Humidity and temperature sensor

1. Theoretical Part

Humidity sensors detect the relative humidity of the immediate environments in which they are placed. They measure both the moisture and temperature in the air and express relative humidity as a percentage of the ratio of moisture in the air to the maximum amount that can be held in the air at the current temperature. As air becomes hotter, it holds more moisture, so the relative humidity changes with the temperature.[2]

These sensors contain a chip that does analog to digital conversion and spit out a digital signal with the temperature and humidity. This makes them very easy to use with any microcontroller.[1]

This project, detects and displays the humidity and temperature in the air. As well as containing a log in part, in order to access the option menu.

## 2. Electrical circuit (Proteus/Tinkercad)

The Arduino Uno board with all the ports and the virtual monitor, (as seen in Figure1.) displays on the LCD (Figure 6.) a welcome message and a first instruction in order to login (Figure 7.). The password is introduced from the keyboard (every time the key is pressed the blue led turns on for 0.2s), confirmed by pressing the '=' key (red led turns on for 0.2s). If the password is correct, the green led will be turned on for about 3s otherwise, the red one will be on for 2s.

After the login part is dealt with, another set of instructions pops up (confirming the selected option/returning). Then, depending on the choice of the user (Figure 8.), either the temperature (°C/°F) and the heat index (°C/°F) or the humidity are displayed. The third options logs out the user, therefore needing to reintroduce the password in order to utilize the device.

