# Realtime Weather Prediction System Using IOT and ML.

Submitted in partial fulfillment of the requirements

of the degree of

Bachelor of Engineering

by

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2022

# Certificate

This is to certify that the project entitled **"Realtime Weather Prediction System Using IOT and ML"** is a bonafide work of **Tanay Gawade (17103A0038) Pratik More (18102A0030) Samdarshak Metkari (18103A0067) Sarvadnya Patil (18103A0045)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of "Undergraduate" in "Bachelor Engineering".

(Name and sign)
Supervisor/Guide

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Head of Department

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Principal

# Thesis Approval for Ph. D. / Dissertation Approval for M. E. / Project Report Approval for B. E.

This thesis / dissertation/project report entitled **Realtime Weather Prediction System Using IOT and ML** by **Tanay Gawade, Pratik More, Samdarshak Metkari, Sarvadnya Patil** is approved for the degree of Bachelor of Engineering.

Examiners

1._____

2._____

Date: 7 May, 2022

Place: Wadala (E)

# Declaration

I declare that this written submission represents my ideas in my own words and where other's ideas or words have been included, I have adequately citedand referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary actionby the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been takenwhen needed

Pratik More (18102A0030)

Date: 3 Dec, 2022

# 1. Preface/ Abstract

The activities of many primary sectors depend on the weather for production, e.g., farming. The climate is changing at a drastic rate nowadays, which makes the old weather prediction methods less effective and more hectic. To overcome these difficulties, the improved and reliable weather prediction methods are required. These predictions affect a nation's economy and the lives of people. To develop a weather forecasting system that can be used in remote areas is the main motivation of this work. The data analytics and machine learning algorithms, such as random forest classification, are used to predict weather conditions. In this paper, a low-cost and portable solution for weather prediction is shown.

# 2. Acknowledgements

We would like to express our special thanks of gratitude to our principal Dr. Sunil Patekar as well as our mini project team mentor Prof. Sheetal Mapare who gave us the golden opportunity to do this wonderful project on the topic **“Weather forecasting using IOT and ML”**. Which helped us in doing a lot of research and we came to know so many things, we are so much thankful to them.

Secondly, we would also like to thank all the professors of ‘electronics department ‘of our college ‘Vidyalankar Institute of Technology’ who helped us in finalizing this project.

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# 3. Introduction & Motivation

The application of science and technology that predicts the state of atmosphere at any given particular time period is known as Weather forecasting. There is a many different methods to weather forecast. Weather forecast notices are important because they can be used to prevent destruction of life and environment. The weather forecasting methods used in the ancient time usually implied pattern recognition i.e., they usually rely on observing patterns of events. For example, it is found that the following day has brought fair weather, if the preceding day sunset is particularly red. However, all the predictions prove not to be reliable.

Weather forecasting is simply the prediction of future weather based on different parameters of the past like temperature, humidity, dew, wind speed and direction, precipitation, Haze and contents of air, Solar and terrestrial radiation etc. Weather forecast is an important factor affecting people's lives. Once the data is taken, it is trained. The heart of this project is the Linear Regression algorithm which is used to predict the weather using these data. The more parameters considered, the higher the accuracy. This project can help many people finding the weather of tomorrow.

The project simply uses temperature, dew, pressure, and humidity for training the data. Here these data are then trained using Linear Regression for the prediction.

