LECTURE 8
Gas Sensor and Application

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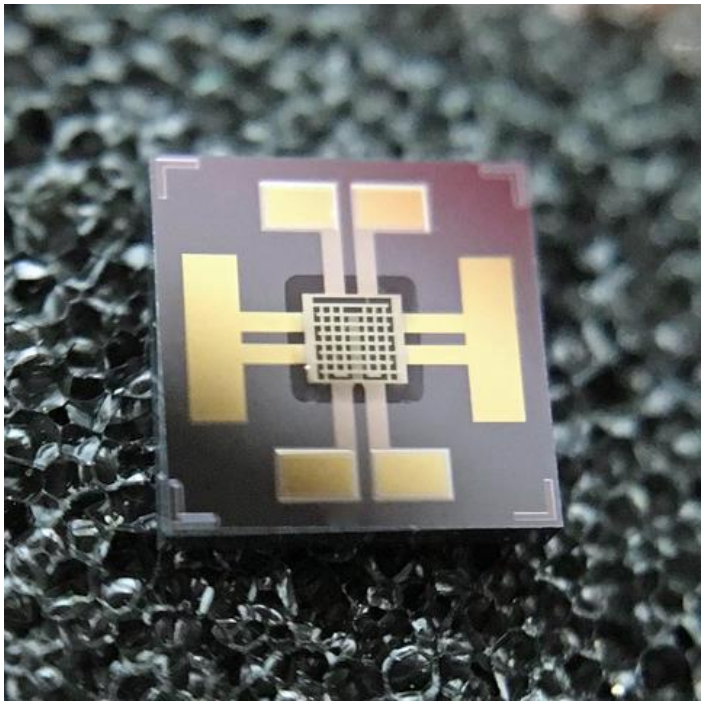
Syllabus:

Week	Date& Time*	Content
1		No Class (Course Add/Drop Period)
2	March 6 (Mon) 20-22	Orientation and Course Overview
3	March 13 (Mon) 20-22	Sensor Fundamentals
4	March 20 (Mon) 20-22	Arduino Fundamentals
5	March 27 (Mon) 20-22	Arduino Programming and Applications
6	April 3 (Mon) 20-22	Force Sensor and Application: Control Multiple LEDs
7	April 10 (Mon) 20-22	Light Sensor and Application: Solar Tracker
8	April 17	No Class (Midterm)
9	April 24 (Mon) 20-22	Humidity and Temperature Sensor and Application: Temperature Controlled Fan
10	May 1 (Mon) 20-22	Gas Sensor and Application: Smoke Detector
11	May 8 (Mon) 20-22	Sound Sensor and Application: Control LED by Clapping
12	May 15 (Mon) 20-22	Accelerometer Sensor and Application: Ping Pong Game
13	May 22 (Mon) 20-22	Ultrasonic Sensor and Application: Flappy Bird Game
14	May 29 (Mon) 20-22	Course Wrap-up
15	June 5	No Class (Final)
16	June 12	No Class (Final)

Gas sensor

MQ-2



MEMS MOS Gas Sensing Chip
with integrated electrodes

- A Typical human nose has 400 types of scent receptors enabling us to smell about 1 trillion different odors. But still many of us do not have the capacity to identify the type or concentration of gas present in our atmosphere.

- A **gas sensor** is a device which detects the presence or concentration of gases in the atmosphere.

- Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

- The type of gas the sensor could detect depends on the **sensing material** present inside the sensor.

Gas sensors are typically classified into various types based on the type of the sensing element it is built with. Below is the classification of the various types of gas sensors based on the sensing element that are generally used in various applications:

- Metal Oxide based gas sensor
- Optical gas sensor
- Electrochemical gas sensor
- Capacitance-based gas sensor
- Calorimetric gas sensor
- Acoustic based gas sensor

Sensor Name	Gas to measure
MQ-2	Methane, Butane, LPG, Smoke
MQ-3	Alcohol, Ethanol, Smoke
MQ-4	Methane, CNG Gas
MQ-5	Natural gas, LPG
MQ-6	LPG, butane
MQ-7	Carbon Monoxide
MQ-8	Hydrogen Gas
MQ-9	Carbon Monoxide, flammable gasses
MQ131	Ozone

MQ2 gas sensor

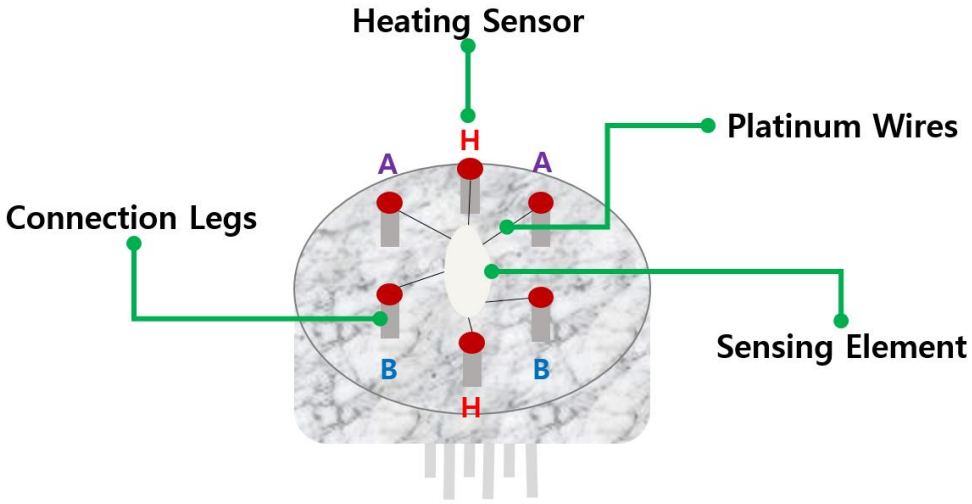
- MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.

- MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

- MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

MQ2 gas sensor working principle

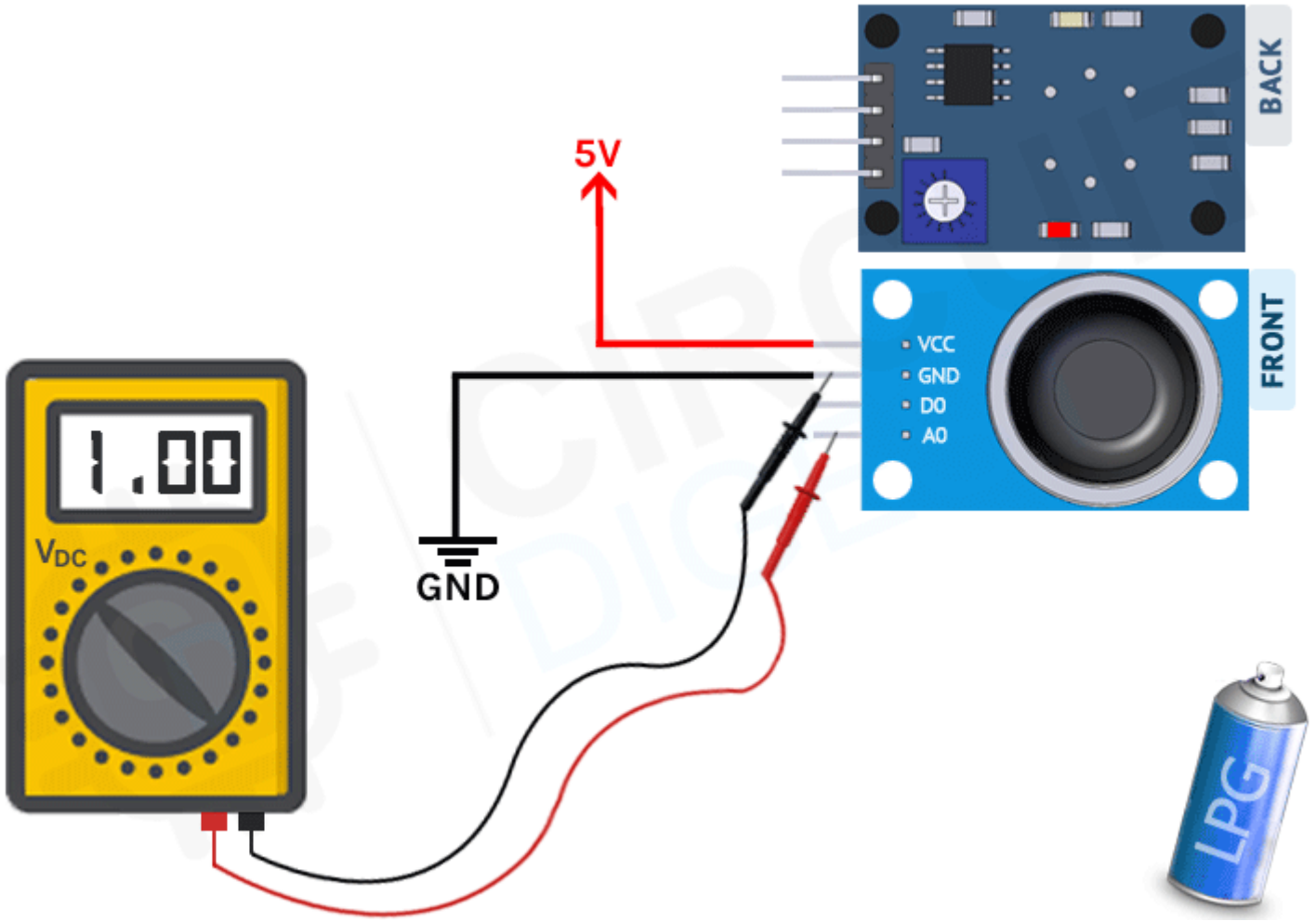
- This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals.



- Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow.

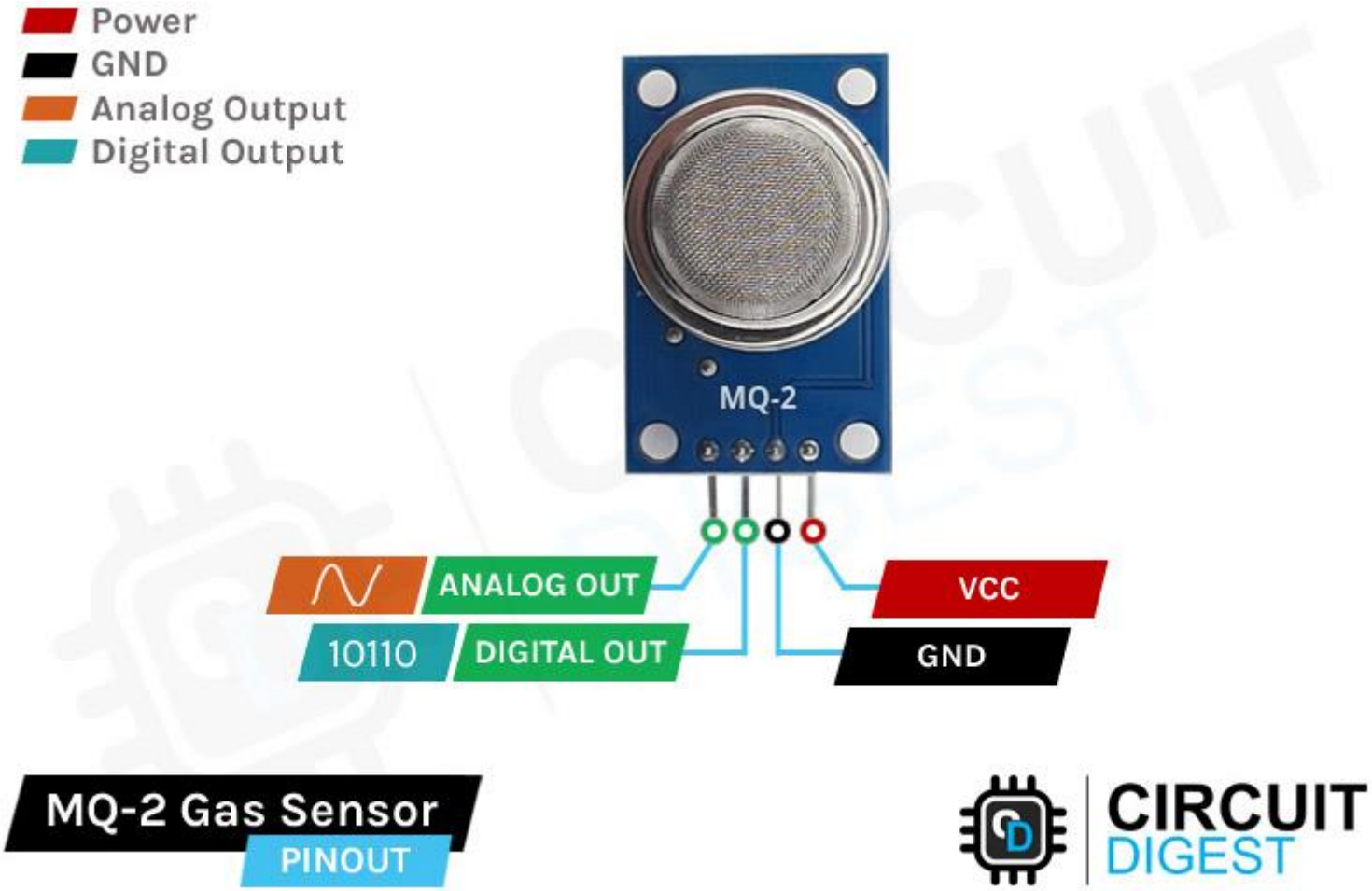
- When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.

