

Fabrication of Solar and Dynamo Power Driven Bicycle

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ABSTRACT

In present scenario a solar and dynamo power driven hybrid bicycle will help to solve the major problems of fuel prices, especially the petrol is rising steadily day by day. Again, the pollution due to vehicles in metro cities and urban areas is increasing continuously. To overcome these problems, an effort is being made to research some other alternative sources of energy to drive the Bicycle. Again, it is also not affordable to purchase vehicles (mopeds, scooters or motorcycles) for all the class of society. Keeping this in mind, a search for some way to cater these economically poor people as well as to provide a solution for the environmental pollution was in progress. The solar and dynamo assisted hybrid bicycle is driven by direct current motor fitted in the front axle housing and run on electrical energy. The solar panels mounted on the carriage will charge the battery and which in turn drive the hub motor. When the bicycle is idle or stationary in parking, the solar panel will charge the battery and a pair of 48-volt dynamo is fixed on the rear wheel of the bicycle will charge the battery when the bicycle is running on the road. This arrangement will replace the petrol engine, the gear box and the fuel tank in case of a two-wheeler or a gear shifting arrangement of a bicycle.

Keywords: Dynamo, Battery, Solar panel, Conventional bicycle, Brushless hub motor, panel, Gate switch, Accelerator, BLDC Motor controller.

1. INTRODUCTION

Solar and dynamo power driven bicycle is designed to meet the present challenges of conventional bikes and also to reduce the pollution caused by conventional bikes. The fast depletion of fossil fuels due to the exponential increase in demand and global warming due to the emission of CO₂ made engineers and scientists to look for an alternative source of energy which is renewable, eco-friendly, affordable and available. Among the renewable sources like wind, tidal, geothermal and solar energy, solar power is promising in nations like India which is in the tropical region. India spends a large amount of foreign exchange to import crude oil. With the use of solar power assisted vehicles, the dependency on the import of crude oil can be reduced and reasonable amount of foreign exchange can be saved. A solar bicycle is a bicycle which runs using the electrical energy of batteries to run the hub motor which ultimately runs the bicycle. Solar energy is used to charge the battery. Two Photovoltaic cells may be used to harness solar energy to generate voltage to charge

the battery and, we use two dynamos to charge the battery when the bicycle is in motion. When there is no sunlight the battery provides for recharging using the wall charger by plugging into ordinary wall outlets, usually taking about three hours to recharge. The battery gives the required voltage to the hub motor mounted on the front wheel to run the bicycle.



Fig1: Fabricated model Solar and Dynamo operated hybrid Bicycle

2. OBJECTIVES

These are the list of the objective to be conducted before continuing to proceed with this project.

- Reduce the pollution.
- Reduce the dependency on fossil fuel
- Easy utilization of Renewable energy
- Sources.
- Environmentally Eco friendly and cheap.

- To upgrade a conventional E-bicycle to Solar-Powered Electrical Bicycle that can be used for leisurely rides.
- To design and develop Solar-Powered Electrical Bicycle which gets its supply by using solar energy from photovoltaic panels and dynamo.

3. WORKING PRINCIPLE

Solar hybrid Bicycle ride on the road showing a block diagram below first solar panels fixed on bicycle carrier which receive the sun rays and convert it into

Fabrication of Solar and Dynamo power driven Bicycle.

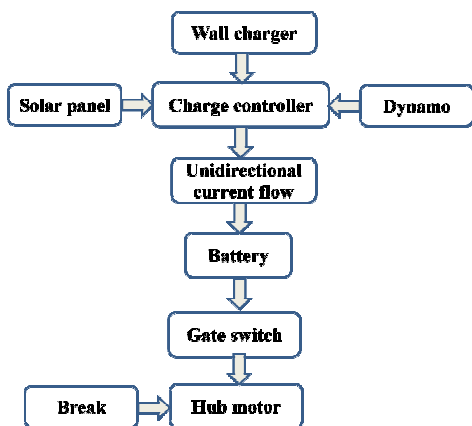


Fig.4 Block diagram

FigII: Block diagram of fabrication of solar and dynamo powered driven bicycle

electricity and stored in battery via charge controller and using a pair of dynamo fixed On rear wheel which convert kinetic energy into electrical energy and stored in batteries and also direct wall charging adaptor to store electrical energy in the battery. All three sourced energy supplied through the unidirectional electronic circuit board and stored in the rechargeable battery. Using Gate switch activates hub motor and run on the road using the accelerator throttle and brake will apply to the motor using breaking arrangement in the front wheel.

