IOT WEATHER STATION

A PROJECT REPORT

Submitted by

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CSE3009 - INTERNET OF THINGS (EPJ)

Under the guidance of

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B. Tech
in
Computer Science and Engineering

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

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ABSTRACT:

A weather station can be described as an instrument or device, which provides us with the information of the weather in our neighboring environment. The goal of this project is to find details about the surrounding temperature, barometric pressure, humidity, etc. Internet of Things (IOT) takes this a step further and connects not only humans but electronic devices which can speak amongst themselves. Hence, this device basically senses the temperature, pressure, humidity, light intensity. There are various types of sensors present in the prototype, using which all the aforementioned parameters can be measured. It can be used to monitor the temperature or humidity of a particular room/place. With the help of temperature and humidity we can calculate other data parameters, such as the dew point. In addition to the above mentioned functionalities, we can monitor the light intensity of the place as well. We have also enabled to monitor the atmospheric pressure of the room. We can also monitor the rain value. Four sensors are connected to the Node MCU namely temperature and humidity sensor (DHT11), pressure sensor (BMP180), raindrop module, and light dependent resistor (LDR). In the cloud service one can utilize these data to alert people by various means such as using a buzzer or sending them an e-mail or sending them SMS etc.

LITERATURE SURVEY:

1. Internet of Things (IoT): A vision, architectural elements, and future directions

Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusi, Marimuthu Palaniswami Department of Electrical and Electronic Engineering, The University of Melbourne, Vic - 3010, Australia and Department of Computing and Information Systems, The University of Melbourne, Vic - 3010, Australia

Abstract:

Ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies cuts across many areas of modern day living. This offers the ability to measure, infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments. The proliferation of these devices in a communicating–actuating network creates the Internet of Things (IoT), wherein sensors and actuators blend seamlessly with the environment around us, and the information is shared across platforms in order to develop a common operating picture (COP). Inspired by the recent adaptation of a variety of enabling wireless technologies such as RFID tags and embedded sensor and actuator nodes, the IoT has stepped out of its infancy and is the next revolutionary technology in transforming the Internet into a fully integrated Future Internet. As we move from www (static pages web) to web2 (social networking web) to web3 (ubiquitous computing web), the need for data-on- demand using sophisticated intuitive queries increases significantly. The key enabling technologies and application domains that are likely to drive IoT research in the near future are discussed. A Cloud implementation using Aneka, which is based on interaction of private and public Clouds is presented.

2. IoT based weather station

IEEE Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2016 Ravi Kishore Kodali, Snehashish Mandal

Abstract:

A weather station provides us with the information of the weather in our neighbouring environment. It can provide us with details about the surrounding temperature, barometric pressure, humidity, etc. Hence, this device basically senses the temperature, pressure, humidity, light intensity, rain value. There are various types of sensors present in the prototype, using which all the

aforementioned parameters can be measured. It can be used to monitor the temperature or humidity of a particular room/place. With the help of temperature and humidity we can calculate other data parameters, such as the dew point. In addition to these functionalities, we can monitor the light intensity of the place as well. We have also enabled to monitor the atmospheric pressure of the room. We can also monitor the rain value. This prototype uses the ESP8266 based Wi-fi module Nodemcu (12E). Four sensors are connected to the NodeMCU namely temperature and humidity sensor(DHT11), pressure sensor(BMP180), raindrop module, and light dependent resistor(LDR). Whenever these values exceed a chosen threshold limit for each an SMS, an E-mail and a Tweet post is published alerting the owner of the appliance to take necessary measures.

3. Internet of Things (IOT) Based Weather Monitoring system

International Journal of Advanced Research in Computer and Communication Engineering

Abstract:

The system proposed in this paper is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. The technology behind this is Internet of Things (IoT), which is an advanced and efficient solution for connecting the things to the internet and to connect the entire world of things in a network. Here things might be whatever like electronic gadgets, sensors and automotive electronic equipment. The system deals with monitoring and controlling the environmental conditions like temperature, relative humidity, light intensity and CO level with sensors and sends the information to the web page and then plot the sensor data as graphical statistics. The data updated from the implemented system can be accessed through the internet from anywhere in the world. By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi. The smart way to monitor environment and an efficient, low cost embedded system is presented with different models in this paper.

4. Comfort control system incorporating weather forecast data and a method for operating such a system

Ulf Stefan Berglund, Bjorn Henry Lundberg, Honeywell Inc

Abstract:

In a comfort controls system for multiple buildings (whether residential, commercial or industrial), a weather forecast unit sends weather forecast data over the Internet to a building management provider which handles building management services for a number of clients, each having a number of buildings and properties. At the provider's reception station, data on the external-building characteristics of all the buildings are compiled with the received data and then fed to the appropriate building management controls system. An object of the invention is to provide a system, and method of operation, for comfort control of buildings involving weather forecast information and suited for use over a wide geographical area. It can be described as a system for air conditioning and/or hot water supplying apparatus using a central heat source which supplies cooling or heating to a plurality of dwelling units of a congregated or multi-storied house. The system includes a database which stores data for forecasting weather or atmospheric phenomena near the multi-storied house on the basis of the data from a weather information sensor. Thus, while such a database may provide a useful record of what weather has previously occurred (during the existence of the database) in the immediate local vicinity, it inevitably has limited data of weather conditions on which to call, and the prediction techniques and expertise are unsophisticated, typically relying on trying to provide a close fit between prevailing weather conditions and what can be found in the database.

5. IOT-based air pollution monitoring and forecasting system IEEE Conference on Computer and Computational Sciences (ICCCS), 2015
Abstract: Using empirical analysis, conventional air automatic monitoring system has high precision, but large bulk, high cost, and single datum class make it impossible for large-scale installation. Based on introducing Internet of Things (IOT) into the field of environmental protection, this paper puts forward a kind of real-time air pollution monitoring and forecasting system. By using IOT, this system can reduce the hardware cost into 1/10 as before. The system can be laid out in a large number in monitoring area to form monitoring sensor network. Besides the functions of conventional air automatic monitoring system, it also exhibits the function of forecasting development trend of air pollution within a certain time range by analyzing the data obtained by front-end perception system according to neural network technology. Targeted emergency disposal measures can be taken to minimize losses in practical application.

6. Wireless Arduino Based Weather Station

International Journal of Advanced Research in Computer and Communication Engineering, April 2016

Abstract:

Weather forecasting is done using predicting the weather and values obtained from sensors or instruments.The device works by taking readings from various sensors at different pins in arduino microcontroller. For this purpose we've used an arduino compatible WiFi shield stacked upon our arduino microcontroller which adds up extra functionality to our arduino board. It increases the scope of this project. The sensor detects either there is any rain or not in terms of values. The raindrop sensor module comes with a potentiometer attached to it. For simulation purpose we can check it by putting some water droplets on the board and we can see the readings fluctuating. The other part of the system is wireless connectivity. We've attached a cc3000 wifi shield over the arduino to connect it to the local internet connection providers and connect. Its job is to transmit the data to a website linked to it and visualize the data over there for every minute or thirty seconds. Since it is a shield and not a breakout board we don't have to make particular connections for each of IRQ, VBAT and CS. It makes our circuit less wired and neat. After registration, create a channel which will be for your device. A channel is made for taking all the information you want to display update send or receive. It is used for interaction between arduino and your channel. While creating the channel, specify or check the number of fields for data you want to visualize or post on the server.

