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Use of Solar Power for Charging Batteries

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Abstract

Solar electrical buggy is one of the models in which solar energy is used to generate renewable photovoltaic electric power, which is then used to drive an electric motor, resulting in less toxic gas emissions since it is pollution free. The buggy makes no noise and is environmentally friendly. The solar power is used to charge the batteries in this paper. Solar panels, motors, BLDC generator, charger, charge controller, power circuits, control circuits, and an inverter circuit are the key components of a solar electric buggy.

Keywords: *Solar panels, BLDC motor, Electric Buggy, Batteries*

INTRODUCTION

For propulsion, an electric vehicle, also known as an electric drive vehicle, uses one or more electric motors or traction motors. An electric vehicle can be self-contained with a battery, solar panels, or an electric generator to convert fuel to electricity, or it can be powered by electricity from off-vehicle sources via a collector system. Electric vehicles (EVs) first appeared in the mid-19th century, when electricity was one of the favoured methods for motor vehicle propulsion, offering a degree of comfort and ease of operation that gasoline cars could not match. Electric power demand on utilities is rising day by day as a result of rapid urbanisation and an ever-increasing population. As a result, today's power grid is much more loaded than before, running at or near their stability limits, and transmission and generation expansion is

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constrained by limited resource supply and environmental conditions.

One of the newest developments in power-electronic technology is the convergence of renewable energy sources and energy-storage systems. In order to sustain or boost power supply reliability and efficiency, the growing number of renewable energy sources and distributed generators necessitates new operational strategies.

For some, the transition from conventional gasoline-powered vehicles to electric vehicles (EVs) has been a gradual phase, while for others, it has been a thrilling leap.

LITERATURE SURVEY

A. H.Osman, & M. Massoud[1],
European Scientific Journal, 61–67 (2013), the renewable energy became an essential demand for today's world life for all its importance in decreasing pollution and keeping our environment clean. The solar car is a step in saving our environment and energy resources. The New project under University Technology Petronas (UTP) - URIF grant is targeted to run the university Buggy using solar photovoltaic. The 48V Buggy Car Charging Station has been developed and installed at Property Management and Maintenance Office (PMMO), UTP. A new solar-powered buggy car is assembled in innovative manner with state-of-art material and component. The maximum solar voltage allowed for the system is 150V at 45Acharging rate and the maximum efficiency of MPPT/CHARGER could be as high as 98%.

M. Yilmaz, P. Krein[2],(2013) paper reviews the current status and implementation of battery chargers, charging power levels, and infrastructure for plug-in electric vehicles and hybrids. Charger systems are categorized into off-board and on-board types with unidirectional or bidirectional power flow. Unidirectional charging limits hardware requirements and simplifies interconnection issues. Bidirectional charging supports battery energy injection back to the grid.

K.W.E. Cheng[3] Recent development on electric vehicles 2009 3rd International Conference on Power Electronics Systems and Applications (PESA) This paper provide an overview of the recent work of electric vehicle in the region. The paper describes the development and the comparison of different part of components. The major components in

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battery technology, charger design, motor, steering and braking are examined. The paper finally shows some electric vehicle prototype as a conclusion of the papers.

Lei Zou ; Youjie Ma ; Zhiqiang Gao ; Yanjuan Wu ; Jinliang Yin ; Xiaoning Xu[4] ,The current research on electric vehicle In 21st century, Electric vehicle(EV) as a green transportation tool, EV has won great attention from researchers, leading to a series of intensive and extensive studies.

With the development of high-storage battery and EV, the number of the EV will rise dramatically, so that the random charging and discharging behavior will bring new challenges to safe and stable operation of power grids.

With the recent rise in energy costs many people have been looking to alternative sources of energy.

One of the greatest energy sources (our sun) is readily available for the taking. We just need to be able to harness its power. Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a packaged; connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. A solar cell is a solid-state electrical device (p-n junction) that converts the energy of light directly into electricity (DC) using the photovoltaic effect.

SOLAR ENERGY SYSTEMS



Fig 1: Solar panel

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The process of conversion first requires a material which absorbs the solar energy (photon), and then raises an electron to a higher energy state, and then the flow of this high-energy electron to an external circuit. Silicon is one such material that uses such process. PV cells are most commonly made of silicon, and come in two common varieties, crystalline and thin-film cells.

