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PROJECT: IOT BASED WEATHER REPORT SYSTEM

SUBJECT: IOT FUNDAMENTALS (ECE_3501)

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CONTENTS

TOPIC	PAGE NO
ABSTRACT	3
1. INTRODUCTION	4
2.LITERATURE REVIEW	5-14
3.PROBLEM FORMULATION 3.1 USE OF DHT11 SENSORS 3.2 USE OF BMP180 SENSOR 3.3 UPLOADING DATA TO ARDUINO	15-`18
4. RESULT AND ANALYSIS 5.1 HARDWARE 5.2 CODE	19-21
5. CONCLUSION	22
6.REFERENCE	23

ABSTRACT

Using sensors,wireless communications and cloud our team will design an iot based weather report system .Weather plays an important role in our life from deciding what to wear to where industries will be set up. Earlier the weather reports were prepared using the statistical analysis of the past data and making a hypothesis out of it but now we have sensors which can sense the weather parameters and this data measured by sensors involves real time analysis of data. Researchers in the recent past using INTERNET have published this real time data for people to know globally the weather reports.Our team is going to use various sensors like BMP180(measures temperature and atmospheric pressure), Rain sensor, DHT11(measures temperature and relative humidity) which will measure environment variables and NODEMCU, the microcontroller takes data from sensors and using UART OR USB the data is transferred to ARDUINO IDE/API. Ability of Rain sensor to detect rain can tell us when the weather is rainy and when it's sunny, So the weather report system that we are preparing not only involves numerical parameters but also qualitative analysis in it. We are going to basically design most of our project using ARDUINO IDE and implement logic through it for providing real time weather reports based on data collected through sensors. In our project we are also going to use ESP8266 Wi-Fi Module which is attached to our NODEMCU board as our project involves uploading the real time weather reports on INTERNET so for enabling us to do that we are going to use this Wi-Fi module. We are also going to use Wi-Fi gateway for our project to connect to INTERNET/CLOUD. For publishing the real-time reports on INTERNET or for applying IOT analytics we need a cloud based management system so for that we are going to use "Thingspeak.com".

1. INTRODUCTION

- Weather Prediction has been and is still most crucial aspect for human life . In the World, where Industrialization and vehicular traffic have affected the the purity of environment , Its very necessary to have some predetermined report parameters for weather. Agriculture industry holds the primary privilege for this weather prediction by NODE MCU and ARDUINO.
- Based on the ideology, we have been involved within these few weeks to assemble and rectify our model for the weather predictions. Our project is based on development of weather report system using ThingSpeak an IoT platform that to show the data of the sensor and beeps an alert for abrupt changes.
- The key function of the model is to transfer the measured data via sensors to cloud and displaying the report on the screen and to alert the users or people if something abrupt change takes place. The whole process deals with the exact weather conditions of the area.
- The Parameters of the report are Rainfall density ,smoke detection, temperature, air quality, humidity and air pressure. So its evident that we are going to have an overall average conditions , instead of restricting to a particular parameter , which could be helpful for the organizations to plan their projects.

- Difficulty to monitor weather parameters through offline system such as agriculture zone during certain hazardous envy and critical situations can be rectified with this model , as manual predictions would be avoided and an efficient model would be in the market to give the informations regarding every aspect of the weather.
- Primary benefit would be for agriculture industry as , quality of weather including air quality is the most crucial strand of the whole process. With Rain sensor , we can measure the rain density , which will then be notified to user. Similarly Air quality would also be predicted.
- Industrialization can also be enhanced using this model. Huge projects could also be planned in a sequential way if weather of an area is known on numerous aspects. For example - Any monument is built after acquiring the information about weather.
- Most important point is that , we have also introduced the beep and alert system , which notify the users or the organizations about the unexpected changes in weather. So These alerts could assist people what to do next.
- Thus our project draws out for the ideal weather prediction in terms of numerous parameters.

2. LITERARTURE REVIEW

Anita Bhagat et al. [1] have worked on IOT enabled weather monitoring system project, for self-monitoring of the environment (i.e., smart environment). To do such a project, se had planted the sensors near the environment to a particular radius to collect the real time data of the surroundings and this can be received by the Wi-Fi application using ESP8266 Wi-Fi module. This paper has the technique for the smart environment in an efficient way and a low-cost budget. Using such a project the diversity will grow and will reduce the pollution. It will also help to understand the pollution made by a particular industry or plant and the government can charge tax on the bases of amount shown by the project. Even the data is saved to cloud so that it can be recovered at any time. To protect the public health, the person can check the real time data of a particular area and can resolve it easily. So overall it is a low cost and a efficient project.

Pauzi et al. [2] has proposed a monitoring weather parameter more easily with the Wi-Fi connection although it is limited to areas but it is still a far better way than the wired connections. So, the author have made a real application in which he used the gas sensor MQ135 and the rain sensor. He installed the hardware in a particular area and got the real time data of that area with the help of the wi-fi module. He even built an application which can be downloaded anywhere to get the real time data of that place. He used the oled display sensor data to display the live data at that exact place. The application he built is even available at google play store. It seen that the weather at particular place has different condition from the exact condition with the accuracy of weather reporting system and forecast system data has been compared and the result say that the report by the weather reporting system is more accurate than the forecast system. The data is displayed to ThingSpeak and IFTTT which will further save it in cloud which can be accessed anywhere and anytime. This is a efficient and a accurate project for weather reporting.

Arun Chakravarthy et al. [3] have made a model in which the farm and weather conditions are monitored and the atmosphere conditions allow the farm to have self defence of the sensitive crops by alerting the farmer or the caretaker of that field. For doing such a project, he used the data set of the region nearer to him with this he built an hardware model using the sensors to get the physical parameters and if above a particular threshold the quantity reaches, the caretaker of the field is alerted with the buzzer or the SMS or email. These techniques can be used to track the real time data of metropolitan cities in which the youth can be alerted about the pollution, the rain probability and even the temperature and humidity with SMS so they can take precautions. Broad area monitoring at low cost is feasible and data collection for further use can be processed and forwarded.