7. Working Principle of Arduino and Using it as a Tool for Research International Journal of Control, Automation, Communication and Systems (IJCACS), Vol.1, No.2, April 2016

Abstract:

This paper explores the working principle and applications of an Arduino board. This also explores on how it can be used as a tool for study and research works. Arduino board can provide a quick tool in development of VLSI test bench especially of sensors. Main advantages are fast processing and easy interface. Today, with increasing number of people using open source software and hardware devices day after day, technology is forming a new dimension by making complicated things look easier and interesting. These open sources provide free or virtually low costs, highly reliable and affordable technology. This paper provides a glimpse of type of Arduino boards, working principles, software implementation and their applications.

8. Design and Implementation of Weather Monitoring and Controlling System International Journal of Computer Applications, Volume 97– No.3, July 2014

Abstract: Weather monitoring plays an important role in human life, so the collection of information about the temporal dynamics of weather changes is very important. In any industry during certain hazards it is very important to monitor weather. The fundamental aim of this paper is to develop an embedded system to design a weather monitoring system which enables the monitoring of weather parameters in an industry. Such a system contains pair of sensors like temperature, Gas and humidity will be monitored and LPC1768 microcontroller (ARM9). The data from the sensors are collected by the microcontroller and also microcontroller sends the sensors data in to the LABVIEW by using the Serial Communication and this module will keep the data in excel page & also we can get the SMS in the mobile with the help of GSM module. The system uses a compact circuitry built around LPC1768 (ARM9) microcontroller Programs are developed in Embedded C using the IDE Keiluvision4. JTAG is used for loading programs into Microcontroller.

9. IOT Compatible Wireless Smart Portable Mini Weather Analyzer

International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 05 | May -2017

Abstract:

Using an IoT the device is connected to the internet and all the information is shared with other objects without human intervention. The IoT is meant to measure real-world events and controlling the specific phenomena. IoT gives the information in all sectors of agriculture, healthcare, home appliances, etc. With the increase in the number and functionalities of sensors and actuators, the IoT which interconnects a particular set of things, is easily programmable, and more capable of interacting with humans. Measurement and Control of humidity & temperature play an important role in the fields like agriculture science, Engineering & Technology. It became essential to monitor the load time weather condition of one place from another place. In this Paper we present the design & development of Arduino based IoT for measuring humidity temperature & CO2. MQ 135 sensor used for measuring CO2 in air. humidity, temperature & CO2 measurements made in real-time are shown graphically. This information is received by specially designed application interface running on pc connected through Wi-Fi wireless link. The data generated will be in excel as well as in graphically form using LABVIEW software for analysis purpose. The Proposed system is also capable of generating short time alerts based on weather

parameters. It gives an on-line & real-time effect. The idea behind this work is to monitor the weather facility & warn AMC from environment effect.

10. A Low-Cost Microcontroller-based Weather Monitoring System

Department of Electrical Engineering, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia, 2006

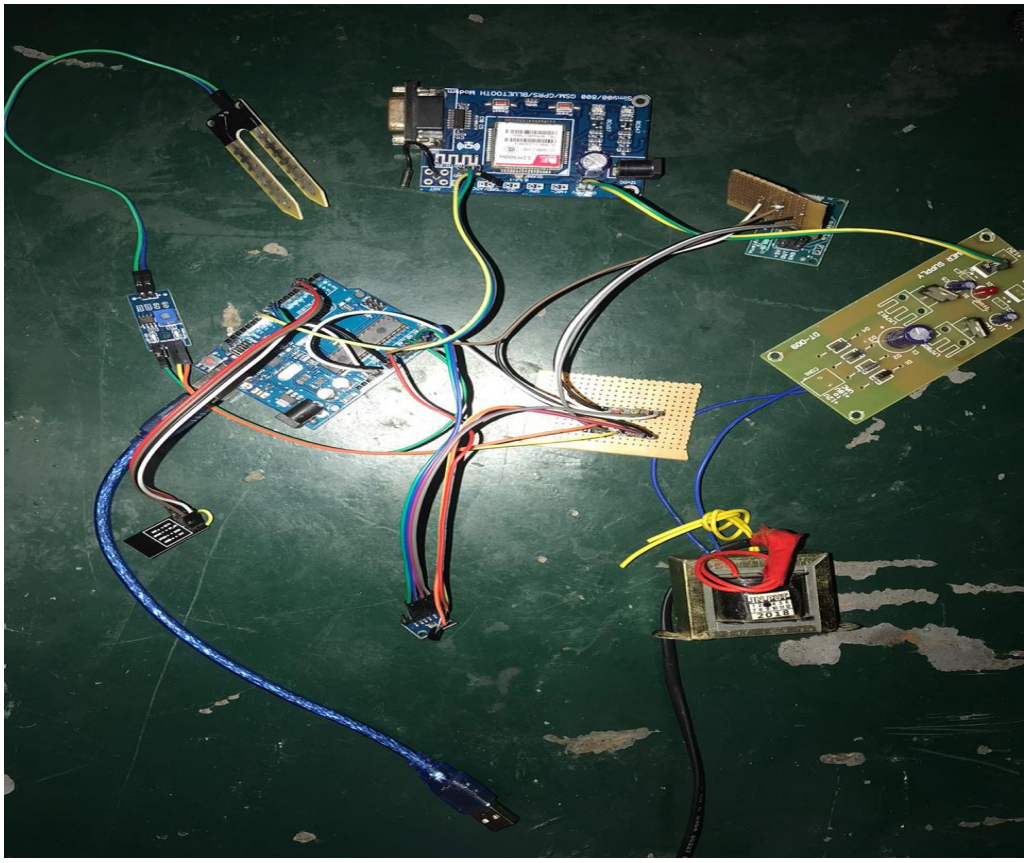
Abstract:

The measurement of temperature, atmospheric pressure and relative humidity remotely by using the appropriate sensors is not only important in environmental or weather monitoring but also crucial for many industrial processes. Sensors are essential components in many applications, not only in the industries for process control but also in daily life for buildings safety and security monitoring, traffic flow measuring, weather condition monitoring and etc. In weather monitoring, for instance, parameters such as temperature, humidity and pressure need to be measured (Ong et al., 2001), thus sensors have always been given the task for doing so.. A device for weather monitoring has been developed as described in this paper to monitor and display the temperature, pressure and relative humidity of the atmosphere, using analogue and digital components. The analogue outputs of the sensors are connected to a microcontroller through an ADC for digital signal conversion and data logging. An LCD display is also connected to the microcontroller to display the measurements. For analysis and archiving purposes, the data can be transferred to a PC with a graphical user interface program through a USB link. The interface program allows sampling parameters such as the date and time of the data-logging operation to be configured. The device has many advantages as compared to other weather monitoring systems in terms of its smaller size, huge memory capacities, ondevice display, lower cost and greater portability.