# 4. Analysis & Design

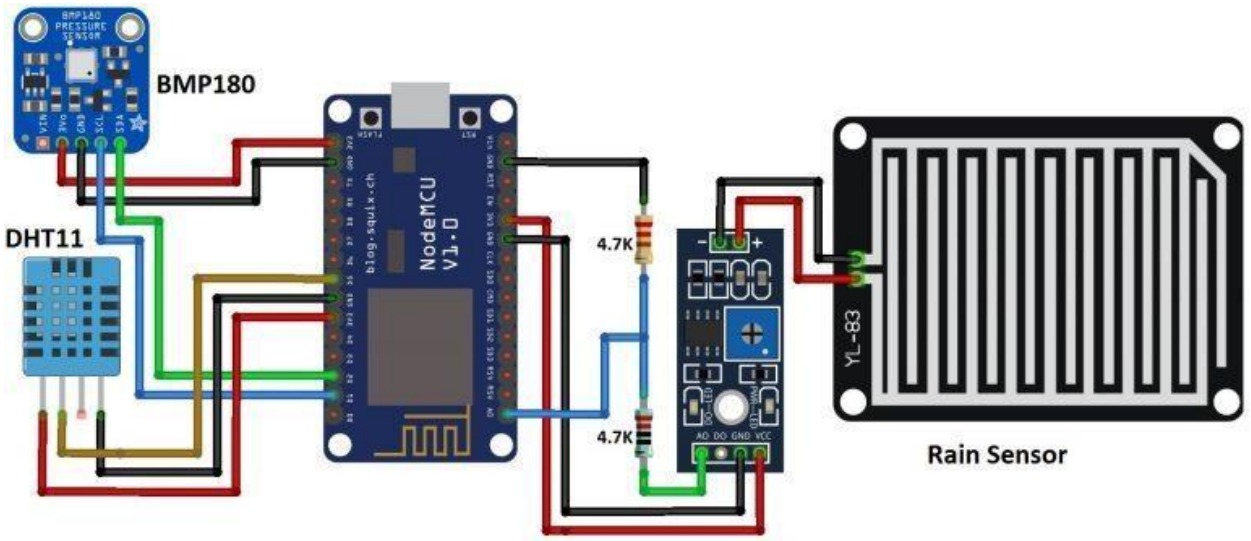


Fig1. Circuit diagram and connections

Live weather monitoring using nodeMCU esp8266. We have interface DHT11 humidity and temperature sensor, BMP180 barometric pressure sensorand FC37 rain sensor with nodeMCU esp8266-12E wifi module. We will measure humidity, temperature, barometric pressure, and rainfall and upload the data to web server.

# Hardware

### 1.ESP8266

1. Processor: L106 32-bit RISC microprocessor core based on the Tensilica Diamond Standard 106Micro running at 80 MHz
2. Memory: 32 KB RAM, 32 KB instruction cache RAM, 80 KB user data RAM, 16 KB ETS system data RAM.
3. External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typically included)

### 2.DHT11 humidity and temperature sensor

1. Operating Voltage: 3.5V to 5.5V
2. Operating current: 0.3mA (measuring) 60uA (standby)
3. Temperature Range: 0°C to 50°C
4. Humidity Range: 20% to 90%
5. Resolution: Temperature and Humidity both are 16-bit

### 3. BMP180 barometric pressure sensor

1. **Input Voltage**: 3 to 5VDC
2. **Logic Voltage**: 3 to 5V compliant
3. **Pressure Sensing Range**: 300-1100 hPa (9000m to -500m above sea level)
4. **I2C Address**: 7-bit address 0x77.

**4.Rain sensor**

1. Working voltage 5V
2. Output format: Digital switching output (0 and 1), and analog voltage output AO
3. Uses a wide voltage LM393 comparator.
4. Comparator output signal clean waveform is good, driving ability, over 15mA

# Software

**1.ThingSpeak**

1. ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud.
2. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak.
3. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in.
4. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics.

**2.Jupyternotebook**

1. The Jupyter Notebook is an open source web application that you can use to create and share documents that contain live code, equations, visualizations, and text.
2. The name, Jupyter, comes from the core supported programming languages that it supports: Julia, Python, and R. Jupyter ships with the IPython kernel, which allows you to write your programs in Python, but there are currently over 100 other kernels that you can also use.

# 5. Features

**1. Collecting real-time weather data:**

1. DHT11, BMP180 and rain sensors are connected with NodeMCU ESP8266, which measure temperature, humidity, barometric pressure, rainfall respectively.
2. The realtime data collected by all the sensors is sent to the ThingSpeak cloud server (database) with the help of ESP8266, Thingspeak sends data to the NodeMCU in form of a JSON file, so that data can now be displayed on a HTML Web Page that reflects measured readings of different sensors.
4. At the same time, a Google spreadsheet is also used to record the different values of temperature, humidity, barometric pressure and rainfall in a csv file format.

**2.Predicting the future data with ML:**

1. This recorded data is used to train the machine learning algorithm. A model based on Logistic Regression.
2. in Jupyter Notebook (Python IDE) is used and trained with the pre-recorded values stored in the Google spreadsheet.
3. Further, NodeMCU records the real time values of temperature, humidity and light intensity of a particular place or location that are used to test the model and take decision.
4. These values are sent to the Jupyter Notebook using serial communication between NodeMCU and Jupyter Notebook.
5. With the help of the model an attempt to predict the feasibility of a match is made. After that, either logic ‘0’ or ‘1’ is sent by the Jupyter Notebook to the NodeMCU as a predicted result.

