

SOLAR CHARGED ELECTRIC SCOOTER

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ABSTRACT

This project focuses on the design and development of a “solar electric scooter” aimed at promoting sustainable transportation. The primary objective was to create a lightweight, efficient scooter that utilizes solar energy for charging its electric battery, thereby reducing dependence on conventional power sources and minimizing environmental impact. The methodology involved selecting suitable materials and components, including a brushless DC motor, lithium-ion battery, and high-efficiency solar panels. A systematic design process was employed, leading to the construction of the scooter. Performance testing was conducted to evaluate key parameters such as speed, range, and charging efficiency under various weather conditions. Key findings indicate that the solar electric scooter can achieve a maximum speed of 25 km/h and a range of up to 30 km/h on a full charge. Under optimal sunlight conditions, the solar panels significantly enhance battery charging, allowing for extended usage without relying solely on grid power. Challenges included optimizing weight distribution and ensuring adequate solar exposure during operation. Overall, the project demonstrates the viability of integrating solar technology into personal transportation solutions, contributing to a cleaner, more sustainable future. Further improvements can be made in energy storage and aerodynamics to enhance performance, paving the way for future innovations in eco-friendly transport.

Keywords- Solar panel, E- bike Controller, lead acid battery - 24v.

1. INTRODUCTION

The increasing global emphasis on sustainable development and environmental conservation has led to a growing interest in alternative modes of transportation. As urban areas expand and populations rise, the demand for efficient and eco-friendly mobility solutions becomes paramount. Traditional gasoline-powered vehicles contribute significantly to air pollution and greenhouse gas emissions, making it crucial to explore innovative alternatives. The solar electric scooter project was motivated by the need to reduce the environmental impact of personal transportation while providing a practical solution for urban commuting. Sustainable transport plays a vital role in addressing climate change and reducing urban congestion. It promotes the use of renewable energy sources, reduces dependence on fossil fuels, and minimizes the carbon footprint of daily travel. By integrating solar energy into personal transportation, we can harness a clean, abundant resource to power electric vehicles, thereby supporting a transition toward greener urban mobility. The solar electric scooter represents a step forward in this transition, offering a sustainable alternative for short-distance travel. Currently, the market is flooded with various electric scooters that cater to different user needs. These scooters provide advantages such as low operational costs and reduced emissions compared to their gasoline counterparts. However, they also face limitations, including limited range due to battery capacity, dependence on grid electricity for charging, and extended charging times. Additionally, many electric scooters lack the integration of renewable energy sources, which can further enhance their sustainability. The solar electric scooter project aims to overcome these challenges by incorporating solar panels for charging, thus extending range and reducing reliance on conventional power sources, making it a more sustainable and practical option for everyday use. The rise of urbanization and the corresponding increase in vehicle usage have led to significant environmental challenges, including air pollution, traffic congestion, and climate change. The rise of urbanization and the corresponding increase in vehicle usage have led to significant environmental challenges, including air pollution, traffic congestion, and climate change. As cities become more populated, the demand for efficient and sustainable modes of transportation grows. Electric scooters have emerged as a popular solution, offering an alternative to traditional vehicles by providing a convenient and eco-friendly way to navigate urban landscapes.

Electric scooters are typically powered by rechargeable batteries, which reduce reliance on fossil fuels and decrease greenhouse gas emissions. However, while they present a more sustainable option compared to gasoline-powered vehicles, they still face limitations. Most electric scooters depend on grid electricity for charging, which can contribute to carbon emissions depending on the energy source. Additionally, battery range can be restrictive, leading to concerns about usability for longer trips.

2. LITERATURE SURVEY

Research into solar-powered vehicles has gained momentum as the world increasingly seeks sustainable transportation solutions. Various studies and projects have explored the potential of solar energy to power vehicles, with significant findings that inform the development of solar electric scooters.

Solar Vehicle Design and Efficiency: Early research focused on optimizing the design of solar vehicles to maximize energy capture and efficiency. Studies have investigated the impact of solar panel placement, vehicle aerodynamics, and weight reduction on overall performance. Innovations in photovoltaic technology, such as thin-film solar cells and flexible solar panels, have enhanced the feasibility of integrating solar energy into vehicle designs.

Performance Analysis: Research has examined the performance of solar-powered vehicles in different conditions. For instance, studies have shown that solar vehicles can achieve commendable speeds and ranges, particularly in sunny climates. However, researchers have also highlighted the challenges of variable solar availability, which necessitates the incorporation of supplementary energy sources or efficient battery systems for optimal functionality.

Case Studies: Various prototypes and commercial solar vehicles have been developed, providing valuable insights into practical applications. Notable examples include solar cars used in competitions like the World Solar Challenge, which demonstrate the capabilities of solar technology in real-world scenarios. These projects have illustrated not only the potential of solar energy but also the engineering challenges involved in creating efficient and reliable solar-powered transport.

Hybrid Systems: Research has increasingly focused on hybrid systems that combine solar power with other energy sources. For example, studies have explored integrating solar panels with electric drive systems to enhance the range and reduce dependency on grid electricity.

This approach is particularly relevant for urban transportation solutions like scooters, where energy efficiency and convenience are critical.