Girija C. et al. [4] by keeping the embedded devices in the environment for monitoring enables self-protection (i.e., smart environment). So to implement this they have deployed the sensor devices in the environment to get the real time data and to interact with the different

physical parameters such as temperature, pressure, humidity and the pollution (mainly gases). These physical parameters are sensed by the sensors ant the real time data is uploaded to the websites which can further be accessed by anyone around the globe. The major gases which is sensed is CO as it is one of the most poisonous gas which is odourless, tasteless and colourless and hence it cannot be identified by human. So planting such system in CO prone area will help the workers to evacuate immediately avoiding the disaster like Bhopal Gas tragedy. This model can be further expanded to monitor the developing cities and industrial zones for weather monitoring. To protect the public health from pollution, this model provides an efficient and low cost solution for continuous monitoring of environment.

Ravi Kishore et al. [5] the proposed IoT based weather station can be modified to incorporate many more features. He added ESP8266 based wi-fi module Nodemcu which is a single hardware with a work of Arduino and the wi-fi module. Then he used the temperature and a humidity sensor to find the respective parameters of a area. A barometric pressure sensor is also used to find the current pressure of that area. Use of LDR is also important to find if the weather is cloudy or clear depending upon the intensity of light falling on it. He also used a raindrop module which detects tha rain drop intensity on its surface and finally he used his mobile phone to receive the email and SMS of the temperature, humidity, pressure and the rain intensity. He also gave us the basic idea of the algorithm which we have used in our project. We can also add a GPS module in the design so that the location of the surrounding will also be mailed or messaged to the user along with the surrounding parameters,like, temperature, humidity, pressure, light intensity etc.

Norakmar binti Arbain, [6] dealt with an IoT-primarily based totally Smart Garden with Weather Station gadget, which may be used to screen the increase of plant each day and expect the opportunity for raining. Many humans are inquisitive about developing the plants are continually neglect about on watering the plants. Hence, in this study, the tool is geared up with a water pump, in which it may be monitored and managed with the aid of using the use of a phone. In addition, the gadgets additionally encompass 4 primary sensors, which are Barometric Pressure, DHT11 Temperature, and Humidity Sensor, Soil Moisture Sensor and Light intensity module sensor. The Soil and Light Intensity sensor used to degree the cost with the aid of using percentages. Besides, actuators, which might be the water pump and LED mild may be used remotely or with the aid of using the use of a button at the gadgets. The LED is purposely to copy the daylight and make the plant grow faster. This IoT-primarily based totally Smart Garden with Weather Station System can document the facts and ship the end result to user thru the phone software named as Blynk apps. This studies is beneficial, and the gadget may be easily controlled with the aid of using all customers consisting of researcher or farmer, and children.

S Sheeba Rani, [7] dealt with the changes in weather and climate conditions are unavailable one in the world. But observing weather conditions is very essential to predict the changes in the environment. Weather forecasting performs a prime position in numerous fields inclusive of agriculture, transportation etc., It is additionally important in prediction of herbal failures like Flood, typhoon etc., So so one can save you the damages from such herbal disorders,

correct climate prediction is important. IoT topology is a mixture of each hardware and wi-fi verbal exchange community applied for real-time facts evaluation. Hence, this proposed topology formulated an IoT primarily based totally climate tracking the usage of artificial neural community (ANN) for prediction. The predominant goal of this designed topology gadget is tracking climate parameters inclusive of temperature/humidity/ pressure/ rainfall etc., IoT is prepared to collect facts from sensors and is communicated thru Wi-Fi community. ANN is customized for climate prediction. The evaluation proves that the proposed structure indicates higher performance in climate prediction than the traditional methods. The main motive of this design is to predict the accurate weather condition using ANN.

Ferdin Joe John Joseph, [8] dealt with the connectivity of the IoT gadgets over the community has extensively decreased the power consumption, robustness and connectivity to get right of entry to information over the community. IoT is powering many frontiers of industries and is seen as a promising generation to take Big Data Analytics to a level higher. Weather tracking device as a module is an issue amongst IoT studies network and it's been extensively addressed. A new climate tracking device is advanced the use of diverse sensors connecting to Raspberry Pi. The implementation and information visualization at the information gathered are mentioned in this paper in detail. Weather parameters like temperature, humidity, PM 2.5 and PM 10 concentrations and Air Quality Index (AQI) are monitored and visualized in graphical approach the use of the Raspberry Pi as server and information accessed over the intranet or net in a targeted subnet or global huge web cities. The implementation done in this paper is based on the heath issues faced by the people in Thailand. The implementation details and the data analysis based visualization are discussed in detail in this paper. The literatures studied on the existing techniques, methodologies and simulations are surveyed

Prof. S.B. Kamble, [9] dealt with tracking the weather situations at a selected area and make the statistics seen everywhere withinside the global. Here he have chosen SIM800L GPRS module. When we are giving an internet source, the data can be exchanged anywhere in the world through its IP address. The further study has done on selecting the microcontroller. Here matters is probably something like digital gadgets, sensors and car digital equipment. The machine offers with tracking and maintains song of temperature, humidity, wind pace and direction, rainfall quantity etc. The machine shows those readings in actual time on a display. It additionally maintains song of historic statistics on an hourly and each day basis. This fact may be display on LCD and sends the statistics to the internet web page after which plot the sensor facts as graphical statistics. To make the system less expensive,they preferred some free data hosting web sites who provides a cloud space for our sensor data to make it universal and also makes the system less expensive.

Iswanto,[10] dealt with measurement of physical quantities.This research consists of several parts, namely; sensor technology, microcontrollers, Internet of Things (IoT), and computer or user interface (UI) interfaces. Sensor technology is used to create appropriate methods for characterizing digital and analog sensors.. Educational approach approximately measuring and calibrating a measuring tool and manipulate require realistic and applicable media to be applied at once withinside the discipline. This article discusses the devising of an Internet of Things (IoT)-primarily based totally gadget to degree, examine and system the bodily portions of climate situations. The climate situations stated are; temperature and humidity, depth of sunlight, rainfall, additionally wind pace and direction. The analyzing of those portions become done with analog and virtual sensors included with the ESP 8266 microcontroller. This sensory gadget become positioned withinside the discipline station. The consequences of analyzing and processing at the microcontroller are uploaded to the net server. A customer gadget, known as a base station, requests periodic sensor facts to the server. The consequences of facts acquisition are then processed once more in Raspberry Pi media to be displayed in layers and saved in Excel form. The consequences of this observe may be used for calibration media analog and virtual sensors which could degree the portions measured via way of means of climate stations. The user interfaces application on the Raspberry Pi was also successfully created for the purposes of monitoring and analyzing the actual weather condition.