The data for displaying is provided by the DHT11 sensor (Figure 3.) and sends it on the D13 pin, through a port named "DATA". It also contains a 4.7kΩ pull-up resistor between the DATA and VDD terminals, because DHT11 sends digital information, which is highs and lows, so the pull up is used to define the low or high state.[3]
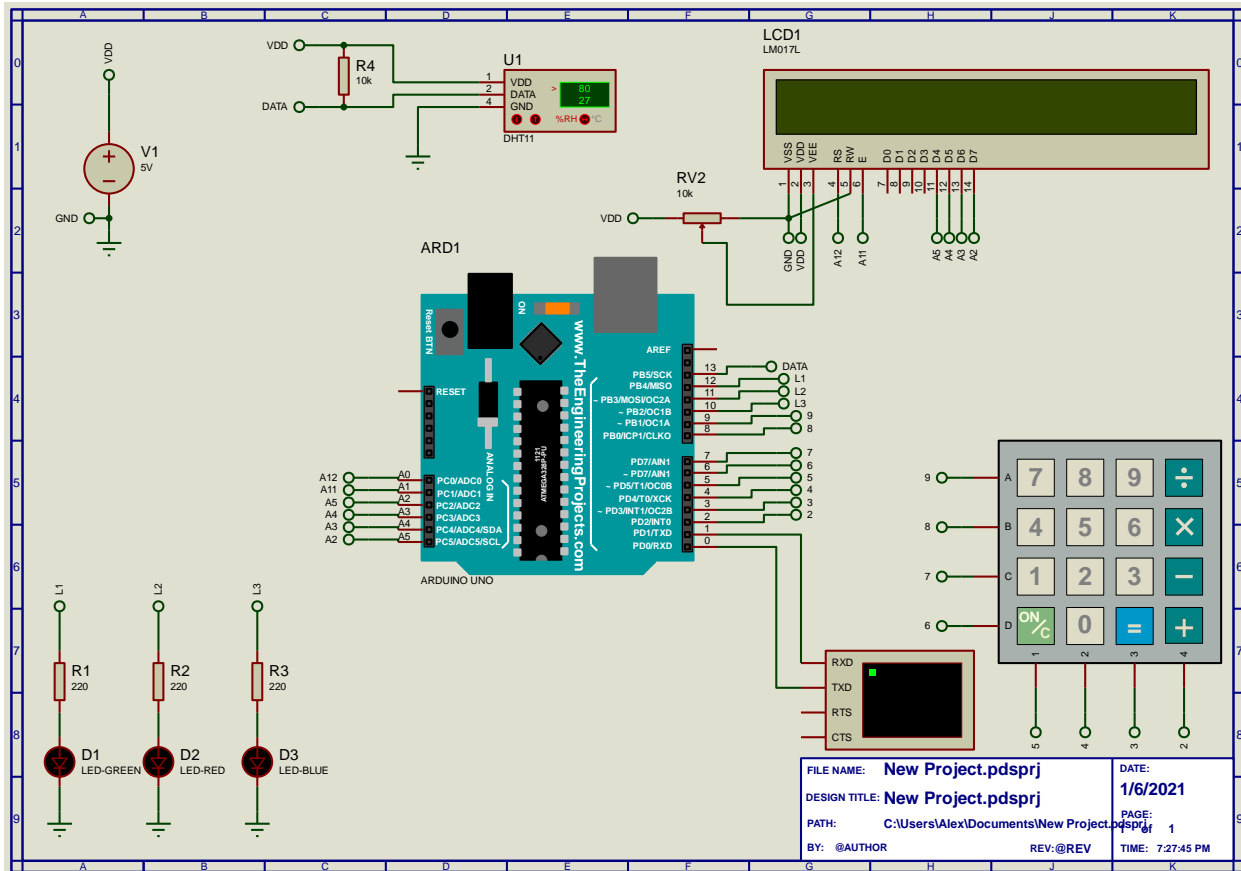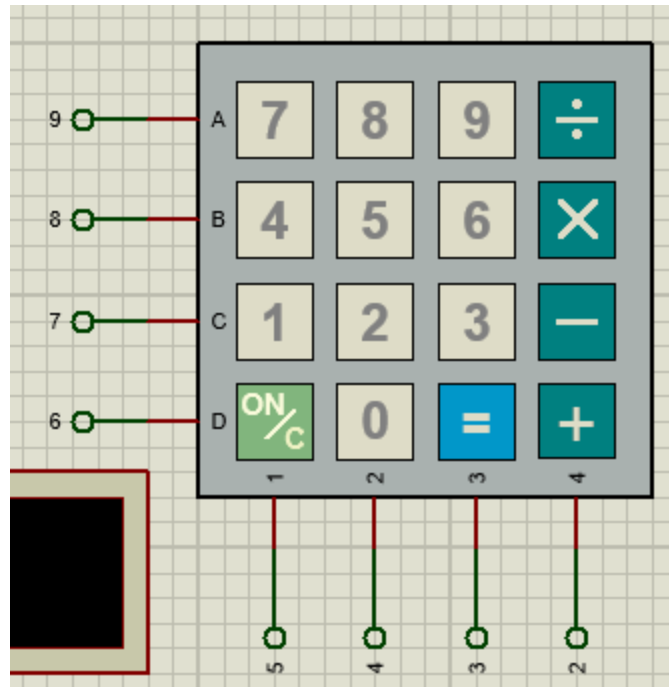
