DESIGN AND ANALYSIS OF VERTICAL LEVITATED AXIS WIND TURBINE (VLAWT)

Minesh Vohra[1], Navdeep Kalsi[2]

[1]School of Mechanical Engineering, Lovely Professional University, Phagwara, Punjab,
[2]School of Mechanical Engineering, Lovely Professional University, Phagwara, Punjab.

Abstract. The layout & fabrication of a vertical axis wind turbine has been accomplished primarily based at the principle of magnetic levitation so that you can replace the bearings and therefore enhance the performance of the turbine and limit the strength losses associated with friction. It aims to promote sustainable improvement the use of wind that's a renewable source of strength. Exclusive kinds of propellers made of different substances and number of blades have been tested in order to locate the maximum appropriate one for the turbine. Specific orientations and alignment of magnets had been tested to discover the right alignment in an effort to produce the enough quantity of repulsion required for levitation.

The minimal wind pace required for the rotation of the turbine is found to be as low as 5 m/s. We have been able to produce voltage of 14 volts and further boosted it up the usage of an amplifier as much as 62 volts. The maximum voltage after stepping up reached 72 volts at high wind pace.

Keywords: Magnetic Levitation, Efficiency, Renewable Energy Recourses, Power Output

1.1 Introduction

The wind turbine is used to generate electricity with the aid of using wind speed. The wind moves at the blades which actuates the generator through attached shaft from rotor and commenced and for this reason in turns generates the power. Maglev orientated wind turbine design is a sizable departure from traditional designs having benefit of using frictionless bearings with a magnetic levitation design. The VAWT'S blades are suspended in the air, replacing the ball bearings. hence this new figure gives an extreme green, versatile and elegant technique of producing power from wind with nearly 0 pollutants. Amit et al. [1] includes a simulated Modal analysis the use of Ansys on wind blades made up of stainless steel and Glass Fiber reinforced Polymer material in an effort to locate the natural frequency and used to decide the response of structure for dynamic loading for SVAWT and found that GFRP R350 mm is suitable for fabrication of wind blades with less weight without affecting its overall performance occur in stainless-steel. Moham-mad M. Bashar [2] has designed and carried a computation study on five specific three bladed Savonius type VAWT and springs up with the result that NACA5510 shows higher Drag Coefficient, Minu John et al. [3] harness wind strength in more efficient manner with frictionless magnetic levitated operation and investigated the appropriate blade angle and configuration using on CFD iterations. Kelvin J Van Dyke [4] cope with sure layout problems related to the layout aspects of a prototype based on magnetically levitated VAWT.

Hence the complete focus is to design a Vertical Axis Magnetically Levitated Wind Turbine for low wind application followed by Performance analysis in terms of electrical power generated using the efficient way of elimination of friction and reduce the weight of the turbine as much as possible by removing gearbox and shaft

1.2 Design and Modelling

Sr. No	Parameters	Dimensions
1	Length of the model	38 cm
2	Breadth of the model	22 cm
3	Height of the model	22 cm
4	Length of Blades	20 cm
5	Día of Rotor	11 cm
6	Number of Magnets in Rotor	25
7	Number of Magnets in Stator	29

For the designing and Modelling aspect, CREO module has been used

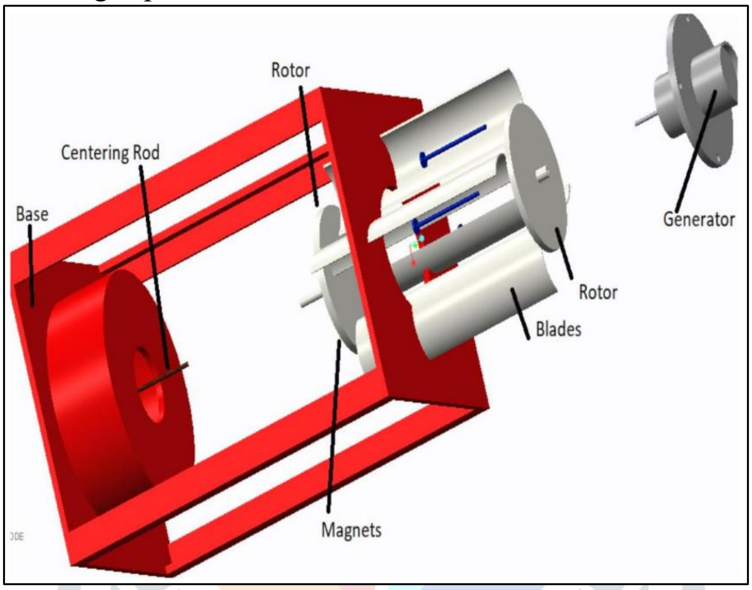

Figure 1: Exploded view of the components of prototype in Creo Parametric 3.0 Software

