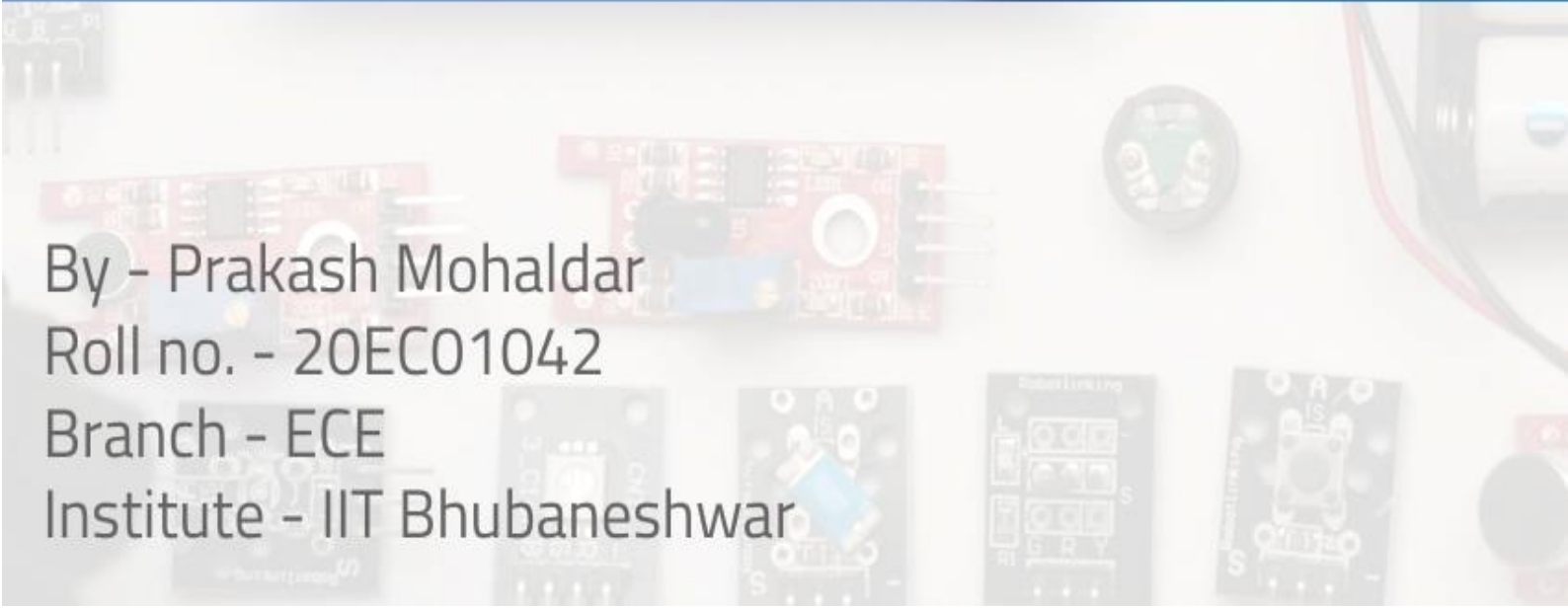
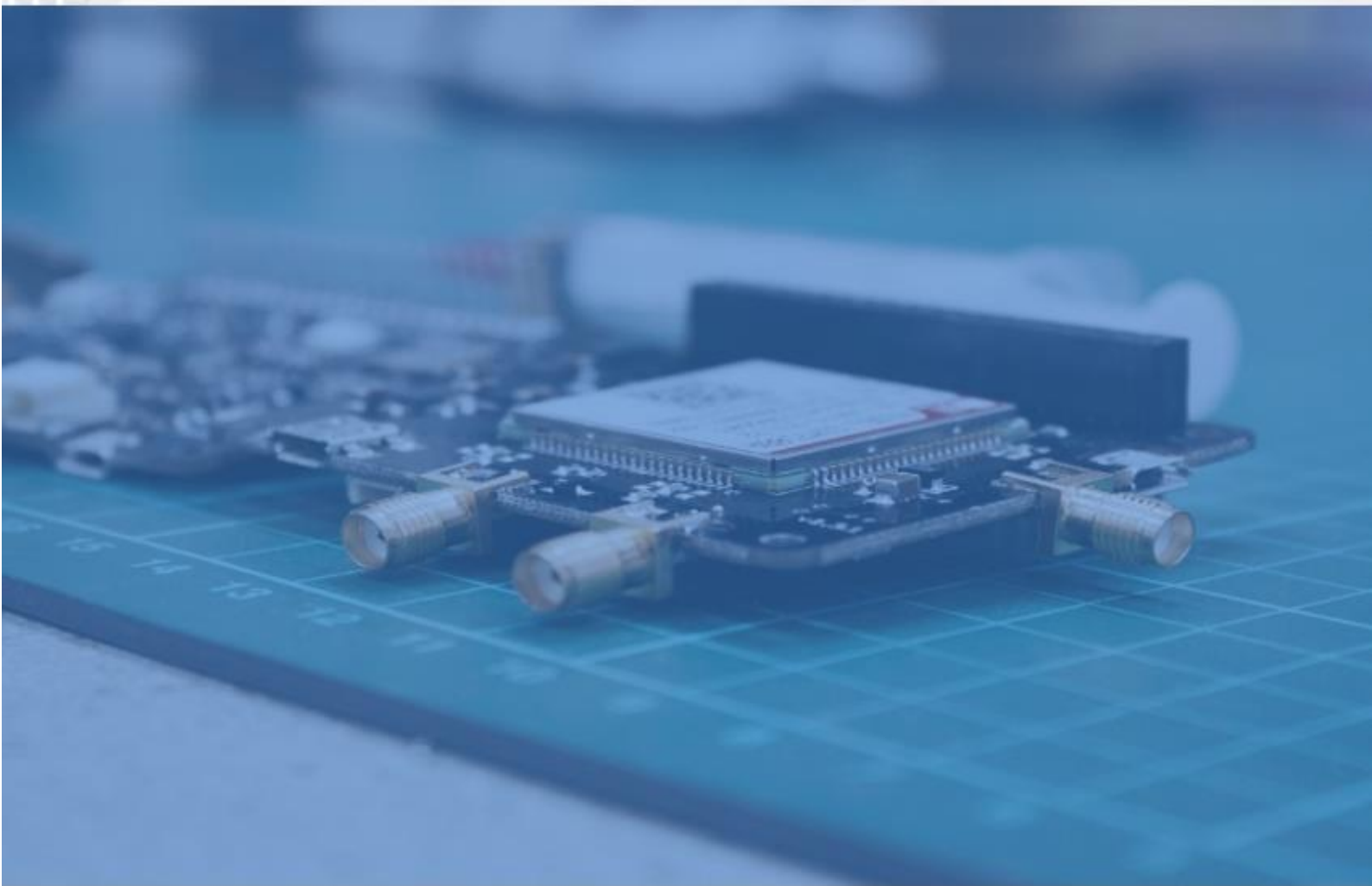




