IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, October 2024

The Design and Development of Hybrid Power Generation Utilizing Wind and Solar Energy is the Main Emphasis of the Study

Ajay Kumar Verma , Aryan Verma, Prabhat Kumar, Rohit Raj, Raj Kumar Choudhary, Ronit Kumar Saw & Rahul Kumar Das
Department of Mechanical Engineering
K. K. Polytechnic, Govindpur, Dhanbad, India

Abstract: *This In our journal, we carefully examined a number of design characteristics, including the number of sunlight-capturing panels, the wind turbine height, number of windmills, and rotor diameter, in order to create the best possible model for a combination of solar-wind energy plant. Our goal was to ensure steady energy generation at the lowest possible cost. Our results clearly demonstrated a complementary relationship: in summer, when solar radiation was abundant and wind energy was low, solar arrays were the main source of energy, while in winter, when wind speeds were higher and solar radiation was lower, wind turbines were the main source of energy. In order to provide consistent energy output throughout the year, this study emphasizes the enormous potential of utilizing both wind and solar power synergies in an optimal hybrid system. Furthermore, our project's main goal was to determine whether it would be feasible to place different kinds of vertical wind turbines—including ones with shrouded blades—on roofs in order to increase turbine efficiency. One significant benefit of vertical axis wind turbines is that they can be installed at ground level, making maintenance simple. Furthermore, because they are omni directional, they do not require exact alignment with the direction of the wind in order to produce electricity. Our primary goal is to use CATIA V5 to build a self-starting vertical axis wind turbine in order to further the development of sustainable energy solutions.*

Keywords: power generation, vertical axis wind mill, renewable energy source, and Catia V5

I. INTRODUCTION

This document demonstrates the recommended structure and look of a manuscript. Many nations have been forced to transition to alternative energy sources in order to meet their needs due to the challenge and cost of transporting fuel to isolated regions of the nation for usage as a source of energy and the risk of increasing air pollution. The true cost of energy is only now, after two decades of cheap fuel, becoming apparent. Fossil fuels, which are used in companies, residences, and power plants to generate heat and electricity, have been by far our largest major energy source.

In addition to supplying us with electricity, hydrocarbons have also been utilized to make the various kinds of plastics we use on a daily basis and as liquid fuel for transportation. Any economy has relied on energy and will continue to do so. Energy comes in a wide variety of forms. Potential energy is the energy that is available due to the position between particles; examples include the energy in a coiled spring, the energy in a dam, and the energy contained in molecules (such as gasoline).

Kinetic energy is the energy that is available when particles move; wind energy is one instance of this. Mechanical, electrical, thermal, chemical, magnetic, nuclear, biological, tidal, geothermal, and so on are just a few forms of energy. Our best chance for a sustainable future is a revolution in renewable energy. It is obvious that clean energy sources and those that are ready for them today will rule the future. In rural areas across the world, solar and wind energy frequently offer the least expensive alternatives for community and economic development. They also provide electricity, generate jobs locally, and support economic growth using clean energy resources. A variety of energy technologies will be used in the future, with renewable energy sources like solar, wind, and biomass becoming more and more significant in the emerging global energy economy.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, October 2024

They are drag-type aerodynamic devices with two or three scoops. The Savonius turbine rotates as a result of differential drag. Long helical scoops are used in some designs to provide smooth torque. A Savonius rotor's swept area is mostly close to the ground, which reduces the overall energy extraction efficiency because of the decreased wind speed at lower altitudes. The ventilator, a cooling device frequently found on the roofs of vans and buses, is the most popular use of the Savonius wind turbine. ipt developed for journals published by SPIE. Professional typesetting will be done for accepted articles. The purpose of this template is to help reviewers better understand the paper. This template layout will not match the typeset paper's final layout.

Designing and building a tiny vertical axis wind turbine is the project's primary goal.

