RESEARCH ARTICLE OPEN ACCESS

Design and Build Control Panel for Vertical Axis Wind Turbine Rotating at 700 RPM

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Abstract:

Wind turbines are the most widely used machines and are now being used across the globe for power generation. The emerging trends and the availability of intelligent technologies help us to satisfy the needs of the emerging world. World needs a constant renewable power supply to meet their energy demands. The model proposes an efficient real- time monitoring the fluctuations in the voltage, R. P. M and current and automate the process to cut the power supply according to the need. The system is accurate and provide the real time data. There are many systems that can detect different parameters in different procedures.

***Index Terms*—- Arduino, Power Generation, RPM, Vertical Axis Wind Turbine.**

I. INTRODUCTION

With populations increasing exponentially and our natural resources being strained by increases in demand, it is more important than ever to invest in renewable energy. Our consumption of fossil fuels as energy has been traced to be a leading cause in environmental issues. The by-product of fossil fuel consumption is carbon dioxide, which has been named to be a primary constituent leading to Global Warming. The amount of carbon dioxide that someone or something produces is known as its "carbon footprint." The media has been focusing on this issue and many green movements have started to try and reduce our "carbon footprint." (Green Student U, 2008) There are only a few types of energy that do not produce carbon dioxide. These are nuclear power and renewable energy sources such as wind, solar and hydro power. Renewable energy sources are the cleanest from of these sources, because there is no waste formed as by-products of these sources. Nuclear energy produces nuclear waste which could take up to but not limited to 100 years until it can be disposed of properly. Wind turbines have been used throughout the world to generate electricity from offshore wind farms to residential smaller scale wind turbines. (California Energy Commission, 2012). There are two main types of wind turbines. The two general categories for wind turbines include vertical axis or horizontal axis wind turbines. The turbines are classified upon how the shaft of the generator is mounted. The horizontal axis wind turbine HAWT was invented before the vertical axis wind turbine (VAWT), which led to its popularity and wide use. This project is an extension of previous work at WPI in MQP projects that focused upon VAWTs. The research in this project was intended to improve VAWT efficiency and maximize the energy generation from the wind's available power. This was done by considering alternate turbine designs adding a shroud around the wind turbine. The project researched blade designs that performed the best with a 90° enclosure. The enclosure is a shroud that surrounds the turbine and allows wind to enter the area at a 90° angle. The enclosure was expected to increase the turbine's revolutions as compared to a turbine without an enclosure. The project also entailed research into reducing the amount of vibration experienced by a roof caused by wind turbines. This was approached by variations of vibration dampening systems on the roof mounting system.

II. METHODOLOGY

The goal of the analysis is to save the power generating grid from overheating and miscalculations and eventually fail to generate power and can cause many more problems.

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Measuring RPM using the IR sensor

Arduino Tachometer - Using a Hall Effect Sensor (A3144) to Measure Rotations from a Fan. In engineering, a tachometer is a useful tool for calculating the rotational motion of a part. Tachometers read out revolutions per minute (RPM), which tells the user how often a rotating part completes one full rotation. Here the IR Sensor Module is used, which works as an obstacle detector. Infrared light does not reflect to the when a black surface is placed in front of it. As a result, the sensor doesn't detect anything, and the sensor output is high (1/+5v). When a white surface is placed in front of an infrared sensor, infrared light is reflected to the sensor. As a result, the sensor detects the surface and outputs Low (0/GND). This disc begins to rotate when the motor shaft begins to rotate. If we set the IR sensor in front of the disc this time, the IR sensor produces a square waveform as output. The IR sensor detection time changes the output square waveform. When the IR sensor detects the first positive edge marking the end of the white surface, the Arduino must start a counter and count the time until the IR sensor detects another positive pulse indicating the beginning of the white surface. The Arduino then compares the measure counters and calculates how long it takes the motor to complete one turn in microseconds. We divide one minute (60.000.000 us) by that value and get the RPM value using Arduino code. The RPM values are printed on the LCD display by the Arduino.

III. BLOCK DIAGRAM

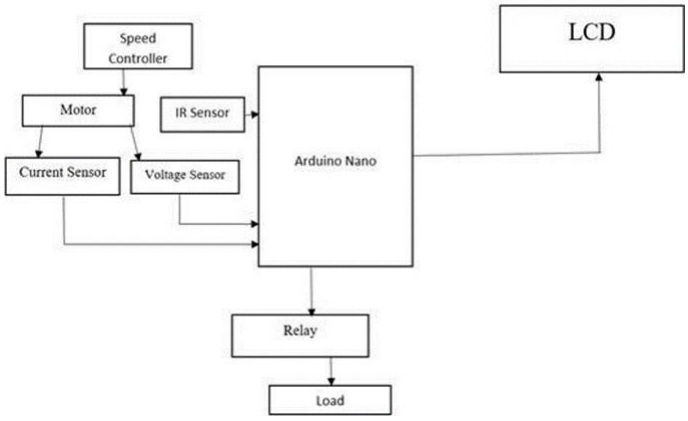


Fig. 1. Block diagram of the control panel used to measure the current and voltage.

