



# **SOLAR MOWER**

Documentation Of The Project

## A Project Report Submitted



by

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### **Abstract**

Mowing of large fields is really a difficult task .This I understand when I joined “ The Scindia School “ ,Gwalior . The Scindia School is a very large premises acquiring 110 acres area with four large fields and few green lawns. Mowing such huge gardens in extreme hot and extreme cold by an individual is really a hectic task. Keeping in mind the necessity to give relief to helper of the school , I decided to innovate mower that makes less effort in mowing the grass.

My innovation is hybrid innovation of a bicycle and mower. The bicycle will run by trapping the solar energy through solar panel. The best part of the mower is, it can work with same efficiency in less sunny days i.e it can be charged with electricity also.

The power for running the motor of the mower will be used by the rechargeable battery, charged by energy generated by absorbing the solar energy through solar panel.



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### ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this innovation

A special thanks to our Principal, Shri Shaumik Ghosh , whose help, stimulating suggestions and encouragement, helped me to coordinate my work.

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Last but not least, many thanks goes to my all teacher who has given their full effort in guiding me in achieving the goal as well as their encouragement to maintain my progress in track.

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I would also like to thank all the helpers of **The Scindia School , Gwalior** for their critical advice and guidance without which this project would not have been possible.

Last but not the least I place a deep sense of gratitude to my family and my friends who have been constant source of inspiration For this work.

Sarthak Agarwal

Date : 1 September ' 2014  
Place : Gwalior

Sarthak Agarwal



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### **INTRODUCTION**

#### **Background**

The Scindia School , Gwalior has a large campus with greenery every where . In order to keep the campus well maintained and clean , large number of employees are engaged for maintaining grass fields all over the school . My Solar Mower will reduce the number of employees engaged in maintaining the large green area in a very less time along with increasing the efficiency of employees.

The Mower will use the energy of Sun to generate power and store in the rechargeable battery which will further be used for running of the solar mower .

#### **Problem Statement**

The solar mower is meant as a challenge to get the mowing done fast on sunny summer days with assistance of the solar energy operated bicycle. The solar bike mower can mow huge area in less time.

The mowing will become entertaining as its simple to use just like driving a vehicle. The solar mower has many benefits. In spite of being economical it is



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eco friendly , noise free, pollution free as it will convert solar energy for mowing and hence a boon against global warming.

The battery can be attached to the solar panel for charging when it is not in use . Once charged for six hours ,it can be used for mowing 25-30 KM per charging with the speed of 35 km/h.

### Scope of the project

This project consists of two part that is hardware and software. The hardware will be the bicycle and mower and the software is the program of the controller to control the operation of the bicycle. The Mower will use

- o Use solar energy to recharge the battery for driving the bicycle.
- o Use PIC Microcontroller for charging system.
- o Use high torque motor to drive the bicycle.



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### Equipments or the Accessories required for converting normal bike to solar bike

Solar mower uses the following equipment / accessories

1. Bicycle
2. Solar Kit by Sikco for comprising
  - Motor 250 watt
  - ST Controller compatible with motor
  - Battery 24volt 7 AH
  - Battery Charger
  - Accelerator
  - Battery Box
  - Wiring with plug
  - Rim
  - Spokes set for mounting motor in wheel
3. Mower



### Specifications of Solar kit

Max Load Bearing : 95 – 110 KG

Top speed : 35 KM per hour

Max distance : 15-20 km /charge (07 AH battery x 02)

25-30 KM /charge (12 AH battery x 02)



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Power consumption : 1KWh /100KM

Battery Type : Lead Acid sealed maintenance free (SMF)

Capacity : 07AH / 12 AH

Battery Box : MS/ Aluminum/ SS box

Voltage : 24 volt DC

Charging time : 3-4 hours (Grid power)

Input voltage : 220 volt AC / 24 VDC (Incase of solar)

Efficiency : 80%

Motor type : Brushless DC Motor

Rated power : 250w

Brand : SIKCO

### Solar panel



Solar panel

- Solar Panel of 12Volts 100 Watts.

