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IoT Based Weather Monitoring & Reporting System

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Abstract: *The IOT based Weather Monitoring and Reporting System project is used to get Live reporting of weather conditions. It will Monitor temperature, humidity, moisture and rain level. Suppose Scientists/nature analysts want to monitor changes in a particular environment like volcano or a rain-forest. And these people are from different places in the world. In this case, SMS based weather monitoring system has some limitations. Since it sends SMS to few numbers. In order to know the information about weather of a particular place then they have to visit that particular sites. Where everyone can see it. The system proposed in this paper is an advanced solution for monitoring the weather conditions at a particular place and making the information visible anywhere in the world. The technology behind this is the Internet of Things (IoT), which is an advanced and efficient solution for connecting things to the internet and connecting the entire world of things in a network. Here things might be whatever like electronic gadgets, sensors, and automotive electronic equipment. The system deals with monitoring and controlling the environmental conditions like temperature, relative humidity, and CO level with sensors and sends the information to the web page, and then plots the sensor data as graphical statistics. The data updated from the implemented system can be accessible in the internet from anywhere in the world.*

Keywords: Internet of Things, Wi-Fi, Weather monitoring, Cloud, temperature and humidity sensor, soil moisture sensor, rain level sensor

I. INTRODUCTION

Here we introduce a smart weather reporting system over the Internet. Our introduced system allows for weather parameter reporting over the Internet. It allows the people to directly check the weather states online without the need of a weather forecasting agency. System uses temperature, humidity as well as rain with humidity sensor to monitor weather and provide live reporting of the weather statistics. The system constantly monitors temperature using temperature sensor, humidity using humidity sensor and also for rain. Weather monitoring system deals with detecting and gathering various weather parameters at different locations which can be analysed or used for weather forecasting. The aim of this system is achieved by technologies such as Internet of Things (IOT) and Cloud. The idea of internet of things is to connect a device to the internet and to other required connected devices. Using Internet the information from the IOT device can easily be transferred to the cloud and then from the cloud to the end user. Weather Monitoring is an essential practical implementation of the concept of Internet of Things, it involves sensing and recording various weather parameters and using them for alerts, sending notifications, adjusting appliances accordingly and also for long term analysis. Also we will try to identify and display trends in parameters using graphical representation. The devices used for this purpose are used to collect, organize and display information. It is expected that the internet of things is going to transform the world by monitoring and controlling the phenomenon of environment by using sensors/devices which are able to capture, process and transmit weather parameters. Cloud is availability of computer system resources

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like data storage, computing power without direct active management of user. The data captured is transmitted to the cloud so that the data could be further displayed. Besides this, the system consists of components such as Arduino UNO board which is a microcontroller board consisting of 14 digital pins, a USB connection and everything used to support microcontroller; DHT11 is Temperature and humidity sensor which is used for detecting these mentioned parameters; WIFI module is used to convert the data collected from the sensors and then send it to the web server. So, in this way weather conditions of any location can be monitored from any remote location in the world. The system constantly transmits this data to the micro controller which now processes this data and keeps on transmitting it to the online web server over a wifi connection. This data is live updated to be viewed on the online server system. Also system allows user to set alerts for particular instances. In today's world many pollution monitoring systems are designed by different environmental parameters. Existing system model is presented IOT based Weather monitoring and reporting system where you can collect, process, analyze, and present your measured data on web server. Wireless sensor network management model consists of end device, router, gateway node and management monitoring center. End device is responsible for collecting wireless sensor network data, and sending them to parent node, then data are sent to gateway node from parent node directly or by router. After receiving the data from wireless sensor network, gateway node extracts data after analyzing and packaging them into Ethernet format data, sends them to the server. Less formally, any device that runs server software.

