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IoT based Weather Monitoring System

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Abstract:- The model proposed in our project is an innovative method for tracking the climatic conditions for a specific place. IoT " Internet of Things" is the concept that's being used here, It'sa innovative & effective way to link to the internet and join the entire universe of things on the network. In today's world IoE or Internet of Everything is ruling almost all industries. IoE provide solutions to various real life problems using wireless devices and by transferring the data over the network wirelessly. It has now become possible to merge the concept of Iot with other domains like Machine Learning, Artificial Intelligence , Cyber Security etc. Our System is an Iot based Weather Monitoring & Prediction System. Here the combination of IoT & ML concepts have been used.

Keywords:- *Internet of Things (IoT), Machine learning, Pressure sensor, NodeMCU, DHT11 sensor, Rain sensor, CNN.*

I. INTRODUCTION

With the introduction of high-speed Internet linking more and more people across the globe as become possible. The Internet of Things (IoT) is a step ahead, connecting not just people but also all electronic devices together. With Wi-Fi enabled devices reducing costs this trend will only gather more thrust. The main concept behind the Internet of Things (IoT) is to connect variable electronic devices via a network and then retrieve the data from these devices (sensors)that can be distributed in any fashion, upload them to any cloud service where the collected information can be analyzed and processed. These data may be used to inform people by different means, such as using a informative website containing the values of different parameters and also using Machine Learning Techniques.

Future technology is to bind the whole world in one place. It is possible to link all objects, items and sensors to transfer the information obtained at different places & process / analysis data to organize applications such as traffic signaling, mobile health tracking in medical use and methods of industrial protection, etc. IOT provides a large range of interface communication with different protocols and different application properties to receive the maximum user interaction. Climate monitoring is important to maintain good crop growth, to ensure safe industrial working conditions etc. Constant progress made the scanning phase of environmental parameters much simpler than in the past. These sensors are Electronic instrument commonly used to measure various natural, physical and environmental parameters. They provide the data that can then be fed into cloud.

The results would be reliable by using sensors to analyze climatic conditions and the entire system will use less resources, and there will be faster response. This system includes wireless technology, which also has Wi-Fi connectivity. Here the weather conditions are controlled and the data is updated on the website. A weather monitoring system could be understood as a system that gives us weather reports in our environment which makes it intelligent and interactive through wireless communication with objects. For example, it can give us information of the atmospheric temperature, humidity, rainfall level and pressure etc. This system therefore essentially senses temperature, humidity, rains and pressure for the specific place. The prototype contains different types of sensors which can be used to calculate all the above parameters. The prototype brain is NodeMCU board along with ESP8266 Wi-Fi Module. The NodeMCU is connected by four sensors namely the temperature and humidity sensor (DHT11), the rainfall sensor (YL83), and pressure sensor (BMP 180). The framework manages observing and controlling the ecological conditions like temperature, relative moistness, pressure with sensors and sends the data to the website page and afterward plot the sensor information as graphical insights. Refreshed information from the framework presented can be accessed on the web from all aspects of the globe.

This paper is organized as follows : Section I. gives an Introduction to the concept of Internet of Things (IoE) & gives a brief about our proposed system. Section II. Gives a literature review of various existing/ implemented & proposed Iot based Weather Monitoring Systems. Section III. Shows the flow and working of our proposed system. Section IV. Describes the system architechture of the proposed system in detail. Section V lists out the advantages and the applications of our system. Section VI. Shows the results and analysis of our IoT Based Weather Monitoring & Prediction System. Section VII. Concludes the paper with future work possible.

II. RELATED WORK

Weather Monitoring systems have play an important role for keeping the weather conditions of the room in check. There are already many existing and proposed weather monitoring systems. This section goes through various papers and shows the literature survey of the same.

