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IoT Based Windmill Parameter Monitoring System

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Abstract: Wind energy is one of the renewable energy sources that are being used more and more often these days to supply the excessive demand for energy. It is necessary to have a good wind turbine tracking system for environmentally friendly energy production. As most windmills are located in remote areas, it takes a lot of time and energy to continuously monitor them. In contrast to conventional methods, using digital equipment that includes sensors and controls will provide accurate results. In the research "IoT based Windmill parameter monitoring system", sensors that might be built on a windmill are used to measure factors including temperature, humidity, vibrations, air pace, and some other characteristics. The output from these sensors enables us to get the information necessary for tracking the characteristics of the windmills. By using this information, we can prioritize and automate security measures. Also, for remote tracking, the data from sensors is shown all at once on a dashboard. The admin and the responsible authorities may see this dashboard, and if necessary, it may be recorded for later use. Important statistics like energy, power, and cash gained may also be created with its help. Professionals may use the same information for any layout modifications,largely based on the materials and geometric parameter requirements.

Keywords: IoT, Windmill, Monitoring system, Sensors, Management

I. INTRODUCTION

The factitious source of energy is wind strength, which satisfies the requirements for the need for power. The correct maintenance of wind farms is crucial for the efficient use of wind energy. Windmills eventually have deficiencies, making reconfiguring them a difficult task. As a result, we need a workable method to carry it out. The Internet of Things (IoT) is a network of physical objects that are implanted with communication, sensing, and interaction capabilities with each other and their environment.

A remote monitoring and management system for windmills built on the Internet of Things. It makes it possible to remotely control the operation of windmills and keep an eye on a few internal and external elements. It uses sensors to determine the environment surrounding the windmill and a wireless network to send information to a crucial server. The main server may then compile assessments of the windmill's condition and send them back to distant locations. The data collected may be used to analyse the windmill's performance and foresee any possible issues that could arise, assisting in maintaining a healthy windmill. Also, the real-time sensor data is plainly shown on a dashboard for remote verification. The management professionals have access to this dashboard and may do a few more tasks as needed. The information may be shown on an hourly, daily, weekly, or monthly basis.

As windmills are expensive pieces of machinery that generate energy, it is crucial that they are inspected. If they are not being observed, they may malfunction and need repairs, which might cost a lot more money than if they were being watched. The use of IoT in windmill parameter monitoring systems has many advantages, including remote tracking, reduced operating costs, increased performance, greater safety, and reduced maintenance downtime. The management may utilise the data gathered by the device to identify the reason of the space by monitoring and comparing the system's actual performance results with the anticipated outcome.

II. METHODOLOGY

The system's central component, an Arduino UNO microcontroller, serves as the primary processing unit. It communicates with the sensor chip at the input to receive readings for temperature, humidity, air velocity, current, and pressure, and with the Wi-Fi module at the output to send the data to the cloud over the Internet. The microcontroller periodically checks the sensor for new data, then sends it over the Internet to the ThingSpeak cloud for analysis.

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The sensors collect specialized information from the surroundings or the machinery. These sensors are calibrated and capable of accurately gathering the data. The Arduino UNO calculates the windmill's state after receiving the sensor data. Moreover, it displays the data on a dashboard for monitoring purposes. The system or device is connected to the Arduino board through a USB connection. With the ESP8266 LAN module, the configured Arduino UNO setup is connected to the ThingSpeak platform. The procedure of uploading the obtained data to the open-source platform, ThingSpeak, is facilitated by the Wi-Fi network. As a protocol shopper, the ESP8266 LAN module will send the data to the ThingSpeak server. The best IoT platform for capturing and storing data is called ThingSpeak. The data analysis and comparison module of ThingSpeak is another distinctive feature. The ThingSpeak platform may be used to compare two different days. The user would be able to utilise ThingSpeak to learn about the condition of the windmill and take countermeasures after closely examining its properties.

III. LITERATURE REVIEW

Since people tend to make mistakes, it may be necessary to rely on electronic devices, such as sensors and micro regulators, to gather information, assist in screening equipment from anywhere, and carry out other essential activities. The real-time sensor data is also clearly displayed on a dashboard for remote inspection [1].

Data (various electrical properties) from the industry's current energy meters can be collected, saved locally, and accessed via laptop or mobile device using Grafana using a simple solution utilizing the Raspberry Pi and Node. js. In order to enable energy-saving practices for reducing energy consumption, the industry has found that the monitoring system is helpful in understanding the daily energy pattern [2].