PROPOSED ARCHITECTURE:

Hardware and Software Components and Their Working:

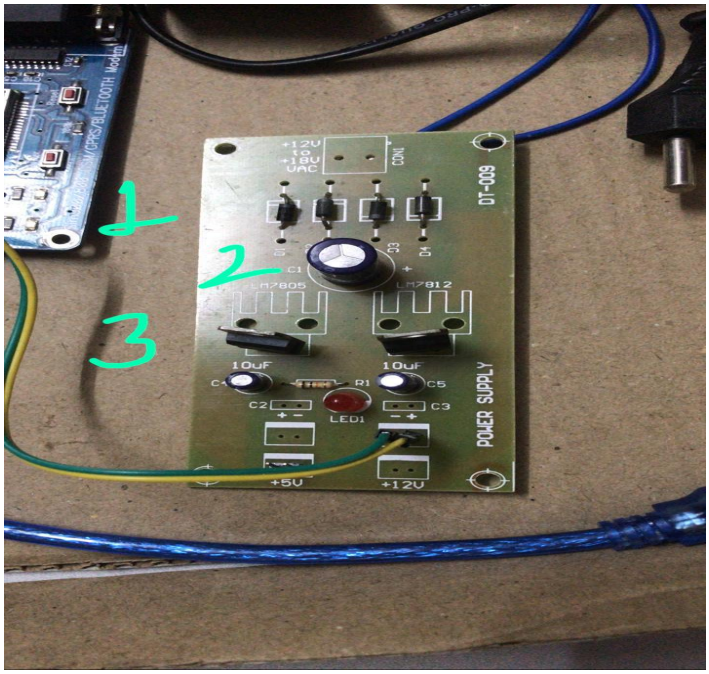
HARDWARE:



Complete Architecture

Transfomer:Transformers (in some cases called "voltage transformers") are gadgets utilized in electrical circuits to change the voltage of power streaming in

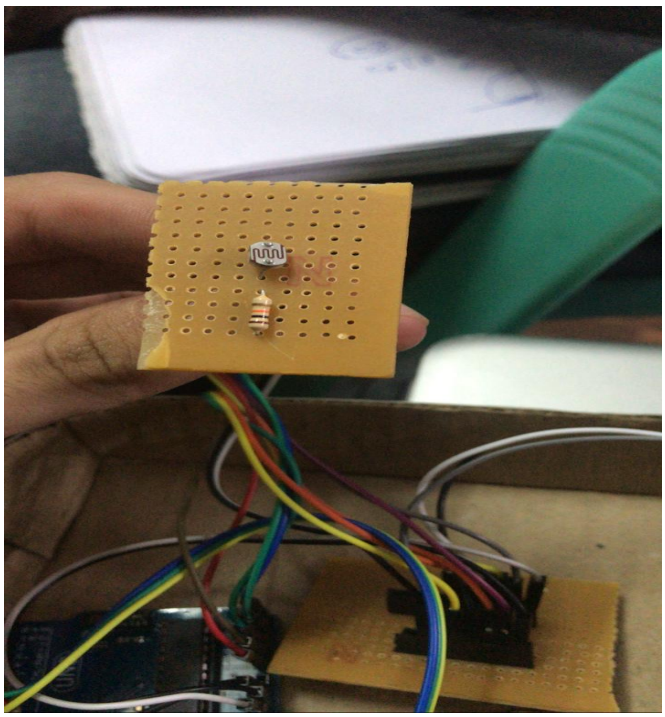
the circuit..The subsequent current streams out of the transformer.



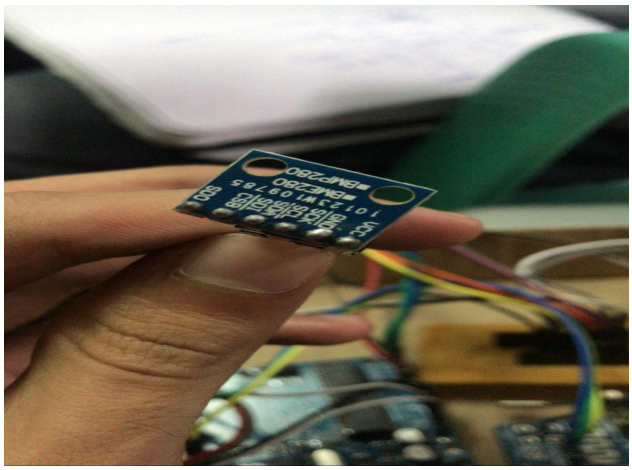
1.Rectifier

2.Capacitor

3.Regulator(5V and 12V)

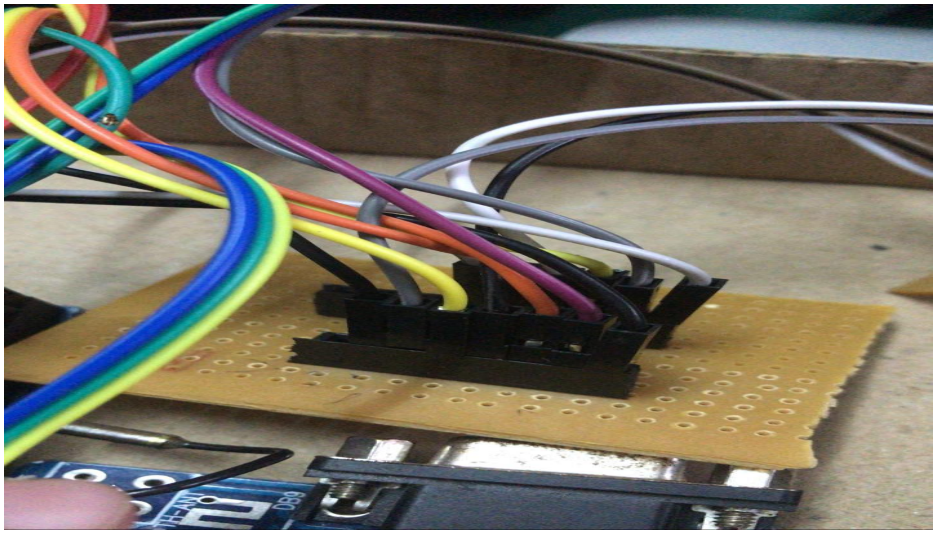


LDR 10 ohm resistor:A Light Sensor creates a yield signal demonstrating the force of light by estimating the brilliant vitality that exists in a very thin scope of frequencies fundamentally called "light", and which runs in recurrence from "Infra-red" to "Unmistakable" up to "Bright" light range.