[1] This system has shown the simulation of a weather monitoring system on the proteus simulation software. The main board used here is the arduino board. [2] In this system , they've used DHT11, Soil Moisture Sensor and vibration sensor, esp8266 wifi module and Arduino board. The data collected from these sensors is then displayed on the blynk server. (viablynk app). [3] This system consists of a Node MCU that is connected to a Raspberry Pi as a main processing unit for the entire system and all sensors and tools. The sensors dht11, rain sensor and pressure sensor are used to recover data and process the analysis using the data collected

through the microcontroller. The processed data is uploaded and stored as a database via nodemcu on a website.[4] Here sensors are used along with Arduino, to display the current values(status) and shows predicted rainfall based on the trained data sets. The weather prediction is done based on the older datasets collected and compared with the current values. Software: Arduino Compiler 2. PLX-DAX 3. Anaconda 4. Jupyter Notebook 5. Google Colab. [5] ARIMA ML Model is used here .This model predicts future values of the various weather parameters which are then displayed onto the server.The Hardware used : Nodemcu ESP8266 Wi-Fi Module, DHT11, BMP280 . Software :ThingSpeak, website and database. [6] The system consists of components: · Raspberry Pi 3 Model B · DHT-11 Sensor · Rainfall Sensor · BMP-180 Pressure Sensor · Wireless Access Adapter . They Have used ML algorithms like decision tree and time series analysis. ARIMA Model. Software used: coding with raspberry pi in python. [7] In This System, DHT11, LDR, NODE MCU, ESP8266 components are used . The data received from these sensors is sent to ThingSpeak server. The Data is then displayed on a Webpage. Logistic Regression Model is used to process the Data. [8] Here, LM35 Temperature sensor, Co Sensor, Sound Sensor,ESP8266 WIFI module and mq6 gas censor are used with the Arduino board. The data received is then sent to the ThingSpeak server which then displays it in graphs. [9] Here, they have interfaced DHT11 Humidity & Temperature Sensor, BMP180 Barometric Pressure Sensor and FC37 Rain Sensor with NodeMCU ESP8266-12E wi-fi Module. They then programmed the Node MCU To get one IP address. This IP address can be browsed from any of WEB browser like Chrome, Firefox, Internet Explorer etc.

III. PROPOSED SYSTEM

For 24-hour weather surveillance, several high-end schemes are now possible to. But these systems are being plotted to monitor real-time weather for a particular place on a broad scale. This weather monitoring system uses three sensors to measure variations in the atmosphere and the climate, such as temperature, humidity, pressure and rain level. The values are then sent to the website; these values are received data and marked a as statistics in graphic form. Uploaded data from the system introduced can be accessed online from every part of the world. The model proposed is an innovative weather forecasting solution that makes its real-time data readily available over a very wide range using IoT. We plan to create a web page to display the data obtained from thing speak. The accessed data could then be processed and machine learning algorithms could be applied to predict the weather and display it on the web server. We will be using Weather Dataset which will be available freely then processes the dataset. Then will split dataset and use CNN Deep learning algorithm. Make predictions out of it. Calculate accuracy and plot it there in Jupyter Notebook in statistical format. We would also be creating a live prediction module where the user can provide some input data and get prediction of how the weather would be. For Our system we would be usings the dataset that would be exported from thing speak server. After receiving the data, it'll then be uploaded to jupyter Notebook where the data would be cleaned and preprocessed (null values and non necessary data would be removed.) As mentioned CNN (convolutional neural network) deep learning algorithm is used on the data to get the predicted values. After which the accuracy is calculated and plotted on jupyter Notebook.

A COMPONENTS REQUIRED:

HARDWARE

- EMBEDDED SYSTEM:
  - A. NODEMCU
  - B. ESP8266-01
- SENSORS:
  - C. DHT11(HUMIDITY AND TEMPERATURE SENSOR)
  - D. PRESSURE SENSOR (BMP 180)
  - E. RAIN SENSOR(YL83)

B COMPONENTS REQUIRED:

SOFTWARE

- IOT LIBRARY:
  - A. ARDUINO IDE
- CLOUD SYSTEM & MACHINE LEARNING MODEL:
  - B. THING SPEAK
  - C. WEB SERVER
  - D. JUPYTER NOTEBOOK

IV. SYSTEM ARCHITECHTURE

The device implemented is composed of a micro-controller called NodeMCU which is the primary processing unit for the whole system and it will be connecting all the sensors and devices to it. The sensors can be controlled via the microcontroller. Micro-controller retrieves data from them and processes it. Sensor data is analyzed and transferred to the Internet via Wi-Fi module (EP8266) connected to it.

