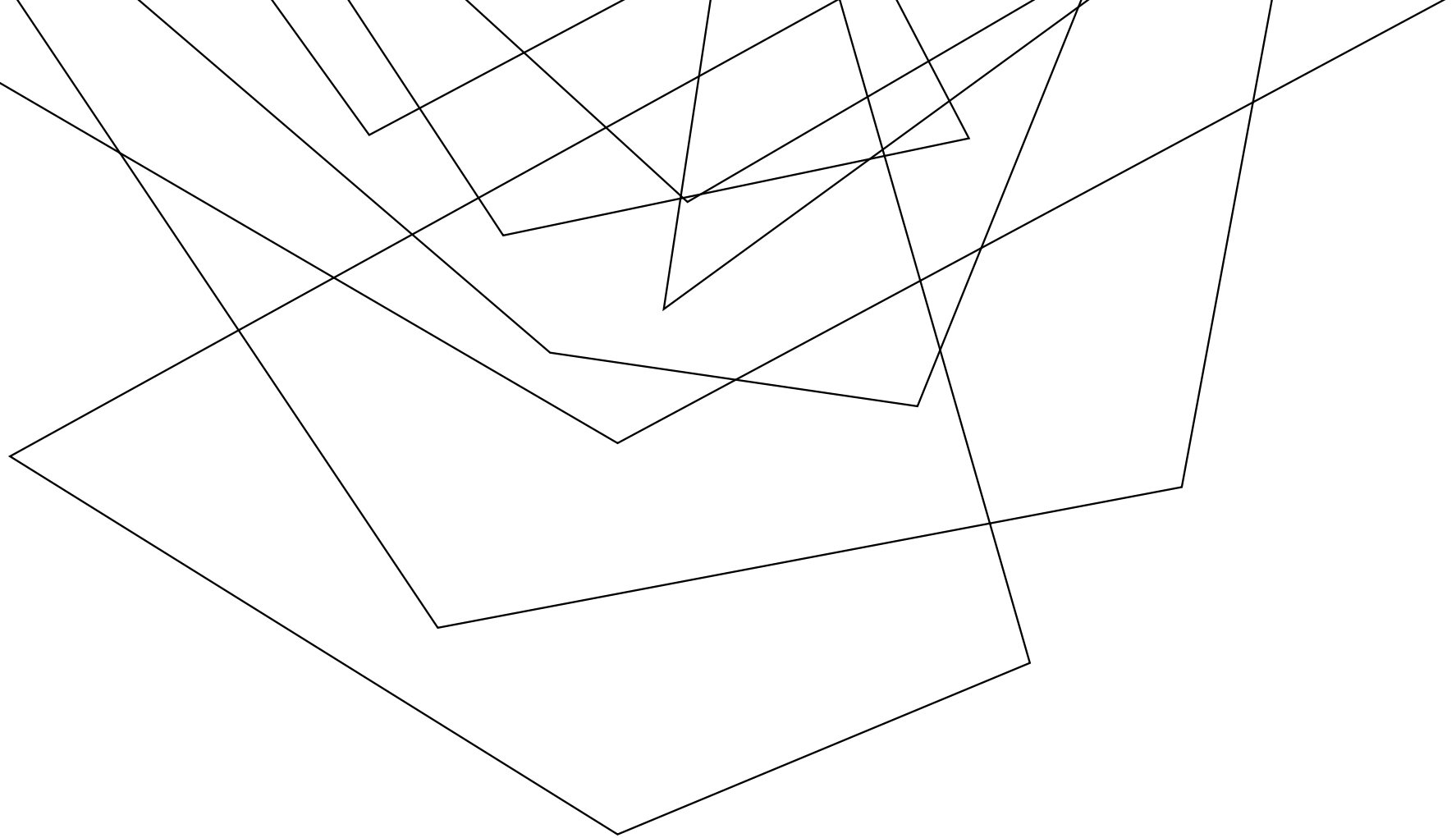

Black Line
Left Sensor
Right Sensor
Left Sensor on black
Right sensor on white
Robot
Turning Left


Black Line
Left Sensor
Right Sensor
Left Sensor on white
Right sensor on black
Robot
Turning Right



