AN EFFICIENT E- BICYCLE WITH HYBRID SOLAR AND WIND SOURCES

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ABSTRACT

A lower and affordable priced hybrid electric bicycle that runs on non conventional sources of solar and wind energy has been suggested, making it readily affordable for everyone. The voltage has been increased using a boost converter. There are two batteries, and the design allows the bicycle to run on one while simultaneously charging the other. This silent hybrid e-bike can go at a top speed of 35 to 40 km/h. Day and night are no longer an issue for battery charging or dependence on the grid because both solar and wind energy are employed. A single battery may go up to 30–35 kilometers after a full charge. The discovery, however, may be a positive step towards developing greener vehicles without carbon dioxide emissions. where solar energy will be harvested utilizing the bicycle's rear solar panel. To obtain the necessary output voltage and steady output current for accelerating battery charging, the panel will be linked to a boost converter. On the front of the bicycle, turbines that also serve as generators are used to harness wind energy. The batteries are further linked to the setups. In this setup, there will be two batteries. The motor has been managed by a motor controller, and the needed speed is managed by a throttle. One battery will be charged using a solar panel while the sun is out, and another battery will be charged using wind power.

Keywords----Hybrid electric bicycle, Lithium ion Batteries, Controller, Wind Turbine

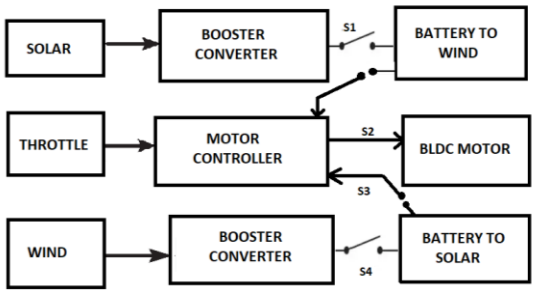
1. INTRODUCTION

The usage of unconventional sources has grown more quickly in current times than at any previous time in history. Lack of energy has an influence on daily tasks. Also, due to the world's fast population expansion, the need for energy is growing by more people every second. Presently, there isn't much of an issue with energy creation. Nevertheless, the creation of energy depletes the environment's natural resources and poses a threat to the environment. The cost of producing energy is likewise high. The desire for alternate energy sources has increased recently. The most popular non-conventional energy sources in this were wind and solar energy. So, vehicles powered by renewable energy have a lot of potential. Therefore, traditional energy sources like wind and solar are in demand in emerging nations like India since they are unaffordable. So People today are dependent on using electric automobiles, thus the hybrid electrical bicycle's design is straightforward and more efficient. An e-bike,

usually referred to as an electric bicycle, is a particular kind of bicycle that has an electric motor to help with pedaling. The battery that powers this motor may be recharged using a regular electrical socket. E-bicycles are made to make cycling simpler, especially for individuals who have trouble pedaling or want assistance while pedaling up hills or over long distances. We have created a hybrid electric bicycle with a system based on solar and wind energy, which are non-conventional energy sources that can be readily and at no cost received from nature. The other source is charged while the e-bike is travelling on one source.

The key benefit of adopting the hybrid model, which allows greater freedom to utilize the system easily, is that the two batteries are used to charge alternately when riding the e-bike. The bicycle will go at a speed of 35 to 40 km/h, and each lithium ion battery has a capacity of 24 volts and 10 amps. It can travel up to 30–40 kilometers on a full charge. Due to their adaptability and simplicity of use, hybrid e-bikes are becoming more and more popular. They are suitable for riders of all ages and fitness levels and may be used for commuting, exercise, or recreational rides. Additionally, they provide a greener option to classic automobiles and motorbikes. E-bikes are a practical and convenient mode of transportation that can increase cycling's accessibility for riders of all ages and fitness levels. Riders can cover greater distances and climb hills more easily with the assistance of the electric motor while still reaping the health and environmental benefits of riding.

2. BLOCK DIAGRAM



3. PARTS AND COMPONENTS

I. BLDC MOTOR

An electric motor known as a brushless DC electric motor (BLDC) is one that is powered by a direct current voltage source and commutated electronically as opposed to using brushes like typical DC motors do. For the e-bike, a 24 v, 350 W BLDC motor is utilized.

