ENERGY BOT (FREE AND CLEAN ENERGY) WIND TURBINE OF LOW POWER FOR THE AREA OF SAN JUAN DE LURIGANCHO - JUAN PABLO II

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INTRODUCTION

In Peru and other countries in the region, imposing increasingly convinced that renewable energies (wind, solar, hydro and biomass), medium term are the only viable alternative and sustainable electricity generation time for a large segment of the rural population.

There are experiences and great tradition with wind energy in our country and has achieved great use in pumping water, but not in power generation, which has attempted the introduction of commercial equipment or imported or local imitations unresponsive the reality of our winds and infrastructure services.

The project addresses the design of a wind turbine low power for rural areas of San Juan de Lurigancho - Juan Pablo II (areas of extreme poverty and less development) focus on the study of winds times in these zones and will be designed and implemented by the engagement team, teachers and students. Only purchase electrical generator and some accessories is necessary.

The proposal will allow substantially lower capital investment and put the team within reach of low-income populations, as proposed in this project.

Concern was left to other teams and teachers of our country to follow the example of Energybot project and continue working on other proposals that help in improving the quality of life of the neediest populations of Peru.

With the data obtained during the test of DC generator, you can check some data theoretically calculated and shown to effectively consumable generates electricity with a capacity of approximately 65watts.

It also concludes that the prototype is made as close to a scale model of a real wind turbine that meets the rigorous requirements of engineering design and most important it is feasible, non-polluting and have a positive environmental impact

SUMMARY

Called Energybot as it is a model of device that converts kinetic energy of wind into mechanical energy and then into electrical energy, the wind should be soft and have a speed of 3m / s to overcome the total torque (rotor system - blades) and to rotate the rotor then by the same inertia of the blades becomes simpler movement.

The wind at that speed and being a fluid has kinetic energy which upon impact with the blades at an angle suitable incidence is transformed into mechanical energy, which you can only take advantage of the 59% maximum, according to the law of Betz then this mechanical energy of the blades is transmitted through the rotor to the generator to produce an induced electromotive force is demonstrated by Faraday's law; this is evidenced as a potential difference is a voltage, which we store in batteries for later use in different applications, then storing it in batteries (voltage dc) make use of a voltage inverter that is convert that DC voltage in voltage alternative as it is this type of voltage which are in our homes and everyday use, then these variables can be displayed on our dashboard.

PRESENTATION OF THE PROBLEM

Due to scarce resources in areas of low economic solvency and development (marginal urban areas), to this lack of basic services such as electricity, drinking water, sewage and others it adds.

Arises the need to find an alternative way to compensate, and most importantly that it is accessible and available to everyone in that area, because people know how are you use candles, kerosene lamps, lighters to light up what has caused fires and misfortunes.

OBJECTIVES

Design and manufacture a device that mitigates these needs using engineering for the benefit of people without disrupting the ecosystem.

Encouraging the spirit of research, raise the level of knowledge and practice of students in simple, didactic and without losing academic rigor required to study the same way.

Consolidate the knowledge learned in the areas of mathematics, statistics, geography, ecology, economy, dynamic resistance of materials, materials science, mechanical drawing, mechanical vibration, digital and power electronics, through a study integrated these areas doomed to this project.

DESCRIPTION OF THE SOLUTION

The main parts of a wind turbine are the engine, gearbox, generator, tower and control system. Looking at operating turbines can see that the moving speed of the propeller is very slow, but by the gearbox that slow blade speed becomes fast speed to feed the generator.

Most modern wind turbines are three helices, with horizontal axis and electrical mechanisms. The steering mechanism of a wind turbine is used to turn the turbine rotor for maximum performance or to protect against dangerous winds.

Statistical study:

Taking an anemometer data for a number of hours, for a period of six months and considering the effects of temperature, pressure and seasons we get this sample, but also taken as reference base and support the wind map Peru obtained through the SENAMHI.