The author walks the readers through each essential design and implementation component of the various IoT functions that are possible. The idea of a smart umbrella is presented in the book. This umbrella can communicate with its users about the weather by using specialized sensors, computing hardware, and Internet access. A chapter on "smart cars" or "connected cars" explains how these vehicles can automatically detect service needs by sending service-relevant data directly to the car maintenance and service centre or to the driver/car user server, as well as automatically send reminders of scheduled servicing, reducing the number of service visits [3].

The many physical parameters, such as humidity, temperature, raindrop, GSM, air pressure, and LDR, can be successfully monitored and made more interactive with the help of a number of sensors that are interfaced with microcontrollers like the ATmega328P. Putting up an instrumentation system enables for the measurement and monitoring of the various characteristics of wind, and the article presents numerous IoT-based applications and demonstrates how the system's monitoring and control may be flexible, reliable, and efficient for any real-time implementation [4].

Due to the environment, the distance between wind farms, and the nacelle's height, it is expensive to physically visit wind turbines for maintenance and repair. As a result, we developed a system that would let anyone on the planet check the status of a wind turbine [5].

The expansion of the Internet of Things (IoT) makes it easier to gather data on conditions like the weather, humidity, temperature, and soil quality. To allow for the detection of weeds, water levels, insect identification, animal infiltration into the field, trim development, and farming, farmers can monitor crops online [6].

The Automatic Weather Stations (AWS) are frequently used to collect meteorological and climatic data. The World Meteorological Organization (WMO) publishes manuals with setup and usage instructions for these stations. The development of autonomous observation systems is now more necessary than ever in the Internet of Things era. These systems will provide scientists with the real-time data they need to develop and implement effective environmental policies [7].

A clean room in the pharmaceutical industry must maintain an airflow rate of 0.36 to 0.54 m/s and monitor the ambient temperature and humidity levels. In this study, an automated system for controlling air velocity, temperature, and humidity is built using an Arduino nano and a Raspberry Pi. The PID method is used to control airflow. The test results show that the prototype performed as expected. The measurement's accuracy is 5%, 2 °C, and 5% for air velocity, temperature, and moisture, respectively [8].

The research developed ESP12E-based room monitoring equipment for STMIK STIKOM Indonesia. Temperature and humidity are measured by the DHT22 sensor utilized in the room monitor's design, while light intensity is measured by the BH1750 sensor. Another component of the apparatus that could show measurement data is a 16x2 I2C LCD [9].

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The measurement of temperature and humidity is accomplished via a hardware and software-based functional system. Time tracking will be possible thanks to technology. a sensor placed nearby and connected to an Arduino board to track temperature and humidity. The article aims to achieve the following goals in order to measure and monitor temperature, humidity, and time: a functional system in terms of hardware and software; use of a development board for communication with the sensor and clock; implementation of a program that complies with specifications [10].

All studies involving wind speed, including those involving meteorology, wind turbines, and agriculture, depend on accurate wind speed data to make decisions. The hot wire anemometer is one of several with medium and high pricing, including cup, hot wire, and pitot tubes. It is more sensitive and expensive than other anemometer types. The invention developed in this research is the simple-to-make cup anemometer. The proposal satisfies the work's objective by offering a convincing cost-benefit profile for potential development and manufacture [11].

The advice is for a full-featured real-time meteorological weather monitoring system that uses the cutting-edge Bosch barometric pressure sensor BMP180 and Adafruit humidity sensor DHT22. Monitoring is carried by using an outstanding virtual simulation (LabVIEW) connected directly to an ATmega328 quartz crystal 16 MHZ CPU. In an effort to maintain a number of meteorological metrics below a certain threshold, they are tracked in real time via the LabVIEW display. Conclusions: The findings point to a system that makes the whole monitoring process both affordable and simple to use thanks to its user-friendly interface [12].

The study examines the capabilities and uses of an Arduino board. It also examines the potential applications for academic and scientific endeavours. The Arduino board is a useful tool for building a VLSI test bench, especially for sensors. The main characteristics are quick processing and a straightforward UI. As more individuals use open-source hardware and software products every day, technology is creating a new dimension by making challenging tasks seem easy and interesting 13].

Use open-source tools and resources, such as Arduino and ThingSpeak, to track and analyse a solar photovoltaic plant's performance. This is a test version of a novel, economical IoT method. We have a place to check our parameters online thanks to ThingSpeak, a SaaS (Software as a Service) platform [14].

