



NYU

**TANDON SCHOOL
OF ENGINEERING**



Promoting robotic design and entrepreneurship
experiences among students and teachers

Lesson 18: Robotics Challenge - Line Follower Robot

Innovative Technology Experiences for Students and Teachers (ITEST), Professional Development Program, July 2017-19

Mechatronics, Controls, and Robotics Laboratory, Department of Mechanical and Aerospace Engineering, NYU Tandon School of Engineering

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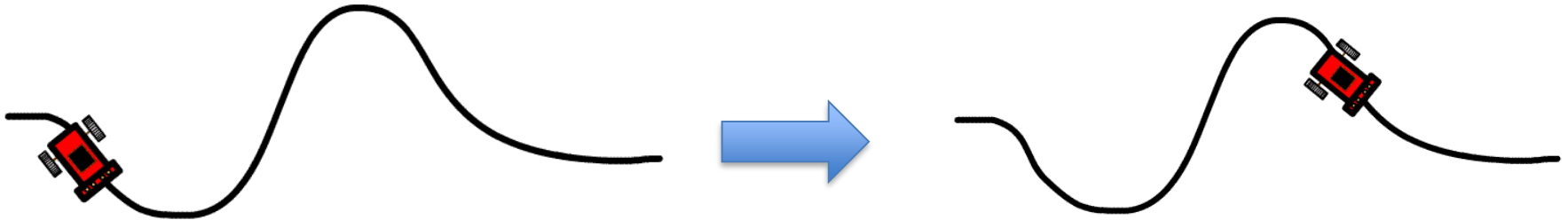


- Introduction to line follower robot
- IR sensor
- Building a line follower robot

- **TASK/ACTIVITY:** Programming a line follower robot

LINE FOLLOWER ROBOT

- A mobile robot that moves on a black line drawn on the floor
- It continuously corrects itself to stay on the track
- It is an autonomous robot

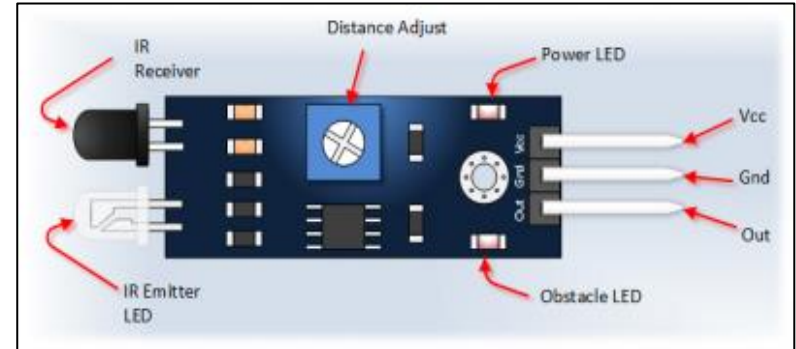


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IR SENSOR WORKING

- The device consists of an infrared transmitter, an infrared detector, and support circuitry
- It only requires three connections
- Photodiode receives the IR rays
- When it detects an obstacle within range it will send an output signal
- You can alter the distance by adjusting the potentiometer



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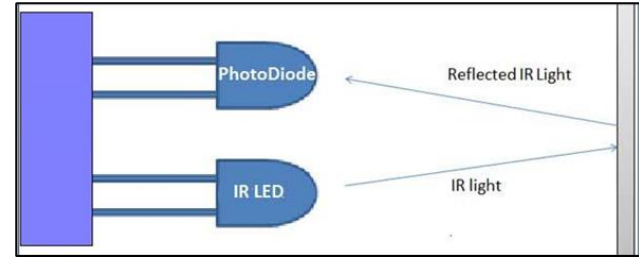
Transmitter

Receiver

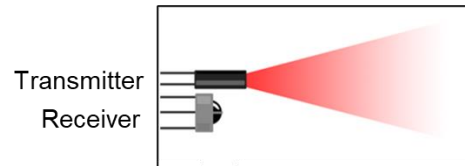
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IR SENSOR