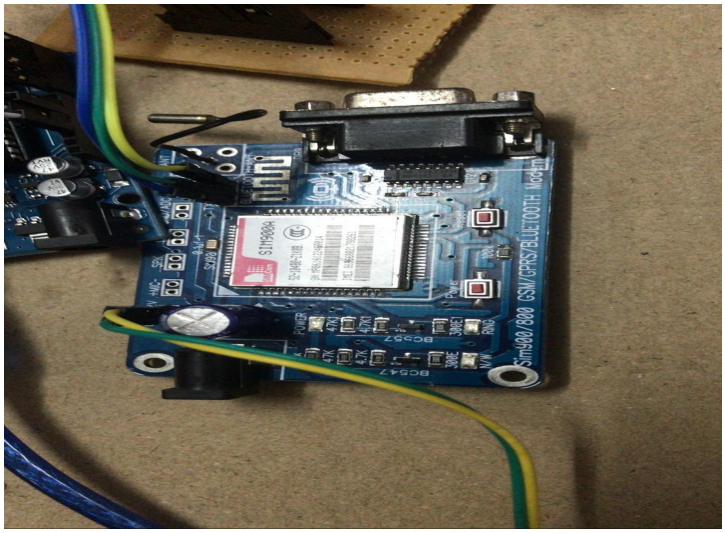
BMP : Temperature and approximate altitude measurable sensor:

BMP280 is an outright barometric weight sensor particularly intended for portable applications. The sensor module is housed in an incredibly minimized bundle. Its little measurements and its low power utilization consider the usage in battery controlled gadgets, for example, cell phones, GPS modules or watches.

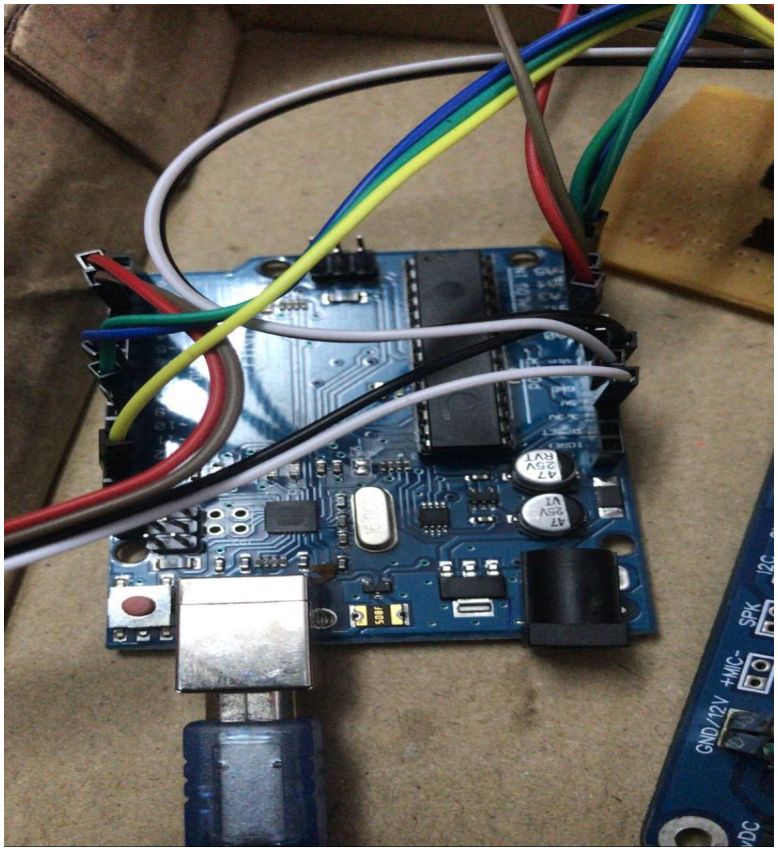


Power Distribution Unit:A power distribution unit (PDU) or mains dissemination unit (MDU) is a gadget fitted with different yields intended to disperse electric control, particularly to racks of PCs and systems administration

gear situated inside a server farm. Server farms face difficulties in control insurance and the executives arrangements.

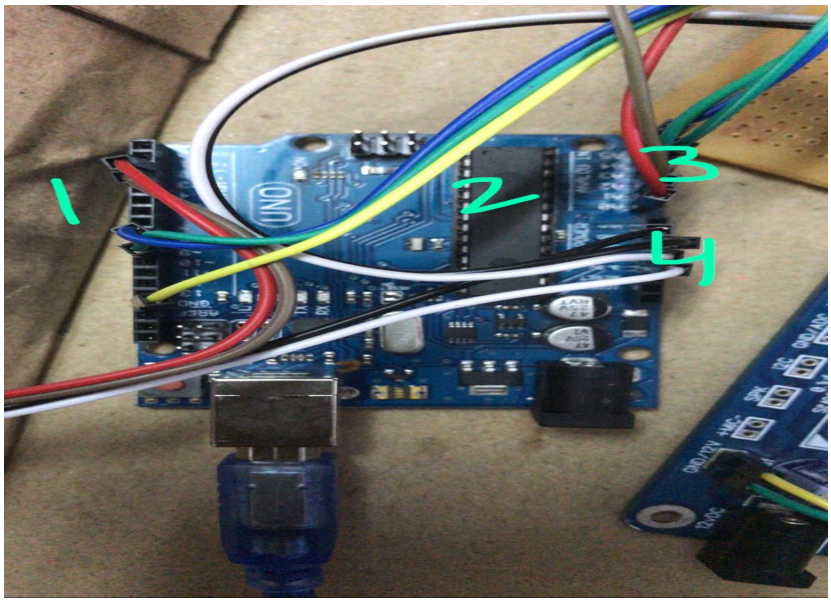


GSM module(12V):A GSM module or a GPRS module is a chip or circuit that will be utilized to set up correspondence between a cell phone or a figuring machine and a GSM or GPRS framework.



ARDUINO:

Arduino is an open-source gadgets stage dependent on simple to-utilize equipment and programming. Arduino sheets can understand inputs - light on a sensor, a finger on a catch, or a Twitter message - and transform it into a yield - actuating an engine, turning on a LED, distributing something on the web.