4. LITERATURE SUMMARY

To perform this project, literature review has been made from various sources like journals, Book, article and other After going to the number of above literature survey as to be drawn out the main objective of this survey is to drive the bicycle using renewable energy sources such as solar, dynamo and wall charger use to charge the battery using electrical energy. The main aim of this survey is to run the bicycle using dynamo power. A pair of dynamo will be fixed on the rear wheel without using peddling dynamo charge the battery and produced electricity and stored in battery and battery supply power to the hub motor of the front axle and bicycle run on the road.

5. METHODOLOGY

An attempt is made in the fabrication of a solar and dynamo powered hybrid bicycle System for a two-wheeler. There are so many vehicles that came to influence in the existing world. Their operating systems are based on the usual fossil fuel system. At the present sense the fossil fuel can exceed only for a certain period after that we have to go for a change to other methods. Thus, we have tried to design and fabricate solar bicycle, which would produce the cheaper & effective result than the existing system. This concerns with different parameters like

- I. Design parameters
- II. Fabrication procedure

I. DESIGN PARAMETERS

The design involves the calculation of driving torque and power requirement to ride the bicycle, rating of motor, selection of motor, battery capacity, dynamo and solar panel.

DESIGN OF SOLAR AND DYNAMO POWER DRIVEN BICYCLE	
1. Problem statement	
Diameter Of wheel	D = 0.45 Meter
Speed	V = 10 KM/H
Weight of Bicycle	W ₁ = 40 Kg
Weight of Rider	W ₂ = 60 Kg
Total weight.	W = 100 Kg
2. Power calculations	
1) Normal reaction on each tire	N ₁ = W/2 = 100/2 = 50 Kg = 50*9.81= 490.5 N
2) Friction Force acts on each tire	F = u* N ₁ = 0.3*490.5= 147.15 N
3. Torque requirement	
	T = F*r = 147.15 *0.225 =33.10 NM
Speed calculations	w = V/r = 10000/ 0.225*3600 = 12.34 rad/Sec. N= (60*12.34)/2*3.142 = 117.82 RPM
4. Power requirement	
	P = 2*3.142*NT/60 = 2*3.142*117.82*33.10/60 = 408 W
5. Motor selection	
The power required for riding the bicycle is 408 W The solar power is used to assist the rider Hence a motor of lesser power is used of 300 W and 48 Volt rating standard motor is selected.	

6. Battery selection	
Since motor selected is of 48V hence battery voltage rating should also be 48 V and the current rating is calculated $P = V \cdot I = I = P/V = 300/48 = 6.25$ Ah Therefore, we select four batteries of 12V 7.0 Ah in series combination of getting 48V output.	
7. Electrical, Charging time	
Time required to charge the battery by adapter 48 V 3Ah.	$P = V \cdot I = 48 \cdot 3 = 144$ W $t_1 = 48 \cdot 7 / 144 = 2.33$ Hours.
8. Panel selection	
We use two panels of 20 W each having dimension 200mm* 160 mm to develop a voltage of 336 V Time require to charge the Battery two panel 20 Watt each $20 \cdot 2 = 40$ Watt. $48 \cdot 7 / 40 = 8.4$ Hours.	
9. Dynamo selection	
We have selected 48 Volt Motor, so we selected 24 V 50 W two dynamos.	
Time required to charge the battery	$t_3 = 48 \cdot 7 / 100 = 3.36$ hours.
10. Result	
The Voltage rating of motor	48 Volt 300 Watt.
Rated speed	10 Kmph
Current rating	6.25 Ah
Power rating	408 W
Lead acid battery	48 Volt 7 Ah
Speed in RPM	117.82 RPM
Time required to charge the battery using the electrical charger	$t_1 = 2.33$ hours
Time required to charge the battery using Solar panel	$t_2 = 8.4$ hours
Time required to charge the battery using Dynamo	$t_3 = 3.36$ hours

