Design and Fabrication of Magnetic Levitating wind mill

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***Abstract*—The increasing global demand for clean and renewable energy has accelerated innovation in wind energy systems. This project presents the design and fabrication of a Magnetic Levitating Frictionless Windmill, integrating magnetic levitation (maglev) technology with a Vertical Axis Wind Turbine (VAWT) to enhance efficiency and reduce mechanical losses. Conventional wind turbines suffer from frictional wear due to mechanical bearings, resulting in higher maintenance and reduced efficiency. By employing magnetic levitation using neodymium magnets, this project eliminates physical contact between rotating and stationary parts, significantly reducing friction, noise, and wear. The prototype uses multiple electromagnetic coils and permanent magnets to generate electricity through Faraday's Law of Induction. The design is optimized for low wind speeds, making it suitable for decentralized and urban applications. Simulation tools assist in modeling magnetic behavior, and the fabricated system demonstrates the feasibility of efficient, frictionless wind energy conversion. This study contributes to sustainable energy development by offering allow-maintenance, high-efficiency alternative to conventional small-scale wind turbines.**

***Key Words*—*Magnetic Suspension, Energy Efficiency, Urban Wind Energy, Green Technology*.**

I. INTRODUCTION

The increasing global demand for clean and renewable energy has driven innovation in wind energy technologies. Among these, vertical axis wind turbines (VAWTs) have gained attention for their ability to operate efficiently in turbulent and variable wind conditions, making them suitable for urban and decentralized power generation. However, conventional VAWTs often suffer from mechanical friction and wear due to their reliance on traditional bearing systems. To address these limitations, the integration of magnetic levitation (maglev) technology presents a promising solution. Maglev systems eliminate mechanical contact between rotating and stationary parts, thereby reducing friction, noise, and maintenance requirements while enhancing overall efficiency. This project focuses on the design, analysis, and fabrication of a Maglev Vertical Axis Wind Turbine, combining the aerodynamic advantages of a VAWT with the low-friction performance of magnetic levitation. The aim is to develop a cost-effective and sustainable wind energy solution with improved durability, efficiency, and performance, particularly in low-wind-speed environments. Magnetic levitation (Maglev) technology has emerged as a cutting-edge solution across various engineering fields, enabling frictionless motion by suspending objects using magnetic forces. By eliminating direct mechanical contact, Maglev systems significantly reduce wear, noise, and energy losses, making them ideal for high-speed transportation, precision engineering, and renewable energy applications.

II. LITERATURE REVIEW

Mayur Patel et al,(2018), the authors were discussed on Design, Analysis & Fabrication of Maglev Vertical Axis Wind Turbine. A wind turbine is device that converts the winds kinetic energy into electrical energy .Magnetic levitation is a method by which an object is suspended with no support other than magnetic fields. Magnetic pressure is used to counteract the effects of the gravitational and any other accelerations. The problem with the traditional structure of VAWT is that weight from the VAWT makes bearings bear larger axial force; makes bearings frayed largely and shorten the life. Magnetic levitation for wind power generators, represent a very promising future for wind power generation. Maglev wind turbines will require lower wind velocity for start-up and also they show better performance at lower wind velocities. [1]

Alex Hitoshi Takinami et al, (2020), the authors were explained on Design, simulation and development of a magnetic levitation system (MAGLEV). The magnetic levitation technology is a relatively new system. It is currently becoming more widespread and it has been applied in various areas of industry. The aim of this paper is to present a methodology for designing MAGLEV systems based on finite element method simulations. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influx hence the work reported in this paper. Through the development of the present work, it was possible to present a methodology for designing a coil for application in MAGLEV through FEMM simulations by varying the parameters such as material core, number of turns and electric current.[2]

Aditya R. Wankhade1, et al, (2022), the authors are experimented on Wind Power Generation Using Magnetic Levitation. The phrase “Levitation” refers to a class of technologies that uses magnetic levitation to force wind turbines with magnets, which otherwise propel with axles and bearings. Maglev (derived from magnetic levitation) uses magnetic levitation to propel wind turbine for the generation of electricity. Energy is a primary and most universal measure of all kinds of work by human beings and nature. Everything that happens in the world is the expression of flow of energy in one of its forms Energy is an important input in all sectors of a country’s economy. As per the project concept the future scope is to save depleting fossil fuels and use maglev technology in generating power even in residential areas as it is cost effective, less spacious, efficient and practical. [3]

Mohammad Dehghani Madvar et al, (2019), the authors were discussed on Forecasting of wind energy technology domains based on the technology life cycle approach. Wind energy technologies are being developed in order to reduce the costs of the generated electricity and increasing technological performance. When 2016 came to an end, the total amount of electrical energy was 24353 TWh worldwide, and this was about four times bigger in comparison to the 6131 TWh used the year 1973. The process of converting wind or the flow of air to electrical energy that happens naturally in the earth’s atmosphere is called wind energy. We discussed wind energy sub-technologies and determined their technological states.[4]