Ferdin Joe John Joseph,[11] proposed an implementation of weather monitoring system using Internet of Things (IoT). A raspberry pi based implementation is proposed to monitor PM2.5, PM 10, temperature, humidity and the air quality index (AQI) of the Particulate Matter pollutants available. The hardware connected to the raspberry Pi and the software used in managing the data collected using the sensors like DHT11.This paper uses cloud based technique to store collected data in a cloud server but the reports collected from the weather data are available over intranet in specified subnets. The sensors and cooling fan are connected to Raspberry Pi's input terminals as per the the instructions given to author of this paper.Raspbian Jesse OS is used to support the hardware and software connected to the Raspberry Pi for this analysis. Python is used to code for interfacing the sensors, extraction and storing of data from the sensors. DHT 11 sensor is accessed using Adafruit library available in GitHub.Since the device is set to run whole day to analyse weather reports , a cooling fan is attached as mentioned above to the Pi to remove the heat generated by the sensors and Raspberry Pi.

Python code is written to run the sensors once an hour continuously until an interrupt is given just like in an arduino enviroment.The temperature and humidity from DHT 11, PM 2.5 and PM 10 are collected and stored in a JSON file and appended as a record to a CSV file in the root directory of the lighty web server. A web based interface is designed in this analysis using HTML, CSS and JavaScript to generate reports from the sensor data populated in the JSON and CSV files. al. The access to this data is available in the intranet with the real time analysis of temprature and other parameters and it could be made public when the data is made to store in cloud servers or other sources in the internet. This paper mostly dealts with regions which are suffering from PM2.5 pollution.

Devesh Kumar Srivastava, Pawan Kumar Giri, Govind Yadav, Manish Kumar, Jay Singh,[12] presented a climate framework that is useful for horticulture. This climate framework is based on IOT. The authors of this paper used DHT11 waterproof sensors.It is really helpful when you have to measure something far away or in wet conditions.A soil moisture sensor is also used in this project. These sensors measure the volumetric water content with the help of various properties of soil like dielectric steady, electrical opposition etc. Arduino UNO platform has been used here for sensing tempratur and other parameters. In this paper Arduino UNO is utilized like an advancement board, so as to get information from sensor and sent through Wi-Fi Module to the cloud. ESP8266 NodeMCU is used here which is a minimal effort Wi-Fi microchip with a full TCP/IP stack and microcontroller ability. In this paper Wi-Fi Module has been used to send information to the cloud so as to process information and yield in a UI. This proposed project is a propelled answer for climate observing that utilizes IoT to make its continuous information effectively open over an exceptionally wide range. For security of data in the cloud and who is able to access the web page of the designed model is governed by SMQ convention. The SMQ customers can use a secret key hashing, making it conceivable to safely verify customers utilizing a non-secure/non-encrypted association.

Girija C, Harshalatha H, Andreanna Grace Shires, Pushpalatha H P,[13] The main aim of the this paper is to design and implement an efficient monitoring system through which the required parameters mainly (temprature ,humidity and CO levels) are monitored remotely using internet and the data gathered from the sensors are stored in the cloud and to project the estimated trend on the web browser anywhere in the world. The designed model consists of a microcontroller (ESP8266) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. ESP8266 is a preprogrammed chip and any microcontroller has to communicate with it through UART interface.. It works with a supply voltage of 3.3 VOLTS. The system consists of temperature and humidity sensor such as DHT11 and MQ6 sensor to measure CO levels. The authors have used "Things speak" API(an IOT application devloped using MATLAB) to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. After sensing the

data from included sensors the sensed data will be automatically sent to the web server.The web page gives the information about the temperature, humidity and the CO level variations in that particular region, where the embedded monitoring system is placed. The sensed data will be stored in cloud (Authors have used Google Spread Sheets). The data stored in cloud can be used for the analysis of the parameter and continuous monitoring purpose.The data generated will also be helpful for future analysis and can be shared easily via internet. This model is also useful for monitoring the developing cities and industrial zones for weather monitoring.

Zar Zar Oo, Sabai Phyu,[14] For more precise designs for a healthy and safe enviorment the authors have devloped a predictive technique for enviorment variables like tempratures based on several deep learning models based on (RNN) recurrent neural network and (CNN) covolutional neural network. The main aim of authors is to accquire data captured by multiple placed in respective places to forecast the temprature for the enhancement of the crop growth in the green house and to raise the potency and efficieny of the farmers. In weather stations Arduino is used as micro-controller which recieves input from installed sensors(DHT 11, soil moisture sensor). To predict the temprature covolutional long short term memory network(LSTM) is used as an automated learning tool which is trained using cloud services.The proposed predictive weather station platform, collects micro-climate information inside and outside the

Greenhouse and global weather information from the web, Weather API. Now, all data from the sensors and the web are collected every five minutes in the research field, VFRDC and stored in the cloud database. To build the predictive model, the Greenhouse outside data and web data are used as history data(input data) and Greenhouse inside data is used as target value(forecast temperature). The stored history data are then downloaded to Google Colab cloud and is being preprocessed. The preprocessed time series data (as weather is a dynamic parameter) are converted to a supervised learning problem by framing of time series problem given the desired length of input and output sequences. A supervised learning problem is included input patterns and output patterns . Therefore, neural network algorithms can learn how to forecast the output patterns from the input patterns. By using these pairs of input and output sequences, the model is trained by LSTM using CNN layer. The temperature value predicted by the model is passed to the farmers in advance.

Xuefei Liu, Chao Zhang, Pingzeng Liu, Maoling Yan, Baojia Wang, Jianyong Zhang, and Russell Higgs,[15] . With the development of artifcial intelligence, neural networks have attracted much attention because of their ability of self-learning and searching for optimal solutions at high speed. The intrusion detection system based on neural network belongs to the category of abnormal intrusion detection, including data acquisition module, data training, and detection module and a response module. The embedded system analyzes the data and through adaptive wireless network communication, the collection and perception of various signals in the physical world are realized. However, because many sensors are distributed in relatively open and unsupervised places, it is easy to be attacked from

outside.Intrusion detection based on Internet of Tings security technology is a proactive defense technology. By monitoring the state, behavior, and usage of the whole network and system, the intrusion detection system detects the primary use of the system users and the attempt by the external invaders to invade the network or system. By dividing the intrusion detection system into diferent modules, the neural network is applied to each module to realize the intelligent and dynamic detection of the intrusion detection system. The primary data sources and temperature data collected by the automatic acquisition equipment of the Internet of Things are introduced, and the data are pretreated and analyzed. For the training of neural network Levenberg-Marquardt Algorithm has been used by authors. The temperature data collected by sensors were fed into the neural network architecture and were divided into a training set, validation set, and for testing. Using the intelligent perception ability of intrusion detection nodes in the Internet of Things we synthesize intrusion detection and data prediction and provide a new scheme for the construction of the IoT security system.