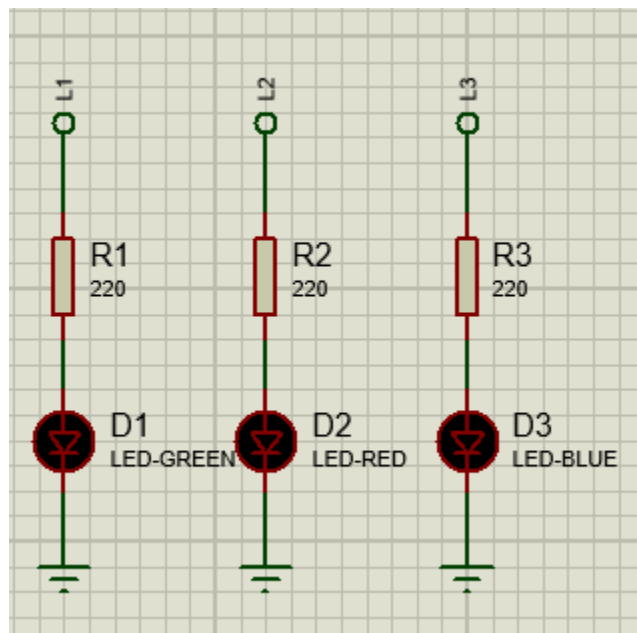**Figure 1.** Circuit schematic
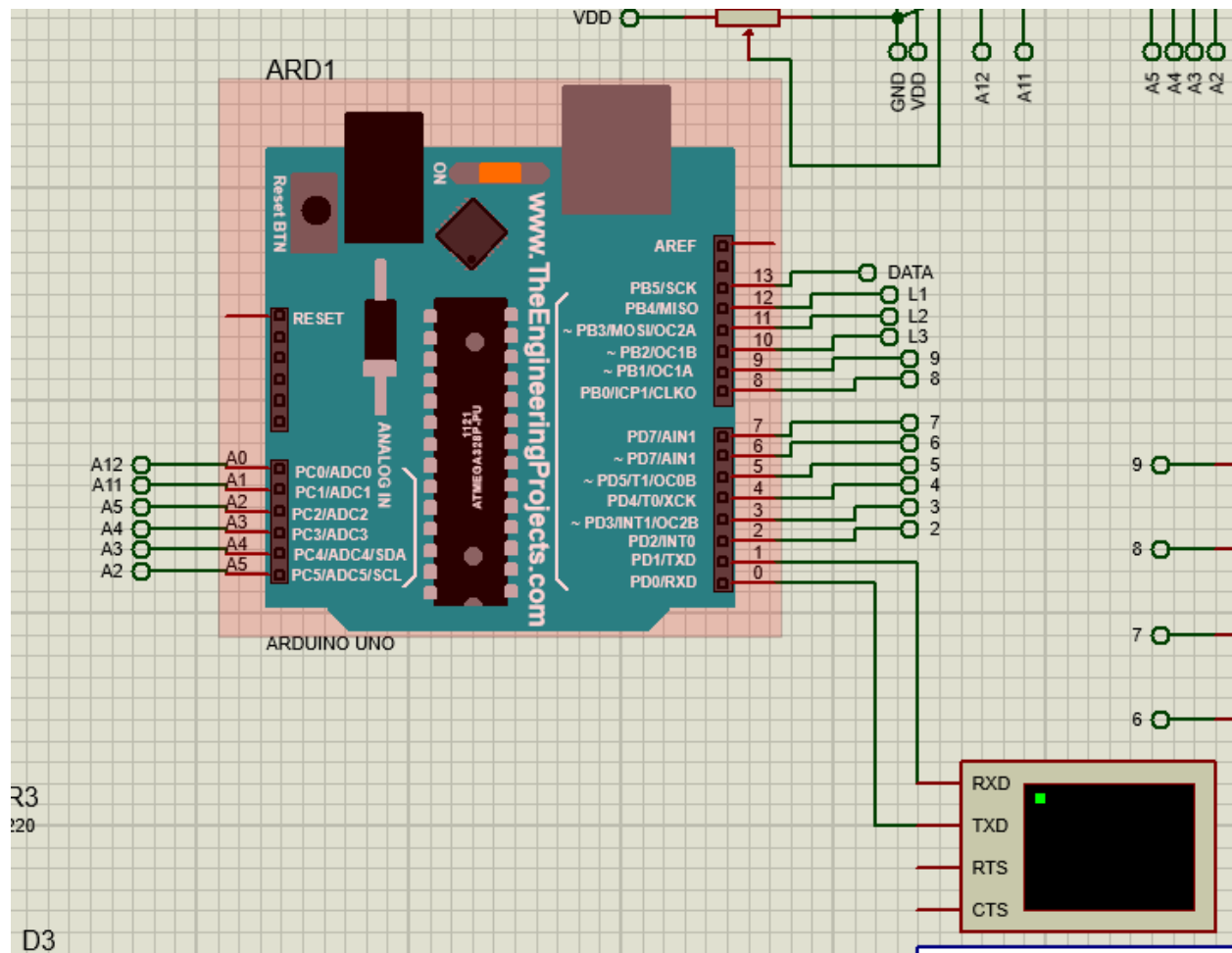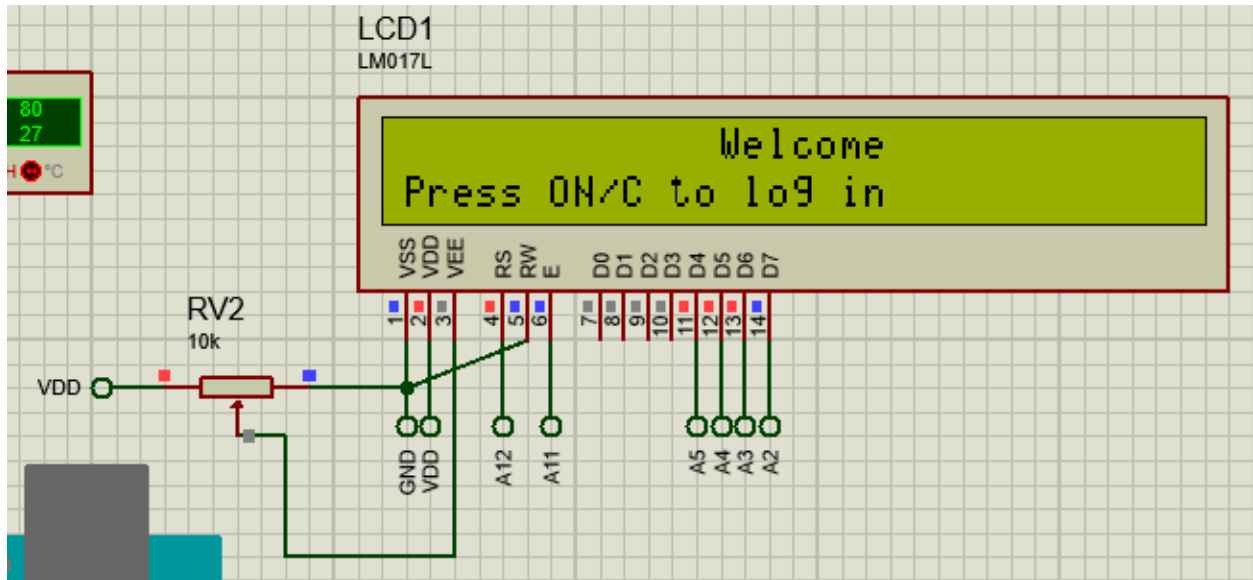
Figure 2. Arduino & Virtual monitor
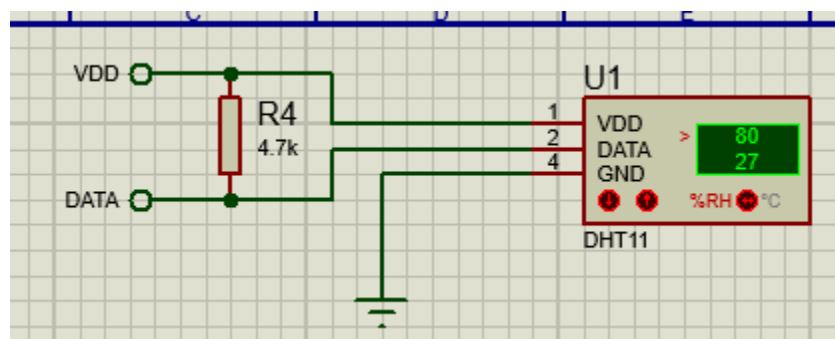
Figure 3. DHT11 sensor

