Wind Plant Monitoring using LabVIEW through Myrio

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Abstract

In this paper we considered wind as a source of energy because it is a natural, renewable and available abundantly, does not have harmful effects on living beings. We measure the voltage produced by the wind mill, speed of the wind and temperature through my-RIO as an interface. There variables are acquired and monitored using Lab VIEW. We decided to determine the efficiency with these parameters. Here my-RIO serves as an interface between the windmill and pc.
Keywords: LabVIEW, NI-MYRIO, Hardware, Power Plant

I. INTRODUCTION

A. Wind:

Wind is a form of solar energy. Winds are formed by the uneven heating of the atmosphere by the sun, the abnormalities of the earth's surface, and the rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover.

Natural wind in the open air is a three-dimensional vector that has the directions of north, south, east and west in addition to vertical components and magnitude (i.e., wind speed). As the vertical component is ignored for most operational meteorological purposes, surface wind is practically considered as a two-dimensional vector. [1]Wind blowing over the earth's surface is turbulent, and is characterized by random fluctuations of speed and direction. This can be seen in smoke drifting from a chimney, for example, as it fluctuates from quick to slow and backward, right, left, up and down. This rapid fluctuation is called gusting.

Wind speed is classified into instantaneous and average types. The average wind speed is the average of the instantaneous wind speed over a ten-minute period. As described above, however, wind speed fluctuates continuously, and measured values of instantaneous wind speed are affected by anemometer response characteristics.[2] Defined below are some basic terms and units used in wind measurement, with a focus on those related to response characteristics that affect anemometer performance.

B. My-Rio:

LabVIEW is a graphical programming environment that can be used to quickly develop applications. The power of LabVIEW is in its ability to interface with thousands of devices and instruments using hundreds of built-in function libraries to help you accelerate development time and quickly acquire, analyze,[2] and present data. It features a 667 MHz dual-core ARM Cortex-A9 programmable processor and a customizable Xilinx field-programmable gate array (FPGA) .All Programmable system on a chip to unleash the power of NI Lab VIEW system design software both in a real-time application and on the FPGA level. NI my-RIO is a reconfigurable and reusable tool.

II. WIND TURBINE

Wind turbines are like aircraft propeller blades which work in moving air and power an electric generator that supplies an electric current. in simple state a wind turbine is the antonym of a fan which creates wind using electricity but the wind turbine uses wind in order to make electricity. The wind rotates the blades which is connected to a generator through a shaft which a generator, produces electricity. the turbine includes the horizontal-axis and the vertical-axis design turbines[3]

A. Turbine Components:

Horizontal turbine components includes a blade or rotor, which is used to convert the kinetic energy in to rotational shaft energy a drive train, usually including a gearbox and a generator which converts mechanical energy into electrical energy a tower that supports the rotor and drive train; and other equipment's.

III. WIND BLADE

In general the wind blade design depends on aerodynamic performance and opposing force of the blade. It also depends on various factors like blade shape, length, number of blades, pitch, and material etc. so considering all these factors we have to design the blade. There are two laws which make the blade to spin in the wind.[3] They are Newton's third law and Bernoulli Effect. We here choose blade material as foam and shape as curved. By running the windmill after installing all the components we acquire the data and compare it.

