ABSTRACT

• Thermal comfort brings a great influence that may affect the satisfaction of a person about the indoor environment, as this could lead to the level of productivity and social interactions.

• One of the most suitable tools that have been utilized in tropical region to create thermally comfortable indoor environment is the air conditioning (AC) system.

• However, the conventional method of controlling the AC may not guarantee thermally comfortable indoor environment, furthermore excessive cooling chosen by users may also contributed to negative side effect toward the person's health.

• To overcome this problem, an IOT-based smart system that can control the AC to provide a suitable thermally comfortable environment is proposed in this project. The system will interact with the users by recording their feeling toward the environment as the input for the system.

- Together with sensor data [Skin Temperature Sensor, and Integrated Transmitter sensor] the information will be integrated with a model to control the AC smartly so that the occupant can feel thermal satisfactory.

• Based on the results, the IOT based smart system can create a thermally comfortable indoor environment compared to the maximum cooling setting as usually being adapted by the room's occupants

INTRODUCTION

Bio-Sensor’s are used in order to predict patient temperature condition for proper medication. For this we used sensor’s for the patient. The main concept is when the patient is unable to move from the bed, then we can use this sensor to change the temperature of the Air-Conditioning automatically. With the help of the sensors, the sensor will sense the temperature of the body and it will transmit signals to Air-Conditioning system. Then the room temperature will be changed with respect to the body temperature of the patient.

Problem Statement of HVAC&R SRPG

• We came up with this idea of different temperature and thermal stress.

• To stabilize the temperature of room based on the human body metabolism by using IOT devices and sensors.

RESEARCH GAP

• Especially in intensive care unit hospitals, it is necessary to maintain indoor air characteristics such as temperature, humidity, wind speed, and air purity 24 hours a day, 7 days a week, depending on the patient's health condition.

• But in reality, it often didn't happen in the way it needed to be maintained.

• In order to maintain and improve health, air conditioners need to adjust their condition based on signals from biosensors embedded with artificial intelligence.

OBJECTIVES OF PROJECT

Wearable sensors and artificial intelligence (AI) are two crucial areas for attaining the objective of customizing the best precision medical therapy for each patient.

• The gathering of patient data, wearable sensor design, and wearer health, fitness, and environment can all be improved by combining these two sectors.

• Wearable sensors have received a great deal of attention for useful insights into people's performance and health, since the introduction of smart phones and other mobile devices.

• Early efforts in this area focused on mobility and physical sensors that monitor vital signs such as steps, calories burned, and heart rate.

• The face of wearable devices has changed rapidly in recent years as researchers focus from tracking physical activity to addressing key challenges in healthcare applications such as diabetes treatment and remote monitoring of the elderly.

HUMAN COMFORT

A human body feels comfortable thermodynamically when the heat produced by the metabolism of human body is equal to the sum of the heat dissipated to the surroundings and the heat stored in human body by raising the temperature of body tissues. This phenomenon can be represented by the following equation.

$$QM = \pm QS + QE \pm QR \pm QC$$

Where ,

QM Metabolic heat produced within the body (kJ/h.)

±QS = Stored energy n temperature rise of body tissues; +ve when the tissue temperature rises and - ve when it falls.

QE = Evaporative heat loss due to the water evaporating at skin surface and the lungs expressed in kJ/h.

±QR = Heat loss and gain by radiation; + ve when heat is lost to the surrounding, and - ve, when it is gained from the surroundings kJ/h.

±QC = Heat loss or gain by conduction and convection; + ve when heat is lost, and - ve, when heat is gained from the surroundings in kJ/h.

CONTROL MECHANISM

• ***Vasomotor Control***

This control regulates the blood supply to the skin. It acts by causing vasodilatation of the peripheral blood vessels, if environment temperature is increased. The vasomotor mechanism alone is sufficient to maintain the heat balance at a low level of heat load, and is therefore known as “First Line of Defense ". This decreases blood circulation and reduces body cooling.

• ***Sudomotor Control***

This control regulates sweat production. Whenever the heat loss by convection and radiation becomes negative due to high temperature of atmosphere compared to body temperature, the only mode of heat transfer to disappear the heat is by evaporation. The Sudomotor control acts by initiating sweat gland activity. The sweating capacity differs according to person’s degree of acclimatization to heat and work.

