Cloud Based Wind Energy Monitoring System

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ABSTRACT

Wind energy is used as an alternate form of energy to meet the increasing energy crisis. Wind farms are set up in highly exposed sites. Wind is fluctuating in nature and hence a continuous monitoring system is needed. The wind turbine is used for converting wind energy into a useful form of energy. In this project the various parameters of wind are measured and monitored by setting up an instrumentation system. Due to environmental conditions, the remote location of wind farms, and the vertical height of the nacelle, it is expensive to physically visit wind turbines for maintenance and repair. The proposed system is to monitor the status of wind turbine from anywhere in the world using Internet of Things (IoT) technology. The work deals with the data transmission between two units in the exact time without any disturbance.

INTRODUCTION

Wind energy converts kinetic energy of air current flowing across the earth's surface into usable power which can provide electricity for home, farm, school or business applications on small to large scales. Wind energy is one of the fastest growing sources of new electricity generation in the world today. These growth trends can be linked to the multi-dimensional benefits associated with wind energy.

- **Green Power:** The electricity produced from wind power is said to be "clean" because itis a source of energy which is non-polluting and renewable, the turbines create power without using fossil fuels. That is, without producing greenhouse gases or radioactive or toxic
- greenhouse gases. As both health and environmental concerns are on the rise, clean energy sources are a growing demand.
- **Sustainable:** Wind is a renewable energy resource, it is inexhaustible which uses the wind that blows across the earth instead of fossil fuels. Many users views this infinite energy supply as a stable investment in our energy economy as well as in our children's' future.
- **Affordable:** The cost of generating electricity from wind has fallen considerably over the past decade with wind energy being the least expensive of all other forms of alternative energy. This has left the Wind Industry as a leading competitor on price with fossil fuel sources of generation.
- **Economic Development:** Wind power is a locally-produced source of electricity that enables communities to keep energy dollars in their economy.By keeping capital flowing within localities instead of being exported to other nations – energy independence becomes institutionalized at the local level. Job creation (manufacturing, service, construction, and operation) and tax base increase are other economic development benefits for communities utilizing wind energy.

Wind Electric System

In wind electric systems, the rotor is coupled via a gearing or speed control system to a generator, which produces electricity. Wind power is used in large scale wind farms for national electrical grids as well as in small individual turbines for providing electricity to rural residences or grid-isolated locations. For small turbines the electricity generated can be used to charge batteries or directly consumed. Larger, more sophisticated wind energy converters are used to feed power into the grid.

Small turbines intended for battery charging have a turbine diameter of between 0.5 –5 m and a power output of 0.5 – 2 kW. Installed costs vary between US$ 4 – 10 per watt. Medium sized turbines are used in small independent grids in hybrid with a diesel or PV generator. These turbines have diameters of between 5-30 m and a power output of 10- 250 kW. Large wind turbines are normally grid connected. This category includes diameters of 30-90 m and power outputs 0.5 – 3 MW. Total installed global capacity is 58,982 MW of which Europe accounts for 69% (2005). In the Eastern Africa region experience with wind generators has been isolated and largely driven by donors and missionaries. In Europe wind energy cost

was estimated at $55.80/MWh, coal at $53.10/MWh and natural gas at $52.50/MWh.

RELATED WORK

Joon-Young Parketalproposed to efficiently monitor the structural health and detect damages in wind turbine blades.

Huan Long et al proposed approach identifies turbines with weakened power generation performance through assessing the wind power curve profiles.

Tinghui Ouyang et al proposed in this paper to realize effective monitoring on wind turbines' unhealthy status.

Evangelos Papatheou et al presented a geometrically growing interest in exploring and investing in such offshore power plants as the continent's water sites offer impressive wind conditions.

Long Wang et al performed to demonstrate that existing SCADA features are unable to present irregular patterns prior to occurrences of blade breakages.

Joon-Young Park et al Compared with the existing methods, this algorithm automatically calculates the power curve limits for power curve monitoring, even when a considerable number of abnormal data are included in wind speed-output power data measured at a wind turbine.

Wei Qiao et al provided a comprehensive survey on the state-of-the-art condition monitoring and fault diagnostic technologies for wind turbines.

Yayu Peng et al developed and most of them transmit data using wired communication channels.

Meik Schlechtingen et al developed adaptive neuro-fuzzy-interference system models are set up and their performance compared with the other models, using the same data.

Wenxian Yang et al presented in this paper is an effort to meet such a requirement.

Joon-Young Park et al proposed algorithm automatically generates an alarm message when the wind speed-power data measured at the wind turbine deviate from the power curve limits.

Tinghui Ouyang et al proposed in this paper to realize effective monitoring on wind turbines' unhealthy status.