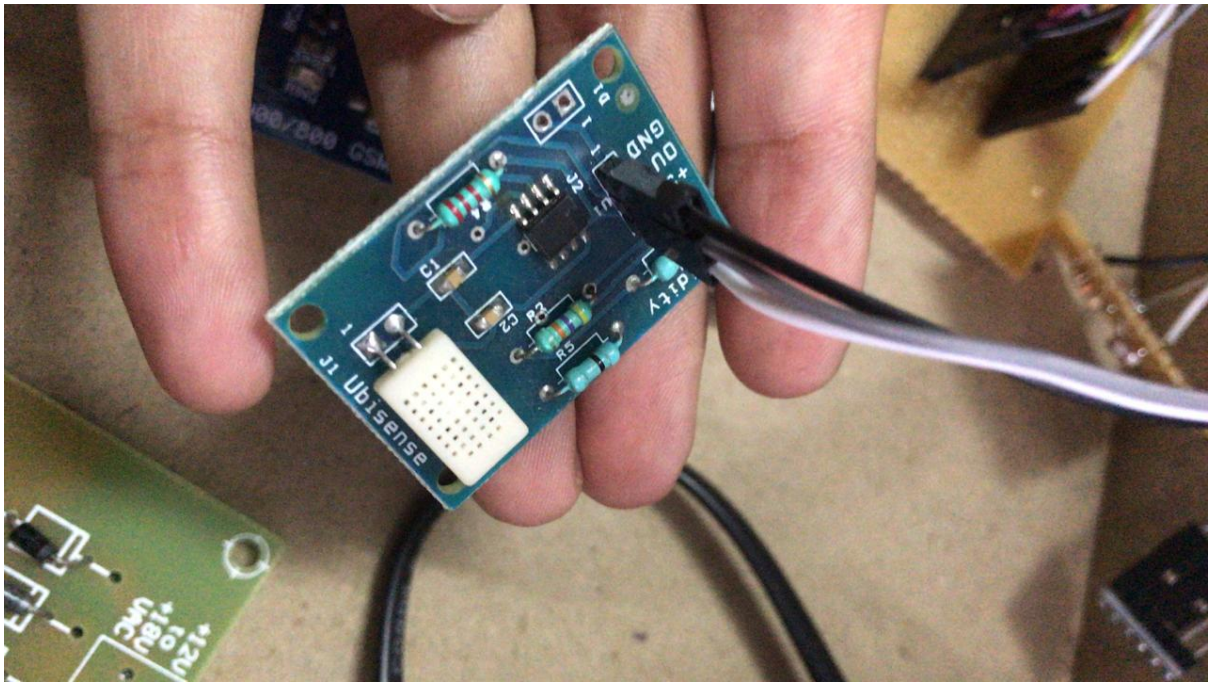


1.I/O pins

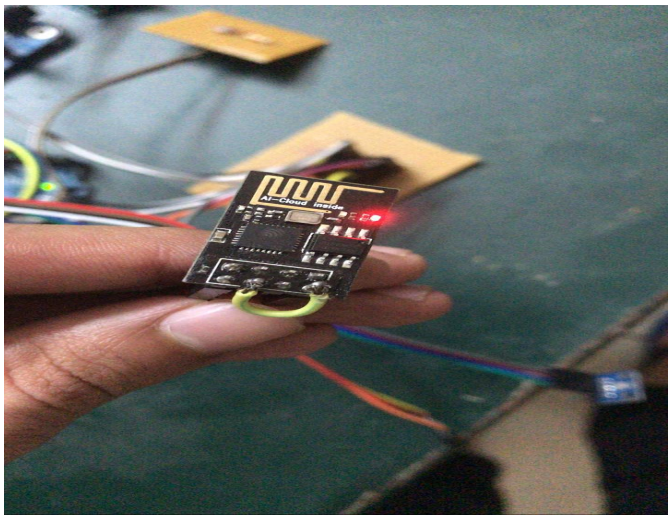
2.Atmegha328

3.Analog to digital convertor

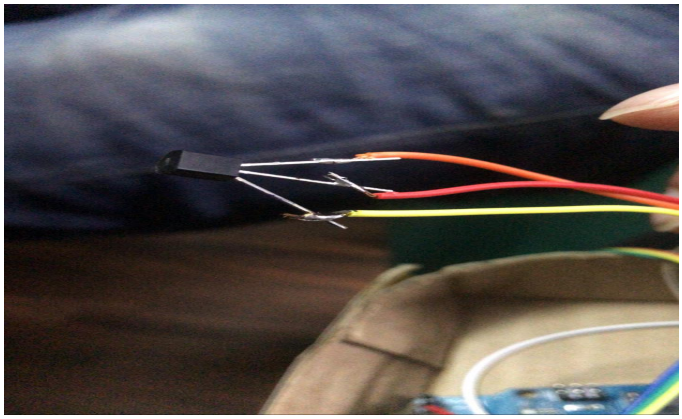
4.Power supply



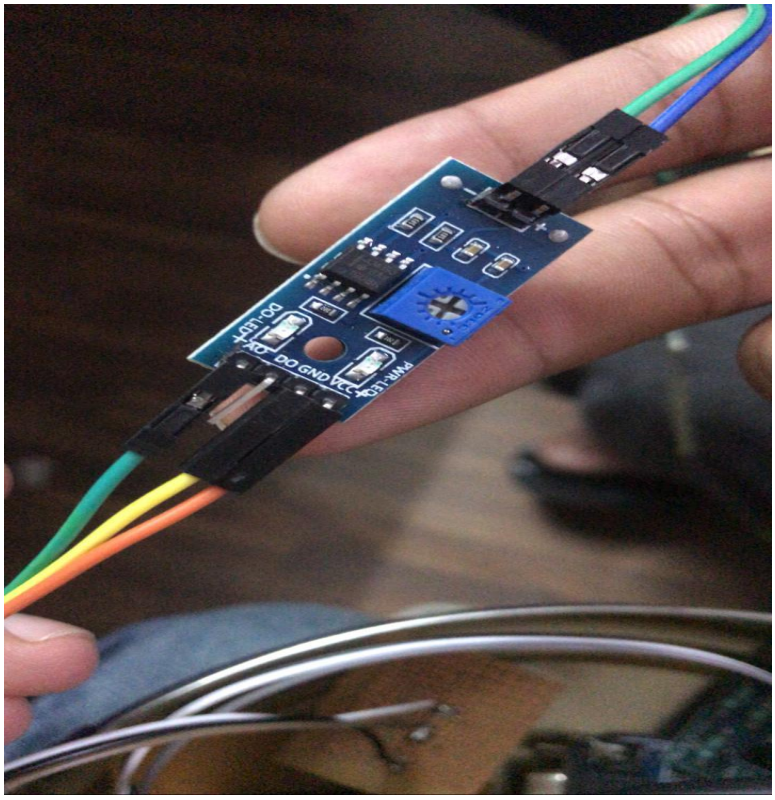
Humidity Sensor:A humidity sensor (or hygrometer) detects, measures and reports both dampness and air temperature. The proportion of dampness noticeable all around to the most noteworthy measure of dampness at a specific air temperature is called relative mugginess. Relative stickiness turns into a significant factor when searching for comfort.



