IoT-based Weather Forecasting System

Pasupuleti Rohith Sai Datta
Computer Science Engineering
MS Ramaiah university of Applied Sciences
Bengaluru,India
19ETCS002083@msruas.ac.in

Rakesh Kumar
Computer Science Engineering
MS Ramaiah university of Applied Sciences
Bengaluru,India
19ETCS002152@msruas.ac.in

Jayendra
Computer Science Engineering
MS Ramaiah university of Applied Sciences
Bengaluru,India
19ETCS002066@msruas.ac.in

Nithin krishna
Computer Science Engineering
MS Ramaiah university of Applied Sciences
Bengaluru,India
19ETCS002081@msruas.ac.in

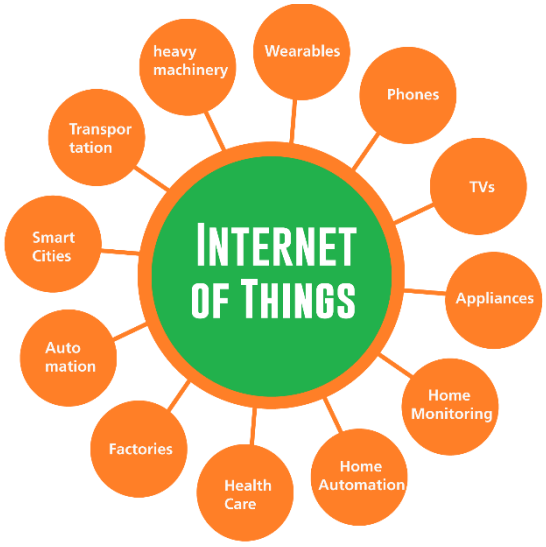
Rakshith
Computer Science Engineering
MS Ramaiah university of Applied Sciences
Bengaluru,India
19ETCS002098@msruas.ac.in

Abstract*— With a drastic change in climate continuously it is very harmful to the people who are living in the disaster-prone areas. In some areas the people are not warned for the consequences of coming specifically in their areas, they are told about the average temperature and humidity of the city while the humidity and temperature vary at different altitude and changes at short distances. The system is a very cost-effective and efficient method for controlling and monitoring the weather, and it sends the data to the cloud so that it can be visible anywhere through internet. The temperature, humidity, and pressure play a significant role in different fields like agricultural, industrial and Logistical Field. Weather forecast is necessary for the growth and development of these industries. The Internet of Things (IoT) is the technology used in developing the proposed system, which is an efficient and advanced method for connecting the sensors to the cloud which can store real-time sensor data and connect the entire world of things in a network. The design and development of a Weather forecasting system are covered in this paper. With the use of an temperature & humidity sensor we can get to know the real time value of temperature and humidity. With the use of an pressure sensor we can get to know the real time value of atmospheric pressure. With the use of an Rain drop module sensor it will detect the real time rain fall. This technology will collect all the real time data and it will save into Blynk IoT Cloud where the user can access all the data with mobile application & with web dashboard.

Keywords—IoT, Weather forecasting, real time, Temperature & humidity Sensor, Pressure Sensor,Rain drop module Sensor, Node Mcu ESP-32 , Blynk IoT.

I. INTRODUCTION

An IoT system contains smart devices which are connected to the internet and uses an embedded processor, sensors and communication hardware to save, transfer and perform an action on the data which they acquire from their surroundings.[1]



IoT devices transfer the sensor data which they receive from connecting the IoT gateway or another edge device where data is transferred to cloud for analysis or being analyzed locally. Sometimes, these devices communicate with each other and take action according to the information collected from other devices.[2]

IoT devices can work without the help of people, although people can interact with the devices for performing tasks and getting more straightforward as well as accurate data, give them instructions or access the output.[3]

The Weather Forecasting system continuously monitors and measures the Temperature and Pressure and Rain statues in the environment. This data is stored, analyzed in the cloud And that stored data can be accessed by using BlynkIoT with Mobile application as well as Web dashboard.[4]

Through the BlynkIoT application user will get to know the real time data from the environment.