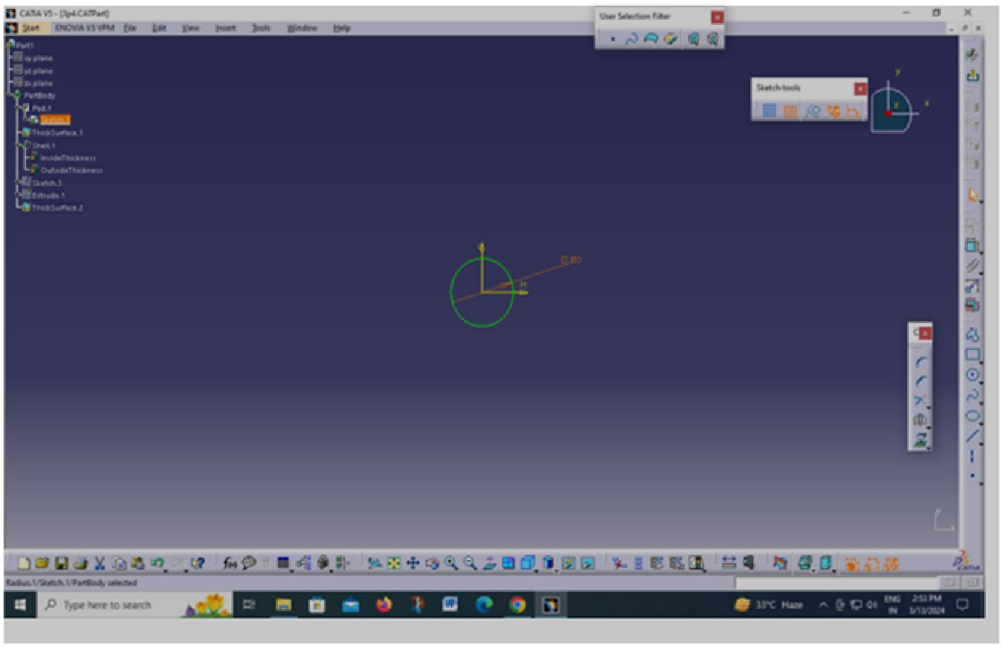

Fig: 1.1 Design of the vertical axis wind mill by using the catiav5

In order to demonstrate the design of the vertical axis wind mill, we used the Catiav5 to create the Savonius wind turbine. Selecting the appropriate generator and transmission system to effectively transform the rotational energy of turbines into electrical power. We created the vawt's aerodynamically efficient blades utilizing the CATIAV5 technologies in order to efficiently gather wind energy.

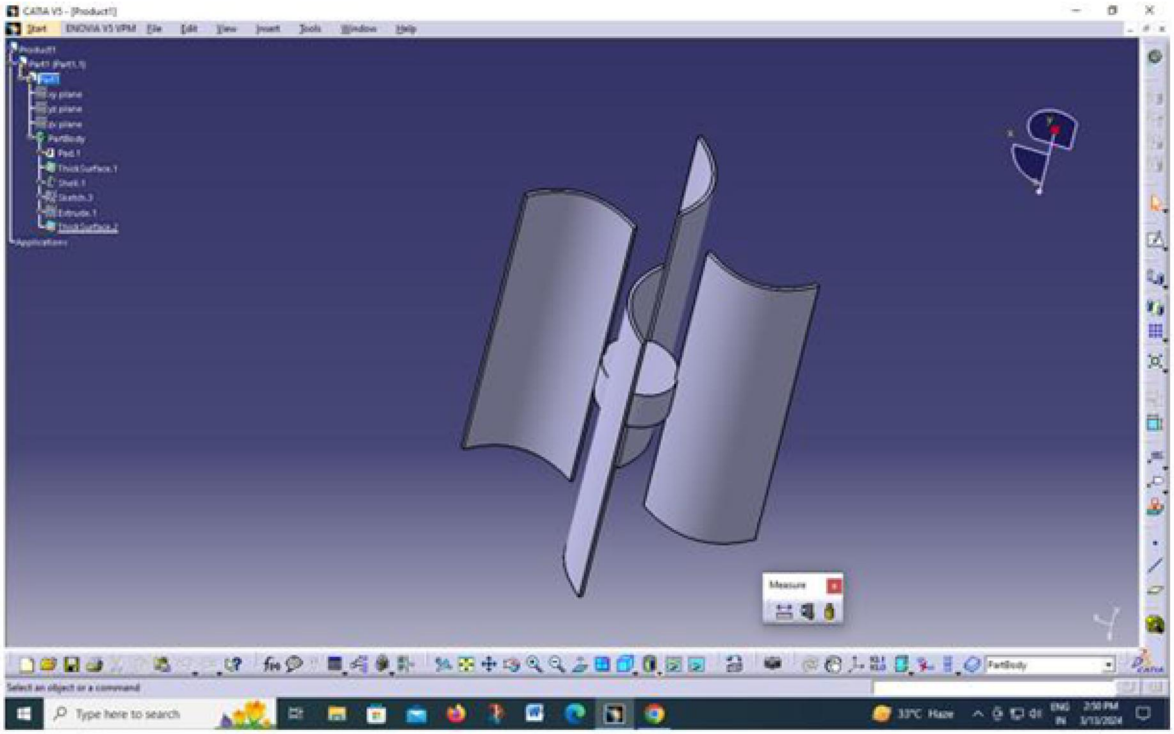

Fig: 1.2 Vertical axis wind mill by using the catiav5

The general layout of the vertical axis wind mill (Savonius type) is shown in fig. 1.3.You can create a Savonius-type vertical axis wind turbine that satisfies your performance goals and specifications by using Catiav5's robust modeling and simulation capabilities.