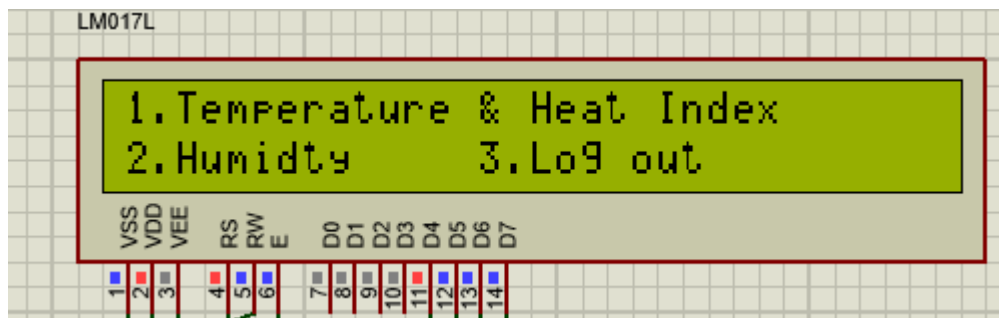**Figure 4.** Keypad

Figure 5. LEDs

Figure 6. LCD

Figure 7. Log in credentials

Figure 8. Menu pane

3. Arduino IDE

```
//libraries
#include <LiquidCrystal.h>
#include <Keypad.h>
#include <DHT.h>

//DHT Sensor
#define DHTPIN 13 //define the pin where the data will be transmitted
#define DHTTYPE DHT11 //define the type of dht
DHT dht(DHTPIN, DHTTYPE); //create a dht object

#define passLength 9 //password length

//Defining LCD
LiquidCrystal lcd(A0, A1, A2, A3, A4, A5); //lcd pinout

//Keypad
const byte r = 4;//rows
const byte c = 4;//columns

//keymap define the key pressed according to the row and columns just as appe
ars on the keyboard
char keys[r][c]={
  {'7', '8', '9', 'A'},
  {'4', '5', '6', 'B'},
  {'1', '2', '3', 'C'},
  {'#', '0', '*', 'D'}
};

byte rowP[r] = {9, 8, 7, 6};//row pinout
byte colP[c] = {5, 4, 3, 2};//column pinout

Keypad customKeypad = Keypad(makeKeymap(keys), rowP, colP, r, c); //initializ
es an instance of the keypad class

//variables
char data[passLength]; //array in which we put the password that will be intr
oduced
char pass[passLength] = "2035ACDC"; //password
byte data_count = 0; //index for the passsord build array
char key; //key from keypad
int greenLED = 12; //green led pinout
```

```cpp
int redLED = 11; //red led pinout
int blueLED = 10; //blue led pinout
int choice = 0; //menu sel var
float tempC = 0; //temperature in Celsius
float tempF = 0; //temperature in Fahrenheit
float hum = 0; //humidity
float hiC = 0; //heat index Celsius
float hiF = 0; //heat index Fahrenheit
bool locked = true; //protected by pass

//screen var
bool welcome = true; //star screen var
bool mainScreen = true; //menu selection var


//functions
int checkPass();
void clearData();
void readSensorData();
void startScreen();
void optionSelect();
void mainScreenP(int choice);
void tempHeatInd();
void printHum();
void logOut();
void goBack();

void setup(){
  Serial.begin(9600);//debugging purposes
  dht.begin();//setting up the DHT

  lcd.begin(32,2); //seeting up the lcd

  //setting up the diodes
  pinMode(greenLED, OUTPUT);
  pinMode(redLED, OUTPUT);
  pinMode(blueLED, OUTPUT);
}

void loop(){
  //initial messages
  lcd.setCursor(13,0);//column 13; row 0
  lcd.print("Welcome");//print on the lcd, first line
  lcd.setCursor(0,1); //column 0 row 1
  lcd.print("Press ON/C to log in");//print on the lcd, second line
```

```
  key = customKeypad.getKey(); //defining a pressed key

  //pass check
  //if the password is introduced correctly, then the welcome message is prin
ted, with a few instructions
  //and the green led is on for 3 seconds
  //if the password is incorrect, an incorrect mesage is displayed
  //and the red led is on for 2 seconds
  if(key == '#' && locked == true){
    if(!strcmp(checkPass(),pass)){
      lcd.print("Welcome in the system");
      lcd.setCursor(0,1);
      lcd.print("ON/C to confirm = to go back");
      digitalWrite(greenLED,HIGH);//green led on
      delay(3000);
      digitalWrite(greenLED,LOW);//green led off
      locked = false;//protection off
    }
    else{
      lcd.print("Incorrect password");
      digitalWrite(redLED,HIGH);//red led on
      delay(2000);
      digitalWrite(redLED,LOW);//red led off
      delay(2000);
      lcd.clear();
    }
  }

  clearData();

  //menu
  //after the passwors was introduced correctly, the start screen pops up
  //and we are able to navigate through it, selecting options as we like.
  if(locked == false){
      if(welcome == true){
        lcd.clear();
        startScreen();
        welcome = false;
        delay(2000);
      }
      if(welcome==false){
        lcd.clear();
        key = customKeypad.getKey();
        if(mainScreen == true){
```

```
            while(key!='#'){
              startScreen();
              optionSelect();
              mainScreenP(choice);
              Serial.println(choice);
            }
            delay(2000);
            mainScreen = false;
            }

            if(mainScreen == false){
              mainScreen == true;
              //lcd.clear();
              if(choice == 1){
                tempHeatInd();
              }else
                if(choice == 2){
                  printHum();
                }else
                  if(choice == 3){
                    logOut();
                  }
            }
          }
        }
      }

//pass validation
//we build an array with the keys pressed, untiul the '*' button is pressed
//thus confirming the password
//anytime a key is pressed, the blue led is turned on for 0.2s
//when the confiramtion key is pressed, the red led is on for 0.2s