A. CIRCUIT DIAGRAM

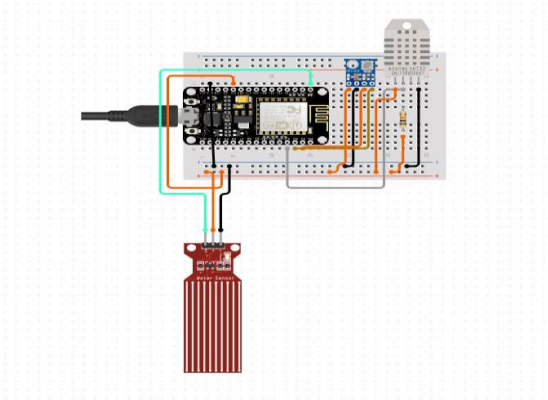

Fig. 1: Block Diagram of our weather monitoring system.

B. Node MCU with ESP8266 Wi-Fi Module.

Fig 2: NodeMCU with Wi-Fi Module ESP8266-01.

The name "**NodeMCU**" combines "node" and "MCU" (micro-controller unit). It is a low-cost single-board microcontroller based open source IOT platform. It has a memory of 128kBytes and a storage of 4MB. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. The firmware uses the Lua scripting language. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. It also provides access to the GPIO (General Purpose Input/Output).

C.SENSORS:

This weather monitoring system consists of sensors for temperature and humidity. (DHT 11), pressure sensor (BMP 180) and rainfall sensor (YL83). All this sensor will give the analogue voltage reflecting one specific weather element. This analogue voltage will be transformed by the microcontroller into digital data.

a) TEMPERATURE SENSOR AND HUMIDITY SENSOR

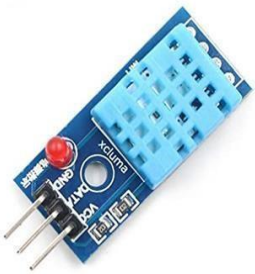

Fig. 3: Temperature and Humidity Sensor DHT 11

The DHT11 is a computerized temperature and humidity sensor, an essential, ultra-minimal effort. To gauge the surrounding air, it uses a capacitive temperature sensor and a thermistor and distributes the digital data on the data pin (no pins needed for analogue information). The serious drawback of this sensor you can't get fresh information from it once every 2 secs, so the data fetched by the user can be up to 2 seconds old for sensor readings while using this library. It runs on a 3 to 5-volt power supply. Good for 20-80 percent humidity with 5 percent precision and temperature ranges from 0-50 ° C. Precise measurements ± 2

b) PRESSURE SENSOR

Fig 4: Pressure sensor

A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.

Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers, among other names.

c) RAINFALL SENSOR

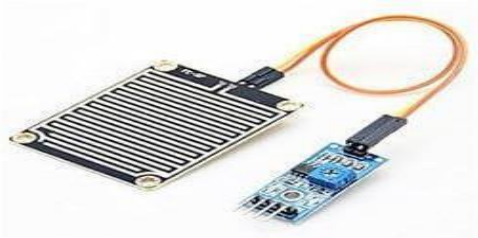

Fig. 5: Rainfall Sensor

The rain sensor module is a simple instrument for a particular place to detect rain levels. It can be used as raindrop comes through the rainy board as a turn and also to calculate the rainfall rate. To detect the volume of rainfall, analogue output is used. The LED will turn on when there is no rain drop in the high DO performance induction board attached to the 5V power supply. When a small volume of water occurs on the induction surface, the transfer indicator will turn on while the DO output is low. Clean the water droplets off, and it creates high performance where it is returned to its original condition. A weather sensor or weather switch is a disruptive system triggered by rainfall.

