



Facultatea de Electronică,  
Telecomunicații și  
Tehnologia Informației

# **Electronics and Telecommunications Measurements Project**

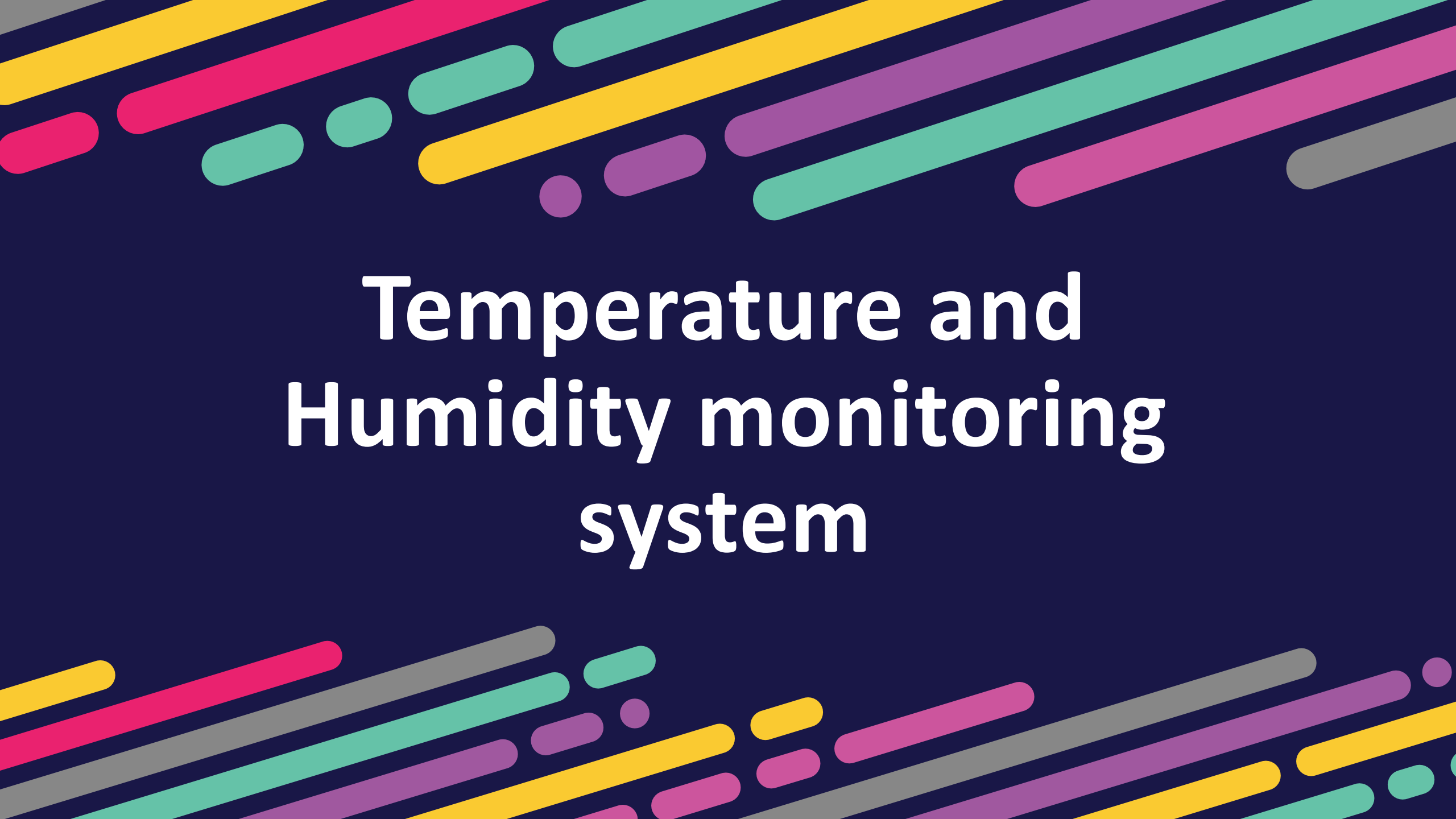
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Conf. dr. ing. R Holonec**

**Students: Onuț Elena-Sabina  
& Cozma Cosmin**

**Group: 2023**



**TECHNICAL UNIVERSITY**  
OF CLUJ-NAPOCA  
ROMANIA



# Temperature and Humidity monitoring system

# TABLE OF CONTENTS

## 1. THEORETICAL PART

1.1 Arduino

1.2 Our circuit

1.3 What is relative humidity?

1.4 How the DHT11 measures humidity and temperature?

1.5 DHT11 sensor

## 2. CIRCUIT DIAGRAM

## 3. CODE FROM ARDUINO

## 4. COMPONENTS REQUIRED

## 5. ELECTRICAL CIRCUIT

5.1 DHT11 sensor

## 6. HOW IT WORKS?

## 7. USE OF TEMPERATUE AND HUMIDITY SENSOR

## 8. REFERENCE LIST

# 1. THEORETICAL PART

## 1.1 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. [1]

## 1.2 Our circuit

Our circuit automates the control of temperature and humidity in rooms. The temperature and humidity of the air are read by a temperature and humidity sensor named DHT11 which has an operating voltage between 3.5V and 5.5V, a temperature range of 0°C to 50°C and humidity range of 20% to 90% with an accuracy of  $\pm 1^\circ\text{C}$  and  $\pm 1\%$ . [2]

# 1. THEORETICAL PART

## 1.3 What is relative humidity?

The DHT11 measures relative humidity. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air.

The saturation point changes with air temperature.