int checkPass(){
  lcd.clear();
  lcd.print("Press = to confirm the password");
  delay(3000);
  lcd.clear();
  lcd.print("User: Vakutz Alexandru");
  lcd.setCursor(0,1);
  lcd.print("Password: ");
  int pos = 10;//set the column
  while(data_count<33){
  key = customKeypad.getKey();
  if(key == '*'){
    Serial.println(key);
```

```
      digitalWrite(redLED,HIGH);
      delay(200);
      digitalWrite(redLED,LOW);
      goto retMen; //jump to retMen label
    }
  if(key){
      lcd.setCursor(pos,1);//write characters one after another
      lcd.print('*');//print * so that the key reamins private
      digitalWrite(blueLED,HIGH);
      delay(200);
      digitalWrite(blueLED,LOW);
      data[data_count]=key; //add key to array
      data_count++;
      pos++;//next column
      Serial.println(key);//debugging&testing purposes
    }
}
  delay(5000);
  lcd.clear();
  return data;

retMen:
  delay(1000);
  lcd.clear();
  return data;
}

//main menu with 3 options
void startScreen(){
  lcd.setCursor(0,0);
  lcd.print("1.Temperature & Heat Index");
  lcd.setCursor(0,1);
  lcd.print("2.Humidty");
  lcd.setCursor(14,1);
  lcd.print("3.Log out");
}

//chossing an option
//waiting for keypad input
void optionSelect(){
  key = customKeypad.getKey();

  if(key == '1')
    choice = 1;
  else
```

```cpp
    if(key == '2')
      choice = 2;
      else
        if(key=='3')
          choice = 3;
        else
          choice = choice;
}

//main screen writting
//based on the option chosen, the appropriate meniu version is displayed
//'>' points the option selected
void mainScreenP(int choice){
  if(choice == 1){
    lcd.setCursor(0,0);
    lcd.print("> Temperature & Heat Index");
    lcd.setCursor(0,1);
    lcd.print("2.Humidty");
    lcd.setCursor(14,1);
    lcd.print("3.Log out");
  }
  else
    if(choice == 2){
      lcd.setCursor(0,0);
      lcd.print("1.Temperature & Heat Index");
      lcd.setCursor(0,1);
      lcd.print("> Humidty");
      lcd.setCursor(14,1);
      lcd.print("3.Log out");
    }
    else
      if(choice == 3){
        lcd.setCursor(0,0);
        lcd.print("1.Temperature & Heat Index");
        lcd.setCursor(0,1);
        lcd.print("2.Humidty");
        lcd.setCursor(14,1);
        lcd.print("> Log out");
      }

}

//reading data from dht11
void readSensorData(){
  hum = dht.readHumidity();
```

```
  tempC = dht.readTemperature();// temperature in celsius
  tempF = dht.readTemperature(true); //isFahrenheit=true
  hiC = dht.computeHeatIndex(tempC, hum, false); //heat index in Celsius (isF
ahrenheit = false)
  hiF = dht.computeHeatIndex(tempF,hum);
}

//display temp & heat indexes
//displays a short set of instructions regarding the display placement of the
 data
void tempHeatInd(){
  readSensorData();//read data from dht
  lcd.clear();
  lcd.print("Column 1 -- Temperature C/F");
  lcd.setCursor(0,1);
  lcd.print("Column 2 -- Heat indexes C/F");
  delay(1000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print(tempC);
  lcd.setCursor(5,0);
  lcd.print("C");
  lcd.setCursor(0,1);
  lcd.print(tempF);
  lcd.setCursor(5,1);
  lcd.print("F");
  lcd.setCursor(9,0);
  lcd.print(hiC);
  lcd.setCursor(13,0);
  lcd.print("C");
  lcd.setCursor(9,1);
  lcd.print(hiF);
  lcd.setCursor(13,1);
  lcd.print("F");
  lcd.setCursor(20,0);
  lcd.print(">Back");
  goBack();
}

//displaying humidity
void printHum(){
  lcd.clear();
  readSensorData();//read data from dht22
  lcd.print("Humidity: ");
  lcd.setCursor(11, 0);
```

```
    lcd.print(hum);
    lcd.setCursor(16,0);
    lcd.print("%");
    lcd.setCursor(0,1);
    lcd.print(">Back");
    Serial.println(hum);
    goBack();
}

//logging out
void logOut(){
  lcd.clear();
  lcd.print("Logging out...");
  locked = true;//reset protection
  choice = 0;//reset main menu option
  mainScreen = true; //reset mainScreen animation
  delay(2000);
  lcd.clear();
}

//return
void goBack(){
    // key = customKeypad.getKey();
     while(key!='*')
     {
         key = customKeypad.getKey();
         if(key=='*')
         {lcd.clear();
         mainScreen=true;
       }
      }
}

//clearing pass data, and making the data array reusable
void clearData(){
  while(data_count !=0){
  data[data_count--] = 0;
  }
  return;
}
```

Reference list

[1] Complete Guide for DHT11/DHT22 Humidity and Temperature Sensor With Arduino , 25th of April 2019

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[4] Circuit Basiscs https://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-an-arduino/

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[8] Circuit Basics https://www.circuitbasics.com/how-to-set-up-an-lcd-display-on-an-arduino/