

GENERATION OF WIND POWER USING HELICAL STRUCTURED BLADES BY THE CONCEPT OF “WIND TREE”

VIVEK R. RAUT

Department of Electrical, DBACER, Nagpur, India, vivekrautphw@gmail.com

SAYLI S. DHANDE

Department of Electrical, DBACER, Nagpur, India, sayli.dhande30@gmail.com

ROHIT H. JAMBHULKAR

Department of Electrical, DBACER, Nagpur, India, rohitjam76@gmail.com

ABSTRACT:

Power requirements of the world are ever increasing. In order to fulfill these, it is essential to discover new energy sources or rather improvise the existing techniques for extracting maximum energy. The Wind tree is a concept that uses a helical blade (VAWT) for generation of electric power. The helical blade is Omni-directional which means it is capable of rotating irrespective of the wind flow. The project aims at generating electricity by means of small wafts of air that circulate around the buildings and streets. Despite of the wind being fluctuating in nature; the turbine is capable of generating electricity, as a small waft of air is sufficient to rotate this turbine.

KEYWORDS: Wind turbine, Helical Blades, Omni-directional, VAWT, Generation.

BETZ'S LAW:

Before you begin to format your paper, According to Betz's law, no turbine can capture more than 16/27 (59.3%) of the kinetic energy in wind. The factor 16/27 (0.593) is known as Betz's coefficient. Practical utility-scale wind turbines achieve at peak 75% to 80% of the Betz limit. The Betz limit is based on an open disk actuator. If a diffuser is used to collect additional wind flow and direct it through the turbine, more energy can be extracted, but the limit still applies to the cross-section of the entire structure. The power of the wind is proportional to air density, area of the segment of wind being considered, and the natural wind speed. The relationships between the above variables are provided in equation,

$$P_w = \frac{1}{2} \rho A u^3.$$

I. INTRODUCTION:

Wind is considered as the fastest growing clean energy source which is readily available. The concept of wind tree is unique in itself the turbines are sculpted in the form of an artificial tree. It aims at utilizing the low winds that circulate around buildings and streets. The artificial Aeroleafs serving as microturbines spin on a vertical axis and is capable of harnessing more gentle winds. The turbine being small and light in weight are set in motion by winds as light as 4.4 miles/hr. The Betz's law calculates the maximum power that can be extracted from the wind, independent of the design of a wind turbine. According to Betz's law, no turbine can capture more than 59.3% of the kinetic energy in wind. Betz law explains that power extracted from wind energy is directly proportional to the cube of wind velocity.