The formula to calculate relative humidity is:

$$RH = \frac{\rho_w}{\rho_s} * 100\%$$

RH – Relative Humidity

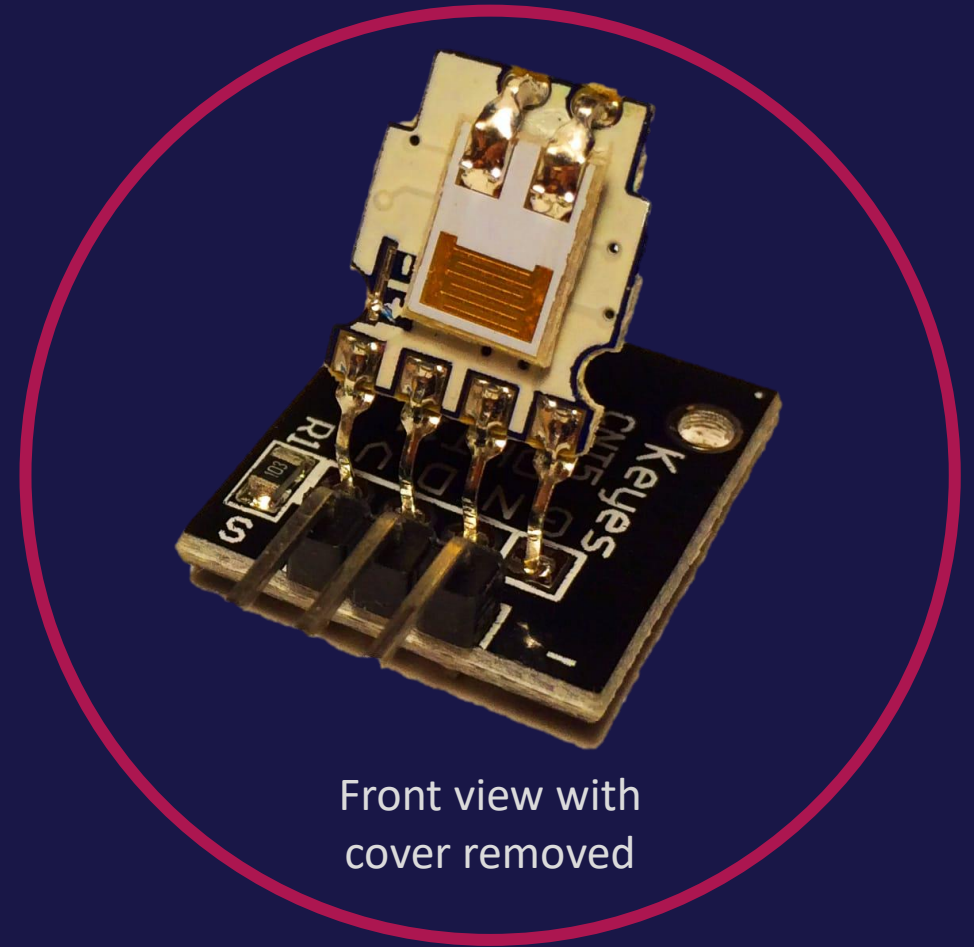
$\rho_w$  – Density of water vapor

$\rho_s$  – Density of water vapor at saturation

# 1. THEORETICAL PART

## 1.4 How the DHT11 measures humidity and temperature?

- The DHT11 detects water vapor by measuring the electrical resistance between two electrodes;
- When water vapor is absorbed by the substrate, ions are released by the substrate which increases the conductivity between the electrodes;
- The change in resistance between the two electrodes is proportional to the relative humidity;
- The DHT11 measures temperature with a surface mounted NTC temperature sensor (thermistor) built into the unit.