TEMPERATURE SENSING METHODS

In this we can see, there are 2 types of sensing methods they are:

1. Skin Temperature Sensing
2. Integrated Transmitted Sensing

1. Skin Temperature Sensing

• Skin temperature is the temperature of the outermost surface of the body.

• Normal human skin temperature on the trunk of the body varies between 33.5 and 36.9 °C (92.3 and 98.4 °F), though the skin's temperature is lower over protruding parts, like the nose, and higher over muscles and active organs.

• Recording skin temperature presents extensive difficulties.

• Although it is not a clear indicator of internal body temperature, skin temperature is significant in assessing the healthy function of skin.

• Some experts [who?] believe the physiological significance of skin temperature has been overlooked, because clinical analysis has favored measuring temperatures of the mouth, armpit, and/or rectum.

• Temperatures of this parts typically are consistent with internal body temperature.

• Patterns in skin temperature often provide crucial diagnostic data on pathological conditions, ranging from locomotion to vascular diseases.

• Such information can prove significant to determination of subsequent therapeutic treatments.

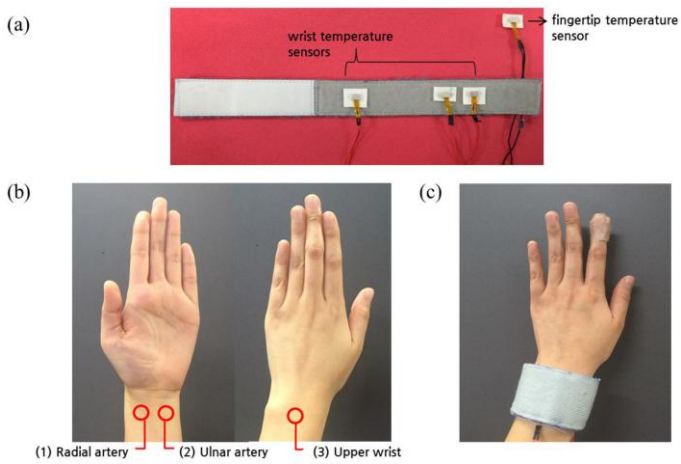


Figure 1: Represents the measuring of skin temperature

How Skin Temperature Sensor Work

• Temperature sensors work by providing readings via electrical signals.

• Sensors are composed of two metals that generate an electrical voltage or resistance when a temperature change occurs by measuring the voltage across the diode terminals.

• When the voltage increases, the temperature also increases.

2. Integrated Transmitted Sensing

• An ICU Temperature Sensor is a two terminal integrated circuit temperature transducer that produces an output current proportional to the sensor package is small with a low thermal mass and a fast response time. The most common temperature range is 55 to 150°C.

• In electronics and telecommunication s, a radio transmitter or just transmitter is an electronic device which produces radio waves with an antenna.

• The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. • When excited by this alternating current, the antenna radiates radio waves.

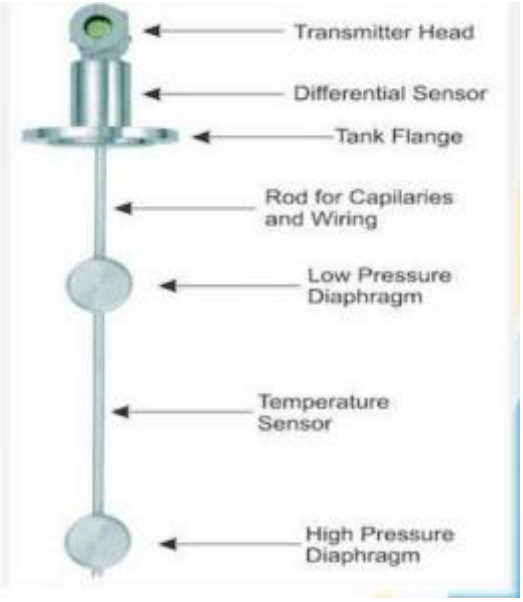


Figure 2: Integrated Transmitted Sensor

PATIENT IN AIR-CONDITIONING ROOM

• In this region we will see, the patient is unable to move and he is not able to adjust the Air-Conditioning.