- These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.


BACK
5V
FRONT
VCC
GND
DO
AO
1.00
VDC
GND
LPG

How do MOS type gas sensors detect gas?

https://www.youtube.com/watch?v=hX5kLqPe8nc

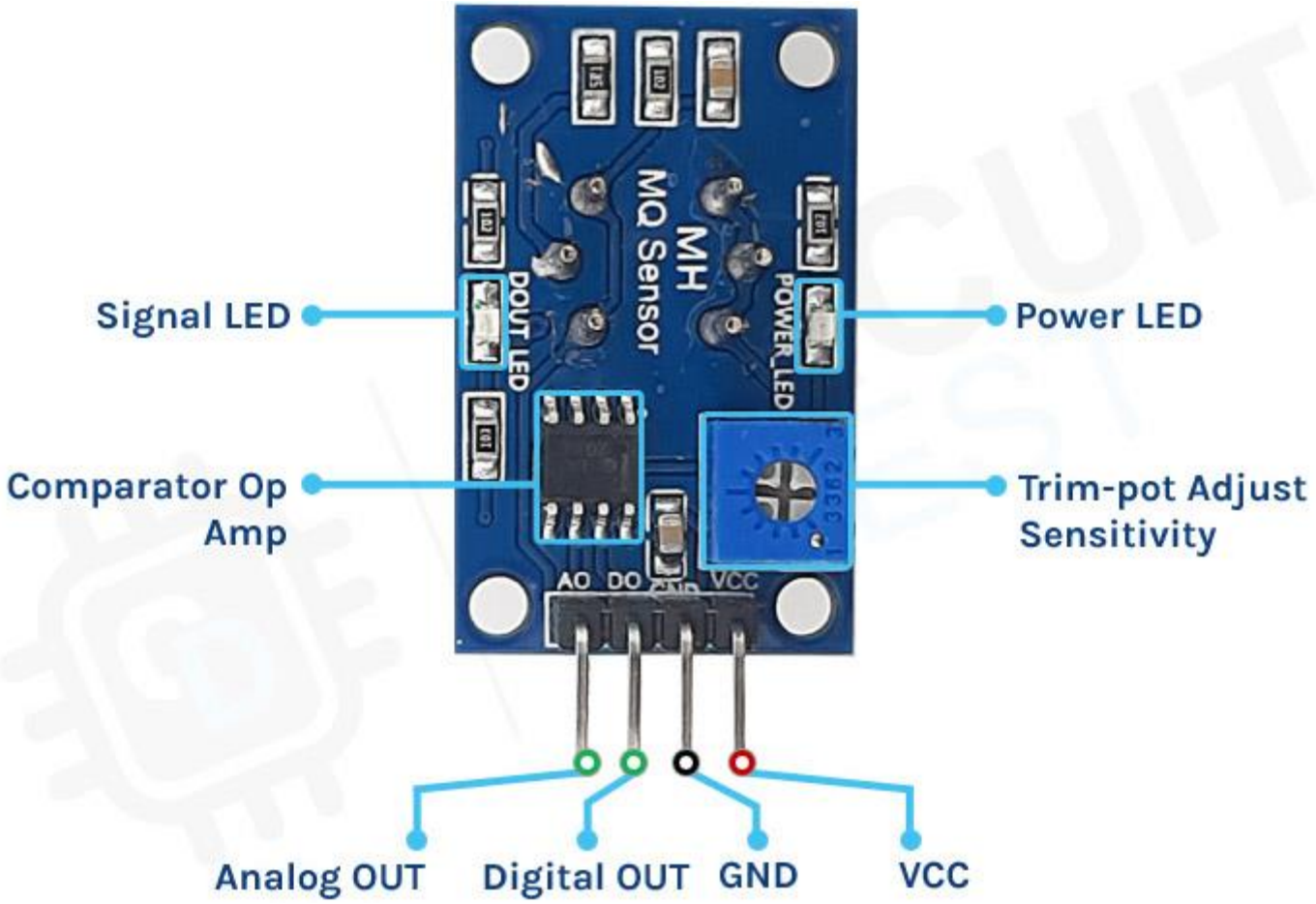

Power
GND
Analog Output
Digital Output
MQ-2
ANALOG OUT
10110
DIGITAL OUT
VCC
GND
MQ-2 Gas Sensor
PINOUT
CIRCUIT
DIGEST

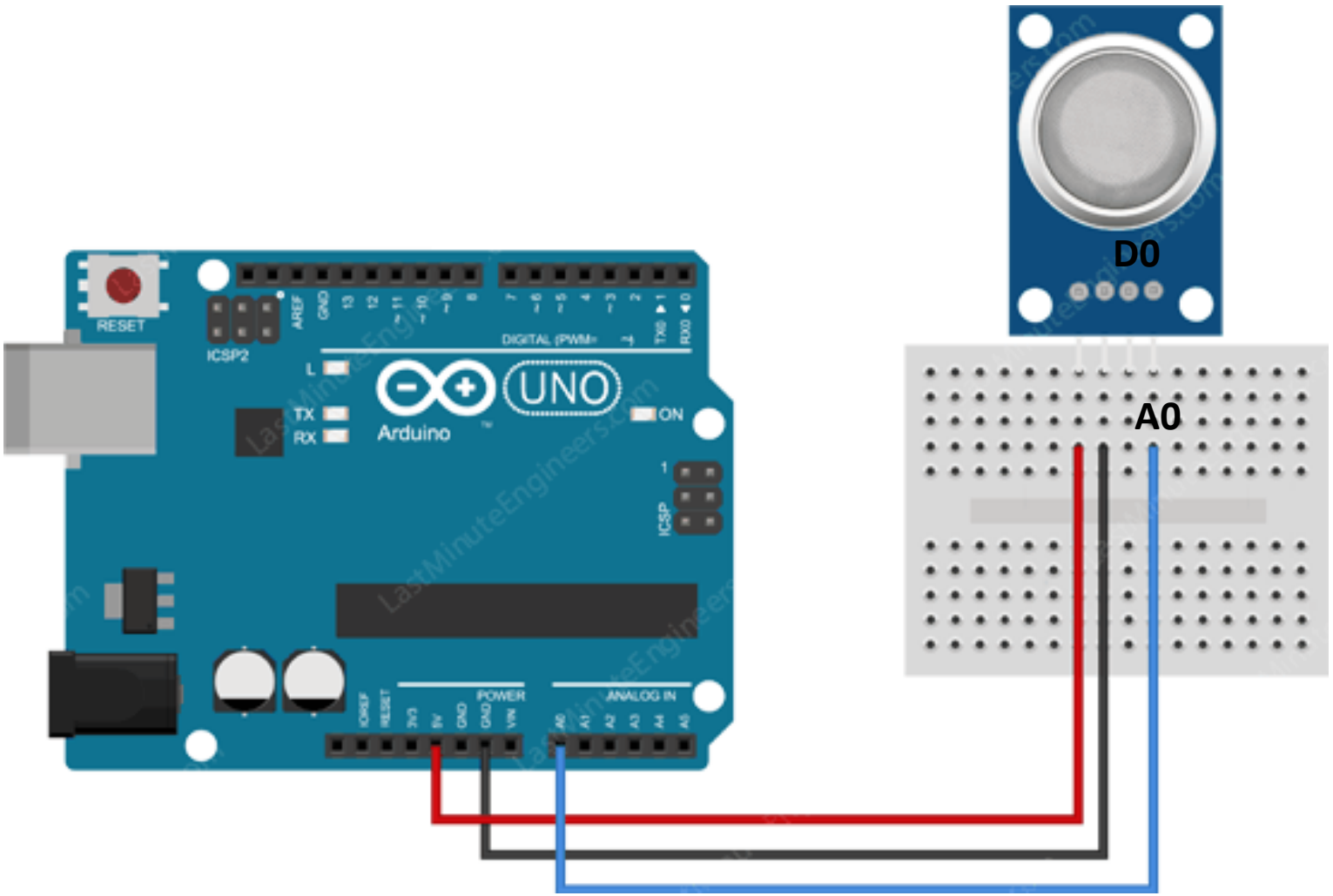
GND is the ground pin.