Building A Wireless Temperature and Humidity Monitoring System



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Objective:

1. Collecting data of Temperature and Humidity using temperature and humidity sensor DHT11
2. Interfacing Bluetooth module with microcontroller and transferring data
3. Displaying the transferred data over a linked Android Application

Components required:

Hardware:

- Arduino UNO R3 Microcontroller
- DHT11 Temperature and Humidity Sensor (3 pins)
- HC – 05 Bluetooth Module
- Bread Board
- Jumper wires
- USB A to B cable

Software:

- Arduino IDE
- Bluetooth Terminal Android Application (built using MIT App inventor)

Design Specification:

1. Hardware Design of System

1.2 Main Control Module



This control module uses the Arduino platform. Arduino is an opensource software and hardware platform that based on the Atmel AVR and ARM micro controller. It is cheap, convenient and flexible. Its software design uses a high-level language like C++.

The core of Arduino UNO processor is ATmega328. It has 14 roads digital input/output

(six roads can be used as a PWM output), 6 roads analog input, 32 KB Flash Memory and 1 KB EEPROM. At the same time, the ATmega328 of Arduino UNO presets the bootloader, program can be download in UNO directly by the Arduino software program.

Along with code, USB A/B cable also provides power supply to Arduino from Desktop/laptop. COM3 port is used to upload code.

