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Real Time Weather Monitoring System

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Abstract: Monitoring weather plays a key role in various industries especially the agriculture sector. In the earlier system, all the industries were entirely dependent on the mechanical instruments to monitor weather, which leads to many errors in measurement. Hence, to remove the errors a remote monitoring system can be used to capture and send the required parameters. This can also be achieved using IoT and by interfacing the required sensors to monitor the weather. In our project, we will be developing a Real Time Weather Monitoring System. Our device is capable to measure the current temperature and rain probability in real time. We are using Arduino IDE software platform for coding which runs on C Language and using Node MCU as our primary microcontroller and required sensors as hardware. We will be interfacing the Node MCU with the Temperature and Rain Sensor and will be displaying the output on the OLED.

I. INTRODUCTION

Technology has come a long way. From just observing weather patterns to accurately measuring the current weather conditions within a fraction of a second, Weather Monitoring has come a long way. Now using IOT, this weather monitoring process can be done remotely as well. When such a system is built, then from any corner of the world we can measure the environmental parameters of the region via the internet where the system is deployed.

Real Time Weather Monitoring plays a very important role in every sector. It plays a key role in various industries especially the agriculture sector. In the earlier system, all the industries were entirely dependent on the mechanical instruments which gives arise to many errors. Hence, to remove the errors a remote monitoring system can be used to capture and send the required parameters. This can also be achieved using IoT and by interfacing the required sensors to monitor the weather.

In our implementation of Weather Monitoring System, we will measure the Current weather conditions using the sensors and displaying the data on a Web server and on an OLED Display. The data from the server can be accessed and used for future analysis in predicting the future weather conditions which will be helpful especially for farmers. This will help us to keep an eye on the weather conditions remotely which is especially useful in the agricultural sector.

The primary objectives of our project are:

- To study the working of sensors required for the Monitoring System.
- To design and implement Real Time Weather Monitoring System using Node ESP8266-Wifi-Module.
- To provide Real time weather like Current temperature, humidity and rain probability.
- To provide statistics on the current weather conditions and visualizes graphically predicting future weather and making better decisions.

II. LITERATURE SURVEY ANALYSIS

[1] Ravi Kishore Kodali and Snehashish Mandal, have presented a Weather Monitoring prototype based on Internet of Things (IOT) where they have used different sensors to extract a variety of parameters of the current environmental conditions. Temperature and Humidity sensor has been used to get the temperature and humidity of the present area where the prototype is been deployed. The prototype also has Rain Sensor for calculating the possibility of Rain and LDR Sensor for calculating Light intensity. The system is able to calculate the Dew Point Value of a particular area from the Temperature Sensor.

[2] Tanmay Parashar, Shobhit Gahlot, Akash Godbole have discussed the application of a Wi-Fi Module in a Weather Monitoring System which gets its output through the Wi-Fi connection. In the transmitter section, the presented system contains a Wi-Fi Module which works as the main microcontroller of the system, a controller and multiple sensors such as Temperature and Humidity sensor to get the information on Temperature and Humidity, pressure sensor to measure the actual pressure of a particular area has been used. As for the Receiver section of the presented system, a web server is used to view the data received on a Browser application, a router is used for connecting the Wi-Fi Module and all the sensors to the Wi-Fi so that relevant data is received by the web servers.

[3] Mircea Popa and Catalin Iapa have discussed the importance of why a system for weather monitoring is needed in these current times considering the applications of a weather monitoring system in many key areas like Agriculture, Defense and Military, Entertainment etc. The Authors of the presented paper have also presented the 3 key solutions regarding to the monitoring of the present weather conditions in a given particular area and why it is crucial to know the climatic situation is areas where weather monitoring is used. The authors have proposed a system which monitors the weather using various sensors to measure the environmental parameters like Temperature, Humidity, Pressure and Luminosity which can be controlled by the SMS service via the user's mobile phones.

[4] Ukhurebor, Kingsley & Abiodun, Chukwutem & Azi, Samuel & Otete, Ikechukwu & Obogai, The authors of this paper have created a low-cost weather monitoring device, which is also our goal. The study demonstrates the development of a Low Cost Weather Monitoring System which is portable when a 9V Battery is used and scalable to some extent when more sensors are interfaced within the controllers.The sensors used provide precise readings of the temperature, humidity, and all of the other features included in the proposed system and all this information is displayed on a LCD Display. In this system, all this information is provided with a Logger which updates the data in real time which can be used for Data Analysis purpose.

