Monitoring and Fault Diagnosis in Wind Turbine Using can Network
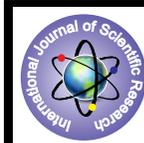
Engineering

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ABSTRACT

Electrical energy can be created using fossil fuels and also by natural resources. The production of electrical energy using fossil fuels is worthier when compared to natural or survival resources. Solar, wind, thermal and tidal energy are most widely used natural resources for the production of electrical energy. Presently wind energy is used in fullest extent. Because Natural resources which could reduce the emission of carbon dioxide. The amount given or required of the wind turbine is extremely higher and work in jarring to the senses and unattended environment. Hence the monitoring and the automation of wind turbine are unavoidable. This paper describes the monitoring and fault diagnosis system for wind turbine using CAN interface. The monitoring parameter and CAN interface are described in detail.

I.   INTRODUCTION

Wind is the natural movement of air from high pressure area to low pressure area caused by difference in temperature before a particular period of time has passed in the atmosphere. Wind energy is a kind of Green energy which is effective because of advancement in technologies and low cost. Wind energy is the most advanced renewable energy at the present time [1]. Using such wind energy a turbine is providing to rotate and electricity is produce. Wind turbine is a rotating mechanical device that transmits wind energy in to mechanical energy resulting in the production of electricity.

In whatever way, Wind turbines are fault prone, that is they are given in harsh environment such as desert, plains apart from that they are difficult electromechanical system that are situated far away from the control center. So the chance of fault happens and the side cause will be more, even it leads to power off. It is important to develop the remote controlling and defect diagnosis system to monitor the run time status and the identification of fault to improve the effort and the life time service of the wind turbine [2].

Wind turbine monitoring system collects the parameters such as Speed, Temperature, vibration, power, voltage and current from the main elements of turbines such as shaft, gear box, generator and nacelle [3]. Determining on the collected data from the monitoring system analysis done and the fault diagnosis system makes the choice of location and the fault type to be occurs in the wind turbine. This analysis is uploaded to the mobile web server and an SMS is sent if there is possible of fault occurrence [4] – [6].

CAN bus is one the Field bus control system which is used in automation, intelligence and networking. CAN protocol have been designed by Robert Bosch in 1986 for automotive applications. As it is a method for enabling robust serial communication. The importance of using CAN bus in the automation is an added value to the system and increase its reliability. The determination of using CAN bus is to enable any system to communicate with other system without adding heavy load to the main controller [7]. CAN bus is a speed serial bus with the speed of 1 Mbps that is designed to provide an efficient, reliable and economical link between various CAN systems, sensors and actuators.

We use CAN to communicate between the Wind turbine and the control center which adopts client/server frame works to implement the monitoring and fault diagnosis system.

II.   INTRODUCTION TO CAN

CAN bus is a network protocol which is used for exchange of ideas between the microcontrollers or any other devices without the use of any control computer. CAN is originally designed for industrial networking but at the present it finds wide use in automation, mobile machines, military and other harsh environment monitoring application. CAN bus does not carry any address between the transmitter and the receiver. Instead it holds the unique identifier which is a numeric value used to label the message throughout the network. Each of the receiving nodes provides the acceptance or uses the filtering to check whether the message is relevant to the particular node or not. If the message is appropriate to the particular node the message is accepted and processed or else the message gets distorted.

III. DEFECT DETECTION IN WIND TURBINE

Fault or defect is defined as the termination of the capability of an object to complete a function. When a situation in which something stops working properly inside the wind turbine like, High oil temperature in gearbox, the control unit logs the failure without changing or registers the effect of the fault is noticed and responds referring to the type of function is failure. Some unspecified times, in order to avoid hazards or main system breakdowns; the turbine has to be turn off. Frequently they are again started because of wrong failure notice, which could be caused by sound within the system, and therefore these faults are not taken as crucial problems. If the failure is dangerous, a visual inspection has to be made which can be carried out by the operators or by official personnel. At the dispute, every important failure occurs be noticed and the report is documented.

Wind turbine rotors are prone to obtain creep and damage fatigue, which can be carefully watched as cracks and delaminations in the blades. Moreover, dirt, ice, bird collisions, dampness or manufacturing faults can cause the rotor blades being imbalance and having asymmetric aerodynamic. Gear tooth damages, high speed and low speed shafts faults are the often caused failures in wind turbine gearbox. Similarly, vibration measurement and spectrum analysis are chosen for gearbox monitoring.

Stator, bearing and the rotor inside the generator are subject to cause failures. Usually, the faults in generators could be identified by current measurement. Pitch mechanism, Yaw system and Electrical system faults are also cause on system efficiency and even some breakdown.