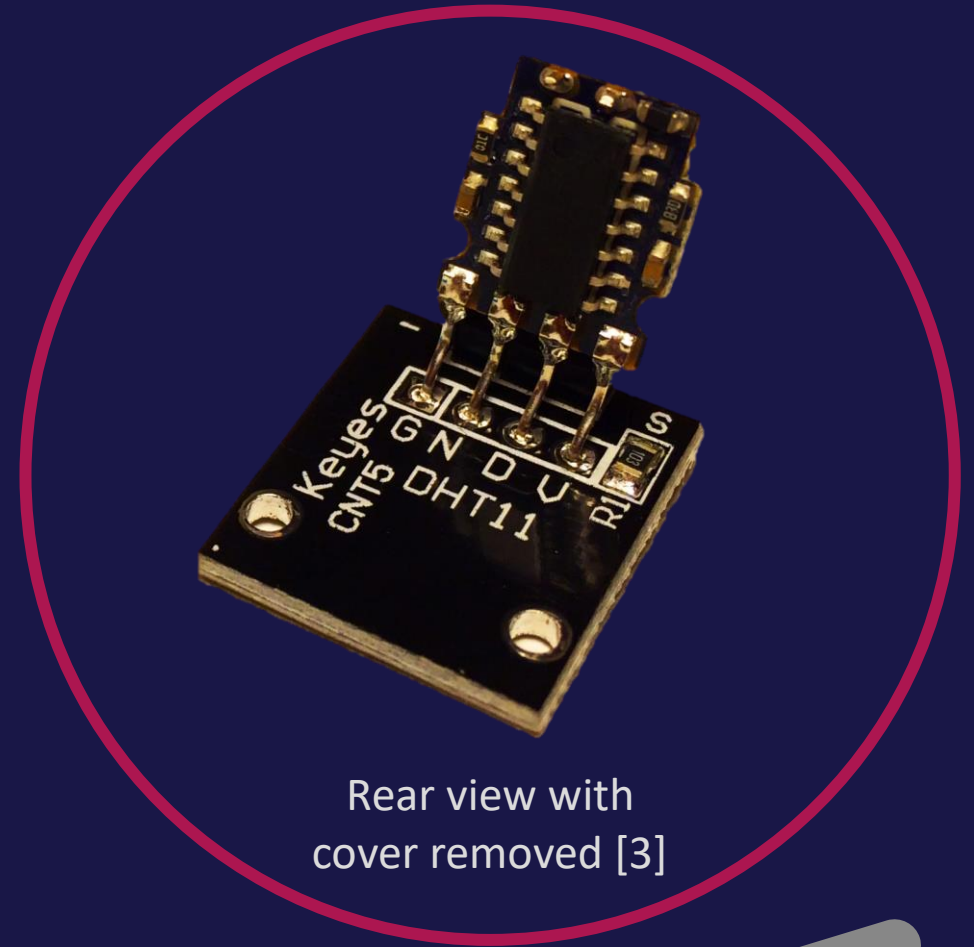


Front view with  
cover removed

# 1. THEORETICAL PART

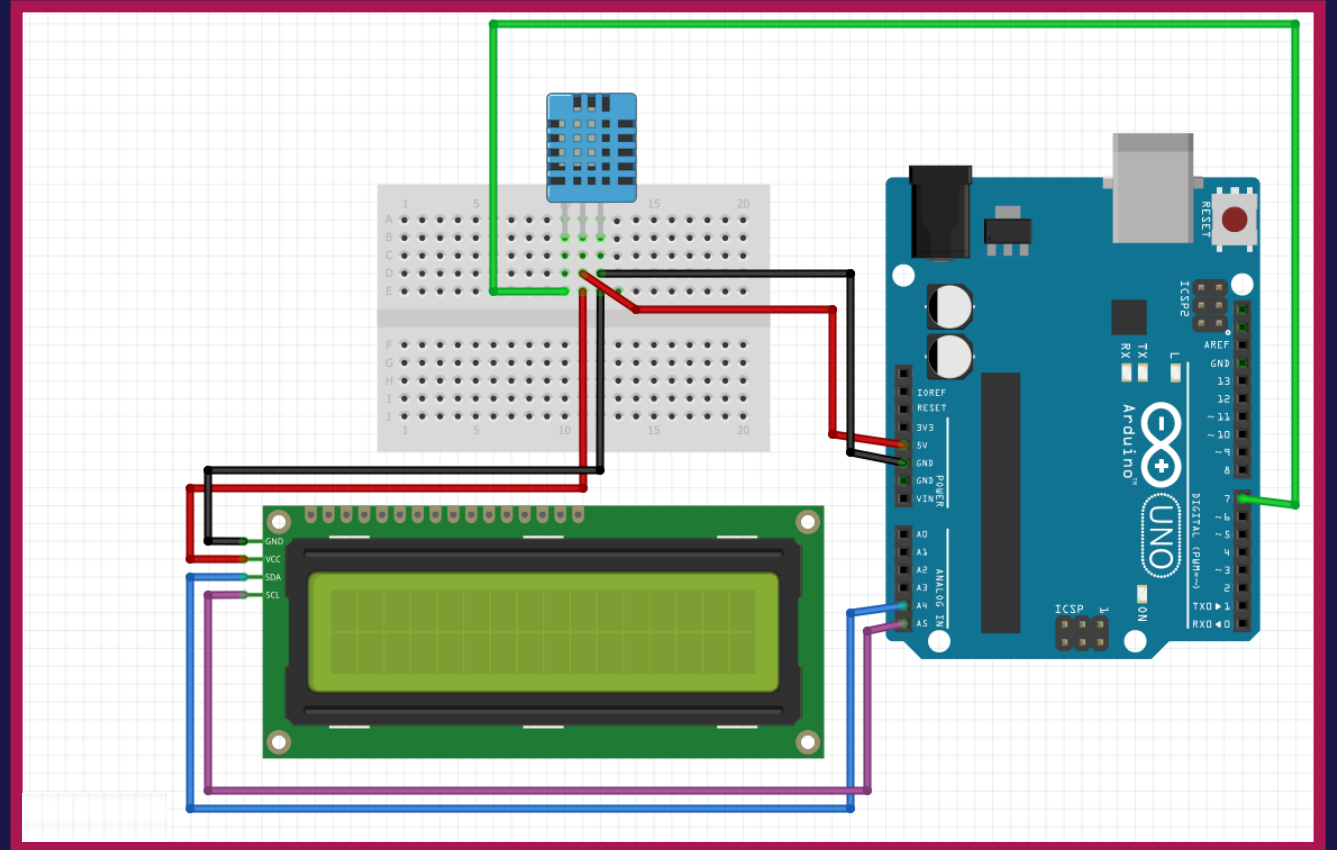
## 1.4 How the DHT11 measures humidity and temperature?

- An Integrated Circuit mounted on the back of the unit converts the resistance measurement to relative humidity. It also stores the calibration coefficients, and controls the data signal transmission between the DHT11 and the Arduino;
- The DHT11 uses just one signal wire to transmit data to the Arduino.



Rear view with  
cover removed [3]

## 2. CIRCUIT DIAGRAM





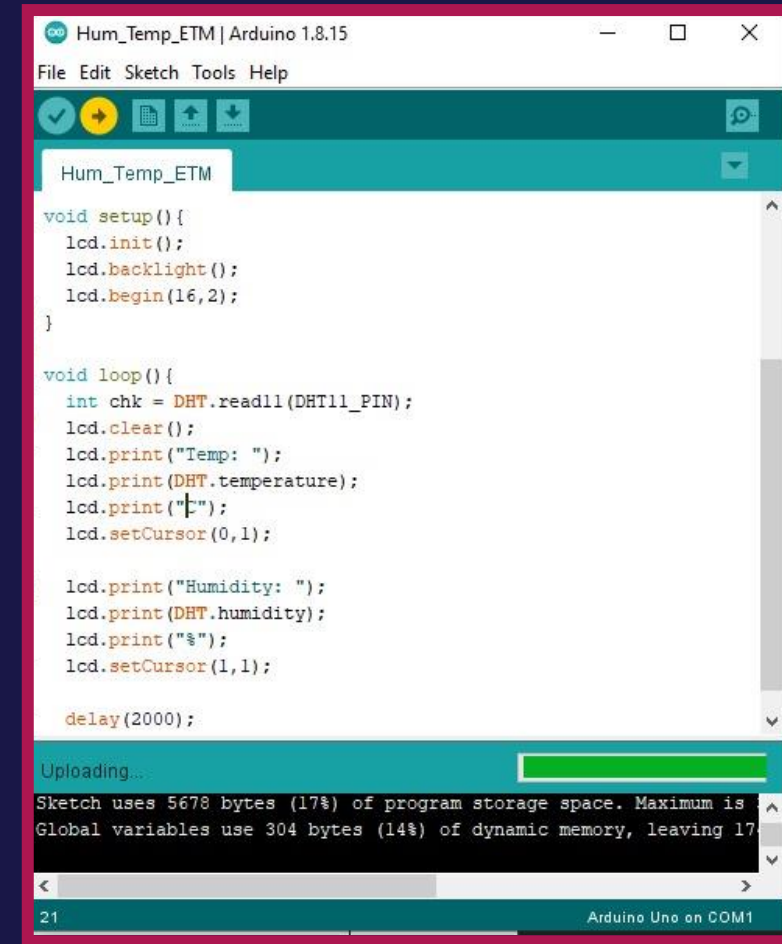
### 3. CODE FROM ARDUINO

```
#include <dht.h>
#include <Wire.h>
#include<LiquidCrystal_I2C.h>
```

```
LiquidCrystal_I2C lcd(0x27, 16, 2); // I2C address 0x27, 16 column and 2 rows
dht DHT;
```

```
#define DHT11_PIN 7
void setup() {
    lcd.init(); // initialize the lcd
    lcd.backlight(); // open the backlight
    lcd.begin(16,2);
}
```

```
void loop() {
    int chk = DHT.read11(DHT11_PIN);
    lcd.clear(); lcd.print("Temp: "); // print the temperature
    lcd.print(DHT.temperature);
    lcd.setCursor(0,1); // start to print at the second row
    lcd.print("Humidity: "); // print the humidity
    lcd.print(DHT.humidity);
    delay(2000); // wait a few seconds between measurements
}
```