Fig:2 BLDC motor

II. SOLAR PANEL

An assembly of photovoltaic solar cells installed on a (often rectangular) frame is referred to as a solar cell panel, solar electric panel, or solar panel. It is also referred to as a photo-voltaic (PV) module or PV panel. Sunlight is used by solar panels to collect radiant energy, which is then transformed into direct current (DC) power. The e-bike uses a panel with a 24 volt, 20 watt rating.

Fig 3: Solar Panel

III. BLADE CONNECTED TURBINE

Blades are used in wind turbines to capture the kinetic energy of the wind. The wind passes over the blades, providing lift (much to what happens with an airplane's wing), which turns the blades. The driving shaft that rotates an electric generator, which creates (generates) power, is attached to the blades. When two 12v turbines are linked in series, the output voltage is 24v.

IV. MOTOR CONTROLLER

Energy is drawn from the battery and sent to the motor by an e-bike controller in accordance with user and sensor inputs. It keeps an eye on things like pedaling activity, motor power, bike speed, and battery voltage. Additionally, the controller manages features like Pedal Assist. There is a 24v, 350 W controller available.

Fig: 4 Controller

V. LITHIUM ION BATTERY

A lithium-ion battery, often known as a Li-ion battery, is a type of rechargeable battery that stores energy by the reversible reduction of lithium ions. A common lithium-ion cell's anode is built of carbon-based graphite. Typically, a metal oxide serves as the cathode. There are two 24v, 10Ah batteries utilized, one for each of the two sources.

Fig 5 Lithium ion batter

VI. BOOSTER CONVERTER

A boost converter, which is sometimes referred to as a step-up converter, is a DC-to-DC power converter that lowers current while raising voltage from its input (supply) to its output (load). In boost converters, which are often used in electronic devices like mobile phones, laptops, and digital cameras, the battery voltage is raised to provide the necessary voltage for the electronic components. They are also used as power supplies for LED lighting, electric vehicles, and solar energy systems. Boost converters are reliable and efficient, but designing them may be difficult and requires close attention to each component of the circuit, such as the size of the inductor, the switching frequency, and the feedback control.

Fig 6: Booster Converter

4. WORKING OF PROPOSED MODEL

An BLDC motor, controller, two batteries, wind turbines, solar panels, and booster choppers are all included in a hybrid electrical bicycle model. The controller, the brain of the model, is located in the middle of the bicycle and is connected to the front section of the wind turbine and the rear end of the solar panels. As a result, the solar panel and the wind turbine are each linked to a pair of 24v lithium ion batteries that are connected in parallel. Therefore, while the bicycle travels at 20 to 25 km/h, the propeller turns, creating dc electricity that is transmitted to the booster chopper to increase voltage before being stored in the battery. Similar to how the solar panel warms up when exposed to heat while travelling, the heat energy is converted to dc voltage and MPPT is used to stabilize the voltage and generate the most power possible. The voltage obtained is then stored in the battery, which in this case is a lithium ion battery, and this is how the two batteries are charged. The controller is connected to the battery, motor, and throttle. When the throttle is moved, the controller's battery receives power, the motor's attached battery begins to rotate, and the cycle travels ahead at a maximum speed of 35 to 40 km/hr. Last but not least, the bike may travel up to 30 to 40 kilometers on a full battery charge

5. COMPARISION TABLE

Existing Model	**Proposed Model**
1.Maximum Speed is 14-15 km/h	1.Maximum Speed is 35-40 km/h
2. It travels 15km on full charge.	2. It travels 30 to 35km on full charge.
3. Single Energy Source ,i.e Solar Energy	3.Hybrid model with Solar and Wind Based
4. Only one Battery source of 24v	4. Two Battery sources of 24v each.
5. Lead Acid Battery is Used	5. Lithium Ion Batteries are Used.
6.Static torque is 4.93N	6.Static torque 4.48N
7.Dynamic torque is 0.658N	7.Dynamic torque is 0.596N
8.Static power required 291.7W	8.Static power required 622.3W

9.Dynamic power required is 174.6W	9.Dynamic power required is 371.3W
10.static Force of cycle 70.03N	10.Static Force of cycle 64N
11. Dynamic force of the cycle 41.97N	11. Dynamic force of the cycle 38.2