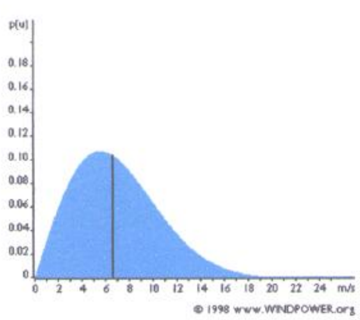

Figure 1: Distribution of Weybull

To model this shows wind speed used Weybull Distribution and thereby obtain the wind speed limits and variations thereof and with which we can begin with the design of the parts.

We can see that the speeds will be:

Geographical study:

Characteristics of the selected place:

- Selected Area: San Juan de Lurigancho Juan- Pablo II (3rd, 4th and 5th zone)
- Altitude: 480 m.s.n.m.
- Humidity: 88%
- Temperature: [15 ° C-26 ° C]
- Terrain roughness: 0.001 m
- Anemometer location Height: 1 meter
- Turbulence: None
- Measurement type: Ongoing
- Land type: Flat type plateau.
- Hours of measurement made: 400 hours

Figure 2. Study area

Design parameters:

Either propeller of a wind turbine windmill or aircraft comprises a number of blades. For our project will use the Danish tripalar concept. The most important reason is the stability of the generator. A rotor with an odd number of blades (and at least three blades) can be regarded as a disc when calculating the dynamic properties of the machine.

A rotor with an even number of blades can give stability problems on a machine that has a rigid structure. The reason is that at the very moment when the uppermost blade bends backwards, because it gets the maximum power from the wind, the lower blade passes into the wind shade in front of the tower (you can produce a moment respect and dump away from the wind turbine rotor).

It is the section of a blade located at the distance r from the rotation axis whose pitch angle is α

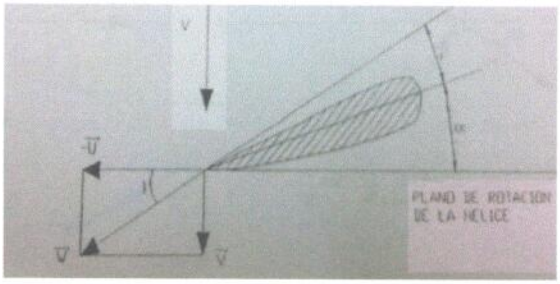

Figure 3. Analysis of blade section

- ✓ Support: The aerodynamic resultant force in the direction normal to the free stream due to the combined effect of the static pressures acting normal to the surfaces.
- ✓ Drag: The aerodynamic resultant force in the direction parallel to the free stream due to the stresses of viscous shear effect integrated static pressures acting normal to the surfaces and the influence of vortices behind the aerodynamic center of the airfoil.
- ✓ AIRFOIL: The shape of the wing in two dimensions in the X and Z axes The aerodynamic profile of the wing have characteristic features such as its angle of attack (α), the maximum lift coefficient (climax), the time of the aerodynamic center (that Cmα point where = 0), Cl of least resistance and viscous. The test data of a two dimensional aerofoil are obtained in a wind tunnel by extending the wing span through the tunnel and prevent the formation of vortices at the tip leakage (essentially an infinite aspect ratio wing induced zero resistance). 2D the aerodynamic coefficients of lift, drag and moment are denoted by lowercase letters (ie, Cl, Cd and Cm).
- ✓ Reynolds number: This is a dimensionless number which is an important parameter and is the similarity ratio of inertial forces to viscous forces and is a function of density (ρ) wind speed (V), the resulting viscosity (μ) and a characteristic length that is the mean aerodynamic chord (L).