### Specifications

- Maximum Power Pmax - 110W



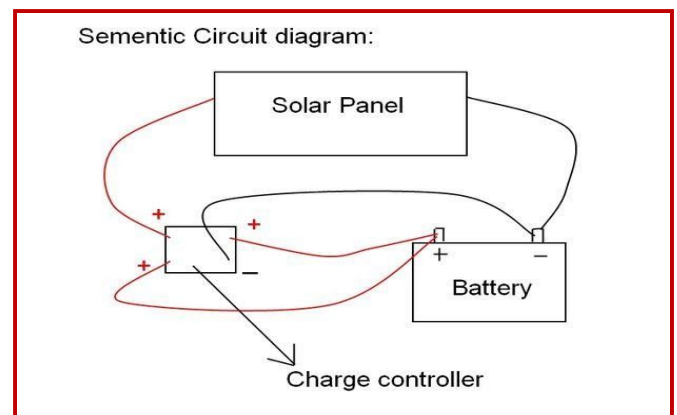
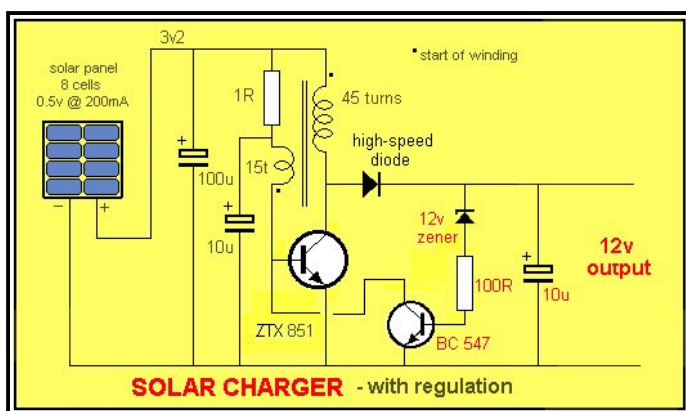
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- Maximum Power Voltage  $V_{max}$  - 17.25 V
- Maximum Power Current  $I_{mpp}$  (A) - 5.79A
- Open Circuit Voltage - 21.7 V
- Short Circuit Current - 5.90 A
- Module Efficiency – 13.35 %
- Module dimensions - 1350 \* 650 \* 32mm ( $\pm 1.5$ mm)
- Mounting Hole & Distance – 6.9 & 200 mm
- Weight – 7.9 Kgs
- No of cells – 36
- Cells Configuration – 13X3
- Block Diodes -Available
- Junction Box Protection with diodes

A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells. The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer power for mower.

### Solar charger



Circuit diagram Solar charger







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### Circuit diagram for solar charger

Solar battery chargers are an inexpensive, environmentally friendly, and convenient way to make sure the batteries are always fully charged and ready to go all the time. The problem with charging a battery from a solar panel is cloudy day for which the mower is supplied with electric charging system.

### Battery



There are 2 Lead Acid batteries of 12V each. Despite having a very low energy-to-weight ratio and a low energy-to- volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large



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power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

The consideration taken into account while opting battery for solar bicycle is -

**1. Voltage.** Batteries are available in both 6V and 12V units

**2. Amp-hour rating.** The capacity of a battery is rated in amp-hours. This rating must be specified with a given discharge rate.

**3. Discharge rate.** The discharge rate of a battery is the minimum length of time during which the battery must be discharged in order to meet the specified ampere hour rating.

**4. Watt-hour rating.** The watt-hour rating is a true indication of the energy capacity of a battery, Like the amp-hour rating, this rating must be specified with a discharge rate. The watt-hour rating of a battery is the amp-hour rating multiplied by the specified voltage of the battery.

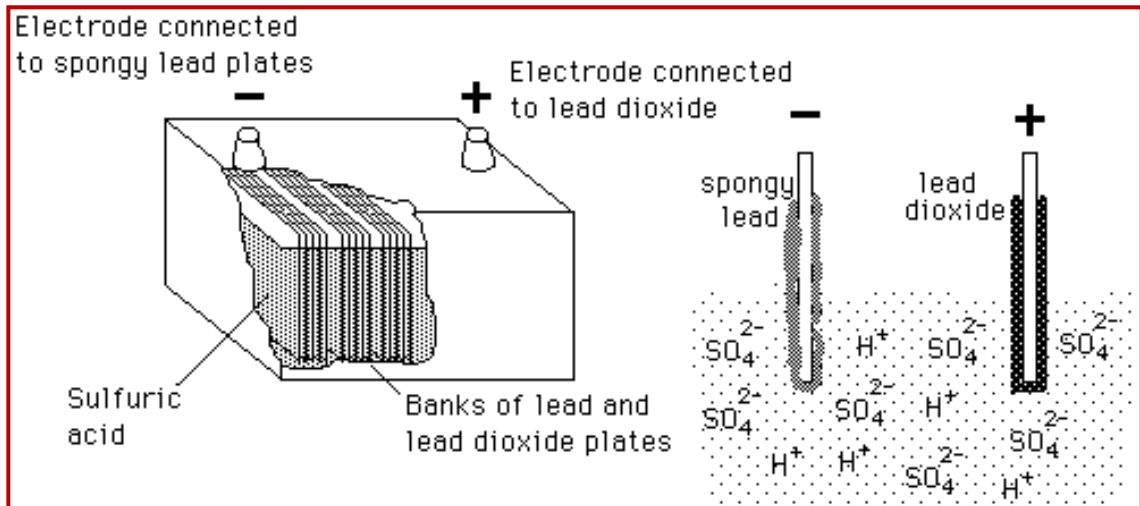
**5. Energy density.** Energy density is the energy capacity of the battery, in Watt hours, divided by the weight of the battery, in kilograms. This is a critical



