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Revolutionizing Weather Monitoring: Wireless Connectivity for Smart Weather Stations

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ABSTRACT
Since climate monitoring is crucial to human existence, gathering time-varying dynamic data on climate change is crucial. A large portion of human knowledge about the Earth's ecology is derived from data gathered by satellites in addition to physical isolation from the natural world. On the other hand, in situ systems are site-specific, physically valid, and essential for adjusting and validating climate measurements. However, commercial data loggers with expensive, unavailable data are frequently the only devices with field choices nowadays. Weather Chimes provides near-field information (such as light, temperature, relative humidity, and soil information) and is an open-source, low-cost hardware and software package for Arduino programming that may be used anywhere there is an Internet of Things (IoT). Any device or equipment that provides us with information about the weather and our surroundings might be considered a weather station. Anything that gathers meteorological information about the environment around us, such as temperature, pressure, air quality, and precipitation totals, is called a weather monitoring station. Temperature allows us to determine additional characteristics, including dew point. In this paper, a weather monitoring system is developed using sensors (temperature, pressure, air quality and rainfall) which are interconnected with Node MCU and IoT that gives reliable values of rainfall, temperature, pressure and air quality of coordinates (15.7981° N, 78.0784° E).

KEYWORDS
NodeMCU ESP8266, BMP 180, Rainfall Sensor, Air Quality Sensor, WiFi Device, Blynk Application, Arduino IDE, Embedded C

1. INTRODUCTION

This article describes the most sophisticated technology for tracking the weather at a specific location and displaying the data anywhere in the world. About networking and connecting all the IoT devices in the globe, the Internet of Things (IoT) is the most effective technology. Products here include electronics, sensors, automotive electronics, etc. it could be. Using sensors, the system keeps an eye on and regulates variables related to temperature, humidity, and carbon dioxide levels. The sensor data is then transformed into graphical statistics and sent to a web page. The information updated by the system can be accessed from anywhere in the world via the internet. In addition to allowing online data tracking, Weather Chimes leverages state-of-the-art computer technology to transform data into audio and audio applications, sound production, or artistic animation. Tests and field tests validated the system's sensor and online data determination function. In addition to demonstrating the environmental sensors tab and examining our many sensor function locations, we describe how WeatherChimes are used in an Honours College classroom and STEM (Science, Technology, Engineering, and Mathematics) education programme in Sitka, Alaska. Environments influence each other through sonification (i.e. heat and soil).

The new method now focuses on managing and monitoring different projects. These also seem to meet people's needs. These systems generally focus on quality control and control of different tasks [3]. Good environmental monitoring requires monitoring and analyzing conditions (such as noise, carbon dioxide, and excess electricity) with defined measurement levels. An increasing number of individuals worldwide are linked to one another because to the introduction of high-speed internet. By linking not just people but also electrical items that are capable of communication with one another, One step further is made possible by the Internet of Things (IoT). [4]. This trend will only increase as the price of Wi-Fi devices continues to drop. The fundamental idea behind the Internet of Things (IoT) is to connect various electronic devices to a network, collect data from these devices (sensors), which can be scattered anywhere, and send the data to any cloud that can identify and analyse it. Using the cloud service, users can send notifications to others by email or letter, or they can utilise this information to make ringtones. Weather forecasting is the process of using science and technology to predict local weather. Illegal weather prediction has been practiced for thousands of years, and since the eighteenth century, it has proven successful [5]. Weather forecasting is done by collecting a lot of information about the current weather in a particular location and using the weather forecast to predict what the

weather in that location will be like and how it will change. Air is moved from one place to another due to the difference in air pressure (temperature and soil). Differences in altitude and temperature may occur due to the angle of the sun at every location in the tropics, which varies according to latitude. A small alteration to one element can have a big impact on the atmosphere as it is a chaotic system. This is why it is difficult to predict the weather for the previous day, even though we are continuously working to raise this limit through research on weather and environment. Theoretically, it is not possible to use one day to predict more than two weeks into the future, which leads to the upper limit of the ability to develop skills intelligently, that is, when people try to keep track of high altitude, current weather. Predictions of changes in weather and climate are now based on computer models that consider various atmospheric factors [6]. Human resources also need to select the best predictive model for forecasting, which includes pattern recognition, remote sensing, modeling knowledge, and awareness of biased patterns.