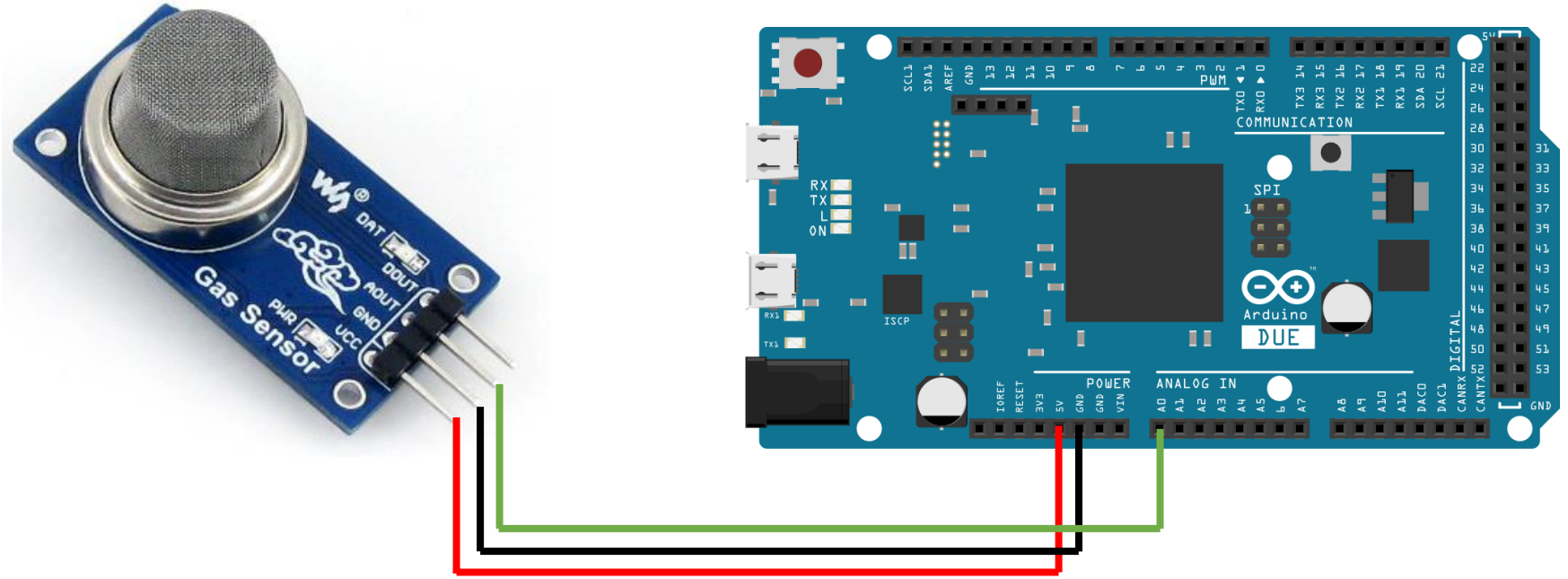
D0 indicates the presence of combustible gasses. D0 becomes LOW when the gas concentration exceeds the threshold value (as set by the potentiometer), and HIGH otherwise.

A0 produces an analog output voltage proportional to gas concentration, so a higher concentration results in a higher voltage and a lower concentration results in a lower voltage.

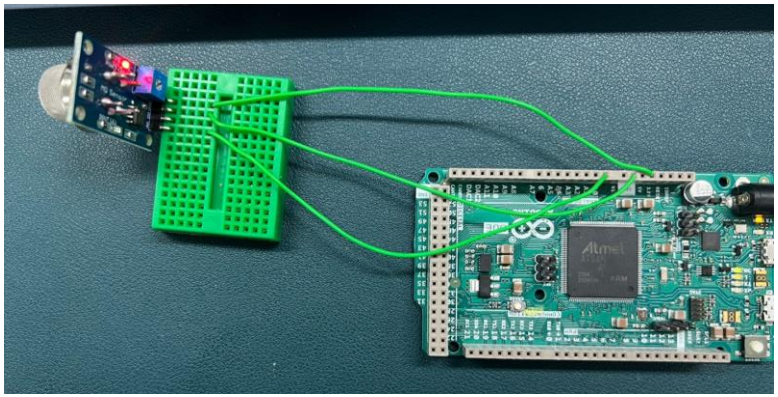
VCC supplies power to the module. Connect it to the 5V output of your Arduino.


Signal LED
Power LED
Comparator Op Amp
Trim-pot Adjust Sensitivity
Analog OUT
Digital OUT
GND
VCC
MH
MQ Sensor
DOUT LED
POWER_LED
AO
DO
GND
VCC