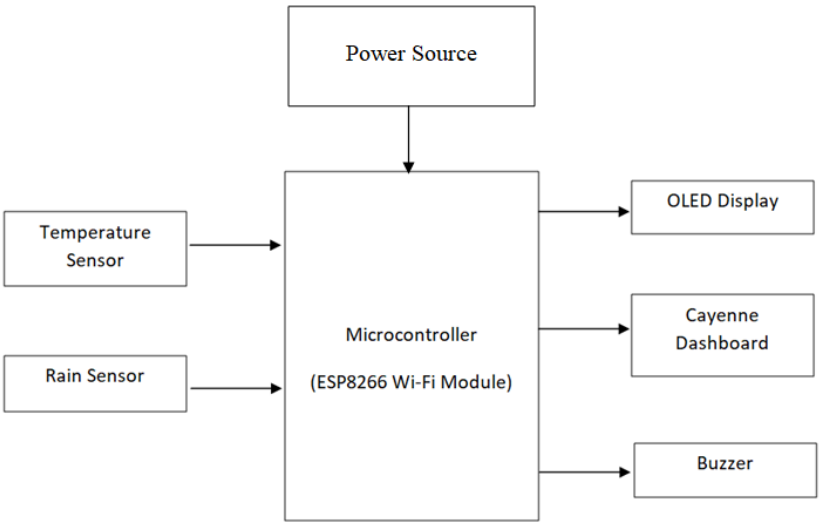
[5] Daniele, Strigaro & Cannata, Massimiliano & Antonovic, Milan in their paper have addressed the issue of Weather Monitoring in low income countries and the adverse effects of not getting accurate weather information. In low-income and developing countries, insufficient weather monitoring systems have a negative impact on the ability to manage natural resources and related risks. The authors have proposed a system which is cost effective, consumes less power and measure the data accurately.

[6] J. Mabrouki, M. Azrour, D. Dhiba, Y. Farhaoui and S. E. Hajjaji, have developed a IOT based Weather Station which has been tested under extreme conditions. In this paper, the authors have aimed to develop a low cost IOT based weather station which has been rigorously tested to measure the air and weather conditions. The proposed Weather Station has been tested indoors and it contains sensors which consume less power and also makes use of a Wi-Fi Module which helps to interface all the sensor data and gathers all the information required and sends to the output device.

[7] Andriy Holovatyy has developed a IOT based weather station using Arduino and ESP8266 Wi-Fi Module. Using the data obtained from the proposed weather station, the data has been graphically visualized by creating a dashboard using the data visualization tools. All the relevant data like Temperature, Humidity, Current Pressure conditions were accurately deduced by the sensors and this data has been further analyzed by using Data visualization tools using various tables, graphs, charts etc.

[8] Susmitha and Sowmyabala have created a self-contained weather station with a remote communication facility for gathering and transmitting the current climatic parameters. The proposed model has the capability to gather current data on Temperature, Gas and Humidity of the present environment conditions wherever the proposed system is deployed. Alongwith the sensors, accelerometer sensors are also used in the design and a GSM Module is also used which can be used to provide real time weather data as a SMS on our phones.

III. BLOCK DIAGRAM



IV. KEY COMPONENTS USED

- **ESP8266 Wi-Fi module** –
  NodeMCU is a Wi-Fi Module which is based on the ESP8266 Development Board which is very widely used nowadays in IOT based Applications due to its high processing power. The NodeMCU has the capacity to store programs with its 128kB of RAM and 4MB of Flash memory. It also has many key features like Wi-Fi and Bluetooth. To upload the code in this board, a Micro-USB Pin cable in used and the coding is done on a software application named "Arduino IDE". Here we use ESP8266 Wi-Fi Module as our primary microcontroller where the Temperature Sensor, Rain Sensor and the OLED Display are interfaced with the Wi-Fi Module.

- **DHT11 Temperature sensor** –
  A Basic temperature and humidity sensor which is relatively accurate and is extremely cheap in price is the DHT 11 Temperature Sensor. The DHT 11 Sensor is capable of measuring the current present area temperature from 0°C to 50°C, which is sufficient for most applications because temperatures rarely reach 50°C. It can also measure humidity from 20% to 90% with an accuracy ±1°C and ±1.In our system, DHT 11 is interfaced with the Node MCU and after relevant programming, the Temperature and Humidity can be measured. The DHT 11 Sensor has the ability to interface with other microcontrollers like the NodeMCU or the Arduino Boards so that relevant data can be extracted from the sensor and used as an output or as a data for data analysis purpose.

