



## Multiple parameter Monitor and Control in Wind Mills

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**Abstract:** Generating power through the wind mills is very common and essential now-a-days. In wind mills, designing a proper Condition Monitoring System is a difficult task. The main objective of this paper is a) to monitor the parameters like generator current, temperature, voltage, vibration, turbine speed in wind mills b) to detect fault in the temperature sensor and in the storage unit c) to control the parameters such as speed, temperature, current through LabVIEW. Basically, signal parameters will be detected by sensor units and conditioned with the help of Signal Conditioning Unit (SCU). Generally most of the signals will be analogies, and so it's not convenient to process it further to the PIC Microcontroller. In order to do that, an Analog to Digital Converter (ADC) to be used for digital conversion and the PIC microcontroller has In-Built with ADC. Then, the controller will process those data and sends the appropriate output signal to Personal Computer (PC). Thus the information such as the temperature sensor fault, battery/storage unit fault, fault current etc is received and stored in the PC. The controller is interfaced to the PC through LabVIEW using Ethernet. The measured parameters is displayed through LabVIEW and based upon the data, the faults are rectified. The sequential monitoring of the data is possible through the LabVIEW and any variations that have to be made to maintain the stability of the control system is done with the help of Ethernet at any time. The Ethernet is the advanced communication link that enables us the faster transmission. This paper prevents the replacement of the Microcontroller every time an error occurs as done before and also reduces the total number of Microcontrollers used.

**Keywords:** Wind mill, LabVIEW, Ethernet, Signal Conditioning Unit, vibration sensor and PIC Microcontroller

### 1. INTRODUCTION

Recent advances in wind mill technologies have already made enormous contributions in many industrial areas. Automation provides increased efficiency, throughput, accuracy and repeatability. In this era, automation has reached a limit where unplanned automation doesn't provide expected results. In many applications it is difficult and time consuming the process for the entire devices to monitor and control the parameters and to perform the specified task[1],[2]. To overcome this problem we are planned a system that single operator manages the entire system. The concept of the multiple parameter monitoring involves the multiple tasks performed working in coordination with the environment to accomplish a complicated task. When the entire wind mill parameters are monitored as a whole in single PIC Microcontroller, it becomes possible to achieve a complicated task. This device makes optimum utilization of available resources which gives maximum efficiency compared to previous methods used for power generation[4].

This application have been implemented in the wind mills becomes an ideal setup to demonstrate the concept of multiple planning. There are certain situations where overloading, short circuiting, etc creates a problem to the operator and the setup. In those situations, it's apt to have a device that reduces the effort of the operator to modify the parameter when ever needed. By having this device, it adapts to the environment and manages to provide the constant efficient output [5]. Thus this research works aims to reduce the complicated situations and has a constant eye on the parameters and controls it in the unstable situations at less time duration. We propose an approach of neglecting several controllers into a single controller wherein providing the energy efficient at the same time simple and reliable system [6].

### 2. METHODOLOGY

Total circuit has to be implemented to obtain various parameters in windmills. The generator output current is measured by using the Current Transformer (CT) which is located inside the generator. The generator output voltage is measured by using the Potential Transformer (PT) which is located next to the generator output block. Vibration in the generator is measured by using piezo electric crystal. Piezo electric crystal is kept inside the generator. The output of piezo electric crystal is given to the microcontroller through the signal conditioning unit. The Signal Conditioning Unit (SCU) is used to amplify output signals produced from various sensor blocks (current sensor, voltage sensor, vibration sensor, blade speed sensor). Also it is used to feed the amplified signals to the Analog to Digital Converter (ADC). All the analog signals from various sensor blocks (current sensor, voltage sensor, vibration sensor, blade speed sensor) are converted into digital form. This digital signal is fed into the microcontroller. Fluctuations in the output of the generator are removed by using a capacitor in the smoothing circuit and then it is given to the battery for power storage. Here we are using PIC microcontroller for controlling purpose. It receives all the signals from ADC and based on the inputs given by the user, it controls and monitors all the parameters in the wind turbine. EEPROM is Electrically Erasable Programmable Read Only Memory which is used for store the error data from the microcontroller. This data are read by the main computer through Ethernet after that the information's are erased by the main computer. Driver circuit is used before the control circuit, used to avoid the load

current entering into microcontroller while driving large loads.

A LN2803 driver IC is used. The control circuit consists of relays, temperature controllers, fault current protection. Relays are used for ON-OFF purposes. Temperature controller uses cooling system to control the generator winding temperature. Ethernet is a family of frame-based computer networking technologies for Local Area Networks (LAN). It is used to read the microcontroller's memory directly. It also enables to change the parameters whenever needed. The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. All the sensors are fitted inside the generator to monitor all the electrical parameters.

### 3. PROPOSED METHOD

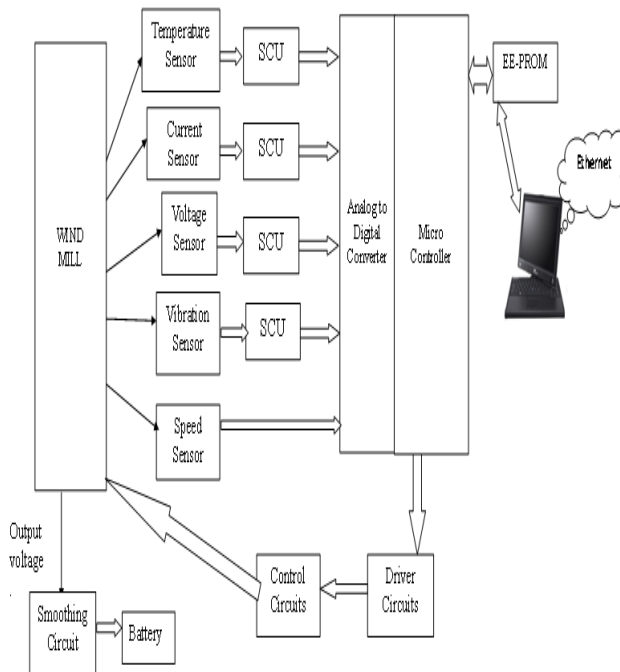


Figure 1. Block Diagram of Multiple Parameter Monitor and Control in Windmills

#### 3.1 Current Sensor

The generator output current is measured by using the Current Transformer (CT) which is located in the generator. A current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments fitted at the output side of the microcontroller.