Dhawan singh et al.[16] dealt with different IOT hardware development platforms . In this research paper they have studied and analysed IoT hardware development platforms. Different IoT hardware have been compared in terms of their processing capabilities, digital I/O pins, communication technology used, ports, analog I/O pins and dimensions, battery power, memories, communication protocols etc. Different IoT platforms have their own advantages and disadvantages and offer a lot of versatility and choice to consumers and developers . From paper we see that IoT reduces human effort and can save us a lot of time, money, and resources but at the same time there are concerns of privacy and security . IOT devices process large amount of data in real-time and will eventually lead to growth and prosperity in nearby future . Authors in conclusion say that IoT will help in creating trustworthy relationships and interactions in different fields like asset tracking and inventory control, location and shipping, individual tracking and conservation of energy, etc.

Joao mesquita et al. [17] dealt with ESP8266 module which is low cost and ultra low power wifi enabled device . They tested the different the built-in sleep modes and measured the impact of infrastructure parameters beacon interval and DTIM period on energy consumption, as well as packet delivery ratio and received signal strength as a function of distance and module antenna orientation to assert area coverage. The experiments and testing was performed indoor in a laboratory environment, with an ASUS RT-AC87U dual-band AC240030 access point, using the default IEEE 802.11 protocol the paper presents the features of the ESP8266 module and discusses the mechanisms that allow it to operate in lower energy consumption when performing recurrent seconds-scale communication .The ESP8266 module can operate for 2 to 4 days from a battery of about1000mAH size .The module is suitable for common building deployment and has a packet ratio of 99% in the same floor .

Kavya ladi et al.[18] dealt with developing a weather report system to collect data about different weather parameters and displaying then though an android application .DHT11 has been used to detect humidity and temperature and a rain drop sensor has been used .ESP8266 is used as an microcontroller .Android used was used to develop an application for streaming

data from thingspeak.com . The sensors are capable of covering a small distance the data collected from the sensors is stored in a website thingspeak.com which provides free cloud storage for IoT projects .The data from thingspeak can imported using an Api key which is provided .Different parameters like heat , humidity , heat index , rain drop can be assessed using laptop , phone or any other device . Thanks to cloud storage there is no need for datacenters this leads to reduced cost .The project provides a software and hardware implementation of IoT.

Mudila kusriyanto et al.[19] dealt with developing a weather station design using Arduino mega .Arduino mega 2560 microcontroller is used as data processing center . Rain sensor module is used to find out if there is rain. The module works by measuring the humidity obtained from drops of water collected on the sensor board. BMP180 a pressure sensor made by Bosch company was used . The air pressure sensor measures the absolute pressure around the sensor and varies according to weather and altitude . DHT22 a digital sensor that is used to measure the temperature and humidity of the surrounding air was used .To measure humidity, DHT22 uses two electrodes by holding the substrate moisture between the electrodes . ESP8266 was used to access the wifi network . PCE-THB 40 a digital thermometer-hygrometer with data recording functionality was used to display data on a screen . The DHT22 gave a mean error of 1.35 celsius during testing and PCE-THB 40 gave maximum error of 5% and mean error of 2.14% .

Leo louis el al.[20] dealt with working principle and working of an Arduino board .The paper discusses about the history and need for Arduino . The paper mentions about different types of Arduino boards and the commonly used shields .The paper discusses about the hardware elements of Arduino board and about different parts of Arduino ide . The paper than discusses about programming techniques of Arduino sketch in the Arduino IDE. There is discussion about void loop and void setup which are the fundamental of Arduino coding .The paper mentions some projects which have been made using Arduino like Arduino Satellite (ArduSat) an open source satellite completely based on Arduino to create a stage for space discoveries and ArduPilot (ArduPilotMega - APM) an unmanned aerial vehicle (UAV) based

Silanon et al. [21] dealt with the Implementation of a Weather Monitoring Station using CoAP on NB-IoT Protocol. The primary goal of this research is to design the prototype to monitor and collect environmental data like atmospheric pressure , rainfall, emprature etc. The Weather station is divided into two main parts. There are Environment Data Acquisitions (EDA) and Master Control Unit (MCU). The process of EDA is to read data from environment including wind speed and direction, humidity and temperature, atmospheric pressure and rainfall. The weather data would be encapsulated using CoAP and transmitted to cloud server (iSYNC). For database server, there is service to fetch the data and store it in MySQL database. All data in MySQL server are represented as dashboard by using Grafana. For the future work, all data could be used to build weather forecasting model using different algorithms.Thus, this system can be very beneficial for many who depend on weather data as part of their everyday lives as it can give the rough idea of whether forecast using several data.

Hwang et al. [22] dealt with the Designing of IoT-Based Weather Monitoring System using MQTT. This paper proposed an IoT-based weather monitoring system architecture which uses the technology of message queuing telemetry transport (MQTT) and distributed and layered approaches. It is based on developing the weather monitoring system. The main motive of the research is to use the technology of message queuing telemetry transport (MQTT) as roles of the communication layer instead of direct-connecting database, which can isolate the system migration complexity from heterogeneous relational database management system (RDBMS) and construct a distributed information system. Basically ,Weather monitoring system includes many sources like wind direction, wind speed, climate change, raining, snowing. Thus more information retrieval needs more sensors and actuators and more complex technology is involved. Future research works can be to propose a robust system architecture, better deployment method, and efficient algorithms to visualize and enhance data retrieval when large scale weather monitoring applications are applied . It could be more efficient to use as more data would be available to catch up the high accuracy.

Parmar et al. [23] presented an IOT Based Weather Intelligence system using node MCU wifi Arduino . The basic idea of the project is to gather the climatic parameters. The system works on Node MCU device and it is also combined up with d sensors like temperature, humidity, noise, CO, rain. Thus resulting in helping in reducing pollution level and also enhance the life of the users .In this research , For the advancement of weather monitoring, the sensors store the data with GPS coordinates which will help to get more accuracy in data in real-time with the help of graph. The collected details of the different sensors help to control the pollution in the area. This help to reduce the pollution in the environment , The sensors detect the weather condition and pass the information to the Node MCU Wifi

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3. PROBLEM FORMULATION

- As mentioned we are using NODEMCU as the micro-controller element in designing of our weather station and THINGSPEAK cloud servers by MATHWORKS.