Achal K. Dudhe, and Jitendra A. Gaikwad (2024), the authors were discussed on Vertical Axis Levitating, Frictionless Windmill. Wind Power Technology has played a significant role in power production since decades. It is the cheapest available energy resource. Wind energy is one of the non-conventional forms of energy and it is available in affluence. Electricity can be generated with the help of vertical axis wind turbine. Shows multimeter reading, where dial is set for voltage indication with red wire as positive connection and black wire as negative connection (common). [5]

Abhilasha Pawar, et al (2020), the authors were discussed on MAGLEV Wind Turbine. The formation of wind is an outcome of the variance developed by warming of the atmosphere by the Sun. The wind energy is always found to be very useful. With increase in population rapidly the demand for the energy is also increasing. To attain the increasing need of population the conventional resources are depleting with a very fast rate in comparison to the rate of its generation. All-inclusive, the MVAWT is a success. The blades of the maglev wind turbine are designed to sweep enough wind to generate power. The VAWT with Maglev is used over the conventional horizontal axis wind turbine as the efficiency is increased around 30% and at the same time the operational cost has been reduced by 45% over the ordinary wind turbine. [6]

Working Principle

The power is produced by the vertical axis wind turbine utilizing Faraday's Law of Induction, which states that “Wherever a conductor is place Dina varying magnetic field, elf is induced which is called induced elf, if the conductor circuit is closed, the current is also induced which is called induced current" The wind energy powers the turbine blade edges to rotate, while a fixed disc containing magnets generates magnetic flux. This flux interacts with a coil positioned at the base of the Maglev windmill. The generated power is in the form of DC (Direct Current) and is stored in a battery. This stored power can be used to directly supply DC loads, or it can be converted to AC (Alternating Current) using an inverter to supply AC loads. The system can be used in both off-grid and on-grid configurations. Wind power is a proven and highly effective method of generating electricity. Maglev technology is one of the most efficient means of transferring kinetic energy to electrical energy. In this setup, the vertical axis wind turbine platform floats on a magnetic cushion with the aid of permanent magnet suspension and a companion linear synchronous motor. This technology eliminates nearly all mechanical friction and delivers maximum wind energy to the downstream linear generator.

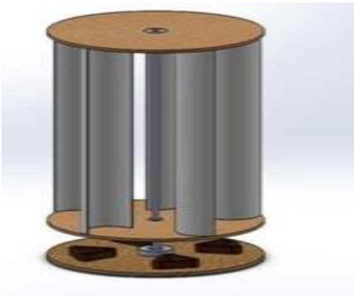

Fig1.1:3D Model of a Wind mill

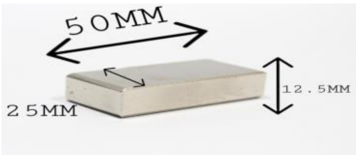

Fig1.2: Rectangular type Neodynamium Magnet

Copper Coil

An electromagnetic coil is an electrical conductor—typically a wire—wound into the shape of a coil, spiral, or helix. When an electric current passes through the conductor, it generates a circular magnetic field around it, as described by Ampère's Law. The coil shape is advantageous because it amplifies the magnetic field strength produced by a given current. This happens because the magnetic fields generated by the individual turns of the wire combine (superpose) and concentrate through the center of the coil, resulting in a stronger magnetic field. The greater the number of turns, the stronger the resulting magnetic field. Conversely, a changing external magnetic flux induces a voltage in a conductor, such as a wire, according to Faraday's Law of Induction.

Design Calculation
Average wind speed: v= 2.45 m/sec
Density of air: ρ= 1.23kg/m^3
Swept area of turbine= D x H = 0.28x0.353 = 0.098m^2

Kinematic energy = $\frac{1}{2}\rho AV^3$
= 1/2x1.23x0.098x2.45^3
= 0.88 Watt

Future Scope

- To compare the performance with frictional contact ball bearing-supported wind turbines.
- To study the effect of increasing the size of the model on power output.
- High-power magnets and more copper coil can be used for better levitation and increased power generation.

III. CONCLUSION

According to the project concept, the future scope is to help conserve depleting fossil fuels by using maglev technology for power generation, even in residential areas, as it is cost-effective, space-efficient, practical, and efficient. Sustainable generation of electric power is key to realizing the vision of a world free from dependency on fossil fuels. The challenge lies in scaling up electricity production to a level that can begin to match the energy obtained from burning coal and oil without the perceived dangers of nuclear power. If large-scale maglev wind turbines can supply vast amounts of electricity at an economic cost, then the advancement of maglev wind turbines is both timely and significant. It plays a major role in global development. Magnetic levitation is an important innovation to reduce the mechanical stress on wind turbines.

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