Wind Turbine Monitoring and Fault Diagnosis by Can Protocol

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Abstract:- **Electrical energy can be produced using fossil fuels and also by natural resources. The production of electrical energy using fossil fuels is costlier when compared to natural resources. Solar, wind, thermal and tidal energy are most widely used natural resources for the production of electrical energy. Presently wind energy is most widely used natural resources which could reduce the emission of carbon dioxide.**

We declare the system with ARM and CAN protocol to avoid the problems which occur in the wind turbine. The project deals with the data transmission between two units in the exact time without any disturbance. The data transmission time is increased with the CAN protocol. One of the section runs with CAN and LPC2148 as normal node and another as data acquisition node to which sensors are connected. Data acquisition node also used the ARM. Communications between two nodes (normal and data acquisition node) are accomplished through the CAN protocol. The basic view of this technique is to reduce the possibility of fault occurrence and increase the monitoring of wind turbine. Sometimes based on the weather conditions turbine is power off and continuously monitoring the wind turbine is not possible. So in our proposed system to avoid this type of faults we are using CAN protocol.

INTRODUCTION:

The most developing renewable energy is wind energy. This wind energy is used to produce electricity by rotating the wind turbine. Wind turbine is a rotating mechanical device which is used to converts kinetic energy into mechanical power resulting in the production of electricity.

Wind turbines are located away from the control centre. Because, they are deployed in harsh environment such as desert and plains. So the chance of fault occurrence and the side effects will be more. The needs for monitoring the wind turbines are,

1. Unlike other power generation equipment, walk around maintenance checks are not feasible due to the difficulty and expense of physically reaching the wind turbine.
2. The overall installation costs are more, due to the manufacture cost of blades, gear box, etc.
3. Failure may occur due to the higher probability of stress in the gearboxes and related mechanical components.
4. Constantly changing loads and highly variable operating conditions create high mechanical stress on wind turbines. This high degree of stress demands a high degree of maintenance.

So, we proposed a method to gather the parameters which are used to monitor the wind turbine efficiently. The main components of turbines are shaft, gear box, yaw drive, blade, generator and nacelle. The collected data are analysed by the fault diagnosis system.

CAN PROTOCOL:

CAN (Controller Area Network) is serial communication protocol and it supports real time control applications. CAN is very similar to SPI or SCI which is also used in automation and networking. Efficiently supports distributed real time control applications with a high level of security.CAN bit rates up to 1Mbps which is used in automotive electronics, engine control units and sensors. Also, it is a cost effective to build into vehicle body electronics, e.g. lamp clusters, electric windows etc. If can bus is free, any node may begin to transmit. But when two or more nodes are transmitting the message at the same, it works based on the priority concept. A “non destructive arbitration technique” is used to ensure the messages which are sent without any lost and it also check the priority order of the message. The lower numerical value of an identifier has higher level of priority. That means the message with identifier has dominant priority and it is received by all nodes.

CAN uses a message based on the data format instead of using address based format for communication. Here the messages are transferred from one location to another by sending a group of bytes at one time (depending on the order of priority).
The CAN is used for the applications that required a large number of short messages (e.g.: wind turbine monitoring information such as temperature, rpm).

MEMS TECHNOLOGY:

MEMS stands for Micro Electro Mechanical Systems. MEMS sensor has holes, cavity, channels, cantilevers, membranes, etc. The MEMS sensor is manufactured by silicon based fabrication technique. MEMS introduce a special step to make free the mechanical structures as etching and thicker layer deposition. MEMS are not only manufactured by silicon it also be fabricated by polymer, glass and quartz.
The reason for using the MEMS sensor is cost effective and it decreased the material consumption. It also increases the real time application by reducing mass and size. This sensor can place in anywhere.
This is also called smart integrated MEMS because it includes data acquisition, communication, interfacing and networking etc. This technology not only makes the things smaller and it also often makes them better.
Developers of mobile applications, as well as gaming and automotive applications were the first to know the options for utilizing the MEMS sensors. The sensors are also open an abundance of options for the application of MEMS sensors are industry, medicine and home appliances.
Especially it attracts the many applications in the 3- axis acceleration sensor.

TEMPERATURE SENSOR:

The temperature sensor is placed on the wind turbine and it is used to sense the temperature, because these wind turbines are always deployed in the desert and plains. So the temperature may vary from one place to another place. The sensor is capable of sense temperature ranges from -40 degree Celsius to 120 degree Celsius. These temperature values are converted to voltage values. If the values are drops below the default low value or raise the default high value, then the severe action to be taken by controller in the controller room.

