

1. Description of Work

The device is constructed as follows. There are two part of the device. The humidifier module and the Light module.

- Humidifier Module

The humidifier module is created using one Grove-Relay(<https://www.seeedstudio.com/Grove-Relay.html>),humidifier wires, Grove-Temperature Humidity Sensor (DHT11)(<https://www.seeedstudio.com/Grove-Temperature-Humidity-Sensor-DHT11.html>), and Grove Beginner Kit for Arduino (<https://www.seeedstudio.com/Grove-Beginner-Kit-for-Arduino-p-4549.html>) as shown in figure1.

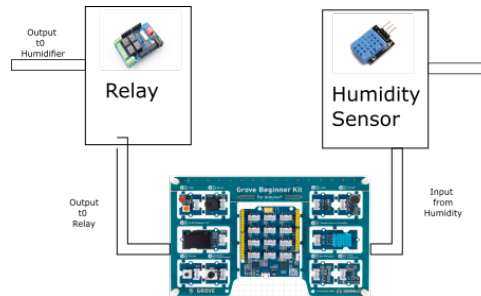


Figure 1: Humidity Module [8][3][5]

The humidity and temperature sensor is connects to certain the digital pin 3 (D3)as input in arduino. The relay is connected to digital pin D4 as output in arduino. This pin is also connected to an led. The led tells us weather the humidifier is turned on or off. The Humidity sensor reads the humidity level in the environment. DTH library is imported to the code. This code directly returns the humidity in percentage and temperature in degree Celsius. If the value of humidity in percentage is less than desired value, arduino board send HIGH signal to relay which turns the relay on. Then since the relay provides closed circuit, the humidifier starts working. Once the humidifier sets the room humidity to the desired level, the humidity sensor detects it and send signal to arduino board. The arduino board the turns off the relay which in turn turns off the humidifier.

- Light Module

The light module consists the relay(<https://www.seeedstudio.com/Grove-Relay.html>), PIR motion sensor (<https://www.seeedstudio.com/PIR-Motion-sensor-module-p-74.html>), and Light Sensor (<https://www.seeedstudio.com/Grove-Light-Sensor-P-v1-1.html>), wires, Grove Beginner Kit for Arduino (<https://www.seeedstudio.com/Grove-Beginner-Kit-for-Arduino-p-4549.html>). The PIR sensor is connected to digitla pin D7 in arduino. It retuns HIGH in presence of motion and LOW in absence of motion to the arduino board. Similarly, the Light sensor is connected to analog pin A6 as input. It provides numeric voltage from 0 to the source voltage of arduino to arduino board. This is quantized to 0 to 1023 level i.e. 1024 levels. The input of arduino board is mapped to 0 to 255 different levels. The relay is connected to digital pin D5 as output.The entire setup is sown in the conceptual figure 2.

When the light sensor and motion sensor detect light or motion respectively, it send data to arduino board. If the output of light sensor is below certain threshold and the output of motion sensor is HIGH, the arduino board sends HIGH output to the relay. This turns on the light. In every other scenario, the Low output is sent to the relay connected to the light spource. The light source connected to the relay and the light sensor are isolated as the light from the light controlled by relay could interfere with the reading of the light source.

The entire assembly consists of only one arduino board as show in the conceptual figure3

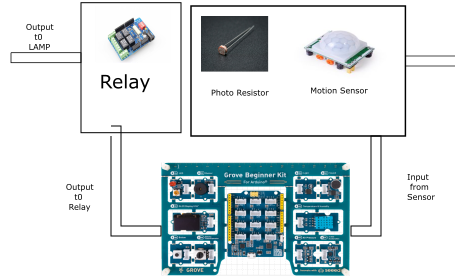


Figure 2: Light Module [1][3][5]

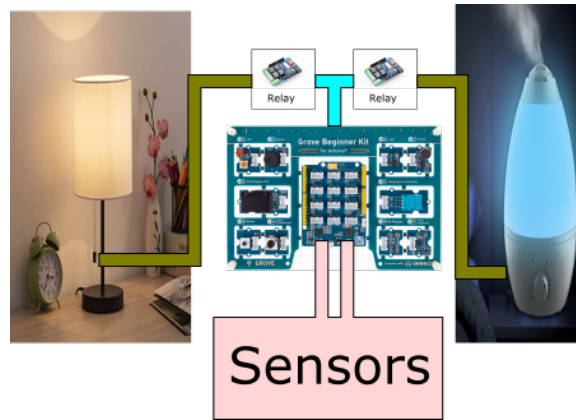


Figure 3: Assembly [1][8][3][5][7][6]

All the outputs from the sensor are show in the 0.96” LCD display.(https://wiki.seeedstudio.com/Grove-OLED_Display_0.96inch/)

Table 1 shows the list of components we use, as well as their prices on the Seeed store.