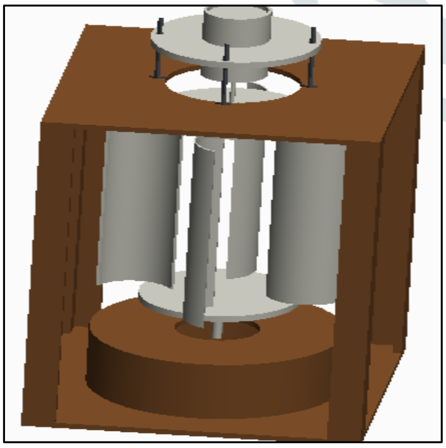

Figure 2: Generator Mounting for the Model on the top

Figure 3: Blade Alignment

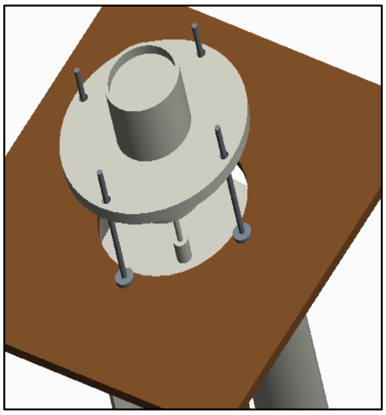

Figure 4: Top mounting for Generator

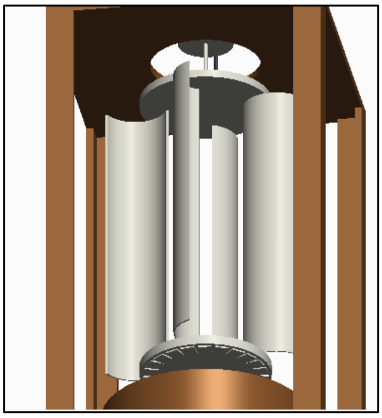

Figure 5: Magnetic Levitated Axis

1.3 Specifications

A) Magnet placement

The magnets are used in collection. the first collection on the bottom facet is constant to the desk bound floor and the second collection is fixed to the rotor of the turbine. The magnets are inclined from the horizontal at an attitude of diploma. This guarantees that the magnets create repulsion effect sufficient to maintain the weight of the rotating components as well as to create ahead momentum that allows you to hold the blades rotating for an extended time period

Figure 6: Stator component of Turbine

B) Rotor and Blades

It includes two spherical plates of cardboard of diameter. The blades are attached to the rotor. The plastic blades are of very mild weight and competitively priced.

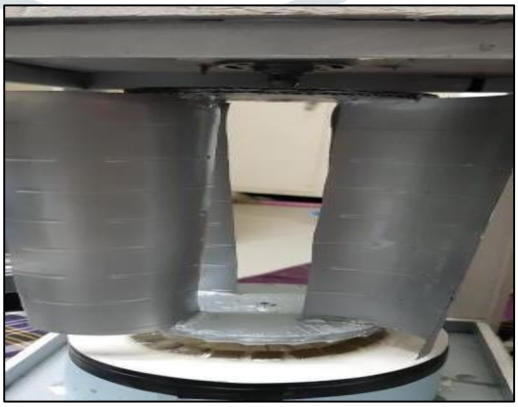

Figure 7: Rotor and Blades

C) Magnetic levitation

Magnetic levitation is the use of magnetic fields to levitate an object. Here stator and rotor are separated by means of some centimeters in air due very high repulsive force between two collection of neodymium magnets placed on shaft. Neodymium magnets of grade N50 having dimensions are used. It replaces the use bearing hence reduces the friction. So, it rotates at even low beginning velocity.

D) Generator:

The generator converts the mechanical energy of the rotor of the turbines into electricity. It is capable of producing 6 volts at 2400 rpm. It can produce a maximum of 48Volts at 12000 rpm.

