Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 14, Issue. 01, January -2023
ISSN : **1906-9685**

Roadways Wind Turbine Technology

Raja Kumar
Assistant Professor
Mechanical Engineering
Arya Institute of Engineering & Technology, Jaipur, Rajasthan

Pankaj Kumar
Assistant Professor
Mechanical Engineering
Arya Institute of Engineering & Technology, Jaipur, Rajasthan

Pritam meena
Research Scholar
Electrical Engineering
Arya Institute of Engineering & Technology, Jaipur, Rajasthan

Rahul meena
Research Scholar
Electrical Engineering
Arya Institute of Engineering & Technology, Jaipur, Rajasthan

Dilraj meena
Research Scholar
Electrical Engineering
Arya Institute of Engineering & Technology, Jaipur, Rajasthan

ABSTRACT

The project aims to develop a wind turbine system capable of harnessing wind energy generated by vehicles on highways. Wind energy is recognized as a rapidly growing and clean energy source; however, its use is constrained by the variability of natural wind. Highways, with their high volume of traffic, offer an ample source of wind that remains untapped. To achieve this goal, extensive research into wind patterns is essential in order to determine the average wind velocity produced by oncoming vehicles. The wind turbines will be strategically placed on the medians, taking into account the fluid flow from both sides of the highway in the design process. With the data collected, these wind turbines can be integrated into existing streetlights located on the medians. Recognizing that the wind source may fluctuate, a power storage system will be designed to ensure a consistent and reliable power

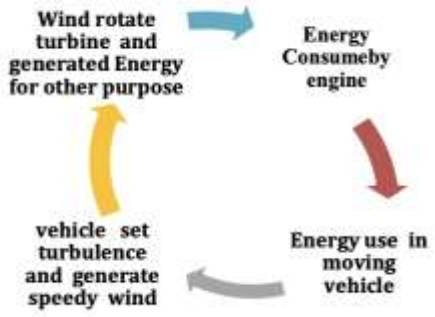
http://doi.org/10.36893/JNAO.2023.V14I1.0001-0007

supply. The ultimate objective is to create a turbine system that can be adopted worldwide, providing an essentially limitless power source for streetlights and various other public utilities.

Keywords:- Wind turbine system, Wind energy, Clean energy source, Natural wind variability, Highways, Traffic volume, Wind patterns, Wind velocity, Fluid flow, Medians, Streetlights, Power storage system, Reliable power supply, Worldwide adoption, Public utilities, Sustainable energy, Energy generation, Renewable energy, Turbine design, Power source.

1. INTRODUCTION:-

The world is currently experiencing an unprecedented surge in energy consumption, driven by rapid urbanization, population growth, and a rising demand for advanced technologies. This surge in energy demand has prompted a crucial shift towards sustainable and renewable energy sources. The need to reduce greenhouse gas emissions, mitigate the impacts of climate change, and secure a clean and reliable energy future has never been more pressing.



One innovative approach to addressing this energy challenge is the development and implementation of Roadway Wind Turbine Technology (RWTT). As vehicular traffic continues to grow, highways and road networks are becoming increasingly congested. This growing traffic not only symbolizes the complexities of modern urban life but also serves as a largely untapped source of energy.

RWTT aims to harness the energy potential created by the constant movement of vehicles on roadways. Wind energy is recognized as a clean and renewable source, but its utilization is often constrained by the variability of natural wind patterns. However, the turbulence generated by the high-speed motion of vehicles on highways offers a consistent and predictable source of kinetic energy that can be converted into electricity.

This technology holds the promise of transforming our road networks into sustainable energy generators. By strategically placing wind turbines along roadways and integrating them with existing infrastructure, we can tap into a powerful, continuous source of energy. As we look to the future, this concept offers the potential to not only reduce the environmental footprint of our transportation systems but also contribute significantly to our energy needs.

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008

In this research paper, we delve into the various facets of RWTT, exploring the scientific principles behind it, the existing efforts and research in this field, and the potential applications and challenges. We aim to provide a comprehensive overview of the technology, its feasibility, and the implications it holds for a sustainable energy future.

Throughout this exploration, we will consider the technical aspects of RWTT, from the design and placement of turbines to the generation and storage of electricity. We will also examine real-world applications, environmental considerations, and the potential impact on energy generation and road infrastructure.

As society seeks to transition toward cleaner and more sustainable energy solutions, RWTT emerges as a promising and novel approach to address both our energy needs and our commitment to environmental stewardship. The research and development in this area are crucial as we work towards a more sustainable and energy-efficient future.