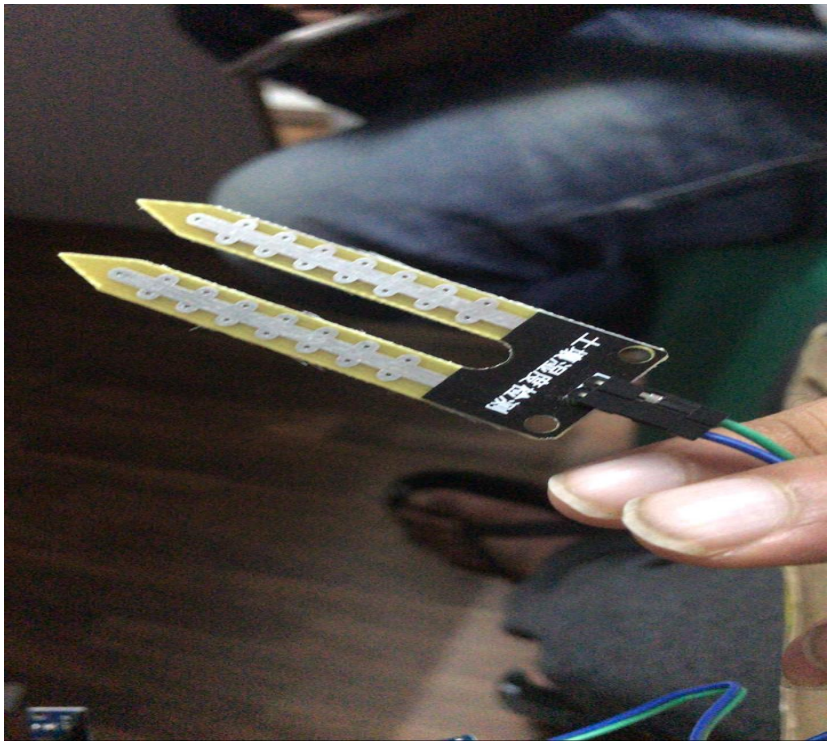
ESP8266:The ESP8266 WiFi Module is an independent SOC with incorporated TCP/IP convention stack that can give any microcontroller access to your WiFi organize. The ESP8266 is able to do either facilitating an application or offloading all Wi-Fi organizing capacities from another application processor.



Tempraeture Sensor(LM35):LM35 is a temperature estimating gadget having a simple yield voltage corresponding to the temperature. It gives yield voltage in Centigrade (Celsius). It doesn't require any outside alignment hardware. The affectability of LM35 is 10 mV/degree Celsius.



Amplifier Circuit:Amplifier is the nonexclusive term used to depict a circuit which delivers and expanded form of its information signal. In any case, not all speaker circuits are equivalent to they are ordered by their circuit arrangements and methods of activity.



Rain Module:The rain sensor module is a simple instrument for downpour discovery. It tends to be utilized as a switch when raindrop falls through the coming down board and furthermore for estimating precipitation power. The module includes, a downpour board and the control board that is discrete formore accommodation, control pointer LED and a flexible affectability however a potentiometer.

ThingSpeak (Software)

ThingSpeak is a free of cost cloud computing service developed by MathWorks. It allows us to interact with data in many ways. One must create an account and fill in each field with the different types of data being collected, i.e. temperature, humidity etc. The API key mentioned on the portal has to be typed into the Arduino code.

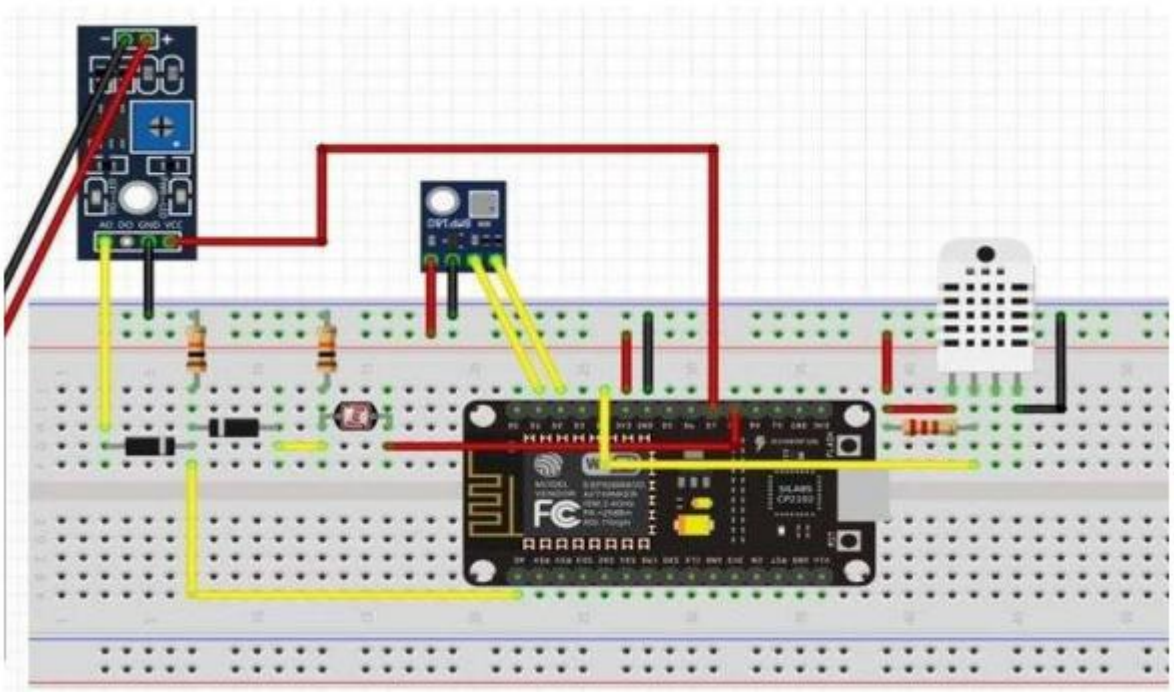
Thingspeak has lots of plugin options, for example, gauges and publish them on the website. Codes for these plugins are automatically generated. It is possible to adjust the gauges colors, numbers, scale etc.) by adjusting the code.

IDEA OF THE PROJECT:

The goal of this project is to make a weather monitor that wirelessly logs the

temperature, humidity, air pressure, dew point, light intensity and chances of precipitation to a remote server. In order to log measurements online, you need to have a website or webservice that can accept GET http commands. We are using Thingspeak, which uses REST APIs and MQTT APIs. This compact, easy to access weather station can be used in homes, offices etc. for an accurate description of the external weather conditions. In big towns and cities, weather conditions vary in different areas. Hence, our device can be used to find out the exact temperature, air pressure etc. that a person will be facing outside.

