

## Novel Design of Solar Electric Bicycle with Pedal Assistance



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### ABSTRACT:

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 non hub drive system, brushed DC motor for high performance. 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.

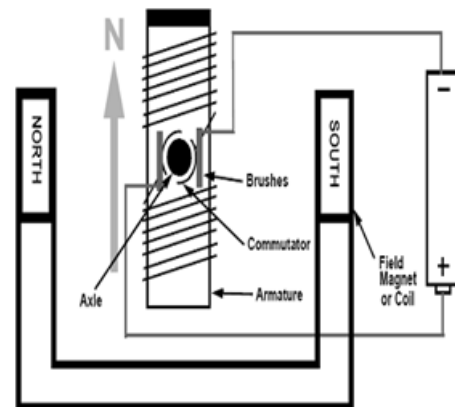
The idea is to make the bicycle last longer and can be automatically recharge when the bicycle is not in use by the renewable solar energy. Electric bikes have simultaneously gained popularity in many regions of the world and some have suggested that it could provide an even higher level of service compared to existing systems. There are several challenges that are related electric bike design: electric-assisted range, recharging protocol, and bike and battery checkout procedures. This project outlines system requirements to successfully develop and deploy an electric bike.

### METHODOLOGY:

The solar electric bicycle consist of following components. 1. Brush type DC motor, 2. Gear wheel system (spur gears), 3. Lead acid battery, 4. Solar panel, 5. Throttle

#### 1. MOTOR:

In this project we used 12V, 80W brush type motor.



Atypical dc brushed motor looks like a small metal can with an axle sticking out of one end and battery leads on the other end. The commutator shaft, armature, wires, brushes, and magnets are contained inside the can. Those carbon brushes inside the can connect with the commutator shaft. When Voltage is applied through the battery leads to the brushes in contact with the brushed motors are rated by number of turns of copper wire around the armature within the motor. A Higher number of turns provides for more torque but lower rpm and less speed. But it also provides longer battery life.

The lower the number of turns of brushed motor, the more voltage can be applied with less torque and higher rpm also.

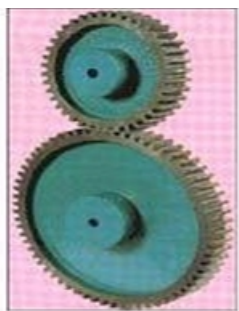
### Motor specifications :

	voltage	current	Power consumption
<b>No load</b>	12v	3Amp	36W
<b>Full load</b>	12V	7Amp	84W

The above specifications are considered practically.

### 2.GEAR WHEEL SYSTEM:

In this system we use spur gear arrangements to increase the torque.

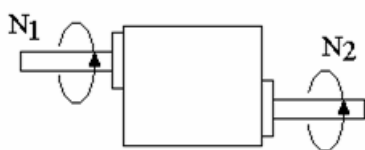


### SPUR GEARS:

A gear box is a device for converting speed of shaft from one speed to another. In this process the torque T also changed. Gears are wheels which mesh with each other through inter locking teeth. Rotation of one wheel produces rotation of other with no slip between them. The shape of the gear teeth is important in order to produce a smooth transfer of motion the most common shape is INVOLUTE gear form.

### GEAR BOX THEORY:

Consider a simple gear box with input and output shaft.



The gear box ratio is defined as

$$GR = \frac{\text{INPUT SPEED}}{\text{OUTPUT SPEED}} = \frac{N_1}{N_2}$$

N is usually rev/min but the ratio is same whatever units of speed are used | angular velocity is used then

$$GR = \frac{\text{INPUT SPEED}}{\text{OUTPUT SPEED}} = \frac{\omega_1}{\omega_2}$$

### 2.BATTERY:



Battery used here is 12V, 35Ah lead acid battery. Lead acid batteries (Fig.8) are one of the most popular types of batteries in electronics. Although slightly lower in energy density than lithium metal, lead acid is safe, The provided certain precautions are met when charging and discharging. This have many advantages over other conventional types of batteries, the lead acid battery is the optimum choice for a solar assisted bicycle. A battery is rated in ampere-hours (abbreviated Ah) and this is called the battery capacity. The lead acid cell technology is the most efficient and practical choice for the desired application. The battery chosen for this project was a high capacity lead acid battery pack designed specifically for vehicles. Plastic casing is provided to house the internal components of the battery.

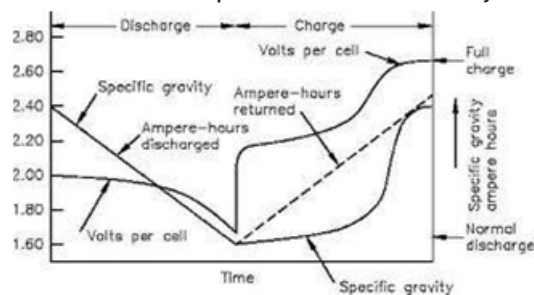


Fig 10: Charge per cell of Lead acid battery

## 4. SOLAR PANEL:

The solar panel used in this project is 20W, it can be extended

Table 1: Specifications of Solar Cell	
Maximum Power (Watt)	20w
Open Circuit Voltage	21.6v
Short Circuit Current	1.316amp
Lifespan	25 years
Size	
Power Measured at Standard Test Condition	1000W per m <sup>2</sup> at 25°



As the title suggests the bicycle is operated by solar energy. The lead acid battery is charged with solar energy with the help of a solar cell. Solar cells convert the energy of sunlight directly into electricity through the use of the photovoltaic effect. The photovoltaic effect involves the creation of a voltage into an electro-magnetic radiation.

