Design and Development of Solar Operated Bike

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Abstract— As we all know the petrol and diesel prices increases day by day due to this it is more difficult to use vehicle to common man. It is not affordable to all society of people. Also due to emission of various gases from this fuel pollution is increases continuously and these will affect to ozone layer and it is hazardous to human being as well as environment. The fossil fuels on the earth will be exhausted in future and these are non-renewable sources of energy. So there is necessity of use renewable sources of energies like wind energy, solar energy, etc. To overcome this problem we are choosing eco- friendly and pollution free solar energy to operate bike. The solar operated bike is driven by DC motor which is mounted on rear wheel of the bike. The solar panels are arranged in series on the roof and the energy is supplied to the 48V lead acid batteries of 33Ah which gives you 250 watt power rating to the bike and with travelling speed of around 25-30 kmph. The photovoltaic capacity of solar panel is 50 watt. There is also provision for electric charging of battery in case of poor solar supply due to cloudy weather. Provision is made in the design to charge the battery from electrical source also so that the usage of the bike is extended in places and time where solar power is not available.

Key words: Electric E-Bike, Solar Panel, Pollution free and Noiseless

I. INTRODUCTION

Energy is one of the crucial inputs for socio-economic development. Rate of energy consumption along with population growth increases at the same time usage. In addition to an increase in price of fossil fuel products and resources will be exhausted in a relatively short period of time. The current high prices of fossil fuel resources are affecting economic and social development worldwide

The 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 step in saving these non – renewable source of energy. The basic principal of solar bike is to use energy that is stored in battery during and after charging it from a Solar panel. This idea in future may help protect our fuels from getting extinguished.

A. Objectives of the Project

- To increase the efficiency of solar bike.
- To reduce the cost of solar powered bike.
- To compare the characteristics and performance between Solar Operated Electrical Bike and electric operated bikes.
- To reduce maintenance of bike as compare to other bike.
- To design and develop Solar-Powered Electrical Bike which gets its supply by using solar energy from photovoltaic panels.

B. Scope of the Project

The scope of this project is to design and develop a Solar-Powered Electrical Bike that is powered by an electric motor which gets its supply from photovoltaic (PV) panels and partially uses solar energy. This project will focus on how to apply the photovoltaic (PV) panels on the electric bike in term of:

1) Speed of a Solar-Powered Electrical Bike compared to electric powered bike.
2) Performance of DC motor Solar-Powered Electrical Bike compared to electric powered bike.

II. BASIC FUNDAMENTAL

A. Electric Bike

Fig. 1: Hero optima + electric bike

B. Specification of the HERO OPTIMA + E-BIKE

- Fuel type - Electric
- Max. Power – 0.33 bhp
- Brake type - Drum
- Front Suspension – Telescopic Fork
- Kerb Weight – 86 kg
- Electric Start – Yes
- Tachometer – No
- Electric System – 250 Watt BLDC Hub Motor
- Battery - 48 Volt 24 AH VRLA
- Headlight type – Halogen and Bulb type

1) HUB / DC Motor:

The hub motor is a conventional Dc motor. The rotor is outside the stator with the permanent magnets mounted on inside. The stator is mounted and fixed onto the axle and the hub will be made to rotate by alternating currents supplied through batteries. Hub motor generates high torque at low speed, which is highly efficient and which doesn't need sprockets, brackets and drive chains. This means they are very reliable and have a long life. The main characteristic of Brushless DC Machines is that they may be controlled to give wide constant power speed ranges.

2) Lead Acid Battery:

Lead acid batteries are one of the most popular types of battery in electronics. Although slightly lower in energy

density than lithium metal, lead acid is safe, provided certain precautions are met when charging and discharging. It demands for a battery with longer running hours, lighter weight with respect to its high output voltage and higher energy density. Among all the existing rechargeable battery systems, the lead acid cell technology is the most efficient and practical choice for the desired application.

3) Voltage Regulator:

A voltage regulator is installed in a solar bike and is generally connected between the solar panels and the battery. This is because the power output of the solar panel is not always constant and hence such a system cannot be connecting to battery directly. The voltage regulator always feeds the battery with a constant voltage as input. It is also used to protect the system from over and under voltages.

4) Solar Panel:

Fig. 2: Solar Panel

A Solar panel consists of a number of solar modules, which are connected in series and parallel configuration to provide specific voltage and current to charge a battery. A diode is connected on the +ve terminal of such string in forward bias. This is called Blocking diode. This diode is provided so that in daytime current can flow from module to battery, but at night or in cloudy day current should not flow back from battery to module or from one string to another string Drawing

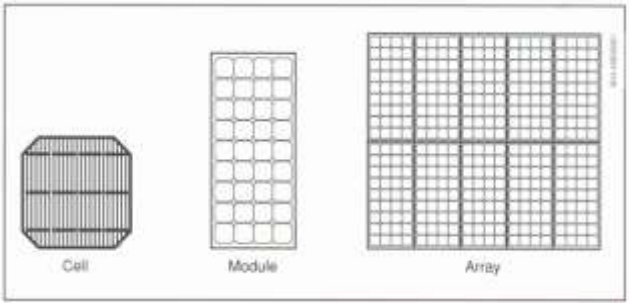

Fig. 3: Sketches showing Cell, Module and Array

a) Solar Cell:

The basic photovoltaic device, which generates electricity when exposed to sunlight, shall be called a "Solar Cell".

b) Solar Module:

The smallest complete environmentally protected assembly of interconnected solar cells shall be called "Module".

c) Solar Panel:

A group of modules fastened together, pre-assembled and interconnected, designed to serve as an installable unit in an Array shall be called "Panel".

d) Solar Array:

A mechanically integrated assembly of modules or panels together with support structure, but exclusive of foundation, tracking, thermal control and other components, as required to form a dc power producing unit shall be called an "Array".