A screenshot of the Arduino IDE interface. The title bar reads "Hum\_Temp\_ETM | Arduino 1.8.15". The menu bar includes "File", "Edit", "Sketch", "Tools", and "Help". The toolbar shows icons for opening, saving, and running. The sketch editor displays the code for "Hum\_Temp\_ETM". The code includes headers for dht.h, Wire.h, and LiquidCrystal\_I2C.h, defines DHT11\_PIN as 7, and contains setup() and loop() functions. The loop() function reads data from the DHT11 sensor and prints it to the LCD. The status bar at the bottom indicates "21" lines of code and "Arduino Uno on COM1". The bottom panel shows the upload progress bar and the message "Uploading..." followed by memory usage statistics: "Sketch uses 5678 bytes (17%) of program storage space. Maximum is 32768 bytes. Global variables use 304 bytes (14%) of dynamic memory, leaving 17192 bytes free." data-bbox="570 220 875 875">

```
Hum_Temp_ETM | Arduino 1.8.15
File Edit Sketch Tools Help

Hum_Temp_ETM

void setup() {
    lcd.init();
    lcd.backlight();
    lcd.begin(16,2);
}

void loop() {
    int chk = DHT.read11(DHT11_PIN);
    lcd.clear();
    lcd.print("Temp: ");
    lcd.print(DHT.temperature);
    lcd.print("°C");
    lcd.setCursor(0,1);

    lcd.print("Humidity: ");
    lcd.print(DHT.humidity);
    lcd.print("%");
    lcd.setCursor(1,1);

    delay(2000);
}

Uploading...
Sketch uses 5678 bytes (17%) of program storage space. Maximum is 32768 bytes.
Global variables use 304 bytes (14%) of dynamic memory, leaving 17192 bytes free.

21 Arduino Uno on COM1
```

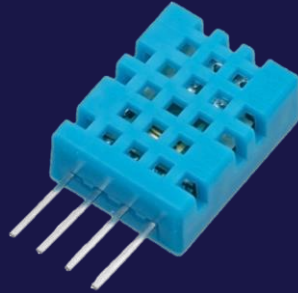
# 4. COMPONENTS REQUIRED

The project was implemented using:

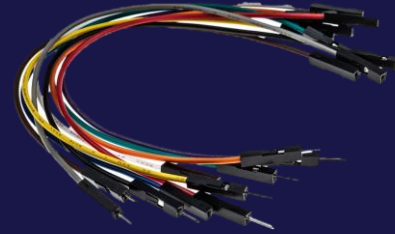
Arduino Uno R3 board



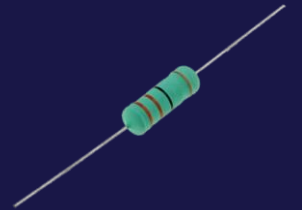
DHT11 Temperature & Humidity Sensor (4 pins)



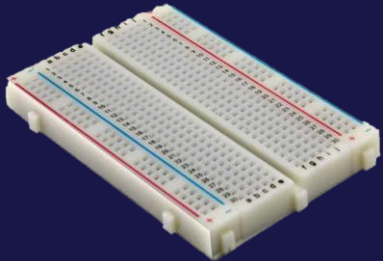
Jumper Wires



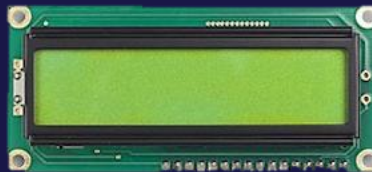
10 kΩ Resistor



Breadboard (generic)



Liquid Crystal Displays (LCD I2C model)