Keywords:- Energy consumption, sustainable energy, Renewable energy sources, Greenhouse gas emissions, Climate change mitigation, Roadway Wind Turbine Technology (RWTT), Vehicular traffic, Wind energy, Kinetic energy, Road networks, Wind turbines, Infrastructure integration, Environmental footprint, Energy generation, Research paper, Feasibility, Sustainability,Energy storage, Real-world applications, Environmental considerations, Energy-efficient future, Urbanization, Population growth, Advanced technologies, Clean and reliable energy, Impacts of climate change, Continuous source of energy, Technical aspects, Environmental stewardship, Research and development.

2. GLOBAL APPLICATIONS:-

Every city on the planet can make advantage of the design. It should be environmentally friendly. There will be manuals and labels available in multiple languages for each individual city.Figure 1 shows a dramatic increase in the e power increased by nearly 20% in 2012 reaching a new peak of 282 GW. Various sources such as the Global Wind Energy Council show China as a leading country in the employment of Wind energy

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008

Highway Wind Turbine (Quite Revolution Turbine)

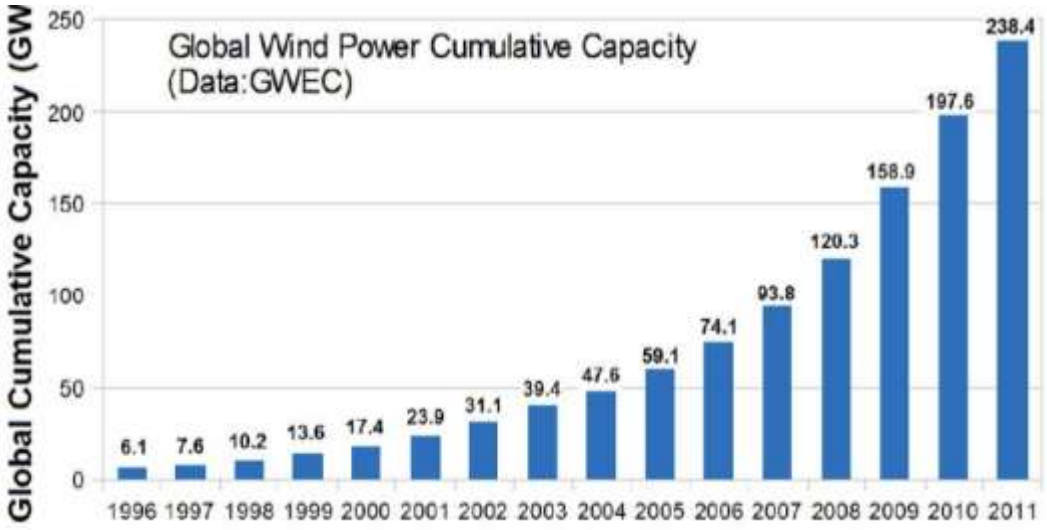


Figure 1:*Global Wind Energy Trend, Global Wind Energy Council data*

3. DESIGN PARAMETER:-

Wind speed, V = 7 m/s
Blade length, l = 0.226 m
Breath, b = 0.077 m
Area of Blade = l x b = 0.0174 m2
Power generated-150 w
Rated wind speed-6.5 m/sec
Aspect ratio-8.91
Solidity-16.66
Diameter-Heigh-300mm300m
Number of blades-3

4. COMPONENT:-

1. Angle
2. Dynamo
3. Gear
4. Shaft
5. Blades
6. Nut, Bolts and Washer
7. Bearing
8. Other attachments
9. Wiring

5. POWER CALCULATION:-

Power can be defined by the formula P= 1/2ρAV^3

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008

Where, P = power output
velocity = 40kmph

A is the turbine's area; h * d = 1.21 * 0.91 Taking into account a 41% turbine efficiency and a 75% generator efficiency,

P= ½ ϱ AV^3

P = 0.00508 * (1.21 * 0.91) * (40)^3 * 0.41 * 0.75

P = 110.08 Watt.

6. PROBLEM STATEMENT AND SOLUTION:-

Wind energy faces a significant challenge due to the variability of wind sources. One promising solution is to harness wind energy from highways, which exhibit considerable wind potential. To achieve this, it is essential to conduct a thorough analysis of the airflow resulting from traffic on highways.

This analysis will provide crucial boundary parameters for designing a wind turbine capable of storing energy for use during periods of low traffic or congested conditions, such as bumper-to-bumper or stop-and-go traffic. It is imperative that the design prioritizes sustainability and environmental friendliness.

The majority of wind turbines used in various applications are of the horizontal axis type. However, a key limitation of these turbines is their inability to efficiently capture wind from all directions. Alternatively, vertical-axis wind turbines offer a distinct advantage in their ability to harness wind power from all directions. This advantage has led us to choose vertical-axis wind turbines for our project.