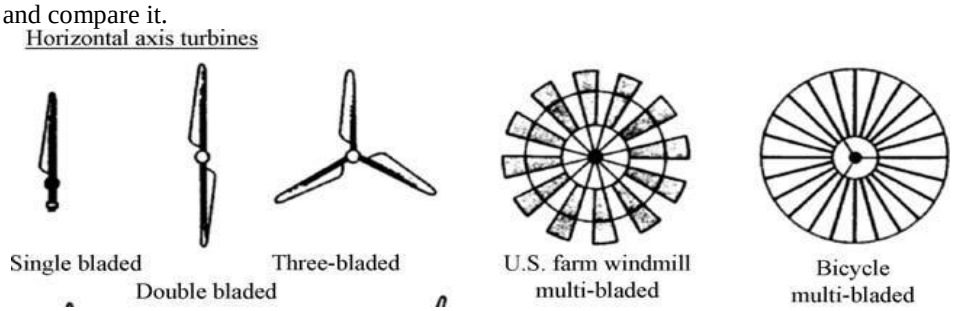

Fig. 1: Horizontal Axis Turbines

A. Drag:

Drag means the opposite force to the relative motion of the object with respect to the surrounding. The pressure distribution over the body surface exerts normal forces which, summed and projected into the free stream direction, represent the drag force due to pressure. The nature of these normal forces combines shock wave effects, vortex system generation effects and wake viscous mechanisms all together. When the viscosity effect over the pressure distribution is considered separately, the remaining drag force is called pressure (or form) drag. In the absence of viscosity, the pressure forces on the vehicle cancel each other and, hence, the drag is zero. Pressure drag is the dominant component in the case of vehicles with regions of separated flow, in which the pressure recovery is fairly ineffective. [4]The friction drag force, which is a tangential force on the aircraft surface, depends substantially on boundary layer configuration and viscosity. The calculated friction drag utilizes the x-projection of the viscous stress tensor evaluated on each discredited body surface. The sum of friction drag and pressure (form) drag is called viscous drag. This drag component takes into account the influence of viscosity. In a thermodynamic perspective, viscous effects represent irreversible phenomena and, therefore they create entropy. The calculated viscous drag use entropy changes to accurately predict the drag force.

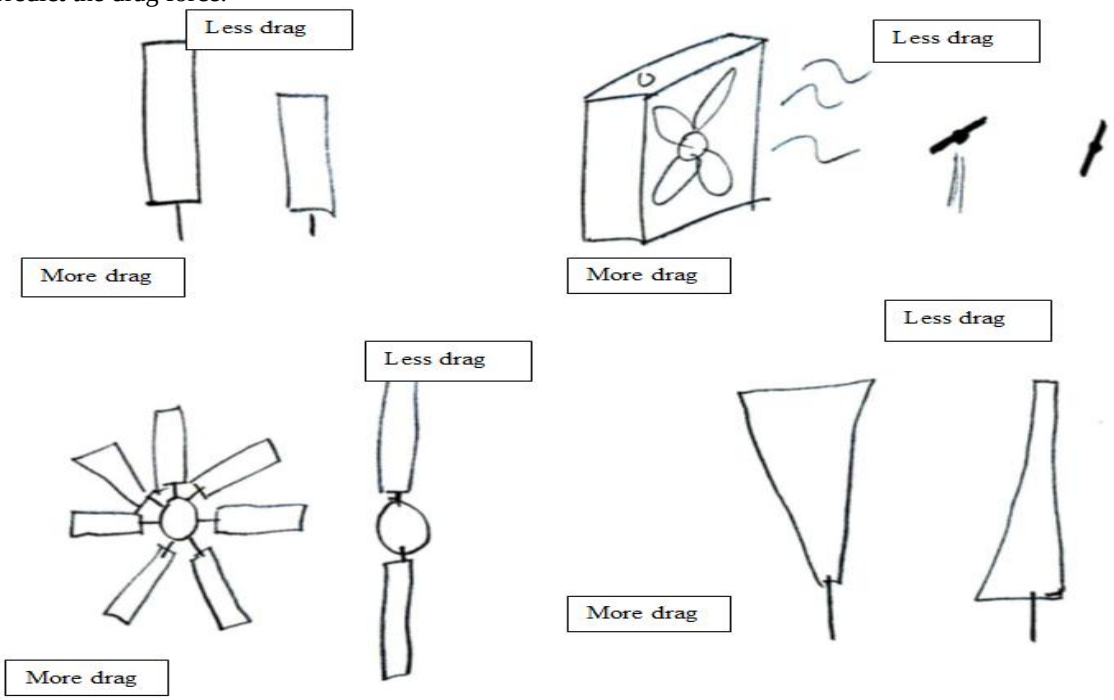

Fig. 2: Drag

IV. HARDWARE SETUP

The hardware we have includes a wind turbine from this output voltage is generated in accordance to the wind flow. Then the output is stored in the battery and also passed to my-RIO to view the real time data using Lab VIEW. An inverter circuit is used to convert 12V DC signal into 230VAC .After converting CFL bulb gets ignited at the same time this output voltage is used to power up the my-RIO.[4] If the wind speed exceeds the limit the alarm is set to ON in order to indicate the user. Then the temperature of the converter circuit is also measured to prevent the damage of the kit. The temperature is measured using LM35 sensor which is fixed on the converter circuit. If the temperature exceeds the limit the alarm is set to ON position.