II. LITERATURE SURVEY

• In this paper, the author elaborates how the weather prediction system is becoming a crucial challenge in every Weather extreme event that causes an adverse effect of the system on lives and property as well. Hence the accuracy of weather data is being one of the critical challenges to enhance the weather prediction skills and build up the resilience to effect of detrimental weather report condition. The author describes that Uganda and various other developing countries have looked challenges in developing timely & accurate weather data due to scarce weathers observation. The scarce weather monitoring is a part of the high cost of developing automatic weather situations. The restricted funding is available to national meteorological services of the respective countries. In this proposed system the author firstly takes care of the problems and then applies them. The author proposed an Automatic weather monitoring Station based on a wireless sensor network. The planning of the author is to develop three generations of Automatic weather stations or AWS prototypes. In this research, the author evaluates the 1st-generation AWS prototype to improve the 2nd generation depending upon the need and generation. The author provides a suggestion to improve the nonfunctional requirement such a power consumption, data accuracy, reliability, and data transmission in order to have an Automatic Weather Station. The non-functional requirement collapsed with cost reduction in order to produce a robust and affordable Automatic Weather Station (AWS) Therefore the proposed work, like developing countries like Uganda will be able to acquire the AWS in suitable quantities. So that it can improve the weather forecasting.

• The author in [2], presents an IoT-based weather monitoring system. 4 In this research, the environmental parameter can be retrieved through sensors. The author uses a different sensor to scale the various parameter like humidity, temperature, pressure, rain value & the LDR sensor is used. The system also calculates the dew point value from the temperature prototype. The temperature sensor can be used to measure the value of the particular area, room, or any place. With the help of the LDR sensor, the light intensity can be used as described by the author. The author in this used an additional functionality of the weather monitoring as SMS alert system based on the exceed the value of the sensing parameters as temperature, humidity, pressure, light intensity, and rain value. The author also adds an email and tweet post alerting system. The author in this system uses node MCU 8266, and various sensors.

• In this paper [3], the author represents a low-cost live weather monitoring system using OLED display, in which the author displays the various fields where the IoT has produced innovative things in the system. The author described A new revolutionary system. Which measures the real-time Weather's condition. The monitoring weather situation is very much helpful for everyone either for farmer or industry or daily working people or for school as well. So, the author by developing a live weather monitoring system reduced the difficulty level for farmers and industry as well. In this paper,

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the author uses an OLED display that will display the weather conditions and In the proposed model, the author uses an ESP8266-EX microcontroller-based WeMos D1 board executed on Arduino, that retrieved the data from the cloud. WeMos D1 is a wifi module that is developed on ESP- 8266EX microcontroller. It has a 4MB flash memory. It one of the Excellent which is programmed with node MCU and Arduino ide. In this paper Author uses only two gadgets to measure the weather conditions i.e., Wemos and OLED, After the connection, it will store the data on the cloud for storing data a thingspeak website is used to display the data regarding weather. The system displays the data on OLED and thing speak cloud. The author's aim is to obtain live information on weather conditions on OLED display.

• The author in [4], proposed a system that monitors and predicts the weather condition by which anyone can plan for our day-to-day life. This activity became helpful in every field either in agriculture or industry. So as to achieve monitoring and predicting weather info, the author uses 2 stages of the weather management system. In which they amalgamated the information from the sensors, bus mobility, and deep learning technology is used to allow a weather reporting system in stations and buses in real-time. Forecasting of weather is achieved through the friction model. Depending upon the sensing measurement from vehicles like buses, the work incorporates the strength of local information processing. The author talks about in stage-I, sensing of weather's condition, multilayer perception model and long-term memory are trained and then it will verify using temperature data, humidity, air pressure of test environment. In Stage-II, the training is applied to learn the time series of weather information. To get accurate data or not, to check the system performance, the author comparing the predicted weather data and actually obtained data from the environment Protection Administrator and central Baeuro of Taichung observation system that calculate the prediction of accuracy. The author finally talks about the proposed system has 5 reliable performance on monitoring of weather. And this model also proposed a one-day weather forecast or prediction via the training model. So finally, the author demonstrates that this system presents a real-time weather monitoring and prediction system using bus information management. The author represents 4 basic components 1- Information management. 2- Interactive bus stop 3- Machine learning predictive model 4- weather information platform. In this, information shown via dynamic chart.