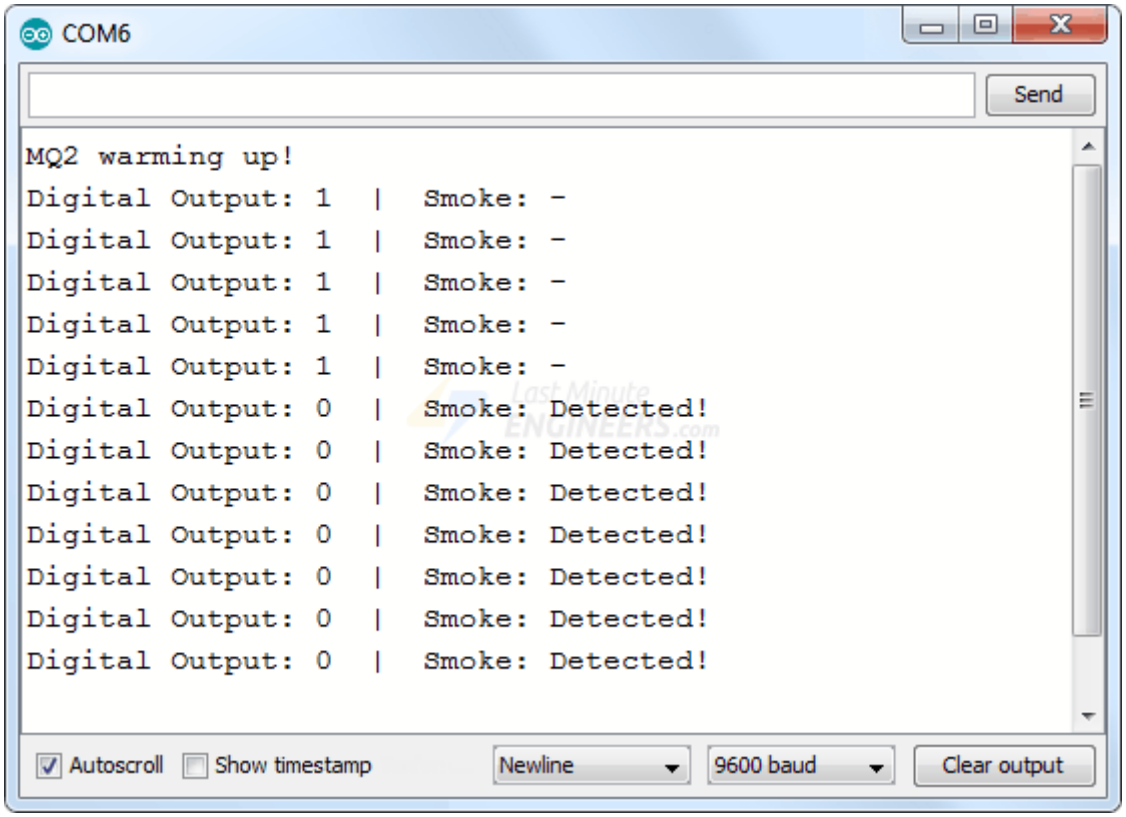

D0
A0
RESET
ICSP2
UNO
Arduino
TX
RX
ON
POWER
ANALOG IN

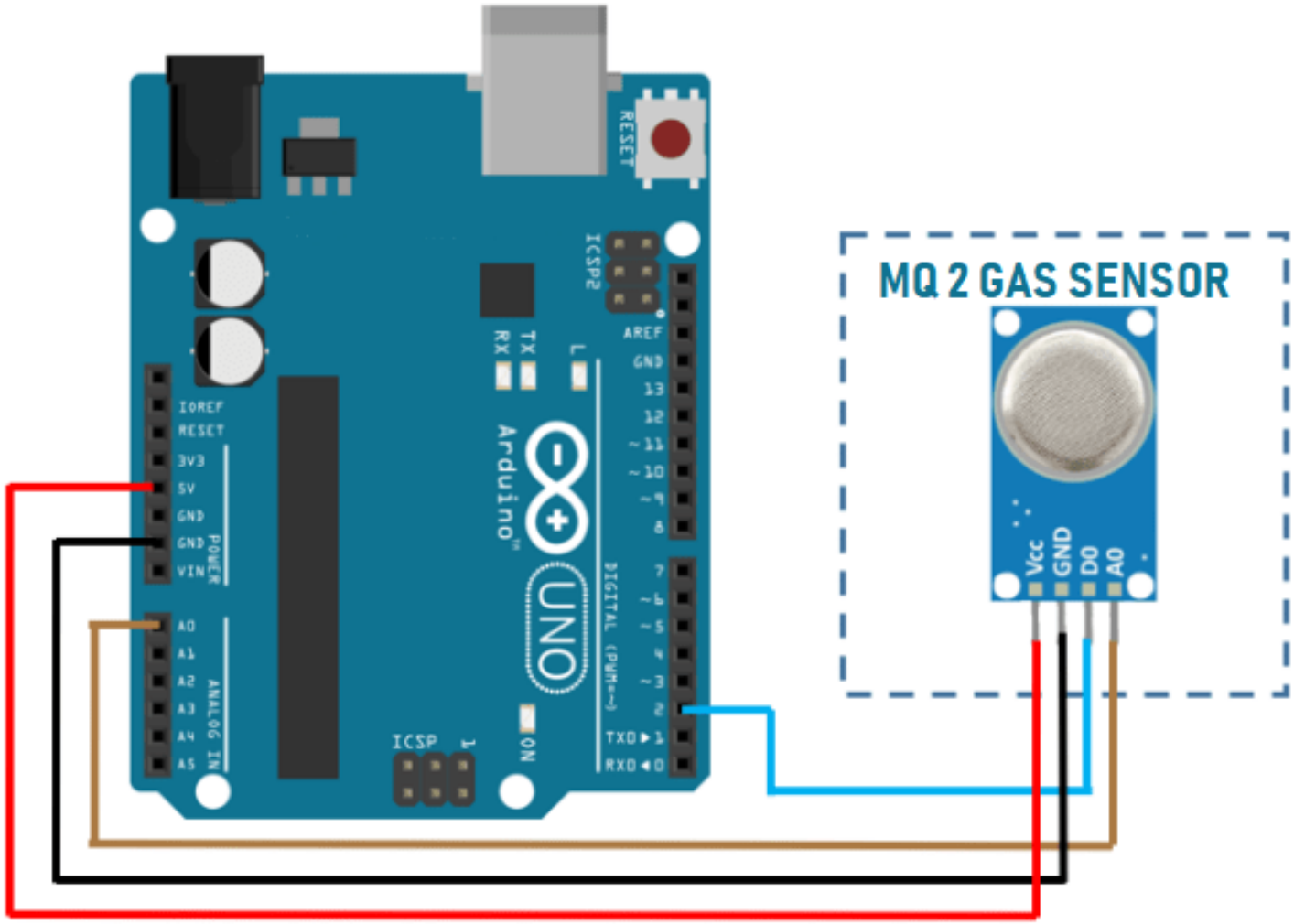

Gas Sensor
DAT
DOUT
AOUT
GND
VCC
PWR
Arduino
DUE
PWM
COMMUNICATION
SPI
POWER
ANALOG IN
DIGITAL
RX
TX
L
ON
ISCP

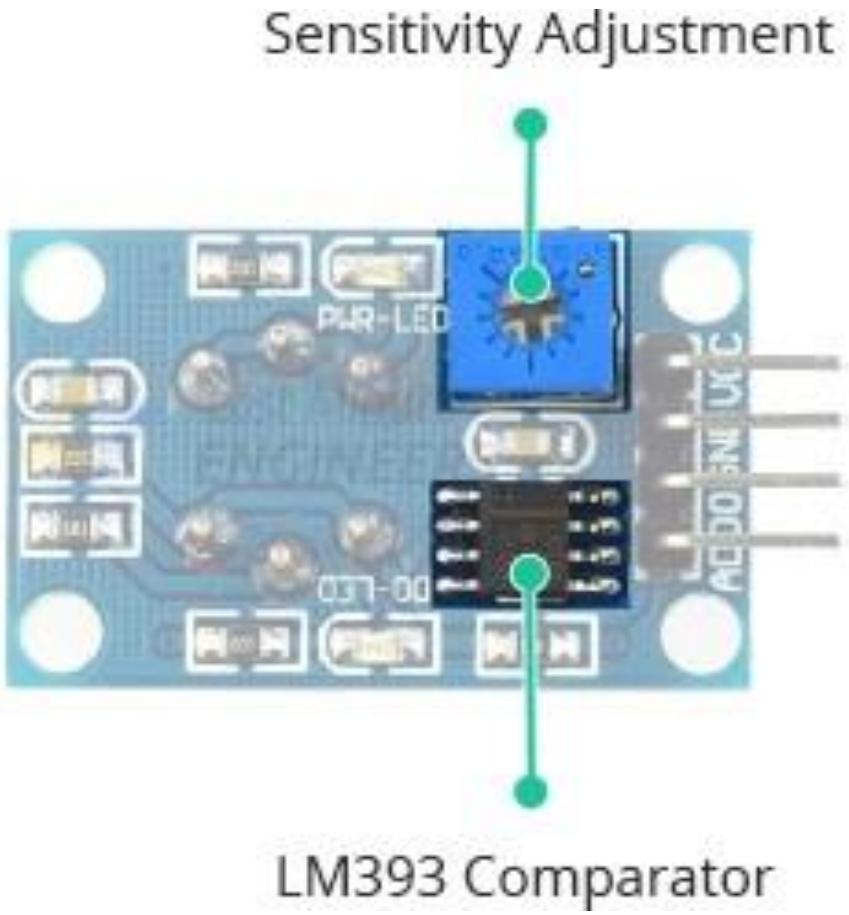
```
#define MQ2pin 0

float sensorValue;  //variable to store sensor value

void setup() {
        Serial.begin(9600); // sets the serial port to 9600
        Serial.println("MQ2 warming up!");
        delay(20000); // allow the MQ2 to warm up
}

void loop() {
        sensorValue = analogRead(MQ2pin); // read analog input pin 0

        Serial.print("Sensor Value: ");
        Serial.println(sensorValue);