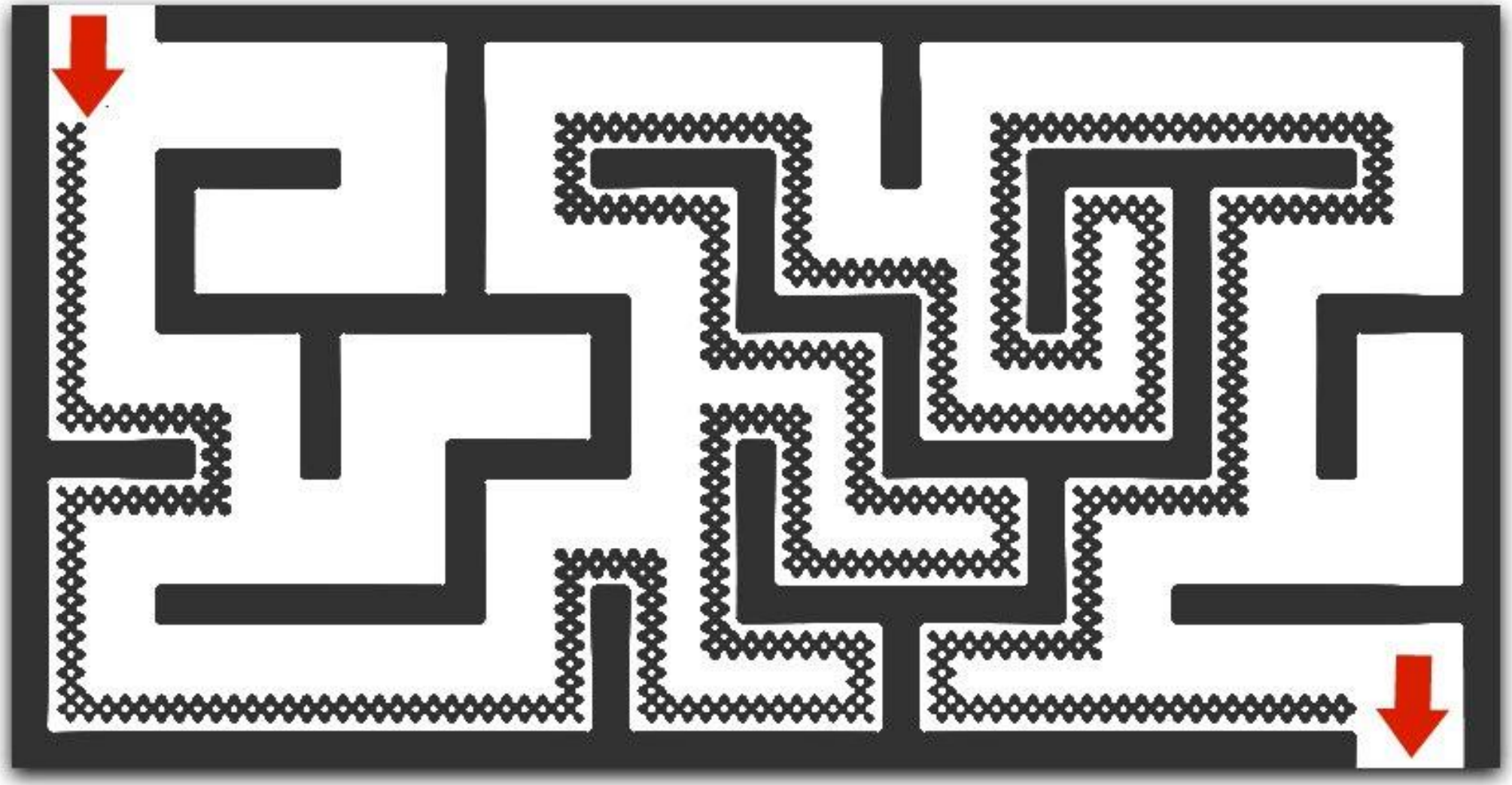



Start
Read Sensors
If Both are White
No
If Right IR is Black
No
If Left IR is Black
No
If Both are Black
Yes
Yes
Yes
Yes
Forward
Right
Left
Stop