IV.   A DELIBERATE SYSTEM DESIGN

The system composed of microcontroller, GPRS module, CAN controller, and parameters of wind turbine. Microcontroller has great effect and it is the primary or key element in processing module which continues on monitor the wind turbine parameters. The block diagram of processing module is shown in Fig.

1. CAN controller is used to communicate between the wind turbine and the database. For every particular amount of time, microcontroller preprocesses the sensed data and it will update the parameter values to the central database via GPRS module. Memory module is also provided for future references. RS232 is used for serial communication between the sim slid and the CAN Bus
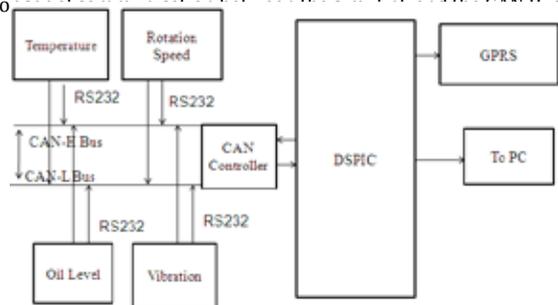

Fig. 1 Block Diagram of Processing Module

Monitoring parameters are more important in diagnosis system. The vibration parameters are observed from nacelle, gear box, generator shaft. The rotation speed is measured from slow shaft, fast shaft and generator shaft. Oil levels to be monitored are lubricant, brake oil. Yawing is observed from the nacelle.

V. CAN INTERFACE MODULE

CAN interface module is used to communicate the monitored parameters between the wind turbine and the control center. The CAN interface module contain three components CAN Transceiver (MCP 2551), CAN Controller (MCP 2510), DSPIC.

The block diagram of CAN interface module is given in the Fig 2. MCP 2510 has two mode of operation: basic CAN which is a default mode and PeliCAN. CAN transceiver is required to shift the voltage levels of the microcontroller to those appropriate for the CAN bus. This will help to create the differential signal CAN High and CAN Low which are needed in CAN bus. This device must be able to withstand voltage tolerance which may be caused by noise pickup. DSPIC which contains the feature of signal processing. The optocoupler and power isolator are used to improve the reliability of CAN interface module. All of the nodes may not be used for complex functions and algorithms. Therefore to reduce the development cost and increase the system integrity, a node can consists of an MCP25050 chip which is manufactured for CAN bus system for simple input output application
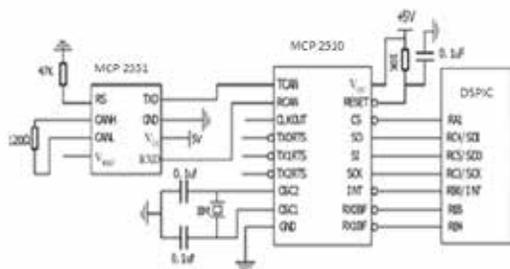

Fig. 2 CAN Interface Module

VI. RESULT AND CONCLUSIONS

The defect identification is done using the MATLAB and the parameters are measured through the CAN interface module the monitored data is analyzed using the neural network. The location and the type of faults are analyzed before it occurs and are transmitted from wind turbine to the control center through CAN bus and SMS is sent to the technical person to rectify the fault.

Fig. 3 shows the MATLAB output of parameter measurement such as current, voltage, speed, pitch, power.
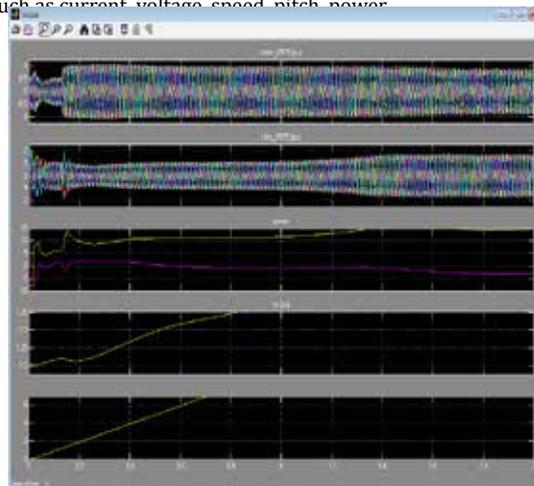

Fig. 3 MATLAB Output of monitoring the parameters

The effect of harsh condition and the nature of large electromechanical system are the causes of fault to be occurred in the wind turbine. It is very important perform the monitoring and fault diagnosis of wind turbine parameters. The CAN protocol which is used for serial communication which provides high data transmission rate and reliability. Therefore in this paper, the design of a remote monitoring and fault diagnosis system based on CAN and the SMS is sent regarding the location and the type of fault is proposed. Finally the System performance and the efficiency are effective and reliable.

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