II. FABRICATION PROCEDURE

In this project we selected the required components depending upon the calculated rating values using the standard formulae. We have selected 48 Volt hub motor, four batteries of 12 Volt each are connected in series, two dynamos of 24 Volt, two solar panels of 12 Volt, Electronic control module, Full twist accelerator throttle,

brushless electronically commutated direct current motor controller and gate switch each component working principle are discussed below and all components are assembled and fabricate the solar and dynamo power driven bicycle.

List of components required

Sl.No	Components	Capacity	Pieces
1	Conventional pedal operated bicycle		1
2	Hub motor	48Volt 300 Watt	1
3	Maintenance free Batteries	12 Volt	4
4	Photovoltaic solar panel	20 Watt	2
5	Dynamo	24 Volt	2
6	Battery charger.	48 Volt	1
7	Regulated power supply (PCB)		1
8	Accelerator/Throttle		1
9	BLDC Motor controller.		1

6. WORKING PRINCIPLE OF EACH COMPONENTS

6.1 Conventional pedal operated bicycle

First of all selected a conventional pedal operated bicycle.



FigIII: Conventional pedal operated bicycle

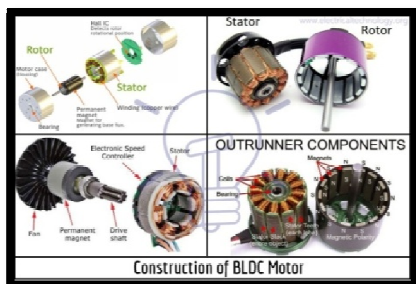
6.2 BLDC HubMotor

BLDC Hub motor electromagnetic fields are supplied to the stationary windings of the motor. The outer part of the motor turning the attached wheel. Energy is transferred in a brushless motor electronically, eliminating physical contact

between stationary and moving parts BLDC Motor powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the Motor. In BLDC motor the roles of the coils are opposite compared to normal DC motor: the inner part having the coils is stationary and the magnet rotates around this coil. The electronic circuit induces power in the inner copper coils in turn, making the outer body spin around the copper coils. There are many small magnetic field sensors attached between some of the coils. These sensors are known as Hall-effect sensors. When the outer permanent magnet passes through the sensors, the sensors sense the position of the north and south poles of the rotor and then activates the required coils for continuous rotation.



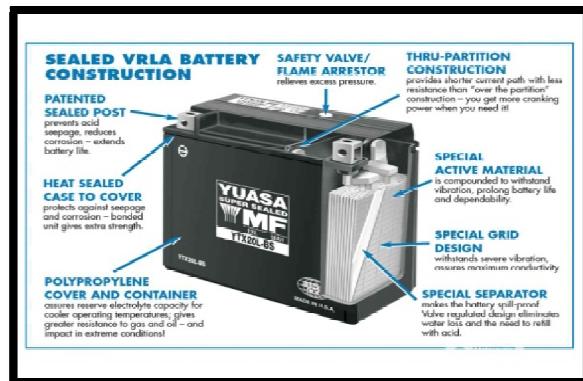
Fig IV: BLDC hub motor



FigV: Construction of BLDC motor

6.3 Batteries

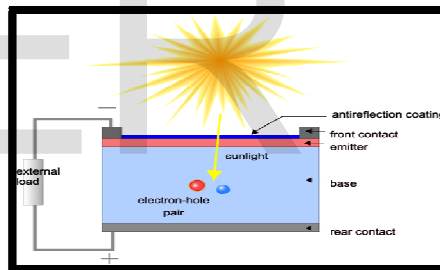
Depending upon design calculation requires voltage to drive a BLDC Motor is 48Volt so we selected four 12Volt maintenance free batteries connected in series. Chloride safe power sealed maintenance free battery is lead-acid battery was invented in 1859 by French physicist Gaston Planté and is the oldest type of rechargeable battery.



