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Design and fabrication of eco - friendly solar scooter from electric scooter

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Abstract

Solar energy, a renewable source of energy, is an imminent form that, if properly used, can give rise to incredible energy that can be further used in different forms. Research is still in progress on applications like solar-powered automobiles, solar-powered steam turbines, etc. The concept of the design and fabrication of solar-powered scooters was mainly intended for the reduction of non-renewable energy consumption and environmental protection. In this connection, it is essential to design and develop an eco-friendly solar-powered vehicle. This is an electric vehicle powered by solar energy obtained from solar panels on the surface of the vehicle, and it works on the principle of the photoelectric effect. Solar vehicles aren't practical day-to-day transportation vehicles at present, but they are used as primary demonstration vehicles. In our work, a Li-ion battery is an energy storage device that can store charge from a flexible monocrystalline solar panel. A brushless DC hub motor is the prime mover, and it drives the vehicle with the support of two wheels. A solar charge controller is used to manage the charging of a battery bank and control the ratio of current and voltage. This solar electric scooter has the capability to carry weights up to 150 kg and can travel at speeds of 40 km/h. The developed solar scooter can provide an incessant journey of 7 km, or it can travel up to 3 hours continuously. It is designed to be user-friendly, free from pollution, and entirely different from conventional vehicles. This solar powered vehicle solves various problems related to the environment, and it is the most efficient pollution-free technique.

Keywords: Solar energy; Electric scooter; Solar panel; Eco- friendly Solar scooter

1. Introduction

Electric scooters are progressively available on the market. This occasion is taken towards the design and fabrication of a solar two-wheeler. Solar vehicles are a multi-disciplinary subject that covers broad and complex aspects [1]. However, it has core technologies, namely propulsion technology, energy source technology, and storage and control technology [1]. Nowadays, nonrenewable energy sources are being destroyed, so we need to use renewable energy sources. Renewable energy sources are natural sources of energy that can be replenished over time through natural processes, so we use renewable energy sources like solar energy with the support of solar panels. In this connection, we have designed and fabricated a solar-powered electric scooter. Certainly, solar-powered electric scooters are suitable for reducing the harm that CO_2 emissions inflict on the environment. Chavan *et al.* [1] developed a solar two-wheeler from an electric scooter and evaluated its performance. It was found that the average speed obtained from that solar scooter is 30 kmph. It was also found that the maximum speed attained at the end of the acceleration period was satisfactory. Vaibhav Barbade *et al.* [2] developed a solar-powered electric bike and evaluated its performance. It was found that the solar panel used in the fabricated solar-powered bike provides an efficiency of 30 to 35%. It was also found that solar hybrid scooters have the potential to be an important alternative to fuel-efficient vehicles. Mahesh S. Khand *et al.* [3] compare the different parts of the components in an electric scooter and study the design and development. It focuses on the main components, such as the battery, battery charger, motor, dc-dc converter, brushless dc hub motor, and also the rolling resistance of the tires of the vehicle. Satyendra Pratap Singh *et al.* [4] give a brief overview of the role of

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electric vehicles in reducing pollution in India. 27 percent of air pollution is caused by the transport sector, which leads to the premature deaths of 2 million Indians every year. Sreelakshmi *et al.* [5] also use a BLDC hub motor, which is 24V, a lithium-ion battery, and a speed controller, which controls the speed and also acts as a dynamic brake in the electric scooter. By considering the research gaps in these reviews, the present research work has been carried out.

2. Material and methods

In the present research work, solar thermal energy is used as fuel. A solar panel converts the sunlight into electrical energy. This energy is used as power for electrical vehicles. A BLDC hub motor replaces the engine of this scooter. The rating power of that hub motor is 48 volts, or 0.33 hp. This BLDC hub motor gets power from a 48V, 26 Ah lithium-ion battery. For controlling the speed, the potentiometric method is used. A single 120-watt solar panel is used to charge the battery. The photographs of the solar panel, electric scooter, lithium-ion battery, and solar charge controller have been presented in Figures 1–4. In addition, the technical specifications of the solar panel, lithium-ion battery, and hub motor are provided in Tables 1–3.

