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Power generation on highway by using Vertical windmill and Solar System

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Abstract: In today's modern life, the demand on electricity is greater than the production of it. One of the biggest issues that has been realized is that natural resources are going to be finished one day and a replacement is to be found. In order to overcome such problems, the use of renewable energy sources is very important. Renewable energy sources such as wind and solar has gained command over the last few decades. The output of these sources depends on the weather conditions Hence if, there is a combination of two sources then the desirable electrical power can be produced. The proposed hybrid power generation system uses wind and solar resources. The proposed system focuses on use of air on highway divider with the help vertical axis wind turbine. When the vehicle passed on the highway it produces a considerable amount of air due to its speed. This air tangentially strikes on the blade of the vertical axis wind turbine and it makes a rotation of the turbine in only one direction. The solar system is used to generate electrical energy. The electrical output of vertical axis turbine and the solar system is stored in a battery. This stored energy can be used for automatic street lighting, toll gates, etc.

Keywords: Solar Panel, Vertical Windmill, Aurdino, Wifi Module, Led, Power Generation and Battery.

I. INTRODUCTION

The demand for electricity is rising in modern times, and the depletion of natural resources and the pollution caused by conventional energy sources must be addressed. Renewable energy sources, such as wind and solar power, offer a solution to these problems. India, with its large population, has a significant demand for electricity, and a shift towards nonconventional power generation methods is necessary. The use of vertical axis wind turbines (VAWT) on highways is a cost-effective and environmentally friendly method of power generation. A hybrid system using both wind and solar energy sources can supplement each other in case of unavailability. The rotor turbine is designed to rotate from traffic in both lanes, making it an efficient way to generate power on highways. The solar panel uses the maximum power point tracking (MPPT) principle. An additional feature of this system is street light control using light-dependent resistors (LDR) and infrared (IR) sensors. Overall, this method is not only cost-effective but also highly efficient.

II. LITERATURE SURVEY

Liu, J et.al,[1], Review on the technical perspectives and commercial viability of vertical axis wind turbines, 2019. In the context, the existing technical challenges and specific solutions in the development of Vertical Axis Wind Turbines (VAWTs) is presented.This paper will present a fresh look at cutting-edge VAWTs in order to look into new opportunities and possibilities for their commercial potential. A thorough comparison between VAWTs and HAWTs was done, with various sections focusing on their aerodynamic performance, efficiency, power density in a wind farm, and ability of self-starting. The goal of this review paper is to identify the future of commercial VAWTs in the market for wind turbines, which is now dominated by traditional HAWTs, as well as technical obstacles, design issues, and market potential. The paper will go over the major technical obstacles that will keep VAWTs from competing with HAWTs in the future.Also the investigation on whether VAWTs are more competitive in offshore applications or not as a result of lessons learned from onshore turbine installations is done. Kumar.R et.al,[2]

A critical review of vertical axis wind turbines for urban applications, 2018. By doing exploratory searches among the signals present on the internal field bus system and contrasting the observed signal relationships across a variety of equipment that performs comparable activities, it is possible to perform the exploratory searches. this research offers an alternative method that accumulates knowledge over time. As vehicles of similar 6 make will have the same type of data signals flowing in their CAN (controller area network) and data bus, they can use it as a reference to find vehicles with errors. They used an internet module to collect signals from vehicle Controller networks and data transmission buses and compared them with the data from other vehicles of similar make. Tasneem.Z, et.al,[3] An analytical review on the evaluation of wind resource and wind turbine for urban application: prospect and challenges, Developments in the Built Environment, 2020. The goal of this review article is to highlight the current state of technology for urban wind farms as well as its economic and environmental implications. On the basis of recent data, thr observations and forthcoming trends in research have been provided. Conclusion: More investigation into the wind mapping and the appropriate building of turbine is needed in order to make the wind farm in urbans, a reliable and workable alternative for decentralised power generation. The study concluded that VAWTs are more preferable than HAWTs because they are more economical, environmentally friendly, and less susceptible to turbulence and changing wind conditions. Savonius turbines are good for their low-cost and are extremely reliable projects, whilst Darrieus turbines are suggested for fairly priced and effective wind farm facilities. H-rotors are efficient in cities, but further research is needed before they can be considered a distinct UWT technology. The importance of dispersed power generators, such as urban wind farms, is underlined as a means of addressing the present energy demand. Amjith, L. R et.al,[4]

