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OPTIMIZING THE EFFICIENCY OF SOLAR PANEL EQUIPPED WITH -ARGON BASED INSULATION AND IoT BASED DUST CLEANING SYSTEM

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Abstract— *With the increment in the surface temperature of solar panel their efficiency decreases quite dramatically. To overcome the heating of surface, plane glass and Argon gas can be used with an optimized thickness. As the dust layer settled down on the surface of the solar panel it decreases the efficiency, to cure this an IoT based solution would be effective.*

Keywords— *PV cells , IoT, Argon , Efficiency*

1. INTRODUCTION

As the population is increasing demand of energy has been increased, most of the energy generation has been done by the coal industry to meet the several demands. Moreover, the fact that these fuels will soon be used up, revealed the need for renewable energy sources.

Solar energy has provided a great solution for the energy needs of the world. Besides the fact, solar energy can be more efficient among other renewable energy sources. Depending on the semi-conductor material of the panel, the p- v Panel converts solar energy to electrical energy with the efficiency of 10-21%. There are many factors affecting the efficiency of the solar panels i.e. temperature, dust, wind velocity, shading. Change in the environmental condition considerably affect the panel efficiency. As the temperature start rising after 25º Celsius, panels start losing their efficiency at the rate of 0.5% per degree. The need of research and development on solar efficiency has become major field to work on as the temperature rises up to 48º Celsius in many parts of the world.

Dust has been seen as the key challenge to optimizing the efficiency of PV panels. Through an experiment it was found that dust reduces 89% efficiency of solar panels. Space agencies like NASA and ISRO have been tackling the problem especially on Mars because of dusty winds covering the solar panel. On earth, cleaning of the panels have been done by the man power, drones, robots, water cleaning sprays which are not very feasible in terms of cost and technological environment. To reduce the stress of dust, major works has to be done.

The global solar panel market reached a volume of 178.3GW in 2020 (source- IMARC) and it has been expected the market to grow at a CAGR of 18.5% during 2021-2026.

2. LITERATURE REVIEW

[1] Experimental study of efficiency of solar panel by phase change material cooling, they have represented phase change material PCM cooling system to increase the efficiency of solar panels. they have taken melting temperature of PCM 40 degree which is not efficient to increase the efficiency.

Limitations- need melting temperature of PCM ranging from 25 -30 degree Celsius.

[2] In this paper they have presented reflector concept to use the additional sunlight. They have good output in morning and evening, but in peak position of sun, temperature got increased because of reflectors They also need maintenance time to time

Limitations - as they are not very fit for surrounding environment.

[3] This paper has presented usage of different materials like CIGS and CdTe Hetro-junction along with band gap. They state that multi-layer, multi junction with different material improve the efficiency 19.9% and 18.7% respectively. Germanium based cell reaching the conversion efficiency till 40%.
Limitations -it is very costly.

[4] This paper is using water immersion technique to increase the efficiency of panels. They have written results on different-different water depth, they were able to increase the efficiency by 11% at water depth 6cm.
Limitations - Not feasible from engineering point of view.

[5] This paper tells us about effect of dust which settled down on the surface of solar panels. The results shown in this paper through graphs tell us that dust particle decrease the efficiency by 89 %. And they also suggest that it is very essential to provide automatic cleaning mechanism to remove the dust particles. In India it is very needed as our Country's location falls in dusty winds path.

[6] Evaluation of pyramid, hexagonal, conical forms as solar panels have been done. The main aim of this project was to utilize the sun energy to the fullest which ultimately increase the efficiency. They are using forced air flow to cool the panels. Among all the shape conical shape had been most effective.

[7] This paper is about increasing the efficiency through solar tracker with the help of servo motor and self- adjusting light sensor the paper says that when panels is close to the angle 90 degree, it provides the maximum output of energy. The power increased over a fixed horizontal array is 30%.
Limitations - Energy taking components

3. METHODOLOGY

It has become a challenge to increase the efficiency of solar panel keeping the same output. The method used is based on conduction and convection losses in the double plane glass with a gap of some thickness between them to insert an inert gas Argon. The motive is to decrease the heat transfer rate from outer surface to inner surface. The consideration of using Argon instead of air is that Argon has low heat transfer coefficient of 0.016

The method also presents the IOT based wiper mechanism for automatic cleaning of solar panels, which has been a great solution in the field of solar energy. The IoT mechanism will work depending on the location, the time period is set according to which wiper will move in 180 degrees. There are places where the dust settles down in long period of time so for those areas this method provides program through Arduino IDE software, in such a way that the IoT wiper will clean the panels after every 3-days automatically while for the areas who come in dusty areas like near roads or the crowed area, the method configures the setting according to that with the time of 10 -20hrs. So, in this way, a regular cleaning of the panels without any external measures and continuation of the rated power /energy will be observed by the solar panels.

Components used in IoT mechanism are

1. Stepper motor
2. Node MCU board/Arduino
3. AC to DC converter
4. AC to DC converter

All these components will be fitted with help of frame, the material of the frame is of aluminium. Choosing aluminium instead of wood is because of following reasons -

- Cheap
- Easy to manufacture
- High rate of transfer coefficient

The following results after implementation of this method was assumed:

Table 1. Approximate result of method

Solar heat gain coefficient (SHGC)	0.6
Visible light Transmission (VLT)	0.81
Conduction gain coefficient	1.7 W/m^2 *C- double glass 5.8 W/m^2*C - single glass

Increment in the overall efficiency while the temperature at 45 degree is 5%, By the above methods one can be able to maintain the temperature of solar panels at a certain level to achieve the required efficiency.

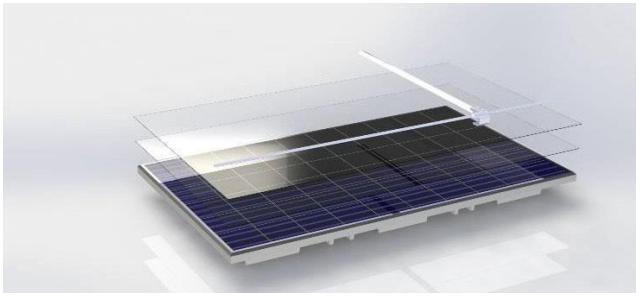

Figure 1. CAD model of our design

4. APPLICATION

Its application is just to increase the efficiency of solar panels of any type -

- Amorphous panel
- Polycrsytalline panel
- Monocrystalline panel

5. CONCLUSION

It was concluded from various papers that the temperature and dust are major aspect to enhance the efficiency of solar panels. There is a standard temperature of 25 degree at which PV cells are operated. Till now no solution has been proved as a rigid solution in the increment or to stable the efficiency of solar panels.

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