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IoT Based Vertical Axis Wind Turbine Monitoring and Power Generating System

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ABSTRACT

In this project, a small wind turbine supported by the electrical grid is designed, put into use, and monitored remotely. The Internet of Things (IoT) is used to remotely monitor the wind turbine and conduct supervisory functions, manage energy consumption, and gather environmental and performance data. Users can collect meteorological data, obtain operational parameters, get energy performance information, and carry out energy manager tasks using the IoT system. The developed software tool's smoothness in remote control without slowing is its most significant benefit. The acquired results reveal that the remotely operated wind turbine operates successfully and highlight the possibilities for onsite observation and the gathering of meteorological and electrical data by the created IoT-based setup. In order to confirm the power curves, optimise performance, and build a database for future study on larger-scale wind turbines and other renewable energy systems, the IoT-based setup will be used to monitor the wind turbine's long-term behaviour.

INTRODUCTION

For the generation of electrical power, wind is now the renewable energy source with the quickest rate of growth. Engineers find it more difficult to maintain wind turbines (WTs) for reliable operation as their number increases. Since many WTs are installed in isolated rural regions, exposed to severe environments, have high failure rates, and are frequently located on tall towers, inspection and maintenance of the WTs is labour- and money-intensive. Reduced maintenance costs and increased WT availability and reliability are required for wind power to be competitive with conventional power generation technology. Wind farm owners and operators can employ condition monitoring (CM) systems to help them accomplish this. The goal is to gather data on the machines' condition so that operational effectiveness can be increased. Instead of time-based periodic maintenance, which is carried out at defined time intervals regardless of the actual status of the health of the equipment, condition monitoring gives the instruments for condition-based maintenance (CBM). By implementing a condition-based maintenance system, any degradation or impending problems can be identified beforehand and repaired before they cause expensive failures. Additionally, it is possible to keep healthy turbines in operation, minimising downtime brought on by potential redundant time-based scheduled maintenance.

SOFTWARE SPECIFICATION

- software = Arduino IDE
- language = embedded C

HARDWARE SPECIFICATION

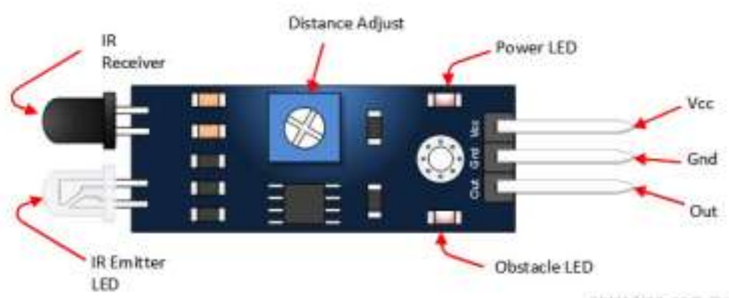
- NodeMcu
- IR sensor
- Voltage sensor
- LCD display
- DC FAN

NODE MCU

There are open-source prototype board designs for the NodeMCU open-source firmware. "NodeMCU" is a combination of the words "node" and "MCU" (micro-controller unit). In a strict sense, "NodeMCU" only refers to the firmware and not the related development kits. The designs for the prototyping boards and firmware are also open source. The Nodemcu ESP8266 and Nodemcu ESP32 are rapidly gaining popularity and are now almost exclusively employed in IoT-based projects.

IR SENSOR

Infrared LEDs produce light in this frequency range. We cannot see infrared light because its wavelength (700 nm to 1 mm) is substantially higher than that of visible light. Depending on the brand and kind of IR transmitter, IR LEDs have an approximate 20–60 degree light emitting angle and a range of a few centimetres to several feet. The range of some transmitters is measured in km. IR LEDs are transparent or white so they can emit the most light possible.

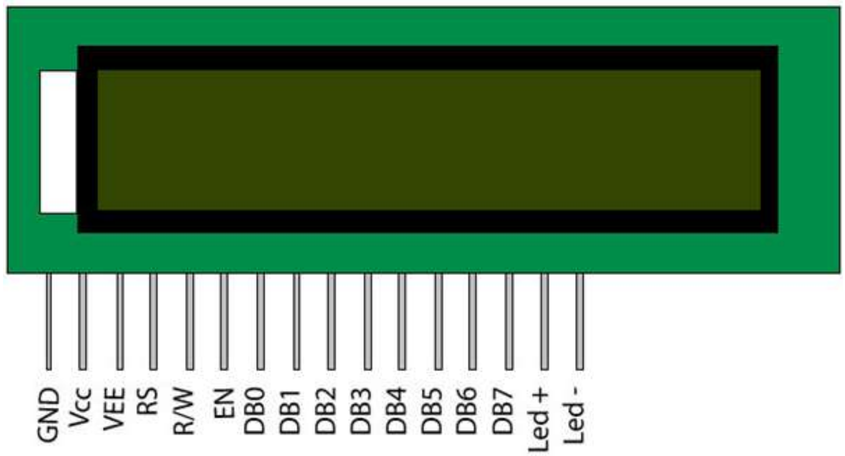


VOLTAGE SENSOR

The resistive voltage divider circuit serves as the foundation for the voltage sensor module, a 0–25 DC voltage sensing device. It produces an analogue output voltage that is equal to the input voltage signal after being reduced by a factor of 5. This is the reason why any microcontroller's 5V analogue pin can measure voltages up to 25V.The Voltage Sensor Module is a straightforward but very practical component that multiplies an input voltage by five using a potential divider. Using the analogue input of a microcontroller to monitor voltages considerably higher than it is able to sense is possible with the 0-25V Voltage Sensor Module.