The photoelectric and photovoltaic effects are related to sunlight, but are different in that electrons are ejected from a material's surface upon exposure to radiation of sufficient energy in photoelectric, and generated electrons are transferred to different bands of valence to conduction within the material, resulting in buildup of voltage .

## 5. THUMB 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.

A thumb throttle is located on the right side of the handle bar and is a small lever on under side of the handle bar that is operated by pushing inwards with your thumb.

When you push your thumb in you are increasing the engine speed. When you bring your thumb back towards you it slows the engine down.

## 6. SOLAR ELECTRIC BICYCLE:



This solar bicycle is driven by non hub drive mounted on frame which is connected to additional freewheel of cycle. The solar panel is adjustable and mounted behind the seat of cycle. It can be tilted according to the direction of sun rays. It can be drive manually by using pedal and also with non hub drive system by using additional freewheel. The battery is placed at the center of the frame, it is charged by solar panel and wall charger. The power supply to the motor given from the battery only. With the help of battery the bicycle runs up to 4-5 hours at 20 km/hr.

	Voltage	current	Power=VI
<b>Battery ratings</b>	12V	35amp/hr	420Wh
<b>Motor ratings</b>	12V	7amp	84w

Table2: Running time of cycle-  $(420/84) = 5$  hours.  
 From above calculation it is shown that the cycle runs up to 4-5 hours and covers 90-100 km distance in single charge.

### 7. BRAKING SYSTEM:

A bicycle brake is used to slow down or stop a bicycle



#### V brakes used in the solar electric bicycle:

V brakes are a side-pull version of cantilever brakes and mount on the same frame bosses. However, the arms are longer, with the cable housing attached to one arm and the cable to the other.. As the cable pulls against the housing the arms are drawn together. Because the housing enters from vertically above one arm yet force must be transmitted laterally between arms, the flexible housing is extended by a rigid tube with a 90° bend known as the “noodle”. The noodle seats in a stirrup attached to the arm. A flexible bellows often covers the exposed cable.

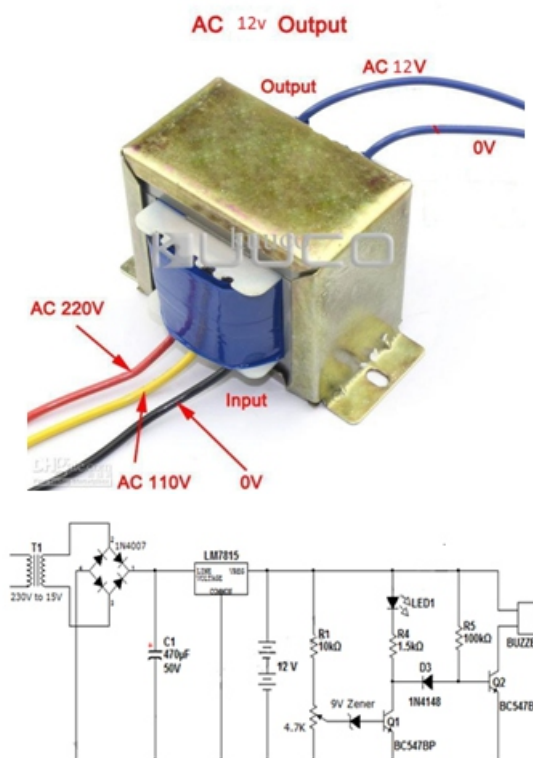
### 8. CHARGER:

In this project we have used a 220V AC, 50Hz, and 3.0A Charger with the following specifications:

INPUT - 180-250V AC,50-60HZ

OUTPUT - 12-15V DC 3.0AMP

In charger circuit we use a 220/12v step down transformer attach with a rectifier circuit and an low battery indicator circuit.



#### ADVANTAGES AND DISADVANTAGES:

##### ADVANTAGES:

The solar electric bicycle is meant as a challenge to get on sunny summer days. It may not cost substantially more energy to drive the solar electric bicycle, when not powered, than a normal bicycle. When there is no sunlight or the batteries are empty the bike should still be light running The solar electric bicycle approach is different. The PV panels have enough power and give the bicycle an infinite range. Solar panel is flexible and can be removed easily. All spare part of new bicycle can be ordered or replaced with spare parts that are available in market. Solar electric bicycle can be charged from home electricity as well as wind generator when there is less sunlight. Some important features of the solar electric bicycle are:

- Commuting with low fatigue at a top speed of 20 kmph.
- The riding range 90-100kms on a single charge.

- 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.

Solar electric bicycle is an environmental beneficial. It is eco-friendly. This project gives a good impact to the environment as a conventional bicycle.

### DISADVANTAGES:

- High center of gravity.
- More wind load.

### RESULT:

	Solar bicycle	e-bike	Ordinary cycle
<b>Max. Speed Limit (km/h)</b>	20-25	25-30	10-15
<b>Initial unit cost (Rs)</b>	7000	30000	3000
<b>Max. Traveling distance at a stretch in km</b>	90-100	35-40	10-15
<b>Charging time</b>	6-7hr. For 74W, 15A solar panels. & 16-18 hr. For 20W, 02A Solar panels	8 hours	Nil
<b>Battery life time</b>	3-4 years	1 year	Nil

Table 3

### 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, simpler in construction & can be widely used for short distance travelling especially by school children, college students, office goers, villagers, postmen etc. It is very much suitable for young, aged, handicap 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 crores of foreign currencies. 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.

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