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OPTIMIZING SOLAR POWER PERFORMANCE BY USING FRESNEL LENS

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ABSTRACT
Nowadays, solar systems that are photovoltaic PV modules installed directly perpendicular to the sunrays and concentrating solar panels are more preferable. This paper defines the improving the power output of solar panel using Fresnel lens with conducted experimental result which is done on the set-up with Fresnel lens. The Fresnel lens help for improving the total power output of the PV panel. The total power output of solar panel increases up to about 7%, and the power rating of solar panel is about 1.2 Watt, which will increase up to 1.6 Watt with Fresnel. For getting a high-power output the quality of solar panel should be high, and it becomes very expensive investment for the system. So, for increasing the efficiency firstly we required to increase the intensity of sunrays by connecting solar panel with Fresnel lens. The highest power output obtained by using a Fresnel lens is about 1.6 watts. The aim of this paper is to increase the power output of solar PV module using a Fresnel lens. A Fresnel lens is a nothing, but magnifying glass made up of glass or plastic that is capable to increasing intensity as well as solar rays of light which are perpendicular to the surface of solar panel, The one point arises were all the sunrays are concentrated on one point called a focal point.

Keywords: Solar PV Module, Power Output, Fresnel Lens, Focal Point, Intensity.

INTRODUCTION

The number of solar panels used is increased from the last 20 years. Such solar systems are mostly placed on building and used to generate a heat or electricity. Actually, the solar system is more popular for building integrated systems (Photovoltaic modules placed directly perpendicular to the sun) than

the concentrating panel solar Systems. Fresnel lens and other concentrating equipment's can be applied both to electricity and heat generation, as well as to control the intensity and the temperature of internal building space covered with the transparent materials of glass or plastic. Fresnel lens is seen to be one of the best because of various Advantages such as less volume, low weight, and huge production with cheap cost and effectively increasing the power output. For the above reasons, the use of Fresnel lens with solar panel for increasing power output is mostly preferred. Fresnel lens made with a discrete concentric prism of plastic elements patterned on a glass, a cross section of a circular Fresnel lens with comparison to cross section surface of a conventional spherical plane convex lens of same power the conventional Fresnel lens help for increasing an output. And the solar panel output increases up to 1.6 watt. Even to get a high level of efficiency required high quality solar panels which is expensive investment of costs. This makes expensive to apply solar panel system as it is one of renewable energy source which meet their day-to-day electrical energy requirements. For that purpose, designed of solar panel system using Fresnel lens is invented. Fresnel lens helps to increase and optimize the intensity of sunlight falling on solar cells so that its efficiency also increased.

OBJECTIVES

- Measuring the intensity of sunlight falling on solar panel.
- Comparison in power output of solar panel with and without lens.
- Increasing the power output of solar panel.

PROJECT METHODOLOGY

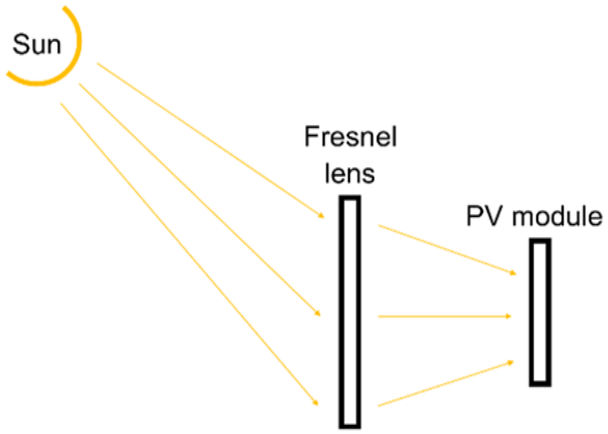

Fig 1: Project methodology

As the main aim of this project is to increase the power output of solar panel with the help of Fresnel lens, this project is to increase the energy output of silicon-based solar cells using a Fresnel lens by positioning the focal point of lens at specified height which is exactly 18 cm above the cell. In our design we placed the solar panel at focal point of specified height to overcome the overheating issue of the solar panel. If we did not maintain the proper distance between Fresnel lens and solar panel there is chances of burning a solar cell. Fresnel lens is a typical magnifying lens. It employs with concentric rings of slope ridge on surface that shows the surface curvature of an exact thin lens. This gives the sunlight intensity focusing ability, while being less light and inexpensive in cost, by reducing the bulk of a material that

would be in the inside of a traditional lens. Like a thin convex lens, it has the special in property of focusing incoming sunrays of light that are exactly perpendicular to its surface area on to a single point, which is known as the focal point. And with the special properties of the Fresnel lens, if the solar cell is exactly positioned with the focal point of the Fresnel lens, then the energy output of solar panel would be greater than the lens at the focal point or no lens was used, regardless of different silicon type solar panel for the solar cell. That was because there is less or may not be much an overheating issue while the sunrays were concentrated on solar panel for higher power output.