LCD DISPLAY

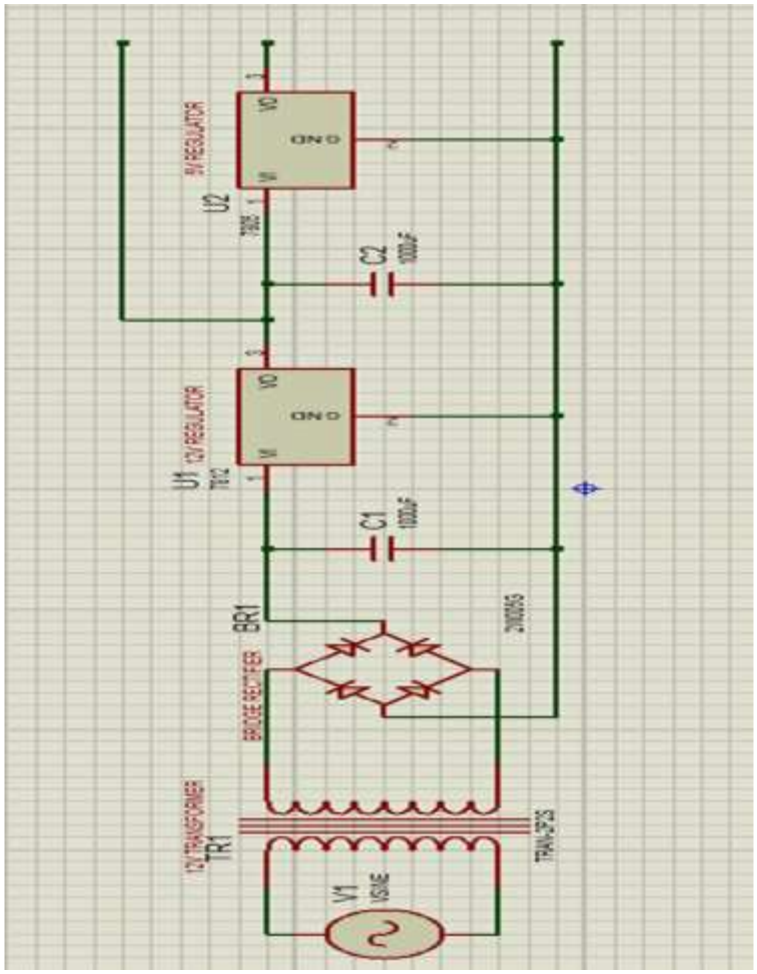
The enthusiasts employ a variety of display devices. One of the most advanced display technologies they utilise is LCD. It will be the simplest and most dependable output device you utilise after you figure out how to interface it! Additionally, not every project based on a microcontroller can use a debugger. So it is possible to test the outputs using LCD monitors.



DC FAN

2" 50mm 12V DC Cooling Fan DC fans, sometimes known as direct current fans, are powered by a fixed potential, such as the voltage of a battery. It has long service life, sufficient heat dissipation air volume, and air pressure, as well as double ball bearings that require no maintenance.

CIRCUIT DIAGRAM



EXISTING SYSTEM

An IoT-based VAWT monitoring system called Wind Iris gathers information from a number of sensors put on the turbine and transmits it to the cloud for analysis. The system offers features for defect detection, predictive maintenance, and real-time performance monitoring. Another IoT-based VAWT monitoring system, called Wind Cloud, offers real-time monitoring of environmental variables, electricity generation, and turbine operation. To gather and send data to the cloud, the system makes use of a wireless communication network and a number of sensors. An IoT-based VAWT monitoring system called Ubiquity use machine learning techniques to forecast the health and operation of the turbine. To be able to estimate maintenance needs, the system gathers data from multiple sensors and integrates it with historical data.

PROPOSED SYSTEM

The majority of currently available products log data on a PC or memory card. This stored information is only accessible on that specific PC. IoT technology overcomes this restriction. The suggested system makes it possible to monitor, regulate, and use parameters like power generation rate, voltage, and turbine speed anywhere. The time and expense requirements are effectively reduced by the proposed solution. Therefore, this might be a desirable product or solution for the customers and current wind farms. This system uses nodemcu to implement IoT and adopts turbine control depending on the level of turbine vibration. The proposed system ensures the dependability and safety of system operation.

CONCLUSION

For data logging, the majority of the currently available products use a PC or memory card. Only that single PC has access to the stored information. IoT technology gets over this issue. Power generation rate, voltage, and turbine speed are just a few of the parameters that may be tracked, managed, and used anywhere by using the proposed system. The time and costs associated with the proposed approach are successfully reduced. For the customers and current wind farms, this may therefore be an appealing solution or offering. This system uses nodemcu to deploy IoT while adopting turbine control based on turbine vibration level. System dependability and safety are guaranteed by the proposed system.

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