ARM MICROCONTROLLER:

Microcontroller is considered as a heart of our system. ARM 7 is an appropriate microcontroller for the embedded system. LPC2148 is the ARM microcontroller which is used here. The special characteristics of LPC2148are as follows,

- It is a 32 bit processor.
- It has 8kB to 40kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- Full-speed compliant device USB2.0 controller with end point RAM of 2KB is used. DMA uses the 8KB of on chip RAM accessible to USB provided by LPC2146/48.
- A total of 6/14 analog inputs can be provided by one or two (LPC2141/42 vs. LPC2144/46/48) 10 bits ADCs with low conversion time of 2.44 µs per channel.
- A variable analog output (LPC2142/44/46/48) which is provided by a 10-bit DAC.
- It has two 32-bit timers/external event counters (with four capture and four compare channels each), Pulse Width Modulation unit and watchdog.
- Real-Time Clock (RTC) with low independent power and 32 kHz clock input. Two UARTs (16C550), two Fast I2C-bus (400 Kbit/s), SPI and SSP with buffering and variable data length capabilities which are consisted by Multiple serial interfaces.
- It consists of configurable priorities and vector addresses of Vectored Interrupt Controller (VIC).
- LQFP64 package contains 45 of 5 V tolerant fast general purpose I/O pins.
- External interrupt pins available up to 21.
- Programmable on-chip PLL provides 60MHz maximum CPU clock with setting time of 100µs.

An external crystal in On-chip integrated oscillator operates from 1 MHz to 25 MHz.

- Idle and Power-down are available in power save modes.
- Peripheral clock scaling and individual enable/disable of peripheral functions are used for power optimization.
- Via external interrupt or BOD processor wake-up from Power-down mode.
- POR and BOD circuits are present in Single power supply chip.

Operating voltage of CPU ranges from 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O pads.

FAULT DETECTION IN WIND TURBINE

Fault is defined as criticize for inadequacy or mistakes. Failure which is usually occurs inside the wind turbine are high temperature, oil leakage in gearbox and destruction in the blade. At the same time the control unit register that consequents the reports or logs that detects directly. Finally it responds as the malfunction.

Sometimes based on the weather conditions turbine is power off and for continuously monitoring it is not possible. In order to overcome these problems in wind turbine, the turbine has to be power off. The wind turbine also shut down even for the wrong fault detection.

A visual inspection has to be made by the operators or by authorized personnel, if the problem is serious. Finally a paper work has to be documented, whenever a major failure has been occurred. Cracks in the blades are may be creep and corrosion fatigue of wind turbine rotors. The rotor blades being imbalance and having asymmetric aerodynamic can be caused by dirt, ice, bird collisions, dampness or manufacturing defects.

The most common failures in wind turbine gearbox are gear tooth damages, high speed and low speed shafts faults. Typically, temperature, speed and current measurement is done.

Mostly, Current measurement is used to detect the Stator, bearing and the rotor inside the generator.

RELATED WORK:

The proposed method used to monitor the wind turbine by using CAN protocol.

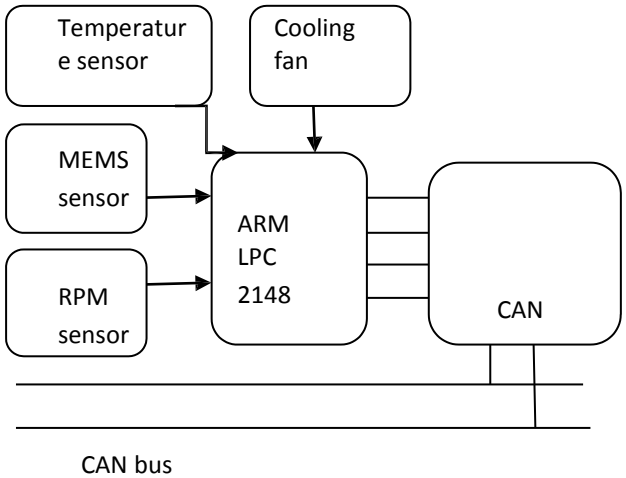

Fig.1 Transmitter node in wind turbine

Here the temperature sensor, MEMS sensor and RPM sensor are connected with the ARM processor.

The collected information is in analog form data. The analog data is converted into the digital data by using the ADC convertor in the arm processor .By using a serial peripheral interface arm processor is connected with the CAN protocol. The can protocol is a serial communication protocol which data is distributed among the electronic devices.

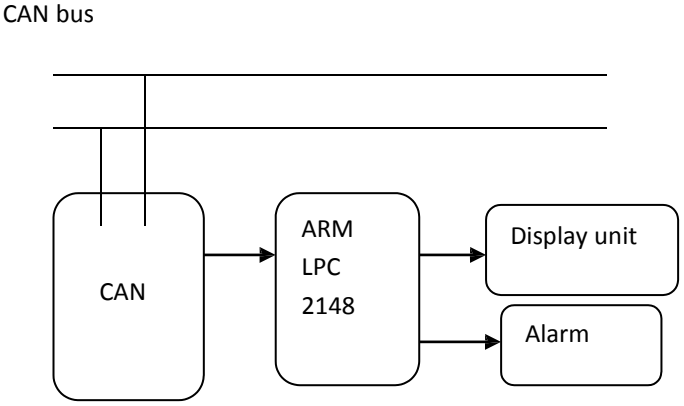

Fig.2 Receiver node for the wind turbine monitoring centre.

After receiving the data, can protocol via serial peripheral interface, these data are transmitted to the ARM core. The collected information is displayed in the digital display unit. The information is delivered to the corresponding control module. If there is a severe change in the collected data value it will compare with the default value, then the corrective measure action to be taken.

RESULT & CONCLUSION:

The proposed method is used to monitor the parameters such as temperature, speed, rpm etc. by using the CAN protocol effectively and efficiently compared to the previous method.

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