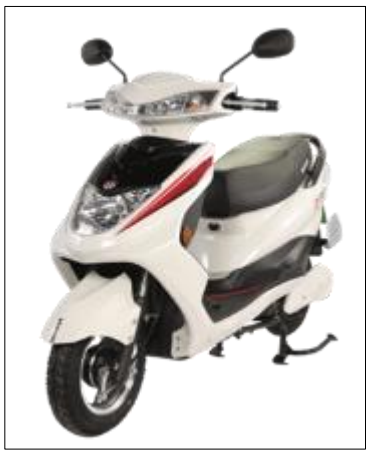

Figure 1 Electric Scooter

2.1. Solar Panel

A monocrystalline-type flexible solar panel with a module efficiency of 18.54% was commercially procured. It converts the light (photon) energy of the sun into electrical energy. It is mounted on the top of the scooter in such a way that it receives more and more photon energy. Monocrystalline solar panels are more efficient. Hence, this type of solar panel was used for this work, and for protection purposes, thick glass is used to cover the module [6].

Figure 2 Flexible Solar Panel

Table 1 Technical Specifications of Solar panel

Solar module type	U6M SF 120W
Rated maximum power(W)	120.0W
Optimum power voltage (V_{mp})	81.64V
Optimum operating current (I_{mp})	1.47A
Open circuit voltage (V_{oc})	96.48V
Short circuit voltage (I_{sc})	1.56A
Module dimensions(mm)	1070 x 690 x 23
Solar cell	Mono crystalline
Module efficiency	18.54%
Weight	3.62 kg

2.2. Lithium-Ion Battery

Li-ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. This battery has a high energy density and low self-discharge. In this connection, this battery is used to produce electricity by transforming an electron in electrochemical reactions. This rechargeable battery is used to accumulate electrons, and these electrons also constitute the current flow in the external circuit with the support of a solar panel [7].

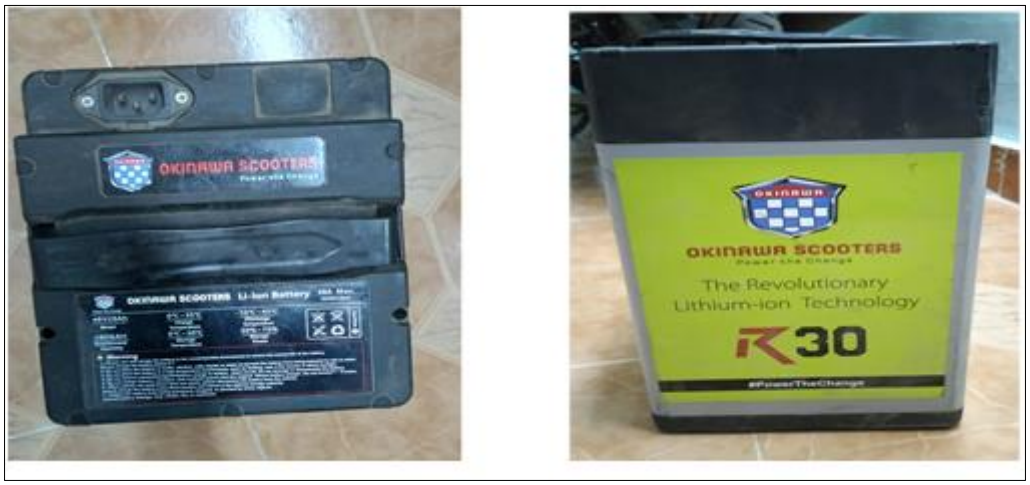

Figure 3 Lithium- ion battery

Table 2 Technical Specifications of Lithium- ion battery

Capacity	1.25Kwh
Voltage	48V
Battery capacity	26Ah
Weight	8kg
Discharge current	40A
Size	30 x17 cm

2.3. Hub Motor

A hub motor is one of a class of rotary electrical machines that converts direct current (DC)electrical power into mechanical power. The most mutual types rely on the forces created by magnetic fields. Here, a 48V, 200W brushless DC hub motor was used as the prime mover, and it drives the vehicle with the support of two wheels [6].