2. LITERATURE REVIEW

Although automatic weather stations have been built and used in remote areas of Sri Lanka, there is no focus on reducing maintenance costs. Universities have built automatic weather stations that receive copies of weather and climate data from a microcomputer network containing communication devices, ports, and sensors, or from commercial data sources [4-6]. The University of Colombo has created an automated weather station that can receive data input and communicate via USB. For the first time, research was conducted on wireless technology to create wireless sensor networks. Ongoing research choose the right wireless technology. It should be about everything like business and technology. Prioritizing communication is the most important consideration when selecting a communication technique. Here, 802.11 b/g Wi-Fi is selected. Information may be transmitted via IP address to any location in the world when we offer the website. Further studies were carried out by selecting a microcontroller. The implementation of the system has an ulterior motive of achieving a low-power solution. Raspberry must be weak like other sensors. We chose the raspberry-pi3, a low-power Raspberry Pi with built-in Wi-Fi running at 3.3v. The following research project carries on investigating the web page's data logger technique. Sensor data often takes the form of equivalent values and represents the effects of the unfavorable environment. Web pages that directly display sensor data will not leave a simple impression on users. It ought to be presented in an understandable graphical format for consumers. The cost and rental fee of hosting the data on your own website will increase. To lower the system's cost, we require some free data storage websites that offer our sensor data cloud space, making it universal and lowering the system cost. The research began with an investigation of the technological process for creating sensor networks. Ongoing research Select a suitable sensor model. It must fit everything, including business and commerce. Communication is the primary factor that needs to be considered while selecting a communication technique. Here, the SIM800L GPRS module is our choice. Data can be sent from any location in the globe via an IP address when we share the website online. More research has been done on the selection of microcontrollers. The System application has an ulterior motive of achieving low resolution solutions. The microcontroller must have less power than all the remaining sensors. We chose the LPC2138, a low power microcontroller that operates between 2.0V and 5.5V. The next step in the research is to use a data logger to collect sensor output data. Data collected by sensors usually represent the consequences of the adverse environment in the form of equivalent values. With the aid of IoT, after the data is logged and stored in EEPROM, the web page also stores the EEPROM's data. The system's temporary store is called EEPROM. Direct displays of sensor data on websites won't improve consumers' ability to think effectively. It should be represented graphically to be easily understood by the user. Hosting data on your own website will be more expensive and rent will have to be paid. To lower the system cost, we require some free data hosting websites that store our sensory data in the cloud, making it universal and further lowering the system cost.

3. PROPOSED METHOD

Here we introduce a network-based weather forecast system. Our system makes it possible to post information about inclement weather online. Without a weather station, it enables individuals to monitor the weather immediately online [7]. The system monitors the weather and sends out immediate alerts based on meteorological statistics using sensors for temperature, humidity, rain, and humidity. Using a thermometer and a humidity sensor, the system continuously tracks temperature, humidity, and rainfall. To detect and record different weather parameters at multiple sites for analysis or weather measurement, a weather station is required [8]. Technologies like the cloud and the Internet of Things (IOT) enable the system to accomplish its goal. The Internet of items is based on the concept of connecting items to the internet and other technologies. Cloud data may be easily accessed by end users via the internet, and vice versa for IoT device data. An major use of the Internet of Things idea is weather monitoring, which entails observing and documenting different weather conditions and using them, in turn, to transmit reports, undertake long-term observation, repair equipment, and provide alerts. We will also try to use graphical representation to analyze and display different variables. Information is gathered, arranged, and presented using the methods that have been suggested for this purpose. The Internet of Things is expected to completely transform environmental monitoring and control by utilizing sensors and gadgets that can measure, analyse, and share air pollution [9, 10]. Processing power and data storage are examples of computer resources that are readily available without needing users to actively use them or exercise direct control over them. This is referred to as the cloud. The cloud receives the collected data in order to provide more details. The system furthermore comprises components like the NodeMCU board 12 digital pin microcontroller board, USB connector and all equipment that will support the microcontroller; BMP180 for measuring altitude and temperature, used to measure the above. NO; Through the use