• For that purpose we are using this Air-Conditioning method, which is used for the patient who are unable to move from the bed.

• Changing the Air-Conditioning conditions automatically without getting-up from the bed, with the help of sensors [Skin Temperature sensor, Integrated Transmitter sensor], we are controlling.

• With the help of our body temperature, which are noted by sensors the Air-Conditioning will change its conditions with respect to body temperature.

• First the body temperature will be sensed by Skin Temperature sensor.

• After that the body temperature which is sensed, it will transmit the body temperature to the Air-Conditioning with the help of Integrated Transmitter sensor.

• With the help of this Integrated Transmitter sensor, the sensor will transmit the body temperature to Air-Conditioning and the temperature in Air-Conditioning will change with respect to the patient body temperature.

COMPONENTS

- Arduino Uno
- Arduino Mini
- Arduino Mega2500
- Bread Board
- OLED VCC- 5V
- TSOP VCC
- IR LED
- LM 35 Temperature Sensor
- DHT 11 Temperature Sensor
- Jump Wires

1. Arduino Uno

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Arduino UNO features AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output.

Figure 3: Arduino UNO

This board contains a USB interface i.e. USB cable is used to connect the board with the computer and Arduino IDE (Integrated Development Environment) software is used to program the board.

The unit comes with 32KB flash memory that is used to store the number of instructions while the SRAM is 2KB and EEPROM is 1KB.

The operating voltage of the unit is 5V which projects the microcontroller on the board and its associated circuitry operates at 5V while the input voltage ranges between 6V to 20V and the recommended input voltage ranges from 7V to 12V.

2. Arduino Mini

This board was developed for applications and installations where space is premium and projects are made as permanent set ups. Small, available in 3.3 V and 5 V versions, powered by ATmega328P.

Figure 4: The Arduino Pro Mini board

The **Arduino Pro Mini** is a microcontroller board based on the ATmega328P.
It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable or Sparkfun breakout board to provide USB power and communication to the board.

The Arduino Pro Mini is intended for semi-permanent installation in objects or exhibitions. The board comes without pre-mounted headers, allowing the use of various types of connectors or direct soldering of wires. The pin layout is compatible with the Arduino Mini.

3. Arduino AT mega 2500

Known for its capabilities in handling more complex projects, the Arduino Mega 2560 gives your projects plenty of room and opportunities. It's recommended for 3D printers and robotics projects with its 54 digital I/O pins, 16 analog inputs, and a large space. Arduino Mega 2560 is an all-around good option.

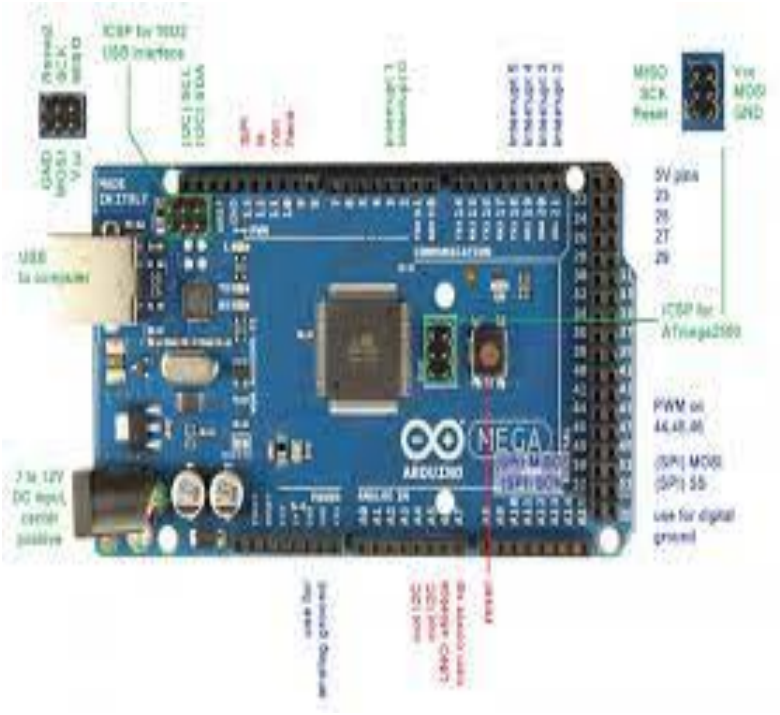


Figure 5: AT mega 2500

4. *Bread Board*

A breadboard (sometimes called a plugblock) is used for building temporary circuits. It is useful to designers because it allows components to be removed and replaced easily. It is useful to the person who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit.

