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Experimental Investigation of Windmill to Generate AC Power using Magnetic Levitation

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Abstract- Electrical power has become a prime necessity for any country for economic development. Due to exhaustion of conventional power generation methods and its adverse effects on the environment, the focus on renewable energy resources has increased significantly in the recent years. Among various resources wind has proved to be a cheaper alternative energy resource and hence extensive research efforts have been put to improve the technology of electricity generation through wind. This project introduces structure and principle of the proposed magnetic levitation wind turbine for better utilization of wind energy. The aim of this project is to design and implement a magnetically levitated vertical axis wind turbine system that has the ability to operate in both high and low wind speed conditions.

I. INTRODUCTION

The Maglev wind turbine design is a vast departure from conventional propeller designs. Its main advantages are that it uses frictionless bearings and a magnetic levitation design and it does not need to vast spaces required by more conventional wind turbines. It also requires little if any maintenance. The Maglev wind turbine was first unveiled at the Wind Power Asia exhibition in Beijing 2007. The unique operating principle behind this design is through magnetic levitation. Magnetic levitation is supposedly an extremely efficient system for wind energy. The vertically oriented blades of the wind turbine are suspended in the air replacing any need for ball bearings.

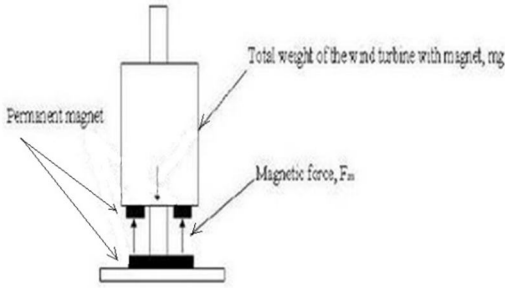

Figure 1: Free body diagram of magnetically levitated object

At the bottom one magnet is placed. It repels the other magnet which is fixed to the shaft of generator. The shaft contains the vertically oriented blades of the wind turbine. Now due to this repulsive power between the magnets, the upper magnet attached to shaft is air suspended, replacing the need for ball bearings. For this levitation, full permanent neodymium magnets are used.

II. PRINCIPLE OF WORKING

The block diagram for output is as shown.

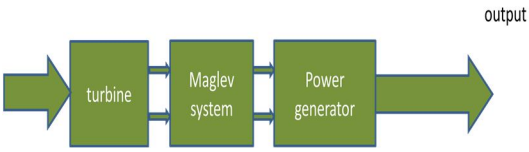

Figure 2: Block diagram of Maglev Windmill

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The basic working principle of a wind turbine is when air moves quickly, in the form of wind, the kinetic energy is captured by the turbine blades. The blades start to rotate and spin a shaft that leads from the hub of the rotor to a generator and produce electricity. Using the effects of magnetic repulsion, spiral shaped wind turbine blades will be fitted on a rod for stability during rotation and suspended on magnets as a replacement for ball bearings which are normally used on conventional wind turbines. The diagram for setup is shown below.

Figure3: Setup of the project

The turbine was rotated freely. Digital tachometer is used to measure the speed of the turbine. With the rotation of turbine voltage is produced and is measured with the help of multimeter. The turbine was rotated at different speeds (RPM) and voltage (V) was recorded. The different voltage at different RPM is tabulated below.

RPM	230	565	1172	1874	2150
Voltage (V)	0.9	2.0	3.5	5.2	7.6

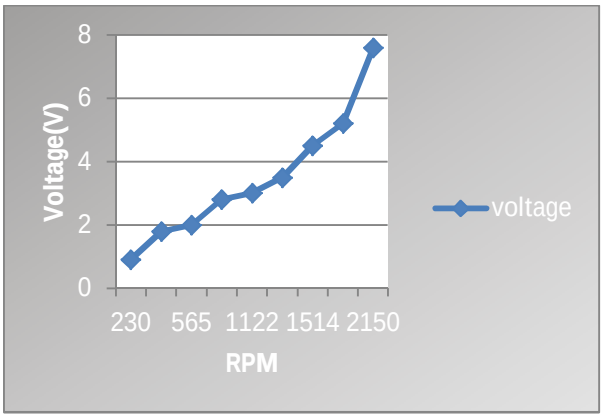


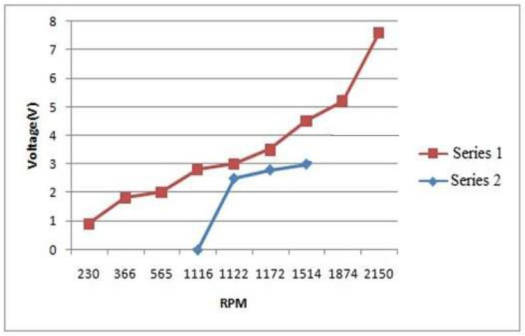
Figure 4 : Graph of Voltage and RPM

The graph obtained between speed (rpm) and voltage (V) from the above obtained values is as shown in graph 7.1. The graph indicates that with the increase in speed of turbine, the voltage obtained in the output is increasing. This is because with the increase in speed, the change in magnetic flux increases. The more the change in magnetic flux, more will be induced voltage. The maximum voltage obtained is 7.6 V at 2150 rpm.