1.2 Bluetooth low energy module



HC-05 Bluetooth Module is an Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. BLE uses the 2.4Ghz ISM band with baud rate of 9600.

The transfer rate of the data can vary up to 1Mbps and is in range of 10 meters. The HC-05 module can be operated within 4-6V of power supply. HC – 05 consist of 6 pins, two of them (Tx, Rx) is used for transmitting received data serially and broadcasting serial data serially over Bluetooth

1.3 Temperature & humidity Sensor DHT11



DHT11 sensor is used to measure the temperature and humidity. It has a resistive humidity sensing component and a negative temperature coefficient (NTC). An 8bit MCU is also connected in it which is responsible for its fast response. After MCU sending start instruction to sensor, temperature & humidity sensor DHT11 that comprises a low power state transform to high-speed condition. When the command finished, sensor will launch instruction of its response signal and 40 bits information of data. At the same time, trigger a instruction of signal collection. Then we can be able to read the part of data information

2. Software design of System

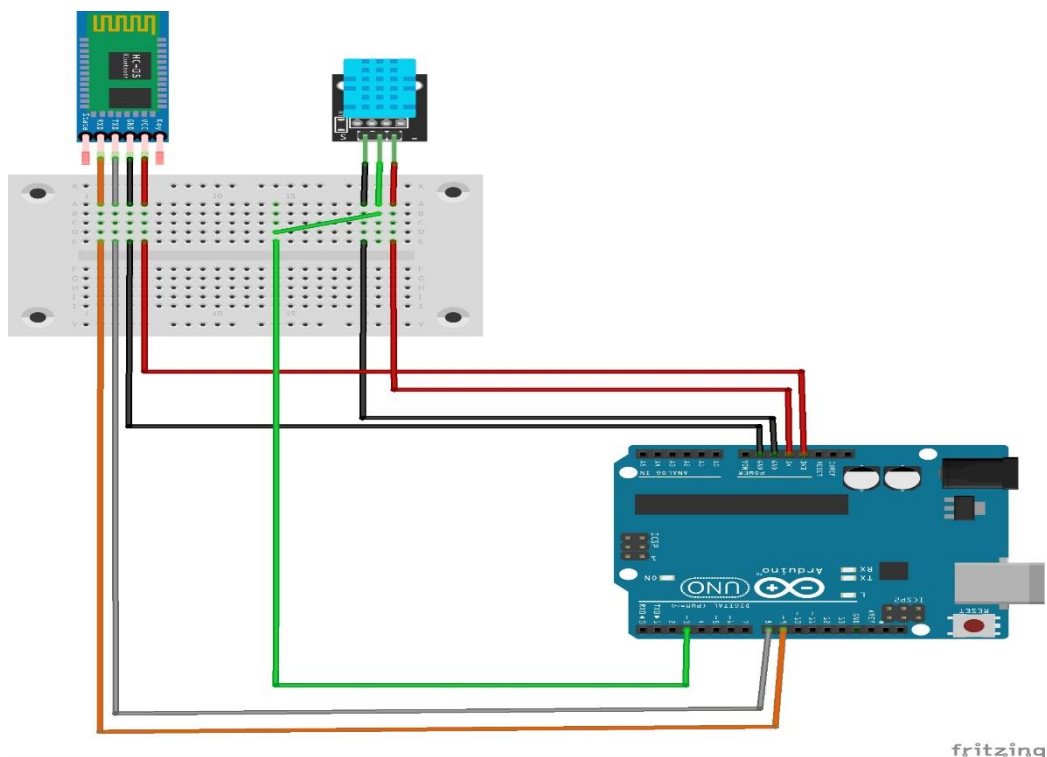
Each main functional modules in the system, such as, wireless Bluetooth module, temperature and humidity data acquisition module, etc., are edited into independent function and then called by the main program.

2.1 Acquisition and Transfer of current time temp and hum data

Temperature & humidity acquisition device DHT11 through single bus connected with MCU when the microcontroller sends a start signal, then DHT11 send its response signal and 40 bits of data to the data buffer of single-chip microcomputer. The main

program of system transmitting terminal is settings initialization of the pin mode firstly, then is the initialization of Bluetooth module HC 05, and set it to send mode. Next, collecting temperature and humidity data, processing temperature and humidity data, packaging the collected data and sending it at the same time.

