

Design and Fabrication of Solar Operated E-Bicycle

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Abstract: As we all know the fuel rate like the petrol is increasing price steadily day by day. Again the pollution due to A vehicle in big cities and urban areas is increasing continuously. To overcome these problems, an effort is Being made to find out next alternative sources of energy for the vehicles Again, it is also not effort to get vehicles (scooters, mopeds or motorcycles) for all the category of society. Keeping this in mind, a look for some welcome to cater these economically poor people as well on provide an answer for the environmental pollution was in progress. The solar operated e-bicycle developed is driven by DC hub motor fit in back axle housing and operated by solar energy. The solar panels mounted on the carriage. Which in turn drive the hub motor by using charge the battery? When the bicycle is idle, battery will be charge the battery by the solar. This arrangement will be substitute the petrol engine, the gear box and the fuel tank in case of a chain sprocket or two wheeler, chain and gear shifting arrangement of a traditional bicycle being used by most common man. As an area of specific work, the solar assisted bicycle is fitted with a dc hub motor on front axle of a bicycle with power rating of 350W and with a travelling speed of around 25-30kemp. It is provided with a pair of lead acid batteries of 22.5 Ah each, a photovoltaic solar battery with capacity of 20 watts, a transformer of 24v 10 Amp, accelerator and motor controller of 24v 25Amp. There as well a provision for charging of the battery with 220-240V, AC wall outlet supply, just in case of Poor solar supply due to rainy or cloudy weather.

Keywords: Solar Assisted Bicycle (SAB), hub motor, solar panel, motor controller, voltage regulator.

1. Introduction

This topic will discuss the main idea of this project and get a larger picture on what is the Problem in the now-a-days technologies, what that I want to achieve in this project and the area that Will cover project. This chapter is divided into a few categories that are project background to describe the reasons to do this project, problem statement to inform about the weakness of the Existing technology, objective to make sure what actually this project must scope and achieve of This project to specific output what will be used in this project for better results.

To find the problem and the weakness, this project needs to do specific research and studying to develop the best technology. To prepare for its success there are many things that

we want to know such as what will be the prime mover, how to stored it, and the benefits of this new vehicle. In that case, these are the list of the purpose to be conducted before continue to proceed on this project:

- Developing a vehicle that uses reproduce energy, environmentally friendly, and cheaper than other sources.
- To develop an electrical bicycle that can charge the battery when it cannot be in working or running condition.
- To develop arrange speed bicycle, as well for a longer distance

2. Literature Review

The main aim of this paper is to present the thought of harnessing the varied energy and use it in today's existence of human life. For individual travelling has become vital. So as to sustain during this fast forward world he must travel from place to place. It's important that time taking for travelling should be less; also it should be economical and simply available. With the fast depleting resources of petrol and diesel, there 'shave to find intermittent choice. Taking all this into consideration, a shift far from conventional based fuels to employing renewable sources may be must. Electric bike which can be driven with the assistance of battery and thus provide required voltage to the motor. The main target of this report is to perform power calculations and system design of this Electric Bike. This bike is driven with the assistance electricity or also with the help of alternative energy. Therefore, the manufacturing of such bike is indispensable. Several studies have established, positive health benefits of e- bike use, providing e-bikers ride more frequently and longer. Recreation conflict literature suggests that almost all conflict follows an asymmetrical pattern, and research on e-bikes shows that have informed perceptions.

3. Methodology

Electric bicycle pedal and handle just like a regular bicycle. And large, an electric bicycle will use the same parts. Electric bicycle hub motor power is different, such as the general

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assembly of 12AH battery the high speed hub motor. In the case of a brushless toothless motor, the actual power is 350W.

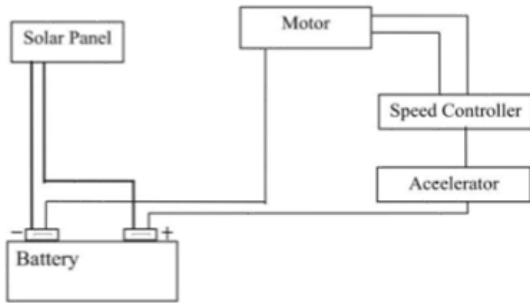


Fig. 1. Basic block diagram of solar e-bicycle

A. Hardware Required

1) Hub motor

The hub motors are conventional Dc motor. The rotor is outside in the stator with the permanent magnets mounted on inside motor. The stator is mounted and glued onto the axle and the hubs are going to be made to rotate by alternating currents supplied through batteries. Hub motor generates high torque at low speed, which is very efficient and which does not need sprockets, brackets and drive chains. This means they're very reliable and have a long life. The most characteristic of Brushless DC motor is that they'll be controlled to give wide constant power speed ranges.