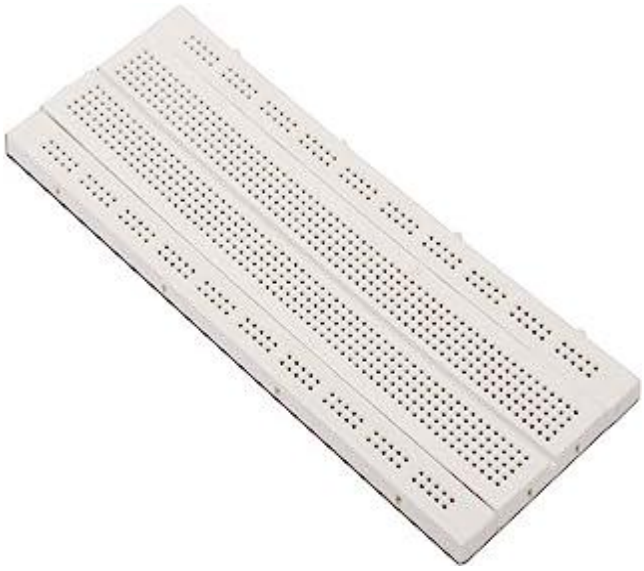


Figure 6: Bread Board

5. *OLED VCC 5V*

OLED (Organic Light-Emitting Diode) is a self light-emitting technology composed of a thin, multi-layered organic film placed between an anode and cathode. In contrast to LCD technology, OLED does not require a backlight. OLED possesses high application potential for virtually all types of displays and is regarded as the ultimate technology for the next generation of flat-panel displays. 2.44 cm (0.96 Inch) I2C/IIC 128x64 OLED Display Module 4 Pin - White Color is a precise small, White OLED module which can be

interfaced with any microcontroller using I2C/IIC protocol. It is having a resolution of 128x64.

OLEDs basic structure consists of organic materials positioned between the cathode and the anode, which is composed of electric conductive transparent Indium Tin Oxide (ITO). The organic materials compose a multi-layered thin film, which includes the Hole Transporting Layer (HTL), Emission Layer (EML) and the Electron Transporting Layer (ETL). By applying the appropriate electric voltage, holes and electrons are injected into the EML from the anode and the cathode, respectively. The holes and electrons combine inside the EML to form excitons, after which electro luminescence occurs. The transfer material, emission layer material and choice of electrode are the key factors that determine the quality of OLED components.

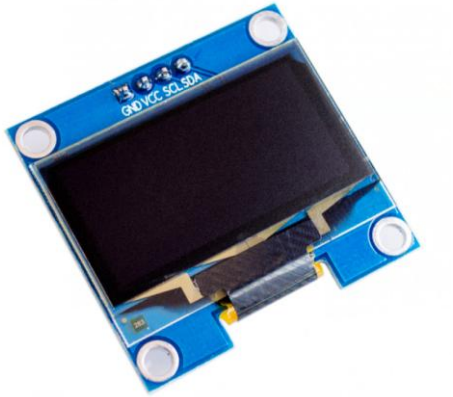


Figure 7: OLED Display

6. *TSOP VCC*

The TSOP1738 series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP1738 is the standard IR remote control receiver series, supporting all major transmission codes.

Figure 8: TSOP 1783 Sensor

7. *IR LED*

These are high power 5mm Infrared Red Light Emitting Diode sensor emits light at a range of 700nm to 1mm. An IR sensor is an electronic sensor that measures and detects the infra-red light radiating from an object or its environment. These lights are not visible by naked eyes but can be seen through a camera. That is the reason why these IR sensors used in night vision cameras. When light falls on the IR sensor, the photodiode response in terms of change in resistance. This change in resistance measured in terms

of voltage. This module can be connected directly to a microcontroller, Arduino, or Raspberry Pi with a few current limiting resistors.

