ISSN (Print) : 0974-6846
**Indian Journal of Science and Technology,** *Vol 9(17), DOI: 10.17485/ijst/2016/v9i17/93112, May 2016* ISSN (Online) : 0974-5645

# An Efficient Identification of Dynamic Faults using CAN and ARM7 in a Wind Turbine

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## Abstract

**Background/objectives:** This paper main focus on the monitoring and identifying the faults in the wind turbines. **Methods and Analysis:** In this paper we declare the system with ARM and CAN message protocol for monitoring and to diagnose the problems in the wind turbine. ARM core1 runs with CAN and LPC2148 works as a wind turbine unit to which sensors are connected and ARM core2 works as a monitoring section and also this system consists of a GSM modem which works as an intimate to the owner with an SMS to alert from dangerous situations and in necessary situations. **Findings:** Turbines working was changes under different climate conditions so using different sensors dynamic faults are outlined in turbine. **Application/Improvement:** wind turbines are extremely works in harsh environments so there is a need of observation by implementing this technique faults are outlined in future we can use many sensors.

**Keywords:** ARM7, CAN, GSM, RPM, Wind Turbine

## 1. Introduction

Renewable energy sources had a lot of attention because of the latest energy crisis and therefore to wish the pure power. Along the major choices wind energy may be a powerful competitor due to dependability and increasing of the technology, good frame work. Due to the advancement of a wind power changeover system saves the normal power sources however the most interesting way in wind turbine power sources is that we can reduce the pollution in the environment.

As past says the speed of the air will be terribly robust, and it will be visible only when a cyclone or a storm occurs. Traditionally, humans controlled and most significantly used for the sailing when the external combustion was not invented. It was additionally employed to pump water for and also for the electricity as the generation passes this wind mills said to be as a wind turbine.

An at most early turbine blade has a low voltage dc and also having huge losing thus power was created at the near locations. This technique was additional economical, complicated rather than other technologies simply above the previous year's. Mostly as a result of advanced system designs the usage of cost is also mostly decreases within the spent 20 years[1,2].

These turbines are change this mechanical energy into the power energy and this power can use in any way for companies, schools and etc.; and it was the quickest energy source at present. The power created from wind is claimed as pure power as a result it gives no polluted power as per the environment considerations this type power has a high demand.

Wind energy is used to allow a turbine to rotate and to get electricity. Sometimes that rotating mechanical energy is converted directly by a generator into electricity. Wind turbines are placed in a harsh environment like desert, additionally they're consists of various elements that are a lot of complicated, apart from this they're faraway from room. Presently the wind generation is quick increasing worldwide as popularity as an oversized scale energy supply. Thus the rapid construction of power plant capability leads to a necessity of implementation of health observation systems for turbine generators[3].

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## 2. System Overview

Faults are outlined because if any system doesn't complete it work properly if the failure occurs inside the wind turbine for example like increases of oil temperature in the gear case unit so at the time the control unit directly undertakes these failures and correctly responds to those failure results. So to avoid these we need to stop the entire working of the engine. If the failure is serious, a visible review must be created which may be applied by the operators or by approved personnel.

These turbine rotors are placed in harsh areas so which may causes damages to the blades and also due to the uneven seasons and also due to the birds and dust will cause the damages to the blades. And also there will be a varying of speed faults.

So to diagnosis this faults this technique is introduced and system which consists of a ARM and CAN message protocol and other sensors of the wind turbine. ARM microcontroller is the main element that which monitors the parameters of the wind turbine system.

The Figure 1 describes that ARM core1 runs with CAN message protocol and the LPC2148 works as the wind turbine system and the all sensors are connected to this wind turbine so the values which obtained by the sensors are transmitted through the CAN message protocol and the ARM core 2 works as a monitoring and the fault diagnose sections.