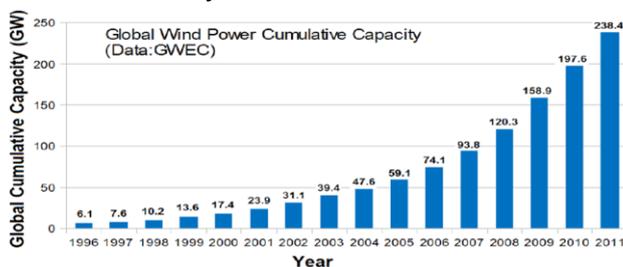


Figure 1. Global Wind Data

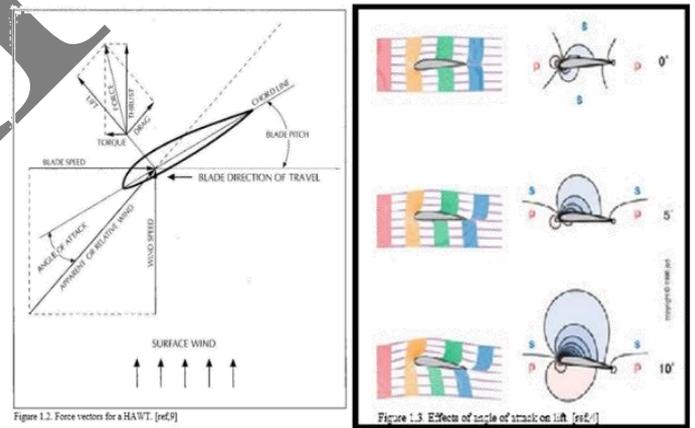
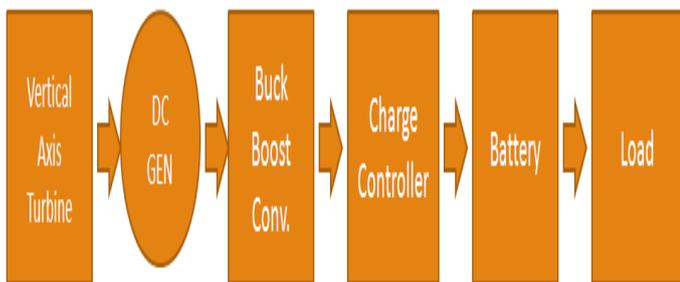


Figure 2. Betz's law

II. BACKGROUND STUDY:

The idea of creating an electrical power generating system in the form of a tree, with each leaf as an actual mini wind turbine. Capturing low wind speeds and turbulence is at the crux of this novel approach which can deliver power and autonomy simply through a proliferation of leaves. It is the first human-scale biomimetic wind turbine capable of recreating a sympathetic bond between the consumer and their means of power generation.

III. SYSTEM BLOCK DIAGRAM:



IV. HELICAL BLADES:

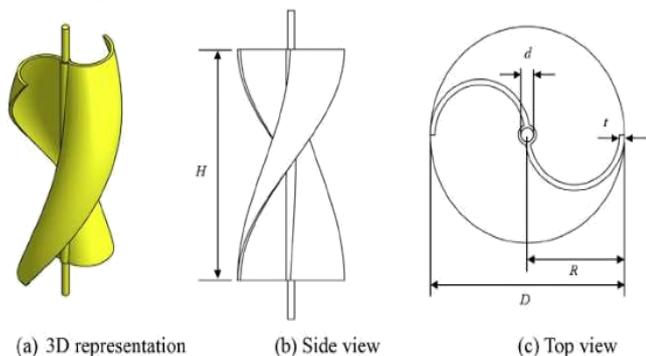


Figure 3. Helical blades views

V. DC GENERATOR:



Specifications:
 Type: Coreless
 Rated Output Voltage: 3V-48V DC.
 Maximum Speed: 5000 rpm.
 Rated Torque: 2.1 N-m.
 Noiseless.

Figure 4. DC Series Generator

VI. CONTROL UNIT:

Control unit helps to store electrical energy by charging the battery as well as supplying power to load using the wind energy thus resulting in maximum wind power utilization during charging mode. Control unit checks for the main generated voltage and the battery voltage. If generation is ON, supply is directed to battery and it is charged. If generation is OFF, then battery is charged using wind tree. In case of no main supply, load is switched ON, which uses the voltage from battery. The battery voltage is checked continuously and shown in display. If it goes less than a 8V battery indication is shown and the load is turned OFF. The control circuits is a microcontroller kit programmed in embedded C. The control circuit consists of LDR, so that the lighting load will be switched OFF during day and the LDR is connected to relay to trip the load from battery.

