

DESIGN AND IMPLEMENTATION OF SOLAR BICYCLE

R. Anjana¹, S. Sharmila², A. Aswin³, M. Vimal Kumar⁴, K. Ragul Kumar⁵

^{1,2,3,4}UG Students, Department of Electrical and Electronics Engineering, Valliammai Engineering College (SRM Nagar, Kattankulathur, Kancheepuram Dt, Tamilnadu).

⁵Assistant Professor, Department of Electrical and Electronics Engineering, Valliammai Engineering College (SRM Nagar, Kattankulathur, Kancheepuram Dt, Tamilnadu).

ABSTRACT:- Since the fuel cost and pollution throughout the world increasing day by day due to general vehicles. Every vehicles has own emission of gases, but the problem occurs when the emission is beyond the standardised value .This emissions from the vehicles cannot be completely avoided, but it also can be controlled by implementing the solar bicycle. The solar bicycle is driven by BLDC motor by using energy from the solar panel .The motor is fitted in rear axle. The energy from the panel will charge the battery and it drives the BLDC motor. It also charge by using wall charger when the sufficient solar power is not available. And it can also driven by normal pedalling method.

Keywords: "Solar Panels, Bicycle, BLDC Motor, Converter, Motor controller".

1. INTRODUCTION

Solar bicycle is developed to reduce the pollution caused by conventional bikes. To develop a low cost application for rural and remote area where fuels are not available to drive two wheelers so that they can run this bicycle on renewable solar energy. The solar energy from the sun is free of cost and is used to drive the motor. When there is no sunlight or the batteries are drained the bicycle should still be running. The solar bicycle is different from others vehicle. The PV panel save more power and give the bicycle required range. The solar panel will be charged while bicycle is running. We can also use pedalling operation when sufficient energy is not available.

2. EXISTING SYSTEM

- 1) The existing bicycle can run a speed only upto 15 kmph.
- 2) It will take time to charge upto 6 to 8 hours.
- 3) Overall performance and efficiency of the process is less.

3. PROPOSED SYSTEM

- 1) It will take time to charge upto 4 to 6 hours.
- 2) Bicycle can run a speed upto 20 to 22 kmph.
- 3) Overall performance and efficiency will be increased.
- 4) We can use three different operations.

4. COMPONENTS REQUIRED

- Solar panel
- Cycle
- BLDC Motor
- Motor controller
- Charger

4.1 SOLAR PANELS

The head line shows that the bicycle is worked by solar energy. Solar PV cells directly convert the energy from the sun into electricity by using photovoltaic effect. The photovoltaic effect means the generation of a voltage based on the electrons ejected by another light effect called Photoelectric effect. Solar cell works on two different kinds of effects, one is photoelectric and another one is photovoltaic. In photoelectric effect, electrons are emitted when photon are subjected on

a metal and these electrons are moved to the valence and conduction band creating potential difference between these electrodes because of the photovoltaic effect.

40W SOLAR PANEL



PANEL RATING

Parameter	Value
Maximum Power (Watt)	40
Optimum Operating Voltage	18.9V
Open Circuit Voltage Voc	22.5V
Optimum Operating Current (Imp)	5.29A

4.2BLDC MOTOR

A standard BLDC motor does not contain any brushes and also to minimise their maintenance, cost efficiency and time saving. That's why brushless DC motors are often more useful than normal DC motors. In BLDC motor the performance of the coils are opposite when its compare with ordinary DC motor. It have major two parts, the inside part having the coils which is stationary and the magnet are rotates around this coil. Due to the induces power in the inside copper coils in turn create the outer magnet body spin around the coils. There are different type of small magnetic field sensors attached between the coils. These sensors are called as Hall-effect sensors. The sensors senses the position and direction of the rotor. When the permanent magnet passes through the sensors, and then excitation the suitable coils for rotation of the rotor. The main disadvantage of using this type of motor is that it add an extra electronic circuit for the rotor rotation.