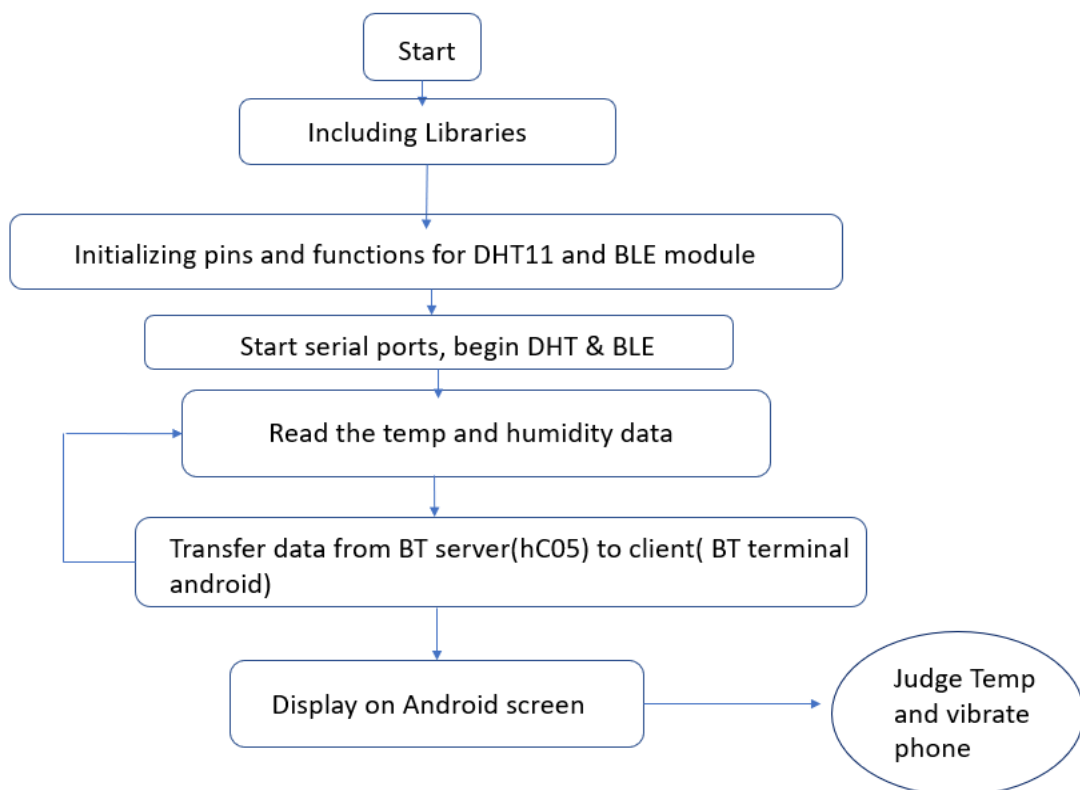
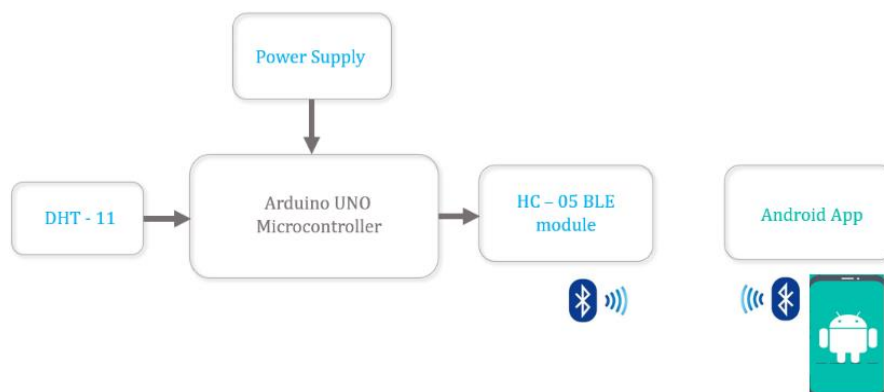
Circuit Diagram:



2.2 Software design of system receives

The Bluetooth Client component (i.e. Bluetooth in android) sends the connection request and the Bluetooth Server component (i.e. HC – 05 BLE) accepts the request and connection is established. The master (HC – 05 BLE) is plugged into Arduino, the HC05 server-master is connected to Bluetooth slave- client in MIT A12 App.

