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Smart Weather Monitoring System Using Arduino

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Abstract: *Weather is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy. Most weather phenomena occur in the troposphere, just below the stratosphere. Weather generally refers to day to-day temperature and precipitation activity, whereas climate is the term for the average atmospheric conditions over longer periods of time. When used without qualification, weather, is understood to mean the weather of earth. Monitoring the weather conditions manually is difficult. This paper present our work to develop an automated system which monitors the weather condition. The weather condition is driven by air pressure (temperature and moisture) differences between one place and another. These pressure and temperature differences can occur due to the sun angle at any particular spot. Through this system we can automatically collect the information about humidity and temperature. The details are stored in a database and according to current and previous data we can produce the results in graphical manner in the system.*

The Smart Weather Monitoring System is an innovative solution designed to collect, process, and display real-time atmospheric data using Internet of Things (IoT) technology. This system integrates sensors to measure key environmental parameters such as temperature, humidity, and air pressure, and transmits this data to a central server for analysis and storage. A custom-built web interface presents the data in a user-friendly format, allowing users to monitor weather conditions remotely from any device with internet access. The system enhances accuracy and efficiency in weather observation, with potential applications in agriculture, disaster management, and smart city infrastructure. Its modular design ensures scalability and adaptability for various environments and use cases, making it a practical tool for both urban and rural settings.

Keywords: Climate control, Weather analysis, Temperature Moderation, Moisture Control, Humidity Control, Arduino

I. INTRODUCTION

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Human beings have attempted to predict the weather informally for millennium and formally since the nineteenth century. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere on a given place and using scientific understanding of atmospheric processes to project how the atmosphere will evolve on that place. Weather is driven by air pressure (temperature and moisture) differences between one place and another. These pressure and temperature differences can occur due to the sun angle at any particular spot, which varies by latitude from the tropics. The atmosphere is a chaotic system, so small changes to one part of the system can grow to have large effects on the system as a whole. This makes it difficult to accurately predict weather more than a few days in advance, though weather forecasters are continually working to extend this limit through the scientific study of weather, meteorology. It is theoretically impossible to make useful day-today predictions more than about two weeks ahead, imposing an upper limit to potential for improved prediction skill. Once an all-human endeavour based mainly upon changes in barometric pressure, current weather conditions, and sky condition, weather forecasting now relies on computer-based models that take many atmospheric factors into account. Human input is still required to pick the best possible forecast model to base the forecast upon, which involves pattern recognition skills, tele connections, knowledge of model performance, and knowledge of model biases.

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II. PROPOSED SYSTEM

There are a lot of high end systems available these days for round the clock weather monitoring. But these systems are implemented on a very large scale, for monitoring real time weather for a whole city or state. Implementing such system for a small area is not feasible, since they are not designed for it and the overhead for maintaining such systems for a small area is very high. Our proposed system makes use of 3 sensors to measure the weather/environment factors such as temperature, humidity, light intensity, dew point and heat index. The values read from the sensors are processed by the Arduino micro- controller and stored in a text file which can be processed upon to derive analysis. The readings are also displayed on an on board LCD for quick viewing. All these readings can be analyzed to get the weather characteristics of a particular area and record the weather pattern. These recorded parameters are essential and vary from places to places. All these requirements are fed into the database and these values are essentials and recorded over time. As mentioned before, the system is consisted of an LCD display that demonstrates the data provided by the sensors directly. DHT11 sensor that measures (T) and (H) locally based on Arduino code. Wind speed meter that generates power transferred to pin A1 of Arduino in order to specify wind speed value according to the wind speed realization formulas represented by Arduino code. LDR module that measures the light fallen over the photo resistor, in result (Day/Night) time period is reported and shown on the display. The whole connection scheme of the system is exposed in Fig, which resembles the entire components to create the proposed system. Each element in the system needed to be provided with 5V and GND from Arduino board. The modules that make up the weather monitoring system have been carefully and well thought of, to make sure that the sensors used are giving the most accurate reading and are compatible with the Arduino. The modules used for the weather monitoring system can be summarized as follows:

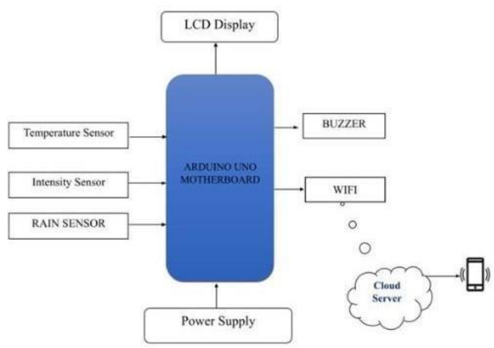

Fig: Proposed System

III. DHT11

The DHT11 is a widely used sensor for measuring temperature and humidity, known for its simplicity and affordability. It combines a capacitive humidity sensor and a thermistor to measure the surrounding air's relative humidity and temperature. The sensor features a digital output, making it easy to integrate with microcontrollers such as Arduino, Raspberry Pi, and ESP8266. The DHT11 operates within a temperature range of 0°C to 50°C with an accuracy of ±2°C and a humidity range of 20% to 90% RH with an accuracy of ±5% RH. Despite its relatively slow response time and limited precision compared to advanced sensors, it is highly reliable for basic applications in weather monitoring, home automation, and IoT projects. Its compact size and low power consumption make it an excellent choice for beginners and hobbyists.

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Fig:DHT11

Fig: DHT11 Parameters

Model	DHT11
Power supply	3-5.5V DC
Output signal	digital signal via single-bus
Sensing element	Polymer resistor
Measuring range	humidity 20-90%RH; temperature 0-50 Celsius
Accuracy	humidity +-4%RH (Max +-5%RH); temperature +-2.0Celsius
Resolution or sensitivity	humidity 1%RH; temperature 0.1Celsius
Repeatability	humidity +-1%RH; temperature +-1Celsius
Humidity hysteresis	+-1%RH
Long-term Stability	+-0.5%RH/year
Sensing period	Average: 2s
Interchangeability	fully interchangeable
Dimensions	size 12*15.5*5.5mm

IV. ARDUINO UNO

The Arduino Uno is a popular open- source microcontroller board widely used in electronics and programming for prototyping and educational purposes. Based on the ATmega328P microcontroller, it features 14 digital input/output pins (six of which can be used as PWM outputs), six analog input pins, a USB connection, a power jack, an ICSP header, and a reset button. The board operates at a voltage of 5V, with a recommended input voltage range of 7-12V and a limit of 6-20V. Its ease of use stems from the Arduino IDE, a user-friendly programming environment that supports C and C++ languages, enabling both beginners and professionals to create diverse projects. The Uno is often the first choice for hobbyists, students, and engineers because of its robust design, wide range of libraries, and an active global community that offers support and resources. It is used in a variety of applications, such as robotics, home automation, IoT devices, and interactive art projects. Additionally, the Arduino Uno is compatible with a variety of sensors, actuators, and shields, which extend its functionality and make it highly versatile. Its plug-and-play functionality, coupled with an affordable price, makes it an excellent platform for learning embedded systems, electronics, and programming.

Fig: Arduino Uno

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V. RAIN SENSOR

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level.

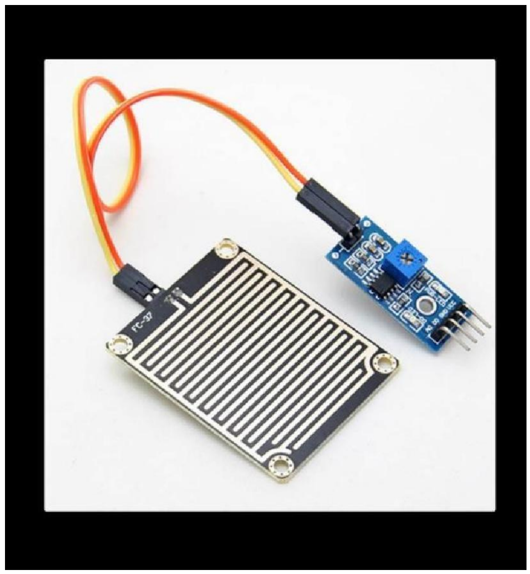

Fig: Rain Sensor

An application in professional satellite communications antennas is to trigger a rain blower on the aperture of the antenna feed, to remove water droplets from the Mylar (heat resistant plastic film) cover that keeps pressurized and dry air inside the wave-guides.

