Modeling and Controlling of Wind Power Station by using Different Dynamics

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Abstract— In this paper we discussed about what are all problems caused by the wind power plant and which sensors are used to overcome these problems. Wind energy is one of the growing renewable energies in the world. The generation of wind power is clean and non-polluting; it does not produce any byproducts harmful to the environment. We chose the project to create awareness to the people if they use in the home it can reduce the electricity problem. This project is a miniature model of wind mill and it is horizontal axis wind turbine model. We are going to monitor the wind power plant by using LABVIEW software and MY-RIO kit.
Key words: Wind Power, Cup anemometer, LABVIEW

I. INTRODUCTION

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. This heating is higher at the equator and lowest at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power. Now wind power is harnessed to generate electricity in a larger scale with better technology. By using Wi-Fi enable in the RIO kit we can analyze the whole plant from the control room.[6]

II. WIND ENERGY ADVANTAGES

- It is a clean fuel source available as renewable energy
- Wind energy is a domestic source of energy in the world
- It's sustainable energy resource
- Wind power is cost effective source

III. CHALLENGES OF WIND POWER

- The turbine blades may damage local wildlife
- Turbines may cause noise and aesthetic pollution
- Wind resource development may not be the most profitable use of the land
- Good wind sites are often located in remote locations, far from cities where the electricity is needed.

IV. WIND PARAMETERS

In this paper we monitor the wind parameters which are going to affect the wind power generation process. There are many parameters are monitor and controlled in major power generation process they are

- Pressure
- Wind speed
- Temperature
- Vibration
- Humidity
- Voltage
- Current

In our project we mainly focused wind parameters are

- Wind speed
- Temperature of the generator
- Vibration
- Output voltage

V. SENSORS USED

A. Wind Speed:

Speed measurement sensor is anemometer. In these anemometers we have standard types of anemometer.
Types are,

- Cup anemometer
- Vane anemometer
- Plate anemometer
- Sonic anemometer
- Acoustic resonance anemometer
- Tube anemometer
- Ultrasonic anemometer

For our convenient we chose the 4 cup anemometer. Which was made by our own designing method. Which has 4 cups and one 9V DC generator when the wind flow occur on the cups then it make the cups to rotate in anti-clockwise or clockwise direction. Which in turn rotates the generator shaft due to electromagnetic induction principle the voltage induced on the generator.[4]
From the output of the generator we calculated the wind speed.

1) Cup anemometer:

It consisted of four hemispherical cups, each mounted on one end of four horizontal arms, which in turn were mounted at equal angles to each other on a vertical shaft. The air flow past the cups in any horizontal direction turned the shaft in a manner that was proportional to the wind speed. [5]Therefore, counting the turns of the shaft over a set time period produced the average wind speed for a wide range of speeds. On an anemometer with four cups, it is easy to see that since the cups are arranged symmetrically on the end of the arms, the wind always has the hollow of one cup presented to it and is blowing on the back of the cup on the opposite end of the cross.

Fig. 1: 4 CUP ANEMOMETER

Revolution in (10S)	Wind speed in(Kmph)	Voltage(V)
2-4	2	0.0-0.4
5-7	3	0.5-0.6
8-9	5	0.7
10-12	6	0.8
13-15	8	0.9
16-18	10	1
19-21	11	1.1
22-23	13	1.2
24-26	14	1.3
27-29	16	1.6-2

Table 1: Wind speed calculation

From the above table shows the wind speed calculations based on the output voltage of the 9V DC generator and the rotation of wind sensor cups. We calculated the wind speed in KMPH, when the rotation of the blade increases the output voltage and wind speed also get increases. The wind speed sensor used to measure the flow of wind.

B. Temperature of the Generator:

In the wind plant continuously we need to monitor the temperature of the generator. Because if the temperature increases the turbine section will get damage. For this purpose we go for temperature sensor like RTD, thermostat, LM35. In our project we chose the LM35 sensor to sense the heat dissipation of the generator.

1) Temperature Sensor Description:

The temperature sensor is that use substances of various physical properties with temperature variation of the sensor and let the temperature converted to electricity. These regularly change the physical properties of the main body temperature sensor is a core part of the temperature measuring instruments, and a wide variety. In accordance with the measurement method is divided into contact and non-contact two major categories, In accordance with the characteristics of sensor materials and electronic components into the thermal resistance and thermocouple.