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factor in selecting an electric vehicle battery-the amount of energy a battery



carries per unit weight.

**6. Cycle-life.** Cycle-life is the number of times a battery can be fully discharged before replacement.

**The chemistry of the production of a voltage by a lead-acid battery**

**-**

spongy lead

$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$   
Lead electrode must supply positive ions and is left negative

**+**

lead dioxide

$PbO_2 + H_2SO_4 \rightarrow PbSO_4$   
Lead dioxide electrode must supply electrons and is left positive

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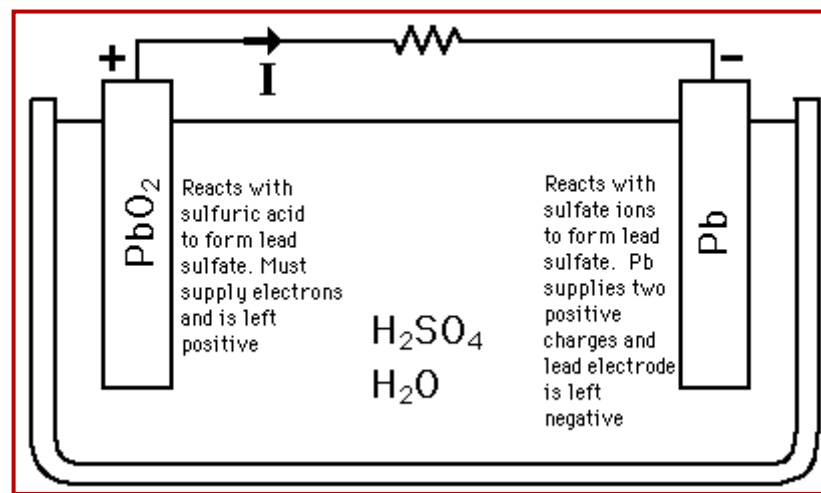
Or the total discharge reaction  $Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O + \text{energy}$

**Made by Sarthak Agarwal**

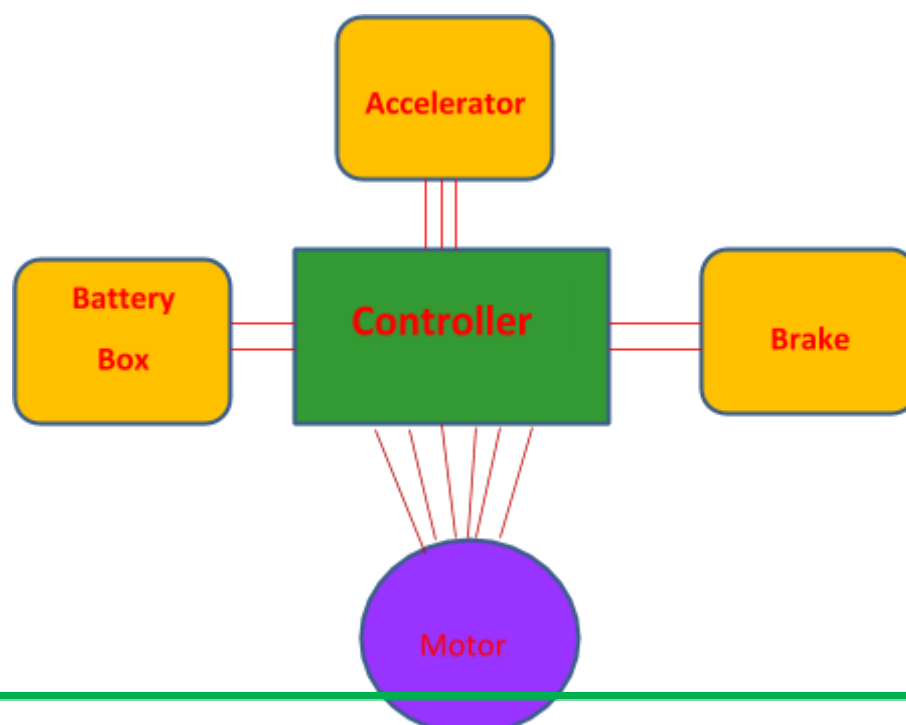


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Electrical diagram for Installation of E- Kit