RATING OF BLDC MOTOR

Parameter	Corresponding factor/value
Type of Motor	Hub motor
Design of Motor	BLDC (Brushless DC)
Power Rating	500W
Rated Voltage(V)	36
Weight(kg)	5
Efficiency (%)	80
Torque	12 N-m
Speed (rpm)	300

200W BLDC MOTOR



4.3 THROTTLE

The highest speed of the bicycle is 25kmph. It may change this speed from 0-25kmph based on the road conditions and traffic. So that throttle is connected in the bicycle to increase and decrease the speed based on the situation. The throttle is installed to the right side handle bar and is connected to a motor controller. The accelerator contain of three different wires a black, red, and green. In this wires, red and black wires are used to provided the supply voltage, generally 4 volts supply is required to provided to accelerator and green wires are used to rise the accelerator.

THROTTLE



4.4 MOTOR CONTROLLER

The motor controller is used to supply the constant voltage to the BLDC motor. The motor controller consist of different type of sensors called as the Hall Effect sensors that senses position and direction of the magnet in the rotor and give commends to excite the suitable coils to rotate the rotor. A motor controller is a electronic circuits consisting of MOSFET, transistors, microprocessors etc, that are required for the higher and lower voltage, over current protection of the motor.

MOTOR CONTROLLER



RATING OF MOTOR CONTROLLER

Parameter	Values
System voltage (V)	36
Rated current (A)	27
Under voltage protection (V)	31.5
Ambient temperature (°C)	0-50

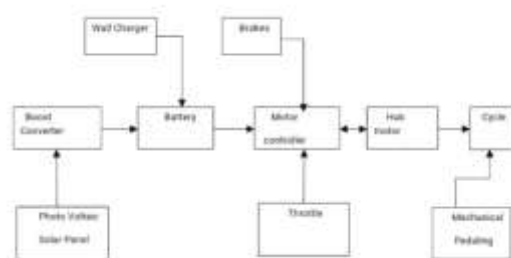
4.5 BOOST CONVERTER

A voltage regulator is connected to a solar bicycle and is normally installed between the solar panels and the motor controller. This is done such that the power output of the solar panel is sometimes varying. Thus a voltage regulator is connected between these components to make the input of a motor controller as constant. The voltage regulator normally used in this type of applications boost converter. The voltage regulator always gives the motor controller with a non varying voltage as input. It is thus used to safe guard the components from peak and low voltages.

Voltage output from solar panel = 18V. Required duty cycle $D = 2/3$.

5. METHODOLOGY

BLOCK DIAGRAM



Solar energy is obtained from the sun using solar panels installed on the rear end of bicycle. These solar panels are connected to a boost converter thus to step up the voltage to there required capacity. The arrangement is further connected to a DC motor. The battery can also be charged using a wall charger in case of absence of sun. A brushless DC motor is used here because of zero maintenance, high efficiency, and less noise and also the brushes are not being used so sparking in a BLDC motor is avoided. A motor controller is used here for controlling the operation of the motor. Also a throttle is used to raise the speed of the solar bicycle. This accelerator is directly coupled to the motor controller which controls the speed of the motor. In the absence of sunlight the solar bicycle can be driven using pedalling.

6. FACTORS EFFECTING EFFICIENCY

Normally a positive terminal of the solar panel is connected with the positive terminal of the battery same as negative terminal of the solar panel is connected to the negative terminal of the battery. A battery can charge in a simple way. But problem is arrive during night's times. During nights because of the voltage there is a current flow from the battery to the panel. This may create a battery to discharge. To reduce this problem, a diode is connect between the panel and the battery so that the diode perform as a one way to move the power from panel to battery. The output power from the solar panel mostly depend on the Panel angle: Any ways the sun light is diffused in the atmosphere which decrease this effect. Time of day: Time of the day The rays are stronger and maximum power can be produced between 11 a.m. – 3 p.m. Solar cell reflections: The power generated will be decreased if the solar cell reflects high value of rays. Hence protection layers on the top having low coefficient of reflection.