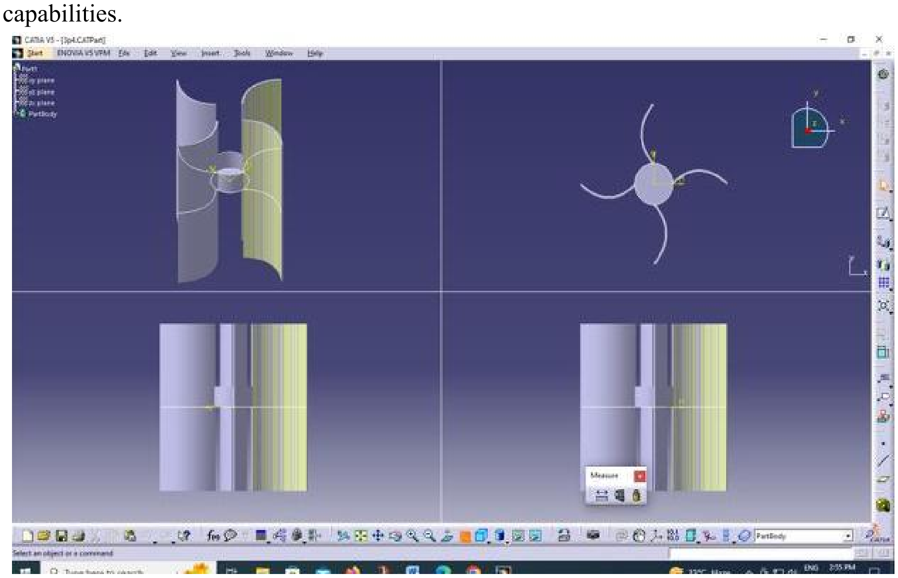

Fig 1.3 represents the design of vertical axis wind mill (savonius type).

Solar Panel:-

A collection of electrically connected solar photovoltaic modules installed on a supporting structure is called a solar panel. In both commercial and residential settings, a photovoltaic module is a part of a larger photovoltaic system that produces and supplies electricity. An inverter, a panel or array of solar modules, and occasionally a battery, solar tracker, and connection cable are the standard components of a photovoltaic system. One method of using solar energy to generate electricity is through photovoltaic cells or panels. Although they are the most convenient to utilize on a small to medium scale, they are not the most effective. Silicon used to make computer "chips" is also utilized to make PV cells. Even though silicon is a widely common mineral, solar cell production, like that of computer chips, requires an extremely clean atmosphere. High production costs result from this.

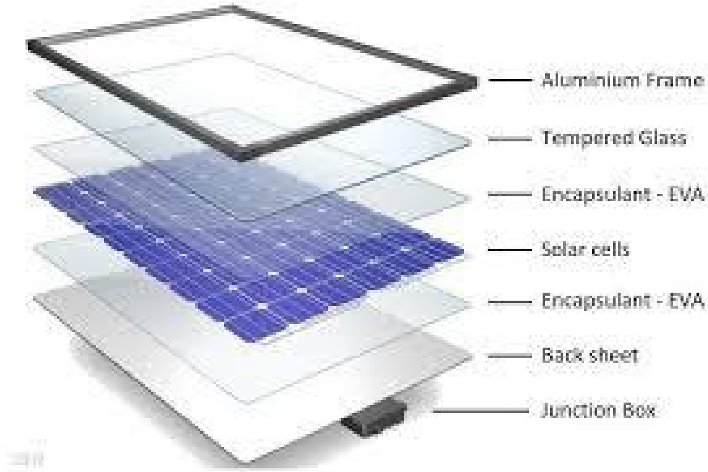

Fig 1.4 Solar Panel

NEMA 17 STEPPER MOTOR

A 1.7 x 1.7-inch (42.18 x 42.18 mm) stepper motor's faceplate Compared to a NEMA 14, for instance, the NEMA 17 is larger and typically heavier, but it also has more torque-putting capacity. But its magnitude doesn't necessarily translate into power. A brushless DC electric motor that splits a whole revolution into several equal steps is called a stepper motor. Nema Integrated with a 48.4mm planetary gearbox of 49:1 gear ratio, the 17A-stepper motor has a 39mm body and a 1.69A rated current.