Block Diagram & Algorithm:



In Arduino IDE install and include “DHT11” library, “SoftwareSerial” library for assessing commands and functions. Define and Initialize the pins and functions for BHT11 and BLE module. The DHT type is initialized as DHT11. DHT’s data pin is connected to D3 pin in Arduino. TX and Rx pin of BLE is connected with D8 and D9 pins. SoftwareSerial object “bt” and DHT object “dht” is declared. Also declare float variables

Start the serial port at 9600, also begin the DHT sensor and BLE sensor with baud rate of 9600. Read the temperature over the loop using “readHumidity”, “readTemperature” and save it to a “hum”, “temp”, “f” variables. Use “print” function of “bt” object with input of temperature and humidity values stored in variable and display it over the Bluetooth serial monitor (Android screen). Give a delay of 5000 for reading and transmitting data after every 5sec.

Use MIT App inventor for developing an app consisting of BluetoothClient which requests the HC – 05 Bluetooth server to connect. Read the “temp” and “hum” variables. Also use conditional statements to notify the users about the temperature.

Real Time evaluation Results:

Connect the sensors according to the circuit diagram. Connect the USB A/B cable with Arduino and plug it into Laptop. Upload the code from Arduino IDE selecting COM3 port. In mobile open the App and press connect and select HC 05 to establish connection.