Analytical review on Design, modeling and economic performance of a vertical axis wind turbine, 2020. The main goal of the project was to build and to model a small-scale VAWT that was used to supply electricity for applications with minimal demand. The rotational performance of Savonius rotor blades in two novel configurations was compared to that of the conventional straight and curved blades. Using MATLAB simulation, a mathematical model was developed that took into account the mechanical, electrical, tip speed ratio, and wind power coefficient. The model was validated using measured data from the constructed turbine. The tests was conducted for the rotational performances of four styles of Savonius rotor blade types and were examined too. In all four designs, the straight blade is determined to be the least efficient, with the twisted blade type showing the best performance. Belmili, H et.al,[5]

Study, design and manufacturing of hybrid vertical axis Savonius wind 7 turbine for urban architecture, 2017. It is stated that a modest household renewable energy conversion system has been studied, designed, and manufactured. It is based primarily on a vertical axis wind turbine with a Savonius-rotor type that is locally produced and is outfitted with a photovoltaic panel and a storage Battery. This method can be applied to both building integration and remote areas. This method can be modified to ensure an uninterrupted electrical 7 supply in remote areas. The analysis, design, and production of a residential renewable energy conversion system are presented in this work. This system is based mostly on a locally produced Savonius rotor-type vertical axis wind turbine. Zhang,Z et.al,[6]

Knowledge structure and research progress in wind power generation (WPG) from 2005 to 2020 using CiteSpace based scientometric analysis, 2021. The study's conclusions about the sustainability elements of WPG systems are briefly provided by contrasting the sustainability traits for various sources of WPG. The goal of the work is to demonstrate the intellectual background, current research status, and state-of-the-art knowledge structure of WPG related literature using scientometric analysis based on CiteSpace. From the investigation following can be drawn: According to the elements impacting it, the most popular journals for WPG-related research were Renewable Energy, Energy, Energy Conversion and Management, Energies, and Journal of Wind Engineering and Industrial Aerodynamics. Regarding the core domains, performance, design, wind turbine, optimization, and model were the top five co-occurring terms connected to WPG listed based on counts. China is the most significant country among others in the wind energy harvesting, holding 29 percent of the total with 224 publications. Chougale, P. K. N et.al,[7]

Highway windmill, 2018. In this work, VAWT is used to overcome the challenge of supplying lighting over the entire length of a highway (Vertical Axis Wind Turbine). This study sought to develop a highly portable and environmentally friendly method of producing electricity utilising wind energy and other renewable energy sources. By utilising the latest vertical axis turbine approach and customising the blade design, we can create a reliable energy-generating system that operates in and around our residential area regardless of the direction of the wind. The goal of this essay is to lessen the effects of global warming. If the turbine's speed rises, the alternator's speed rises as well, resulting in more power being produced at the output terminal. Vignesh, J et.al,[8]

Design and fabrication of vertical axis wind mill with solar system, 2020. This paper's major goal is to design and build a vertical axis wind mill that can function even in light winds. The best use of wind energy was made possible by the design and construction of a windmill with a solar system for power generation and irrigation. Padmanaban, S et.al,[9]

On The Structural Implementation of Magnetic Levitation Windmill, 2017. This article describes the optimal structural design and performance of a vertical axis wind turbine (VAWT) that uses magnetic levitation technology. The additional benefits, such as spinning at low wind speed, greater efficiency, minimal noise emission, etc. are quantified with the support of conventional VAWT. One maglev turbine with a large capacity provides extra productivity when compared to conventional horizontal wind turbines. Utilizing magnets 8 to spin quickly and with less friction as it removes tension

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from the turbine shaft increases the efficiency of the turbine. In comparison to traditional wind turbines, the suggested turbine plan produces more electricity while maintaining a greater efficiency. Prabowo, A. R et.al,[10]

Investigation on Savonius turbine technology as harvesting instrument of non-fossil energy: Technical development and potential implementation, 2020. In this paper, the Savonius turbine technology is evaluated as a tool for harvesting clean energy.The use of the technology in water and open air conditions follows a succession of advances on turbine performance and technical adjustments. Several key influencing factors are noted, including rotor design, operation depth, and nozzle attachment. Cashman, A et.al,[11]