CIRCUIT DIAGRAM:



CODE:

```
#include <DHT.h>
 #include <ESP8266WiFi.h>
 #include <Wire.h>
 #include <Adafruit_Sensor.h>
#include <Adafruit_BMP085.h>
#include <SoftwareSerial.h>
```

```
SoftwareSerial espSerial =  SoftwareSerial(2,3);
#include <LiquidCrystal.h>
const int trigPin = 9;
const int echoPin = 10;
const int motor = 7;
const int buz = 5;
float t = 0;
float s,so,l;
long duration;
int distanceCm, distanceInch;
const int rs=12,en=11,d4=5,d5=4,d6=3,d7=6;
LiquidCrystal lcd(rs,en,d4,d5,d6,d7);
String apiKey = "KFH5JIY10X9R08Q7";     // replace with your channel's thingspeak WRITE API key
String ssid="Nikku";    // Wifi network SSID
String password ="2444666668888888";  // Wifi network password
boolean DEBUG=true;
void showResponse(int waitTime){
    long t=millis();
    char c;
    while (t+waitTime>millis()){
      if (espSerial.available()){
        c=espSerial.read();
        if (DEBUG) Serial.print(c);
      }
    }

}
```

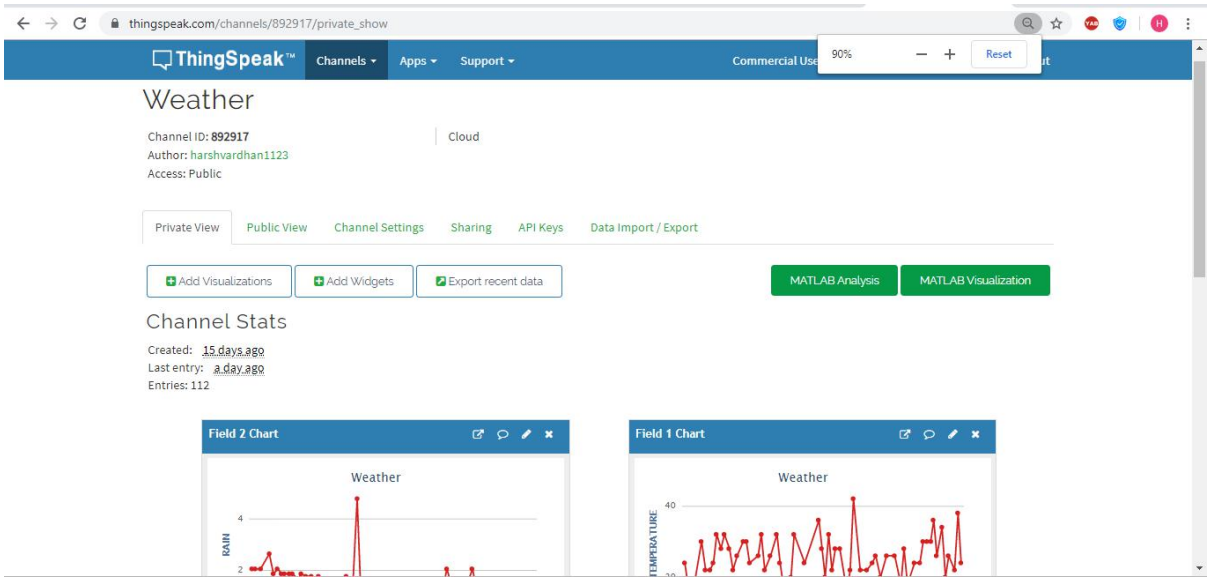
```
boolean thingSpeakWrite(float value1, float value2,float value3){
  String cmd = "AT+CIPSTART=\"TCP\",\"";
  cmd += "184.106.153.149";
  cmd += "\",80";
  espSerial.println(cmd);
  if (DEBUG) Serial.println(cmd);
  if(espSerial.find("Error")){
    if (DEBUG) Serial.println("AT+CIPSTART error");
    return false;
  }
  String getStr = "GET /update?api_key=";   // prepare GET string
  getStr += apiKey;

  getStr +="&field1=";
  getStr += String(value1);
  getStr +="&field2=";
  getStr += String(value2);
   getStr +="&field3=";
   getStr += String(value3);
  getStr += "\r\n\r\n";

  cmd = "AT+CIPSEND=";
  cmd += String(getStr.length());
  espSerial.println(cmd);
  if (DEBUG)  Serial.println(cmd);
```

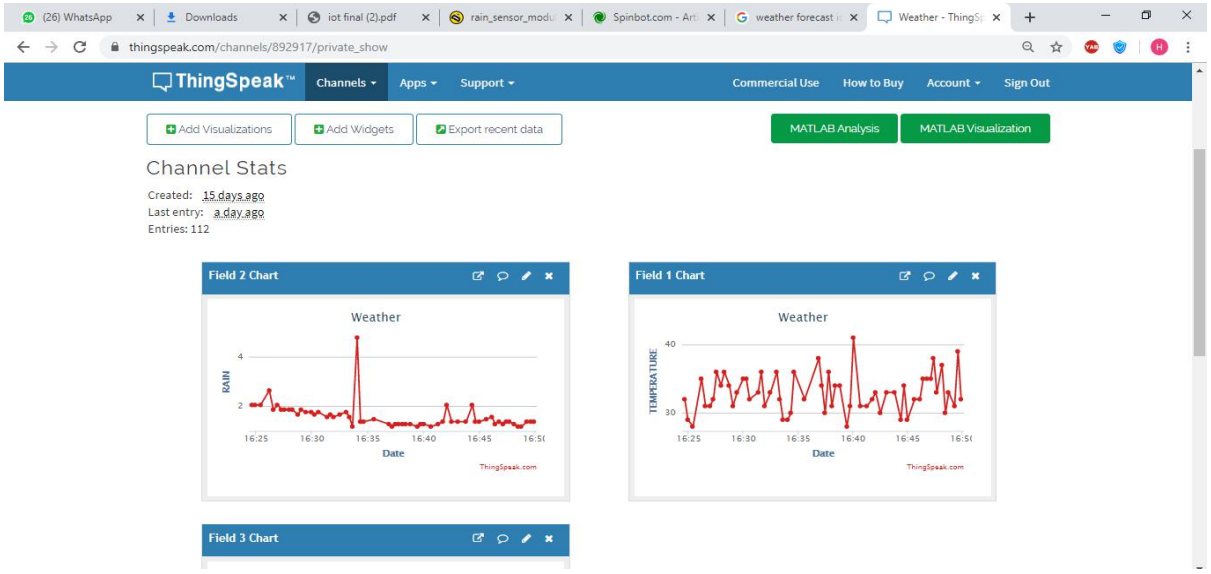
```
  delay(100);
  if(espSerial.find(">")){
    espSerial.print(getStr);
    if (DEBUG)  Serial.print(getStr);
  }
  else{
    espSerial.println("AT+CIPCLOSE");
    if (DEBUG)   Serial.println("AT+CIPCLOSE");
    return false;
  }
  return true;
}
void setup() {
  DEBUG=true;
  Serial.begin(9600);
  espSerial.begin(115200);
   pinMode(motor, OUTPUT);
pinMode(buz,OUTPUT);
  pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
  espSerial.println("AT+CWMODE=1");
  showResponse(1000);

  espSerial.println("AT+CWJAP=\""+ssid+"\",\""+password+"\"");
  showResponse(5000);

   if (DEBUG)Serial.println("Setup completed");
```