To evaluate the environmental quality, environmental parameters must be continuously monitored. Data collection from the sensing device is essential and depends on IoT, the most recent and developing technology. The study analyses and uploads the observed data to the ThingSpeak cloud using an Arduino UNO Wi-Fi module. Sensing units often consist of many sensors, including ones for temperature, humidity, wetness, etc [15].

the implementation of an environmental monitoring system that makes use of sensors to gauge the local climate's humidity and temperature, as well as the outcomes. This information may spark long-term statistics or prompt actions, such as remotely controlling HVAC equipment. The detected data is obtained from the cloud using an Android application, which also displays the findings to the users [16].

Several high-performance BMS (Building Management Systems) keep track of the interior climatic conditions, however there might be issues with data access, sensor placement, and other factors. On the other hand, the IoT (Internet of Things) is expanding significantly as more and more gadgets and sensors are connected to the cloud. As a result, a sensor-based interior temperature monitoring system was created. The suggested treatment is cost-effective and is based on a Raspberry Pi gadget with pressure, humidity, and temperature sensors. After reading the values acquired by the sensors, the developed program analyses the data and then sends it to the Wi-Fi ThingSpeak platform [17].

IV. RESULTS

The study examines how IoT-based windmill parameter monitoring systems may be used to track and control wind turbines to provide environmentally friendly electricity. The system comprises sensors that analyse variables including temperature, humidity, vibrations, and air speed in order to gauge the performance of the windmills. The sensor data is shown on a dashboard for remote monitoring and may be used to automate security activities, prioritise security operations, change layouts, and evaluate performance. The monitoring system built on the Internet of Things has a number of advantages, including remote tracking, lower operating costs, improved performance, enhanced safety, and less maintenance downtime. The system is essential for making sure that wind turbines are properly examined, maintained, and working so they can generate electricity without needing to be repaired frequently.

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The simulation and the outputs are depicted in the following figures.