of a WiFi module, the sensor's collected data is sent to the network server. Thus, this makes it feasible to keep an eye on the weather from any remote location in the world. After processing the data after receiving it from the system, the microcontroller sends it via the WiFi connection to the online web server [11]. This data is updated in real time to be presented on internet server systems. Users of the system can also programme notifications for particular circumstances. Many pollution monitoring systems in use today are tailored to specific environmental conditions. Hardware description: -

NodeMCU Firmware:

An open source IoT platform is called NodeMCU. Subsequently, the NodeMCU is able to support the MQTT Internet of Things protocol, as well as access MQTT through Lua. It is necessary for Arduino.cc to update the Arduino IDE when they begin creating new MCU boards for use with Arduino that are based on non-AVR processors (such as ARM/SAM MCUs) [12]. This will make it simple for support to switch the IDE.

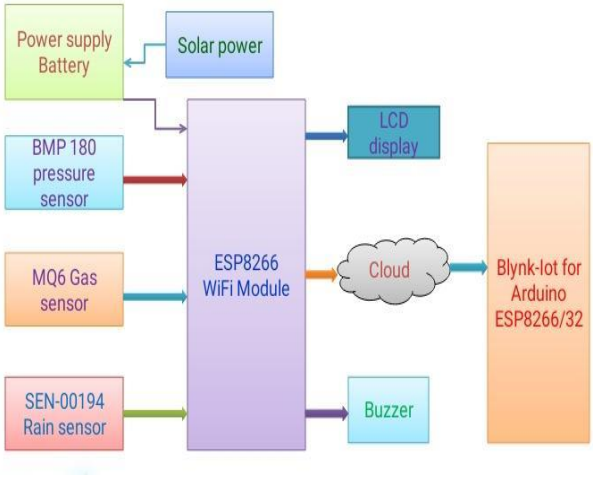

Fig. 1 Block Chain

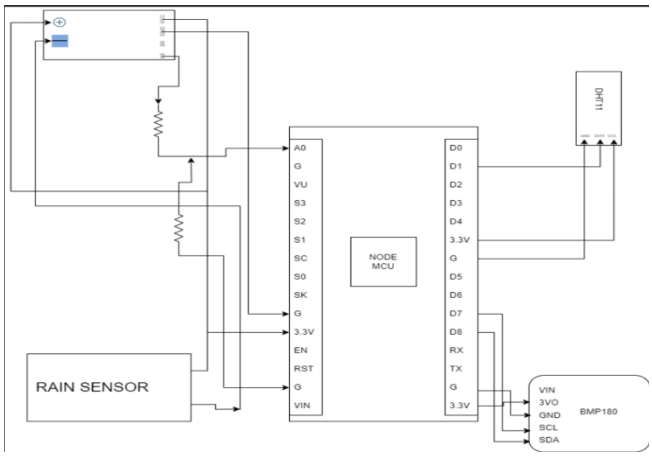

Fig. 2 Weather Station Monitoring System

A. MQ2 GaSensor

Electronic devices called sensors are utilised to communicate with the outside world. Smoke, light, loudness, closeness, etc. There are several different kinds of technologically detectable sensors; they can be either digital or analogue. Sensors play a critical role in both security and environmental communication.