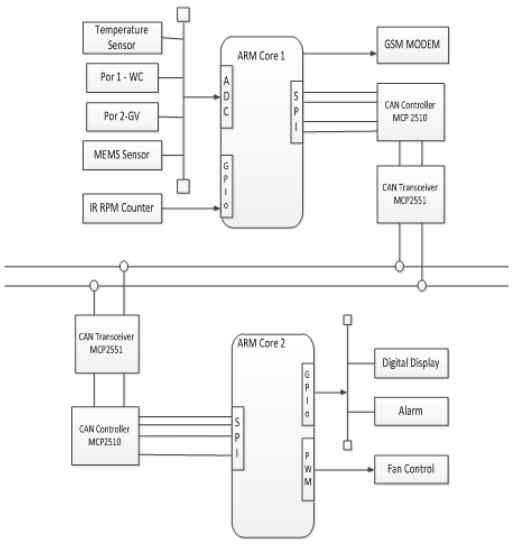


**Figure 1.** Turbine and fault unit working overview.

A controller area network is mainly communicating in between the turbine and controller so the results which obtain that will update to the database. The values which updated are transferring through the CAN controller 1 to the CAN controller 2. The serial peripheral was connected to the can protocol which gives the values directly to the protocol. A weather conditions are based on monitoring the wind blades so due to changes in the atmosphere the blades may damage and generic voltage display is also added in this system. As the wind turbines are placed in harsh areas so the main faults occur in the temperature and control unit. If there is a variation in temperature, then the LM35 sensor will monitor. A MEMS sensor is used to measure the acceleration forces so the forces are may be a static or dynamic that is by moving or vibrating the accelerometer IR RPM counter is mainly depends on the turbine speed and it was connected to the GPIO which may be taken as a output or input and also there is a inbuilt PWM to control the fan and this fan was used to cool down the temperature. So the finally LCD displays the temperature, RPM of the turbine, and the generic voltage and the buzzer which sounds in a dangerous situations. So the additional advantage is GSM module which can gives the faults through SMS[4–8].

## 3. Hardware Elements

**LPC2148:** ARM7 family involves more processors and it was the most widely used 32-bit embedded RISC processor. The ARM architecture includes operating systems it includes more than 40 real operating systems it has a von Neumann architecture with a 32-bit data bus that which carries instructions and data it has a 3 stages of instructions those are fetch, decode, execute.

This ARM7 was a 32 bit general purpose microchip that performs highly and it consumes really low power. This design has RISC principles, and therefore the set of instructions and rewrite operations was less complicated than those of small programmed instructions. This simplicity leads to a high instruction out turn and spectacular period interrupt response from a low efficiency. By using the pipeline techniques there will be an endless working in the elements of process and also memory system. The thumb 16-bit instruction length was allowing the density of standard ARM code and this thumb was providing the 65% code size ARM and160%of an ARM processor which has been linked to a 16-bit memory system[9].

## 4. Controller Area Network (CAN)

CAN is an advance serial protocol that it can be used for the distributed real time control in a high level security. Basically controller area network is made for the automobile applications and at present it was also used for the broad range applications in between the transmitter section and the receiver section it does not involve any address but it holds a unique numeric value. Transmitting the data using CAN network was a lossless bit wise arbitration method to synchronize the sample every bit in the CAN network at the same time this arbitration technique was uses all nodes in the CAN network. CAN has a two bus states the dominant bits and the recessive bits where logic '0' was taken as dominant bits and logic 1 as a recessive bit. Logic 0 was actively driven by the transmitter and the logic 1 was passively driven by the transmitter and the idle state was represented as a recessive level i.e.; logic 1. If one node transmitting the dominant bit and the other node was transmitting the recessive bit, then there is an occurrence of collision because of the higher priority the dominant bit was transmitted and after transmission the recessive bit was retransmitted. This transmission of nodes of CAN simply suitable for real time communication systems.

CAN controller MCP2510 was 18 pin standalone controller it has a feature of standard SPI interface and a busy connection to any microcontroller this CAN controller provides maximum design flexibility. The MCP2510 contains an on board features those are masking of message, interrupt capability, multipurpose input output pins and also multi transmitting and receiving's. CAN transceiver MCP2551 was a high speed transceiver which acts as a fault torrent device this transceiver acts as an interface in between the CAN controller and the physical bus. CAN transceiver has a different transmitter and receiver sections which has a standard 24v and has a speed of one mb/s[10].

## 5. GSM

In the system design the GSM module has been taken and it was frequently used to provide cellular connectivity. This modem was a cost based for receiving messages because the sender was acquiring the message sending. This modem can easily connect and starts the operation. The GSM Module is employed to supply data regarding the conditions prevailing within the turbine to the keeper. It sends SMS to the keeper just in case of any abnormal things.