# 6. Results

**1. Weather data representation:**

Using NodeMCU the sensor's collected data is sent to the ThingSpeak cloud server (database) as shown in figure 2.

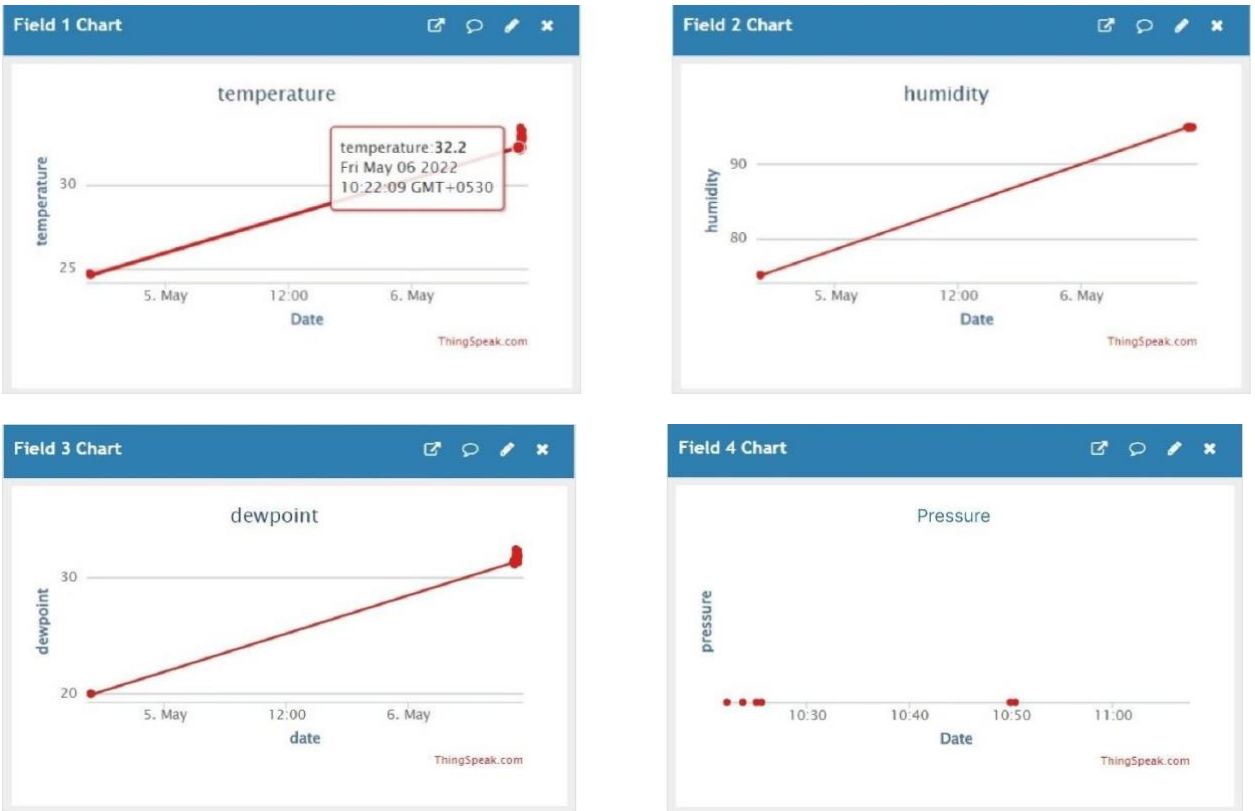


Fig2. Realtime weather data on ThingSpeak

**2. Data prediction:**

Using the datasets from thingspeak the model is tested and trained and successfully predicting the future weather data with 55% accuracy rate. And showing the realtime and predicted data comparison graph as shown in figure 3.