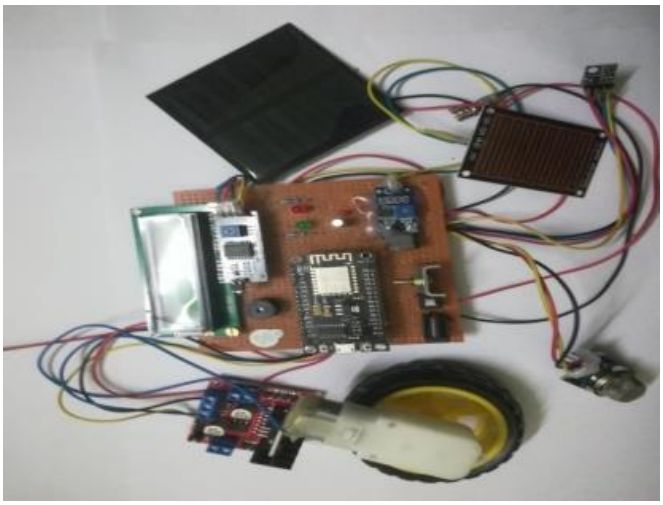

Fig.3 Protype

In order to detect fire and give timely, suitable protection, fire extinguishers are used [13]. Humidity sensors are used to regulate the humidity in equipment, which is necessary for sensitive electronic equipment and control systems to function properly. One sensor used in security systems to identify pollutants is the MQ2 gas sensor [14]. The concentration of various gases in the air, such as carbon monoxide, alcohol, hydrogen, propane, methane, liquefied petroleum gas, and smoke, can be measured using an electrical device called the MQ2 gas sensor. Another name for the MQ2 gas sensor is chemical resistance. It has a sensory property that refuses to change when in contact with oil. Use changes in resistance values to detect gas.

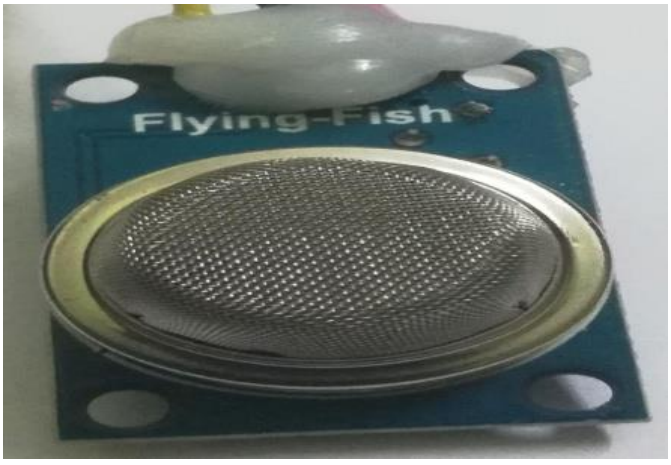

Fig. 4 MQ2 Gas Sensor

B. Rain Sensor

Rain is detected by the raindrop detection sensor module. It is also used to measure rainwater usage. Rain sensors can be used for various weather monitoring and can be converted to output and AO. Raindrop Detection Sensor Module Raindrop sensor module Arduino etc. Suitable for. The tornado sensor can be used to monitor various weather conditions and convert it into a variety of fixed lighting and analog outputs. It has a printed panel (control panel) that "collects" the rain. Raindrops that gather on the circuit board create a circuit that the op-amp detects. The output voltage decreases with decreasing resistance (or increased water content). Conversely, the analogue pin's output voltage increases with decreasing water content [15].