7. RESULT AND CONCLUSION

Based on the traffic surveys, data collected and data analysis Amount of Traffic in the Study Area found per day was -56532 numbers of vehicles from Bogarves to Chennamma Circle, from RTO Circle to Chennamma circle-53116 numbers of vehicles and for Chennamma Circle to Kolhapur Circle is- 64141 number of vehicles. The average velocity was found as 18.94 from the Chennamma circle to the RTO Circle and 19.73 is for the RTO Circle to the Chennamma Circle. Traffic Windmills for the Smart Road Network are designed with the followinG specifications;

- Height of wind turbine=1400mm
- Height of blade = 500mm
- Velocity of wind = 7m/s
- Diameter of shaft = 25mm

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008

- Number of blades = 3 no's.

Fabrication of the Traffic windmills for the Smart Road Network is done with the following Specifications.

- Height of wind turbine=1400mm
- Height of blade = 500mm
- Velocity of wind = 7m/s
- Diameter of shaft = 25mm

References:

[1] Pramod M S, Naveen P N, Chaithra N R, Ranjith K and Vikas G H S 2018 Monitoring of highway wind power parameter and controlling highway light through IOT In RTEICT 2017 - 2nd IEEE International Conference on Recent Trends in Electronics, Information and Communication Technology Proceedings 1750-1753

[2] Fahmi M I, Kumar Rajkumar R, Wan W Y, Lee W C, Arelhi R and Isa D 2016 The Effectiveness of New Solar Photovoltaic System with Supercapacitor for Rural Areas International Journal of Renewable Energy Development 5 249-257

[3] Al-Bahadly Ibrahim 2009 Building a wind turbine for rural home. Energy for Sustainable Development 13 159-165

[4] Khan M, Alavi M, Mohan N, Azeez A, Shanif A and Javed B 2017 Wind Turbine design and fabrication to power street lights MATEC Web of Conferences 108 08010

[5] Howell R, Qin N, Edwards J and Durrani N 2010 Wind tunnel and numerical study of a small vertical axis wind turbine Renewable Energy 35 412-422

[6] Acosta P S, Tilvaldyev S, Anaya L G G, Sanchez G E G and Garay J F 2012 Advance High Efficient Aerodynamic Blades For Vertical Axis Wind Turbine Modular Aggregate International Journal of Arts & Sciences 08 617-626

[7] Tyagi R K 2012 Wind Energy and Role of Effecting Parameters European Journal of Applied Engineering and Scientific Research 1 73-83

[8] Kalmikov A 2017 Wind Power Fundamentals In Wind Energy Engineering: A Handbook for Onshore and Offshore Wind Turbines 1-46

[9] Liton Hossain M, Abu-Siada A and Muyeen S M 2018 Methods for advanced wind turbine condition monitoring and early diagnosis: A literature review Energies 11 1-14

[10] Bruce C, Geatjens A and Antonia S 2013 Highway Wind Turbines 1-21 Master Thesis Florida International University

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008

[11] Chong W T, Fazlizan A, Poh S C and Pan K C 2014 Vertical axis wind turbine with the omni-direction-guide-vane for urban high rise application Journal of Central South University of Technology 19 1-7

[12] Louis Vathan B, Murugaperumal G, Paramasavan K and Hoshila K 2014 Design and Fabrication of Three Bladed Giromill Wind Turbine (Chennai: Final Year Dissertation Anna University) 1-69

[13] R. K. Kaushik Anjali and D. Sharma, "Analyzing the Effect of Partial Shading on Performance of Grid Connected Solar PV System", *2018 3rd International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE)*, pp. 1-4, 2018.

[14] R. Kaushik, O. P. Mahela, P. K. Bhatt, B. Khan, S. Padmanaban and F. Blaabjerg, "A Hybrid Algorithm for Recognition of Power Quality Disturbances," in *IEEE Access*, vol. 8, pp. 229184-229200, 2020.

[15] Kaushik, R. K. "Pragati. Analysis and Case Study of Power Transmission and Distribution." *J Adv Res Power Electro Power Sys* 7.2 (2020): 1-3, no. X, pp. 1-4, October 2021.

[16] R. Kaushik, O. P. Mahela and P. K. Bhatt, "Hybrid Algorithm for Detection of Events and Power Quality Disturbances Associated with Distribution Network in the Presence of Wind Energy," *2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)*, Greater Noida, India, 2021, pp. 415-420.

[17] P. K. Bhatt and R. Kaushik, "Intelligent Transformer Tap Controller for Harmonic Elimination in Hybrid Distribution Network," *2021 5th International Conference on Electronics, Communication and Aerospace Technology (ICECA)*, Coimbatore, India, 2021, pp. 219-225

[18] R. Kaushik, O. P. Mahela and P. K. Bhatt, "Events Recognition and Power Quality Estimation in Distribution Network in the Presence of Solar PV Generation," *2021 10th IEEE International Conference on Communication Systems and Network Technologies (CSNT)*, Bhopal, India, 2021, pp. 305-311

http://doi.org/10.36893/JNAO.2023.V14I1.0001-0008