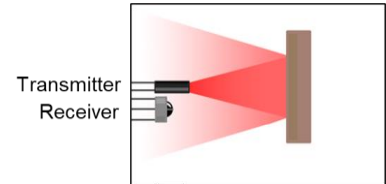
- Can be used to detect an obstacle
- IR rays reflected from the obstacle change voltage level across the IR receiver
- Long-range and short-range IR sensors are available
- Range starts from 3mm for small range sensors and is up to 50m for long-range sensors



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Absence of obstacle –
receiver does not get input

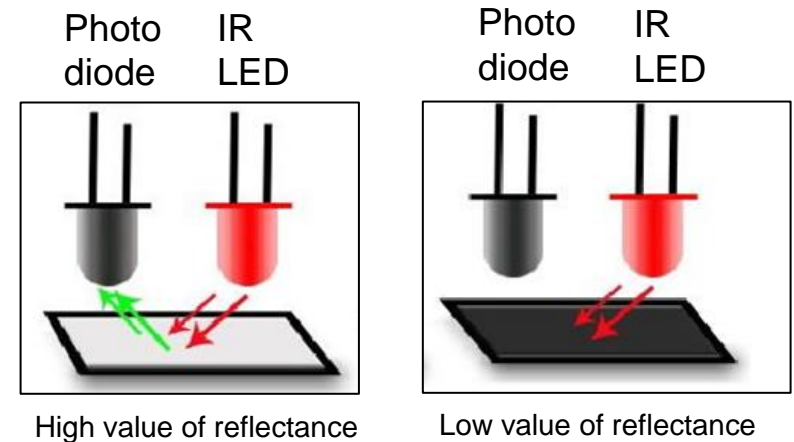
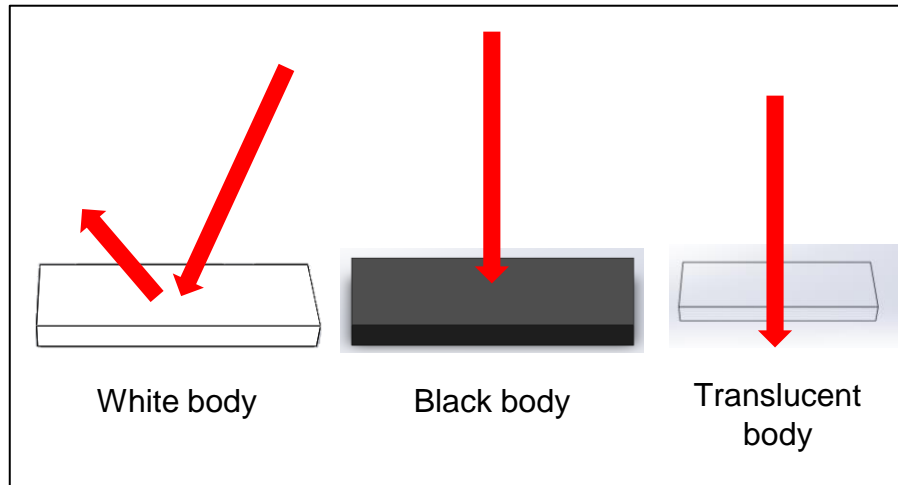


Presence of obstacle –
receiver gets input

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IR SENSOR

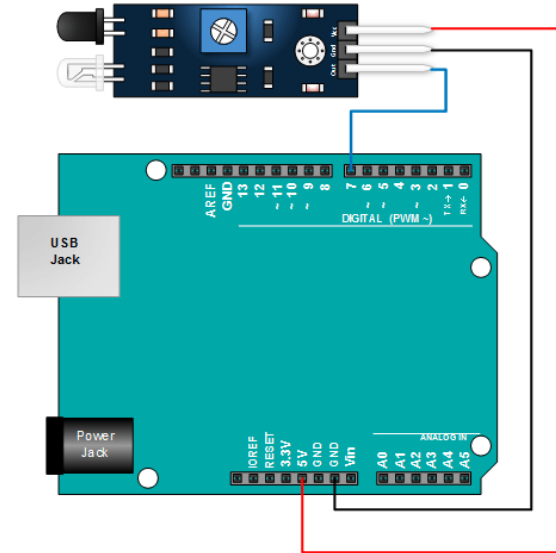
- Reflected wave in case of different types of material