- **Rain sensor** –
  One of the most common used tools to detect Rain is the Rain Sensor Module. This sensor is very cost effective and is used to measure the intensity of the rain and it can also be used to predict whether there is any chance of rain in the future by using previously acquired data. There are two parts of a Rain Sensor, one is a Pad which senses the rain i.e., senses the whether any water is present on the pad or not and other one is the controller which read the information from the pad. If there is water present on the pad, then the controller reads the information and converts into a Binary form and sends it to the microcontroller. This rain sensor can be used in many applications.

- **OLED Display –**
  OLED Display is used as a display device. After relevant code is uploaded to the microcontroller, the relevant data gets displayed in real time. The OLED Display is easily interfaced with Arduino as there are multiple libraries available to interface it with the Microcontrollers.

- **Cayenne Dashboard** –
  Cayenne is a browser application which is used to create Dashboards and visualize the data. Inside the dashboard all the relevant data is displayed like Temperature, Humidity and Rain Probability. Using this tool, Alerts can also be sent when a certain parameter exceeds a set threshold. Alerts can be sent in the form of SMS or E-Mail or both. Data stored on the Cayenne Software can be extracted in the form of an Excel or CSV file where further Data analysis can be done.

V. WORKING METHODOLOGY

- The Node MCU is connected to the Temperature Sensor, Rain Sensor and the OLED Display with relevant Vcc and Ground Connections. The Node MCU gets its power from the Power Supply board used where Vin of the Node MCU is connected to the 5V Input of the Power Supply Board and Ground connection is made.
- Initially for uploading the Arduino code to the Node MCU, a USB cable is used. After successful sketching and uploading of the code the USB Cable can be removed since the Node MCU is getting the power from the Power Supply board used.
- After uploading the code to the Node MCU, we can see the data on the OLED Display. The current Temperature and Humidity is seen first and it will be updated every 2-5 seconds. If Rain is detected then the Buzzer will start and on the OLED it will show "Rain Detected!"
- On the serial monitor of Arduino the status of the Temperature, Humidity and Rain Probability can be monitored. On the Cayenne Dashboard, three channels are created each for Temperature, Humidity and Rain Probability. On each of these channels, triggers are set up. These triggers help us to receive messages on out smart-phones. If Temperature and Humidity increases beyond a certain threshold then we will get a message saying "Channel has reached Threshold Value.
- Along with this, on the cayenne tool the Temperature, Humidity and Rain Probability can be seen in the form of Dashboard. This data can be then downloaded in the form of an Excel Document and also visualizes in the form of a Line Chart. It helps in displaying the data on the dashboard and also visualizing the data. The data can later be downloaded for further analysis.

VI. RESULTS

- The System is expected to sense the Temperature, Humidity and Rain probability in the area where the system is deployed. After uploading the code to Node MCU, all the relevant information received from the sensors is then displayed on an OLED.
- On the Cayenne Software, three channels are created each for Temperature, Humidity and Rain Probability and data is displayed in the form of a dashboard and this data can be visualized in the form of charts.
- On all the three channels, relevant information like Temperature, Humidity and Rain Probability can be seen distinctly.
- We have set up triggers for receiving the messages. After the values of Temperature, Humidity and Rain Probability breach a certain threshold then we receive messages in the form SMS on our mobile phones (registered with Cayenne)

VII. CONCLUSION

Weather changes are natural. There is nothing we can do to control it. However we can observe the patterns and make predictions for the future and Technology has made the prediction easier. In our proposed system, the current Weather Conditions viz. Temperature, Humidity, Rain Probability are measured accurately with data displaying on both OLED and on the web server. But this system will not be effective in areas where weather conditions are changing constantly. Our proposed system has minimum cost with maximum accuracy which is very important in today's world. This system will be effective where weather is constant and changes occur normally according to the weather cycles of the year viz, Summer, Winter and Monsoon Season. The data obtained from the web server can be accessed and used to perform Data Analysis which can help in predicting the weather conditions for the next day or next week or even next month provided a large amount of data is collected.
All the obtained results were taken under constant weather and hence there were no abnormalities in the data. With these results, the future weather conditions can be predicted to some extent. These results can be used as analysis for air pollution and how it can be tackled because Air pollution directly impacts the humidity of a region.

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