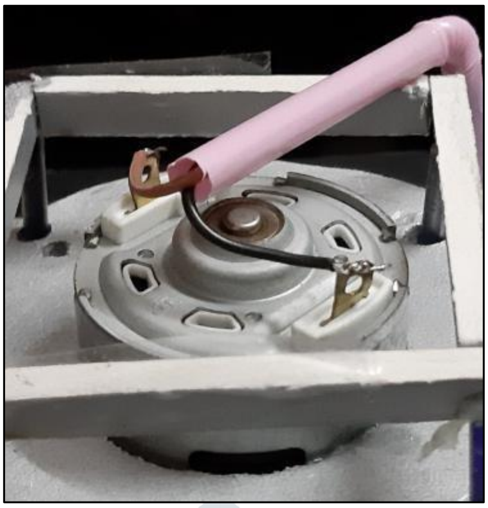

Figure 8: Generator

E) Circuit Diagram:

The electronic circuit connecting various components Such as generator, amplifier, USB ports, LEDs, Voltmeter, switches etc is given below:

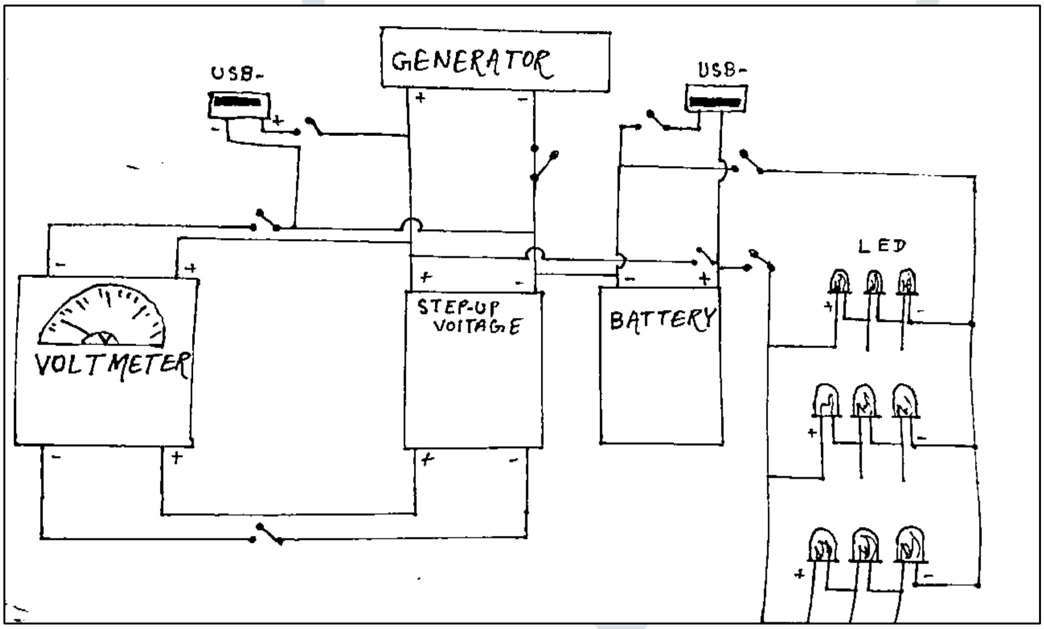

Figure 9: Electronic Circuit Diagram

F) Final prototype

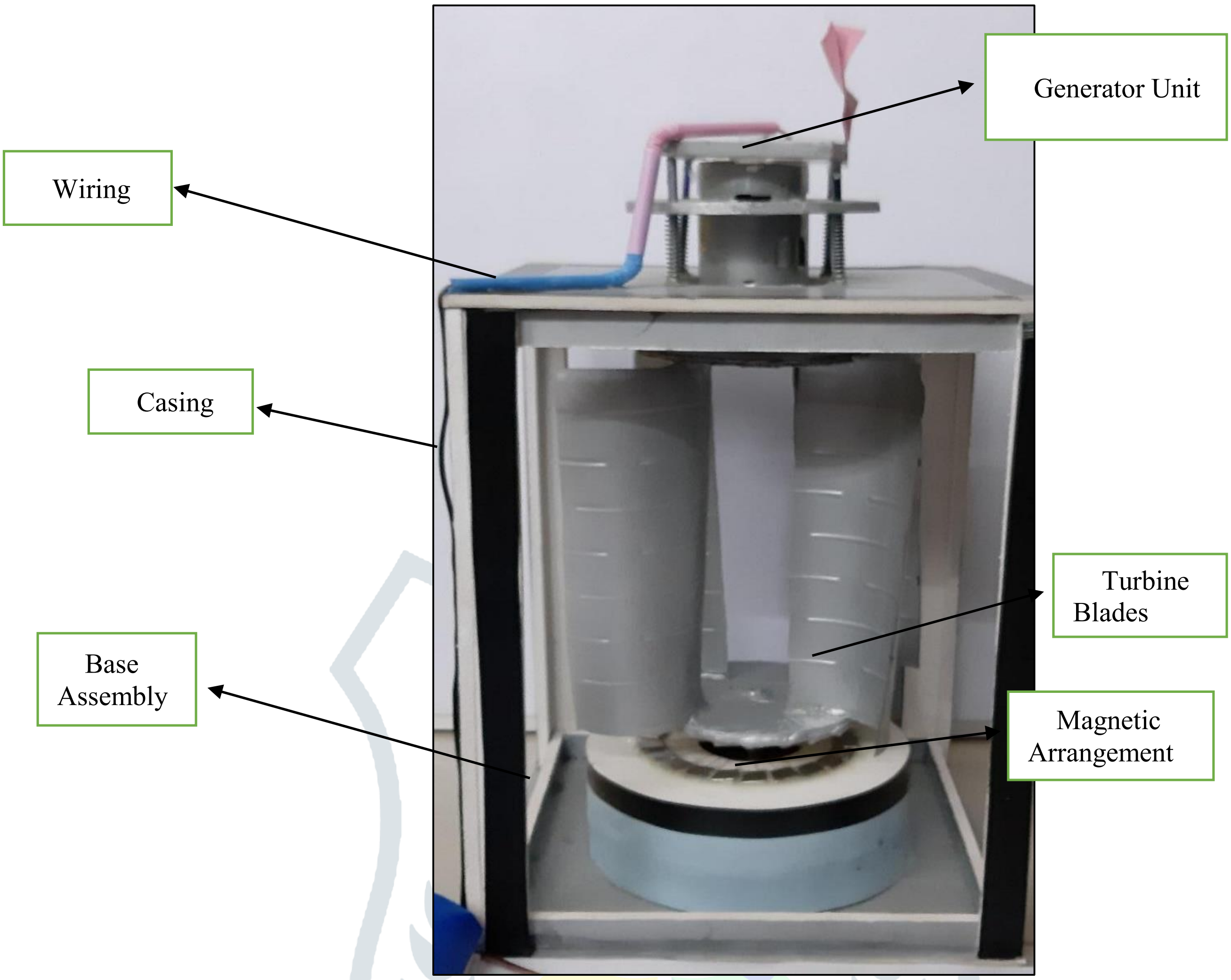

Figure 10: Final Prototype of Maglev

1.4 Fabrication and Assembly

Sr. No.	Material Used for Fabrication	Electronics Components
1	Sun board	Copper Wires
2	Neodymium Permanent Magnets	Amplifier
3	Plastic Rotor Blades	Multimeter
4	Steel Rod	Switch boards
5	Hollow Plastic Pipe	Generator
6	Springs	Battery
7	Anemometer	LEDs
8	Plastic Pipes	USB Port
9	Adhesives	Soldering Iron

1.5 Calculations:

CASE 1: Wind Speed v/s Generated Voltage (With and Without Booster)