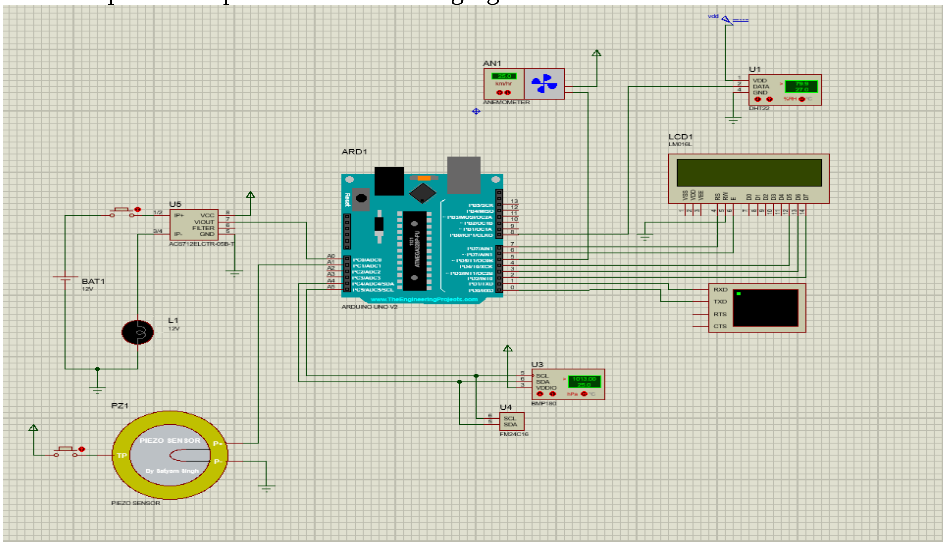

Figure 1: Simulation of the circuit

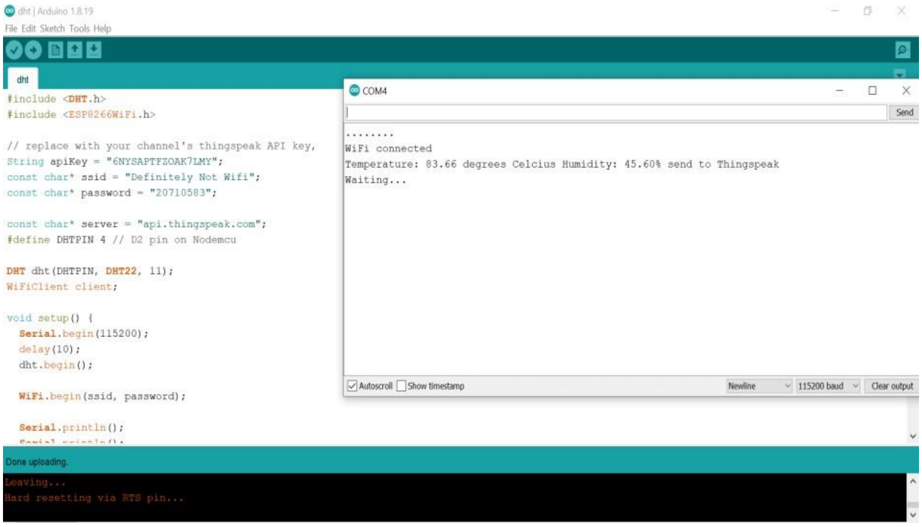

Figure 2: Output from DHT22

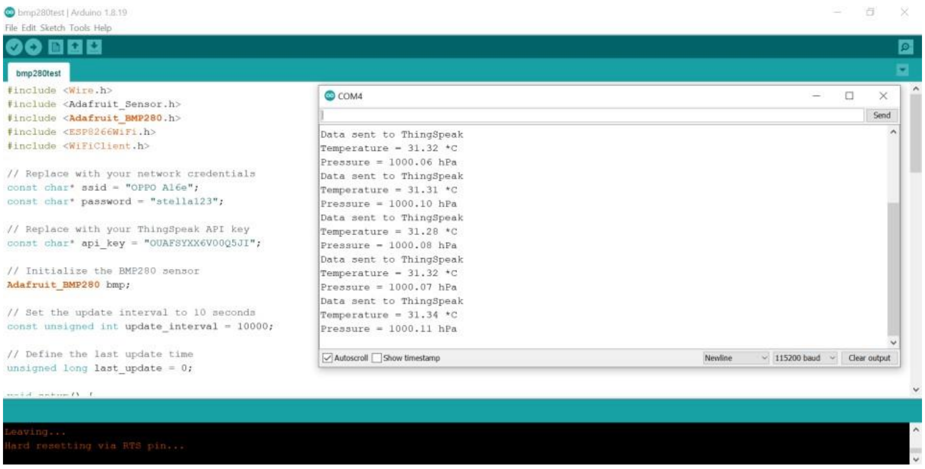

Figure 3: Output from BMP280

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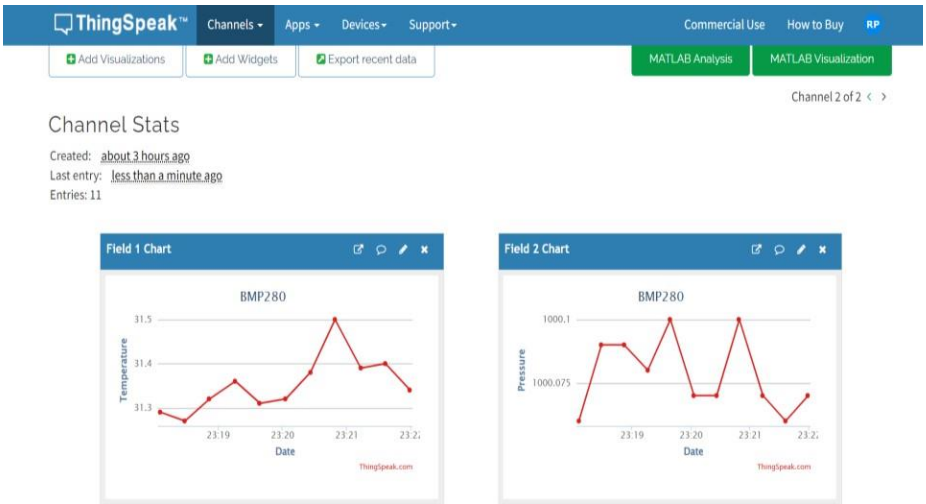

Figure 4: ThingSpeak Output from BMP280

V. CONCLUSION

Remote monitoring, cheaper operating costs, more efficiency, improved safety, and reduced downtime for maintenance work are just a few benefits of incorporating IoT in windmill parameter monitoring systems. We can schedule its upkeep and automate the wind turbine using the information. Authorities may access the recordings for purposes of protection and other purposes.

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