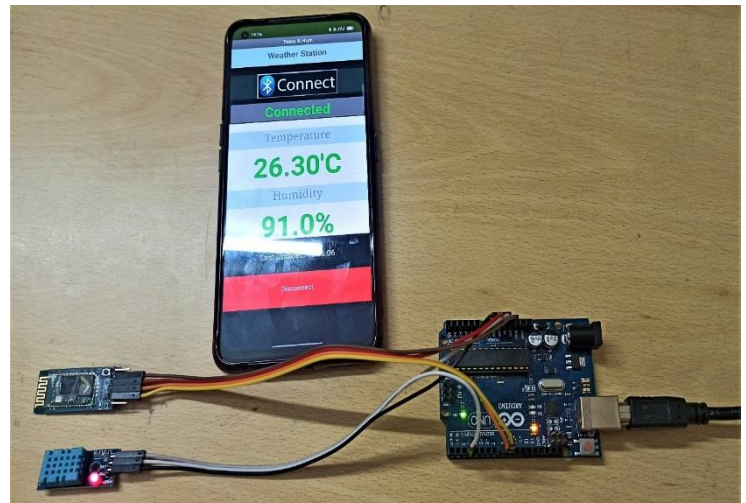


Fig – Display of current time temperature and humidity on Android

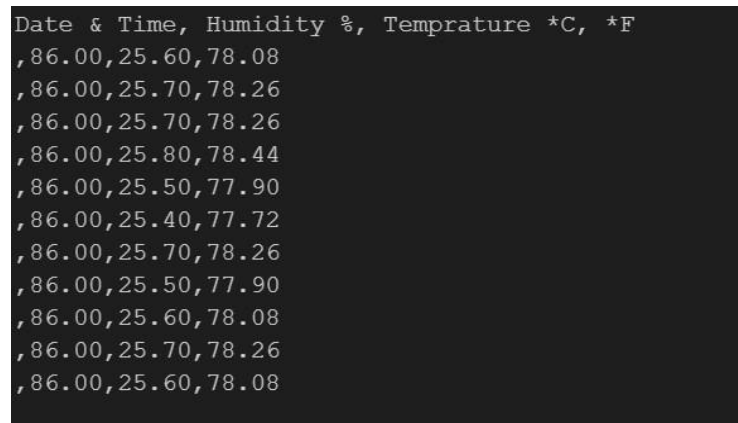


Fig – Display of current time temperature and humidity serial monitor

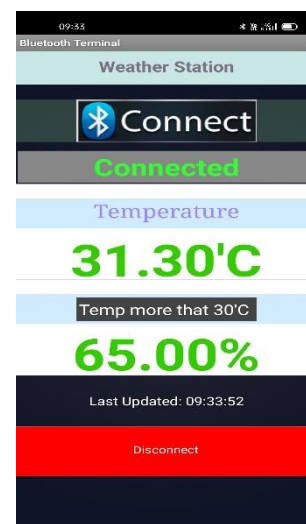


Fig – Buzz notification to user about high temperature

Source code:

```
#include <SoftwareSerial.h>

#include<DHT.h>

SoftwareSerial bt(8,9);// Tx Rx

#define DATAPIN 3

#define DHTTYPE DHT11

DHT t(DATAPIN,DHTTYPE);

float temp;

float hum;

float f;

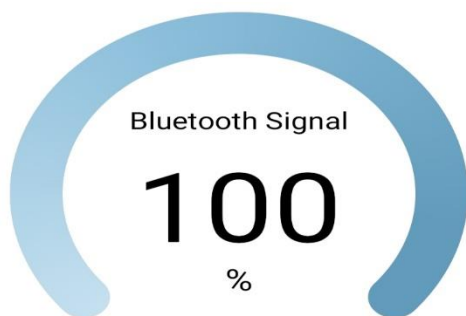

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  t.begin(9600);
  bt.begin(9600);
  Serial.println("Date & Time, Humidity %, Temperature *C, *F");
}


void loop() {
  // put your main code here, to run repeatedly:
  hum = t.readHumidity();
  temp = t.readTemperature();
  f = t.readTemperature(true);

  bt.print(temp);
```

```
bt.print(";");  
bt.print(hum);  
bt.println(";");  
  
Serial.print(",");  
Serial.print(hum);  
Serial.print(",");  
Serial.print(temp);  
Serial.print(",");  
Serial.println(f);  
  
delay(5000);  
}
```

Observation:



Device:	HC-05
MAC:	00:18:E4:00:11:51
RSSI:	-56 dBm
Signal strength:	Excellent

Fig – Bluetooth signal strength test

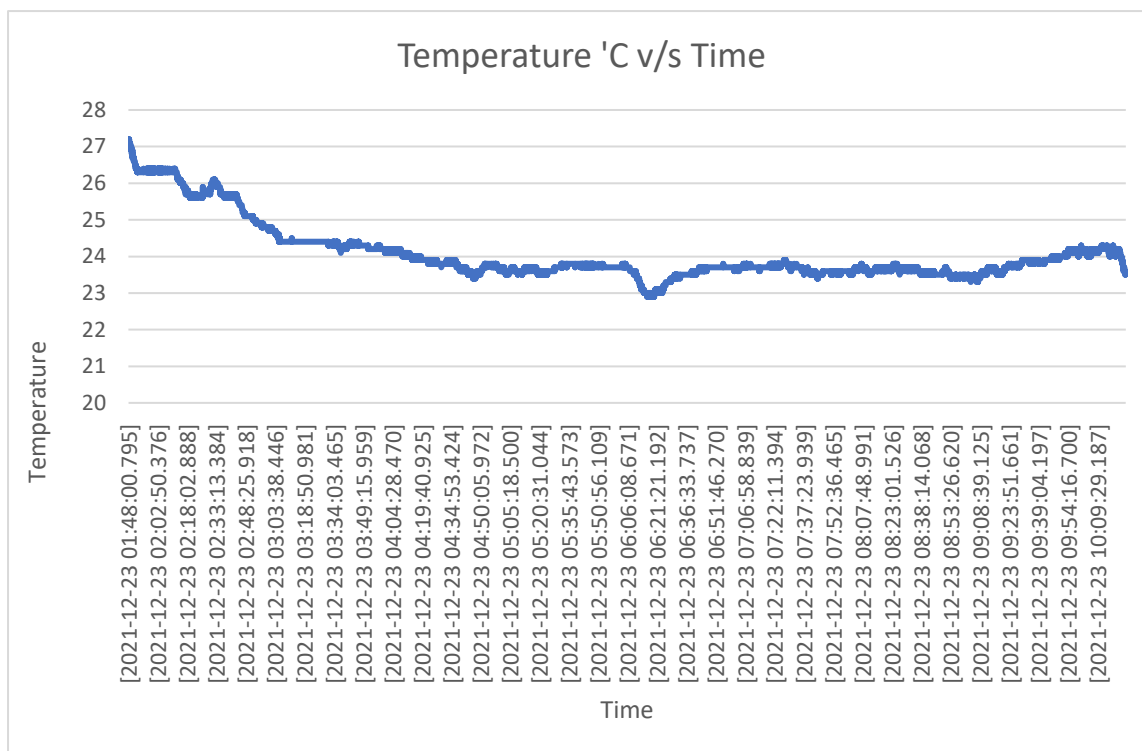


Fig – Plot of Temperature value recorded over night

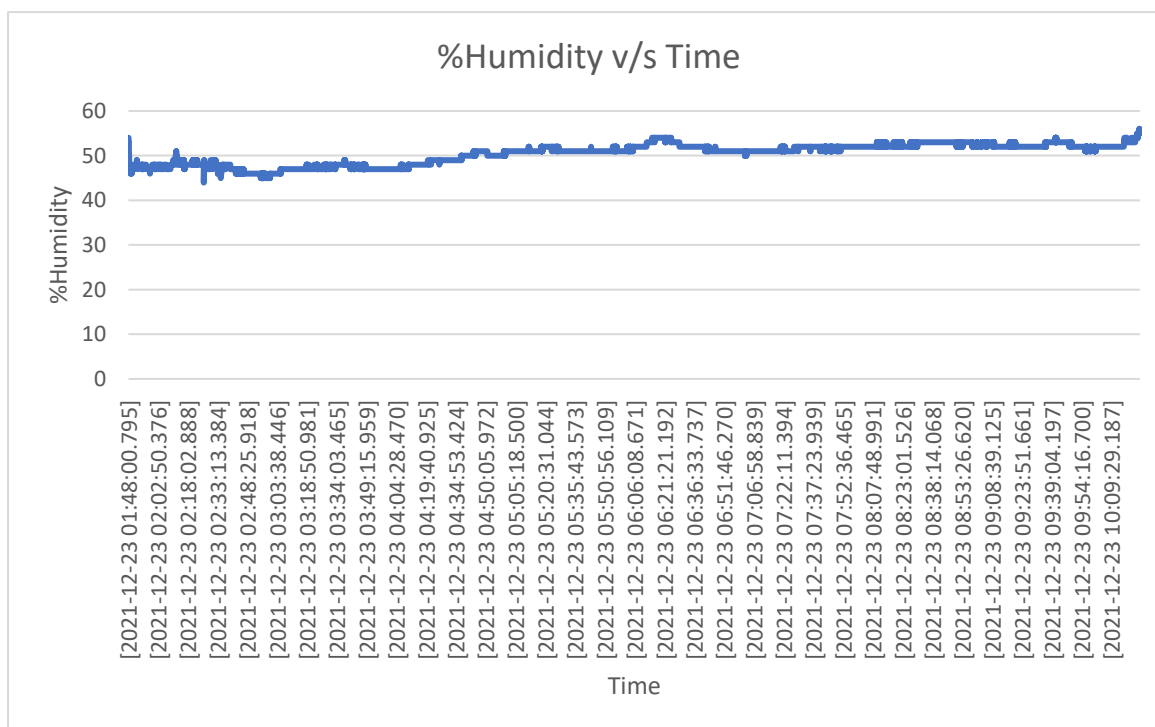


Fig – Plot of Humidity value recorded over night

The things I learned:

I have learned about Arduino microcontroller, its design specification & pinouts, and programming in Arduino IDE. Concepts like Serial communication and Pulse width modulation. Simulating software such as TinkerCad and Fritzing.

Different sensors used in IOT like – HC- SR04 Ultrasonic Module, DHT11 Temperature and Humidity sensor, PPG sensor, Soil Moisture Sensor and components like RGB led, servo motors, LCD screen, push button, buzzer etc. The library used for these sensors and components for programming were also made clear while doing this project.

Conclusion:

ATmega328P based microcontroller board Arduino is the main controlling system. HC – 05 BLE module is the key device for wireless data transmission. And it through temperature & humidity sensor DHT11 collects temperature and humidity data. Eventually, the results of communication will be displayed on the android screen using Bluetooth connecting App. In addition, the user gets notified when the temperature of the surrounding is very high or low. This design has lots of characteristics, such as, small size, low power consumption, low cost, high accuracy and it can be real-time and easy development.

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