7. RESULTS OF PROPOSED MODEL

After testing the developed e-bike, the output characteristics were used to design a hybrid electrical bicycle with solar and wind sources. The obtained parameters are as follows:

Cycle Speed =35km/hr ,

Weight of bicycle = 40kg ,Rider weight =60kg

Power Calculations,

Normal reaction, N=W/2=50kg=50*9.81=490.5 N

For static friction, u=0.03

F=u*N=0.03*490.5=14.7 N

For dynamic friction u=0.004

F=u*N=0.004*490.5 = 1.96 N

Torque Requirement,

For static Friction, T=F*R=14.7*0.305=4.48 N-m

For dynamic Friction ,T=F*R=0.35*1.96=0.596 N-m

Speed Calculations,

W=V/R = 35*(5/18)*(0.305) = 31.8 rad/sec

For static friction ,

Total force Required to vehicle

F= u*m*g*cos(a) + m*g*sin(a) = 64.3 N

Power required = F*v = 622 W

For Dynamic Friction,

Total force Required to vehicle,

F= u*m*g*cos(a) + m*g*sin(a) =38.2 N

Power required = F*v = 371.3

PARAMETERS	CORRESPONDING VALUES
Maximum speed	35-40 km/hr
Paddling Required	No
Maximum Travelling Distance	30-35 km
Charging time	During sunlight and during operation
Type of Energy used	Solar and wind
Solar	24v , 20W
Wind	24v
Controller	24v, 350W
Li Battery	24v,10Ah
BLDC motor	24v,350W

Table 1: Different parameters of designed model

8. Output Working Model

Fig: 7 Back view of proposed Hybrid E-Bicycle

Fig: 8 Side view of proposed Hybrid e Bicycle

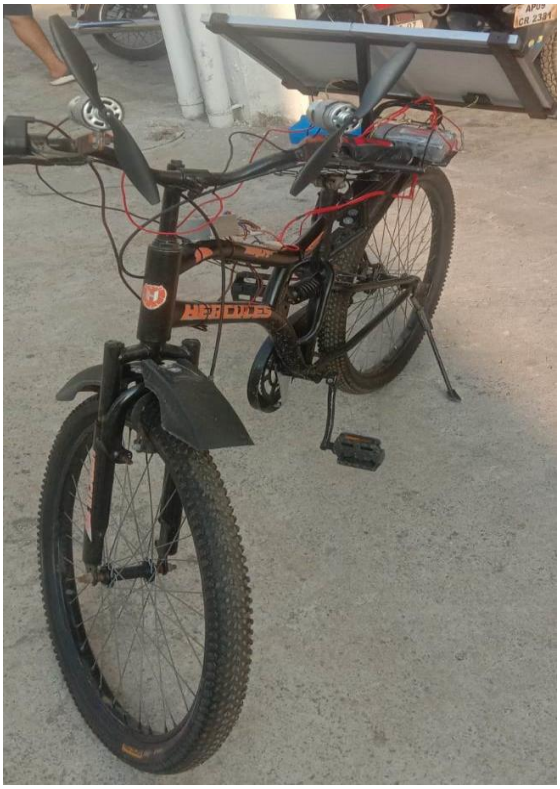


Fig: 9 Front View of Proposed Hybrid E-Bicycle

9. CONCLUSION

The Designed Hybrid E bicycle offers users greater flexibility and affordability. The bicycle was successfully operated with respectable efficiency ratings thanks to the circuit's overall design and functioning. As a result, the expense was maintained to a minimum. The experiments conducted in various weather conditions amply shown that the technology was successful in operating the bicycle. Therefore, the distance covered while using a full charge is

around 30 km under various conditions and speeds. The availability of radiation and wind affects charging. Hybrid e-bikes are so effectively created and available in a variety of designs and price points, enabling a wide spectrum of individuals able to use them. Hybrid e-bikes do, however, have significant disadvantages, such as a greater initial cost and the requirement for routine battery charge. In general, hybrid e-bikes are a great choice for anybody searching for a more practical, effective, and environmentally responsible means of transportation.

10. REFERENCES

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