DESIGN AND IMPLEMENTATION OF MAGNETIC LEVITATED WIND GENERATOR

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Abstract

This paper dwells on the implementation of an alternate configuration of a wind turbine for power generation purposes. Here we have used Magnetic levitation vertical axis wind turbine to generate power instead of conventional wind turbine. The basic Principles used in this project are Magnetic Levitation and Faradays Law of Electromagnetic Induction. Magnetic levitation is a method by which an object is suspended above another object with no support other than magnetic fields. The electromagnetic force is used to counteract the effects of the gravitational force. Magnetic levitation is used to reduce the energy loss due to friction. This energy wasted in friction can be saved by maglev method. The main aim of this project is to eliminate ball bearings which are normally used on conventional wind turbine. Two powerful magnets of same poles are placed one over other for levitation.8 Cup shaped wind turbine blades are fitted at 45degrees between the two circular shaped plates supported on a shaft. Blades are designed such a way that the system has the ability to operate in both low and high wind speed conditions.

This assembly is suspended on levitated magnets as a replacement of bearings. Permanent magnets are fitted on the rotor; the changing flux induces EMF in the coils provided beneath them. We have used 4 No volt coils on the stator which are placed such a way that the total flux is additive in nature. Power will then be generated with an axial flux generator, which incorporates the use of permanent magnets and a set of coils. The power generated in this project is 6 volts which is used to deliver a basic loads like LED Bulbs, Fans, etc.
Keywords:-Maglev, Wind Power Etc.

I. INTRODUCTION

Renewable energy is generally electricity supplied from sources, such as wind power, solar power, geothermal energy, hydropower and various forms of biomass. These sources have been coined renewable due to their continuous replenishment and availability for use over and over again. The popularity of renewable energy has experienced a significant upsurge in recent times due to the exhaustion of conventional power generation methods and increasing realization of its adverse effects on the environment. It is estimated that renewable sources might contribute about 20%-50% to energy consumption in the later part of the 21st century. Facts from the World Wind Energy Association estimates that by 2010, 160GW of wind power capacity is expected to be installed worldwide which implies an anticipated net growth rate of more than 21% per year.

Maglev wind turbines have several advantages over conventional wind turbines. For instance, they’re able to use winds with starting speeds as low as 1.5 meters per second (m/s). Also, they could operate in winds exceeding 40 m/s. Currently, the largest conventional wind turbines in the world produce only five megawatts of power. However, one large maglev wind turbine could generate one GW of clean power, enough to supply energy to 750,000 homes.

II. Proposed System

When designing a generator it is important to have a firm grasp of the basic laws that govern its performance. In order to induce a voltage in a wire an ear by changing magnetic field must exist. The voltage induced not only depends on the magnitude of the field density but also on the coil area. The relationship between the area and field density is known as flux (Φ). The way in which this flux varies in time depends on the generator design. The axial flux generator uses the changing magnetic flux to produce a voltage. The voltage produced by each coil can be calculated using Faraday's law of induction

In order to explain how an axial flux generator is designed the elements that produce an electromotive force or voltage must be described. An induced EMF is produced by a time varying magnetic field. Michael Faraday performed experiments with steady currents and a simple transformer in hopes of producing a voltage from a magnetic field. He discovered that a constant magnetic field would not induce a voltage but a time varying field could This was an important discovery in what is known as electromagnetic induction, a discovery that is fundamental in the design of a generator. It is this relative motion of a magnetic field producing a voltage that allows us to be creative in the ways we produce electricity.

There are three ways to induce a voltage. The first way is to change the magnetic field. The axial flux generator, which we are designing, utilizes the changing magnetic field produced by the magnets to induce a voltage. The rotating magnets pass over a number of coils each producing their own voltage. The second way is to change the area of an individual coil in a magnetic field. The third and final way is to change the angle between the coil and the magnetic field. Many generators today use this method to induce a voltage. Some of thesea generators rotate the coils in a field and others rotate the field around stationary coils.

III. Experiment and Result

Some modifications are made in order to overcome the limitations of theoretical design of magnetically levitated vertical axis wind turbine and a prototype is constructed. This section includes details of modifications made

MAGNET PLACEMENT

Two ring type ferrite (Fe) magnets of grade N-35 of outer diameter 40mm, inner diameter 20mm and thickness 10mm are placed at the centre of the shaft by which the required levitation between the stator and the rotor is obtained. Similar Disc type magnets of 25 mm diameter are arranged as alternate poles one after the other, along the periphery of the rotor made of plywood of 40mm diameter as in figure1. These magnets are responsible for the useful flux that is going to be utilized by the power generation system.

Figure1 – Magnet Arrangement

COIL ARRANGEMENT

42 gauge wires of 5000 turns each are used as coils for power generation. 14 sets of such coils are used in the prototype. These coils are arranged in the periphery of the stator exactly in a line to the arranged disc magnets. The coils are raised to a certain height for maximum utilization of the magnetic flux. Each set of such coils are connected in series to obtain maximum output voltage. The series connection of the coils are

preferred over the parallel connection for optimizing a level between the output current and voltage. The coil arrangement is shown in figure 2.

