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REVIEW STUDY ON DESIGN AND ANALYSIS OF SOLAR PANNEL FOR ELECTRIC VEHICLE

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Abstract - *The solar panel based electric car is one of the oldest version electric vehicle. This paper briefly presents the design and analysis of different types of solar panel required for electric vehicle. The market is flooded with different types of solar panels, different size, mechanism and efficiency. So the main motive of this project is to identify the best solar panel available in market with good working efficiency, which will go excellent with the electric vehicle. In India, the growth of solar panels are rapidly increasing. Now a days more and more efficient solar panels developed in India. The Main goal of this paper is to comparison and studying of various types solar panels. As we know the demand for energy is increasing as the country population, to overcome this situation renewable energy such as solar energy will be the long term solution. This paper illustrate, how sun rays are converted into electric energy with the use of solar panel. To collect maximum solar radiations at a point we used the Maximum Power Point Tracker system. We will also be trying to improve the efficiency of solar panels which will go with solar vehicle.*

Keywords- PV cell, Solar panels, MPPT, Electric vehicle

1. INTRODUCTION

Now a days whole world is shifting towards renewable energy sources to fulfill their energy requirement to run main appliances. Solar power generation is also one of the main source of generating electric energy using sun rays. Solar cell is a collective word for photovoltaic cell which is generally made up of silicon PN junction diode is sandwiched to form pv modules as photovoltaic module. Solar panels are also widely used in vehicles to provide energy for its traction. It's also used in satellite, so in total it has a very huge demand. Nowadays Government is also pushing and encouraging the society to go for hybrid connection of solar generation. As solar panels doesn't required any type of nonrenewable energy to generate electricity and also it's light in weight and easy to handle & setup. It's widely excepted by our society.

2. PV CELL

A photovoltaic cells are based on the principle of photovoltaic effect. The pv cell is a simple semiconductor that converts the solar radiation energy into the electrical energy. This conversion is done by absorbing photon incident light from the sun. when light falls on the surface of pv module then the crystal atoms get Ionizes. This will create negatively charge electron and positively charge ions. As the pv cell has the PN junction with a glass window on the top of p-type material is made too thin, so that incident energy from photon may easily reach to the PN junction. If the photon has energy greater than band gap energy then the electron jump from valance band to the conduction band. This will create electron- hole pair in the PN junction.

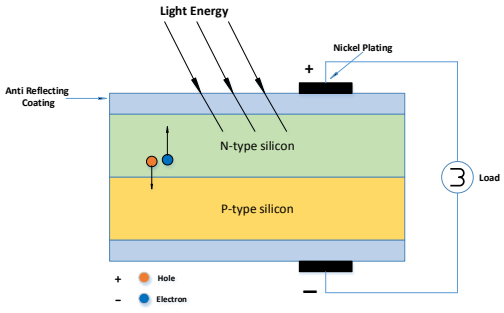

Fig. 1 PV Cell

This phenomenon of electron- hole pair causes the current to flow through the junction. Most widely use PN junction materials are silicon and germanium, but Gallium, Arsenide, Cadmium Aresenide are also being used nowadays. The photovoltaic cells are manufactured by various materials of monocrystaline, polycrystalline or amorphous structure like amorphous silicon(a-si), cadmium tolluride(CdTe), copper indium gallium selenide. But in all material monocrystaline produced more power as compare other pv cells. The voltage generated by single solar cell is very low around 0.5v. So that, to produced large amount of power many number of solar cells are connected in series or parallel whose power range can be varied from watt to kilo watt.

3. SOLAR PANELS

A)Monocrystalline solar panels- In this type of solar panel monocrystalline silicon material which are cylindrical in shape. It has high efficiency rates because there are made out of the highest grade silicon. the efficiency rate is about 15-20% which is higher compare to other two solar panels. This panel required least amount of spacing between two cells. Tend to perform better in low light conditions. This type solar panels are more expensive. The entire circuit can break down if dust, dirt will partially covered.

B)Polycrystalline solar panels- It is one of the oldest type of solar panel which is also known as polysilicon or multi-crystalline silicon. The process of making polycrystalline

solar panel is easy and simple. The amount of silicon wastage is less compared to mono crystalline solar panel. Sometimes high temperature can affect the solar panel. The efficiency is typically 13-16%.

C)Thin-Film solar cells- This type of solar panel are manufactured by depositing one or several thin layers of photovoltaic material onto a substrate. They are categorized by which type of material is deposited onto the substrate.