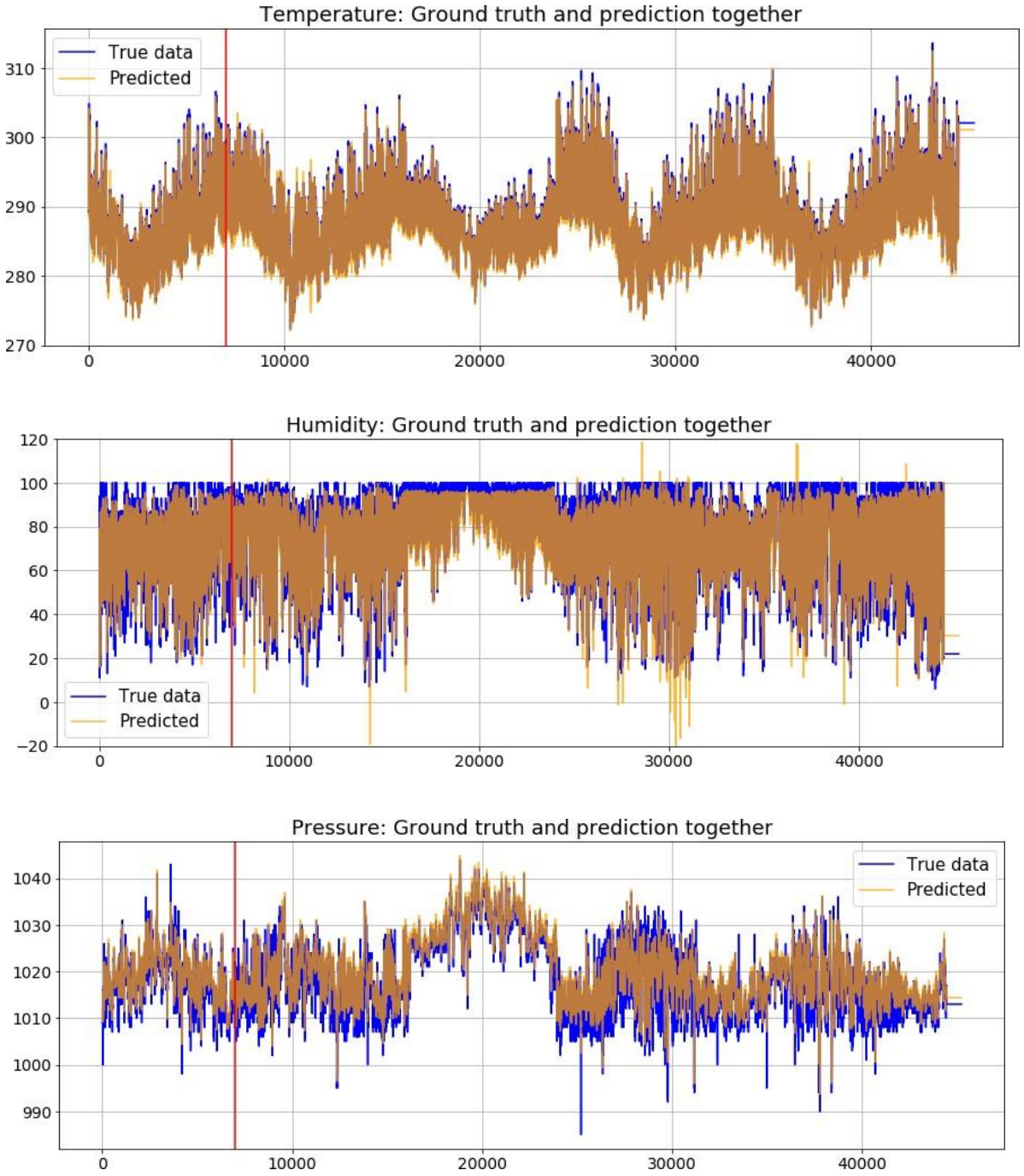


Fig.3 Good truth and prediction data comparison

## 7. Cost Analysis

| Component | Price (Rs.) |
|---|---|
| **Esp8266 Microprocessor** | **350** |
| **DHT11 Sensor** | **135** |
| **BMP180 Sensor** | **85** |
| **FC37 Rain Sensor** | **100** |
| **Jumper Wires** | **50** |
| **Total** | **720** |

# 8. Conclusion

The real time weather prediction system presented in this paper has been developed around low cost IoT board and sensors. The temperature, light and humidity are the three important parameters that are monitored and uploaded on thingspeak cloud. The system has been deployed in an indoor environment and values of the parameters have been recorded in Google spreadsheet.

A Logistic regression model has been used in Jupyter notebook environment that is trained with prerecorded values of parameters and used to predict the weather parameters in real time environment. The result of the model can be compared with the other works available in literature and the proposed system is slightly better in terms of accuracy. Further, the system can be modified to be used at commercial level and have many applications in smart homes, buildings, sports, hospitals etc.

# 9. References

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