Data Acquisition System Project
Weather station

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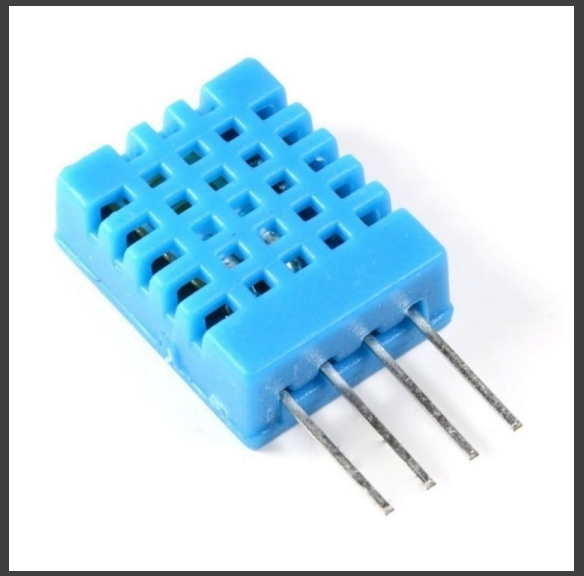
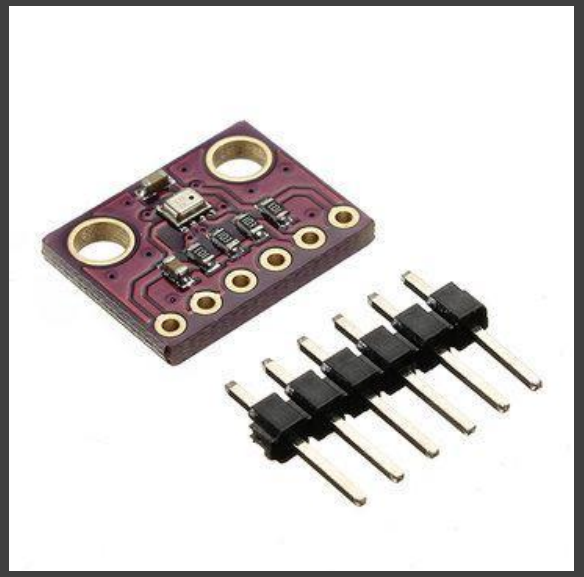
Components: input sensors