This system is efficient, accurate and simple to implement and use. The project will be beneficial mainly for the people to check the weather conditions with real time data which occurs in environment.[5]

The following are some of the main advantages of Weather Forecasting by using sensors are:

- Real time data
- Share Data
- Accurate local Forecast
- Easy to use

II. Literature Review

Weather Forecasting System is a system which monitors the humidity, temperature, pressure and rain in the environment. Effective and cheap methods to monitor the quality of the air and prevent it from a potential hazard. The author collects the data from the app and analyzes the Weather Changing at different time intervals. They correlate CO and NO2 levels against humidity and temperature.[1]

The embedded controller is designed to measure the temperature and humidity of the environment. The monitoring station sends the data through a wireless network on a web page. It uses the GPS module, Real Time Clock to measure real-time weather data at a particular location. The monitored data uploaded on the cloud using a mobile application. The sensor used is Rain statues, wind pressure, temperature, and humidity.[2]

I have Created a wi-fi network by the client to get access the cloud services and microcontroller. The data is uploaded on the BlynkIoT. The system used by the author is cost effective as it cannot use the DHT sensor which reduces the cost at a lesser extent. The author displays the result in the OLED display. It uses Wemos board instead of ESP8226 board which has inbuilt WIFI module. The result obtained is compared with commercial thermometer and barometer.[3]

The sensors used are BMP085(Pressure Sensor), CC3200 and LM358(Rain statues). The average error in pressure measurement is 0.035%. In temperature measurement, the average error is 2.02%. It has various sensors like DHT11 which calculates the humidity and temperature.
In this, we send the data to the cloud than using a machine learning algorithm prediction is carried outThe measured parameters are sent to the cloud services.[4]

The author works on Nodemcu which is also combined with different sensors like temperature, humidity, pressure and rain. The main advantage of this work is that it is low cost and less power consumption. It is installed anywhere to monitor the climatic changes. The system helps the user to select the best suitable environment. It uses various sensors like temperature, humidity, pressure, Rain status.[5]

This system automatically displays the temperature, humidity, pressure, rain, air quality, and weather condition on specific webpage of IoT in BlynkIoT as well it will also display this data on the weather station display.[6]

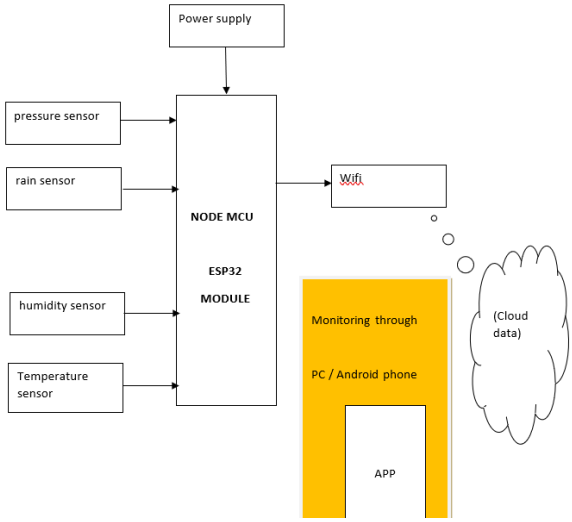
III. METHODOLOGY

This section explains, in detail, the various methods and techniques used to build this system.

A. *System Architecture*

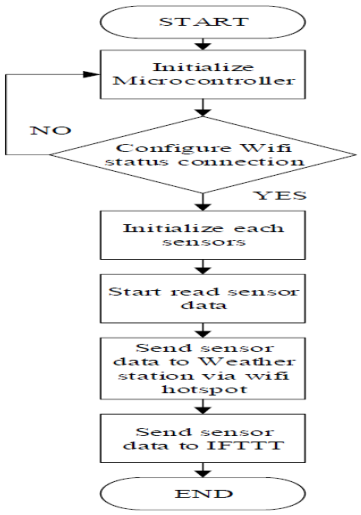
In this model, we use temperature & humidity sensor, pressure sensor, raindrop module sensor to measure the weather.

The sensed data is processed by the Node MCU and published to the cloud service i.e BlynkIoT. The data can be analysed with BlynkIot application by various graphical methods.[1]



B. *Control Unit*

- This project is proposed to implement the IoT technology as a communication medium in this project. As stated in the previous section. [1]
- The process of the system is start after the microcontroller ESP32 configured all the sensor and start to read the data from the sensor.[2]
- Then, the data also be sends to the IoT platform that is BlynkIoT via wireless communication by ESP32 Wi-Fi network.[3]
- The sensors that connect to ESP32 is act as the control unit of the system where all the data is collected here. [4]
- This system automatically displays the temperature, humidity, pressure, rain, air quality, and weather condition on specific webpage of IoT in BlynkIoT as well it will also display this data on the weather station display.[5]



Control unit flowchart.