A review on the historical development of the lift-type vertical axis wind turbine: From onshore to offshore floating application, 2020. The lift-type vertical axis 8 wind turbine (VAWT) and its historical progression from the invention of it in the early 1930s are covered in this study. Because the HAWT dominated the wind energy industry in the 1990s, this assessment emphasises how little engineering work was done on the VAWT. However, the data also indicates that the VAWT has entered a Renaissance era in which the offshore floating wind turbine industry is currently using it. There have been recorded attempts to commercialise floating VAWT technology as well as the most recent advancements in this field. Hariharan, R et.al,[12]

Design of wind turbine blade material for higher efficiency, 2020. The implementation of efficiency through the mixing of new materials is examined in this paper.This article comes to the conclusion that using materials like copper, aluminium, zinc, and other metals will make the blades survive longer and allow them to revolve smoothly with the wind's speed.It can also generate the required amount of power, which can be easily stored and used without wasting any of the power generated. Oguz, E et.al,[13]

A review of the optimization studies for Savonius turbine considering hydrokinetic applications, 2020. This essay aims to discuss Savonius turbine optimization studies in light of the turbine's potential uses in hydrokinetic energy harvesting. There is a full discussion of the studies pertaining to each structural parameter determining the performance of the turbine. It summarises the Savonius design optimization studies that only take the operating medium of water into account. In order to fill the gaps in this field with regard to hydrokinetic application, researchers will be able to use the data offered in this study as a basis to understand the Savonius turbine research that has already been done. Mondal, T et.al,[14]

Sun Tracking Solar Panel Without Microcontroller, 2019. There are two primary categories of sun tracking systems: single-axis solar trackers and dual-axis solar trackers. The suggested idea aims to create a scalable sun tracking system without a microcontroller, which can be more affordable than previous solar panel circuits from our perspective. The solar system proposed in this study can follow the sun using two small solar panels as a reference, track the path by monitoring the difference between the voltages of the two reference panels, and move the system's structure using a stepper motor. Allamehzadeh, H. et.al,[15]

An Update on Solar Energy and Sun Tracker Technology with a Dual Axis Sun Tracker Application, 2019. This essay provides an overview of solar energy's history as well as an update on Sun tracker technology. The major focus of this project is the development of a sun tracker system using four LDR sensors and electrical control circuits. To ensure the maximum power is delivered from the solar array to a load, the MPPT algorithm is used. In order to improve the system's overall performance, a PID controller was added to the feedback loop. The composite system is simulated using MATLAB software. Finally, the developed circuits are implemented in a lab and the composite system's overall performance is assessed.

III. METHODOLOGY

The proposed project aims to create a system that can generate power on highways using a combination of vertical axis turbine and solar energy. The project will be divided into three stages, with the first stage being focused on energy generation. In this stage, the design of the vertical axis turbine will be developed, and the optimal placement of the solar panel over the turbine will be determined. The solar panel will operate using the concept of maximum power point tracker (MPPT), which will ensure that it operates at its maximum efficiency. The generated power will be used efficiently and stored onto the battery.

The second stage of the project will involve energy monitoring. The power generated by the renewable source of energy will be monitored and uploaded to the cloud using ThingSpeak, where the data will be stored and analyzed for a set duration.

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The third stage of the project will involve the usage of the generated power for two end applications: EV charging stations and street light control. The overall working of the project will be such that whenever the air strikes the savonious type of vertical axis wind turbines, some amount of electricity will also be generated and stored in the battery for further use. The solar panel will operate using LDR sensors, which will detect maximum sunlight and then rotate the motor to the corresponding direction, producing electrical energy by vehicle headlights during night time.