- The **NodeMCU ESP8266 development board** comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor.

- This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs.

- Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

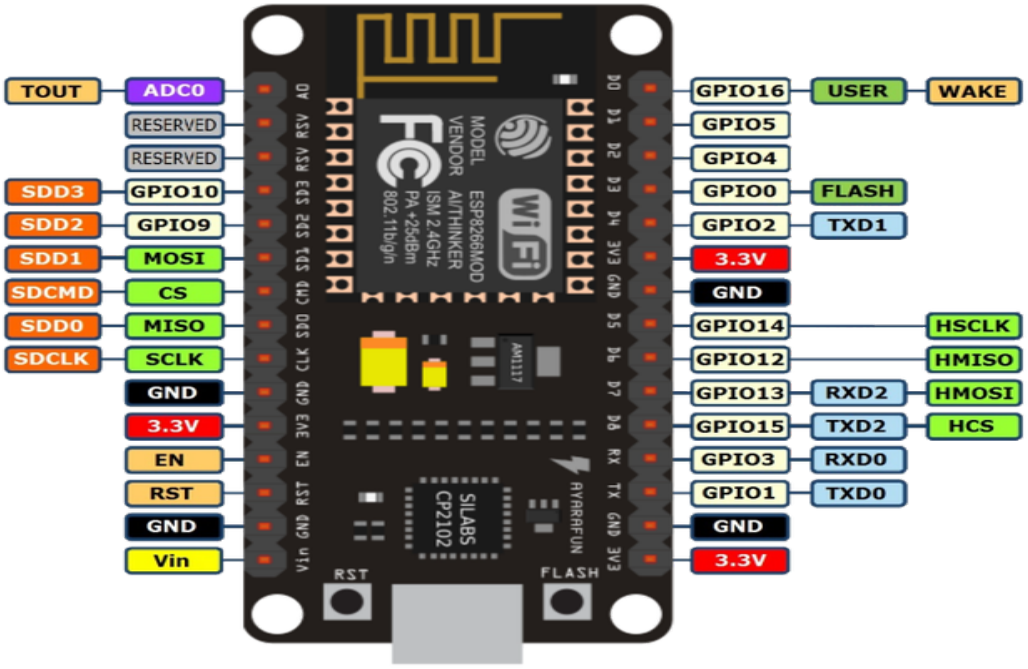

Fig-1-NODEMCU PIN CONFIGURATION

3.1 Use of DHT11 sensors

- For measuring temperature we will use DHT11 sensors
- **The DHT11 sensor is** one of the best sensors for measuring temperature and humidity.
- These sensors consist of two parts, capacitive humidity and a heat resistor.
- There is also an analog-to-digital converter unit in the DHT11, which generates digital output. With the help of this converter, the user can use it in microcontrollers to read values.
- There are total three pins in DHT11 sensor pin-1 i.e Vcc of DHT11 is connected to input supply of NODEMCU i.e Vin
- Pin-2 i.e Data pin of DHT11 is connected to digital pin D3 of NODEMCU and Pin-3 i.e GND of DHT11 is connected to GND of NODEMCU.
- This way we have setup the connections between controller and DHT11 sensors to detect real time temperature and humidity.

Fig-2- DHT11 SENSOR

3.2 Use of BMP180 sensors and Rain sensors

- The BMP180 is a piezoresistive sensor that detects pressure. Piezoresistive sensors are made up of a semiconducting material (usually silicon) that changes resistance when a mechanical force like atmospheric pressure is applied.

- The sensor uses real-time temperature measurements to compensate for the pressure readings for changes in air density.

- Its configuration with NODEMCU is quite same as DHT11 ,it has namely 4-pins Vin, SDA,SCL and GND.

- The Vin is connected to Vin of NODEMCU, the GND pin of BMP180 to GND of NODEMCU, SCL to D1 of NODEMCU and SDA to D2 of NODEMCU.

- Similarly rain sensors can be connected to NODEMCU it has 4-pins GND, Vcc ,D0 and A0.

- .GND is connected to GND of NODEMCU, Vcc is connected to Vin of NODEMCU , D0 to digital pin D0 of NODEMCU and A0 to analog pin A0 of NODEMCU.

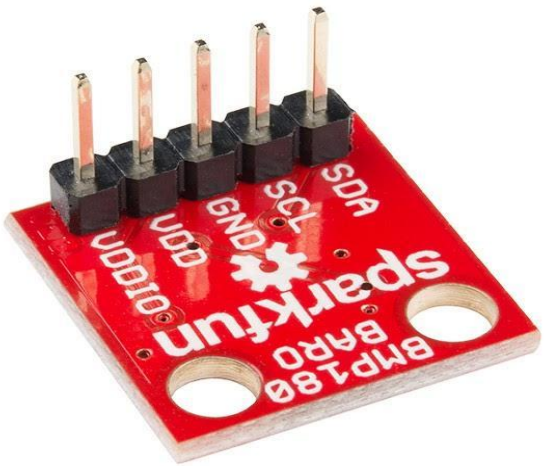

Fig-3-BMP10 SENSOR

3.3 UPLOADING THE DATA TO ARDUINO IDE AND THINGSPEAK

- Now making all the connections mentioned above using a breadboard and jumper wires.

- Connect the power supply to NODEMCU via micro-usb cable to your PC and open arduino IDE.

- Install all necessaries libraries and boards in the IDE for eg: For our system and code we installed bmp_180 libraries and DHT libraries from github and all installed thingspeak and esp8266 libraries for making the connection to cloud through wi-fi.

- Now running the code and uploading it the NODEMCU establishes connection to THINGSPEAK server via API-KEY of our thingspeak server we included in code.

- Figure below is screenshot of our work that how we have connected to thingspeak and what libraries are included.