FigVI: construction of maintenance free battery

6.4 Solar panels

A solar cell: A solar cell is a solid-state electrical device (p-n junction) that converts the energy of light directly into electricity (DC) using the photovoltaic effect. The process of conversion first requires a semiconductor material which absorbs the solar energy (photon), and then raises an electron to a higher energy state, and then the flow of this high-energy electron to an external circuit.



FigVII: solar cell structure

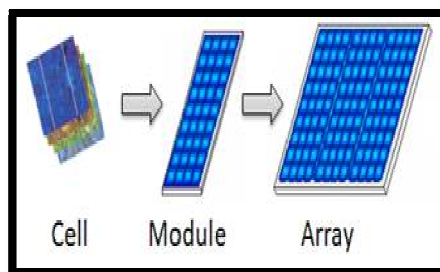


Fig VIII:solar panel configuration

6.5 Dynamo

A dynamo is an electrical generator that produces direct current with the use of a commutator. Dynamo selection is depending upon battery and Hub motor capacity. We used 48 Volt battery and 48 Volt hub motor, so we are selected 24 volts two dynamos fixed to the rear wheel of bicycle using

arc welding. The rotor shaft of the dynamo attached fiber teathed wheel and made friction to the rear wheel bicycle and produced electricity stored in batteries.

Dynamo consist mainly three parts.

Stator is a fixed structure that makes magnetic field.

Armature: is made of coiled copper windings which rotate inside the magnetic field made by the stator. When the windings move, they cut through the lines of magnetic field. This creates pulses of electric power.

Commutator is needed to produce direct current. In direct current power flows in only one direction through a wire, the problem is that the rotating armature in a dynamo reverses current each half turn, so the commutator is a rotary switch that disconnects the power during the reversed current part of the cycle.

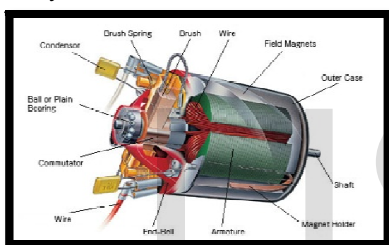


Fig IX: Construction of dynamo

6.6 Battery charger

Here mainly three methods are used to charge the bicycle battery.

- Solar charging method
- Dynamo charging method
- Wall charging method

6.6.1 Solar and dynamo charging methods.

Recharge Lead Acid Battery through Solar Panel and dynamo. Solar and dynamo battery charger worked on the principle that the "charge control circuit" will generate the constant voltage. The charging current permits to LM317 voltage regulator using the D1 diode. The o/p current and voltage are controlled by changing the adjust pin of the LM317 voltage regulator. The charging of the battery can be done by using the same current.

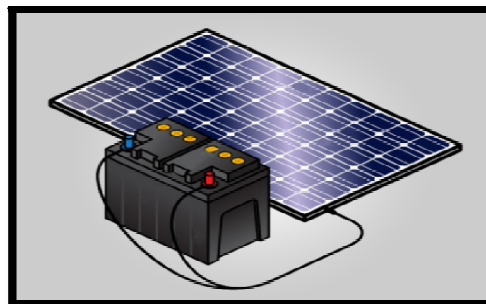


Fig X: Recharge Lead Acid Battery through Solar Panel

6.6.2 Wall Charging methods.



Fig XI: Battery charger 48Volt 3 Ah.

The electrical energy used to charge the rechargeable batteries usually energy taken from AC mains electricity and convert into DC using rectifier in battery charger and store in the battery

6.7 Regulated power supply

A device or system that supplies, electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often, to mechanical ones, and rarely to others. transformer use to increase or decrease the intensity of current and rectifier use to convert AC to DC current and filter use to Restrict unwanted signal and regulator regulate the flow of current.