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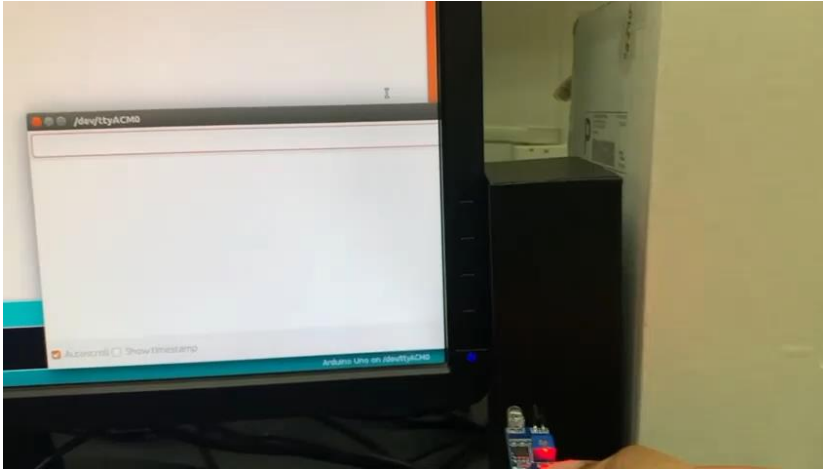
ACTIVITY-1

- Make a circuit with an IR sensor
- Program Arduino to check the result when you move the IR sensor in front of a white object and a black object
- What change can you see if you move the IR sensor away from the white object?



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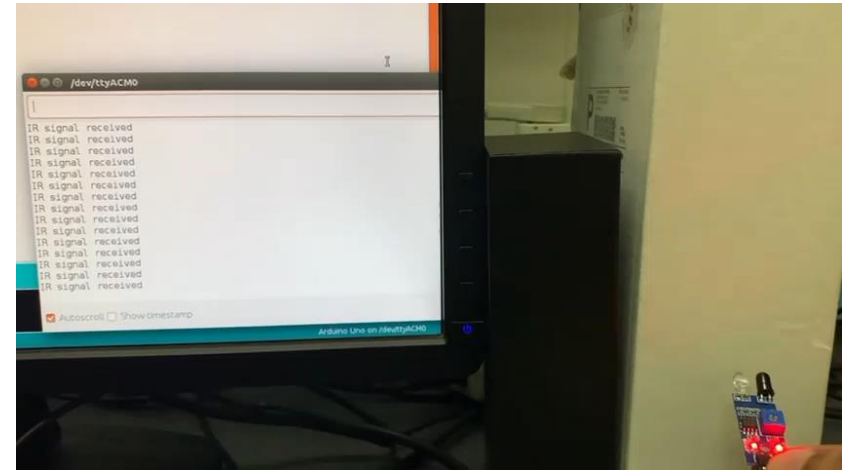
ACTIVITY-1 SOLUTION



IR response for a white and black object

[Video](#)

[Program](#)



IR response while moving away from the white object

[Video](#)

ACTIVITY - 2 SOLUTION

```
int LEDpin = 13;
int ObstaclePin = 2;
int Obstacle = HIGH;
//Initialise LED pin and Obstacle pin

void setup() {

    pinMode(LEDpin, OUTPUT); //setup LED as output
    pinMode(ObstaclePin, INPUT); //setup ObstaclePin as input
    Serial.begin(9600);
}

void loop() {
    Obstacle= digitalRead (ObstaclePin);
    if (Obstacle== LOW){
        Serial.println("OBSTACLE!!, OBSTACLE!!");
        digitalWrite(LEDpin, HIGH);
    }
    else{
        Serial.println("Clear");
        digitalWrite(LEDpin, LOW);
    }
    delay(200);
}
```

Program

BUILDING A LINE FOLLOWER ROBOT

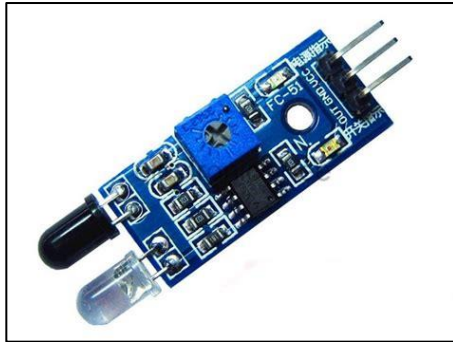
- Line follower robots can be built using one IR sensor (transmitter-receiver pair) or two or more IR sensors
- With one sensor the circuit is simple but controlling the robot is difficult
- With two or more IR sensors the circuit is complex, and coding is more involved but controlling the robot is easier