Fig. 2. Hub motor

2) BLDC motor

Brushless DC (BLDC) motors are synchronous motors consisting of an armature winding on the stator permanent and magnets on the rotor. The stator of a BLDC motor consists of stacked the steel lamination with winding placed within the slots and these stator winding is arranged in two patterns I.e. a star pattern or the delta patter. The star pattern gives high torque at the low RPM and thus the delta pattern gives low torque at the low RPM. There are many advantages of BLDC hub motor are better speed versus torque characteristics, the high dynamic response, high efficiency and the long operating life a noiseless operation and higher speed ranges

Table 1 Features

Type of Motor	Hub motor
Design of Motor	BLDC (Brushless DC)
Power Rating	350W
Rated Voltage(V)	36
Weight(kg)	5
Efficiency (%)	80
Torque	12 N-m
Speed (rpm)	300

3) Solar Cells/Panels

As the title suggests the bicycle is operated by solar power. The lead acid battery is charged with solar energy with the assistance of a photovoltaic cell.

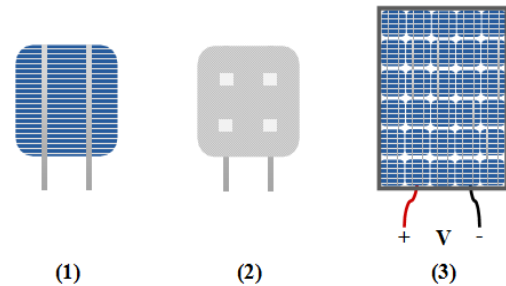


Fig. 3. Solar cell/solar plate

Photoelectric cells convert the energy of sunlight directly into electricity through the use of the photoelectric effect. The photovoltaic effect involves in the creation of an electric voltage energy into an electro-magnetic radiation. The photoelectric and photovoltaic effects are related to sunlight energy, but are different in this electrons are ejected from a material' s surface upon divestiture to radiation of sufficient in photoelectric energy, and generated electrons are transferred to different bands of valence to conduction within the fabric, leading to the build-up of voltage between two electrodes in photovoltaic.

4) SPV Charge Controller

It is essential to control the voltage output from the solar panel before it's supplied to the battery. Voltage regulators are power converter with an output DC voltage greater than the input DC voltage. It is used to regulate an input voltage to a higher regulate voltage. The output of the solar panel isn't always being stable because of fluctuations in intensity of sunlight, angular changes with reference to the direction of sunlight, as well as other environmental factors. It is the voltage boost/regulator Converter comes into SAB. The output of the solar panel is that the input of the boost converter, which then outputs into the battery for charging. Because the output of the solar panel will be varying constantly, we need a voltage regulator/boost converter that will take an input from a large range of voltages and output a selected, constant voltage value.

Voltage regulator/boost converters are power converter which will take in a DC voltage and output a higher value DC voltage. Our voltage boost/regulator Converter requires output of the solar panel, which may range from 0V to 28V, and output for charging of the battery.

We were initially attracted to the SPV Instruments Module because it has the characteristics of taking in an input range of 9.8V to 13.2V and outputting 24V at a maximum of 2-4 amps. This SPV charge controller has an area of 2.5 square inches and it's also small in size, which makes it very practical to be placed Anywhere on the bicycle. We go thought the battery voltage & we need to supply 24V and 10A in way to charge it.

5) Relay lead acid battery

Lead acid batteries are the most popular types of battery in electronic. Although slightly low in energy than lithium metal battery, lead acid is safe, provided certain precautions are met

when charging and discharging power. This have a many advantages over other types of batteries, the lead acid battery is the good choice for a solar assisted bicycle. Current supplied from battery indicates input the flow of energy from the battery and is measured in amperes (or Amps). A battery is rated in Ah and this is called the battery capacity. This project revolves around supply and utilizing power within a high voltage. It demands in a battery with longer running hours, among all the rechargeable battery systems, the lead acid cell technology is the most efficient and practical use for the desired application. The battery chosen for this project was a high capacity lead acid battery designed to specifically for solar vehicles. Plastic casing is provided to house in internal components of the battery pack.

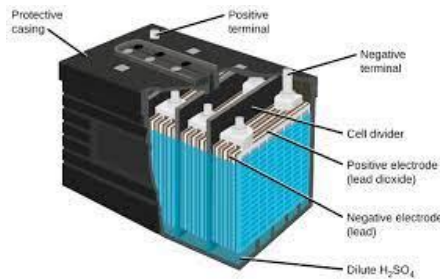


Fig. 4. Lead acid battery

Table 2
Parameters

Parameter	Corresponding factor/value
Type	Li-ion
Number	three Batteries
Voltage	12 V
Expected cycle life	2000 times
Max. Continuous Discharge current	15A
Max charge voltage	14.6 V
Connected	in series
Amp-Hour Rating	20 Ah
Discharge cutoff voltage	10 V