        delay(2000); // wait 2s for next reading
}
```



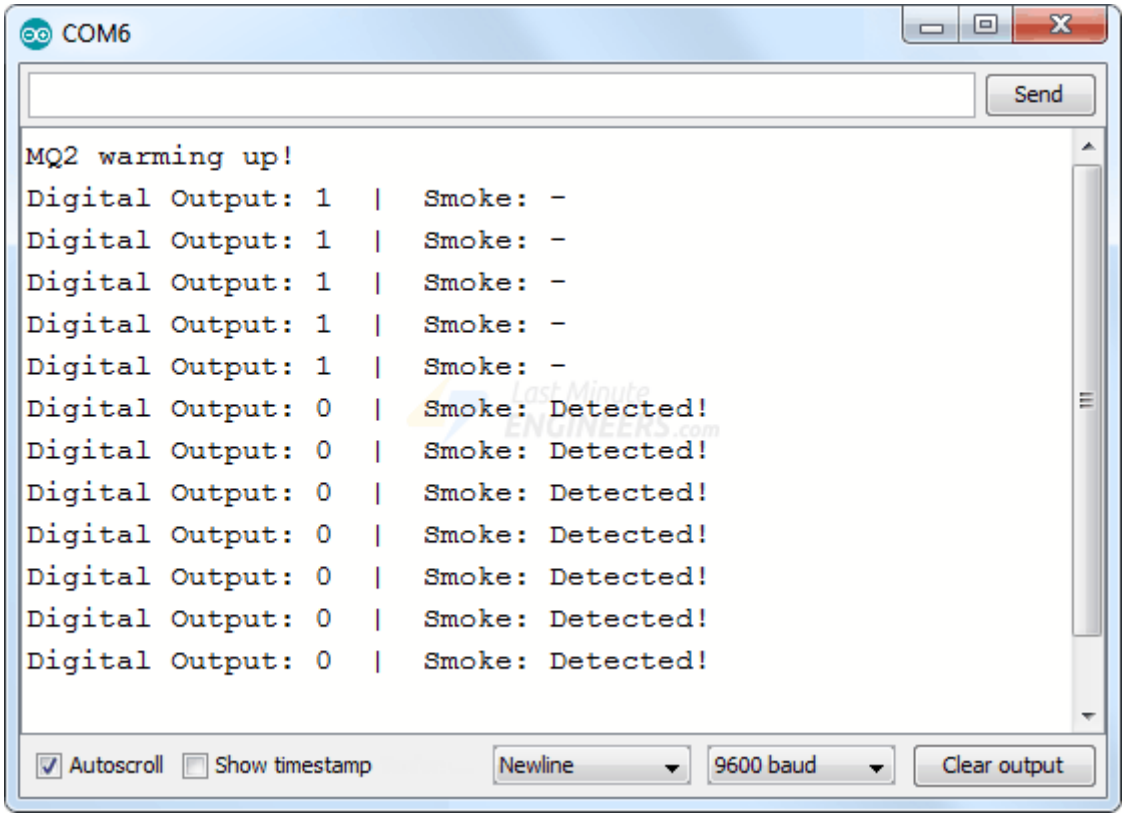
```
/* Change the threshold value with your own reading */
#define Threshold 400

#define MQ2pin 0

float sensorValue;  //variable to store sensor value

void setup() {
        Serial.begin(9600); // sets the serial port to 9600
        Serial.println("MQ2 warming up!");
        delay(20000); // allow the MQ2 to warm up
}

void loop() {
  sensorValue = analogRead(MQ2pin); // read analog input pin 0

  Serial.print("Sensor Value: ");
  Serial.print(sensorValue);

  if(sensorValue > Threshold)
  {
    Serial.print(" | Smoke detected!");
  }

  Serial.println("");
  delay(2000); // wait 2s for next reading
}
```