- Temperature and humidity sensor DHT11

- Pressure and temperature sensor BMP280

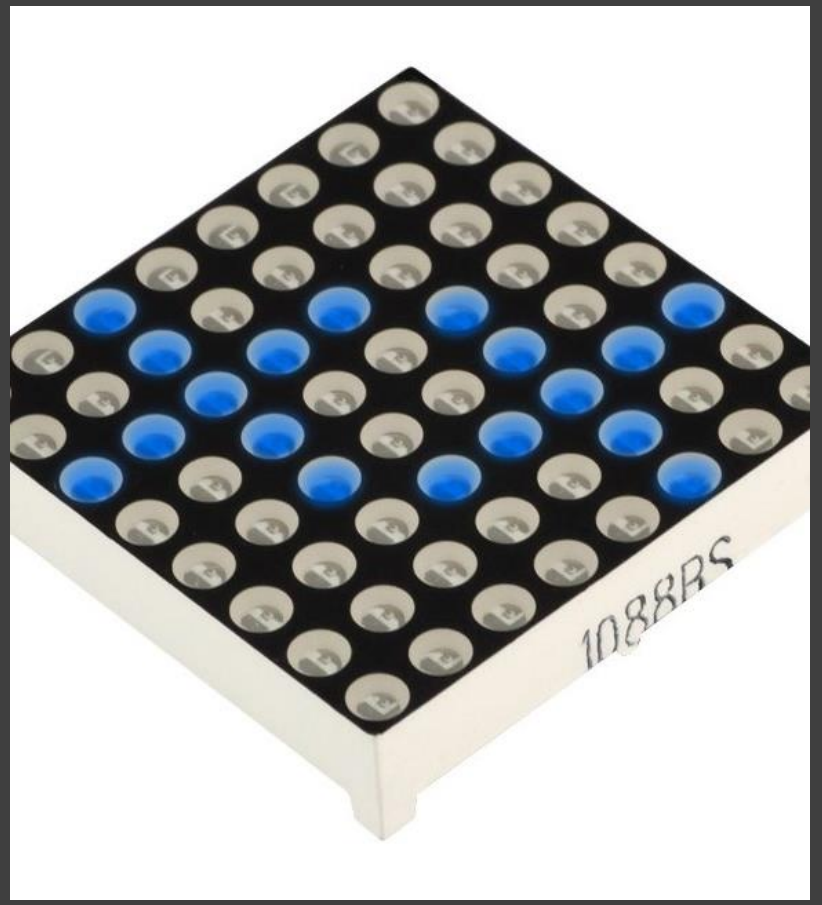




Components: outputs

- Serial monitor

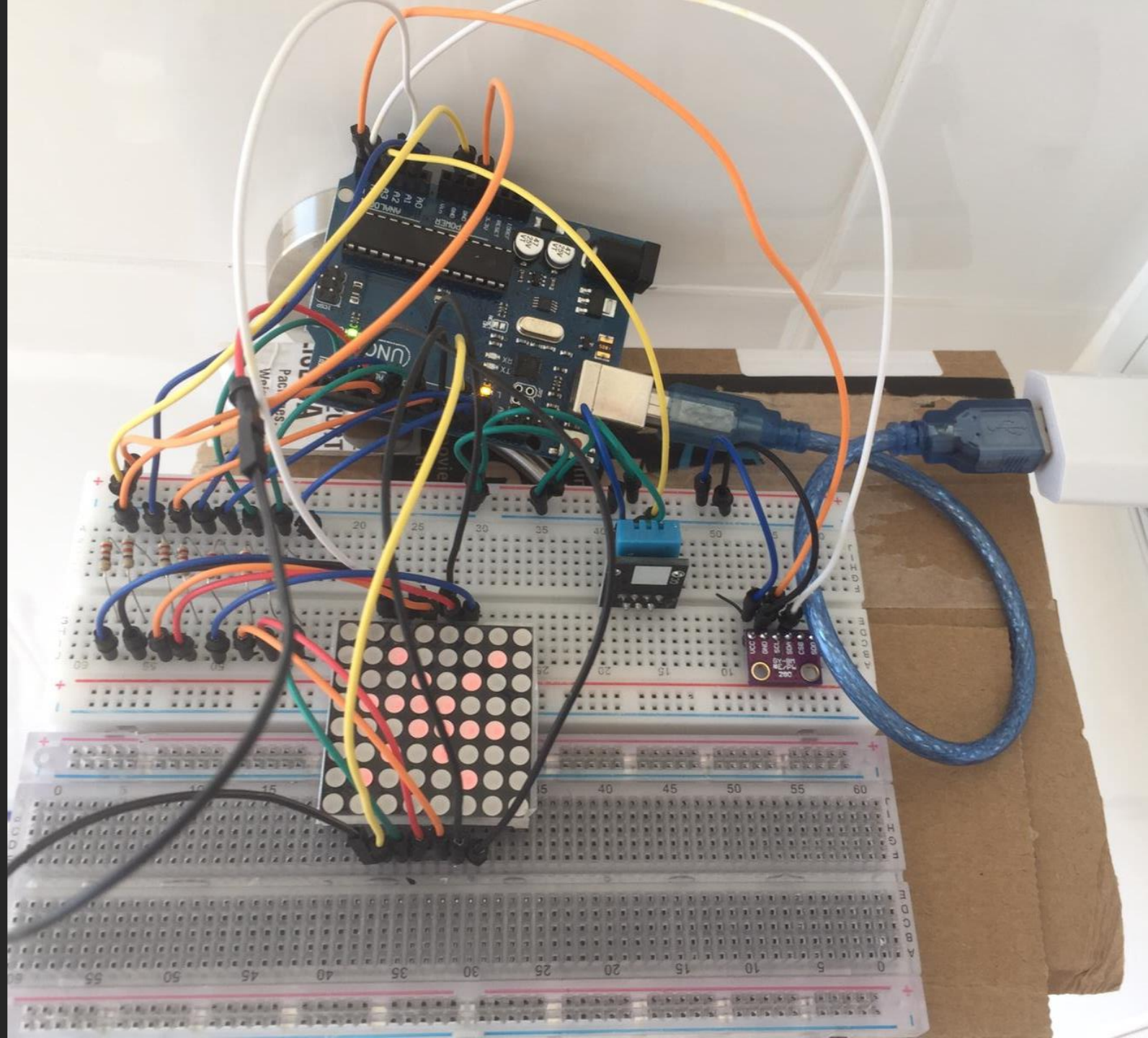
- 8x8 LED matrix



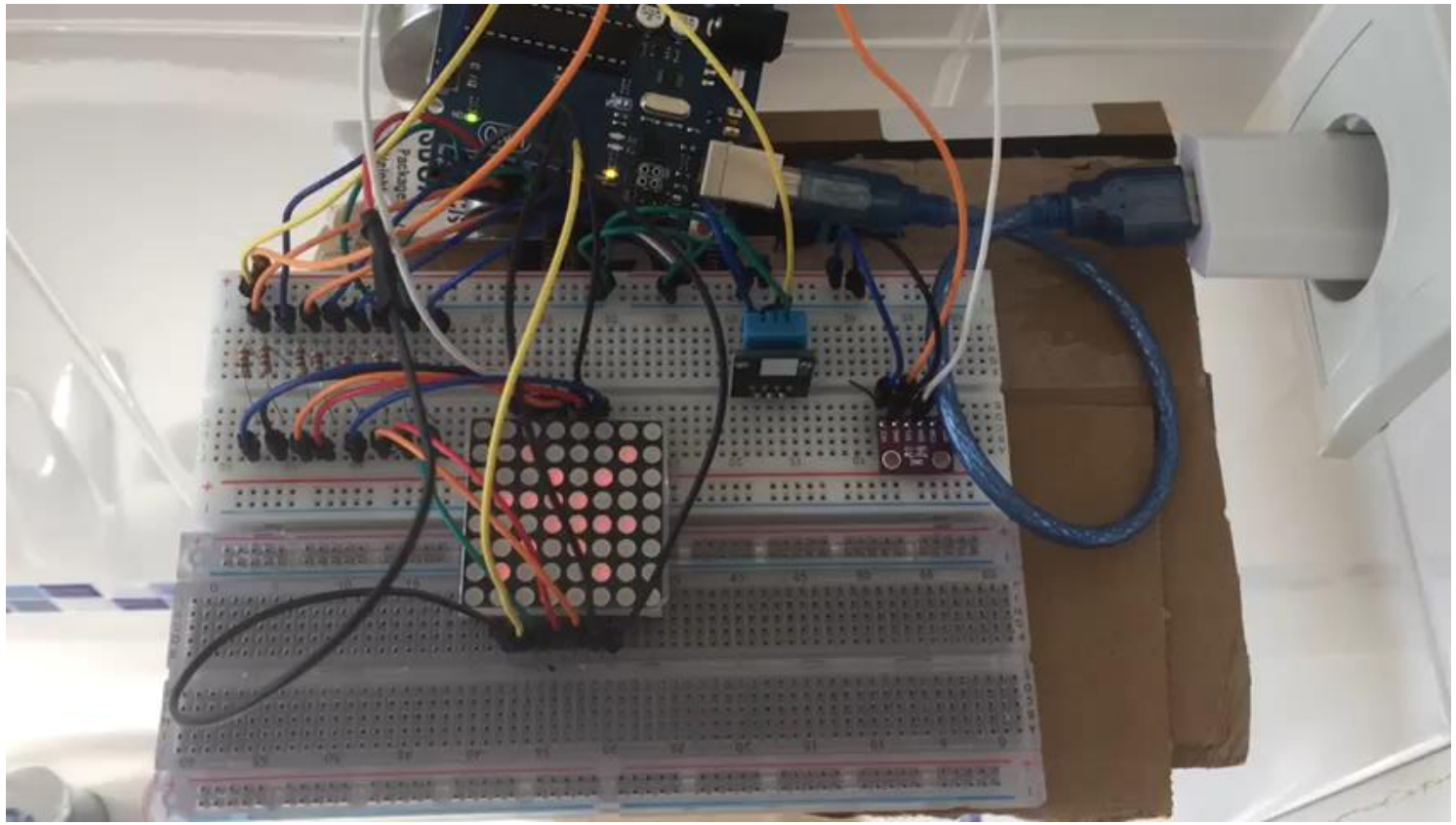
Things to do	Due date	Hours
Implementation of the circuit	Jun 8	5
Code acquisition of humidity	Jun 15	2
Code acquisition of Pressure and Temperature	Jun 20	7
Code outputs devices	Jun 22	5
Write down the mathematical model and code it	Jun 27	2
Test the system	Jun 30	9
Fix problems and improve the project		
+ Add		
		30

Time schedule

Implementation of the circuit



Implementation of the circuitf the circuit



Model used

The model used to predict the weather is based on humidity(H) and change in pressure(P).