Equations

In the aerodynamic study of an object it holds that the following

$$\mathrm{Re} = \frac{\rho v L}{\mu} \qquad (1)$$

$$C_L = \frac{L}{\frac{1}{2}\rho V_\infty^2 S} \qquad (2)$$

$$C_D = \frac{D}{\frac{1}{2}\rho V_\infty^2 S} \qquad (3)$$

$$mg = C_L \frac{\rho}{2} S v^2 \qquad (4)$$

$$T = C_D \frac{\rho}{2} S v^2 \qquad (5)$$

$$v = \sqrt{\frac{2mg}{C_L \rho S}} \qquad (6)$$

$$P_{lev} = T * v = \frac{C_D}{C_L^{3/2}} \sqrt{\frac{(mg)^3}{S}} * \sqrt{\frac{2}{\rho}} \qquad (7)$$

$$P_{lev} = \frac{C_D}{C_L^{3/2}} \sqrt{\frac{2ARg^3}{\rho}} * \frac{m^{3/2}}{b} \qquad (8)$$

If we take account of a viscous incompressible fluid but in our analysis of the airfoil, then ρ can be considered constant (as in a liquid) and the Navier-Stokes equations of conservation of mass

$$\frac{\partial(v_x)}{\partial x} + \frac{\partial(v_y)}{\partial y} + \frac{\partial(v_z)}{\partial z} = 0 \qquad (9)$$

And conservation equation of motion is as follows:

$$\rho(\frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} + v_z \frac{\partial v_x}{\partial z}) = \mu(\frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_x}{\partial y^2} + \frac{\partial^2 v_x}{\partial z^2}) - \frac{\partial P}{\partial x} + \rho f_x \qquad (10)$$

$$\rho(\frac{\partial v_x}{\partial t} + v_x \frac{\partial v_y}{\partial x} + v_y \frac{\partial v_y}{\partial y} + v_z \frac{\partial v_y}{\partial z}) = \mu(\frac{\partial^2 v_y}{\partial x^2} + \frac{\partial^2 v_y}{\partial y^2} + \frac{\partial^2 v_y}{\partial z^2}) - \frac{\partial P}{\partial y} + \rho f_y \quad (11)$$

$$\rho(\frac{\partial v_z}{\partial t} + v_x \frac{\partial v_z}{\partial x} + v_y \frac{\partial v_z}{\partial y} + v_z \frac{\partial v_z}{\partial z}) = \mu(\frac{\partial^2 v_z}{\partial x^2} + \frac{\partial^2 v_z}{\partial y^2} + \frac{\partial^2 v_z}{\partial z^2}) - \frac{\partial P}{\partial z} + \rho f_z \quad (12)$$

Basic formula for calculating width and length of the blades

a) According Betz's theory, the total axial thrust on the whole of the wind is equal to:

$$F_A = \frac{\rho A}{2}\left(V_1^2 - V_2^2\right)$$

b) V being the speed of the wind through the wind: a:

$$V = \frac{V_1 + V_2}{2}$$

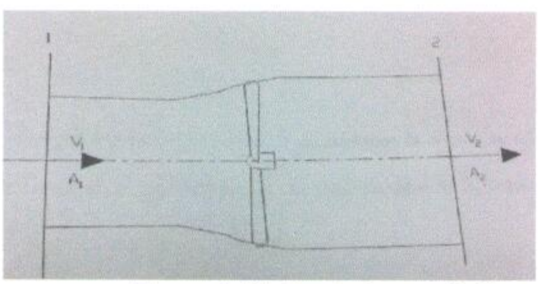

Figure 4. Air flow before and after

$$C_L pl = \frac{16\pi}{9} \frac{r}{\lambda\sqrt{\lambda^2 + \frac{4}{9}}} \qquad \mathrm{cotgI} = \frac{3\lambda_0 r}{2R}$$

Where:

λ_0 : Specific speed at the blade tip

$$\lambda_0 = wR / V_1$$

$$\lambda = \lambda_0 r / R$$

p: number of blades

l: length of the blade

Replacing obtain data

- R=20.5cm
- r=1.5cm
- L=19cm
- Width =4.6cm
- p=3

RESULTS

- Calculations and Results
- According to the experiment could compare and verify the following:
- Engine Features
- Motor 12v DC
- Motor current 3A
- Motor starting voltage: 3 V
- Starting current output: 0.40A
- Starting time: 3s
- Minimum wind speed: 5m / s
- Maximum wind speed: 15m / s