Yayu Peng et al developed and most of them transmit data using wired communication channels.

Meik Schlechtingen et al applied to evaluate the turbine power output and detect deviations, causing financial loss.

Xiandong Ma et al proposed method can adjust the active power output of individual turbines according to their health condition and can thus optimize the total energy output of a wind farm.

EXISTING SYSTEM

Now days, non renewable energy only used for home appliance. There is no scheduling method is available. Zigbee communication protocol.

ZigBee Tranceiver

ZigBee is an specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, ZigBee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances upto 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive.

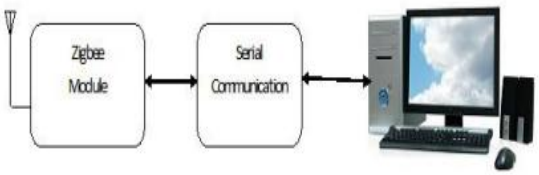

Fig 2.1 Block Diagram of ZigBee Control Units

Drawbacks of existing system

- The Manual work is needed.
- High power consumption.
- Demand for Non-renewable energy source.

PROPOSED SYSTEM

To avoid economic problems and to provide more convenience to the users we are using a microcontroller as a data acquisition system. As usual the control and monitoring process is carried out. The software part includes web server for real time monitoring of any system. The programming part is much simpler when compared to other tools. The sensors are used for collecting various information and sending them to a controller. Theyare used to measure voltage,current and speed. WIFI module is used to connect with server /client . By using Universal asynchronous receiver/transmitter interfacing connecting both Arduino Microcontroller and Internet of things. IoT consists of the one microcontroller which is used to control the relay.

This IoT-based monitoring system is consisted of a FPGACPU hybrid controller, a host computer, an uninterruptable power supply (UPS), a Network-Attached-Storage (NAS), and a hardware firewall. As reprogrammable silicon chips, FPGA is a reprogrammable hardware which has better reliability than most processor-based systems. Parallel processing of FPGAs provides equal resources for different tasks without processing resources competition [20]. This parallel processing nature enables the deterministic processing for the FPGAs which is extremely critical for a real-time system with multiple inputs processing. However, due to the technical limitations of the FPGAs, CPU is also required for the data logging and network communications in this application. An industrial standard controller with 1.91 GHz Quad-Core CPU, 2GB DRAM, 16GB storage, Kintex-7 325T FPGA, and an RJ-45 Gigabit Ethernet port is adopted. The controller is powered by an UPS to prevent monitoring system fail caused by power loss or interruption. A 4-Bay 8 TB NAS is applied as the data storage to record all detailed event data which can be accessed remotely through the Local Area Network (LAN) with the authorization. As an IoT-based application, cyber security is a critical factor that needs to be considered in the design. Thus, a hardware firewall is considered over software firewall in this application due to the faster speed and higher security levels. As a simplified illustration, the structure of a holistic IoT based monitoring system for wind turbines.

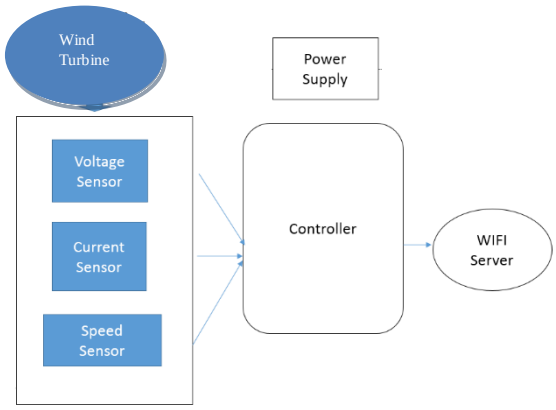

Fig 3.1 Structure of IOT based Monitoring

In this system, IoT provides real-time and remote communication in this monitoring system. The data communication is realized through a LAN, and the monitoring objects can be visualized in real-time by the system operators in the control room with the authorized computer in the network.

Advantages of proposed system

- Low Cost.
- Reduces the power demand.

CONCULSION

In this paper an IoT based monitoring system is developed for wind energy system .The fault identification is done and the parameters are measured and the monitored data is analyzed and send to PC through WIFI. The location and the type of faults are transmitted from wind turbine to control through IoT. The effect of harsh condition and the nature of large electromechanical system are the causes of fault to be occurring in the wind turbine. It is very important to perform the monitoring and fault diagnosis of wind turbine parameters. The WIFI which is used for serial communication which provides high data transmission rate and reliability. Thus, the design of a remote monitoring and fault diagnosis system based on the UART. Finally, the system performs efficiently. Our future work in this project is to intimate the abnormal status to the user by automatic voice call.

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