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Optimisation of solar panel efficiency for Solar powered vehicle

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ABSTRACT

The aim of the project is to increase the efficiency of the solar panel. Solar technology offers great potential in terms of supplying the world's energy needs. The effective way of utilizing sunlight with solar energy concentration technology and recent developments of its applications using Fresnel lens and water cooling method is reviewed in this project .The increased efficiency saves the number of solar panels used and also its cost efficient. This increased efficient solar panel can be used for several purposes either domestic applications and also industrial applications. In our project we are going to optimize the efficiency of the solar panel using the water cooling method and Fresnel lens and implement them in the solar power vehicle for more power output with less power input.

Keywords

solar panel, Fresnel lens, thermocouple.

Non-conventional energy

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. Renewable energy resources exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Renewable energy resources exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries.Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits.Climate change and global warming concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization. New government spending, regulation and policies helped the industry weather the global financial crisis better than many other sectors.

1.0 INTRODUCTION

SOLAR ENERGY

Solar energy is radiant light and heat from the Sun harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture and artificial photosynthesis .It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on the way they capture and distribute solar energy or convert it into solar power.

SOLAR PANEL

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. A single solar module can produce only a limited amount of power; most installations contain multiple modules.

FRESNEL LENS

A Fresnel lens is a type of compact lens originally developed by French physicist Augustin-Jean Fresnel for lighthouses. The design allows the construction of lenses of large aperture and short focal length without the mass and volume of material that would be required by a lens of conventional design. A Fresnel lens can be made much thinner than a comparable conventional lens, in some cases taking the form of a flat sheet. A Fresnel lens can capture more oblique light from a light source, thus allowing the light from a lighthouse equipped with one to be visible over greater distances.

WATER PUMP (12V)

The pumping of water is a basic and practical technique, far more practical than scooping it up with one's hands or lifting it in a hand-held bucket. This is true whether the water is drawn from a fresh source, moved to a

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needed location, purified, or used for irrigation, washing, or sewage treatment, or for evacuating water from an undesirable location. In this project water pump is used to cool the solar panel .

MULTIMETER

A multimeter or a multitester, also known as a VOM (Volt-Ohm meter or Volt-Ohm-milliammeter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current, and resistance. Analog multimeters use a microammeter with a moving pointer to display readings. Digital multimeters (DMM, DVOM) have a numeric display, and may also show a graphical bar representing the measured value. Digital multimeters are now far more common but analog multimeters are still preferable in some cases, for example when monitoring a rapidly varying value.

LEAD ACID BATTERY

The lead–acid battery was invented in 1859 by French physicist Gaston Planté and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its

ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors.

THERMOCOUPLE

It is a mechanical device that is used to measure temperature. It consists of two conducting materials of different conductivity. These are connected to form junction. When this junction is placed at the point where the temperature is to be measured a potential difference is created at the junction due to different thermal conductivity. This leads to a current flow through the material. When this current is measured it will be directly proportional to the temperature at the junction. The thermocouple used in the proposed setup is of digital display.

FEA ANALYSIS

Finite element analysis is a computerized method for predicting how a product reacts to real world forces, vibrations, heat, fluid flow and other physical effects. The finite element analysis shows whether a product will break, wear out, or work the way it was designed to.In this case heat analysis is carried out to find out the heat flow in 2 dimension, for the solar panel. For this heat analysis of the solar panel we are using NX Nastran.

Fig.1 solar panel and fresnel lense

2.0 PROBLEM IDENTIFICATION

A photovoltaic cell converts only a small fraction (~less than 20 %) of the irradiance into electrical energy. The balance is converted into heating of the cell. One of the important parameters that affect the energy output of the PV module or system is the operating temperature .The electrical efficiency of PV cells decreases with temperature increase cooling can improve the electrical production of standard flat panel PV modules, since cooling keeps the PV cells from reaching temperatures at which irreversible damage occurs. It has been found that the efficiency and output power of PV module is inversely proportional to its temperature.

The irradiation of the panel surface reduces during cloudy and rainy days, so increasing the irradiation will improve the power output of the panel. Therefore increasing the irradiation is an important factor for improving solar panel efficiency.

As the rate of photoelectric effect increases with the time rapidly, the heat generated in the panel will burn the PV module of the panel. This will require cooling. The efficiency of the solar panel will be less with the considerable less temperature therefore maintaining the panel's surface temperature at minimum level is necessary.

3.0 THE SOFTWARE MODELLING

Fig.2 3D modelling

4.0 ANALYSIS

First the experimental readings without the proposed method is taken. The hardware components are connected as shown in the figure.