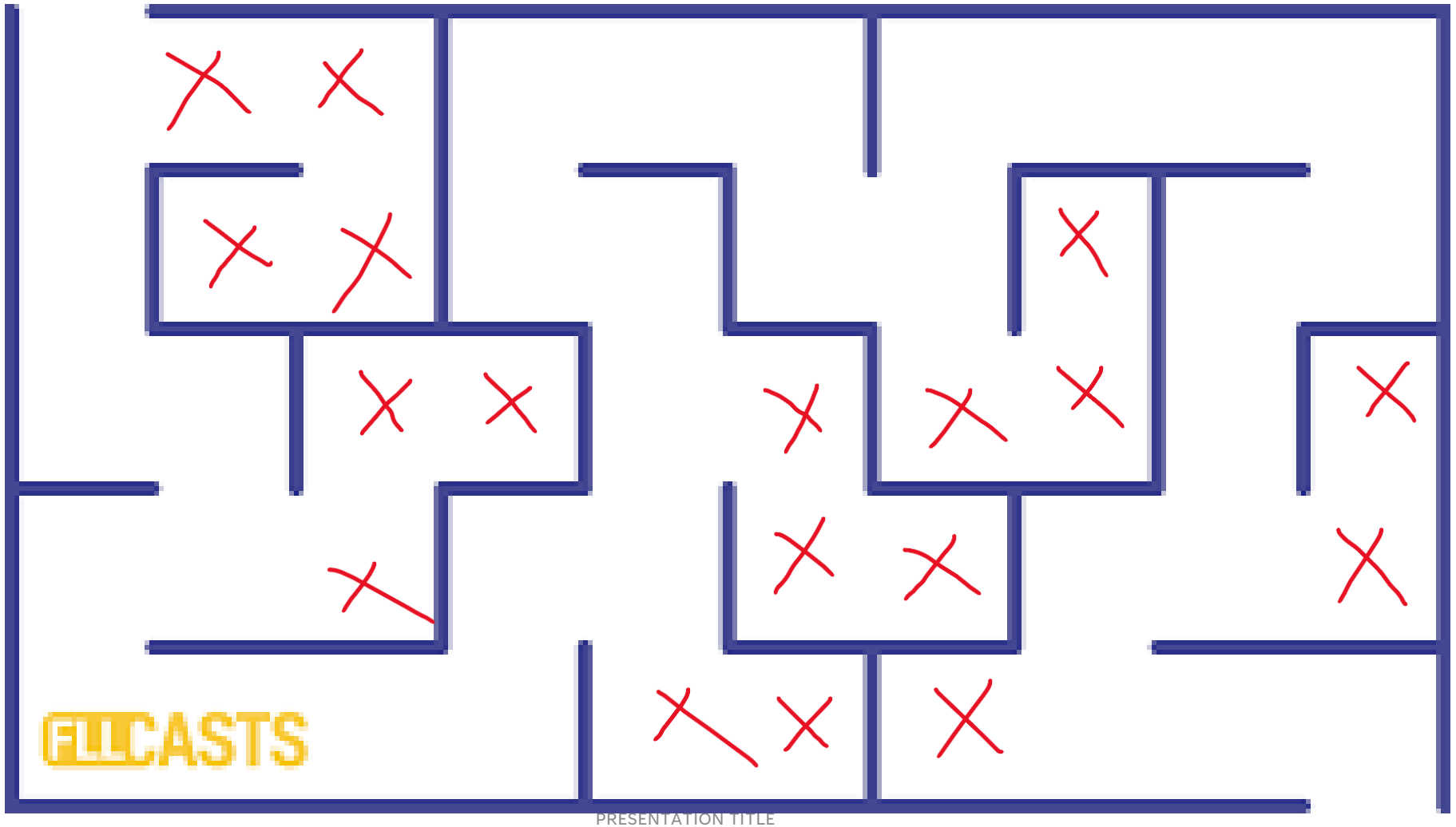


MAZE SOLVING

WALL FOLLOWER



DEAD END FILLING



Obstacle Avoidance Robot

Understanding Sound

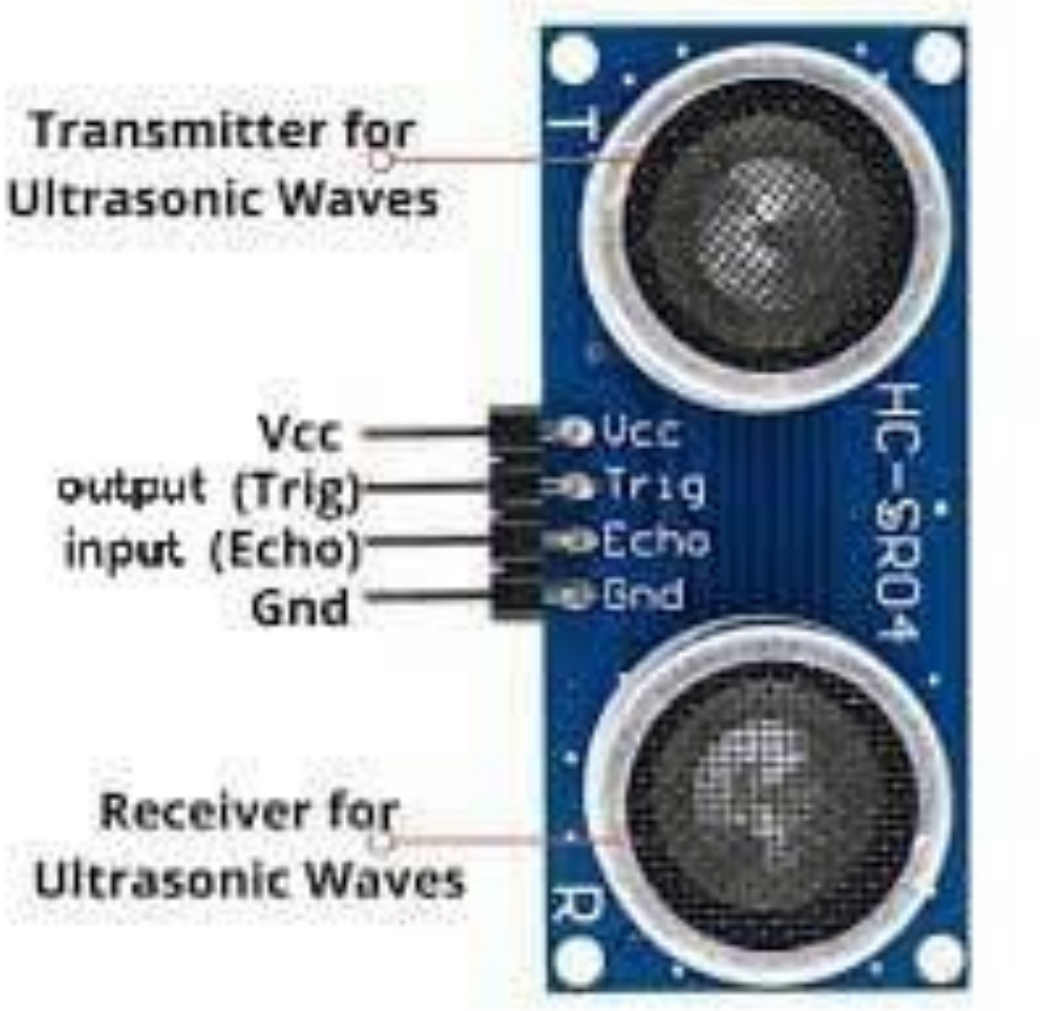
Understanding Sound

- Humans with normal hearing can hear sounds between 20 Hz and 20,000 Hz
- Frequencies above 20,000 Hz are known as ultrasound (Sonar), on the other hand are the very low -frequency sounds (below 20 Hz), known as infrasound.

