

# Hybrid Powered Electric Bicycle

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**Abstract**— The hybrid powered electric bicycle is a system that involves three different ways of charging a battery: solar power, Dynamo and 220V Ac wall charge. The power from these three modes is used to charge an electric PMDC motor running a bicycle. The hybrid powered bicycle is designed in such a way that the rider can have to modes of operating bicycle that is he can choose the bicycle to be driven completely with the electric PMDC motor or it can be driven manually by himself.

**Key words:** Hybrid Powered Bicycle, Hybrid Powered Electric Bicycle

## I. INTRODUCTION

The term "hybrid" usually implies that more than one energy source. There are many types of bicycle in the world such as normal bicycle that people need to paddle for it to move, motorized bicycle that uses fuel as its prime power and electric bicycle that can only be sufficient for an hour. Because of some weaknesses in the existence system, the idea of a solar bicycle came in mind. The idea is to make the bicycle last longer and can be automatically recharge when the bicycle is not in use by the renewable solar energy. The concept of the solar energy is that a high torque motor will be put on the bicycle which will be generated by the solar energy. The solar energy will be absorbed by the portable solar panel to generate the power. The power that had been absorbed by the panel can be used directly by the motor if the power matches the power requirement. If not, the motor will use the power from a battery. When the bicycle was not in use during the day, the solar panel will charge the battery. The system will make bicycle to operate more efficiently. Rechargeable battery is used with long life for charging. The hybrid bicycle is a project that can promote both cleaner technology as well as a lesser dependence on oil. It will run on clean electric power with the ability to recharge the battery 3 separate ways: through the 230 V AC wall source, by solar-cell generative power and by dynamo which is attached to bicycle wheel.

## II. WORKING PRINCIPLE

The block diagram hybrid bicycle driven by DC motor fitted on middle shaft of bicycle & operated by battery energy shown in fig1. The solar panel mounted on carriage. Solar panel generates 12v power when sun light falls on it and its terminals are connected to charge controller. Dynamo is mounted on side shaft of bicycle, supports in such a manner that dynamo shaft is touching the back wheel tyres. As wheel rotates dynamo shaft rotates and generates 12V power. Its terminals are also connected to charge controller. When the bicycle is idle in day time, the solar panel will charge the battery. Due to non-uniform sunlight and varying in wheel speed, output voltage from both solar panel and dynamo is varying in nature. Charge controller adjusts the constant voltage of 12 volt and charges the battery. The power flow acts in parallel with the power delivered by the rider via the

pedaling. The rider of an solar bicycle can opt the motor completely or pedaling (as in conventional bicycle).

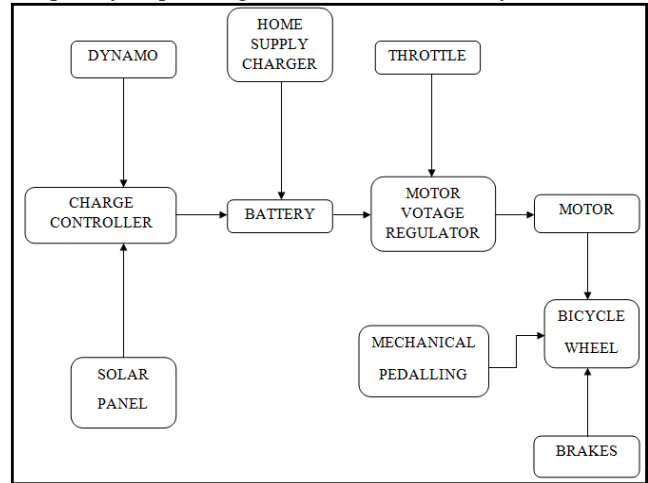


Fig. 1: Block diagram of hybrid powered bicycle

## III. COMPONENTS OF HYBRID BICYCLE

The hybrid electric bicycle consists of following components.

### A. Brush Type PMDC Motor

In this project 12v, 80W brush type permanent magnet dc motor is used which is shown in the fig 2.



Fig. 2: PMDC motor

load	Voltage	Current	Power
No load	12V	3Amp	36watts
Full load	12V	7Amp	84watts

Table 1: Motor Power Consumption

### B. Solar Panel

Solar power is the generation of electricity from sunlight. Solar power is the conversion of sunlight to electricity. Sunlight can be converted directly into electricity using photo voltaic (PV) panel.