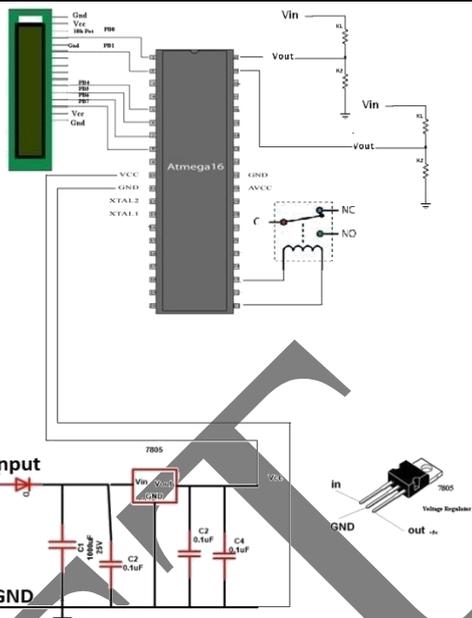
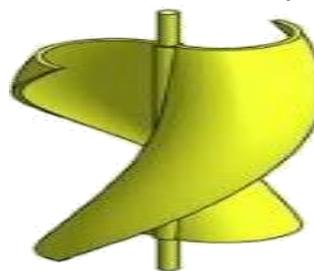


Figure 5. Control Circuit Pin Diagram

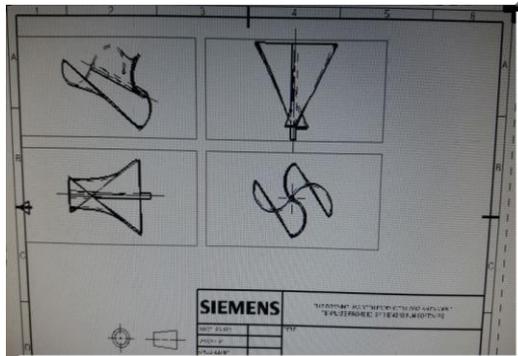
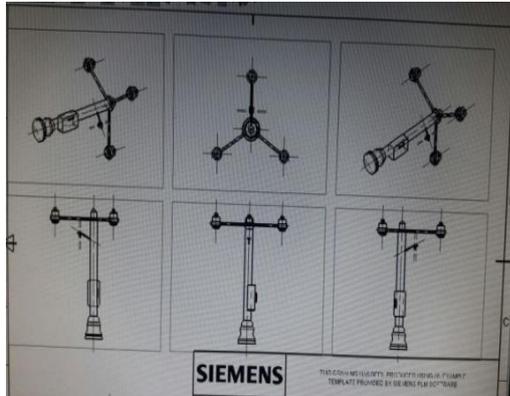
VII. SYSTEM WORKING:

The design of wind tree is capable of extracting maximum kinetic energy from the wind owing to the structured blade design. The helical structured blades are used for this purpose wherein the blades are positioned vertically or transverse to the axis of rotation. These turbines are independent of the direction of fluid flow, thus making it possible for them to rotate even at low velocity of air. The helical structured blade is considered the most efficient owing to its unique design and a lighter weight enabling a smooth flow of air throughout. The unique blade design rotates the turbine even by small wafts of air.



A gearbox is attached between the blade and generator in order to increase the number of rotations and enables the system to work smoothly. A coreless DC generator having rated output of 3-48V and maximum speed of 5000 rpm is used that has good efficiency even at low rotations. A buck boost converter is connected to the DC generator which helps in providing a regulated DC output voltage from either a Vin or a Vout. A battery is used to store the generated power. A charge controller is connected to the battery in order to protect it from over charging and to stop the reverse flow of current. A suitable load is attached to the battery in case of overcharging.

VIII. PROPOSED DESIGN OF SYSTEM:



IX. SYSTEM PROTOTYPE:



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CONCLUSIONS:

Hence we have come to the conclusion that there is still a lot of scope of energy production with the help of wind turbines. With better design and increasing the number of turbines along with some advanced technology it is possible to implement this project on a large scale. It would not only solve the problem of energy crisis to a great extent but would also give a landscape view to the city. We highly recommend these wind trees alongside the streets in order to save electricity required for the street load. By further increasing the height and the number of turbines, it is possible to light up an entire building with the help of these wind trees. Even though the wind being fluctuating in nature, it is constantly available 24*7 which makes it a more reliable option than the solar panels. The test result obtained ranged between 12-23V, and can be improved by précised design of areoleafs.

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