H>65 % and ΔP> 200 hPa in the last 3 h

↓

probable bad weather in the following 24 hours

H<65 % regardless the P

↓

probable good weather

Humidity

To do :

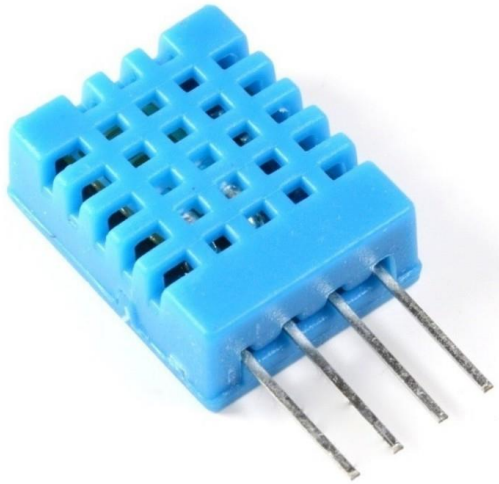
- Code the acquisition
- Test the data acquires

Time schedule :

- 2 hours needed

Problem :

- none



```
#define DHT11_PIN 17

dht DHT;

int chk = DHT.read11(DHT11_PIN);

Serial.print(F("Humidity: "));
Serial.print(DHT.humidity);
Serial.println(" %");
```

Pressure and Temperature

To do :

- Code the acquisition
- Test the data acquires

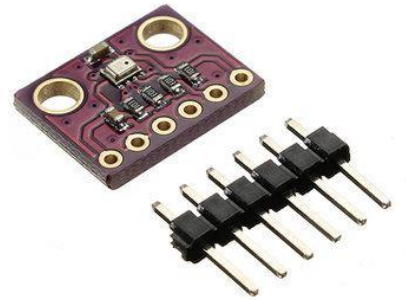
Time schedule :

- 7 hours

Problems :

- It’s possible to acquire data only every 2 seconds
- A timer interrupts has been coded in order to get the right acquisition ratio without compromising the other functionality in the loop function
- Total time needed : 10 hours

```
#include <Adafruit_Sensor.h>
#include <Adafruit_BMP280.h>
Adafruit_BMP280 bmp;
void setup(){
  cli(); //stop interrupts
    //set timer0 interrupt at 62Hz
  TCCR0A = 0;// set entire TCCR0A register to 0
  TCCR0B = 0;// same for TCCR0B
  TCNT0  = 0;//initialize counter value to 0
  // set compare match register for 62hz increments
  OCR0A = 252;// = (16*10^6) / (2000*64) - 1 (must be <256)
  // turn on CTC mode
  TCCR0A |= (1 << WGM01);
  // Set CS01 and CS00 bits for 64 prescaler
  TCCR0B |= (1 << CS12) | (1 << CS10);
  // enable timer compare interrupt
  TIMSK0 |= (1 << OCIE0A);
}
ISR(TIMER0_COMPA_vect){
  inc0 = inc0 + 1;
  if (inc0 == 248)
  {
    flagPrint = 1;
    inc0 = 0;}
}
if(flagPrint == 1){
    Serial.print(F("Temperature: "));
    Serial.print(bmp.readTemperature());
    Serial.println(" °C ");
    Serial.print(F("Pressure: "));
    Serial.print(bmp.readPressure());
    Serial.println(" Pa ");
    }
```



Output devices

To do :

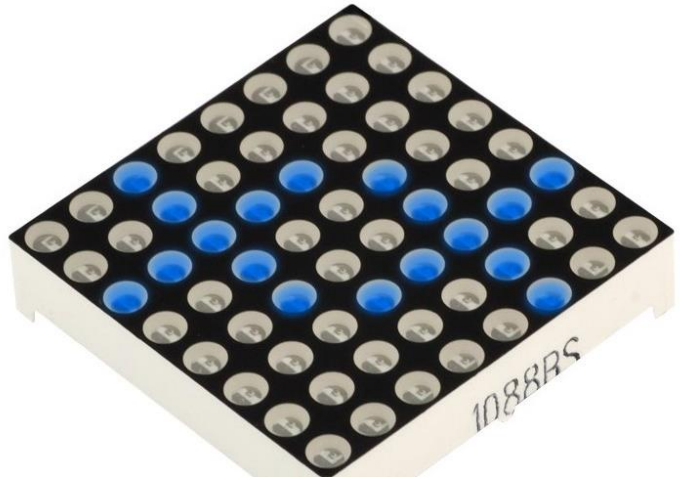
- Code the LED matrix
- Code the serial communications