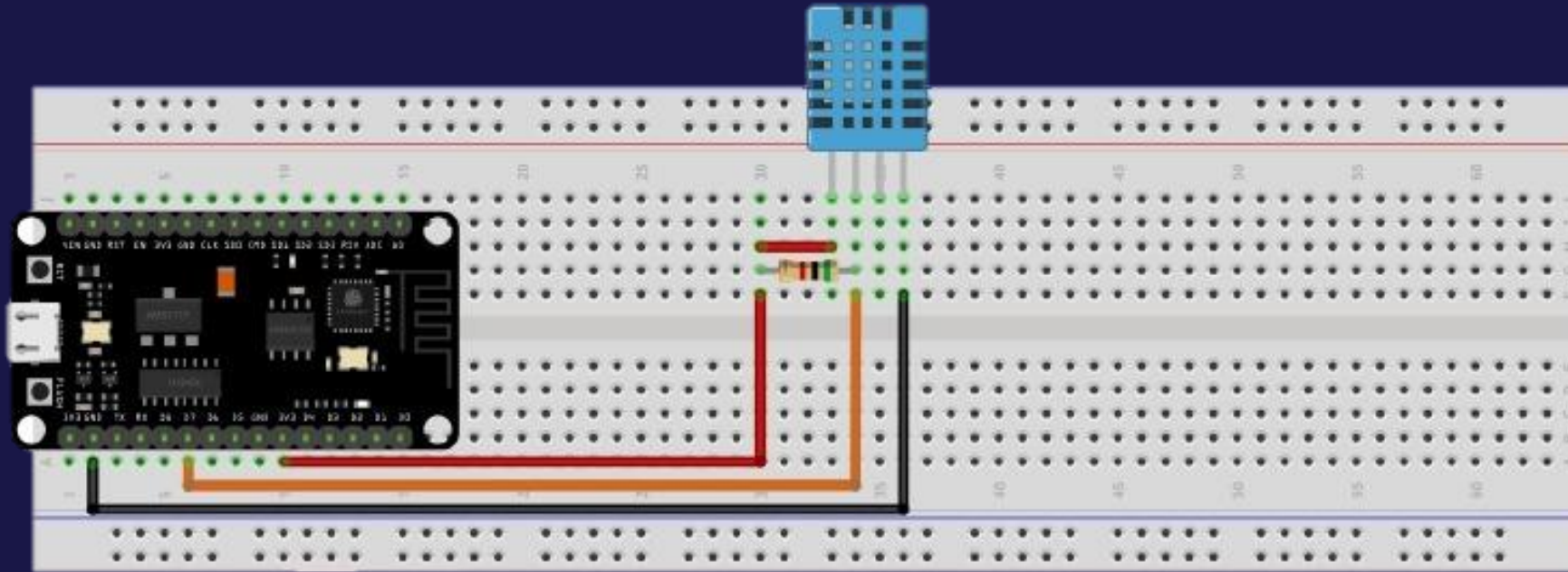


Arduino USB 2.0 Cable

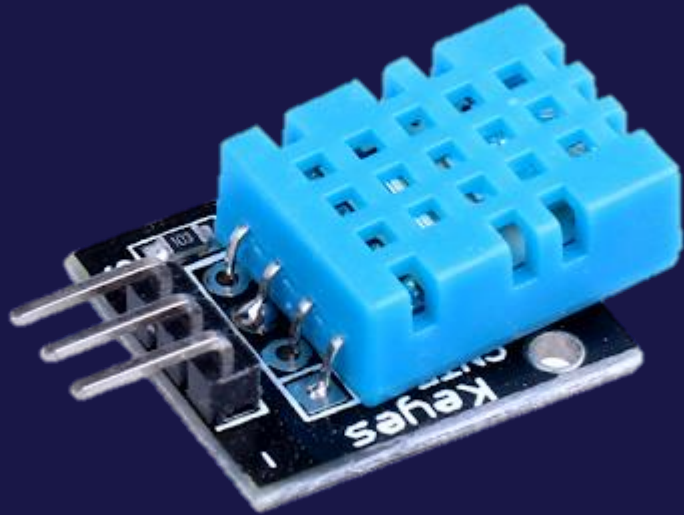


## 5. ELECTRICAL CIRCUIT

Below, you can find a visual representation of the connections for breadboard and DHT11 sensor:

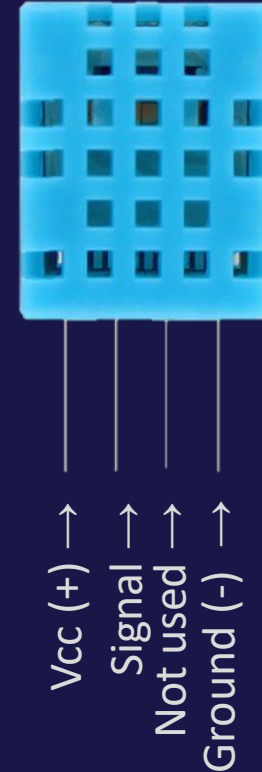


## 5.1 DHT11 sensor



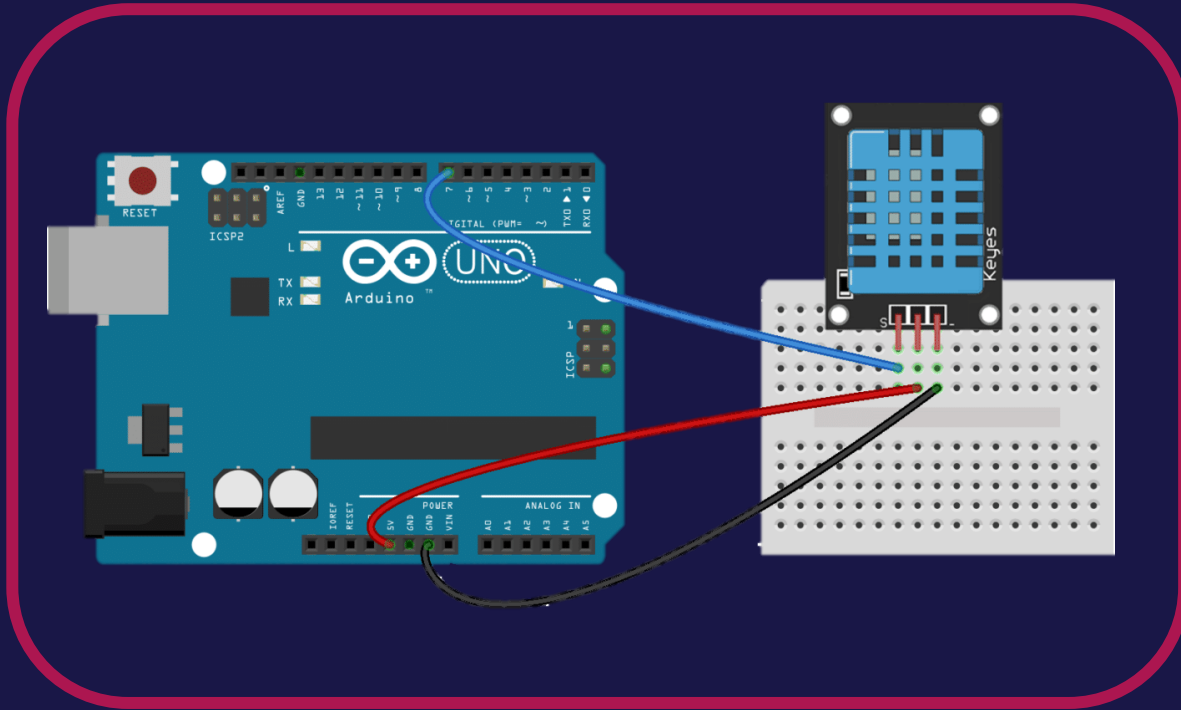
Humidity and Temperature  
DHT11 Sensor

We used a DHT11 sensor  
with 4 pins, like this one:

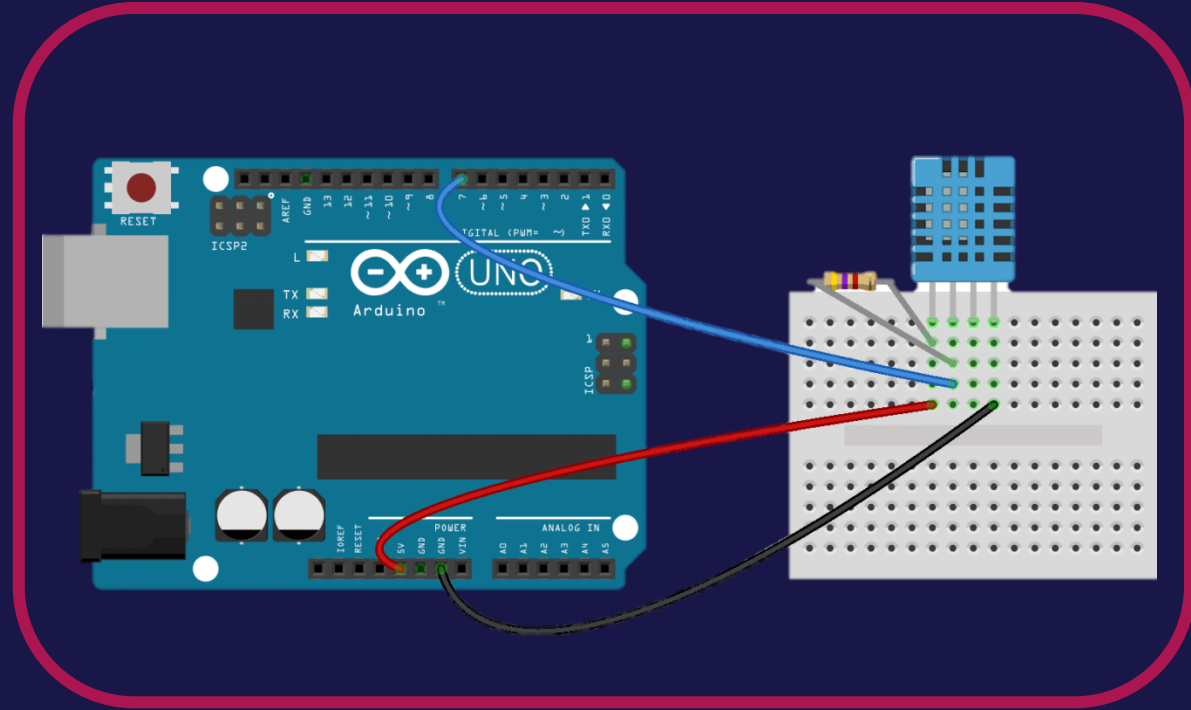


## 5.1 DHT11 sensor

The difference in the connection  
of a 3-pin and 4-pin DHT11 [5]



Connecting a three pin DHT11



Connecting a four pin DHT11



# 5. ELECTRICAL CIRCUIT

We also have an LCD connected to our board:

## Step 01

We connected the SDA and SCL in A4 and A5 on the Arduino board.

## Step 02

We connected GND in series with the GND of the DHT11 sensor.

## Step 03

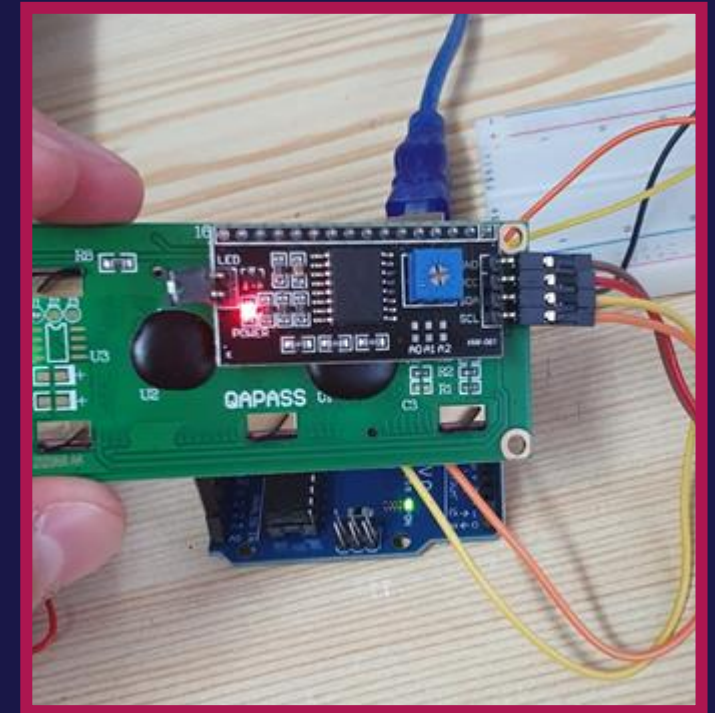
We connected the GND on the Arduino.