Parameter	Value
Rated max power	12W
Open circuit voltage	21.6V
Short circuit current	0.66 Amp
Rated voltage	17.6 V
Rated current	0.59 Amp
Life span	25 years

Table 2: Specifications of solar panel

### C. Charge Controller

It is essential to regulate the voltage output from the solar panel before it is supplied to the battery. A charge controller is a power converter with an output DC voltage greater than the input DC voltage. This is used to regulate an input voltage to a higher regulated voltage.

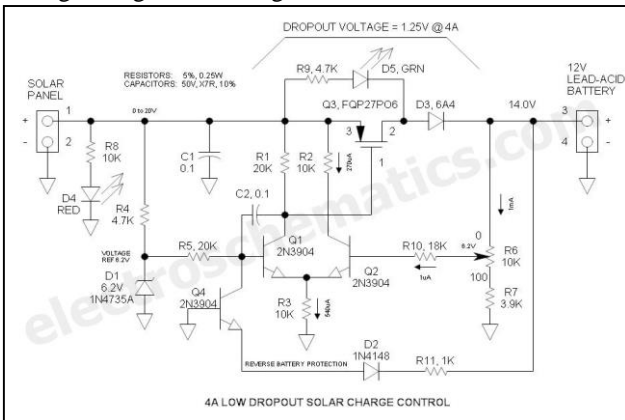


Fig. 3: Charge Controller Circuit

Parameter	Value
Rating of controller	4A,12V
Max solar panel voltage	25V
Low voltage disconnect	11.6V
Boost voltage	14.3V
Battery type	12V lead acid
Self consumption	less than 20mA
Efficiency	>96%

Table 3: Specifications of solar charge controller

### D. Dynamo

Dynamo for generation the electric power. A dynamo is electrical generator that produce power with use of a commutator. Dynamo is placed on front wheel of the bicycle and dynamo commutator is connected with front wheel of bicycle is shown in fig4.



Fig. 4: Dynamo

Parameter	Value
Voltage	12 Volt
Output power	3 watt

Table 4: Specifications of dynamo

### E. Voltage Regulator

Figure5 shows a typical voltage regulator. Voltage regulator controls the voltage level as per requirement. The voltage regulator used in this project acts as a tapping switch. In our project two voltage levels are used.as per required voltage levels regulator can be adjusted.

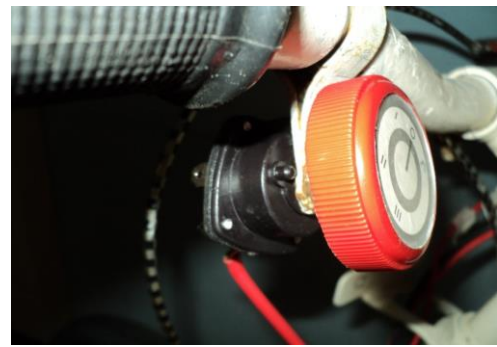


Fig. 5: Voltage regulator.

### F. Throttle

This solar electric bicycle thumb throttle is easy to use and great for those that want to keep their original handlebar grip. Typically the thumb throttle is used on bikes that have a twist gear changing system. Thumb throttle that said it comes down to personal choice as the thumb throttle can also be used on a bike that has a thumb gear changing system. A “Thumb Throttle” refers to a method of controlling the speed of an engine or motor.

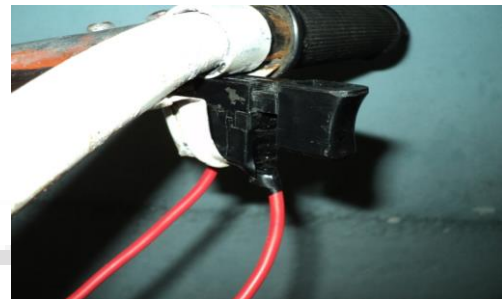


Fig. 6: Throttle

## IV. SPEED CONTROL OF MOTOR BY BATTERY VOLTAGE LEVEL

Motor speed is controlled by voltage levels of the batteries as shown in figure 7. Battery negative terminals are connected to voltage regulator and Voltage regulator is nothing but a tapping switch. In series with regulator a ON/OFF switch i.e. throttle is connected and its end terminal is connected to motor negative terminal. Battery positive terminals are connected parallel to the motor positive terminal. Motor speed can be adjusted as per requirement by varying regulator tapping.