d) THINGSPEAK

ThingSpeak is known as an open IoT platform which

contains MATLAB analytics that provides us with the facilities to accumulate, view, and examine live data streams into the cloud. We can also send data to ThingSpeak from our devices, where we can produce a quick visualization of our live data, and can also send warning notifications.

e) ARDUINO IDE
The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware

V. ADVANTAGES & APPLICATIONS

- IOT based weather mentoring system project using NodeMCU is absolutely mechanized.
- It doesn't require any personal attention.
- We can get notice of weather conditions at any location beforehand.
- Cost Effectiveness
- Easy to deploy and autonomous
- Low energy and low power
- Accuracy is high.
- Efficient

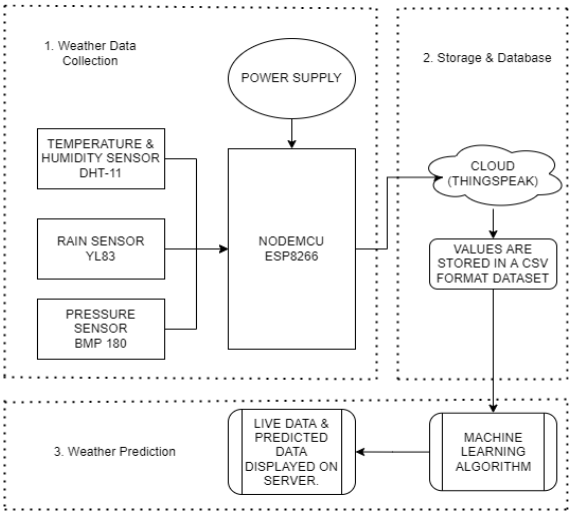

Fig. 6: Block Diagram

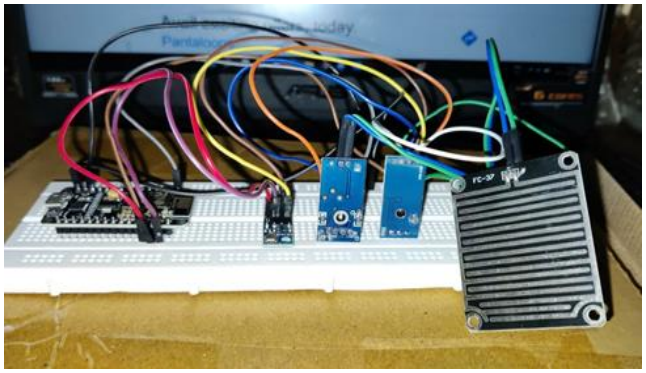

Fig. 7: Embedded System

- The weather monitoring system will play a very crucial role in the field of industry, farms, agriculture.Etc.
- It's beneficial at locations such as rain forests and volcanos
- The weather monitoring system can help to take preventive measures against rains which can be destructive more often, winds, Too high or too low temperature.
- The use of proposed system will help us survive with the ground frost and high temperature in summers.
- Our system could be used in cold storages at factories and industries to keep the temperatures of those places in check and to get alerts if there's any major change in the values.
- Our system could be used in green houses and nurseries to check if the weather conditions of those areas are suitable for the growth of certain plants.

VI. RESULTS

- Cloud: The Data obtained by the sensors that's transferred to the cloud via the node mcu is displayed in graphs.