Table 1: Grove Component Prices

ITEM	Quantity	Price
Relays(Needed From Department)	2	\$2.90[3]
Light Sensor	1	\$2.90[1]
PIR Motion Sensor(Needed From Department)	1	\$5.90[8]
Oled Display	1	\$14.90[2]
Humidity Sensor	1	\$5.90[4]

2. Code Explanation

We import “DHT.h” and other libraries.

```
#include "DHT.h"
#include <Arduino.h>
#include <U8x8lib.h>
```

We define necessary output and input variables, constants and configurations.

```
#define DHTPIN 3 // what pin we're connected to
#define DHTTYPE DHT11 // DHT 11
DHT dht(DHTPIN, DHTTYPE);
U8X8_SSD1306_128X64_ALTO_HW_I2C u8x8(/* reset=*/ U8X8_PIN_NONE);

//output (relay)
const int humid=4;//humidifier
const int light=5;//light source

//input (sensors)
const int lightSensor=A6;
const int PirSensor =7;

//internal variables
int temperature,humidity;
int motion,lightvalue;
```

The necessary configurations for different pins

```
void setup() {
  pinMode(humid,OUTPUT);//initialize relay for humidifier
  pinMode(light,OUTPUT);//initialize relay for light source
  pinMode(lightSensor,INPUT);//initialize light sensor
  pinMode(PirSensor,INPUT);//initialize pir sensor
  Serial.begin(9600);
  dht.begin();
  u8x8.begin();
  u8x8.setPowerSave(0);
  u8x8.setFlipMode(1);
}
```

This part is the never ending loop. All names are self explanatory.

```
void loop() {
  temperature = dht.readTemperature();
  humidity = dht.readHumidity();
  motion=digitalRead(PirSensor);
  lightvalue= map(analogRead(lightSensor), 0, 1023, 0, 255);
  printTemp();//prints in LCD
  printHumidity();//prints in LCD
```

```

    printLightandmotion();//prints in LCD
    lightlogic();//prints in LCD
    humidifierlogic();//prints in LCD
}

```

The logic for light module. Light turns on in presence of motion and in absence of motion.

```

void lightlogic(){
    if ((lightvalue<=80)&&(motion=HIGH)) {//light is low and motion is present
        digitalWrite(light, HIGH);    // turn RELay ON
        delay(150);
    }else {
        digitalWrite(light, LOW); // turn LED OFF
    }
}

```

The logic for humidifier module. Humidifier turns on if the humidifier is below threshold.

```

void lightlogic(){
    if ((lightvalue<=80)&&(motion=HIGH)) {//light is low and motion is present
        digitalWrite(light, HIGH);    // turn RELay ON
        delay(150);
    }else {
        digitalWrite(light, LOW); // turn LED OFF
    }
}

```

This code prints in LCD

```

void printTemp(){
    u8x8.setFont(u8x8_font_chroma48medium8_r);
    u8x8.setCursor(0, 0);
    u8x8.print("Temp:");
    u8x8.print(temperature);
    u8x8.print("C");
    u8x8.refreshDisplay();
}

void printHumidity(){
    u8x8.setFont(u8x8_font_chroma48medium8_r);
    u8x8.setCursor(0,33);
    u8x8.print("Humidity:");
    u8x8.print(humidity);
    u8x8.print("%");
    u8x8.refreshDisplay();
}

void printLightandmotion(){
    u8x8.setFont(u8x8_font_chroma48medium8_r);
    u8x8.setCursor(0, 50);
    u8x8.print("Light:");
    u8x8.print(lightvalue);
    u8x8.print(" ");
}

```

```
u8x8.print(motion);  
  
u8x8.refreshDisplay();  
}
```

3. Results

The device performed as expected. Initial, I didn't realize that the light from the light that is being controlled by the relay could interfere with the light sensor. But it was a quick read. The Light source turned on in presence of motion and in absence of light. Similarly, the humidifier turned on if the humidity was below threshold and turned off if the humidity was above the threshold. There was minor delay between the change in condition and the output of the device. This was because of sequential action taking by arduino board. The arduino could only run a part of code at a moment and would neglect other part. This caused delay between the input of sensors and the output logic implementation. But the delay was too minor for the project.

Figure 4 shows our device in action.



Figure 4: Photo of Smart Room assembled

This project was overall a success. If we had more processing power, we could implement machine learning and add features such as voice control with two inputs: "ON" and "OFF" which would be possible by people saying the same words.

References

- [1] Grove - Light Sensor (P) v1.1. <https://www.seeedstudio.com/Grove-Light-Sensor-P-v1-1.html>. Accessed: 2020-10-20.
- [2] Grove - OLED Display 0.96". <https://www.seeedstudio.com/Grove-OLED-Display-0-96.html>. Accessed: 2020-10-20.
- [3] Grove - Relay. <https://www.seeedstudio.com/Grove-Relay.html>. Accessed: 2020-10-20.

- [4] Grove - Temperature Humidity Sensor (DHT11). <https://www.seeedstudio.com/Grove-Temperature-Humidity-Sensor-DHT11.html>. Accessed: 2020-10-20.
- [5] Grove Beginner Kit for Arduino. <https://www.seeedstudio.com/Grove-Beginner-Kit-for-Arduino-p-4549.html>. Accessed: 2020-08-31.
- [6] Humidifier. <https://secure.img1-fg.wfcdn.com/im/89842021/compr-r85/4197/41970022/1-gal-ultrasonic-tabletop-humidifier.jpg>. Accessed: 2020-10-20.
- [7] Lamp. https://images-na.ssl-images-amazon.com/images/I/61fRbwYlhKL._AC_SX679_.jpg. Accessed: 2020-10-20.
- [8] PIR Motion sensor module. <https://www.seeedstudio.com/PIR-Motion-sensor-module-p-74.html>. Accessed: 2020-10-20.