LINE FOLLOWER VIDEO

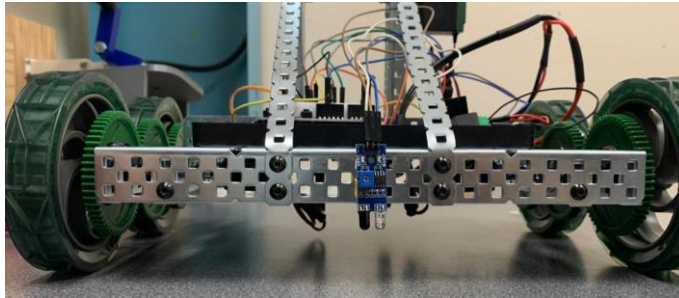


[Video](#)

LINE FOLLOWER ROBOT - 1 SENSOR

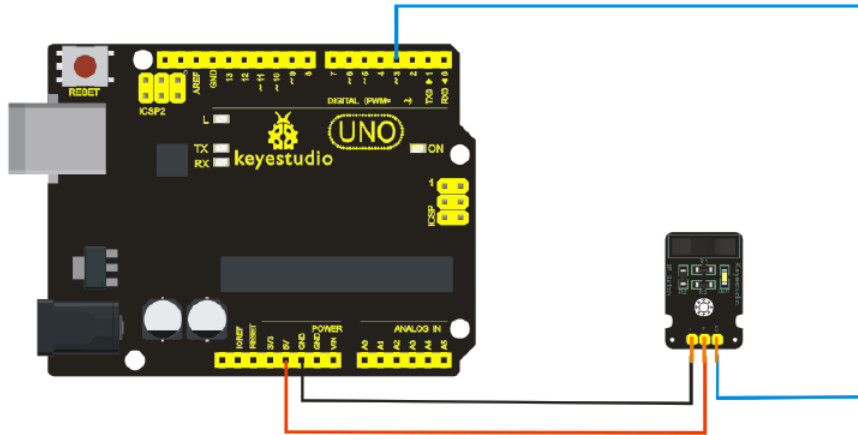


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- Fix the **obstacle detection sensor** upside-down position at the front of the robot as shown
- Connect the VCC pin to 5V, out pin to any digital pin, and GND pin to the ground of the Arduino

LINE FOLLOWER ROBOT - 1 SENSOR



```
/*Arduino Sample Code to read data from
sensor when signal pin is connected to 3*/
```