7. SHADOW EFFECT

When installing the solar panels on the bicycle ,shadow effect must be noticed because if shadow is subjected on the panel the quantity of output power decrease. Thus the solar panels are mounted on the roof top to eliminate the shadow effect.

8. POSITIONING OF PANEL

By installing Solar panels on roof top output power can be raised because shadow effect can be decreased by this positioning and also enormous surface area is available. There are few demerits with this model of positioning such as weight raises and air drag increases. But, efficiency remains constant.

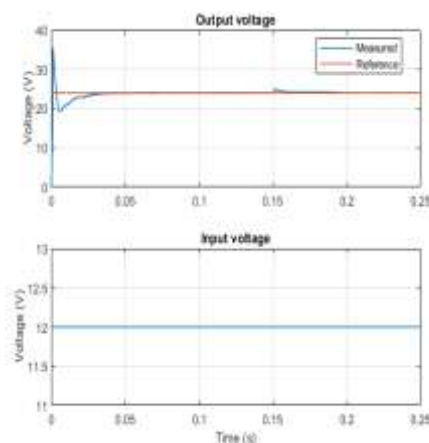
9. AERODYNAMICS

Wind directions play a important role in speed of bicycle. If the wind flow is horizontal to solar panels then there is no problem, whereas if wind flow in vertical then large amount of power will be reduced from the batteries to overcome the air.

10. RESULTS

We can able to produce sufficient high energy by sun itself with full free of cost and also save more amount of consumption of fuels. It will also produce constant output voltage to work system with more reliable , and maintenance cost also very low.

BOOST CONVERTER CONSTANT OUTPUT VOLTAGE



11. CONCLUSION AND FUTURE SCOPE

By using of solar powered bicycles, pollution can be decreased and mainly it will save large amount fossil fuels It can be used all age group people up to the weight of 120 Kg. It can be travel up to 25 to 35 km with one full charge.

In future we can improve speed of the bicycle up to 25 to 30 km/h. Charging time can be reduced up to 2 to 4 hours.

REFERENCES

1. Muetze, A., Tan, Y. C., "Electric Bicycles: Jul-Aug, 2007, A performance evaluation," IEEE Industry Applications Magazine [online journal] Vol. 13, No. 4, , pp.12-21.
2. T. Markel, K. Bennion and W. Kramer, National Renewable Energy Laboratory & J. Bryan and J. Giedd Xcel Energy August 2009 "Field Testing Plug-in Hybrid Electric Vehicles with Charge Control Technology in the Xcel Energy Territory." Technical Report of National Renewable NREL/TP-550-46345.
3. C.E.(Sandy) Thomas" Fuel Cell and Battery Electric Vehicles Compared" Journal ofH2Gen Innovations, Inc., Alexandria, Virginia, 22304, USA. 4. Chung-Hsing Chao, Solar energy powered bicycle for wireless supervisory control and remote power management applications, Electrical Machines and Systems (ICEMS), 2010 International Conference.
5. Chetan Kumaar Maini, Deputy Chairman and Chief Technology officer, Reva Electric Car Company, India May13- 16,2009,"Development of a next generation Electric Carfor World Markets" Journal of EVS 24 Stavanger, Norway.
6. Graham S. Aikenhead, (2011) "Bicycle Applications for On-Board Solar PowerGeneration System Adaptation". Guelph Engineering Journal, Vol. 4, page 9 - 23. ISSN: 1916-1107
7. Arsie, I., Rizzo, G., Sorrentino, 2006.
8. "Optimal Design of a Hybrid Solar Vehicle," Proceedings of the International Symposium on Advanced Vehicle Control, Department of Mechanical Engineering, University of Salerno, Italy.