Environmental Impact: Numerous studies have assessed the environmental benefits of solar-powered vehicles, highlighting their potential to significantly reduce greenhouse gas emissions compared to traditional vehicles. Research has emphasized the importance of lifecycle assessments, considering not only the operational phase but also the manufacturing and end-of-life disposal of solar panels and batteries.

3. METHODOLOGY

Design and Components of the Solar Electric Scooter

The design of the solar electric scooter focuses on integrating advanced technology with user-friendly features while below is an overview of the design elements and critical components.

Frame Design-

Material: The scooter frame is constructed from **Mild steel**.

Ergonomics: The design includes an ergonomic handlebar height and foot placement for user comfort during rides.

Solar Panel System-

Solar Panels: High-efficiency monocrystalline solar panels (20% or higher efficiency) are integrated into the scooter's body to maximize solar energy capture.

Battery System -

Type: A lead acid battery with a capacity of at least 24V is utilized for energy storage.

Motor-

Type: A brushless DC motor provides efficient power delivery and low maintenance

Power Rating: The motor is rated for 500-1000 W, enabling a maximum speed of 25 km/h and smooth acceleration.

RESULTS & DISCUSSION:

Charging Time and Efficiency

Solar Charging Time:

Sunny: 8 hours to fully charge.

Cloudy: 10-11 hours.

Efficiency:

Solar panels generated 80-100Wh per hour in direct sunlight.

Solar charging contributes 70-75% of energy needs.

Scooter Performance

Range:

Sunny: 30 km.

Cloudy: 22 km.

Overcast: 15 km.

Speed: 40 km/h maximum speed, unaffected by solar charging.

Power Consumption: 0.15 kWh per 10 km.

Comparison with Conventional Charging

Charging Time: Conventional charging takes 4 hours; solar charging is slower (6-10 hours).

Cost & Environmental Impact: Solar offers zero operating cost after initial investment; reduces carbon footprint.

Performance Comparison: Solar-charged scooter performs similarly to conventional scooters in optimal conditions.

4. CONCLUSIONS

Solar-powered electric scooters are a promising green alternative but may need a hybrid system for areas with less consistent sunlight.

Improvements in solar efficiency and battery technology could enhance practicality.

5. REFERENCES

- [1] Chavan, P.L., Akram, G.G., Jaysing, V., Patil, V., Pradip, P., and Kamble, S., Design and Development of Solar Two wheeler, International Journal of Innovations in Research and Technology, 2(4): 1-15, 2015.
- [2] Vaibhav Barbade, Omkar Pawar, Priya Sonkamble, Nayan Pawar, Abhishek Gore, Saurabh Gaikwad, E- Bike Powered by Solar, International Research Journal of Modernization in Engineering Technology and Science, 4(5): 1858-1861, 2022.
- [3] Mahesh S., Khande, Akshay S., Patil, Gaurav C., Andhale, Rohan S., Shirsat, Design and Development of Electric scooter, International Research Journal of Engineering and Technology, 7(5): 359-364, 2020.
- [4] Singh, Satyendra & Sharma, Nitish & Chandrakant, Shukla & Singh, Surendra, Electric Vehicles in India: A Literature Review, 7th International Conference on "New Frontier in Energy, Engineering and Science (NFEES), 19-20 March 2021, ACEIT Jaipur.
- [5] Sreelakshmi, B., Raghavendra, C., Nashad Sultan, MD., Design and Fabrication of Electric Scooter with two way power source, International Research Journal of Engineering and Technology (IRJET), 6(6): 3697-3701, 2019.
- [6] Balaji, H., Shafeek Ali, S., Srikumar, V., Venkatesh Sairam, V., Regenerative Electric Scooter using Solar Module, Indian Journal of Production and Thermal Engineering (IJPTE), 1(1): 24-27, 2020.
- [7] Mahadi Hasan Masud, Md. Shamim Akhter, Sadequl Islam, Abdul Mojib Parvej, Sazzad Mahmud, Design, Construction and Performance Study of a Solar Assisted Tri-cycle, Periodica Polytechnica Mechanical Engineering, 61(3): 234-241, 2017. <https://doi.org/10.3311/PPme.10240>.
- [8] Arsie, Ivan & Rizzo, Gianfranco & Sorrentino, Marco, A Model for the Optimal Design of a Hybrid Solar Vehicle. Review of automotive engineering. 29. 439-447, 2008.
- [9] Arun Manohar Gurrama, P.S.V Ramana Raoa , Raghuv eer Dontikurtia, Solar Powered Wheel Chair: Mobility for Physically Challenged International Journal of Current Engineering and Technology, 2(1): 211-214, 2012.
- [10] S. Prasad and K.R. Nataraj, Design and development of hybrid electric two-wheeler with solar charging methodology, International Journal of Scientific & Engineering Research, 5(11): 1515-1521, 2014.
- [11] Sankar, M.R., Pushpaveni, T., and Reddy, B.P., Design and development of Solar assisted bicycle, International Journal of Scientific and Research Publications, 3(3): 1-6, 2013.
- [12] Nataraju, S.N., Singh, P., Prasad, R., Somashekar, G., and Manoj, N., Fabrication and Development of Hybrid vehicle (scooter), In Proceedings of National Conference on Advances in Mechanical Engineering Science, 219-222, 2016