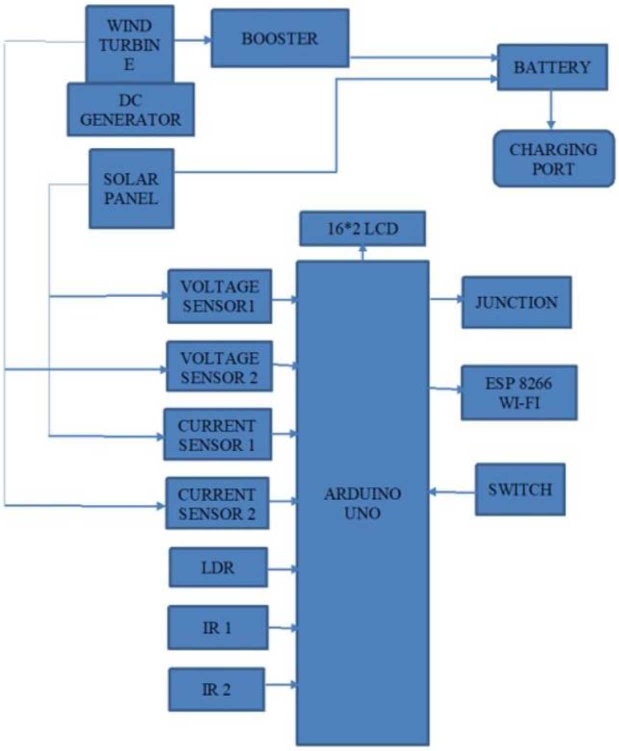

Fig 1 : Block Diagram

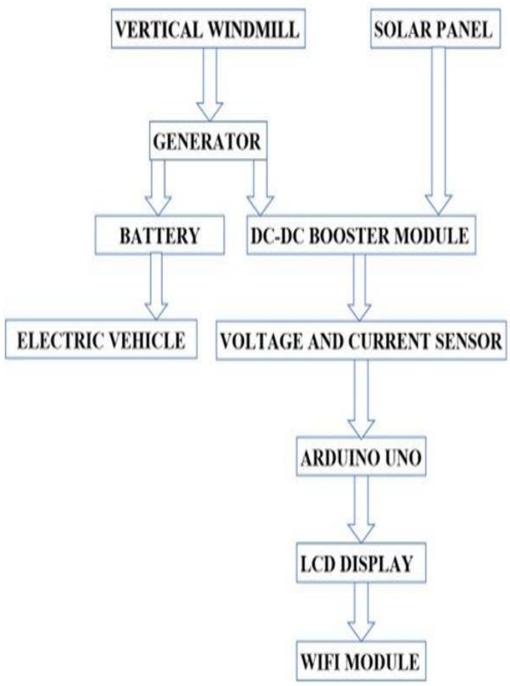

Fig 2 : Flowchart

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IV. CONCLUSION

In today's world, the focus is on creating machines that limit greenhouse gas emissions and promote the use of renewable energy sources over non-renewable ones. Utilizing innovative ideas, renewable energy sources can be implemented in various applications to provide clean energy while reducing costs and minimizing environmental damage. Vertical Axis Wind Turbines (VAWTs) are a low-cost, environmentally-friendly option that can be used for small-scale operations and maintenance. Combining wind and solar energy on highways is an effective way to generate continuous power, providing an alternative to depleting energy sources. Grouping turbines on long strips of highways can produce significant amounts of energy to power street lights, rural areas, and public places, while also allowing for potential profits from selling excess power to the grid.

For our project, we will install vertical turbines on highways to generate electricity from wind energy produced by passing vehicles. Additionally, solar panels will be placed to capture solar energy during the day and energy from vehicle headlights during the night. The power generated will be used to light up the streets at night using a smart energy conservation system that turns on the lights only when there is vehicle movement, saving up to 50 percent of energy. LDR sensors will detect day and night time to automatically turn the lights on and off. We will monitor power generation and consumption using a sensor network and upload the data to the cloud using IoT technology.

V. FUTURE SCOPE

By using vertical windmills and solar systems on highways, we can tap into the renewable sources of energy and reduce our reliance on non-renewable sources such as coal and oil. The use of vertical windmills and solar systems on highways can provide an affordable alternative to traditional power sources, especially in remote areas where the cost of grid connectivity is high. By installing vertical windmills and solar systems on highways, we can create a network of microgrids that can supply power to nearby communities and industries. The use of renewable energy sources can significantly reduce the carbon footprint of the power generation sector. The cost of electricity generated from renewable sources has been declining steadily over the years. The integration of vertical windmills and solar systems with smart grids can enable real-time monitoring and control of power generation and consumption, improving grid stability and reducing the risk of blackouts.

