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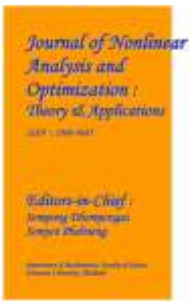

DESIGN AND IMPLEMENTATION OF BICYCLE USING SOLAR PANELS

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Abstract:
In the current context, the integration of a Solar Hybrid Bicycle system offers a promising solution to the pressing issues of fuel consumption and pollution. It's undeniable that the carbon dioxide emissions from vehicle exhausts contribute significantly to the escalating global warming crisis. With fuel prices on the rise in India and worldwide, the urgent need to explore alternatives to preserve natural resources becomes paramount.Encouraging the adoption of hybrid vehicles can effectively mitigate CO2 emissions and lower fuel expenses. Hence, the emergence of solar bicycles as electric vehicles presents a viable alternative by harnessing solar energy to charge batteries, thus powering the motor. Given India's abundant sunshine for approximately nine months a year, the concept of solar bicycles holds immense practicality in the region.To address this need, we've developed a Hybrid bicycle that integrates both solar energy and pedal-generated power through a dynamo to charge the battery and propel the bicycle. The system features an efficient solar/electric power generation unit mounted on the rear of the bicycle, capturing sunlight to charge the battery consistently. During periods of limited sunlight, the bicycle seamlessly transitions to battery power.To regulate motor speed, an accelerator is incorporated, providing precise control over power delivery. This innovative approach not only reduces operational costs but also enhances overall efficiency. Capable of reaching speeds of 25km/hr while accommodating an average-weight rider, the Solar Hybrid Bicycle emerges as a cost-effective alternative to conventional automobiles, underscoring the necessity for its widespread production and adoption.

Keywords:
PMDC motor, Hub Controller, Throttle

I. INTRODUCTION

Both the usage of fossil fuels and pollutants are decreased with the solar hybrid bicycle. Naturally occurring resources must be reserved because, as we all know, they are depleting daily.We are powering our bicycles with solar energy in order to reduce our reliance on fossil fuels. Here, li-ion batteryare used to store solar energy from four 12-volt solar panels. Additionally, a battery charger is used to charge this bicycle. As some villages do not have access to electricity, storing solar energy and using it for transportation is one way to solve a lot of issues. This contributes to pollution reduction, resource conservation, and efficient solar energy use. This bicycle is powered by battery power that is

replenished by solar panels, allowing it to continue riding during the night. This work's concept is this one.

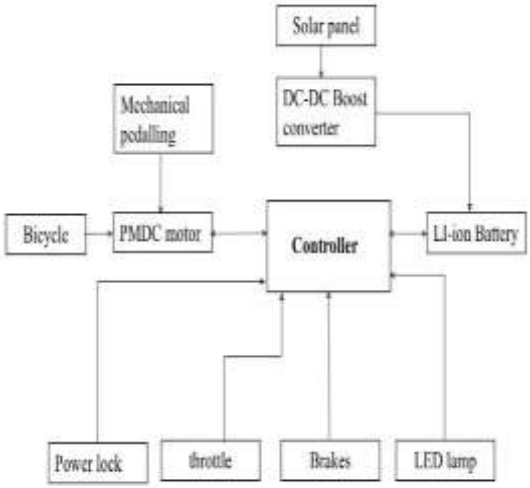

Figure1: Block Diagram

II. COMPONENTS

A. PMDC Motor:

There is a standard DC motor in the hub. The permanent magnets are installed within the stator, whereas the rotor is situated outside of it. The hub will spin thanks to alternating current supplied by batteries once the stator is fastened and fitted on the axle. Sprockets, brackets, and drive chains are not necessary for hub motors, which produce great torque at low speeds in an incredibly efficient manner. They have a lengthy lifespan and are therefore highly dependable. Brushless DC machines may be managed to provide large, consistent power speed ranges, which is their primary property.One kind of DC motor that turns a wheel using electromagnetic force is the hub motor. One half of them is filled with magnets, and the other half is filled with cables that carry the battery's electricity. The rotor spins because of the permanent magnets on it being attracted and repelled by the electromagnets in the stator as electricity flows through them in a circular pattern. The rotor rotates, spinning the motor as a whole, while the shaft turns into the axle and stops spinning. This produces torque capable of spinning either the front or back wheel.