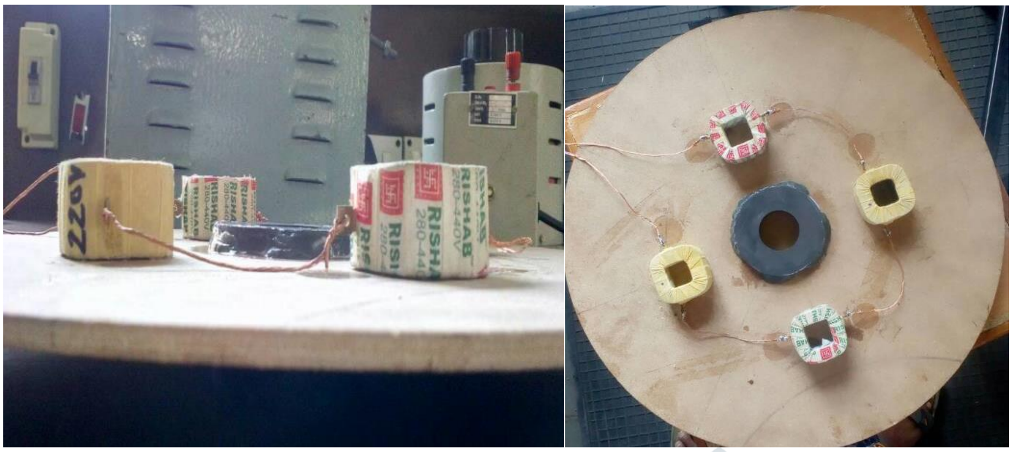

Figure2 – Coil (Set) and Coil Assembly

BLADE DESIGN

The blades used in this prototype are not of the conventional type. In this prototype, we have followed a blade structure known as Savonius type of wind blade. The main peculiarity of this type of blade is that its lower portion has an increased width and upper portion is narrow. This helps for the wind density to be increased in the bottom side and this in turn increases the total system stability. The blades in our prototype are shown in figure3.

If the amount of current was more important in the output of the system, neglecting the voltage, the coils could have been replaced with lesser gauge and they could have been connected in parallel.

Figure 3 – Savonius Type Blades

LEVITATION BETWEEN STATOR AND ROTOR

In the designed prototype, the stator and rotor are separated in the air using the principle of magnetic levitation. The rotor is lifted by a certain centimeters in the air by the magnetic pull forces created by the ring type Neodymium magnets. This is the principal advantage of a maglev windmill from a conventional one. That is, as the rotor is floating in the air due to levitation, mechanical friction is totally eliminated. That makes the rotation possible in very low wind speeds. Figure 4 illustrates the magnetic levitation in our prototype.

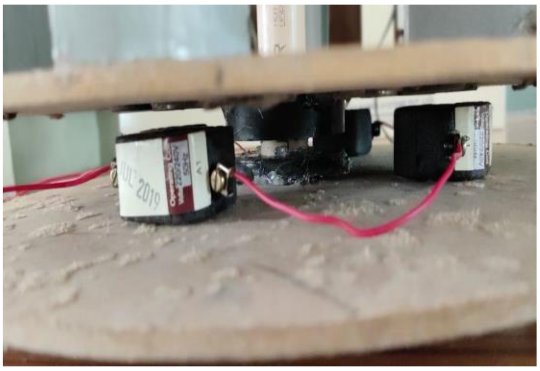

Figure 4 – Magnetic Levitation

BLADE DESIGN

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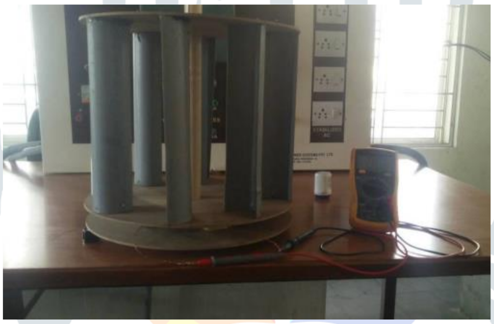

Figure5 – Total Prototype Structure

With the emergence of edge computing in recent years, many researchers have explored edge computing based designs to tackle the IoT security challenges. These designs range from comprehensive security architecture designs to specific designs to achieve dedicated security goals, such as distributed firewalls, intrusion detection systems, authentication and authorization algorithms, and privacy-preserving mechanisms. In this section, we summarize the proposed designs and discuss their strengths and weaknesses respectively. Because there are only a small number of edge-based IoT security solutions, we try our best to include all related and quality work in this survey.

3.1. Limitations

In terms of large scale power production, vertical axis wind turbines have not been known to be suitable for these applications. Due to the overall structure and complexity of the of the vertical axis wind turbine, to scale it up to a size where it could provide the amount of power to satisfy a commercial park or feed into the grid would not be practical. The size of the rotors would have to be immense and would cost too much to make. Aside from the cost, the area that it would consume and the aesthetics of the product would not be desired by this type of consumer. Horizontal axis wind turbines are good for these applications because they do not take up as much space and are positioned high up where they can obtain higher wind speeds to provide an optimum power output.

IV. CONCLUTION

In the magnetically levitated wind turbine The rotors is designed harnessed enough air to rotate at low and high wind speeds while keeping the center of mass closer to the base yielding stability. The efficiency of turbine is increased by replacing the bearings by magnets, the magnetic levitation helps the turbine to spin at much faster rate as it will eliminate the stress on the shaft of the turbine. The major components are placed at ground level. We can say the maglev turbine can power more output with high efficiency conversion compared to traditional wind turbine. The wind turbine rotors and stator levitated properly using permanent magnets which allows smooth rotation with negligible friction. An output ranging from 5V to 60V is obtained from the magnetic levitated vertical axis wind turbine prototype. At moderate wind speeds generator can supply the power to LED load. Strong permanent magnets is used to avoid the wobbling movement of the rotor. The system will provide electricity at a rate lower than coal and nuclear. Thus we believe this technology has the capacity to completely displace current technology in use for wind farm

V.FUTURE SCOPE

The home for the magnetically levitated vertical axis wind turbine would be in residential areas. Here it can be mounted to a roof and 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 ranging 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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