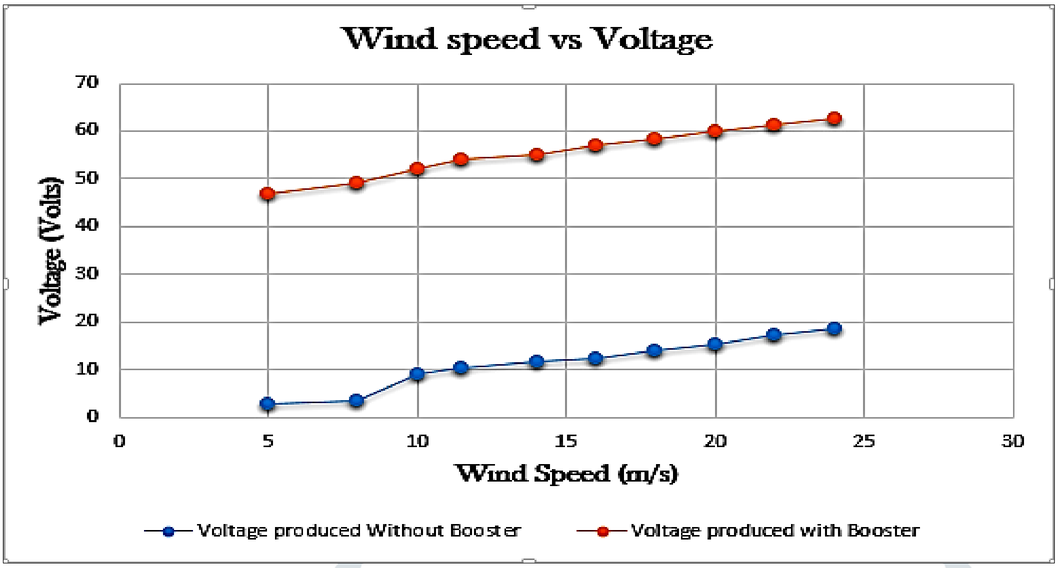

Fig 11: Graph between Wind Speed & Voltage

Fig. 11 constitute the Voltage generation at variable wind pace and the trend displays as there is upward push in wind pace, concurrently the voltage additionally will increase and the same is having similar impact on Boosted voltage. Underneath this phase the maximum voltage output comes out to be round 18V with wind velocity of simply 24m/s while the amplified volt-age performed the usage of the booster reaches round 64V for the equal wind velocity

CASE 2: Wind Speed v/s Generated Current

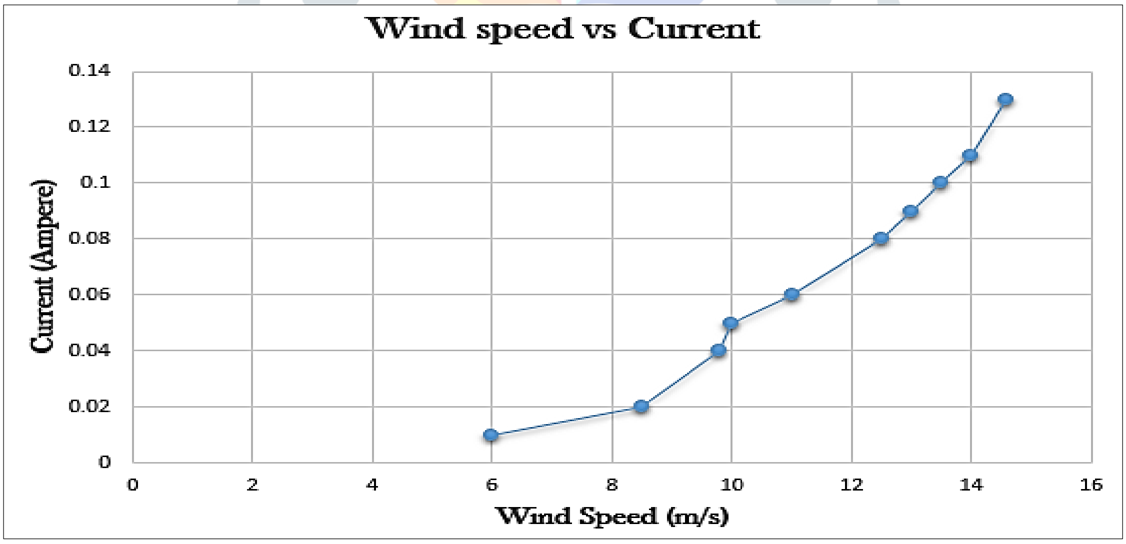

Fig 12: Wind Speed v/s Current

Fig. 12 indicates the current generation w.r.t. variable wind speeds and shows that the maximum output of 136mA has been generated and wind pace of around 14m/s