1)Amorphous silicon(a-Si)
2)Cadmium telluride(CdTe)
3)Copper indium gallium selenide(CIGS)
4)Organic photovoltaic cells(OPC)
The efficiency of solar panel is 7-13%. Compared to other more flexible. High temperature and shading have less impact on solar panel.

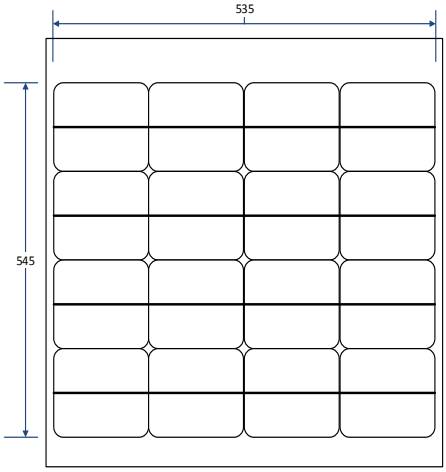

Fig. 2 Solar Panel

Table no. 1
Electrical Characteristics

Max Power	P_{max}	50W
Max Power Voltage	V_{mp}	17.6V
Max Power Current	I_{mp}	2.84A
Open Circuit Voltage	V_{oc}	21.2V
Short Circuit Current	I_{sc}	3.05A
Max System Voltage	-	600V
Series Fuse Rating	-	10A
Temp. Coefficients	Power Voltage Current	-0.38%/^{0}C -60.8Mv/^{0}C 2.2mA/^{0}C
Cell Efficiency	-	21.5%
No. of Cells in Series	-	32
Max Power Tolerance	-	±5%

Table no. 2
Mechanical Characteristics

Weight	0.7KG
Dimension	545^{0}535^{0}3

4. MAXIMUM POWER POINT TRACKER

Maximum power point tracker convert a higher voltage DC output from solar panels to the lower voltage needed to charge batteries. It is an electronic DC to DC converter that optimizes the match between the solar panel and the battery bank. These optimize output by following the sun across the sky for maximum sunlight. These typically give us about a 15% increase in winter and up to a 35% increase in summer. Maximum Power Point Tracking is electronic tracking - usually digital. The charge controller looks at the output of the panels and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. It takes this and converts it to best voltage to get maximum AMPS into the battery. MPPT's are most effective under these condition:

1. Cold weather- Solar panels work better at cold temperature, but without an MPPT we are losing most of that. Cold weather is most likely in winter- the time when sun hours are low and we need the power to recharge batteries the most.
2. Low battery charge- The lower the state of charge in our battery, the more current an MPPT puts into them- another time when the extra power is needed the most. We can have both of these conditions at the same time.
3. Long wire runs- If we are charging 12-volt battery and our panels are 100 feet away, the voltage drop and power loss can be considerable unless we use very large wire. That can be very expensive. But if we have four 12V panels wired in series for 48V, the power loss is much less, and the controller will convert that high voltage to 12V at the battery. That also means that if we have a high voltage panel setup feeding the controller, we can use much smaller wire.

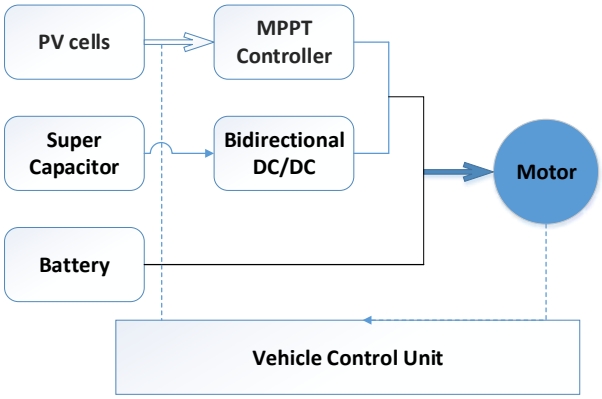

Fig. 3 The structure of photovoltaic power system with MPPT

Main features of MPPT solar charge controller:

- MPPT solar charge controller is used to correct for detecting the variations in the current-voltage characteristics of solar cell.
- MPPT solar charge controller is necessary for any solar power system need to extract maximum power from PV module. It forces PV module to operate at voltage close to maximum power point to draw maximum available power.
- MPPT solar charge controller allows users to use PV module with a higher voltage output than operating voltage of battery system
- MPPT solar charge controller allows reduces complexity of system while output of system is high efficiency. Additionally, it can be applied to use with more energy sources. Since PV output power is used to control DC-DC convert directly.