- HC-SR04 is the model name/number of the sensor commonly used with Arduino

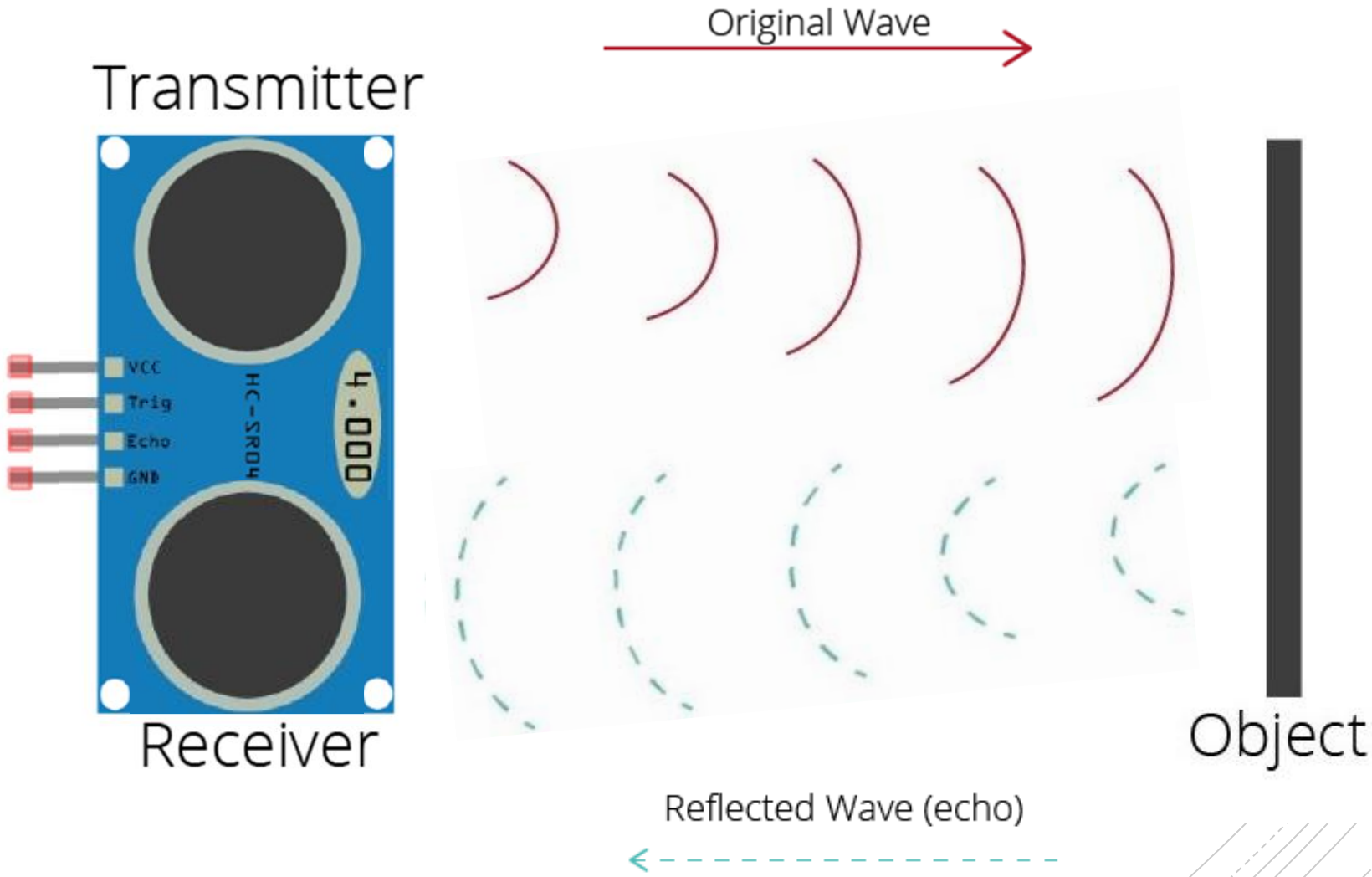
- Frequency: 40 kHz
- Working Voltage: 5V
- Working Current: 15mA
- Range: 2cm – 400 cm
- Number of Pins: 4

How Does It Work?