CASE 3: Wind Speed v/s Generated Power

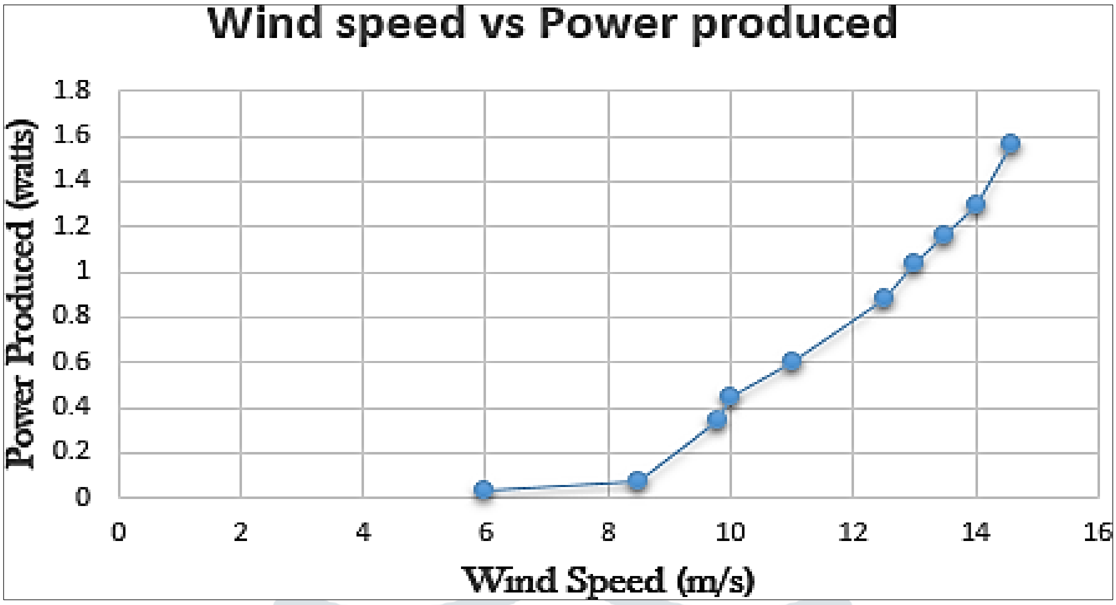

Fig 13: Wind Speed v/s Power Produced

Fig. 13. shows the variation in Wind Speed and its alteration on the power produced from the Maglev Unit and it has been observed that the maximum power produced is about 1.6W with wind speed of 14.6 m/s and hence based on the model specification of the capturing of the wind over the blades can be optimized in order to generate the more power for same magnetic arrangement.

1.6 Result and Discussion

At low wind velocity of 5m/s, the voltage produced is two.5 volts, which when boosted up produced 48 Volts. At mild wind pace of 8 m/s, the voltage produced is 37 volts which become stepped up to 51 Volts the use of the amplifier. At high wind velocity of 14 m/s, the voltage produced is 11.5 volts and the amplified voltage is 57 volts. At even better wind velocity, the amplified voltage produced reached as high as 72 volts.

The best end result obtained could have numerous programs. The load of the turbine also reduced because of the absence of gearbox and the shaft. The preservation and servicing required is also very handy and cost-efficient. The lifespan of the turbine is also longer which provides basis for strength independence

Magnetic levitation for wind energy turbines, represent a very promising destiny for wind strength technology. Maglev wind turbines will require decrease wind pace for begin-up and also, they show better overall performance at decrease wind velocities. The wind turbine rotors and stator having magnets 25 and 29 in numbers are sufficient obtain the levitation with negligible friction required for easy rotation of the blades. The losses because of friction are minimized and the bearings are replaced correctly the usage of magnetic levitation of magnets.

References:

[1] Amit D. Patil, Amit W. Chake, Manoj I. Helonde, Pravin M. Gupta, "Vertical Axis Wind Turbine with Maglev Technology", IJSRD -International Journal for Scientific Research & Development, Vol. 2, Issue 12, 2015
[2] Mohammad M. Bashar, "Computational and Experimental Study on Vertical Axis Wind Turbine in Search for an Efficient Design", Georgia Southern University, December 2014
[3] Minu John, Rohit John, Syamily P.S, Vyshak P.A,"Maglev windmill", International Journal of Research in Engineering and Technology, Volume: 03, Issue: 05, May-2012
[4] Kelvin J Van Dyke, "An introduction to magnetic levitation and its application", IEEE, May-2014
[5] Dinesh N Nagarkarand, Dr. Z. J. Khan, "Wind Power Plant Using Magnetic Levitation Wind Turbine", International Journal of Engineering and Innovative Technology Volume 3, Issue: 01, July 2013.

[6] Vishal Dhareppagol, Maheshwari Konagutti, “Regenedyne maglev wind power generation”, International Journal of Electrical, Electronics and Data Communication, Volume- 1, Issue- 6, July 2010
[7] Javier Castillo Tampere, “Small-Scale Vertical Axis Wind Turbine Design”, University of Applied Sciences, December 2011
[8] Chetan Singh Solanki, “Renewable Energy Technology”, January 2008
[9] US 7,462,950 B2, (United States of America), Dec. 9, 2008, “Magnetic Levitation Weight Reduction Structure for A Vertical Wind Turbine Generator”