CIRCUIT DIAGRAM AND OPERATION

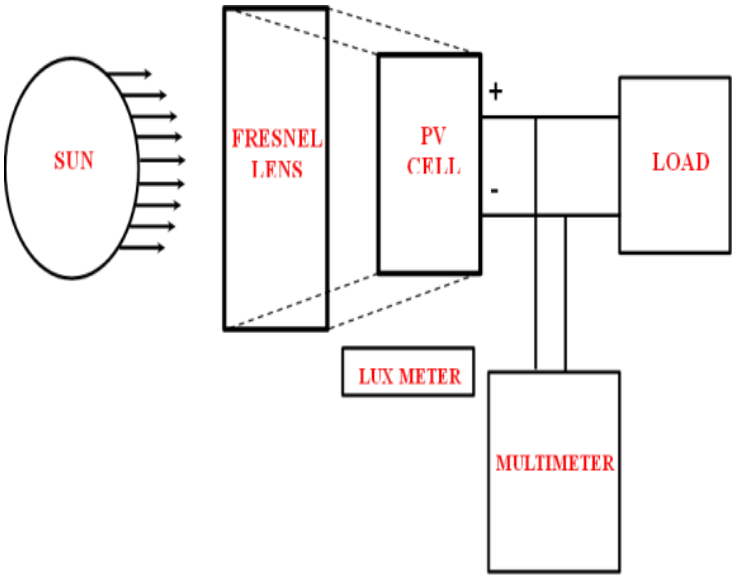

Fig 2: Circuit diagram

When all the setup is don, the sunrays firstly comes on Fresnel lens as the function of Fresnel lens is to increase the intensity of sunlight and then these collected sunrays are concentrated on solar panels Fresnel lens collect the all sunrays falling on the surface area of lens, and then these rays are concentrated on the solar cell. The concentrating point of solar rays is knows as focal point, the area of a Fresnel lens is greater than the area of the solar cell therefore the more sunrays are concentrated on the solar panel and the output of solar panel get increases. Also the intensity of sunlight also gets increased, which is measure with the help of the lux meter. Then the solar panel convert this sunlight into electrical energy which will feed to the load. And increased power output is measured with the help of MultiMate. With positioning the Fresnel lens at its focal point at specified height the overheating issue can't arrive. But if we not maintained the proper focal point then there are chances of burning of solar cell. And then this increased output is supplied towards the load, the load which is used is a DC brushless fan which also help for the measurement of current and provide the cooling to solar cell. The dc brushless fan draw cooler air towards solar panel from the outside, expel warm air from inside and move air towards outside.

COMPLETE WORKING AND OPERATION

When the sunrays comes on Fresnel lens, it collect the al sunrays falling on the surface area of lens, and then these rays are concentrated on the solar cell. The concentrating point of solar rays is knows as focal point, the area of a Fresnel lens is greater than the area of the solar cell therefore the more sunrays are concentrated on the solar panel and the output of solar panel get increases. Also the intensity of sunrays also gets increased, which is measure with the help of the lux meter. With positioning the Fresnel lens at its focal point at specified height the overheating issue can't be arrived. This increased output is then supplied towards the load; the load which is used is a DC brushless fan which also helps for the measurement of current and provides the cooling to solar cell. the dc brushless fan draw cooler air towards solar panel from the outside, expel warm air from inside and move air towards outside to cool a solar panel. With positioning the Fresnel lens at its focal point, our designs placed the solar cells off the focal point at specified height to overcome the overheating issue of the solar cells.

RESULT

Sr. No	Without Lens			With Lens		
	Voltage (V)	Current(A)	Power(W)	Voltage (V)	Current(A)	Power(W)
Morning	6.1	0.10	0.61	7	0.19	1.33
Afternoon	6.8	0.14	0.952	7.5	0.2	1.5
Evening	6.08	0.11	0.6688	6.5	0.18	1.17

The increase in the power output of solar panel and performance of the solar PV module is tested. Results of the measurements made with help of Fresnel lens placed perpendicular to the solar PV module. The distance between Fresnel lens and PV module was varied in the range from 15 to 20 cm. On the other hand, the location of the Fresnel lens in distance of 18cm improved the solar PV module power output. The Maximum Power in rises from 0.6 W (reaches without Fresnel lens) to 1.5 W (when distance between Fresnel lens and PV module is 18 cm). In the case of Fresnel lens placed above the PV module, we can also see an effect of shading on the PV module, when concentrating effect does not occur. The highest values of power output in the PV module is observed, when combination of direct and a

concentrated sun rays was collected on the PV module. There is one disadvantages of Fresnel lens if we not maintained the proper distance between lens and solar panel there is a chance of burning of solar cell, to eliminate these problems, the distance between Fresnel lens and solar cell maintained. Additionally, Fresnel lens is placed with tilt angle in south facing for the most effective electricity generation in PV module system.

CONCLUSION

The analysis of the obtained results allows concluding that the use of Fresnel lens have a positive effect on the PV module power generation. As the PV module south faces installed in a perpendicular position, generates only 10% less electricity than the comparison of PV module with tilt angle from the range of a 30-60°.lower the efficiency resulting from the perpendicular orientation of a solar PV modules may be compensated by the use of solar concentrating system. In the case of tested PV module, its energy performance increased by 7% when Fresnel lens is used. This value was vary for different time of the day and year, as depend on the weather so further analysis should be conducted. Solar tracking option should be implemented to create an impact on the performance of the system for increasing the output. On the other hand, Fresnel lens with a better quality should be used which provide more effective sunlight concentration on the PV modules. Finally, the Fresnel lens gives positive result and might be successfully used for increasing the power output of solar system systems.

FUTURE SCOPE

As the solar panel with Fresnel lens generates more power output, as compared to output without lens, it has some disadvantages like, if a distance between solar panel and Fresnel lens is not maintained properly then temperature of panel gets increases. If this drawback gets overcome in future technology, it will help in following applications. According to this solar panel with Fresnel lens have many scope in future like

 It can be used for water heating system It can be used in solar cocker

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