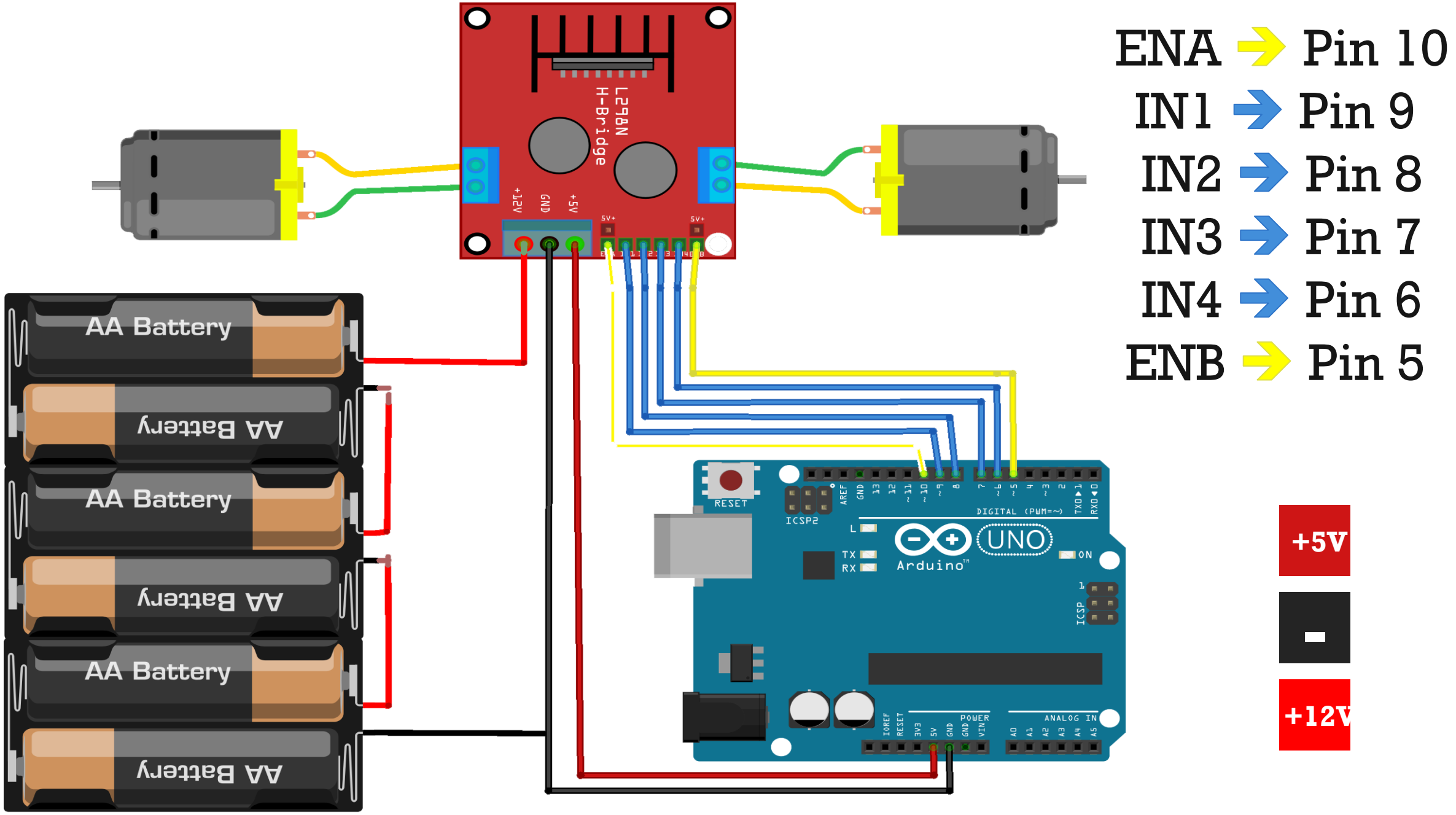
- One of the two piezoelectric transducers functions as an emitter for the sonar waves while the other receives them
- Of the four pins, 2 are responsible for the power; VCC and GND, while (trig) and (echo) are responsible for the transmitter and receiver signals respectively

from the microcontroller (Arduino) perspective



Applications:

1. Autonomous cleaners
2. Car parking
3. Search & rescue bots
4. Security systems
5. Industrial lines control


ENA → Pin 10
IN1 → Pin 9
IN2 → Pin 8
IN3 → Pin 7
IN4 → Pin 6
ENB → Pin 5
L298N H-Bridge
+12V
GND
+5V
AA Battery
AA Battery
AA Battery
AA Battery
AA Battery
RESET
ICSP2
UNO
Arduino
DIGITAL (PWM=~)
POWER
ANALOG IN
+5V
-
+12V

Thank You.

Robotics Club - Workshop 1