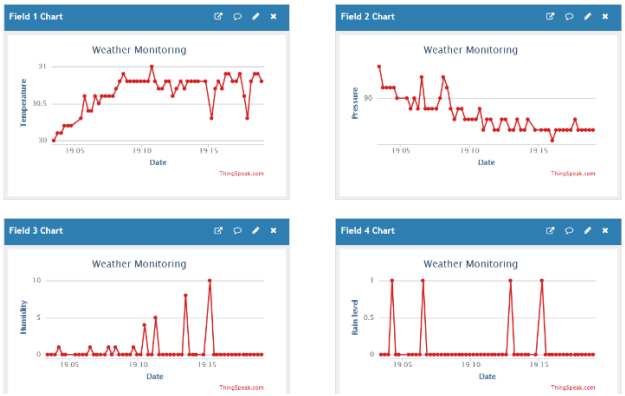

Fig. 8: Thingspeak Output

- Our Web Server: Live Data would be displayed on our server. The data would be updated every 5 mins. This data is the data obtained via the thingspeak server. Our Server also has a weather prediction module where the type of weather would be displayed based on the input values.

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Fig. 9: Server

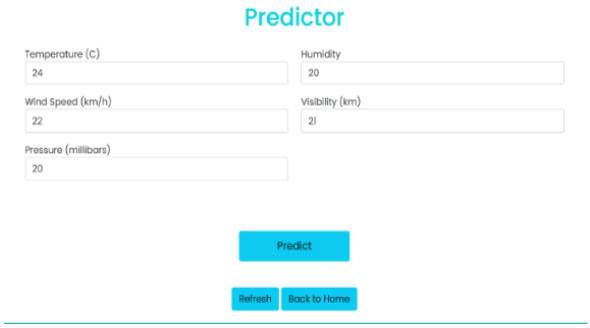

Fig. 10: Weather Prediction

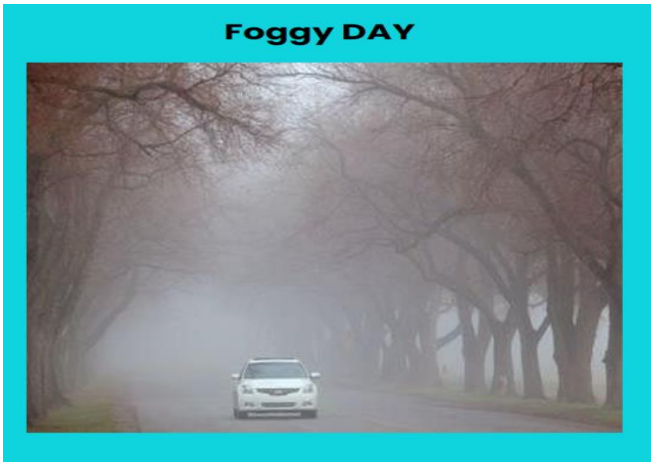

Fig. 11: Predicted Output

VII. CONCLUSION

Our System enables the environment to be self-protected (smart environment) by having the sensors integrated in the monitoring environment. To implement this, sensors need to be installed to capture and interpret data in the particular area(environment). By adding sensors in the system, we can put the world into real life, i.e., it can interact across the network with other artefacts. The product of the processing of data and data analysis will then be made accessible via Wi-Fi to the end user. This offers a clever means of tracking the atmosphere and an effective, low-cost embedded system. With the Internet of Things theory, which is experimentally tested to control four parameters, which are temperature, humidity, rain and CO can be monitored. The parameters for the sensor will also be submitted to the cloud (ThingSpeak). Such information can be valuable for further study and could be easily exchanged with other end users. Model proposed can also be extended to track further data This model provides an accessible and low-cost solution to continuous atmospheric surveillance to safeguard public health from emissions.

VIII. FUTURE SCOPE

- One can actualize a couple of more sensors and associate it to the satellite as a worldwide component of this framework.
- Adding more sensor to screen other ecological boundaries, for example, CO2, Pressure and Oxygen Sensor.
- In airplane, route and military there is an incredible breadth of this continuous framework.
- It can likewise be actualized in clinics or clinical organizations for the exploration and study "Essentially of Weather on Health and Diseases", thus to give better safeguard alarms.
- The IoT based Weather Monitoring System can be further changed and be utilized as an air contamination meter, soil dampness checker and so on.

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