IV. RESULTS AND CONCLUSION

Table. 1. Readings Measured for Current and Voltage

RPM	VOLTAGE (Volts)	CURRENT (Milli Amps)	WHETHER ENERGY CUT-OFF (YES/NO)
126	1.61	41.57	NO
132	1.16	47.52	NO
155	1.59	100.76	NO
195	2.30	118.61	NO
282	3.57	166.24	NO
298	3.73	184.03	NO
299	3.83	192.81	NO
333	4.53	228.44	NO
356	4.77	237.38	NO
431	5.87	287.83	NO
465	5.84	293.73	NO
477	5.82	296.64	NO
500	6.33	299.14	NO
512	6.14	316.87	NO
604	6.43	332.32	NO
667	6.96	331.66	NO
673	6.95	452.42	NO
700	0.07	906.22	YES

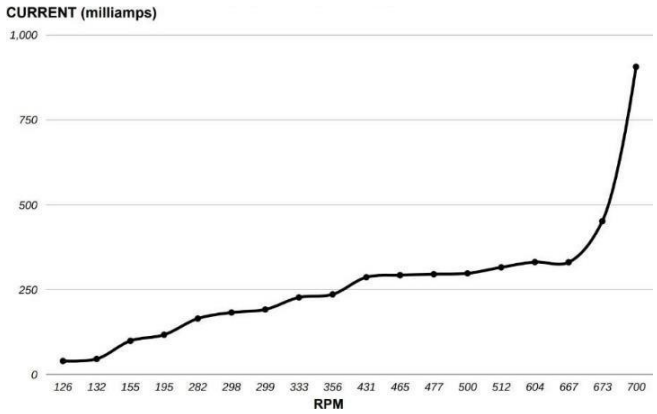
It successfully cut-off the power supply above 700 RPM and provided the measured voltage and current throughout the range. In the table below, it is clearly seen in the table below, it is clearly seen that according to measured rpm the corresponding voltage and current is measured by the control module that is Arduino nano, the energy has been cut off or not. And the rpm above 700 will not be

calculated according to RPM Above 700 will not be able to generate the energy as it will damage the grid and in table also at rpm 661 as measured the energy is generated by the turbine but as rpm goes above the mark of 700 the Arduino will cut-off the turbine and grid making it loosely rotating not generating any electricity.

V. RELATIONSHIP BETWEEN THE CURRENT AND RPM

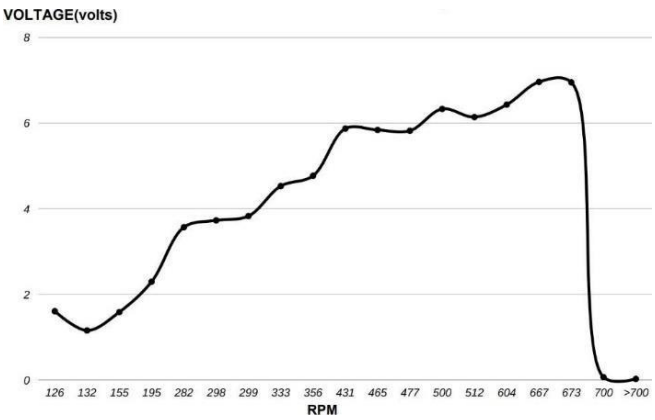
As we can clearly see in the graph as the rpm is increasing the current is also following until the threshold of 700 RPM after which the current is shoot up which indirectly means that the power generation is no longer active.

A. RPM vs. current



Graph. 1. Relationship between the RPM and Current

B. RPM VS. VOLTAGE



Graph. 2. Relationship between the RPM and Current

It is clearly seen that the voltage is dropped after the RPM is reached its threshold i.e., 700 RPM which is the highest it should reach otherwise after that the grid and power generation will be affected.

VI. CONCLUSIONS

The emerging trends and the availability of intelligent technologies help us to satisfy the needs of the emerging world. World needs a constant renewable power supply to meet their energy demands. The model proposes an efficient real-time monitoring the fluctuations in the voltage, R. P. M and current and automate the process to cut the power supply according to the need. The system is accurate and provide the real time data. Thus, it makes it easier to deploy our model to embedded systems like Arduino, etc. There are many systems that can detect different parameters in different procedures. This approach will reduce the damage to different appliances due to the excess current.

VII. FUTURE SCOPE

Nowadays due to pollution renewable energy is the future of humanity. It will reduce the chances of the hardware failure as it will disconnect the power supply. By increasing the R.P.M of maximum power, it will maximize the output. The VAWT technology is sliding into the use in small generating installations, especially in urban environments that currently have winds that are not exploited. There are studies about the omnidirectional-guide-vane which make power, speed and torque increase markedly in these sorts of environments. Employing Wind VAWT in / PV hybrid power generation system can be the solution at many locations since the cost of this system is lower than the use of both individual technologies.

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