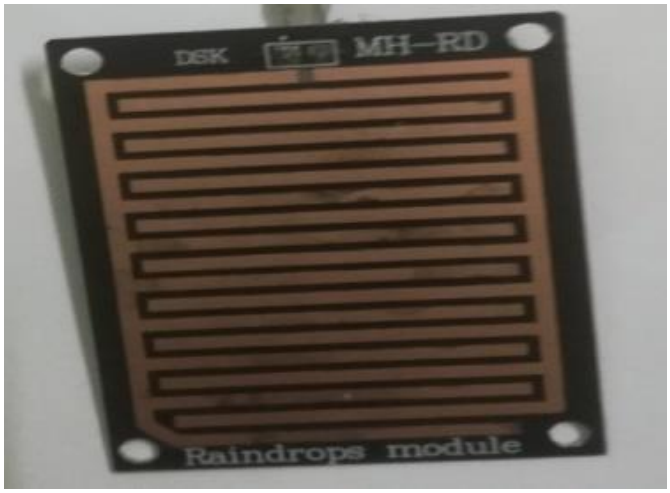

Fig. 5: Rain Sensor

It has a printed panel (control panel) that "collects" the rain. Raindrops that gather on the circuit board create a circuit that the op-amp detects. The output voltage decreases with decreasing resistance (or increased water content). Conversely, the analogue pin's output voltage increases with decreasing water content [15]. For instance, the module will output 5V if the card is totally dry. The module has a rain panel and a separate control panel for further convenience. It has a potentiometer for sensitivity control and an LED power indication. The core of this module is the LM393 operational amplifier.

C. BMP180 (Pressure Sensor)

Among the sensors in the BMP XXX series is the BMP180. Measuring atmospheric pressure, or air pressure, is the aim of both. High accuracy, consumer-focused sensor is the BMP180. All that air pressure is just air weight applied to everything. Because it has weight, you could experience pressure as long as there is air[16]. The BMP180 sensor detects pressure and provides a digital output of the data. Since temperature affects pressure, we need a thermometer to measure pressure. To compensate for this, the BM180 has a respectable temperature sensor as well.

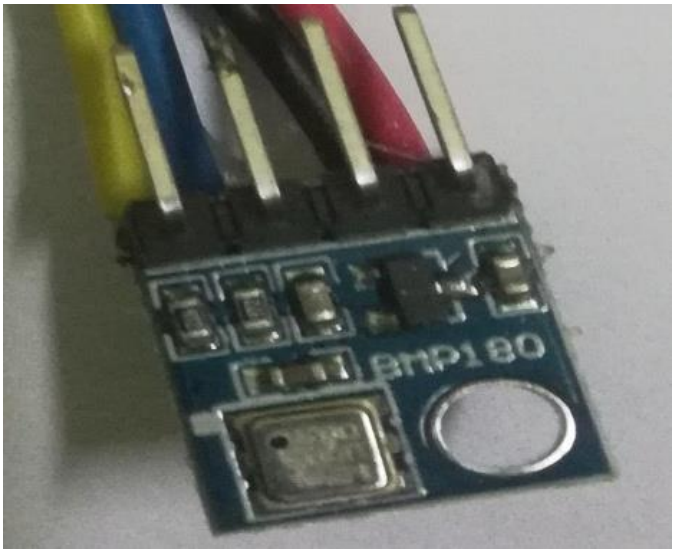

Fig. 6: BMP180 Sensor

D. Solar panels

Solar panels are gadgets that take in sunlight and turn it into either heat or power. Several solar cells, sometimes referred to as photovoltaic cells, combine to form a solar panel and use the photovoltaic effect to produce power. The arrangement of the cells is grid-like and resembles that of a solar panel. As a result, another way to describe it would be as a photovoltaic system that is fixed to the supporting structure [17]. Between 6x106 solar cells are packaged and connected photovoltaic (PV) modules. These panels are very strong when it comes to wear and tear. Solar panels wear out very slowly. Over the course of a year, their profits fall by only one to two percent (sometimes even less). Most solar panels are made from crystalline silicon solar cells

