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Electricity Generation by Vertical Axis Turbine

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Abstract: ***Wind energy is the kinetic energy associated with movement of large masses of air. These motions result from uneven heating of atmosphere by sun creating temperature, density, pressure differences. It is an indirect form of solar energy The device used to convert kinetic energy of wind into electrical power is called a wind turbine. Vertical Axis wind power generators, represent a very promising future for wind power generation. In present study an attempt is made to utilize at low velocity wind below 4m/s for useful power generation using magnetic levitation for vertical axis wind turbine (VAWT) termed as Maglev turbine. A single large Maglev turbine can give output more than conventional horizontal axis wind turbine (HAWT). The rotor that is designed to harness enough air to rotate the shaft at low and high wind speeds while keeping the center of mass closer to the base of yielding stability due to Maglev effect. The efficiency of turbine is increased by replacing the conventional bearings by magnets in repulsion; the magnetic levitation helps the turbine to spin at much faster rate as it eliminates the stresses on the shaft of turbine. The major components are placed at the ground level which ensures the safety of turbine.***

I. INTRODUCTION

VAWTs are a type of wind turbine which were first designed by Croatian inventor, Fausto Verjo
In 1595. The main rotor shaft is set transverse to the wind while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located Close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind-sensing and orientation mechanisms.
Horizontal Axis Wind Turbine (HAWT): -
HAWT have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator.

II. LITERATURE REVIEW

Information of the Wind turbines and deflectors were collected and we selected vertical axis wind turbine for our project. Because of that, they can be packed closer together in wind farms, allowing more in a given space, they are quiet in operation, they produce lower forces on the support structure and especially they do not require as much wind to generate power. There are two types of Vertical Axis Wind Turbine.
They are,

- Darrieus Wind Turbine
- Savonius Wind Turbine

There are lots of thing to explore about the wind turbines. We will do as much as possible.

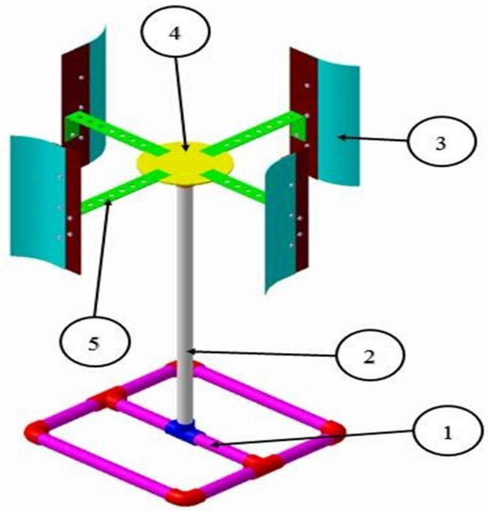
III. DESIGN OF VERTICAL AXIS WIND TURBINE

The main components of the vertical wind turbine are:

1) *Aero Foil Blades:* The standard forms of all aero foils were proposed by National Advisory Committee for Aeronautics (NACA) which is now known as NASA. It is given as NACA „x1x2x3x4". Where „first digit x1" describes maximum camber as percentage of the chord length, the „second digit x2" describes the distance of maximum camber from the aero foil leading edge in tens of percent of the chord and „the last two x3x4" describe maximum thickness of the aero foil as percent of the chord.
2) *Radial Arms:* Plywood was chosen as a material for this component as the strength required here is relatively high. So, two pieces of 9 mm thickness having dimensions as 50 cm x 40 cm were chosen as a raw material. Then by using a reference radial arm diagram drawn on a blank sheet, the arms were cut into the required shape from the pieces by using Zig-Zag machine.

3) *Shaft:* Shaft is a rotating machine element which is used to transmit power from one source to another. The power is delivered to the shaft by some tangential force and the resultant torque set up within the shaft permits the power to be transferred to various machines linked up to the shaft. In this project, an aluminium shafts used. Shaft is designed on the basis of "Maximum Shear Stress Theory" The shaft is usually circular, but may be square or cross section. They are solid but sometimes hollow shaft are also used. But we had used solid circular shaft.

IV. 3D MODEL OF THE VERTICAL AXIS WIND TURBINE



V. THE ORETICAL POWER CALCULATION

The wind mill works on principle of converting kinetic energy of the wind in to mechanical energy. The k.E. of any particle is equal to the one half of its mass times the square of its velocity, or ½ mv2.

K.E. =½ mv2. ………………….. (1)

K.E = kinetic energy

m = mass

v = velocity

M is equal to Volume multiplied by its density ρ of air,

Mass = ρ AV …………………. (2)

Substituting eqn (2) in eqn (1) We had got,

K E = ½ ρ AV3 watts

ρ = density of air (1.225 kg/m3)

A = l*b (Sq.m)

D = diameter of the blade

A = l*b

A = 0.3 Sq.

Available wind power Pa = (½ ρ π D2 V3)/4

P = 1/8 ρ π D2 V3

TRAIL 1

FOR VELOCITY 4.5m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½*1.225*π*0.4*0.4 *4.53)/4

Pa = 7.1watt

TRAIL 2
FOR VELOCITY 5.5m/s
Pa = (½ ρ π D2 V3)/4
Pa = (½*1.225*π*0.4*0.4 *5.53)/4
Pa = 15.1watt

TRAIL 3
FOR VELOCITY 7.5m/s
Pa = (½ ρ π D2 V3)/4
Pa = (½*1.225*π*0.4*0.4 *7.53)/4
Pa = 33 watt

TRAIL 4
FOR VELOCITY 10m/s
Pa = (½ ρ π D2 V3)/4
Pa = (½*1.225*π*0.4*0.4 *103)/4
Pa = 77watt