Different Methods of MPPT

1. Perturb and observe Method
2. Incremental Conductance Method

1.Perturb and observe Method:

P&O algorithm iteratively perturbing measuring and comparing the power generated by the PV module until it reaches the MPP, the algorithm concept is perturbing the operating voltage of the PV generated power. When dP/dV >0,the operating point is considered to be at the left of the MPP and moving towards the MPP so the direction of the perturbation is kept in the same direction to achieve the MPP. When dP/dV <0 the operating point is located at the right of the MPP and moving away from the MPP so the direction of the perturbation should be reversed to achieve the MPP, the MPP is achieved When dP/dV =0 [7].

2.Incremental Conductance Method

Concept of INC algorithm is comparing the instantaneous panel conductance (G_d=dIPV/dVPV), the MPP can be achieved when instantaneous conductance and incremental conductance are equal, by other meaning when the slope of the power curve is equal to zero (dP/dV =0). When G_d > GS the slope of the PV power curve is positive so the operating point is at the left of the the MPP and a perturbation in the same direction is needed to reach the MPP. When G_d < GS the operating point is at the right of the MPP and a perturbation in opposite direction is needed to reach the MPP, at G_d =GS the slope is zero and the operating point is at the MPP. Some defects in tracking and retaining the MPP because it is mainly depending on perturbation what causing some power losses, also it fails to track the MPP under rapid changing in the atmospheric conditions, but still this algorithm is the most simple and popular. INC algorithm can calculate and find the exact perturbation direction to achieve the MPP, and when the MPP is achieved, the algorithm the MPP under rapid change of atmospheric conditions.

5. ELECTRIC VEHICLE

Introduction

Climate change and global warming is becoming one of the serious topics and is also discussed by various governments since early 21st century. And also many scientist and engineers are working on this topic to find solution for this growing global warming. Since last few decades civilization and industrialization boosted in various expects and that resulted in greater power demands to run those factories and instruments available at home that resulted in burning of fossil fuels. Burning of fossil fuels emits many harmful gases like CO_2, CO, NO_x etc. Simultaneously the exhaust emission from automotive vehicle cannot be ignored. These gases lead to increase indifferent form of cancer and other serious disease. Since vehicle on the road is increasing miraculously consuming 49% of oil resources. This increase in use of crude oil gave an idea that our crude oil resource will get depleted by 2038. If we don't find any substitute for this problem after 1 or 2 decade we will be left with zero fuel to power our appliances and vehicles. Our future generation will be facing & dealing with shortage of fuel. Therefore replacing the non- renewable energy resources with renewable energy sources and use of suitable energy saving technologies seems to be mandatory. All these problems gave an idea about electric vehicle. We have achieved a lot in electric vehicle sector, but more new interesting things are yet to discovered.

Classifications of electric vehicle :-
Taking the power supplement and propulsion devices into account, EV could be classified into three different types:

1. pure electrical vehicle (PEV)
2. hybrid electrical vehicle (HEV) and fuel cell electrical vehicle (FCEV).

Challenges:-

- The major challenge for this electric vehicle is efficiency. Our technology is getting advanced day by day, but still we are unable to extract 100% from any energy sources.
- Another major challenge for these vehicles is availability of charging station or management of vehicle according to atmosphere. Like in rainy days, vehicle must have substitute for solar panel if solar car is there.
- These vehicles should be light in weight to provide best efficiency, which makes the design of vehicle difficult.
- Fitting all the technology inside a car with pocket friendly budget raise another major challenge.
- Maintaining the efficiency of solar panel or selecting best panel available in the market or designing panel with best efficiency also makes electric vehicle a challenge.

But, as technology is getting advanced day by day, we'll soon find solution for above mentioned challenges.

6. CONCLUSION

This review article provides brief description of all the Solar Cells, MPPT algorithms those are being used and also about Electrical vehicle. This review paper included solar panel, MPPT and this application in Electrical vehicle. We'll be using Mono-crystalline solar panel as it's more efficient flexible and can be molded and used according to our need. This paper also deals with the MPPT optimization technique. Merits and demerits of different optimization techniques are discussed to choose a suitable MPPT. This review is expected to provide a very beneficial tool to all the researchers working on PV system and Electric Vehicle and also to all the industries equally in the generating an efficient, clean and sustainable energy to the mankind.

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