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

void loop()
{
  Serial.println(digitalRead(3));
  //print the data from the sensor
  delay(50);
}
```

[Program](#)

LINE FOLLOWER ROBOT - 1 SENSOR

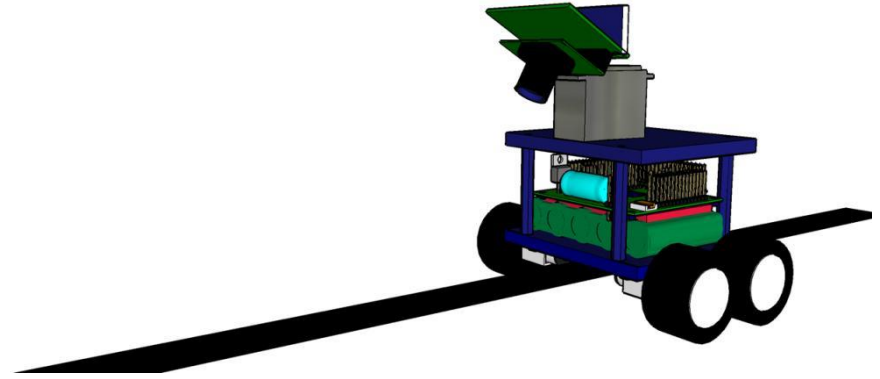
Algorithm

If voltage detected at signal pin (implies that robot is on a white surface)

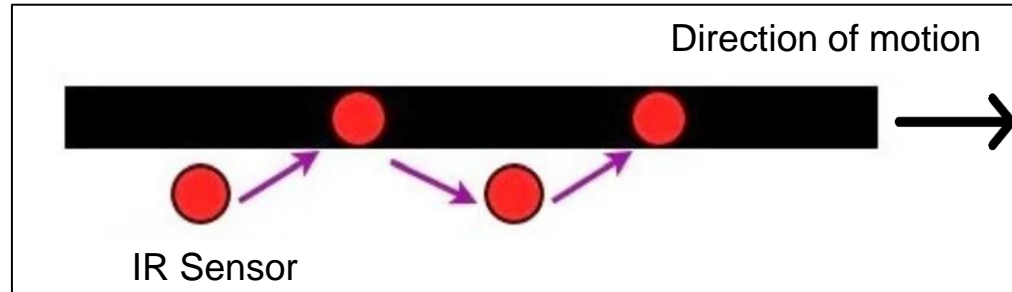
Turn left
Delay x s

If voltage is not detected at the signal pin (implies that the robot is on the black line)

Turn right
Delay 2x s

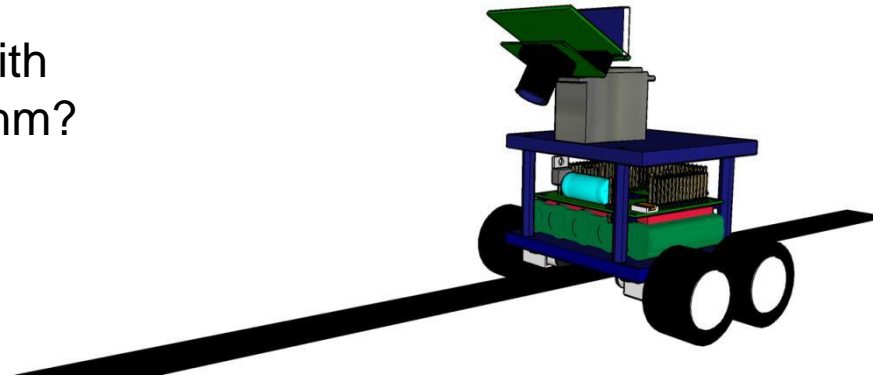


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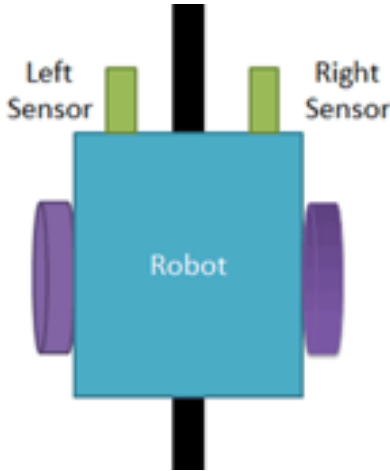
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Can you make your robot follow the line with one IR sensor based on the above algorithm?



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LINE FOLLOWER ROBOT - 2 SENSORS