REFERENCES

[1] Liu, J., Lin, H., Zhang, J. (2019). Review on the technical perspectives and commercial viability of vertical axis wind turbines. Ocean Engineering, 182, 608-626.

[2] Kumar, R., Raahemifar, K., Fung, A. S. (2018). A critical review of vertical axis wind turbines for urban applications. Renewable and Sustainable Energy Reviews, 89, 281-291.

[3] Tasneem, Z., Al Noman, A., Das, S. K., Saha, D. K., Islam, M. R., Ali, M. F., ... Alam, F. (2020). An analytical review on the evaluation of wind resource and wind turbine for urban application: Prospect and challenges. Developments in the Built Environment, 4, 100033.

[4] Dennis, D., Ganesh, P. S., Joy, J., Amjith, L. R., Bavanish, B. (2022). Computational design analysis of vertical axis wind turbine. Materials Today: Proceedings.

[5] Belmili, H., Cheikh, R., Smail, T., Seddaoui, N., Biara, R. W. (2017). Study, design and manufacturing of hybrid vertical axis Savonius wind turbine for urban architecture. Energy Procedia, 136, 330-335.

[6] Azam, A., Ahmed, A., Wang, H., Wang, Y., Zhang, Z. (2021). Knowledge structure and research progress in wind power generation (WPG) from 2005 to 2020 using CiteSpace based scientometric analysis. Journal of Cleaner Production, 295, 126496.

[7] Bavchakar, A., Chougale, P. K. N., Belanekar, S. S., Rane, S. P., Sawant, N. B. (2018, March). A hybrid model of vertical axis wind turbine-solar power generation for highway and domestic application. In 2018 international conference on computation of power, energy, information and communication (ICCPEIC) (pp. 135-139). IEEE.

[8] Vignesh, J., Christopher, A. S., Albert, T., Selvan, C. P. T., Sunil, J. (2020). Design and fabrication of vertical axis wind mill with solar system. Materials Today: Proceedings, 21, 10-14.

DOI: 10.17148/IARJSET.2023.10436

[9] Bhaskar, M. S., Padmanaban, S., Siano, P., Fedák, V., Vaidya, H., Taur, A. (2017, June). On the structural implementation of magnetic levitation windmill. In 2017 IEEE International Conference on Environment and Electrical Engineering and 2017 IEEE Industrial and Commercial Power Systems Europe (EEEIC/ICPS Europe) (pp. 1-5). IEEE.

[10] Prabowo, A. R., Prabowoputra, D. M. (2020). Investigation on Savonius turbine technology as harvesting instrument of non-fossil energy: Technical development and 29 potential implementation. Theoretical and Applied Mechanics Letters, 10(4), 262-269.

[11] Hand, B., Cashman, A. (2020). A review on the historical development of the lifttype vertical axis wind turbine: From onshore to offshore floating application. Sustainable Energy Technologies and Assessments, 38, 100646.

[12] Dathu, K. P. M. Y. V., Hariharan, R. (2020). Design of wind turbine blade material for higher efficiency. Materials Today: Proceedings, 33, 565-569.

[13] Maldar, N. R., Ng, C. Y., Oguz, E. (2020). A review of the optimization studies for Savonius turbine considering hydrokinetic applications. Energy Conversion and Management, 226, 113495.

[14] Mitra, D., Das, D., Brahma, D., Maiti, D., Mondal, T. (2019, March). Sun Tracking Solar Panel Without Microcontroller. In 2019 International Conference on OptoElectronics and Applied Optics (Optronix) (pp. 1-3). IEEE.

[15] Allamehzadeh, H. (2019, June). An update on solar energy and sun tracker technology with a dual axis sun tracker application. In 2019 IEEE 46th Photovoltaic Specialists Conference (PVSC) (pp. 2037-2044). IEEE.

[16] Kim, B. (2019). Design method of a direct-drive permanent magnet vernier generator for a wind turbine system. IEEE Transactions on Industry Applications, 55(5), 4665- 4675.

[17] Meena, P., Prema, V., Bhaskar, M. S., Almakhles, D. (2021). Bi-Furcated Stator Winding Configuration in Three-Phase Induction Generators for Wind Power Generation. IEEE Access, 9, 153188-153198