V. BLOCK DIAGRAM

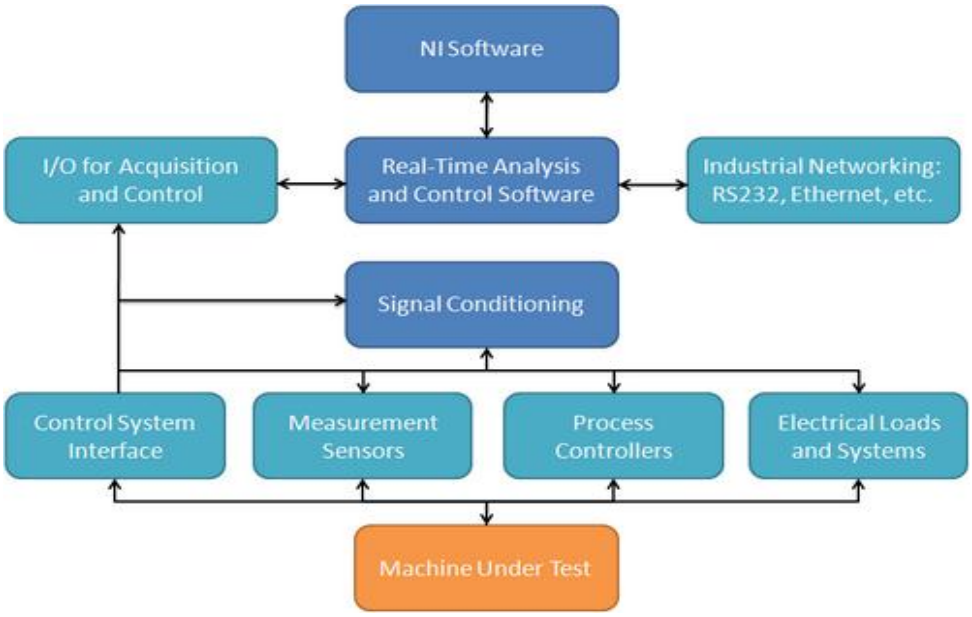

Fig. 3: Block Diagram

VI. SIMULATION

A. Front Panel:

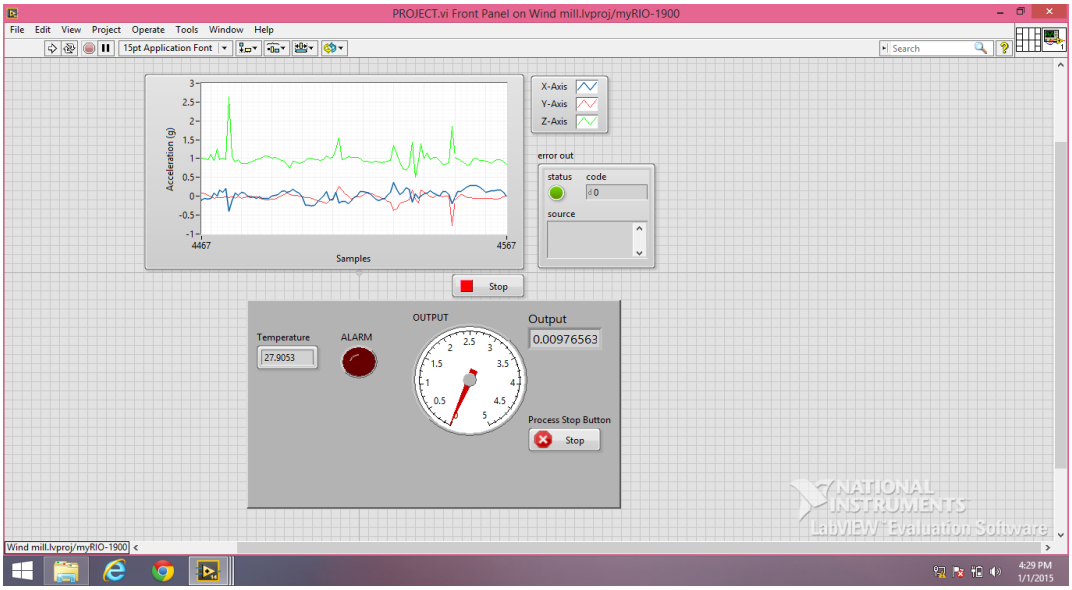

Fig. 4: Front Panel

VII. CALCULATION OF EFFICIENCY

This table shows the voltage range produced with respect to the revolutions and wind speed.

A. Tabulation:

Table – 1
Voltage range produced with respect to the revolutions and wind speed

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

VIII. CONCLUSION

During 2001, India produced around 1000 MW of wind energy making it the third largest user of wind energy in the world. For India, renewable energy production such as wind energy plays a vital role in supporting future generations and providing them with a source of clean, low cost electricity. The use of wind turbines globally is on the increase. The wind is there for everyone; it is renewable and reduces the costs of having to purchase expensive fossil fuels. It is said that between 2020 and 2050, fossil fuel demands will push prices higher than we have ever seen, hopefully this will be the next big step to the more widespread use of renewable energy sources. India is not just focusing on wind energy, and is currently investing in solar energy technologies due to the efficient location of India.

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