Fig-4- Layout of sensors libraries in Arduino IDE

4. RESULTS AND ANALYSIS

4.1 HARDWARE

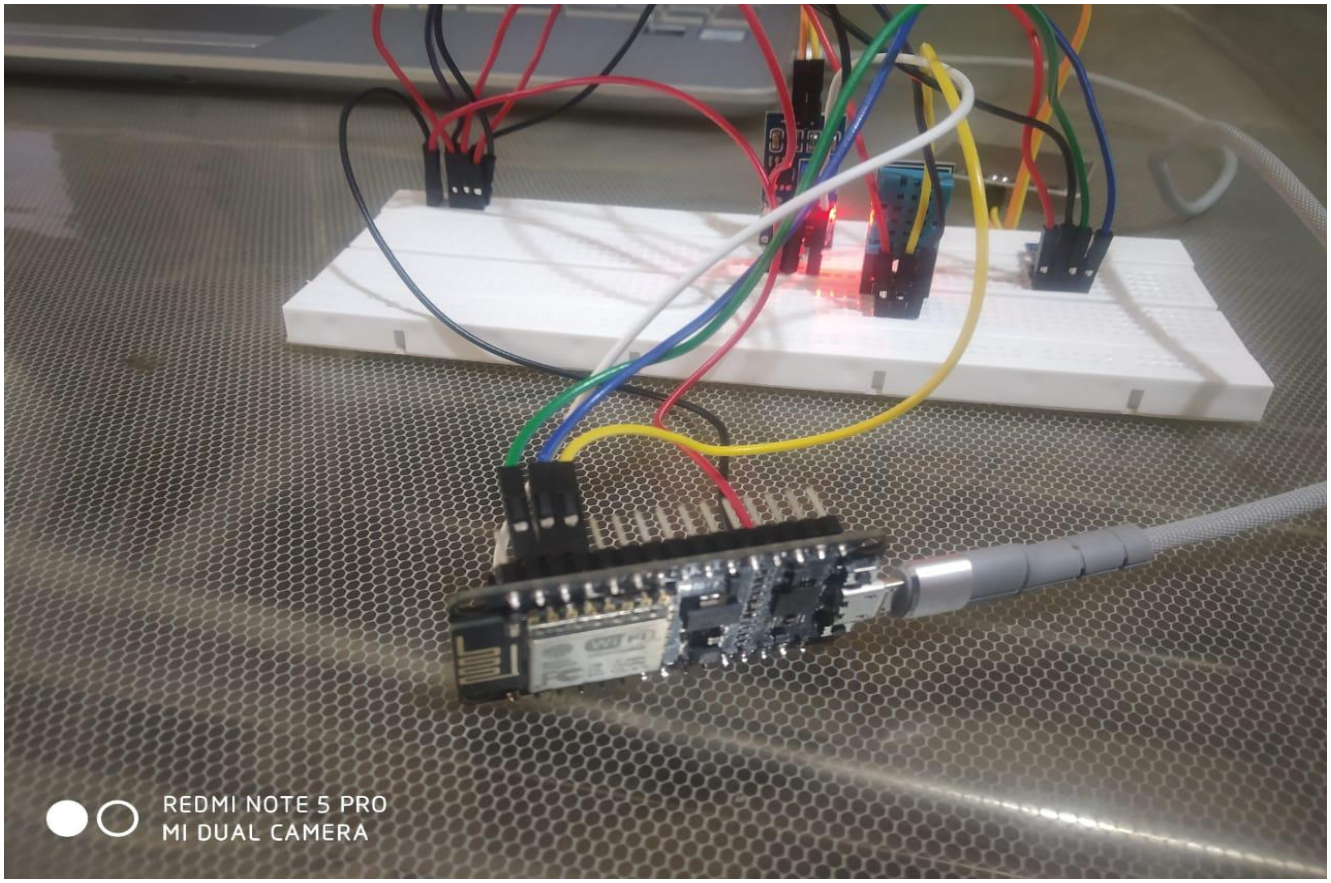

Fig-5- HARDWARE OF OUR PROJECT

- The fig-5 represents hardware of our Project we have attached the hardware using breadboard and jumper wires.
- The power supply to NODEMCU is given by the PC battery via micro-usb the NODEMCU has an internal convertor in input supply.
- This internal convertor makes sure that every sensor involved gets the rated voltage of 5V to avoid any burnout in sensors circuitry.
- The digital and analog pins has been set for each sensors and same has been reflected in the Arduino code.