• The author [5], implement an IoT-based weather monitoring system, in this research paper, the author describes that how with the help of IoT technology, the weather can be monitored. And which provide the info of climate-changing conditions. With the help of this project, people can be aware of the climate condition changes. It gives an accurate and efficient output and the algorithm as the swarm is used to implement for further improving the accuracy. So, in this project, the author aims to make a weather monitoring with the help of IoT. In this project, the hardware and software are used which makes it easy to implement. In the project, the author uses a different sensor to collect the information of the climate and stored it in the cloud. For this storage, the website www.thingspeak.com is commonly used for Internet of things projects. And from the cloud storage space, it extracts the whole weather data and uploads it to the android mobile application using an API key. Tools which detect the rain drops, is called rain sensor. Once the plague reveals the raindrops on the strips and the voltage is considered from that.

III. SYSTEM ARCHITECTURE

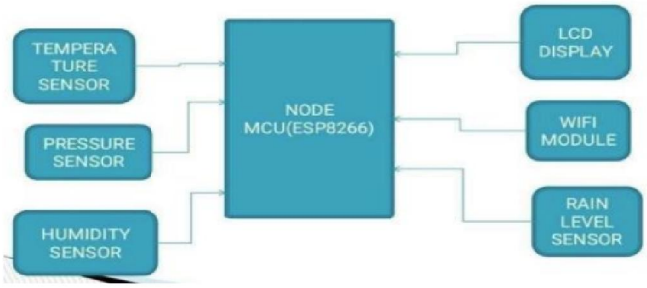

Fig. 1. Block Diagram

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In IOT enabled weather monitoring system project, Arduino Uno measures 4 weather parameters using respective 4 sensors. These sensors are a temperature sensor, humidity sensor, light sensor, and rain level sensor. These 4 sensors are directly connected to Arduino Uno since it has an inbuilt Analog to digital converter. The weather monitoring system gives high accuracy and reliability for weather monitoring and climate changing. It uses the renewable energy source like solar panel for charging the connected battery. Through the web, it access real time weather information and data. This system can be communicated over general packet radio service (GPRS) network. Low maintenance is required for end users. It is capable for storing data and providing it to the users as required.

The implemented system 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. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected with via blynk app then we can measure temperature, humidity, pressure and rain fall.

A. ESP8266:

The ESP8266 is a low-cost Wi-Fi microprocessor manufactured by Espressif Systems in Shanghai, China. It has a full TCP/IP stack and can function as a microcontroller. In August 2014, the ESP-01 module from a third-party company, Ai-Thinker, drew the attention of Western manufacturers. The ESP8266 connects microcontrollers to Wi-Fi networks and uses Hayes-style commands to make simple TCP/IP connections. Initially, there was little English-language documentation available about its chip and its order. The ESP8285 is a version of the ESP8266 with 1024 kB of built-in flash, making it possible to create single-chip Wi-Fi devices. The Node MCU ESP8266 development board includes the ESP-12E module, which contains the ESP8266 chip, powered by a Ten silica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and can operate at a configurable clock frequency of 80.00MHz to 160.00MHz. The Node MCU has 128 KB of RAM and 4096 KB of Flash memory to store data and programs. it is suitable for IoT projects due to its high processing power, built- in Wi-Fi and Bluetooth capabilities, and higher Sleep Operating capabilities.

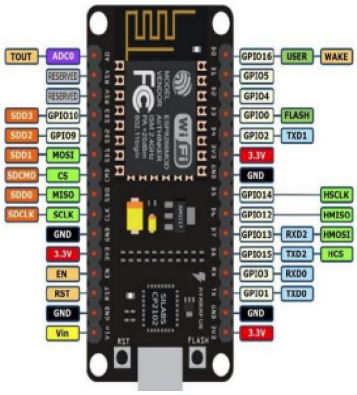

Fig. 2 ESP8266

B. DHT11 Temp/Humidity Sensor:

The DHT11 Humidity & Temperature Sensor (with PCB) is a versatile module designed for accurate measurement of ambient humidity and temperature levels. Featuring a compact design with integrated circuitry on a printed circuit board (PCB), this sensor ensures reliable performance in various applications. With its digital output and simple communication protocol, it is easy to interface with microcontrollers and other electronic devices. The DHT11 sensor provides precise humidity readings within a range of 20% to 90% RH and temperature measurements between 0°C to

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50°C. Ideal for environmental monitoring, HVAC systems, and DIY projects, it offers cost-effective and efficient monitoring solutions.