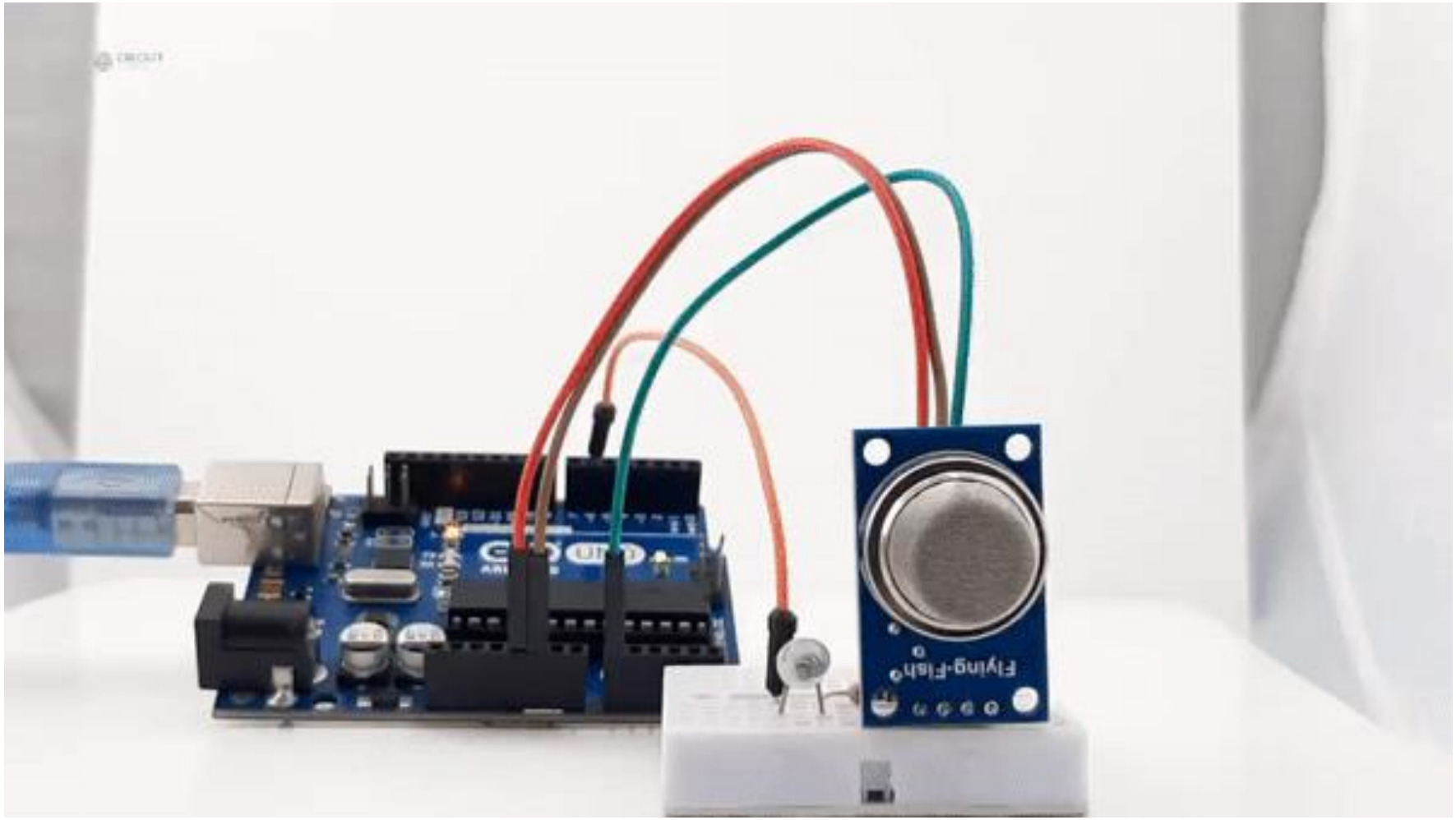

COM6
Send
MQ2 warming up!
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Autoscroll
Show timestamp
Newline
9600 baud
Clear output

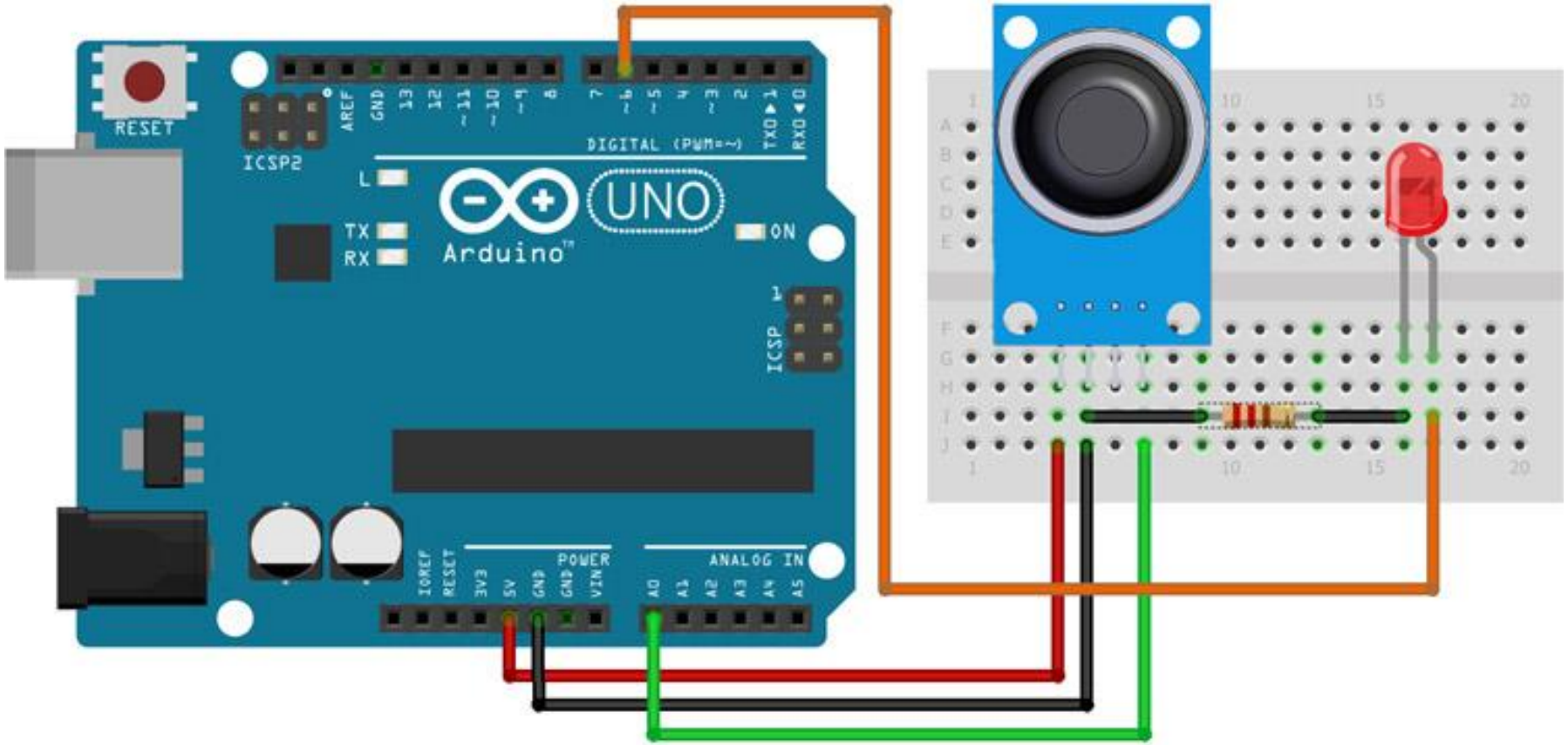

MQ 2 GAS SENSOR
Vcc
GND
D0
A0
RESET
ICSP2
AREF
GND
13
12
11
10
9
8
7
6
5
4
3
2
TX
RX
L
Arduino
UNO
DIGITAL (PWM~)
TXD ▶ 1
RXD ◀ 0
ON
ICSP
1
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN


Sensitivity Adjustment
PWR-LED
LM393 Comparator

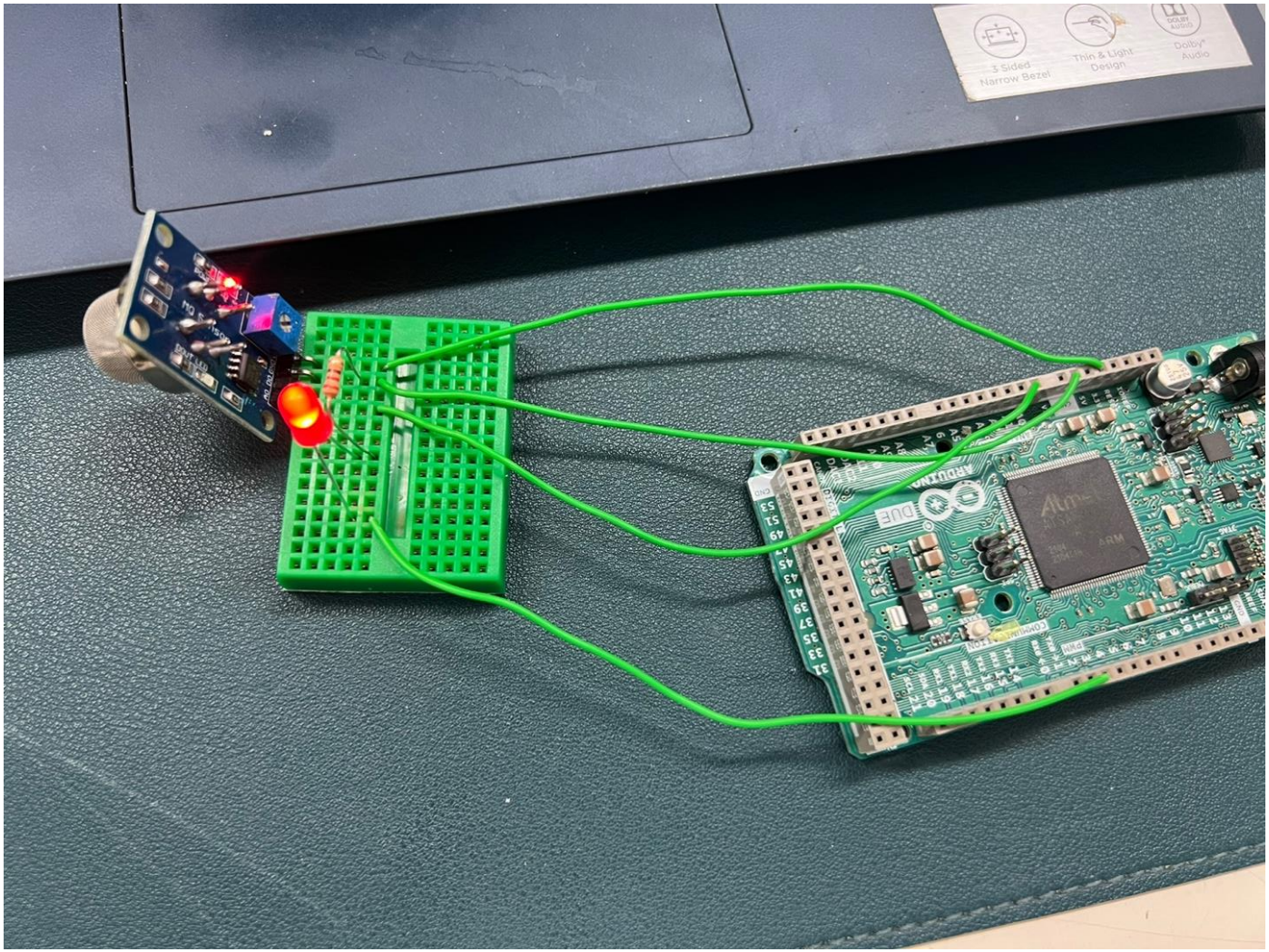
```
#define MQ2pin 8

int sensorValue;  //variable to store sensor value

void setup() {
        Serial.begin(9600); // sets the serial port to 9600
        Serial.println("MQ2 warming up!");
        delay(20000); // allow the MQ2 to warm up
}

void loop() {
        sensorValue = digitalRead(MQ2pin); // read digital output pin
        Serial.print("Digital Output: ");
        Serial.print(sensorValue);

        // Determine the status
        if (sensorValue) {
                Serial.println("   |  Smoke: -");
        } else {
                Serial.println("   |  Smoke: Detected!");
        }

        delay(2000); // wait 2s for next reading
}
```


COM6
Send
MQ2 warming up!
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 1 | Smoke: -
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Digital Output: 0 | Smoke: Detected!
Autoscroll
Show timestamp
Newline
9600 baud
Clear output


Flying-Fish


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
6
5
4
3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
UNO
Arduino™
ON
ICSP
POWER
IOREF
RESET
3V3
5V
GND
GND
VIN
ANALOG IN
A0
A1
A2
A3
A4
A5

```
// Sensor pins pin D6 LED output, pin A0 analog Input
#define ledPin 6
#define sensorPin A0
void setup() {
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  digitalWrite(ledPin, LOW);

}


void loop() {
  Serial.print("Analog output: ");
  Serial.println(readSensor());
  delay(500);

}


//  This function returns the analog data to calling function

int readSensor() {
  unsigned int sensorValue = analogRead(sensorPin);  // Read the analog value from sensor
  unsigned int outputValue = map(sensorValue, 0, 1023, 0, 255); // map the 10-bit data to 8-bit data

  if (outputValue > 65)
    analogWrite(ledPin, outputValue); // generate PWM signal
  else
    digitalWrite(ledPin, LOW);
  return outputValue;           // Return analog moisture value

}
```


3 Sided
Narrow Bezel
Thin & Light
Design
Dolby
Audio
DUE