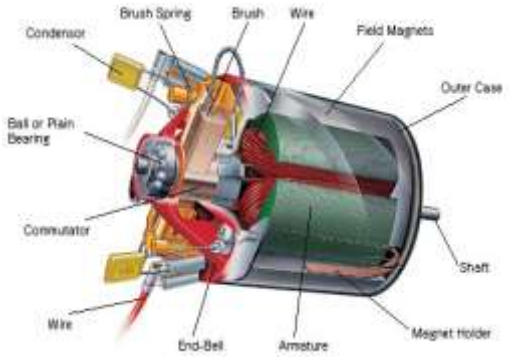

Figure 2: PMDC Motor

Specifications of Proposed Motor:

1. Voltage (24V): Ensures optimal power supply and compatibility by matching the voltage of your 24V PMDC motor.
2. Weight and range are balanced by the capacity (10Ah). Although the theoretical range is 20–40 km, the actual distance that can be covered on a single charge will vary depending on a number of factors, including rider weight, topography, and engine performance.

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3.The current rating of 18A is sufficient to manage the needs of a 250W motor, which usually draws 10–12 amps, as well as any possible surges during acceleration.

B. Hub Motor Controller:

The following connections/features are supported by the controller: Two thicker red and black power connectors should be connected to the same colours in the battery. Three thicker green, yellow, and blue motor connectors should be connected to the same colours on the motor. Connect one (1) Pedal Assist Sensor (Red, Blue, or Black) to the black sleeved connector. Connect the two brake cut-out sensors (Red, Grey, and Black) using the (Black, White, and Red) connections (use only with the in-line sensor option). Three distinct leads are formed when the modular cable that originates from the handlebars divides and terminates: Connects to its mate (Purple/Grey) Speed Sensor (Black/Red/Brown) via the large white plug (Red/Green/Black). Uses the (Green/Red/Black) connector from the speed sensor. Connects to its counter part with an LCD 5-Pin connector.

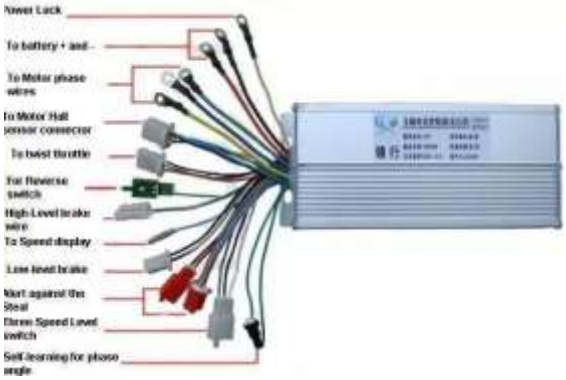

Figure 3: Shows the Pictorial Representation of HUB Motor Controller

The system's motor controller is a crucial component. Both driving the BLDC hub motor and managing the power supply are crucial. The battery's DC voltage is transformed by the controller into an alternating voltage with varying frequency and amplitude, which drives the hub motor at various speeds. The system is primarily composed of MOSFET transistors and a small microprocessor. Its functions range from identifying any issues with the throttle and motor hall sensors to safeguarding against overcurrent and undervoltage, which are perfect for system protection.

C. Throttle:

The potentiometer is a 10-kilo ohm throttle. Changing the speed in response to traffic and road conditions is necessary. Consequently, one needs a throttle or accelerator. We can operate the motor at zero speed or maximum speed thanks to the throttle. The throttle is mounted on the handlebar's right side and is wired to the controller. Technically speaking, this throttle is called a Hall Effect type. There are three wires on the throttle: a black, red, and green wire. Red and black wires carry the supply voltage, which is typically 4 volts. Turning the throttle causes the green wire voltage to rise.