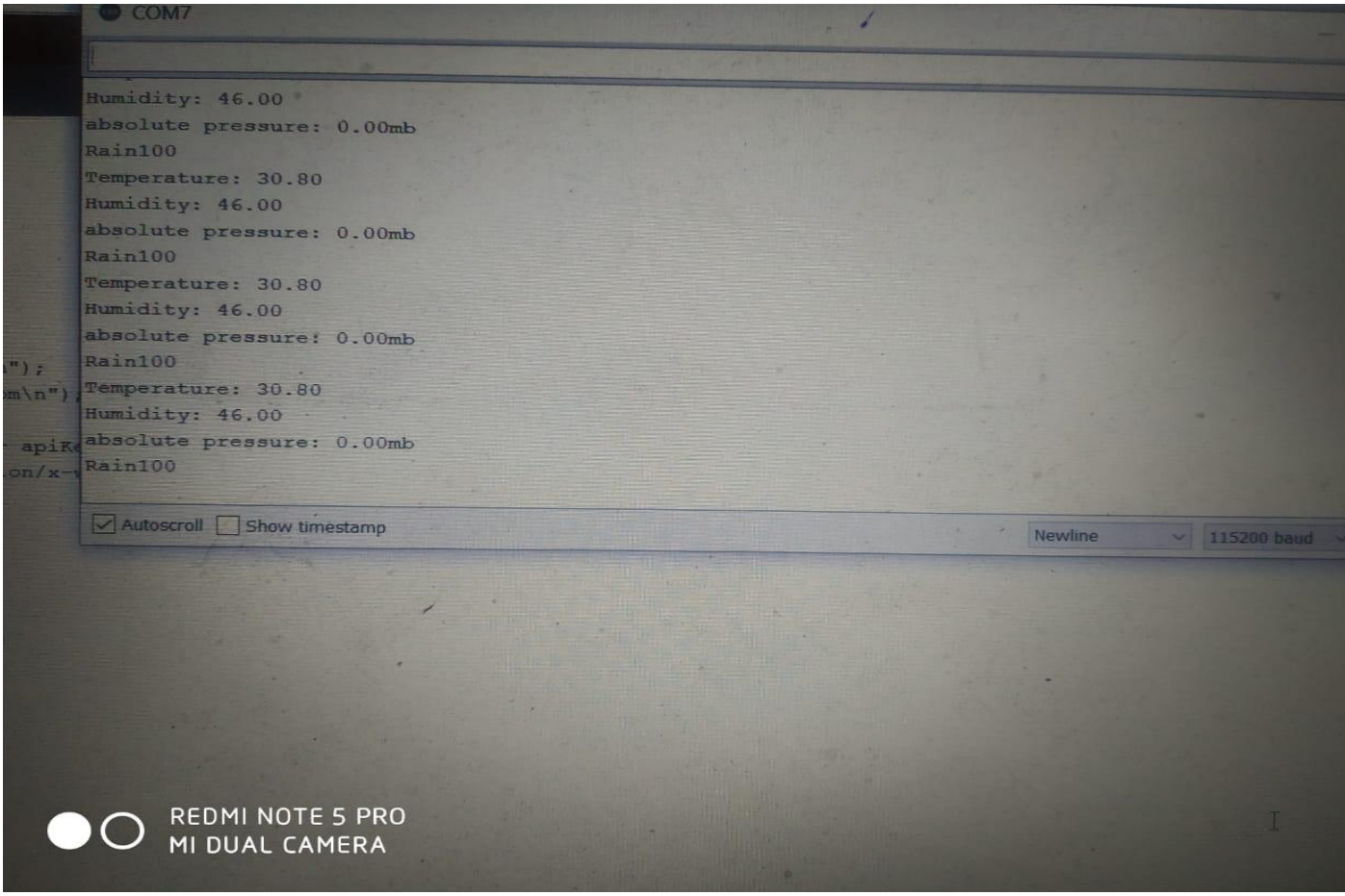

Fig-6- Real time weather Data on Arduino Serial monitor

- In fig-6 we have the serial monitor of arduino displaying real time data based on the data collected by each sensor we have included in our hardware.

- In fig-6 we can see the temp is around 30 degree celsius, humidity is 46% and rain content is 100%

  .

- This same data has also been uploaded to things speak for better visualization and analysis as we can see inn fig-7.