Fig -1.5 Nema stepper motor

SOLAR CHARGE CONTROLLER:-

The voltage and current from solar panels must be controlled by a solar charge controller in order to avoid overcharging and damaging batteries. For panels that produce between 14 and 18 volts, it is very important to make sure batteries receive the ideal 12 to 13.5 volts for full charge. Controllers ranging from 4 to 55 amps are beneficial for the majority of battery-based systems, however small maintenance panels might not need them. The types of these controllers range from straightforward one- or two-stage controls that use relays or transistors to more sophisticated three-stage or PWM controllers, such as those made by Morningstar or Xantrex. Commonly incorporated are indicators like LEDs or digital meters, and some more recent models have integrated computer interfaces for control and monitoring.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, October 2024

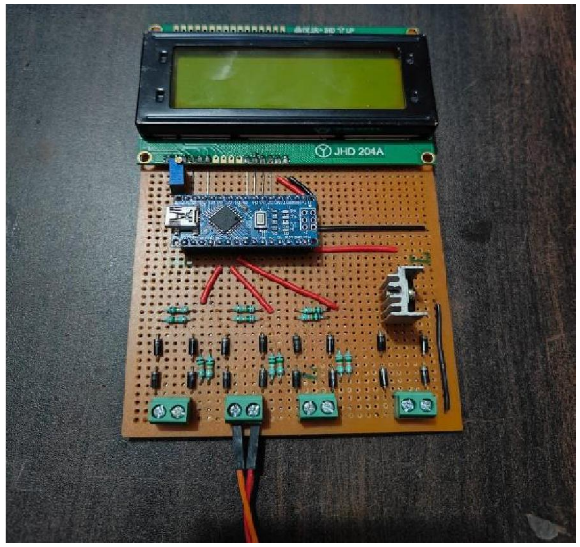

Fig -1.6 Solar charge controller

II. OBSERVATION AND RESULT

The synergy in energy output and dependability attained is an observation of a hybrid power generation system that uses both solar and wind energy sources. While wind energy production might fluctuate during the day and night depending on the weather, solar energy production typically peaks during the day.In conclusion, the observation emphasizes how solar and wind energy work together harmoniously in hybrid power production systems, resulting in improved stability, dependability, and total energy efficiency.

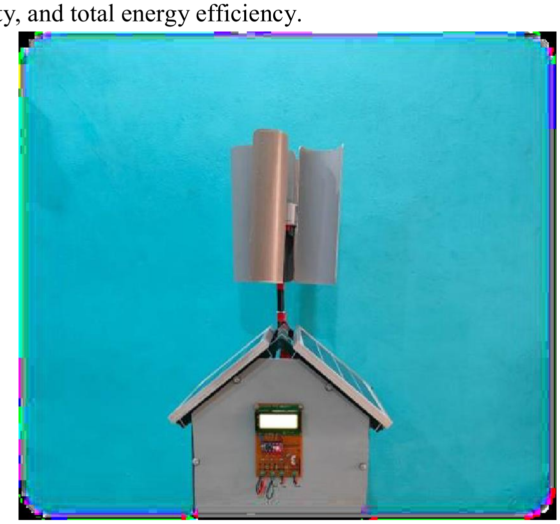

Fig -2.1 Power generation by solar& wind

In summary, hybrid power generation systems that combine wind and solar energy present a viable way to address the issues associated with the unpredictability of renewable energy. These systems can produce power more reliably, steadily, and efficiently by combining the complementing qualities of these two plentiful resources. Such hybrid systems can be observed to provide a more consistent output over time by mitigating the inherent intermittency of individual energy sources. Furthermore, regional optimization is made possible by the geographic diversity of solar and wind resources, which raises the system's overall dependability even further. Additionally, by combining two clean and renewable energy sources, hybrid solar-wind systems lessen their need on fossil fuels and their negative environmental effects, helping to create a more sustainable energy landscape. All things considered, the ongoing advancement and

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, October 2024

implementation of hybrid solar-wind power production systems hold great potential for moving closer to a low-carbon, more resilient energy future.

III. OBSERVATION AND RESULT

[1]. Hau, E. Wind Turbines, Fundamentals, Technologies, Application, Economics, 2nd ed.; Springer: Berlin, Germany, 2006.

[2]. Dominy, R.; Lunt, P.; Bickerdyke, A.; Dominy, J. Self-starting capability of a darrieus turbine. Proc. Inst. Mech. Eng. Part A J. Power Energy 2007, 221, 111–120.

[3]. Holdsworth, B. Green Light for Unique NOVA Offshore Wind Turbine, 2009. Available online: http://www.reinforcedplastics.com (accessed on 8 May 2012).

[4]. Gasch, R.; Twele, J. Wind Power Plants; Solarpraxis: Berlin, Germany, 2002.

[5]. Gorban, A.N.; Gorlov, A.M.; Silantyev, V.M. Limits of the turbine efficiency for free fluid flow.

[6]. J. Energy Resour. Technol. Trans. ASME 2001, 123, 311–317.

[7]. Burton, T. Wind Energy Handbook; John Wiley & Sons Ltd.: Chichester, UK, 2011.

[8]. Hull, D.G. Fundamentals of Airplane Flight Mechanics; Springer: Berlin, Germany, 2007

[9]. Z. Gao, Y. Zhu, C. Liu, H. Qian, W. Cao, J. Ni, Design and test of a soil profile Moisture sensor based on sensitive soil layers, Sensors 18 (5) (2018) 1648