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Solar Powered Bicycle

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Abstract: A solar-powered bicycle integrates photovoltaic technology with traditional cycling mechanics to provide an eco-friendly, energy-efficient mode of transportation. which harness sunlight and convert it into electricity to either directly power the motor or charge a battery for later use. This innovation seeks to reduce dependence on fossil fuels while promoting sustainable mobility. Solar-powered bicycles are particularly advantageous for urban commuters, offering an emission-free alternative to traditional vehicles and reducing energy consumption.

Keywords: Solar panel, BLDC motor, MPPT controller, Speed controller, Lithium ion Battery, Bicycle.

I. INTRODUCTION

A solar-powered bicycle is an innovative transportation solution that combines renewable solar energy with traditional cycling. This bicycle is equipped with solar panels, typically mounted on the frame, wheels, or accessories, to capture sunlight and convert it into electrical energy. This energy can either directly power the bicycle's motor or charge a battery for later use, providing an eco-friendly, cost-efficient, and sustainable alternative to conventional bicycles or vehicles.

Our solar-powered bicycle is a product of the transition to sustainable sources of energy. A bicycle is already sustainable, however this project makes it more efficient and creates awareness amongst the masses. The idea to begin this project was influenced by existing socio-economic factors of bringing affordable and efficient transportation to large numbers of people. Considering a landscape such as rural India, where the land is covered mostly with steep hills, bicycles are the cheapest mode of transport but the rugged terrain is a major obstacle.

It is from here where I got my inspiration to build the solar bike - by utilizing electricity and solar power, a bicycle can be effectively transformed and upgraded into a significantly more efficient version of its standard self. Subsequently, daily activities become much easier and less time-consuming.

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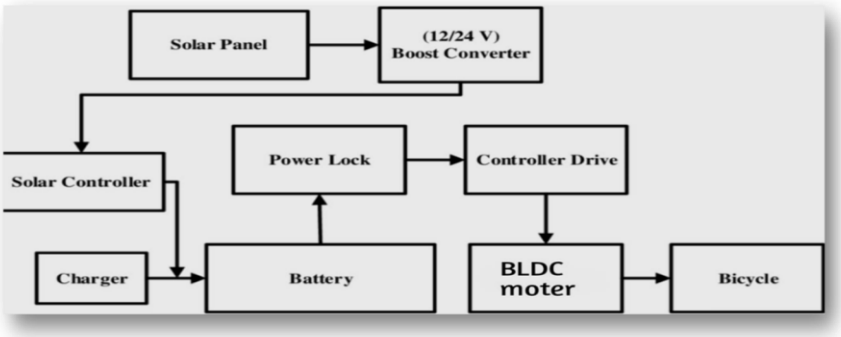
The solar bicycle has a greater range than a conventional bicycle. The solar panel on the top of bicycle can be charged even in the rain and also from the radiation after the sun sets or before the sun rises. The running cost of solar bicycle is very less than that of a fuel powered bike especially for a city intra city travel. With the solar bicycle it is easier to climb hill when then person wants to do moderate exercise is very much suitable for aged people who had to pedal a conventional cycle. The solar bicycle design is very simple to manufacture and can be used for travelling short distances. The batteries are highly efficient when they are being charged at the same time of discharging and in case of solar bicycle there is a direct motor supply.

II. METHODOLOGY



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Solar powered bicycle is a first of its kind vehicle with an overhead solar panel which can be used to recharge the Lithium-ion battery during commute as well as when the cycle is parked outside. Also, it can be charged by plugging in to the grid electricity at homes. The solar bicycle consists of 250W BLDC hub motor to drive the rear wheel when the rider wishes to use the electric assist, a 12V x 6 Ah lithium-ion battery, a 20W 12V solar panel on top, an MPPT to boost solar voltage to battery voltage and a basic metal frame and wheels. The solar panel needs to be welded to the bicycle frame at key locations to hold it firmly in place. The battery will need to be protected from the elements by placing it in GI sheet-metal box. The size of solar panel and the battery may vary during testing in order to increase or decrease range keeping cost in mind. Overall, we hope to achieve more than 30km of range from a single charge and yet be affordable to the average consumer especially in rural places to promote green energy vehicles.

III . PROPOSED WORK

A solar-powered bicycle uses solar energy to help power the bike, typically through a solar panel mounted on the frame or attached to the bike. The primary purpose of a solar-powered bicycle is to reduce or eliminate the reliance on traditional energy sources, such as human pedaling alone or external electric charging, while utilizing renewable solar energy.