III. RESULTS

With the use of magnets for levitation the need for bearings has been eliminated. Due to this turbine rotates at high speed for low wind speed of wind. The maximum voltage obtained in the project is 7.6 V. In the already existing paper by Aravind CV et al., voltage of maximum 2.8V has been obtained. The comparison between the already existing project and our project is shown in the

graph 8.1.



Graph 8.1: Comparison between new and existing model (Series 1- New project and Series 2- Existing project)

The series 1 indicating line graph obtained by plotting voltages obtained in our experimentation whereas series 2 indicates voltage obtained in existing model which is less as compared to ours. The maximum voltage of 7.6 V was obtained as compared to 2.8V.

IV. CONCLUSION

By using magnets for levitation the need for bearings has been eliminated. The wind turbine rotors and stator levitated properly using permanent magnets which allowed for a smooth rotation with negligible friction. The power output of the generator is satisfactory. The turbine gave maximum voltage of 7.6 V which can be further increased by using wire of higher gauge.

V. FUTURE SCOPE

The magnetically levitated vertical axis wind turbine can be used in residential areas where it can be mounted on a roof and can be very efficient and practical. A home owner would be able to extract free clean energy thus experiencing a reduction in their utility cost and also contribute to the “Green Energy” awareness that is increasingly gaining popularity. The maglev windmill can be designed for using in a moderate scale power generation range from 400 Watts to 1 KW. Also it is suitable for integrating with the hybrid power generation units consisting of solar and other natural resources.

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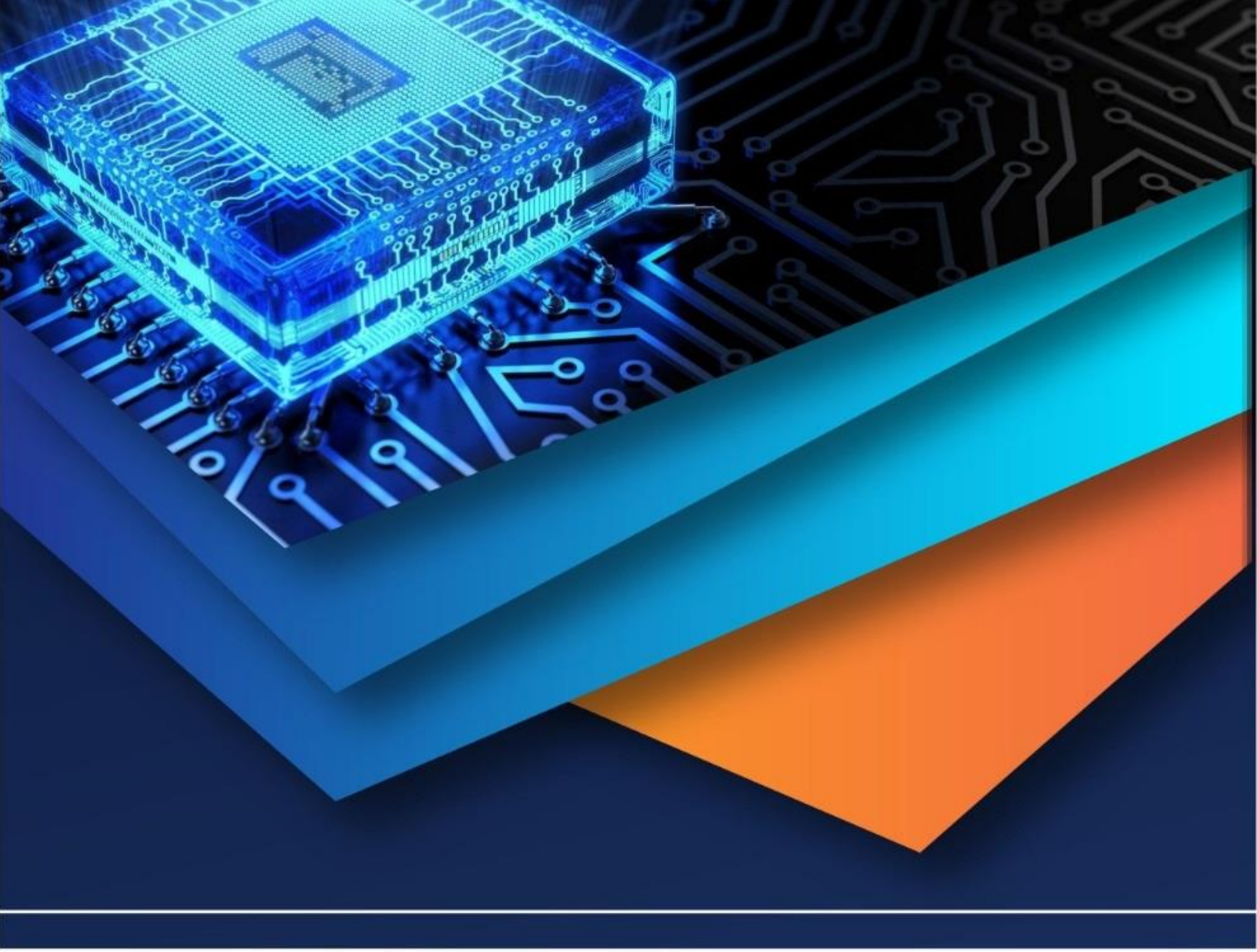

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