#### 3.2 Vibration Sensor

When a large amount current/voltage will causes vibrations. The Vibration in the generator is measured by using piezo electric crystal. Piezo electric crystal is kept in the generator. It works on a Piezo-Electric Effect. It produces the electrical output. The output of piezo electric crystal is given to the microcontroller through the signal conditioning unit (SCU).

#### 3.3 Temperature Sensor

The generator winding temperature is measured by LM35 sensor and the output is given to the PIC Microcontroller and also fault detection is carried out using redundant sensor. LM35 is also used as a redundant sensor for temperature measurement.

#### 3.5 Speed Sensor

Turbine consists of large number of blades .The Blade speed is measured by the proximity sensor and it is given to the microcontroller. It is monitored by using LabVIEW.

#### 3.6 Signal Conditioning Unit(SCU)

It is used to amplify output signals produced from various sensor blocks (current sensor, voltage sensor, vibration sensor, blade speed sensor) connected in the generator. It consists of Instrumentation amplifiers circuits. Also it is used to feed the amplified signals to the PIC Microcontroller which contains an in-built ADC.

#### 3.7 Wind Mill

Wind mills are generally called as wind turbines. It consists of turbine connected to the generator with gear box setup. Here we are using synchronous generator to run the turbine. The reason for using synchronous generator is, they are more stable and secure during normal operation, and they do not require an additional DC supply for the excitation circuit. Voltage regulation is possible and provides higher power coefficient and efficiency.

#### 3.8 Smoothing Circuit

Fluctuations in the output of the generator are removed by using the smoothing circuit and then it is used as a battery power storage. The smoothing circuit is a low-pass filter designed to reduce ripples from the direct current obtained from synchronous generator.

#### 3.9 PIC Microcontroller

PIC initially referred to "Peripheral Interface Controller". It is used for controlling purpose It receives all the signals from the SCU and based on the inputs given by the user, it controls and monitors all the parameters of the wind turbine. PICs are popular with both industrial developers due to their low cost, wide availability, and serial programming (and re-programming with flash memory) capability. It has in-built ADC. It acts as a first level control.

#### 3.10 EEPROM

EEPROM is Electrically Erasable Programmable Read Only Memory which is used to store the error data during the microcontroller operation. It is the part of the Microcontroller. This data are read by the main computer through Ethernet after that the information's are erased by the main computer only limited values stored in EEPROM..

#### 3.11 Ethernet

Ethernet is a family of frame-based computer networking technologies for Local Area Networks (LAN). It is used to

read the microcontroller's memory directly. It also enables to change the parameters whenever needed for turbine operation.

### 3.12 Driver Circuit

Driver circuit is used before of any control circuit. It is used to avoid the load current entering into microcontroller while driving large loads. LN2803 driver IC is used. A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads.

### 3.13 Control Circuit

The control circuit consists of relays, temperature controllers and fault current protection. Relays are used for ON-OFF purposes. Temperature controller used to cool the system and control the generator winding temperature.

### 3.14 Power Supply

Every unit requires power supply to get enabled. The power supply unit consists of step down transformer, rectifier, filter, voltage regulator. There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken into a series of blocks, each of which performs a particular function. Each sensors have a separate power supply sources.

## 4. IMPLEMENTATION

In the wind mills, the Potential Transformer (PT) and the Current Transformer (CT) is placed to the generator output to measure the voltage and current respectively. The Piezo-electric sensor is placed on the generator to measure the vibrations. The Proximity Sensor is placed near the rotor blade such that the rotations of the blade is measured as speed. The LM35 temperature sensor is placed in the generator to measure the temperature. Then the output of all the sensors except the speed sensor output is given to the respective Signal conditioning Unit and fed to the ports of the PIC Microcontroller and the output from the Microcontroller is given to the driver circuits to control the respective parameters.

## 5. RESULT

Here the parameters such as voltage, current, speed, temperature and vibration have been measured using the sensors such as potential transformer, current transformer, proximity sensor, LM35 and Piezo-electric sensors respectively placed in the appropriate places to measure all the parameters in wind mill.

Table 1 shows the output measures across all the sensors placed in the wind mill.

## 6. CONCLUSION

This paper of "multiple parameter monitor and control in wind mills" is very helpful because here we measure and control all the necessary parameters together manually and automatically through LabVIEW. So it enables us to measure and control anytime any parameter. It reduces all the basic needs such as cost, labour power, space, time etc. This feature increases the reliability of the setup with the help of Ethernet. It is possible to manage the setup from anywhere and anyone for a fraction of second. Due to this it is best method

for controlling parameters in windmill. In this research minimum amount of current only measured that cannot be sensed by current transformer, we have to extend a special sensor to measure minimum current also.

**Table 1. Measured output parameters**

Parameter measured	Name of the sensors Used	range/ type
Voltage	Potential Transformer	230V/12V
Current	Current Transformer	5A/500mA
Speed	Proximity Sensor	NPN
Temperature	LM 35	Up to 300 C

## 7. ACKNOWLEDGMENTS

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