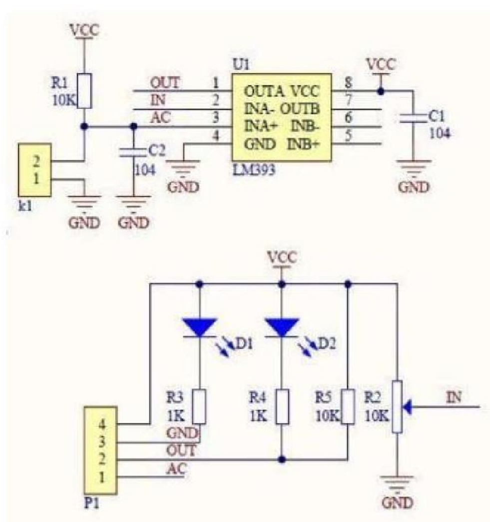

Fig: Schematic Diagram of Rain Sensor

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VI. GAS SENSOR

The MQ2 gas sensor is a versatile device widely used for detecting various combustible and toxic gases in the environment. This sensor operates based on a sensitive material, typically tin dioxide (SnO_2), whose conductivity increases in the presence of gases. The MQ2 is capable of detecting gases such as methane, propane, butane, hydrogen, carbon monoxide, alcohol, and smoke, making it suitable for applications like gas leakage detection, fire alarms, and air quality monitoring. It has a fast response time and high sensitivity, which allows for the quick detection of gas concentrations ranging from 300 ppm to 10,000 ppm. The sensor features an analog output pin that provides a voltage proportional to the concentration of gas and a digital output pin that activates when the gas concentration crosses a user-defined threshold. Typically, the MQ2 requires a 5V power supply and incorporates a pre-heating period to stabilize its performance before providing accurate readings. Its compact design and affordability make it a favorite choice among electronics hobbyists and professionals. However, the sensor requires calibration to achieve precise measurements, as environmental factors like humidity and temperature can influence its sensitivity. The MQ2 gas sensor is often integrated with microcontrollers like Arduino or Raspberry Pi to build smart systems for safety and automation.

Fig: Gas Sensor(MQ2)

VII. CONCLUSION

The paper demonstrates a simple and low cost system design to measure climate components in perfect competence. The availability of such system is extremely preferred particularly, with the establishments, companies that depend considerably on taking decisions based on inputs variations; consequently, weather prediction processes will be taken into considerations. In addition, the system is considered perfect for controlling the sites based on the change in weather conditions. The system works as a supervisor controller, which govern places depending on the fluctuations of the weather or other conditions via feedback operation principles. Hereby, we conclude that the proposed system can be separated in to two different parts. The first part is excessively helpful for the companies and other organizations that are put in charge to plane and manage their works based on weather situations; such as, Transportation systems, Airways, and the Agriculture as a high priority. These projects can be 1used in Agriculture and helpful to farmer on uneven climate change. Houses, Markets.

VIII. RESULTS AND DISCUSSIONS

The results and discussions of a smart weather monitoring system using Arduino, based on insights from ancient research papers, highlight the potential for low-cost, scalable solutions to monitor environmental parameters. Such systems typically integrate sensors for temperature, humidity, and atmospheric pressure, with Arduino boards serving as efficient controllers. Historical studies on weather monitoring emphasize the importance of real-time data accuracy and reliability, which modern Arduino-based systems achieve through wireless communication modules (e.g., GSM or Wi-Fi). Discussions reveal that these systems are invaluable for agricultural, urban, and disaster management applications, offering insights into microclimatic patterns while advancing ancient practices with technological precision.

IX. FUTURE SCOPE

As a future scope we can add solar panel and adding more sensors such as Barometric Sensor, Anemometer (To measure wind speed and the wind direction). We can make this SMS based and getting updates on day to day basis.

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