Figure 9: IR LED

8. *LM 35 Temperature Sensor*

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly- proportional to the Centigrade temperature.

The LM35 uses a solid-state technique to measure the temperature. It makes use of the fact that the voltage drop between the base and emitter (forward voltage – V_{be}) of the Diode-connected transistor decreases at a known rate as the temperature increases.

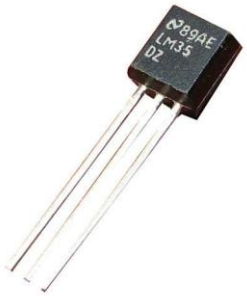


Figure 10: LM 35 Temperature Sensor

Minimum and Maximum Input Voltage is 35V and -2V respectively. Typically 5V. Output voltage is directly proportional (Linear) to temperature (i.e.) there will be a rise of 10mV (0.01V) for every 1°C rise in temperature.

9. DHT 11 Temperature & Humidity Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.

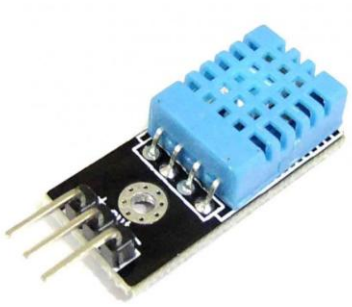


Figure 11: DHT 11 Temperature & Humidity Sensor

DHT stands for Digital Humidity and Temperature. The DHT sensor is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi to measure humidity and temperature instantaneously.

10. Jump Wires

A jumper wire is an electric wire that connects remote electric circuits used for printed circuit boards. By attaching a jumper wire on the circuit, it can be short-circuited and short-cut (jump) to the electric circuit. RF jumper cables - Jumper cables is a smaller and more bendable corrugated cable which is used to connect antennas and other components to network cabling.

(a) (b) (c)

Figure 12 (a), (b), (c): Represents Male – Male, Female - Female, Male – Female Jump wires

EXPERIMENTAL SETUP

LM-35 CODE:

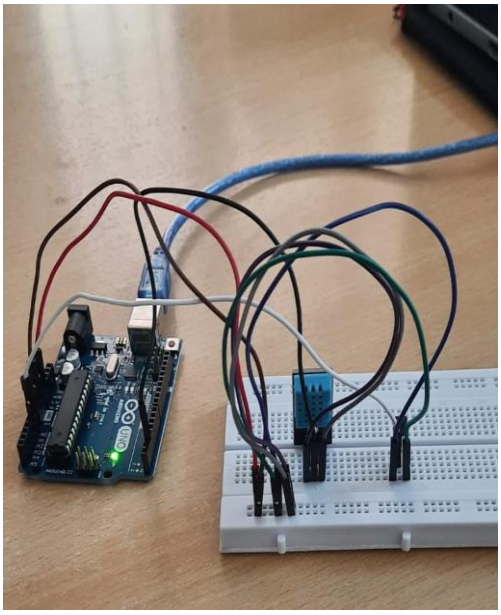
```
#include <LM35.h>
#define LM35 A0
void setup() {
   Serial.begin(9600);
}
void loop() {
  float imvalue = analogRead(LM35);
  float tempr = (lmvalue * 500)/1023;
  Serial.println(tempr); //Temperature in celcius
  delay(2000);
}
```

LM35 & DHT 11 CODE:

```
#include <LM35.h>
#include <DHT.h>
#include “DHT.h”
#define DHTPIN 2
#define DHTTYPE DHT11
#define LED 13
#define LM35 0
DHT dht (DHTPIN, DHTTYPE);
void setup() {
  Serial.begin(9600);
  Serial.println(“DHT11 test!”);
  pinMode(LED, OUTPUT);
  analogReference(INTERNAL);
  dht.begin();
```