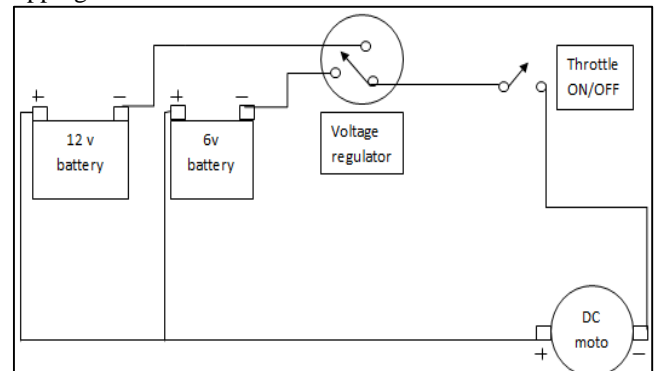


Fig. 7: Motor voltage controller block diagram

## V. RESULTS AND DISCUSSION

Our hybrid bicycle total weight including battery, motor and solar panel is 25kg. When battery is fully charged the

maximum travelling distance at plain road is 25km. Hybrid bicycle can attain a maximum speed of 15 km/hour. Compared to already existing E bikes travelling distance and maximum speed is small but considering the cost our hybrid bicycle is around 8000 Rupees and E-bikes cost is 30000 Rupees. Our hybrid bicycle cost is 73% less than presently existing E-bikes. Hybrid bicycle power can be increased by replacing existing motor and battery to higher ratings as per needed.



Fig. 8: Hybrid Bicycle

Parameter	Hybrid power bicycle	E bike	ordinary bicycle
Max speed limit(km/h)	10-15	25-30	5-10
Drivers pedaling requirement	Optional	No	Yes
Initial unit cost in Rupees	8000	30000	4000
Wight in kg	25	50	15
Max travelling distance (fully charged) in km	25	70	-
Type of energy used	Electrical and muscle power	Electrical	Muscle Power
Driving noise(dB)	5-8	65-70	Noiseless
Charging time	4hours by conventional charger,15 hours by solar panel,30 hours by dynamo	8 hours (depends on charger)	Not applicable
Battery life time	2-3 years	1-2 years	-
Cost per Km in Rupees	2	3.5	-

Figure.8 Hybrid Powered Electric bicycle

#### VI. ADVANTAGES

- It is one of the most used, cleanest and sustainable forms of energy obtained through solar cells.
- It is environmental friendly with no use of any fuels or release of toxic fumes that may cause global warming.
- Solar cells are independent form a power source and can charge constantly which helps lower time to charge through a high AC voltage charger.
- It also has a long life span of at least 20 years and requires little maintenance.
- Lesser maintenance cost.
- Normal pedaling is possible when not on power assist mode.
- Detachable battery can be taken inside the house for charging.
- Thumb throttle - simple to operate and less strain on hands.
- Solar panels keep charging the batteries for our continuous use.
- The unit cost is very low.

#### VII. DISADVANTAGES

- Price of Motor, battery and solar panel increases with the increase in energy demand of consumer.
- Sunlight is not always available, especially at night and may not be evenly distributed where you are located.
- Both Solar cell and dynamo cannot always provide the sufficient amount of power so they cannot be used as primary source of charging.

- It is also not highly energy efficient, because of frictional loss in chains and wheels.

#### VIII. APPLICATIONS

- Hybrid powered bicycle can be used as transportation vehicle in cities instead of petrol vehicles; because of small in size it can avoid traffic jam.
- Young, aged, physically challenged people can use it for short distance travelling.
- Any bicycle can be modified as a hybrid powered electric bicycle.
- For children small hybrid powered bicycle can be used as a kids cycle.

#### IX. CONCLUSION

Solar assisted bicycle is modification of existing bicycle and driven by solar energy. It is suitable for both city and country roads, that are made of cement, asphalt, or mud. This bicycle is cheaper about cost of 8000 rupees and simpler in construction & can be widely used for short distance travelling about 25km especially by school children, college students, office workers, villagers, postmen etc. It is very much suitable for young, aged, physically challenged people and caters the need of economically poor class of society. It can be operated throughout the year free of cost. The most important feature of this bicycle is that it does not consume valuable fossil fuels thereby saving the money. It is eco-friendly & pollution free, as it does not have any emissions. Moreover it is noiseless and can be recharged with the AC adapter in case of emergency and cloudy weather. The operating cost per kilometer is minimal. It can be driven by

manual pedaling in case of any problem with the solar system. It has fewer components, can be easily mounted or dismounted, thus needs less maintenance.

#### X. FUTURE SCOPE

In present project, Hybrid powered electric bicycle uses solar power as one of the energy source. In future wind can also be used as a one of energy source by placing wind turbine at convenient place. Hybrid bicycle can be modified further and make it to use for physically disabled people. Even Bicycle can be digitalized by fitting indicators, advance sensors, digital display, Navigation system etc. Gear variation system can also be implemented to increase torque and control speed.

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