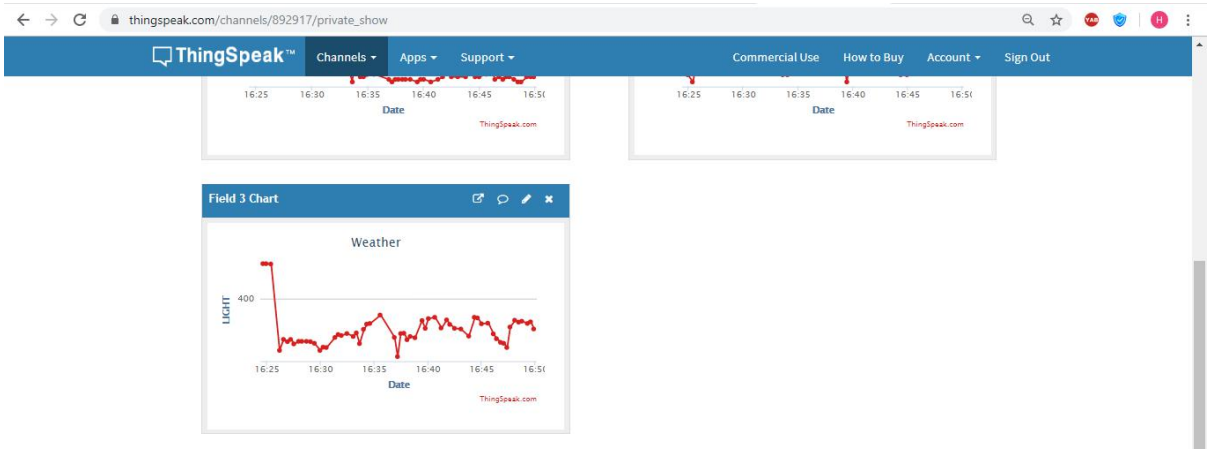
```
void loop() {
  digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distanceCm= duration*0.034/2;
distanceInch = duration*0.0133/2;
  t=analogRead(0)/2;
  s=analogRead(2);
  so=(100-((s/1023.00)*100));
   l=analogRead(1)/2;
        if (isnan(t) || isnan(so)|| isnan(l)) {
      if (DEBUG) Serial.println("Failed to read from temp");
     }
     else {
        if (DEBUG)  Serial.println("Temp="+String(t)+" *C");
        if (DEBUG) Serial.println("Rain="+String(so)+" %");
        if (DEBUG) Serial.println("light="+String(l)+" %");
         thingSpeakWrite(t,so,l);
     }
  delay(2000);
if(so>20)
{
  digitalWrite(motor,HIGH);
  }
```

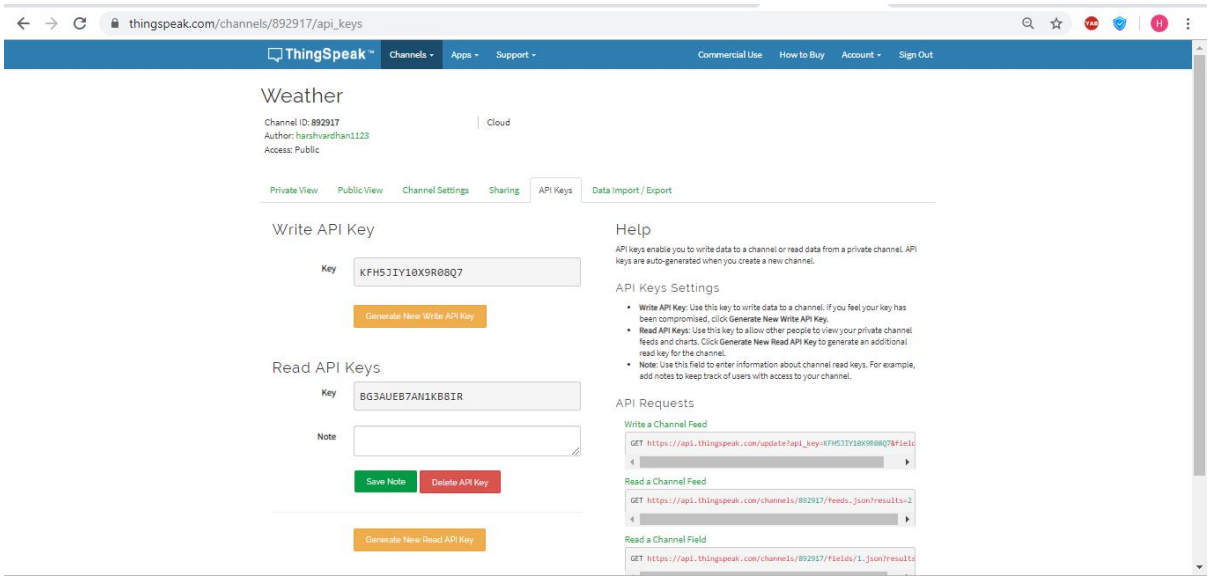
```
  else
  {
   digitalWrite(motor,LOW);
    }
    if(distanceCm>20)
{
  digitalWrite(buz,HIGH);
  }
  else
  {
   digitalWrite(buz,LOW);
    }
}
```

RESULT:



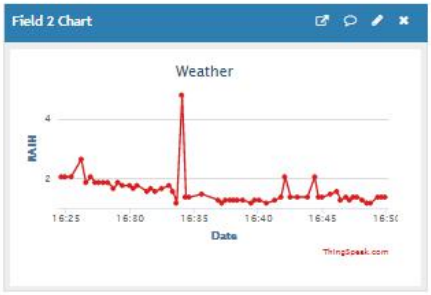

thingspeak.com/channels/892917/private_show
ThingSpeak™
Channels
Apps
Support
Commercial Use
How to Buy
Account
Sign Out
Add Visualizations
Add Widgets
Export recent data
MATLAB Analysis
MATLAB Visualization
Channel Stats
Created: 15 days ago
Last entry: a day ago
Entries: 112
Field 2 Chart
Weather
RAIN
Date
ThingSpeak.com
Field 1 Chart
Weather
TEMPERATURE
Date
ThingSpeak.com
Field 3 Chart

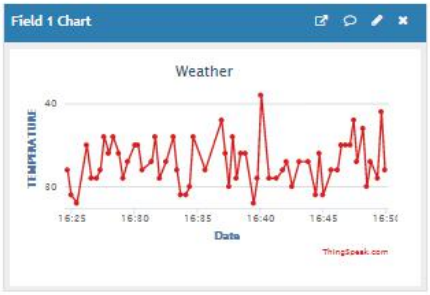

thingspeak.com/channels/892917/private_show
ThingSpeak™
Channels
Apps
Support
Commercial Use
How to Buy
Account
Sign Out
Date
ThingSpeak.com
Date
ThingSpeak.com
Field 3 Chart
Weather
LIGHT
Date
ThingSpeak.com



Channel Stats

Created: 15 days ago
Last entry: a day ago
Entries: 112





CONCLUSION:

The system is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. We implemented it using NodeMCU and not Arduino because it contains inbuilt Wi-Fi which is more convenient.

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