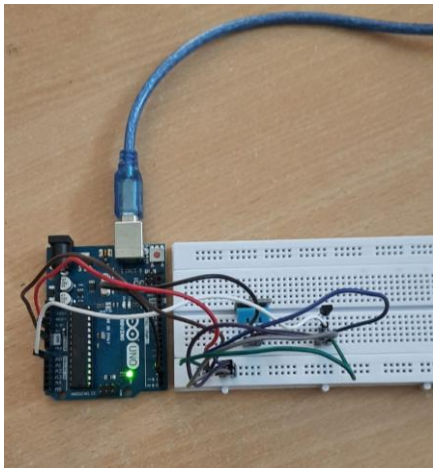
```
}
void loop() {
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  float tempC = analogRead(LM35) / 9.31;
 if (isnan(t) || isnan(h)) {
   Serial.println("Failed to read from DHT");
 } else {
   Serial.print("DHT11 Humidity: ");
   Serial.print(h);
   Serial.print("%\t");
   Serial.print(t);
   Serial.print(" *C, LM35: ");
   Serial.println(tempC);
 }
  delay(5000);
}
```

13 (a)

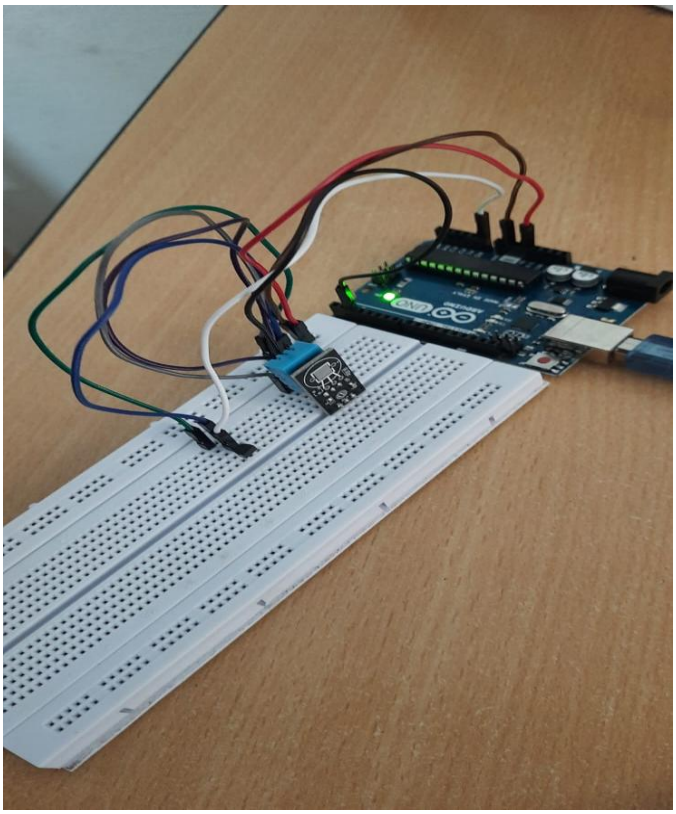


13 (b)

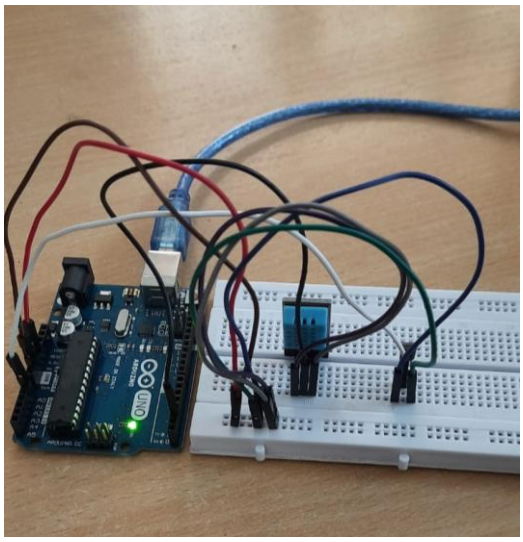
13 (c)



13 (d)



13 (e)



13 (f)

Figure 13 (a), (b), (c), (d), (e), (f): Represents Circuits

CONCLUSION

• This project will be helpful for the patients, those who are unable to move from the bed.

• Without the help of anyone, room temperature can be adjusted automatically by the signals transmitted from the Bio-sensor's which inturn takes the input from the metabolic rate of the person.

• We already interacted with the hospital management near to us, experting to come out with this product as soon as possible for the benefit of the society.