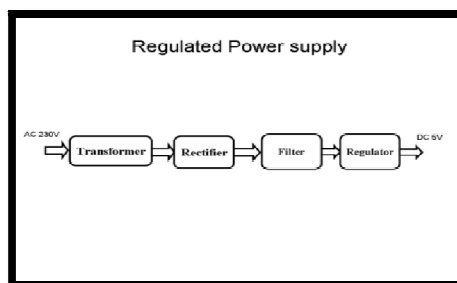


Fig XII: Regulated Power Supply

6.8 Full twist throttle

The full twist throttles antithesis of thumb throttles as they are the largest type of E-bike throttle and require the whole hand to operate. The full twist throttle takes up the entire end of the handlebar, to operate it, the rider simply grabs a handful of throttle and twist it back towards himself. We preferred full twist throttle because they are operated by the full hand all five-finger grip that rider. And use your wrist to accelerate.



Fig XIII: Full twist throttle

6.9 BLDC Motor speed controller

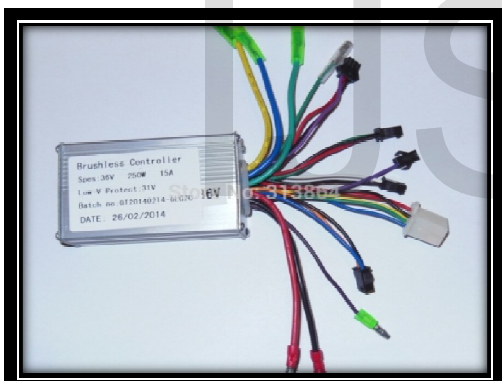


Fig XIV: Brushless DC Motor speed controller

BLDC Motor controller is used to control the speed of the motor when electronic speed control follows a speed reference signal derived from a throttle lever and varies the speed of the bicycle motor.

6.10 Gate Switch

The gate switch is the one type of main switch which is used to use to control the flow of direct current to the motor from the battery. this switch will operate manually

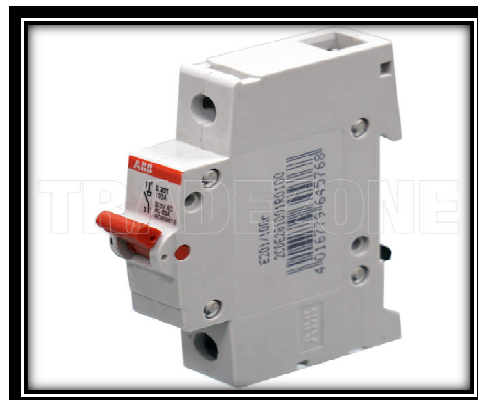


Fig. 15 Manually activated Gate switch

7. FUTURE SCOPE

Our project "Fabrication of Solar and Dynamo power driven Bicycle" is mainly intended to fabricate a Bicycle with renewable energy source solar and kinetic rotational energy. The bike can further be improved by using solar panels on the front and the rear frames of the mudguards or other places which would be responsible for trapping solar energy & converting the same into electric energy thereby improving the battery's efficiency. The solar and dynamo operated bicycle will replace the fossil fuel mobiles in future.

8. RESULT AND TESTING

"Fabrication of Solar and dynamo power driven Bicycle" was designed for renewable energy source solar and dynamo. Riding test is successfully completed with 15 kmph. Total 30 km round trip with one-time charge, solar and dynamo backup.

9. CONCLUSION

After studying various research papers, the following conclusions are proposed.

1. The solar and dynamo hybrid bicycle can be a very good application of renewable energy source which will reduce pollution and can be a useful device for villagers, where the provision of electricity is not adequate.
2. This can be used even in the absence of sunlight since it has an alternate source of power generation using dynamo.
3. Though the efficiency of solar cells is very low, and it is also a costly device, it has the capability to sustain longer. It is a combination of both, non-polluting and an equipment of maintaining health.

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