Fig. 3. DHT11 Temp Humidity Sensor

C. Blynk IOT:

Installation of the Blynk client Android application is made from the Google Play or Appstore for IOS. After the installation on a smart phone is completed, a new account should be created. If a private Blynk server is used, this information should be supplied during the installation. If the Blynk cloud server is used, it is free of charge only for a limited number of widgets. Therefore, for more complex projects (such as this one), it is advisable to use a private Blynk server, which is completely free of charge. In this case, however, the user should provide server installation, configuration and security measures. After a successful login, a new project should be launched, and then defined: the project name, the type of hardware which will be controlled, and the type of connection. After the project is defined, the Blynk server will generate a token which will be used for the authentication during the communication with the server. Blynk is a platform that enables remote control of Arduino, Raspberry Pi, and similar devices over the Internet through iOS and Android apps. The platform offers a digital dashboard with drag-and-drop widgets to create a graphical interface for your project. Setting up Blynk is straightforward, taking only a few minutes, and it supports a wide range of hardware options. Blynk is compatible with devices connected to the Internet through Wi-Fi, Ethernet, or the ESP8266 chip. To set up the Blynk App, users create a project, choose the microcontroller, and create toggle buttons for each relay, linking them to the digital pins of the microcontroller. Blynk then sends an authentication token to the project's registered email address, which should be kept for programming the Node MCU and configuring the IFTTT application.

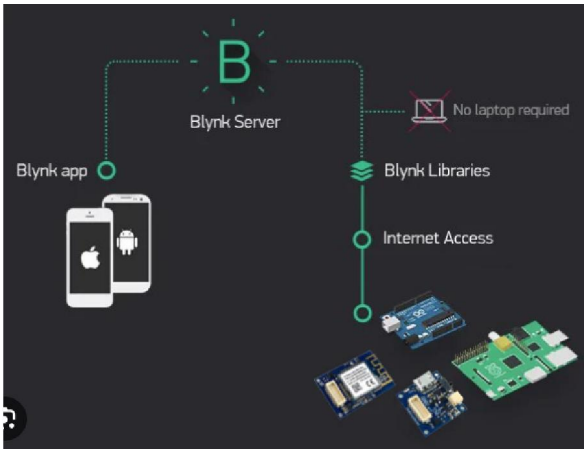

Fig. 4. Blynk IOT

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D. LCD Display:

The 16x2 LCD Display with IIC/I2C interface featuring a green backlight and black characters is an efficient and user-friendly display module for embedded systems. It is widely used in electronics projects due to its compatibility with I2C communication, which minimizes the number of GPIO pins required for interfacing.

This display is ideal for various applications like robotics, IoT devices, home automation systems, and educational projects. Its green backlight ensures excellent readability, while the adjustable contrast allows users to fine-tune the display for optimal performance in different environments

Fig.5. 16x2 LCD Display

IV. CONCLUSION

By keeping the weather station in the environment for monitoring enables self-protection (i.e., smart environment) to the environment. To implement this need to use the sensor devices in the environment for collecting the data and analysis. By using sensor devices in the environment, we can bring the environment into real life. Then the collected data and analysis results will be available to the user through the Wi-Fi. The smart way to monitor the environment an efficient, low-cost embedded system is presented in this paper. It also sent the sensor parameters to the cloud. This data will be helpful for future analysis and it can be easily shared to other users also. This model can be expanded to monitor the developing cities and industrial zones for pollution monitoring. To protect the public health from pollution, this model provides an efficient and low-cost solution for continuous monitoring of environment.

Future Scope:

One can implement a few more sensors and connect it to the satellite as a global feature of this system. Adding more sensors to monitor other environmental parameters such as CO2, Pressure and Oxygen Sensor. In aircraft, navigation and the military there is a great scope of this real-time system. It can also be implemented in hospitals or medical institutes for the research & study in “Effect of Weather on Health and Diseases”, hence to provide better precaution alerts.

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