The left sensor can be a line tracking sensor and the right sensor can be a digital IR transmitter and digital IR receiver



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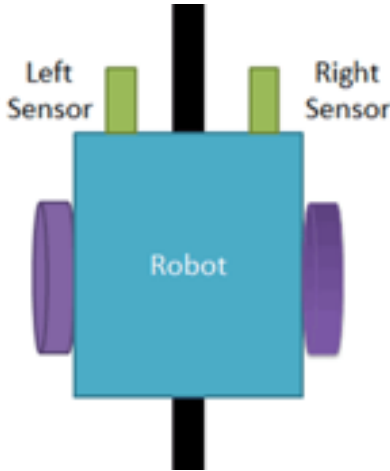
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LINE FOLLOWER ROBOT - 2 SENSORS



The left sensor can be a line tracking sensor and the right sensor can be an infrared obstacle avoidance sensor



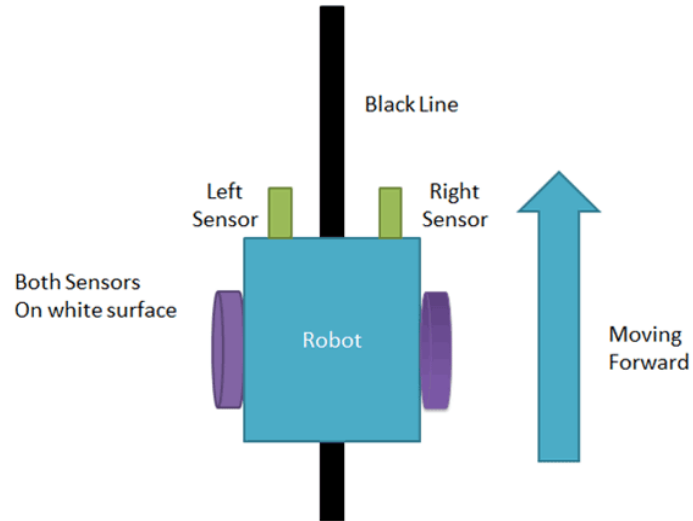
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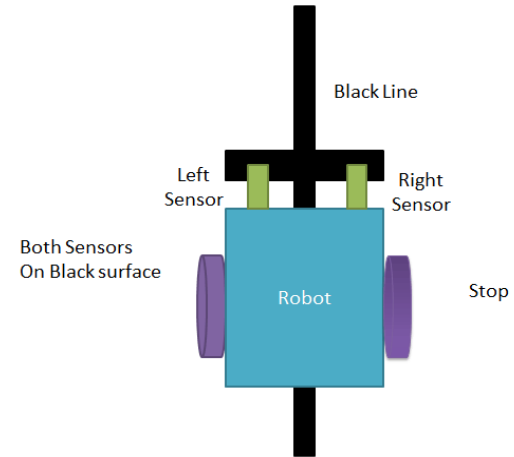
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Algorithm development

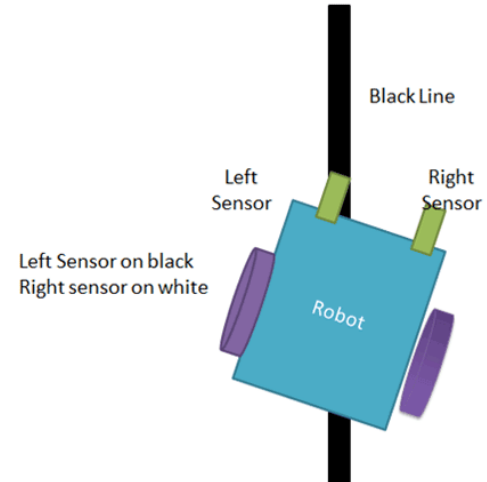
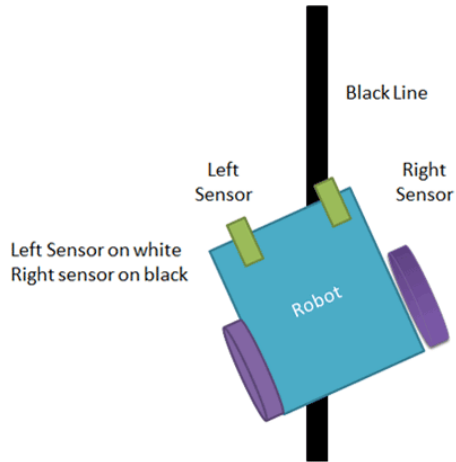


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Algorithm development

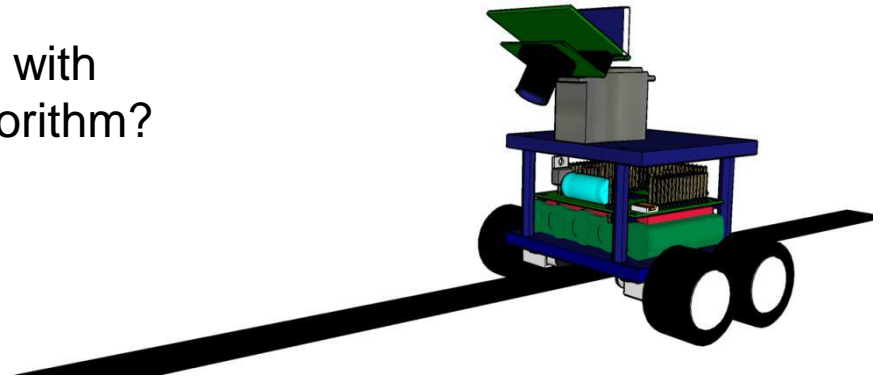