The first step in the making of this bicycle was to buy any ordinary chain-wheeled bike that had room for equipment at the back. The DC hub motor was then installed into the wheel of the bicycle, after which the motor controller and the battery were placed into a box at the back. The controller comes with instructions on how to connect it within the setup. Accelerators were installed onto the handlebars. The solar panel was framed and mounted on a hollow, removable stick. Space for the insertion of the panel was allowed at the back. A speedometer was finally installed on the front handlebar to measure the instantaneous speed. The speedometer is linked with a Hall Effect Sensor that is attached into the front wheel of the bicycle. The bicycle now has a top speed of 15-20 km/h, and for each charge cycle it can travel up to 40 kilometres. The charging time is approximately 3 hours with the standard lithium ion battery present, and around 5-5.5 hours with the solar panel. There is also a display present on one of the handlebars which shows the voltage across the ends of the battery.

IV . USED COMPONENT DESIGN

A solar charge controller - A 24V-350W
BLDC motor - A 24V-18Ah
lithium ion battery - A 12V
Solar panel - A 3A
lithium ion battery charger - 12V

BLDC Motor:

a DC motor uses the interaction between electromagnetic fields to create a mechanical force. The motor creates a magnetic field in which a current carrying conductor develops torque and creates motion. The term “BLDC” stands for “brushless direct current,” and in this case refers to a motor that functions on DC current without the help of mechanical brushes. Brushless motors are much more advantageous than brushed ones because the absence of physical brushes means less overall wear and tear of the system. Commutation in BLDC motors is accomplished by separately energizing coils of wire that are located in the stator.

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Solar Panel:

solar panels can be of two types: -solar panels are made using only one silicon crystal and are much more efficient than solar panels. A few of the advantages panels over panels include: - panels have a higher efficiency rate (18% efficiency) as compared to panels (15-16% efficiency) - panels generate more power per unit area (power density) due to their higher effi-ciency rate - Empirically, it has been found that panels perform slightly better in low light condi-tions than panels. However, panels are relatively more expensive than panels. Nonethe-less, this panel was chosen mainly to ensure maximum productivity.

Lithium ion battery - A 12V

Lithium-ion (Li-ion) batteries are a type of rechargeable battery commonly used in portable electronics, electric vehicles, and renewable energy systems. They offer several advantages, including high energy density, long cycle life, low self-discharge, and high discharge rate. However, Li-ion batteries also have some disadvantages, such as flammability, high cost, sensitivity to temperature, and toxicity. Despite these limitations, Li-ion batteries are widely used in various applications, including portable electronics, electric vehicles, renewable energy systems, and medical devices. To ensure safe and efficient operation, Li-ion batteries require proper charging and maintenance, including avoiding overcharge, deep discharge, and physical stress, as well as proper storage and disposal. Overall, Li-ion batteries play a crucial role in enabling the widespread adoption of portable electronics and renewable energy technologies.

MPPT Controller :

A Maximum Power Point Tracking (MPPT) controller is a device that optimizes the energy harvest from solar panels or other renewable energy sources. It tracks the maximum power point (MPP) of the solar panel or array, ensuring that the maximum available power is extracted and used to charge a battery or power a load. By continuously monitoring the voltage and current output of the solar panel, the MPPT controller adjusts the operating point to match the MPP, typically around 70-80% of the open-circuit voltage. This results in higher efficiency, flexibility, and reduced energy loss. MPPT controllers are widely used in solar power systems, wind power systems, and hybrid power systems, and are available in various types, including DC-DC converters and grid-tie inverters. Overall, MPPT controllers play a crucial role in optimizing the performance of renewable energy systems and maximizing energy harvest.

V . CONCLUSION

solar-powered bicycles represent an innovative and eco-friendly solution to sustainable transportation. By integrating solar panels into the design, these bikes harness renewable energy from the sun, reducing the need for fossil fuels and helping to decrease carbon emissions. Solar-powered bicycles offer several advantages, including reduced operating costs, minimal environmental impact, and the potential to make cycling a more viable option for longer distances or in areas with limited access to charging infrastructure. However, challenges remain, such as limited energy storage, the need for optimal sunlight conditions, and the higher initial cost of the technology. Despite these challenges, the potential for solar-powered bicycles to contribute to a greener and more sustainable future is promising.

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