## Step 04

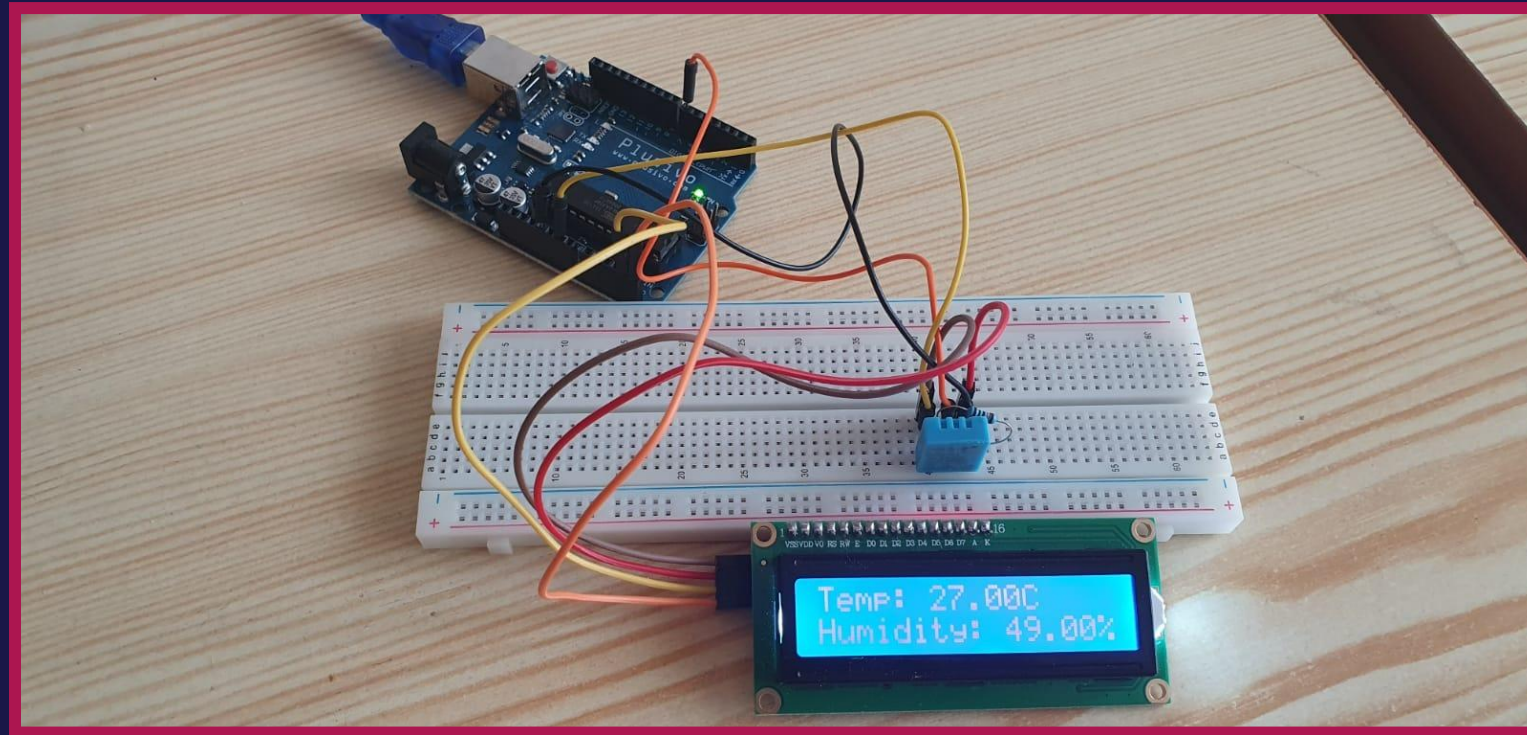
The Vcc in series with the Vcc of the sensor on the breadboard.

## Step 05

Then we connected the breadboard to the Arduino at 5V supply voltage.