6) *Controller*

We used to PIC16F72 controller to control the electric bicycle system. In this electric bicycle system some components are installed such as hub motor, PIC controller, battery, light system so here required to controller for controlling the different component of electric bicycle system. There are different functioning on this controller such as under voltage protection, over current protection, and control power supply, also to drive and control the Brushless dc hub motor. There are different signal were transmitted of PIC controller to drive and Control brushless dc hub motor, such as current detection signal, motor speed control signal, and capacity detection system. In this PIC16F72 controller has 20 pins, 18 I/O pins that are user configurable on a pin-to-pin basis. The operating frequency is 20 MHz Also in this controller there are three I/O port are use such as PORTA, PORTB and PORTC and there are three Timers are use Timer0, Timer1 and Timer2. The current detection signal use here because, if any heavy current situation electric bicycle is running at heavy load the current is increasing in hub motor speed... Also there are under voltage protection is required because of avoid the low voltage power supply, which is affect on the electric bicycle running normally,

then controller should be provide power capacity checking. If voltage supply signal transmitted to PIC controller, then checking supply voltage current.



Fig. 5. Controller

7) *Accelerator/Throttle*

The speed of a bicycle is 30kmph. It is required to vary the speed depending upon the road and traffic problems therefore the accelerator or a throttle is necessary. Accelerator used to drive the motor from zero speed to full speed. The accelerator is fitted on right side of the handle bar and is connected to controller. It converts DC voltage from battery to an alternating voltage with variable amplitude and frequency. Then hub motor drives at different speeds. Throttle consists of MOSFET transistors and a small microprocessor. This throttle is technically mentioned to as a Hall Effect type. The accelerator has three wires contains a black, red, and green. The supply voltage is red and black wires and is typically around 4 volts. Green wire voltage increases because the accelerator is turned.



Fig. 6. Accelerator

8) *CAD model*

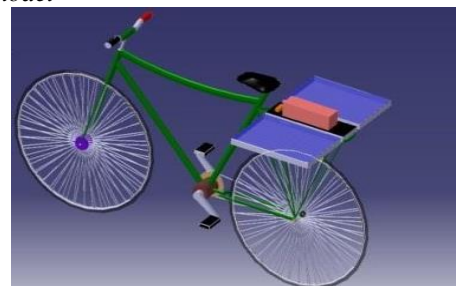


Fig. 7. CAD model

4. Advantages

- E-bikes call battery-powered “pedal assist bicycle.
- It can use regularly reduce stress and impact on your knees and thighs.

- Bicycle gives you the extra power you need to cover miles of distance with little effort.
- Advantage of the multi-purpose cycle lane and paths that are traffic free.
- E-bicycle is just as good as regular bikes at improving fitness in our regular life.
- E-bicycle instead of a motor vehicle it will save you money in the long run life. Petrol and diesel are costly in most countries like India.

5. Application

1. This automatic battery charger is used to charge 12V Lead acid batteries.
2. Use to charge car batteries since IC output voltage is variable.
3. Use to charge toy automobile batteries with a little modification.
4. Developed to reduce the pollution caused by conventional bikes.
5. To developed 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.

6. Future Scope

This project is consisting of two parts that is hardware and software. The hardware will be hub motor, solar panel, battery etc., and the software is the program of the controller to control the operation of the E-bicycle. To be more specific of this project, there will be using several things that are,

- Use solar energy to recharge the battery.
- Pollution frees E-bicycle its means that the no pollutant gases mix the fresh air.
- Use high torque motor to drive the bicycle
- Need not to the any fossil fuel.

7. Conclusion

Solar assisted bicycle modification of existing bicycle and

driven by solar energy. It is suitable for rural, city and country roads that are made of cement and mud. This bicycle is not costlier and easier in construction and can be most used for short distances travelling especially by school children, colleges, office goers, villager's postmen, etc.

It is easily adjustable for young, aged, handicap people and caters the need of economically poor class of society. The price of the solar operated e-bicycle is budget of middle class people and poor people. It can be operated free of cost. It is not count the more money for any person. The most important feature of this bicycle is that is does not consume costly fossil fuel thereby saving cores of rupees.

It is very eco-friendly and pollution free, as it does not have any emission. It is not for noise and can be reached with the AC adapter in case of emergency and cloudy weather. It can be charged to the electricity with the help of adapter. The operating cost per km a minimum around Rs.0.70/km. It can be driven by manual pedaling in case of battery is discharge. It has fewer component can be easily mounted or un-mounted. It is important to identify new ways of transport and generation of electricity and solar powered E-bike pools may just be such a case. E-bicycle are an order of more magnitude energy efficient than the car, bus and other heavy transport mode. Using solar panels at 0.2-0.8m² per E-bike has been shown to be enough to supply the early energy demand by the e-bike pool dependent to simulated system usage.

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