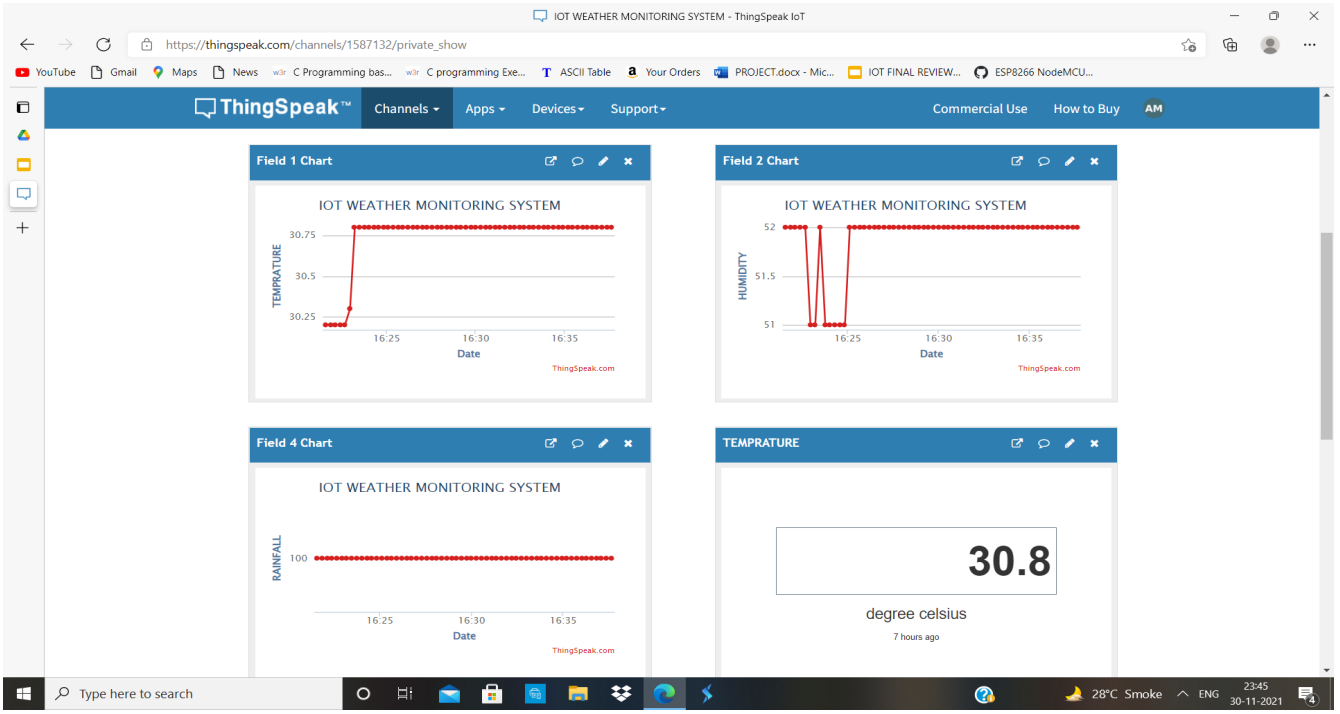

Fig-7- Real time DATA uploaded on Thingspeak server with 24 hrs visualization

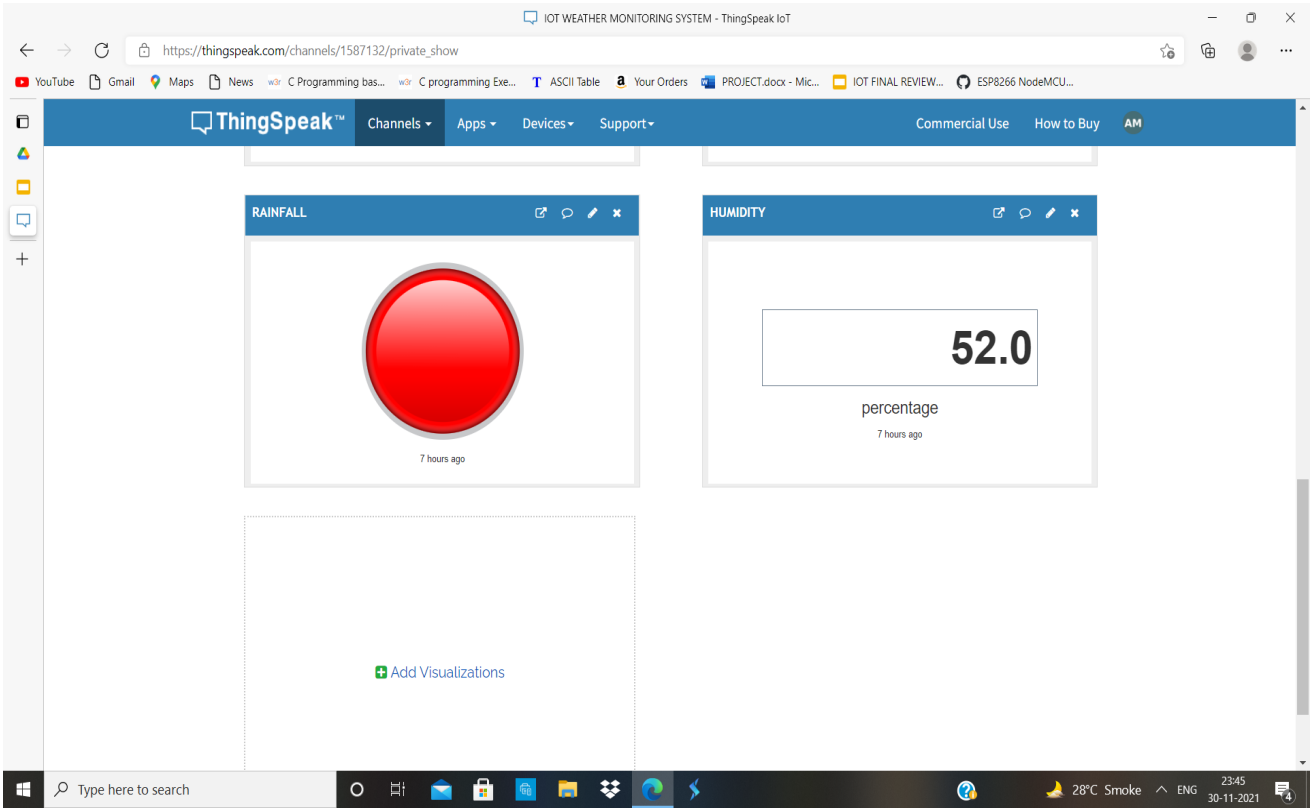

Fig-8- RED Light predicting there are high chances of rainfall

6. CONCLUSION

So basically, we have designed a weather-based monitoring system which involve a hardware project. So, it can be installed at a place where we want the real time data, the sensors sense the physical parameters like temperature and humidity (using DHT11), rain intensity (using raindrop detection sensor), air pressure (using BMP180) and the air quality (using MQ2 sensor). This data sensed by the sensor now will displayed on the board using OLCD or it can be done by uploading the data to the cloud using NodeMCU ESP8266 (Wi-Fi module) and the user can get the real time data through ThingSpeak platform either on the website or the persons Email or the SMS.

Our project can be helpful in protecting the environment and even improving the human health as it can be installed in area prone to fire or the industry. We cannot feel the presence of poisonous gases like CO as it is colorless, odorless and even tasteless, so such project can be helpful for the workers and the local people. If the level reaches a threshold, the buzzers can be included to alert the people so that they can take actions. The project can even be used for the farmers so that they can get the details of the weather and can save their crops from unexpected weather. The system installed in the forest can alert the fire stations about a fire at its early. The coastal areas can even be reported before any thunderstorm by installing the system at an interval of locations so that the storm can be tracked from a long distance and people get sufficient time to get prepared.

So the project is successfully working with the updation of the real time data to the website and overall it is a low cost and an efficient project. We have completed the project within a budget of 2k and it is completed in around 2 months. We basically faced the problems like the unavailability of some of the sensors due to current pandemic. Presence of all the member at a time was difficult due to busy schedule and no physical presence.

7. REFERENCES

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- https://circuitdigest.com/microcontroller-projects/esp12-nodemcu-based-iot-weather-station
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- https://in.mathworks.com/help/thingspeak/collect-data-in-a-new-channel.html
- https://github.com/adafruit/DHT-sensor-library
- https://github.com/LowPowerLab/SFE_BMP180

```
#include <SFE_BMP180.h>
#include <Wire.h>
#include <ESP8266WiFi.h>
#include "DHT.h"

DHT dht(D3, DHT11);
SFE_BMP180 bmp;
double T, P;
char status;
WiFiClient client;

String apiKey = "W1XIB4NY8UY90NF5";
const char *ssid =  "Forbital18";
const char *pass =  "soma1428";
const char* server = "api.thingspeak.com";


void setup() {
  Serial.begin(115200);
  delay(10);
  bmp.begin();
  Wire.begin();
  dht.begin();
  WiFi.begin(ssid, pass);


  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
}
```

```
void loop() {
  //BMP180 sensor
  status =  bmp.startTemperature();
  if (status != 0) {
    delay(status);
    status = bmp.getTemperature(T);

    status = bmp.startPressure(3);// 0 to 3
    if (status != 0) {
      delay(status);
      status = bmp.getPressure(P, T);
      if (status != 0) {

      }
    }
  }

  //DHT11 sensor
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  //Rain sensor
  int r = analogRead(A0);
  r = map(r, 0, 1024, 0, 100);


  if (client.connect(server, 80)) {
    String postStr = apiKey;
    postStr += "&field1=";
    postStr += String(t);
```

```
    postStr += String(t);
    postStr += "&field2=";
    postStr += String(h);
    postStr += "&field3=";
    postStr += String(P, 2);
    postStr += "&field4=";
    postStr += String(r);
    postStr += "\r\n\r\n\r\n\r\n";

    client.print("POST /update HTTP/1.1\n");
    client.print("Host: api.thingspeak.com\n");
    client.print("Connection: close\n");
    client.print("X-THINGSPEAKAPIKEY: " + apiKey + "\n");
    client.print("Content-Type: application/x-www-form-urlencoded\n");
    client.print("Content-Length: ");
    client.print(postStr.length());
    client.print("\n\n\n\n");
    client.print(postStr);

    Serial.print("Temperature: ");
    Serial.println(t);
    Serial.print("Humidity: ");
    Serial.println(h);
    Serial.print("absolute pressure: ");
    Serial.print(P, 2);
    Serial.println("mb");
    Serial.print("Rain");
    Serial.println(r);

  }
  client.stop();
  delay(1000);
}
```