This GSM was built using with standard RS232 interface so that it can easily interface with any controller. It has to handle the serial interface in between the micro controllers and the computer. We here make a tasks like sending SMS and making calls and to perform other GSM tasks. The parameters will be displayed within the computer placed at the centre[11].

## 6. Temperature Sensor (LM35)

This sensor was a high precision integrated temperature sensor that affords the voltage output nearly proportional to the Celsius system of measurement. It doesn't need suggestive accuracy at a room temperature. The output impedance was also low and also linear. It gives the high voltage output. Here in the system design the temperature sensor was connected to the analog to digital converter and also the generic voltage and weather conditions ports are also connected to the temperature sensor these values are analog so the ADC converts to digital and finally using the CAN protocol the values are displayed[11].

## 7. MEMS Sensor

Micro-Electro-Mechanical Systems, or MEMS, may be a technology that in its most general kind are often outlined as miniaturized mechanical and electro-mechanical components (i.e., devices and structures) that area unit created exploitation the fabrication techniques and the dimensions of this device will dynamically change from below one micrometer onwards. Likewise, these devices will change comparatively easy structures without moving components, to extraordinarily complicated mechanical device. This sensor gives the analog values so it is attached to the ADC it gives digital values. By Using this sensor we can calculate the vibrations[6] of the wind mill and while in the earth quakes the windmill may be in abnormal conditions so we have to prevent these conditions by using this sensor. So we can stop the working of the turbine suddenly and we can prevent the damage of the turbine[11,12].

## 8. IR RPM Sensor

RPM counter conjointly finds its importance in such a big amount of industries because it measures current rpm of any motor. Activity current rpm of the motor and supported that take decision prefer to increase rpm or decrease it is that the prime demand. In certain application it's needed to take care of the rpm of motor inside desirable limits. Therefore in this the rpm is continuously measured and brought as feedback. The speed/RPM sensors are designed, based on varied determinant principles – Hall Effect, magneto resistive, inductive – to observe without obtaining a hold of the rotary movement of phonic or toothed wheels and frequently of any rotating device invented in a very metal material and given slots or obstructive elements. they supply a frequency signal that is digital in nature – for the Hall result or magneto resistive versions – or a curving signal – for the inductive versions – that it was exactly presence of alternating sequence and absence of metal material given by the rotating device[11,12].

## 9. LCD

LCD's have a material that which involves both liquids and crystals however it is classified that liquid crystal display has a 2 layers that inside of these 2 layers the transparent electrodes were covered so it displays the symbols and the letter characters. Here in this project we used the 16x2 LCD that is it has a sixteen columns and the two rows finally the LCD displays the sensor values that is the faults which are obtained in the wind turbine[9].

## 10. Result

The below output shows the faults of the wind turbine are identified by using temperature sensor, MEMS sensor, IR RPM counter and also the generic voltage. Using the GSM modem these sensor values are transmitted through SMS and it was displayed in the cellular device[9].


**Figure 2.** Fault displays in LCD.

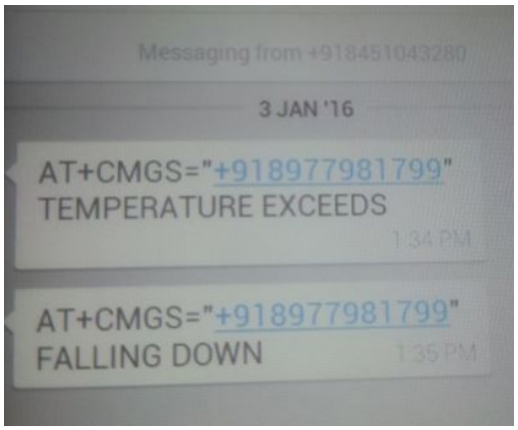


**Figure 3.** Result displays in mobile.

## 11. Conclusion

The wind turbines are mainly placed in a harsh environment so the monitoring of the wind turbine is most important because it effects some problems may be a vary of temperature and vibrating of the wind turbines like these so to identify these this project is designed using ARM and CAN protocols which are used to identify the faults and additionally GSM was placed to send SMS about the conditions of the wind turbine. In future we can prolong this project as that we can monitor more data acquisition units with single data processing unit by allotting a unique ID to each acquisition unit.

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