III. DESIGN OF THE SOLAR PANEL

A solar PV system design can be done in four steps:

- Load estimation
- Estimation of number of panel
- Estimation of battery bank
- Cost estimation of the system

A. Step 1

The Total Energy Requirement of the system (Total Load) i.e., Total Connected load to PV panel system
= no. of units * rating of equipment
= 4*62.5 = 250 Watt

B. Step 2

Total watt-hours rating of the system
= total connected load * operating hour
= 250 * 4 = 1000 Watt - hours

C. Step 3

Actual Power output of PV panel
= Peak power rating * operating factor
= 50* 0.75 = 37.5 Watt

D. Step 4

The power used at the end use is less (due to lower combine efficiency of the system)
=Actual power output of panel*combined efficiency
= 37.5 * 0.81 = 30.375 Watt

E. Step 5

Energy produced by one 20 watt panel in a day
= Actual power output* 8hrs. per day
= 30.375 *8 = 243 Watt-hours

F. Step 6

No. of solar panels required to satisfy given estimated daily load
= Total watt-hour rating / daily energy produced by panel
= 1000 / 243 = 4.11 = 4 (round figure)

G. Step 7

Solar panels should be installed South facing in the Northern hemisphere and North- facing in the Southern hemisphere. Since, India is in the Northern hemisphere, Solar panels will be installed always South facing in our country.

H. Step 8

Angle for Installation of Solar panel
= Latitude + 15 deg. (Winter Season)

= Latitude - 15 deg. (Summer Season)

I. Cost Estimation

(A) Cost of arrays = No. of PV modules × Cost/Module
= 4 × 3000 (for a 50 Wp panel @ Rs.60/Wp)
= Rs. 12000
(B) Cost of batteries = No. of Batteries × Cost/Module
=4 × 3000
= Rs.12000
Total cost of system = A + B
= 12000+12000 = Rs. 24000
[Additional cost of wiring may be taken as 5% of total system cost] .

1) Assumption:

- Inverter converts DC into AC power with efficiency of about 90%.
- Battery voltage used for operation = 12 volts for 1 battery
- The combined efficiency of inverter and battery will be calculated as : combined efficiency = inverter efficiency × battery efficiency = 0.9 × 0.9 = 0.81 = 81%
- Sunlight available in a day = 8 hours/day (equivalent of peak radiation.
- Operation of Bike = 6 hours/day of PV panels.
- PV panel power rating = 40 Wp (Wp, meaning, watt (peak), gives only peak power output of a PV panel)
- A factor called „ operating factor" is used to estimate the actual output from a PV module.
- [The operating factor between 0.60 and 0.90 (implying the output power is 60 to 80% lower than rated output power) in normal operating conditions, depending on temperature, dust on module, etc.]

J. Fabrication of the Roof for the Bike

Fig. 4: Mild Steel Frame

K. Specification of Mild Steel Frame

- Material Used : Mild Steel
- Dimension of the Material : 25*25*3 mm flat angle
- Size of the frame: 3.00*2.5 ft.
- Welding Type : Arc Welding
- Welding Electrode Material : Tungsten Carbide Alloy
- Height: Front Side – 3.38 ft.
- Back Side - 3.00 ft.
- Angle Provided : 2 Degree

IV. RESULT

A. Observation and Result of Solar Bike

Sr. No.	PARAMETER	Moped Bike	Electric Bike	Solar Bike
1.	Max. speed limit	45-50 Kmph	25-30 Kmph	25-30 Kmph
2.	Initial unit cost	50000	33000	45000
3.	Annual Maintenance Cost in Rs.	12000	8500	<1000
3.	Operating cost for 40km travelling in Rs.	80	20	Nil
4.	Weight	120 kg	106 kg	110 kg
5.	Max. Travelling distance at a stretch in km	150	30-40	50-60
6.	Fuel used per 100 km	2 Lit.	Nil	Nil
7.	Type of fuel used	Petrol	Electric	Solar
8.	Charging Time	Not Applicable	5-6 Hrs. Charging	3-4 Hrs. for 50W 33AH
9.	Driving Noise	65-70 dB	Noiseless	Noiseless
10.	Driver's licence required	Yes	No	No
11.	Engine Size	100-125 cc	Not Applicable	Not Applicable

Table 1: Observation of the Solar Bike

Fig. 5: Final model of the Solar Operated Bike

V. CONCLUSION

Solar assisted bike is modification of existing bike and driven by solar energy. It is suitable for both city and country roads, that are made of cement, asphalt, or mud. This bike 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 bike 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 kilometre is minimal, around Rs.0.70/km. It can be driven by electric charging 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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