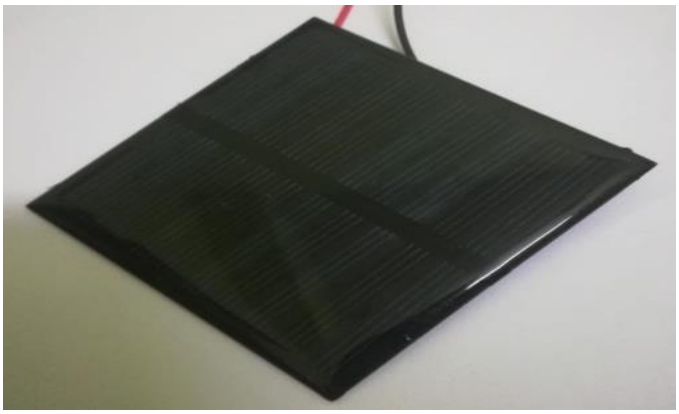

Fig 7: Solar panel

4. EXPERIMENTAL RESULT

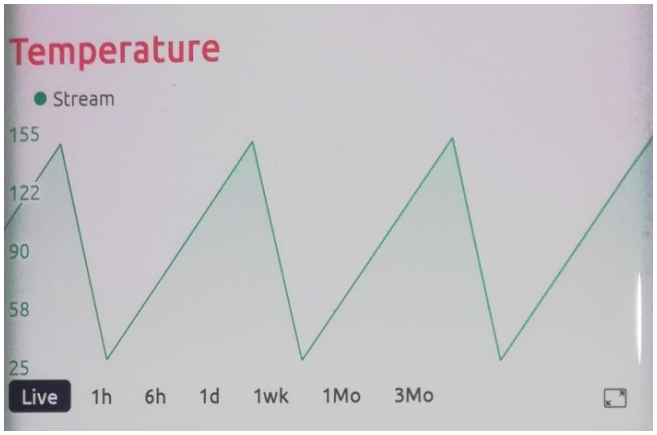

Fig. 8: Temperature

The temperature is monitored in real time for hours, days, weeks, and months, indicated in degrees Celsius, as can be seen in the above figure 8.

Fig. 9: Pressure

The pressure is monitored in real time for hours, days, weeks, and months, expressed in millibars, as may be seen in fig9, above.

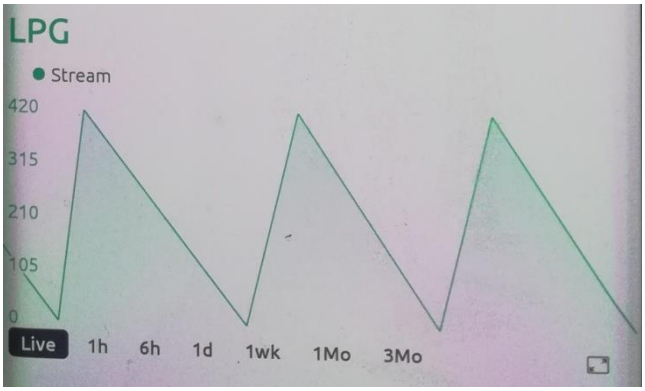

Fig. 10: LPG

The graph depicting the real-time monitoring of LPG using a gas sensor for hours, days, weeks and months is displayed in fig 10, above.

5. CONCLUSION

The environment can exercise self-defense, or smart environment management, thanks to the weather station's constant monitoring of its surrounds. In order to put this into practice, data collection, analysis, and cloud data transmission from sensor devices in the surrounding environment are required. This data is easily shared with other users and will help with analysis in the future. It is possible to expand this model to monitor air pollution in industrial and developing cities. This concept provides practical, affordable options for ongoing environmental monitoring to safeguard public health from contamination

Applications:

It provides information about changes in humidity, temperature and carbon dioxide at the location where monitoring equipment is installed. Cloud data can be used for benchmarking and continuous measurement.

Weather stations that measure precipitation, humidity and other conditions are important in applications such as flooding, storage, water utilities, water treatment and urban drainage.

The Internet of Things has been collecting weather data from sensor networks for some time. It sees the data in time to predict the weather. Barometric pressure, temperature, wind speed, etc. are used in generating final data and preparing the weather report parameters are taken into account.

Advantages:

It can be accurate and fast in the air in different areas. IoT-based cloud monitoring systems seamlessly integrate data from multiple sources. Weather sensors, satellite images, weather stations, drones and even personal devices [18].

IoT Weather Reporting System offers farmers an application through which they can increase crop yields and reduce the risk of bad weather conditions. IoT-based weather stations help monitor weather in areas like volcanoes or forests.

Appendix

Appendixes, if needed, appear before the acknowledgment

Acknowledgment

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