Table 3 Technical Specifications of Hub motor

Voltage	48V
Diameter	265mm
Motor Tire	3 x 10 Tubeless
Tire diameter	3.00- 10
Rated power	250W
Rotating speed	300-600 rpm/min

2.4. Solar charge controller

A solar charge controller is an electronic device. These are used as an important component in battery systems. A charge controller is used to manage the charging of a battery bank and control the ratio of current and voltage [8]. The solar charge controller that matches the off-grid solar system should fit in between the solar panel and the deep-rotation battery. In this connection, the MPPT (Maximum Power Point Tracking) 5 PV solar charge controller is used as a power controller in solar-powered vehicles.

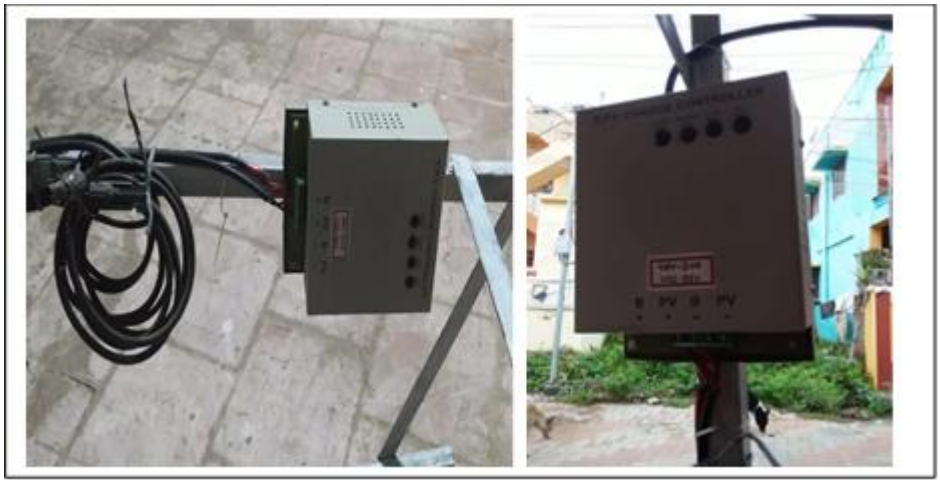

Figure 4 Solar charge controller

2.5. Fabrication of Solar powered Electric Scooter

The present work involves the design and fabrication of a solar-powered electric scooter. The flexible-type solar panel with monocrystalline solar cells was commercially procured. The panel was properly mounted on the top of the scooter with a supporting structure. The supporting rods were properly welded to the solar panel and integrated to form a solar-powered scooter. The developed solar-powered scooter was integrated not only with the solar panel but also with the supporting structure, which was made with bars of adequate mechanical strength, appropriate thermal durability, and corrosion resistance. In addition, the solar charge controller was also fixed to the welded solar panel setup; it was used to control the ratio of current and voltage. At the end, the fabricated solar-powered vehicle was tested with standard test procedures. The research outcomes of the present research work have been recorded, and scientific discussions have been documented in the research paper for the benefits to manufacturers, researchers, and end-users of solar-powered scooters.

3. Results and discussion

The photographs of the welded solar panel stand have been presented in Figure 5. In addition, a photograph of the developed solar panel-assisted electric scooter is presented in Figure 6.