	Time	Voltage	Current	Wind speed
Test 1	20 s	5V	0.55 A	5 m/s
Test 2	60 s	6 V	0.60A	7 m/s
Test 3	180 s	5 .6V	0.60A	7 m/s
Test 4	240 s	6.50 V	0.70 A	10 m/s
Test 5	300 s	7.2 V	0.80 A	11 m/s
Test 6	40s	7.4V	0.80A	13m/s
Test 7	50s	7.5V	0.95A	14m/s
Test 8	30s	8V	1.3A	15m/s
Test 9	25s	8V	1.4A	15m/s
Test 10	20s	11V	2.7A	16m/s

Analysis of Power - Family Consumption

- ✓ turbine power:
- ✓ 3 Battery used: 4V - 4A
- ✓ average Output power: 20W
- ✓ Charging time Battery: 8 hours

Family analysis

With batteries in series then get 12V-4A by the investor we obtain: 220V-460W.

Yielding 2 20 wa saving bulbs 40W each family would c / u then 460W / 40W = 11 families

As seen in the table above it has been transcribed 10 trials the most consistent possible to reality (there were some who threw us values that are fictional, these results to external agents such as impedance control system, should the error rate in the design of each machine and sometimes human error, which results in variation in the data.

	Detalle de Consumo	Consumo-Promedio	Total
1 Family	2 focos ahorradores 22w c/u	44w	44W
10 Family's	2 focos ahorradores 22w c/u	10(44W)	440W

There were times we could not get much in the study sites so that the need to ask the following question arises: What happens if there is no wind as our device will generate the energy needed without the driving force necessary triggering our system praise-dome is why after a thorough and several meetings we conclude that if you can get energy analysis, even if there is no need to wind beneath our system praise-dome is where is technological innovation and opted to replace this praise-dome system for motive power system similar to that used by bicycles.

CONCLUSIONS

Given that is a scale prototype can see that actually achieves its goals.

We can conclude that this project is viable social interest because it produces 8V 1A and at a low cost. Energybot work 10 hours a day so that our system of energy production, stored in a battery and with the help of our power inverter 450W obtain enough power to keep 11 families (2 bulbs 20w c / u).

Our scale model does the job of converting wind energy into electricity, with small economic costs compared with other large investment projects. It should be noted that the power is not very high due to the characteristics of the engine and also by the size of our prototype.

This type of generators has quickly become popular to be considered a clean source of renewable energy because they do not require, for energy production, combustion residues or contaminants producing gases implicated in global warming. Onshore wind (onshore) is the second cleaner energy after hydropower, with 12 g of CO_2 per kWh, compared to 4 hydropower, energy 16 22 nuclear or solar thermal.

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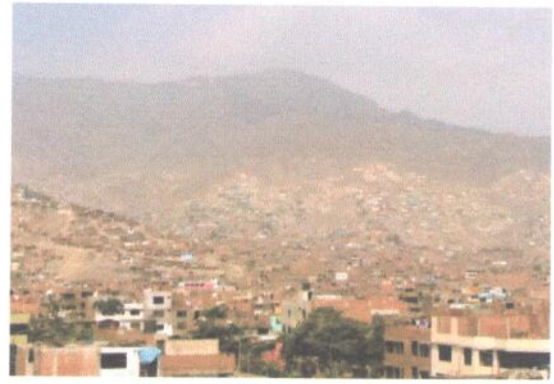
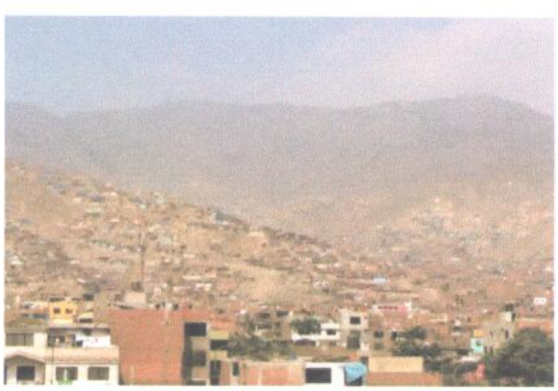


ANEXOS

1. Study photos of the area



2. Wind turbine Photos