Figure 4:Throttle

D. Battery:

In electronics, li-ion battery are among the most widely used battery kinds. li-ion battery is safe, despite having a little lower energy density than lithium metal, as long as appropriate safety measures are taken during charging and discharging. With its numerous benefits over other traditional battery types, the li-ion battery is the best option for a solar-powered bicycle.The energy supply and utilization processes inside a high voltage battery are the focus of this work. Longer running hours, a lighter battery in relation to its high output voltage, and a higher energy density are required. li-ion batterycell technology is the most effective and useful option available for the intended use among all the rechargeable battery systems now in use. A high-capacity li-ion battery pack made especially for cars is the one used for this project. The internal battery components are housed in a plastic case.Battery:

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Figure 5: Li-ion Battery

1. Charging our Solar Electric Bike with a 24V 10Ah 18A Li-ion Battery.
2. The lithium-ion (Li-ion) battery, which offers effective and clean energy storage, is a crucial part of your solar electric bike project. It is a 24V 10Ah 18A battery.
3. Below is an overview of its main characteristics and their importance. characteristics of battery is as shown below

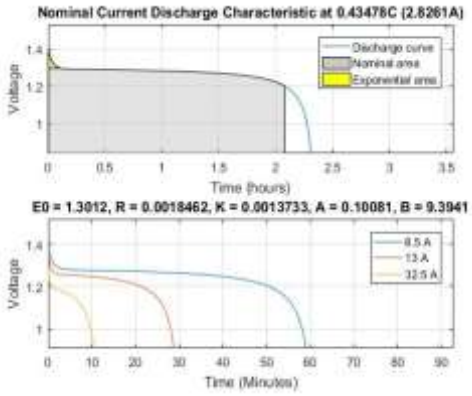

Figure 6: Battery Characteristics

III. CIRCUIT DIAGRAM AND WORKING

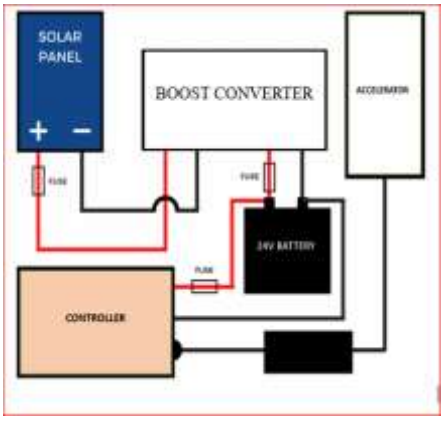

Figure7: Circuit diagram

Hub motors, hub motor controllers, solar panels, throttles, LCD displays, batteries, and solar panels are all used in this project. There is a 24V li-ion battery in the battery setup. The hub motor controller receives battery power when the accelerator is turned on. The hub motor controller changes the frequency and amplitude of the AC power to run the hub motor at varying speeds from the DC voltage.

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Subsequently, the hub motor controller provides the hub motor with the necessary voltage. The hub motor turns on when it gets the necessary voltage.The cycle's speed is controlled via the throttle, which is nothing more than a 10-kiloohm potentiometer used for acceleration. Two techniques are used to charge the battery:
Solar panels are used to charge the battery in the first approach. Four 12 volt, 15 watt solar panels are present. To get a total voltage of 48 volts, these solar panels are connected in series. To charge the battery, the solar panel is attached directly to it. The second technique involves charging the battery directly from the power supply using a charger.
The model's total weight is 20 kg, and it can support a person weighing 60 to 65 kg while running at a speed of 20 to 30 km/h.

IV. RESULT AND ANALYSIS

Table 1: Analysis of solar panel

s.no	Battery charging source	Initial battery condition	Charging time-starting and Ending	Time to Full Charging	Current(A)	Explanation
1.	Solar panel	Low Battery	8.20-17.58	9h33m	1.2A	Radiation is high
2.	Solar Panel	Low Battery	8.00-12.47	14h25min	0.8A	Radiation is Low

The output of the solar panel is completely dependent upon the climatic conditions. From the analysis we can observe that when the radiation is high, battery charging takes less time, when the radiation is low charging takes more time.

Figure 8: Final Outcome

V. CONCLUSION

We have designed a solar operated electric bicycle which runs on Hub Motor. The model of Solar panels and battery used in this electric bicycle has total weight of around 20 kg. It can carry person weight up to 65 kg and runs with the maximum speed of 25 km/hr. Battery percentage is displayed on LCD display to indicate battery status. This same information is sent on user mobile with the help of Node-MCU. The solar panel system takes 5-6 hours to charge the battery fully and can run the bicycle.

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