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# SOLAR ELECTRIC BICYCLE (HYBRID)

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## ABSTRACT
In present scenario a solar 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. The project on Solar Electric Bicycle (Hybrid) mainly focusses on energy conservation. The Hybrid Bicycle system consists of a light weight and compact DC motor which is powered from a lead acid battery. The different ways of charging the battery are incorporated: the 220V AC wall outlet and solar power. The Hybrid Bicycle enables substantially longer distance power assisted cycling by regenerating power from braking and solar energy and charging it in the battery.

**Keywords:** solar power, regenerative braking, wall charging, DC motor, lead acid battery, throttle.

## INTRODUCTION
In present scenario, owing to the increasing number of automobiles the need for petroleum products is reaching its peak point. Petroleum products are non-renewable and may possibly get exhausted in future, so it is better to move to alternate energy sources. Crude oil prices have increased significantly over the past few years and there seems to be no turning back. Currently, there has also been a focus on the environment and it

seems that the demand for cleaner alternatives for fuel has become critical. The hybrid bicycle is a project that can promote both cleaner technology as well as a lesser dependence on oil. An Electric Bicycle is a low-cost alternative to an automobile. Solar energy is used to charge the battery.
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.

## LITERATURE REVIEW
M. Reddy Sankar [1] & et al. developed solar assisted bicycle driven by DC motor fitted in front or rear axle housing & operated by solar energy. The solar panels mounted on the carriage will charge the battery & which in turn drive the hub motor. When the bicycle is idle, the solar panel will charge the battery. This arrangement will replace the petrol engine, the gear box & the fuel tank in case of a two-wheeler or a chain sprocket, chain & gear shifting arrangement of a conventional bicycle being used by most common man.
As a part of dissertation work, the solar assisted bicycle is fitted with a dc hub motor on front axle of a bicycle with power rating of 250W and with a travelling speed of around 25-30 kmph. It is provided with a pair of lead acid batteries of 35 Ah each, a photovoltaic solar panel with capacity of 20 watt, a voltage regulator of 24v 10 Amp, accelerator and motor controller of 24V 25Amp. There is also a provision for charging of the battery with 220-240V, AC wall outlet supply, in case of poor solar supply due to cloudy weather.

N. Sasikumar [2] & et al. published paper that includes Conventional energy sources like coal, oil, natural gas, etc., are limited in quantity, and if these continue to be depleted at the present rate, these will be exhausted in the coming decades. Energy demand is resulting in the creation of fossil fuel-based power plants leading to substantial greenhouse gas emissions having an adverse impact on

global warming and climate change Solar energy offers a clean, climate-friendly, abundant and inexhaustible energy resource to mankind. The costs of solar energy have been falling rapidly and are entering new areas of competitiveness. Solar Thermal Electricity (STE) and Solar Photo Voltaic Electricity (SPV) are becoming competitive against conventional electricity generation in tropical countries solar photovoltaic (SPV) cells convert solar radiation (sunlight) into electricity. A solar cell is a semiconducting device made of Silicon materials, which, when exposed to sunlight, generates electricity. Solar cells are connected in series and parallel combinations to form modules that provide the required power.

Yogesh Sunil Wamborikar [3] & et al. explained in paper about renewable energy is vital for today's world as in near future the non-renewable sources that we are using are going to get exhausted. The solar vehicle is a step in saving these non-renewable sources of
energy. The basic principle of solar car is to use energy that is stored in a battery during and after charging it from a solar panel. The charged batteries are used to drive the motor which serves here as an engine and moves the vehicle in reverse or forward direction. The electrical tapping rheostat is provided so as to control the motor speed. This avoids excess flow of current when the vehicle is supposed to be stopped suddenly as it is in normal cars with regards to fuel. This idea, in future, may help protect our fuels from getting extinguished.

Chetan Mahadik [4] & et al. published paper the aim of this paper is to show that the normal bi-cycle can be upgraded to electric one by some means– that including the development of a regenerative braking system and innovative BLDC motor control. The main components of the electric bicycle are brushless DC motor, motor controller, photo-voltaic, dry cell battery and solar panel. Also throttle and extra features such as horn, speedometer, and LED signal etc. The power source for this system is given by dry cell battery. The output of dry cell battery is 48V. There are multiple forms of charging source is used such as AC voltage through an outlet, solar energy and mechanical pedal charging system. The source of battery charging is photovoltaic solar panel and it is light weight. The solar panel output is 12V and 20 watt. Also they use mechanical pedal charging system, so dynamo is use for this charging system.

Qingfeng Su [5] et al. published paper on Electric vehicle with more advantages of no noise, no pollution, saving energy and reduce carbon dioxide emissions is to power driven vehicle with a motor drive wheels moving. Solar electric vehicle can make to reduce our greenhouse gas emissions and other pollution. All advantages of solar electric vehicle make research and application of solar electric vehicle as a "hot spot" of automotive industry and the trend of future cars. Solar electric vehicle is made of PV panels, battery, electric motor, vehicle controller and vehicle body. Solar electric vehicle drives using dual-mode of PV and battery hybrid. It can be achieved PV-driven and battery-driven independently. In good sunny conditions, the full charge endurance of solar electric vehicle can be increased about 35% substantially compared with no PV panels. Solar electric vehicle can achieve low-carbon, energy saving, environmental protection and true zero-emissions for the future of human life

## METHODOLOGY

### PMDC MOTOR (Permanent magnet DC motor):


Fig 1 PMDC Motor

Permanent magnet DC motors (PMDC motors) consist of permanent magnets, located in the stator, and windings, located in the rotor as shown in Fig 1. The ends of the winding coils are connected to commutator segments that make slipping contact with the stationary brushes. Brushes are connected to DC voltage supply across motor terminals. Change of direction of rotation can be achieved by reversal of voltage polarity. The current flow through the coils creates magnetic poles in the rotor that interact with permanent magnet poles. In order to keep the torque generation in same direction, the current flow must be reversed when the rotor north pole passes the stator south pole. For this the slipping contacts are segmented. This segmented slip ring is called commutator.

