Renewable Energy Lab for Wind & Solar Power System Analysis

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ABSTRACT

Renewable energy resources used to produce electric energy, significantly lower CO_2 emissions by substituting non-renewable resource based power generators. Our investigation hopes to support the use of these renewable energy resources by characterizing a vertical wind turbine whose study will be described through the following content.

The turbine was studied with the main objective of characterizing the turbine by acquiring data manually, then comparing the data with the manufacturer's data sheet, and finally finding a method in which the data acquisition procedure could be automized. First the lab equipment was evaluated and some of the equipment was found to be damaged. Consequentially, new equipment was bought and the manual data acquisition phase was started. The turbine's characteristics were studied with and without load. After manually obtaining the voltage and current output of the wind turbine for different wind speeds the turbine's power curve was successfully obtained.

Finally, the next step was to automize the data acquisition procedure which was done through an Elegoo Mega 2560 microprocessor and Arduino sensors. Once the Arduino sensors were implemented, an interface to view the data that was being captured by the microprocessor was developed. The final interface was designed with LabView.

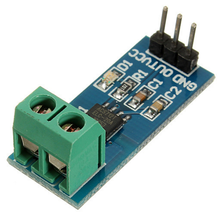
OBJETIVES

- Characterizing the vertical wind power system
- Renewable energy systems integration
- Develop an automatic data acquisition System

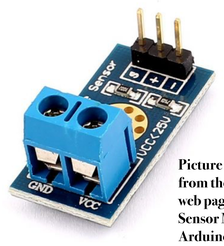
METHODOLOGY

This part will show the steps and the equipment that were used to achieve the results. You will find photos, diagrams and brief descriptions that will help you understand the material in an easier way.

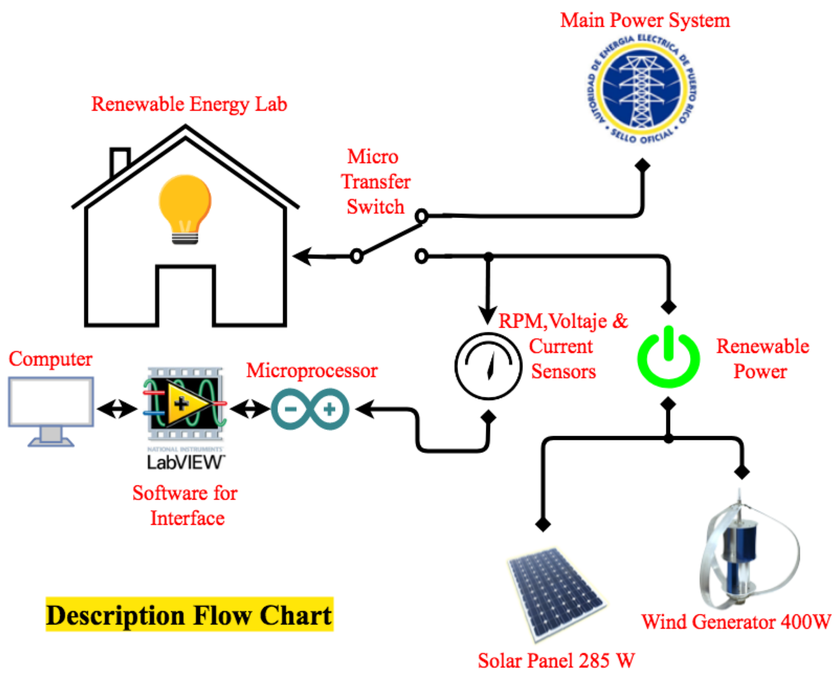
Picture taken from the Amazon web page, SunFounder Switch Hall Sensor Module for Arduino and Raspberry Pi



Picture taken from the Amazon web page, Current Sensor Module for Arduino



Picture taken from the Amazon web page, Voltage Sensor Module for Arduino.



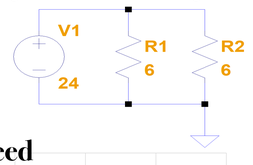
The sensors were a key element in the automation of the data collection. Each sensor communicated with the Arduino in order to send the information to the computer. In the diagram above, you can see the configuration that was used, however, it is important to mention that the sensors are represented by a clock symbol. The micro transfer is a three way switch which allows the selection of the different types of available power.

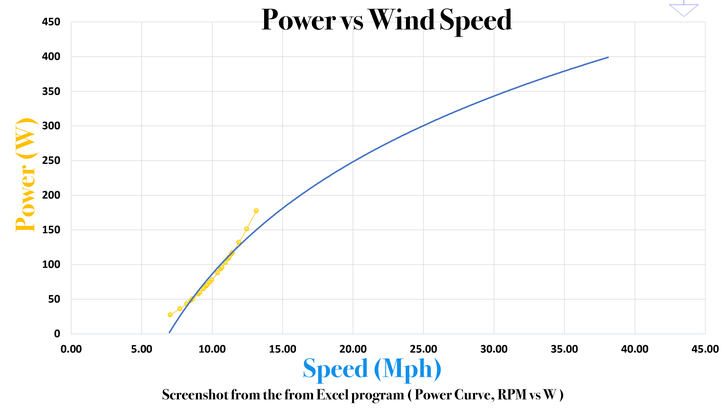
DATA

Formula use to get the velocity for the graph below

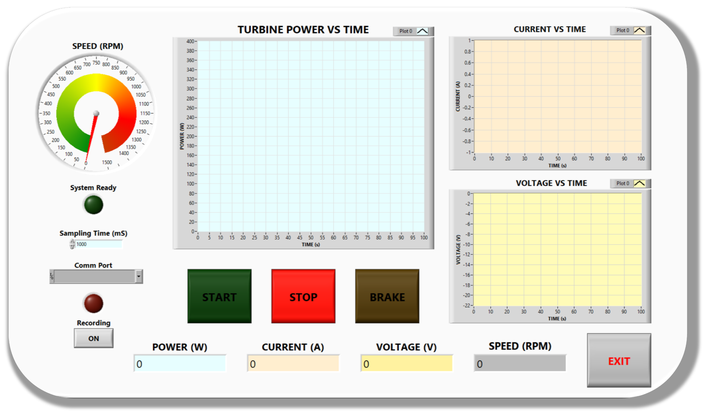
$$P = \frac{1}{2}\rho A V^3 \rightarrow V = \sqrt[3]{\frac{2P}{\rho A}}$$

Screenshot from the Ltspice computer software (simulation program for new resistor and voltage schematic).





Screenshot from the from Excel program (Power Curve, RPM vs W)



Picture from Labview, this photo was taken in order to show how Labview display may look at the final .

ANALYSIS AND RESULT

The main protagonist in our research was the reading that the Arduino, in collaboration with LabVIEW, gave us. This Reading gave us the edge, on the exact behavior of our system. We as a group can say that there can be less than a 5% of error regarding our end result and that, can be because to the precision of the PWM Controller.

CONCLUSIONS

It's safe to say that, all the components that were improved on the laboratory were a complete success. The lectures of the Arduino were 100% percent efficient. The installation of the luminary where applied to both rooms following the NEC. Lastly but no less important, the integration of the solar panel gave us a breakthrough in the charge of our new battery band and that made our new innovative system. Like every investigation, there are always things that can be improved on like The temperature and humidity sensor and the integration of such device to the vertical curtains.

FUTURE WORK

- Create a smart curtain for stabilize room temperature
- Energy savings calculation
- Update LabVIEW and add new sensors for solar panels measurements

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