## E-KIT Installation

### Installing Motor

- Freewheel is fixed on the right side threading of the motor
- Bicycle is inverted to install the wheel
- The plastic connectors from the wiring are removed to enable it pass through some hole. The connector must be connect well to avoid any loosening which can lead to heating of wiring and burning out.
- The spoked motor is now ready to install on the cycle.
- Install the motor in rear fork

### Install the carrier and stand

#### Installing the battery support plate

- Battery support plate is a metal plate which will hold the battery box on the side bar of the cycle,
- The cable is attached from below the plate to the battery box.
- It will need to be detached when removing the box, and also when wanting to charge the battery as the point for charging the battery is the same point.

#### Installing the controller

- Install the outer box that will house the controller .

#### Wiring of controller

- All the wires are connected with controller with insulation tape so they will not be loose or come out.
- All the wiring is take out through the hole in the controller box so as to close the box .

#### Installing the accelerator



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- The inner aluminum grip with emery paper to slide the accelerator on the exact position on the handle if it does not already go in easily .
- Take the wire along the handle.

### **Installing the brake lever**

- In addition to the existing brake lever of the cycle, the clutch lever is installed on the other handle to stop the motor in emergency together with the brake.
- Brake lever will immediately cut the power to the motor , i.e. on pressing this lever and using the accelerator simultaneously , the motor will not run. On leaving the clutch lever and pressing accelerator, the motor will run.
- If mower is not in use, its better to switch off from battery box to prevent damage or accident

### **Installing the outer controller box**

- All wires are compacted into the outer box.

### **Installing the battery box**

- The battery box is kept either on the cycle when charging or flat in upright position that is the charging socket will be below when charging the battery as otherwise life of battery will be effected.
- The marked red arrows must be upwards.



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### **PRINCIPLE OF OPERATION:**

#### **Motor**

The main characteristic of Brushless DC Machines is that they may be controlled to give wide constant power speed ranges because the Motor

Voltage may be held constant at Maximum Bus Voltage over the Constant

Power Range.

#### **V BRAKES:**

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

#### **THUMB THROTTLE:**

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 (going faster). When you bring your thumb back towards you (or let go of the throttle and let the springs return it), it slows the engine down.



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### **Mower**

Mower being used is a hand pushed bent reel mower specifically designed to cut low-growing, creeping grasses. It is a 4-spider, 7-blade.

### **Charger**

For Mower charger used has 220V AC, 50Hz, and 1.0A Charger with the following

specifications:

INPUT : 180 – 300 V AC, 47 – 63 Hz

OUTPUT : 29.4 V DC, 2.0 A

FLOAT : 27.4 V DC  $\pm$  0.4 V

BOOST : 29.4 V DC  $\pm$  0.4 V

### **Driving the Mower**

User drives the mower just as a bike and as the mower moves forward it trims the grass and leaves the place behind smooth and well trimmed.

### **ADVANTAGES:**

The solar mower is meant as a challenge to get on sunny summer days.

- It may not cost substantially more energy to drive the solar mower when there is no sunlight.
- Solar panel is flexible and can be removed easily.





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- Solar mower can be charged from home electricity also when there is less sunlight.
- 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.
- Solar electric bicycle is an environmental beneficial.
- It is eco-friendly

### **Design deciding reasons for Solar Mower**

- Although the solar panel can be fitted on the carrier of bicycle but because of the panel crossing of wind through panel become difficult and hence increases the load on the mower .
- It will require more energy to operate.

### **Conclusion**

The concept of the mower is providing ease to the user while riding a bicycle and also to conserve energy by all possible means. When the solar electric mower is kept under sunlight then the solar rays charge the battery through



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the solar panel . The battery powers an electric motor in the back wheel. It also lowers the resistance in pedalling to make it easier to go up hills. When there is no sunlight, the bicycle can be charged by mains electricity. The solar mower approach is different. It works in normal day as well as in cloudy day. Solar mower is health beneficial. It require less cardiac exertion for those who have experienced heart problems.

The solar mower is an eco-friendly adding more values in our near future.



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