**LEAD ACID BATTERY**

Lead acid battery are one of the most popular types of battery in electronics as shown in Fig 2. Although slightly lower in energy density than lithium metal, lead acid is safe, provided certain precautions are met when charging and discharging. This have a many advantage over other conventional types of batteries, the lead acid battery is the optimum choice for a solar assisted bicycle. Current supplied from battery indicates the flow of energy from the battery and is measured in amperes (or Amps). The higher the current flow faster the battery will discharge.


Fig 2 Lead Acid Battery

**SOLAR CHARGE CONTROLLER**

A MPPT solar charge controller is chosen for the solar power system of the solar three-wheeler to extract maximum power from solar panel throughout the day. This is operated by microprocessors for sensing and recording the panel voltage and current at frequent intervals for computing and adjusting the power output. This solar charge controller takes the uncertain voltage from the solar panel and conditions it to charge the lead-acid battery safely. It cuts out the batteries from the load when the lead acid batteries are depleted to prevent damage to the battery and also protect the panels from the batteries after the sun goes down. Here, it collects charges from solar panels and charges the 12 volt lead-acid battery. It has LED bar readout to show the status of the solar charging system and batteries. With the help of this MPPT solar charge controller about 20 to 30% more energy can be generated than that of a common type charge controller.

**THROTTLE**

The maximum speed of a bicycle is 25 kmph. It is required to vary the speed depending upon the road conditions and traffic as shown in Fig 3. Therefore, an accelerator or a throttle is necessary. Throttle allows us to drive the motor from zero speed to full speed. The throttle is fitted on right side of the handle bar and is connected to controller.

The throttle converts DC voltage from battery to an alternating voltage with variable amplitude and frequency that drives the hub motor at different speeds. It consists of MOSFET transistors and a small microprocessor. This throttle is technically referred to as a Hall Effect type. The throttle has three wires contains a black, red, and green. The supply voltage is via red and black wires and is usually around 4 volts. Green wire voltage increases as the throttle is turned.

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Fig 3 Throttle

**SOLAR PANEL**

High efficiency crystalline cell for "all weather" charging perfect for battery maintenance, off grid lighting projects and use in caravans and boats over a weekend period water resistant, robust construction for outdoor use as shown in Fig 4. In built diode protects against battery discharge 20-year cell warranty and 10-year module warranty

Fig. 5 Layout of hybrid bicycle

Power - 10watts
Peak Output - 660mA @ 16.8V
Approx. watt-hours/day* - 70
Approx. amp-hours/day* - 4.62
Dimensions 397 x 278 x 25mmWeight - 1.6kg

**FRAME**

Fig 4 Solar Panel

The Frame is made up of M.S. along with some additional light weight components as shown in Fig 5. The frame is designed to sustain the weight of the person driving the unit, the weight of load to be conveyed and also to hold the accessories like motor. Also, it should be design to bear and overcome the stresses which may arise able to due to different driving and braking torques and impact loading across the obstacles. It is drilled and tapped enough to hold the support plates.

**ESTIMATING BATTERY CHARGE TIME FROM SOLAR**

You have a 2-Watt, 6 Volt panel and a 1,000 mah, 3.7V battery, how long does it take to completely charge? The quick and very wrong answer would be to figure out the Watt hours of the battery (3.7 * 1Ah = 3.7-Watt hours) and divide. The reality is about 2.5 times longer.

There are three main reasons for the difference, even in ideal conditions. First, the Wattage rating on the panel is the open circuit Voltage multiplied by the peak current. When you connect a panel to a battery, the Voltage drops down to that of the load, about 4.5V. Finally, all the power that enters the battery does not get converted into storage energy. Some percentage is lost as heat as the process to convert the incoming power into stored power takes energy.

In field tests, we're seeing that the combined loss factor is about 2.5. So, Divide the Watt hours of your battery by the Wattage of your panel and multiply by 2.5. In our example above you would get 3.7-

Watt hours / 2.0 Watts * 2.5 = 4.6 hours to fully charge. If you have cloudy conditions, your panel is not pointed at the sun or your panel's Voltage is not well matched to your battery, this could increase. With large-scale systems, maximum power point tracking is used to increase production efficiency. We haven't seen any cost-effective examples in small-scale systems yet. If you know of any, please drop us a line.

## CONCLUSION

This project on Hybrid Bicycle is an alternative to automobiles for medium distance travel and focuses on energy conservation. When the Hybrid electric bicycle is kept under sunlight the battery gets charged which powers an electric motor in the front wheel. The use of motor aids the resistance in pedalling while going up hills. When there is no sunlight, the bicycle can be charged by ac mains. The project focuses on constructing a hybrid bicycle with a minimal additional weight that is capable of greater efficiency through its use of regenerative motor and various other mechanisms. The implementation of the proposed system is on its way and is yet to be completed. In future we also need to look more into the different mechanisms for decision making and control.

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