Time schedule :

- 5 hours

Problems :

- Too many pins requested from the matrix in the board: two pins have been gained making the matrix a 7x7 LED matrix. Fillers number(99) have been used in code in order to keep the same scheme of coding of an 8x8 LED matrix
- It needs a very short time of refresh : time interrupts have been used for the other commands in the loop in order not to waste time in the loop providing the fastest refresh possible to the matrix
- Time needed: 7 hours



```
#define MatrixVector 65
#define Ncolrow 8
#define Npin 17
int pins[Npin]= { 99, 5, 4, 3, 2, 99, 15, 16, 99, 13, 12, 11, 10, 9, 8, 7, 6};
int cols[Ncolrow] = {pins[13], pins[10], pins[15], pins[9], pins[4], pins[16], pins[6], pins[1
int rows[Ncolrow] = {pins[8], pins[7], pins[3], pins[14], pins[2], pins[12], pins[11], pins[5]
int vect[MatrixVector];
int carSun [MatrixVector] = {    ···
int carCloud [MatrixVector] = {   // cloud matrix···
void setup(){
    for (int i = 1; i <= (Npin-1); i++){ // I'm defining at output all the ports in the array
     pinMode(pins[i], OUTPUT);}
 for (int i = 1; i <= Ncolrow; i++) {// I'm switching off all the pin
   digitalWrite(cols[i - 1], LOW);
   digitalWrite(rows[i - 1], LOW);} }
 void loop(){
    for (r1 = 1; r1 <= Ncolrow; r1 ++){
   for (c1 = 1; c1 <= Ncolrow; c1 ++){
     if (vect [(r1-1)*Ncolrow + c1] == 1){ // BYTE = 1 (led to switch on)
         digitalWrite (rows [r1-1], HIGH); // active row (anod)
         digitalWrite (cols [c1-1], LOW);} // disactive (catod) and switch on the led on the
      digitalWrite (rows [r1-1], LOW); // disable the row (anod)
      digitalWrite (cols [c1-1], HIGH); // enable the column (catod) and switch off the led
}}
```

Model of prediction

To do :

- Write down the model
- Code it

Time schedule :

- 2 hours

Problems :

- being sure that the code responds in the right way at each iteration taking in account also the previous output (ex. Previous output=bad weather , at the next iteration the difference in pressure is not satisfied any more but this doesn’t mean that the weather is going to be good)
- 4 hours

```
if (flagMemory == 1)
  {
    hum = DHT.humidity;
    press[add] = bmp.readPressure();
    if (add >= 3)
    {
      if (hum >= HumEdge)
        {
            if ((press[add-3]-press[add]) >= PresDiffEdge || flagBadW == 1 )
              {
              flagMatrix = 1;
              flagBadW = 1;
              }else
                {
                flagMatrix = 0;
                flagBadW = 0;
                }
        }
    }
    if (add == 71)
        {
        add = 0;
        }else
          {
          add = add + 1;
          }
  flagMemory = 0;
  }
```

Test of the system

To do :

- test the system in different humidity and pressure situation
- Test the efficiency of the output

Time schedule :

- 9 hours

Problems :

- Time and different atmospheric situation are necessary to make a real test of the project : different humidity situations have been got artificially while the pressure is much more difficult to be handled with
- Time requested : 48 hours

Possible improvement

Code the EEPROM memory in order to save the parameters that can be useful for other analysis:

- Problem : it’s possible to save just integers and number smaller the 255
- Possible solution : use a union and save the number in different byte
- Cons : comparation for the estimation of the weather more tricky

Implement a real time clock in order to keep count of the time in which the board is switched off :

- Problem : it’s needed a welder to prepare the hardware to use
- Cons : even with a real time clock , if the board has been switched off for a long time comparing the pressure data in the memory with the new ones doesn’t make any sense: the board has to start to work as in the case of first use