IV. COMPONENTS USED AND ITS WORKING

Node MCU: It is a microcontroller which has inbuilt Wi-Fi module. It supports bandwidth up to 2.4GHz. It has similar functionality like Arduino boards. It is a microcontroller very similar to Arduino UNO with the added benefit of inbuilt Wi-Fi Module. It has both analog and digital pins on its board. It ranges from D0 to D7. [1]

DHT 11: The DHT 11 is a humidity and temperature sensor which is used in weather and environment monitoring of data. This is a very efficient and cost-effective sensor. It is widely used in cheap sensor. Its supply voltage is +5 volt. It senses the temperature which is range from 0_0 C to 50_0 C which has chances of error +-2_0 C. It senses the humidity range from 20% to 90%. It is one of the sensors of DHT series. dht.read is one of the function of DHT and it is used for reading the humidity and temperature from the sensor. Where pin number is the digital pin number from which output of DHT sensor is to be read. [2]

BMP180: The BMP180 is a pressure sensor which is created by the BOSH sensor tech Pvt. ltd. Company. It is a high performance, cost effective and efficient device which enable the application in the new generation mobile phones like Tablet, Smartphones and other devices. It is same as BMP085 and takes many changes. It is very smaller in size. The ultra-low power consumption decreases to 3uA make BMP180. BMP180 is known for its stable behavior with reference to independency in supply of voltage. The BMP180 is also used for reading the temperature and it uses bmp.read() function for reading the data from the BMP180 sensor. [3]

Raindrop Sensor: It is a tool used for sensing rain. It consists of two modules, a **rain board** that detects the rain and a **control module**, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems.[4]

LCD: The Liquid crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.[5]

V. TECHNOLOGIES USED

1. Cloud

The cloud service used in this project is BlynkIoT.
BlynkIoT is used to store the depth data that the multiple sensor senses and Node MCU processes.
This data can be retrieved or analyzed in the cloud, based on which some control actions can be performed.
The collected data is displayed in real time using the dashboard, using which data can be visualized as a chart, graph, text, slider, image, stream, and many more. [1]

2. Microcontroller

An MCU is a sophisticated semiconductor integrated circuit (IC) made up of a processor, memory modules, interfaces for communication, and peripherals.
A wide variety of devices, such as washing machines, robotics, drones, radios, and game controllers, utilize MCU technology. The microcontroller used in this project is Node MCU, which is easier to use due to the in-built wifi chip. [2]

3. MQTT Protocol

The Message Queuing Telemetry Transport (MQTT) protocol is a lightweight messaging protocol used to send and receive data between devices.
It is a simple communication mechanism, where data is published and subscribed with respect to the cloud. [3]

4 . Sensor

A sensor detects and records a physical property like temperature, resistance, capacitance, etc. In our application, an ultrasonic sound sensor is used. It is a device that uses ultrasonic sound waves to calculate the distance to an object. It transmits and receives ultrasonic signals using a transducer to determine the proximity of an item. [4]

VI. SOFTWARE USED

A. Arduino IDE

The Arduino IDE [14] is a software which is act as an interface between the microcontroller board and the computer. The integrated development environment (IDE) is an inter-platform application (for UNIX, Windows, Mac and Linux operating systems) which is coded in language Java. It is widely used in writing & uploading the code in different kind of Arduino UNO boards and microcontrollers like NodeMcu and Wemos board and so forth. It has a set of libraries which is used for connecting various sensors and libraries. It provides the facility of the serial monitor through

which we can see the output of the code and it can be dumped in the microcontroller. It compiles the code before it is been uploaded into the microcontroller and checks all the errors which are either of the library error or syntactical error. It is an open source software in which source code is to be written and debug and it is supported by arduino.cc. It saves the file under the .ino extension.[1]

B. BlynkIoT

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

- Blynk App: – It allows you to create amazing interfaces for your projects using various widgets which are provided.
- Blynk Server: – It is responsible for all the communications between the smartphone and hardware.
- Blynk Libraries: – It enables communication, for all the popular hardware platforms, with the server and process all the incoming and outcoming commands.[2]

VII. LIBRARIES USED

- **DHT Library:** The DHT11 library is used for connecting the DHT11 sensor to the Arduino IDE or microcontrollers. It contains 4 files DHT.cpp, DHT_U.cpp, DHT.h, DHT_U.h. It is used for connecting all the DHT series sensors to the Arduino IDE. It is created by the BlynkIoT.[1]