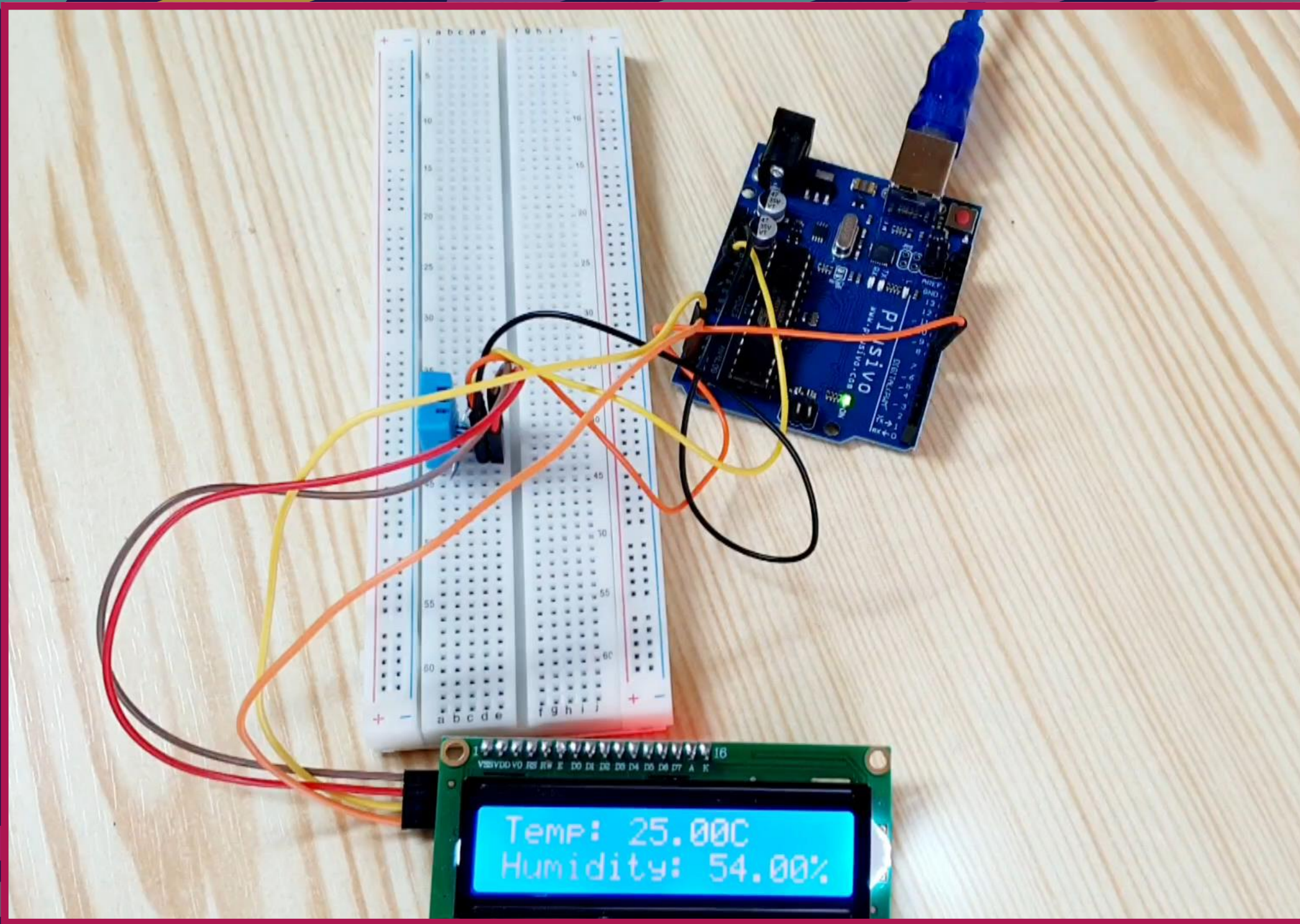


## 5. ELECTRICAL CIRCUIT



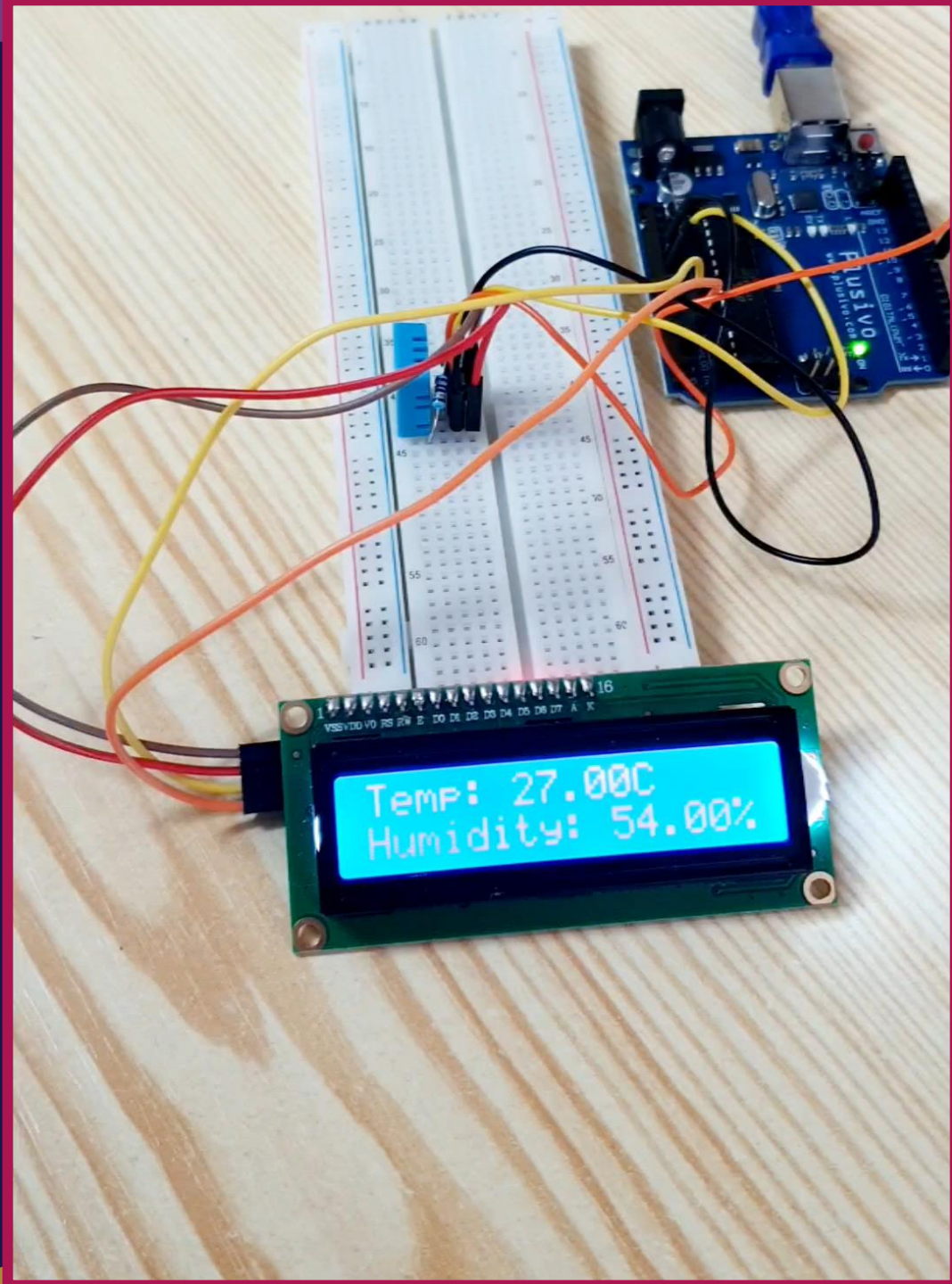


## 6. HOW IT WORKS?





## 6. HOW IT WORKS?



## 7. USE OF TEMPERATURE AND HUMIDITY SENSOR

Heating  
system

Ventilation  
system

Air  
conditioning  
system

Weather  
stations

Safety  
measure

## 8. REFERENCE LIST

- [1] <https://www.arduino.cc/en/guide/introduction>
- [2] <https://www.circuitbasics.com/wp-content/uploads/2015/11/DHT11-Datasheet.pdf>
- [3] [shorturl.at/orwD9](https://shorturl.at/orwD9)
- [4] [shorturl.at/gtwP0](https://shorturl.at/gtwP0)
- [5] [shorturl.at/ikyF8](https://shorturl.at/ikyF8)



THANKS FOR WATCHING!

ANY QUESTIONS?