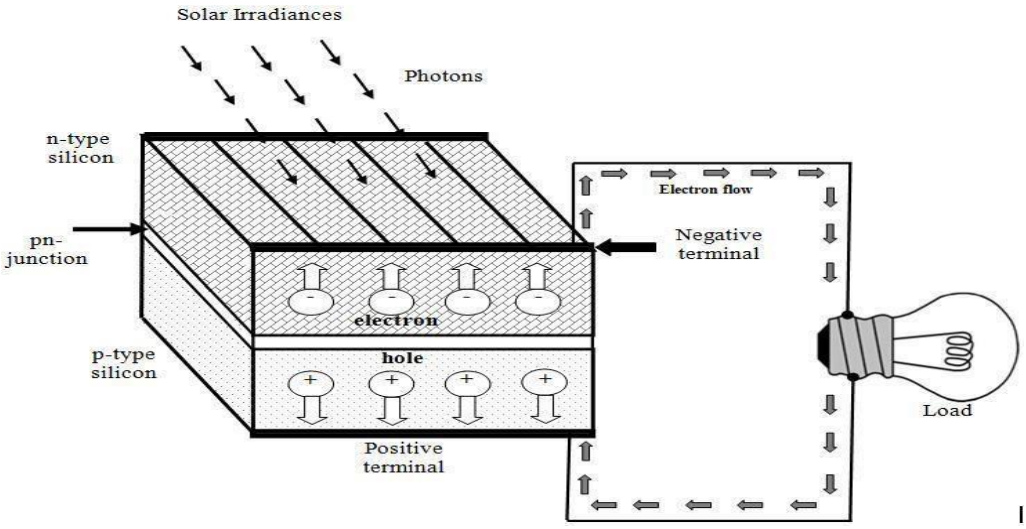


Fig 2: Working diagram of solar panel

Design Components of Solar Electric Buggy:[1][2][3][4]

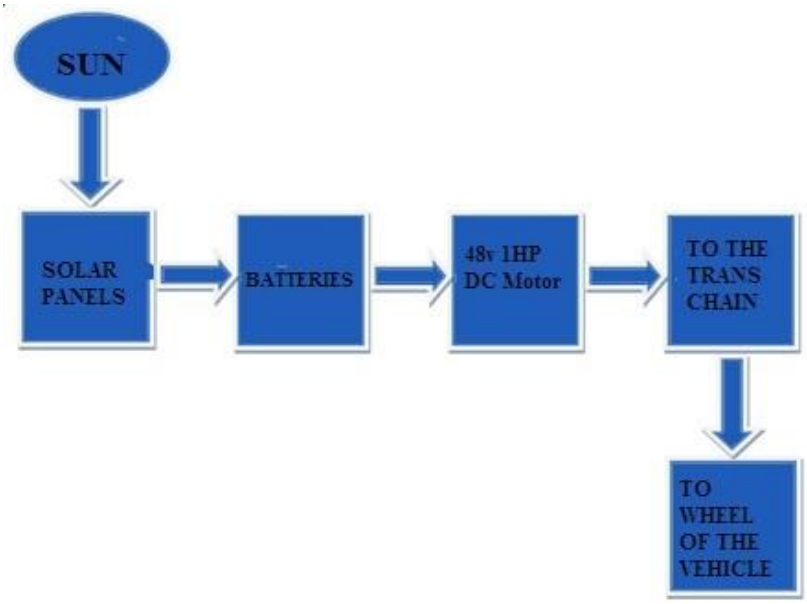


Fig 3: Block diagram of solar electric Buggy

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The solar module mounted on the top of car is used to charge the batteries via charge controller. A 140 WP solar module is used with output ranging from 24V to 25V at STC. The Batteries are initially fully charged and then they are connected to solar module for charging. This helps to keep the battery charged always. This is also done as the efficiency of solar module is only 15%. Thus under this condition the battery gets fully charged again within 3hrs-3.5hrs. Thus to keep the full sine wave of charging this time lap is made. The maximum solar radiations are obtained between mornings 10am to evening 3:30pm. Hence the panel is so mounted that maximum output may be obtained.

On start the load on motor is nearly 250kg including the weight of person driving it. The motor after start acquires the maximum speed of 20kmph to 30kmph. The batteries get charged always from the solar panel and so it provides the continuous run for the vehicle. Motor must be started on top most gear so as to get maximum torque and speed to lift the full load. The speed may be varied later according to the driver's requirements. As the speed varies the load current also varies. So the speed variation must be low to keep battery alive for maximum duration of time. For stopping the motor, the speed control switch should be brought to minimum gear and then switch should be open; thereafter the mechanical brakes should be applied.

The mechanical brakes can be applied instantly during emergency but this should be avoided as this could damage the motor and also produce unnecessary back emf. The average battery back-up is around four hours. The batteries are continuously charged by the solar panel but to increase their rate of charging three dynamos each of 24 V can be connected to the wheels of the vehicle.

Table 1: Design Specifications of Solar Electric Buggy

Serial no	Component name	Ratings	Unit	List Price
1.	Battery	12V,60Ah	4*60A	16000
2.	Solar panels	50W	4	11000
3.	BLDC motor	900W,48V	1	4000
4.	Differential 33"	-	1	4700
5.	Controller	DC 48v,1A	1	3000

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Fig 4: Solar Electric Buggy

CONCLUSIONS

In the present work, the solar electric buggy is designed which runs at a speed of 60Kmph and having a peak load of 5 – 6 person carrying capability, covering a range of around 100Km once the battery was made fully charged, with the battery backup of around 1 and half hour. It is completely equipped with the highly integrated sinusoidal pulse sensored BLDC controller. It is equipped with the solar panels of 48V, 50W each, which maintains the S.O.C of the battery constant. There are still some significant modifications can be made in the motor selection.

Instead of going for BLDC, we can also use a 3phase induction motor, which is low in cost compared to the BLDC motor. And using 3phase induction motor regenerative braking can be achieved. There are still some advance methods can be installed for the BLDC motor like oriented field control technique which is more efficient than the sinusoidal or trapezoidal controllers.

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