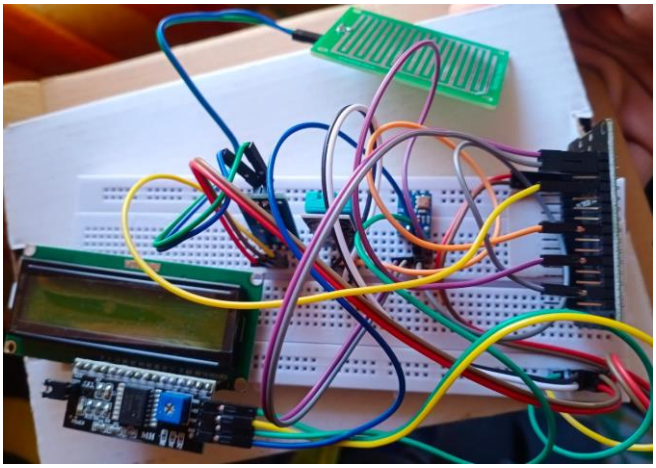
- **Blynk Libraries:** It enables communication, for all the popular hardware platforms, with the server and process all the incoming and outcoming commands.[2]

- **LiquidCrystal library:** Allows communication with alphanumerical liquid crystal displays (LCDs).This library allows an Arduino/Genuino board to control LiquidCrystal displays (LCDs) based on the Hitachi HD44780 (or a compatible) chipset, which is found on most text-based LCDs. The library works with in either 4 or 8 bit mode (i.e. using 4 or 8 data lines in addition to the rs, enable, and, optionally, the rw control lines).This library is compatible with **all** architectures so you should be able to use it on all the Arduino boards.[3]

- **BMP library:** A library for the Bosch Sensortec BMP085 / BMP180 Digital Pressure Sensors. The library supports I2C (via the Wire Library) interfaces. Use of other I2C libraries (e.g. software I2C) is supported by inheritance. Does not block or delay (except for convenience functions) making it better suited for applications where non-blocking behaviour is preferred.[4]

VIII. CIRCUIT AND ITS CONNECTIONS

- LCD is connected to D1 and D2 in Node MCU ESP 32 .
- DHT sensor and LM358 sensor and Rain sensor positive will be shorted to one point and that point is connected to LCD positive.
- DHT sensor and LM358 sensor and Rain sensor Negative will be shorted to one point and that point is connected to LCD Negative.
- BMP180 is connected to LCD directly and negative of BMP180 is connected to Grnd of Node MCU ESP 32.
- All the connection will be shorted and the power supply will be connected to LCD.



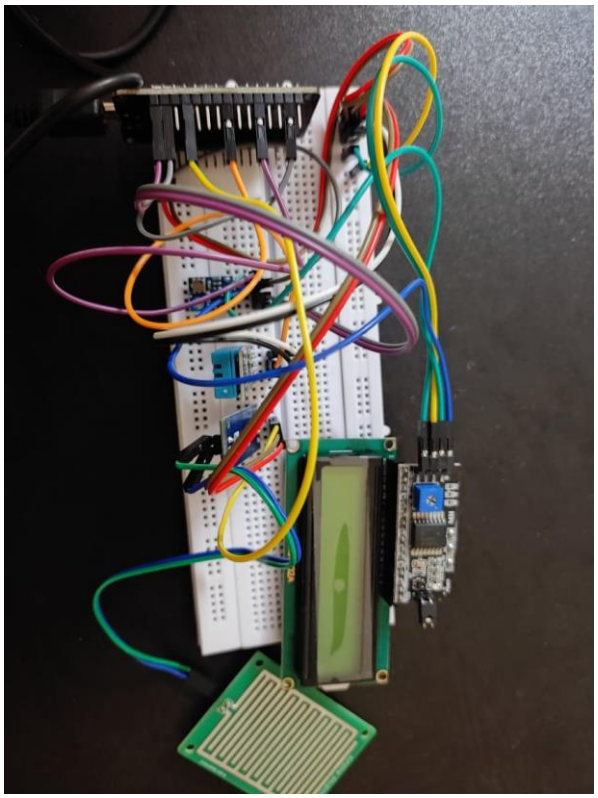
IX. PROJECT DESCRIPTION

In this phase, the temperature & humidity, pressure ,rain drop module sensor, Node MCU , LCD display and the remaining hardware are assembled.