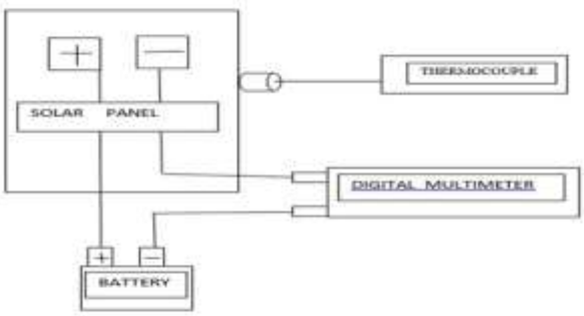

Fig.3 Experimental block diagram

Fig.4. Overall performance

With the proposed setup in place the experimental readings are taken in regular time intervals as before

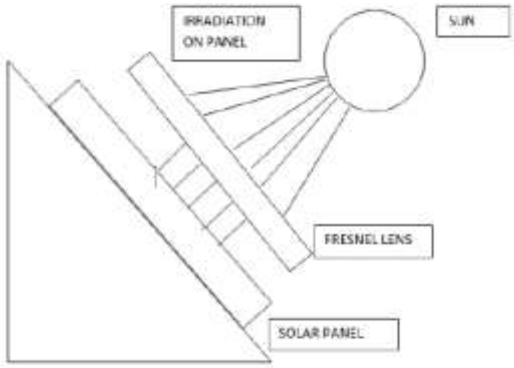

Fig.5 Proposed setup

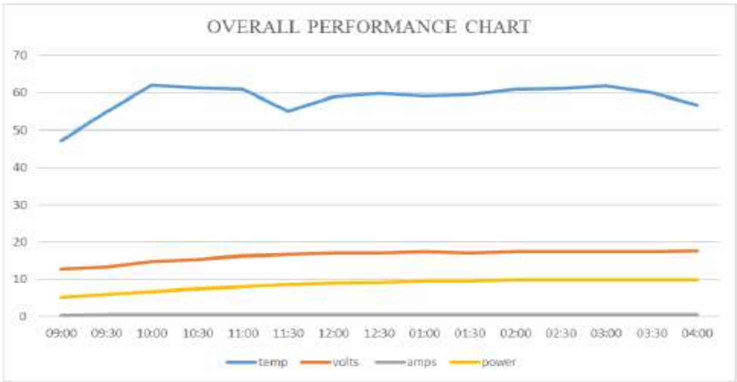

Fig.6 Overall performance for proposed setup

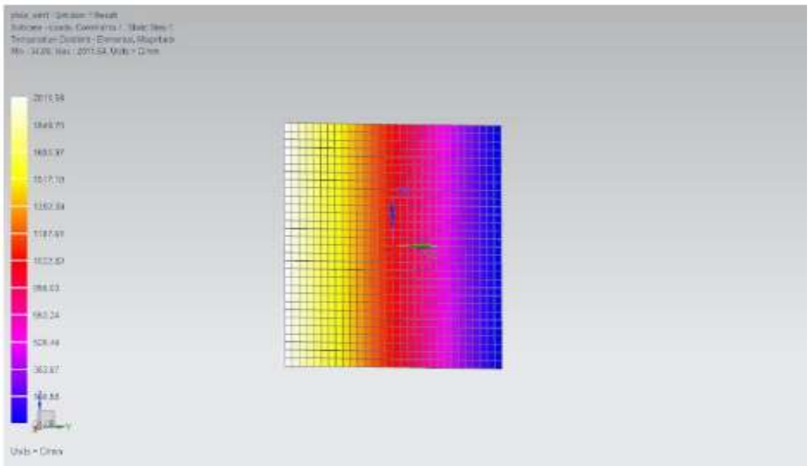

Fig.7 Heat analysis

Calculation for a battery charging and discharging time using a normal solar panel

For solar panel (panel specifications)

For a 850w solar panel

P = 850w

v = 12v

i = 20a

For battery (battery specifications)

Charging time

Ampere hour for one battery = 180 ah

Ampere hour for four battery = 4*180 = 720 ah

Ampere for one solar panel = 20 a

Total charging time = 720/20 = 36 hrs

= 36*3600= 1,29,600 secs.

Charging time = 1,29,600 secs.

Discharging time

Discharging time = $\frac{\text{battery amphere * battery voltage}}{\text{power}}$

= $\frac{720*48}{500}$

Discharging time = 69.12 hrs

The above calculated charging and discharging time are done using the specifications that are predetermined in the solar panel and battery that is used in the hybrid vehicle.

Calculation of charging time for a battery using solar panel under normal condition (without increasing efficiency)

Normal solar panel specifications

P = 10w

v = 17v

i = 0.56a

Charging time using this solar panel (10w)

Ampere hour for one battery = 180 ah

Ampere hour for four battery = 4*180 = 720 ah

Ampere for one solar panel = 0.56 a

Total charging time = 760/0.56 = 1357.14hrs

Charging time = 1357.14 hrs

Calculation of charging time for a battery using a solar panel under normal condition (increased efficieny)

Solar panel after increasing efficiency power= 10 w

Voltage= 18.1 v

Current= 0.6 a

Charging time using solar panel with

Efficiency increased

Ampere hour for one battery = 180 ah

Ampere hour for four battery = 4*180=720

Ampere for one solar panel = 0.6

Total charging time = 720/0.6

charging time = 1266.66 hrs

CONCLUSION

By using this proposed method the potential difference increases by 2% for every increase in 4° c rise in temperature. Application of the proposed method will increase the efficiency of the panel by increasing its power output. Integration of the proposed method in the hybrid vehicle will reduce its charging time. The output parameters of the panel were simulated using MatLab and the results were compared with actual experiment results and were found to be equal according to the need. The same application is simulated for the above hybrid vehicle specifications and the simulated

output results were found to be fulfilling the need.

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