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ACTIVITY - 4

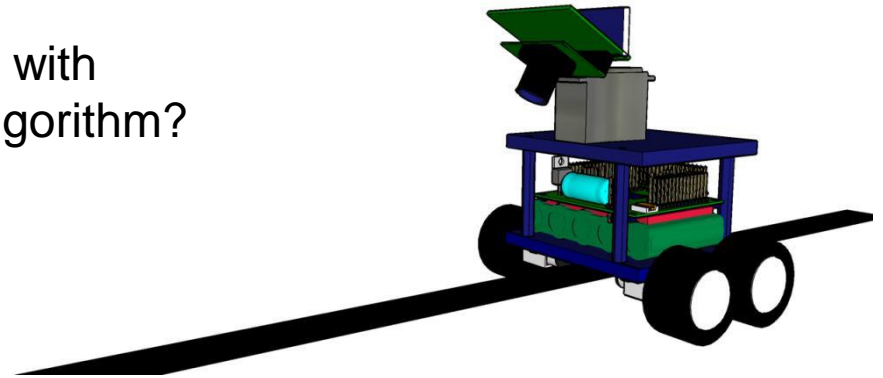
Can you make your robot follow the line with **two** IR sensors based on the above algorithm?



[Source](#)

ACTIVITY - 5

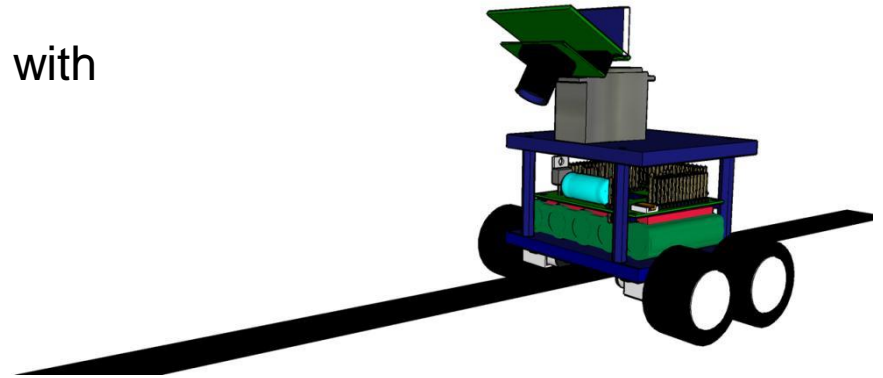
Can you make your robot follow the line with **three** IR sensors based on the above algorithm?



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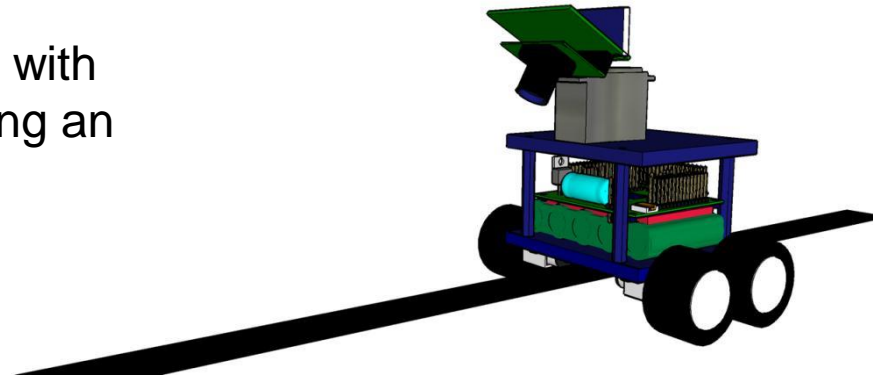
ACTIVITY - 6

Can you make your robot follow the line with **three IR sensors in a square**?



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Can you make your robot follow the line with **three** IR sensors in a **square** with 1 being an **obstacle avoidance sensor**?



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Thank You!

Questions and Feedback?

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