This hardware is integrated with the software tools used i.e. BlynkIoT cloud application. The system prototype is then tested and the outcomes are documented and described.[1]

A. System Prototype

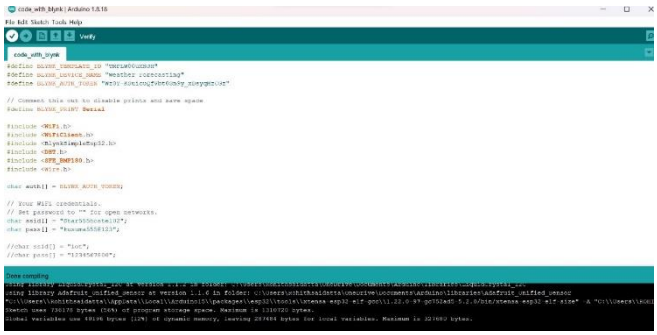
The hardware unit consists of the the temperature & humidity, pressure , rain drop module sensor which is connected to the Node MCU via jumper cables as shown in the circuit diagram.[2]



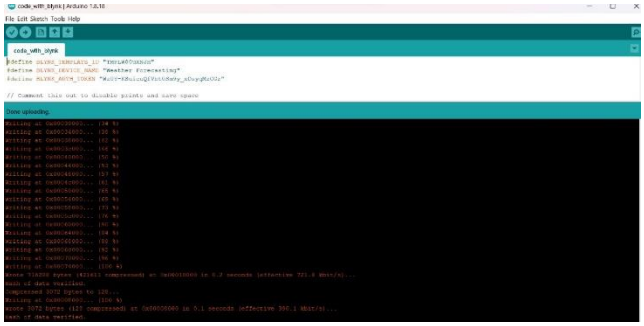
B. Result

The data that is published to the BlynkIoT cloud service when the code is run using the Arduino IDE corresponds to the output that appears on the serial monitor display.[3]

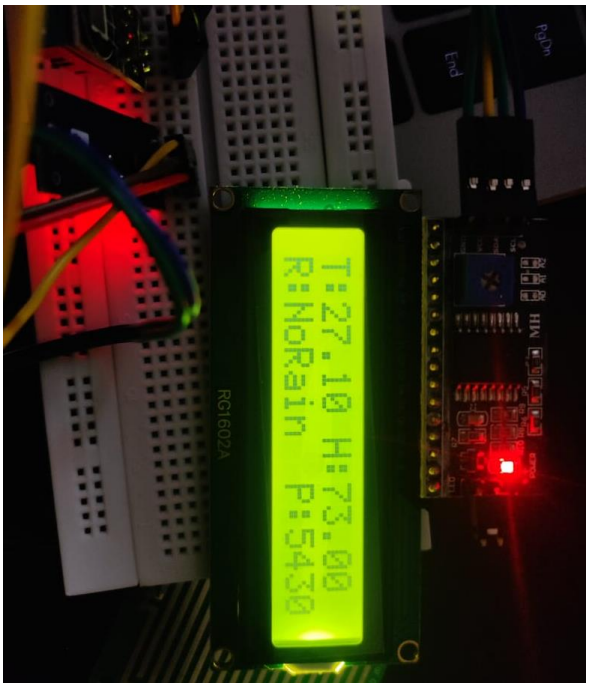
The results of serial monitor BlynkIoT and cloud data are shown below:



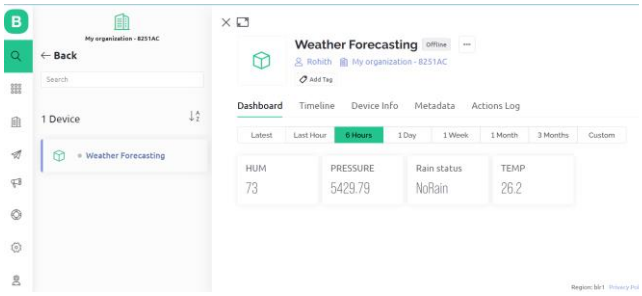
1. Done Compiling Code in Arduino IDE



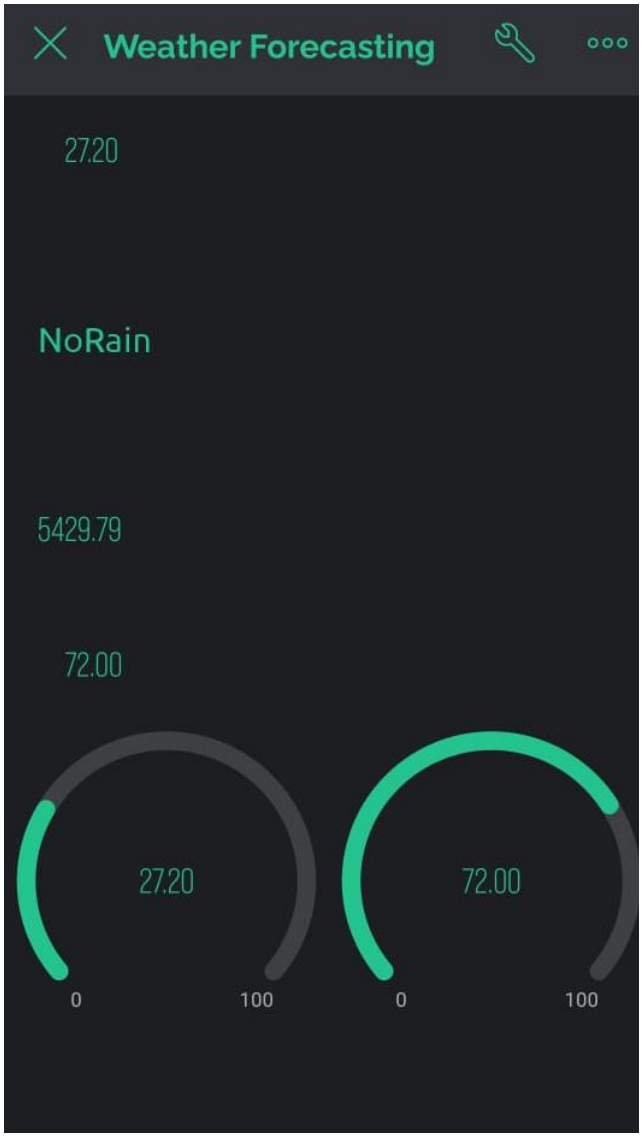
2. Code is getting uploaded to cloud in Arduino IDE



3. LCD Displaying Real time data



4. BlynkIoT web application Displaying Real time data



5. BlynkIoT Mobile application Displaying Real time data

VI. BENEFITS OF OUR APPLICATION

- IOT weather forecasting system has an application to farmers as well. The weather forecasting plays a very important role in the field of agriculture.
- IOT weather forecasting project proves really helpful for monitoring weather at places like a volcano, rain forests. It is quite difficult for a human being to stay for a longer time at such places. Or even areas that are exposed to radioactive leakage.
- IOT weather forecasting system project using Arduino is fully automated. It does not require any human attention.
- You can get a prior alert of the weather conditions. Suppose you are planning to visit a place and you want to know the weather parameters over that place, then you can just visit a website IOT portal.
- Future enhancements to this IOT project. As Arduino Uno has 5 Analog inputs, we can add a 5th parameter for weather monitoring.

.

VII. CONCLUSION

- As the conclusion this project have cleared the objective that to build a system that can monitored weather parameter by wireless system and IoT.
- The Sensor station and Weather station will be communicated by hotspot Wi-Fi and it is limited in areas covered but still better in communication via wireless.
- The value that been recorded from cloud 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.
- It says that weather reporting system is more accurate than forecast system. This weather reporting system will display the sensor data to blink to save the data. It also can be checked in Blynk app that can be installed in google play store or Appstore.

ACKNOWLEDGMENT

This paper was mentored by our teacher, Mrs P Padma Priya Dharshini. She guided us with her insight and expertise. Her valuable experience immensely assisted our journey in this project. She aided our advance by furnishing us with the hardware materials.

We appreciate the suggestions and criticisms made by our peers, which helped to improve this paper.

REFERENCES

[1] J. Shivang, S. S. Sridhar, "Weather prediction for indian location using Machine learning," International Journal of Pure and Applied Mathematics, vol. 118, no. 22 pp. 1945-1949, 2018.

[2] Z. U. Khan and M. Hayat, "Hourly based climate prediction using data mining techniques by comprising entity demean algorithm" Middle-East Journal of Scientific Research 21, vol. 8, pp. 1295-1300, 2014.

[3] S. S. Bhatkande1, R. G. Hubballi2, "Weather Prediction Based on Decision Tree Algorithm Using Data Mining Techniques." Belgaum India: International Journal of Advanced Research in Computer and Communication Engineering, vol. 5, no.5, pp. 483-48, 2016.

[4] Y. Radhika, and M. Shashi, "Atmospheric temperature prediction using support vector machines." International Journal of Computer Theory and Engineering 1.1, vol. 1, no. 1, pp.1793-8201, 2009.

[5] D. Chauhan, J. Thakur, "Data mining techniques for Weather Prediction:" International Journal of Computer Science Trends and Technology (IJCST), vol. 6, issue 3, pp.249-254, 2018.