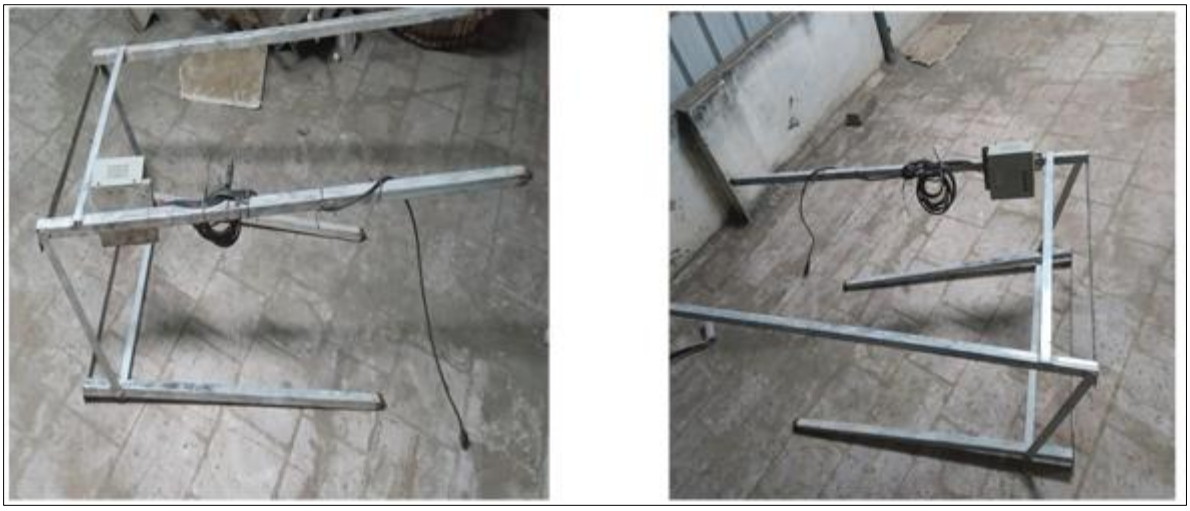

Figure 5 Welded panel stand

The present research work, A brushless DC motor, solar panel, lithium-ion battery, and solar charge controller were used as integral components of the solar-powered scooter. The working principle of solar cells on the solar panel is based on the photoelectric effect, i.e., due to electromagnetic radiation, a potential difference is created at the junction of two different materials [9].

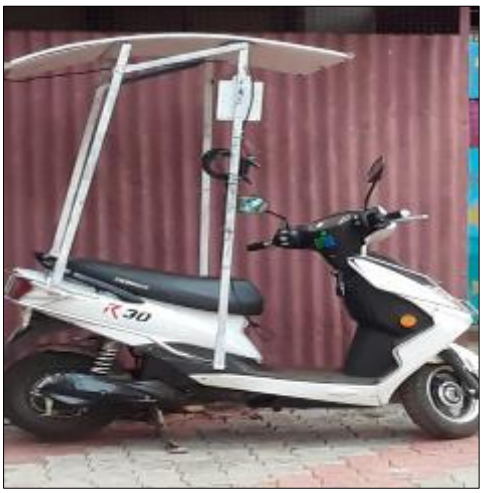

Figure 6 Fabricated Solar panel assisted Electric scooter

The conversion of chemical energy into electrical energy is done by a battery. The chemical reactions that take place in solar cells will generate electricity involving the transfer of electrons. The solar energy from the sun on solar cells will generate the potential difference at the intersection point of two materials for electromagnetic radiation. A lithium-ion battery is used to produce electricity by the transformation of an electron in electrochemical reactions. This rechargeable battery is used to accumulate charges [7]. These electrons constitute the current flow in the external circuit. The mechanical energy is obtained with the help of a DC motor, which converts direct current [7] (electrical energy). Finally, the obtained energy is used to transmit power from the motor, which drives the vehicle with the support of two wheels with the help of the hub motor drive system.

4. Conclusion

On the basis of research outcomes, it could be concluded that the fabrication of a solar-powered scooter from an electric scooter is successful. The working of the solar scooter shows the indigenous infrastructure and capabilities of the scooter. The recharging capacity of the solar panel was found to be satisfactory. The developed solar scooter can provide an incessant journey of 7 km, or it can travel up to 3 hours continuously. Thus, the attempt made to fabricate the solar powered scooter was successful. However, the following limitations are observed: The recharging time can be diminished by increasing the capacity of the solar panels. The solar panels are sensitive to vibrations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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 Mojid 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] Arun Manohar Gurrama, P.S.V Ramana Raoa , Raghuveer Dontikurtia, Solar Powered Wheel Chair: Mobility for Physically Challenged International Journal of Current Engineering and Technology, 2(1): 211-214,2012

[9] 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

[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