2) LM35 Sensor:

a) Principle:

LM35 temperature sensor output voltage linear relationship between the Celsius temperature in ℃, output is 0V, for every 1℃increases in output voltage of 10mV.[5]

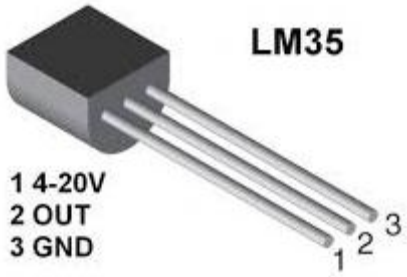

Fig. 2: LM35 temperature sensor

Out can be seen from experimental setup of temperature sensor, temperature sensor side is flat, and the other side is semicircular. Flat face of our own, the leftmost VCC pin, the middle of the GND pin VOUT, and the rightmost pin. In our project this sensor placed on the converter circuit to sense the temperature of the circuit. we didn't sense the temperature of the generator because it is difficult to interface the sensor in the wind turbine.

Fig. 3: DC Generator (12V)

3) Wind Temperature Calculation:

Sensed Temperature(°C)	Output Voltage
Room temperature(30)	0.29
31-32	0.31
33-34	0.32
35-36	0.33

Table 2: Wind Temperature Calculation:

The above table shows for each 1°C temperature rises causes 1mV output voltage increases.

We set the maximum temperature as 80°C if the converter circuit exceeds the maximum limit the alarm will get ON. From that we can control the temperature of the circuit.

VI. VIBRATION SENSOR

If the speed of the wind blade increases due to the increase in wind flow it will cause the noise in the plant or surroundings. It's very harmful to the birds and human being. To overcome these problem we need to control over the plant. For that purpose we use the NI-MYRIO as vibration sensor. The tool kit NI-MYRIO act as sensor. It has inside acceleration measurement tool and it measure the vibration caused by 3 axis.[2]

A. NI-MYRIO:

NI my-RIO uses the latest Zynq technology from Xilinx featuring an FPGA integrated with a processor running a real-time OS. This powerful technology coupled with an onboard accelerometer, programmable LEDs, audio I/O, analog and digital I/O, and USB port helps thousands of project ideas come to life. The NI my-RIO student-ready enclosure and academic pricing discount means students can work on their own hardware device inside or outside of the

classroom. With built-in Wi-Fi capability, students can wirelessly transfer data and deploy code.[2]

Fig. 4: NI-MYRIO

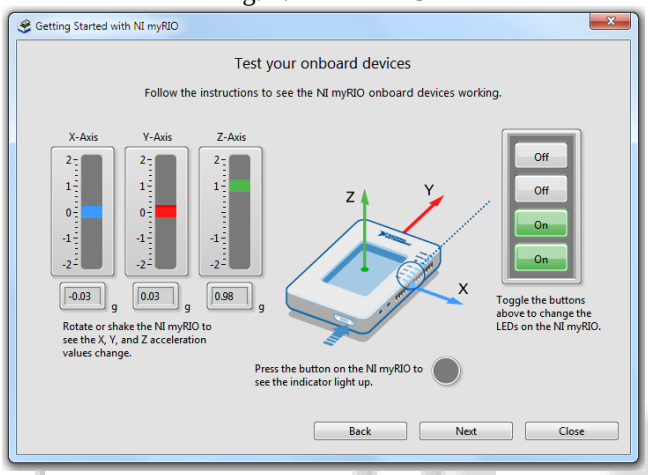

Fig. 5: 3 axis measurement by using NI-MYRIO

VII. Operation

The NI MY-RIO has 20 connectors the above discussed real time signals are acquired from the MY-RIO. Based on the output from the plant the program is developed by using LABVIEW software. Thus the output we can monitor from the software,[1] MY-RIO has Wi-Fi these connection are made. We monitor the plant activity from the control room. Based on the output we can control the plant in an efficient manner.

VIII. Conclusion

In this paper we discussed how to monitor and control the wind plant by using LABVIEW software and NI-MYRIO. And by using different types of sensor used in our project to monitor the output voltage, wind speed, generator temperature, vibration of the surroundings of the environment. By using these sensors we can overcome the problem cause by the plant. If we use these techniques in the home we can reduce the power demand.

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