VI. TESTING AND RESULTS

Sr.no	Wind speed (m/s)	Speed of the shaft	Voltage
1	2 to 3	109 to 121	3.9
2	3 to 4	189 t0 201	4.8
3	4 to 5	271 to 320	6.2
4	5to 6	328 to 353	8.8
5	6 to 7	390 to 396	9.2
6	7 to 8	400 to 409	12

VII. SECOND TESTING WITHIN INTERVAL OF 5 MINUTES

Mass times the square of its velocity, or ½ mv2
K.E. =½ mv2. ………………….. (1)
K.E = kinetic energy
m = mass
v = velocity

Interval of 5 minutes	Wind Speed m/s	Voltage Volts	Current Ampere	Power Watts
1	4.1	6.3	2.1	13.3
2	4.6	9.1	2.7	24.5
3	4.9	9.2	2.6	23.9
4	5.3	9.3	2.7	25.1
5	5.9	9.4	2.8	26.4
6	6.8	10.9	2.9	31.6
7	6.2	9.1	2.6	23.7
8	7.2	11.8	2.9	34.3
9	6.9	11.3	2.8	31.7
10	7.3	11.8	2.9	34.3
11	7.1	11.7	2.9	33.9
12	6.8	11.3	2.9	32.8
Avg	6.1	10.1	2.8	28.3

VIII. CONCLUSION

This paper gives ideas to learn about the design and fabrication of complex Aero foil blades. Vertical axis wind turbine represent a very promising future for wind power generation. A vertical wind turbine can give output more than conventional HAWT.

The rotor that is designed to harness enough air to rotate the shaft at low and high wind speeds. The efficiency of turbine is increased by proper designing of the aero foil shape blade, The major components are placed at the ground level which ensures the safety of turbine.

Thus, it can be concluded that Vertical axis wind turbine can produce power more with higher efficiency compared to traditional wind turbine. At a very low speed wind velocity Thus, this technology has the capacity to completely displace current technology in use for wind farms.

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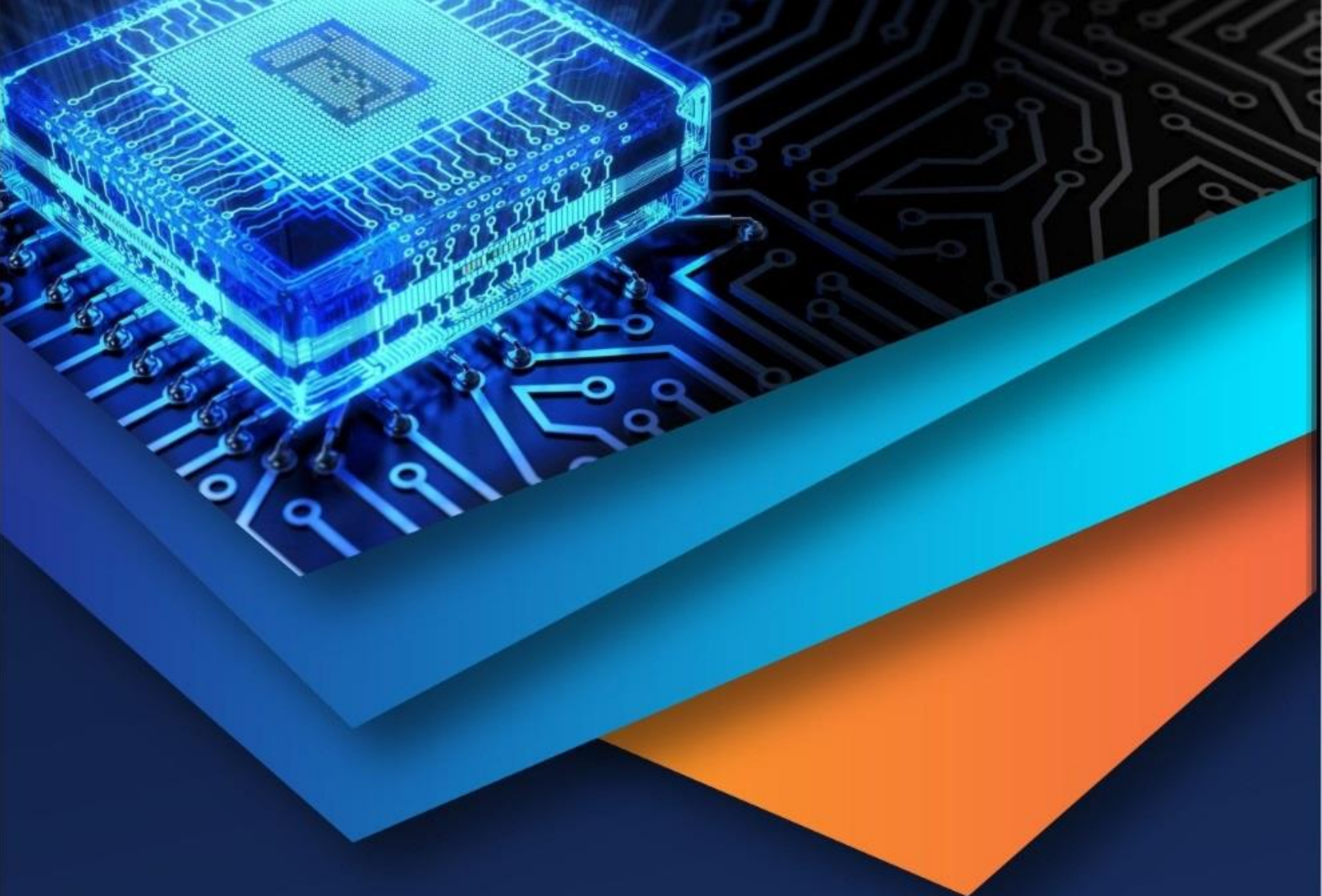

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