iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35557

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Performance Enhancement of Solar Photovoltaic Cell

Parshva Salot[1], Amit Solanki[2], Harsh Shinde[3], Harsh Patel[4], Ramesh Rajpurohit[5], Dr. Jignesh Vaghasia[6]
[1,2,3,4,5]*Student,* [6]*Professor, Department of Mechanical Engineering,*
Shree Swami Atmanand Saraswati Institute of Technology, Surat, Gujarat, India

Abstract: ***This paper consists analysis on performance enhancement of solar photovoltaic cell by using reflecting and cooling system. The performance of PV (photovoltaic) module is strongly dependent on its surface temperature and solar radiation strikes on PV panel. It is necessary to study possible way for maintaining the appropriate temperature for solar panels and make system that will help to strikes maximum solar radiation on panel. High solar radiation and ambient temperature lead to an elevated photovoltaic cell operating temperature, which affects its lifespan and power output adversely. To enhance the electrical performance of the PV module we make one system which consists of two mirrors as a reflector placing beside solar panel and cooling system consists of pipe placed on upper area of solar panel. At time of sunrise and sunset low solar radiation is fall on solar panel, so reflecting system increase the intensity of solar radiation fall on solar panel. At noon time or afternoon the temperature of solar panel is increases it will decrease the efficiency of solar panel to minimize that cooling system is introduced that controlled the surface temperature.***
Keywords: Photovoltaic Cell, Reflecting system, cooling system, Efficiency, Panel surface

I. INTRODUCTION

The use of renewable energy systems for real life applications has been increasing for the last few decades due to the growing concern about the global warming and environmental pollution. A photovoltaic thermal system (PVT) consists of a common photovoltaic unit (PV) which transforms photons received by the sun into electrical energy, and a thermal collector which absorbs both remaining energy of photons and the heat generated by photovoltaic cells. The maximum power generated by the photovoltaic panels can be increased if the reflected solar radiation falls on the photovoltaic panels. This can be obtained in natural-passive reflectance and artificial-active reflectance modes. The temperature of the photovoltaic panels can be reduced using the water which flows on the panels or is sprayed on them. Which increases the 0.33% of voltage as decrease in 1°C temperature.

The photovoltaic systems (PV) which convert the solar energy in electric energy are the most important systems from the renewable energy ones. The added solar PV capacity worldwide in 2017 was 98 GW, and the total installed PV capacity by the end of 2017 was 402 GW. So we make one system by combination of reflecting system and cooling system to increase the efficiency of solar photovoltaic cell. For increase fall of solar radiation on panel is done by reflectors and cooling of surface of panel by cooling system.

II. WORKING ARRANGEMENT OF SETUP

Our set up consists of solar panel, reflecting system and cooling system. Our research work is fully based on experimental analysis. So firstly taken initial reading of voltage, current, surface temperature and solar radiation for only solar panel. Then prepare table for it for power and efficiency. After that we introduced reflecting system set beside at appropriate distance and angle according to solar panel which is at 21.75°. Then taking reading of voltage and current by using multi-meter, solar radiation by using solar radiation meter and surface temperature by using digital thermometer. After taking all readings make table with value of power and efficiency and make graph according to it. At noon of afternoon time surface temperature of solar panel is increases so it decreases the efficiency of solar panel. Then applied water cooling system to on solar panel that decreases the surface temperature of panel. After applying this take reading of voltage, current, solar radiation and surface temperature and make table and graph according to it. By observing above experimental we had planted to combine both reflecting system and water cooling system that simultaneously, solar radiation fall on solar panel also increase and surface temperature of solar panel is also decreases this conclusion is taken by observing reading of voltage, current and surface temperature. Then prepare a graph of comparison of efficiency by all system of only panel, panel with reflector, panel with cooling and panel with combination of cooling and reflecting system. By gathering all readings with different systems we had prepared different tables and graph. Tables includes reading of voltage, current, power, solar radiation, surface temperature, efficiency. From observation of this different graph, required conclusion conceded.

III. ACTUAL MODEL

Figure 3.1. Working set up with cooling and reflector arrangement

IV. APPLICATION SOLAR PV SET UP

A. The agricultural sector,
B. Renewable energy sector,
C. Electricity production,
D. Household

V. EXPERIMENTAL PROCEDURE

A. Set a solar panel at proper inclined angle and where no shadow is impact on solar panel. Set at latitude of place, so set at 21.75° which is latitude of Surat.
B. Use Digital thermometer and stick the thermometer wire on surface of solar panel to measure the surface temperature of panel.
C. Take reading of amount of voltage and current produce by solar panel using digital multi-meter, by attaching two ports of solar panel to two ports of multi-meter.
D. Take reading of solar radiation impact on solar panel using solar radiation meter by placing solar radiation meter on solar panel.
E. Now set reflecting system with solar panel, by setting reflectors at proper distance and proper angle according to solar panel. And then take all types of reading that discuss above.
F. Now only apply water cooling system on solar panel by using pipes and water tank, pipe is placed at upper part of inclined solar panel and attached to pump which is a submersible type, which is placed in water tank. After on the pump water is spray on surface of solar panel that reduces surface temperature of solar panel. And take all four reading discuss above.
G. Now combine both reflecting system and cooling system at a same time on solar panel. By proper adjustment of reflecting mirrors and cooling pipe. After this take the reading of all four parameters.
H. Now prepare tables and graph related to it, graph show time, voltage, current, power, solar radiation, surface temperature and efficiency. By using efficiency formula of solar cell then prepare table of it. Prepare graph of time vs. efficiency, time vs. solar radiation and time vs. temperature of all system.
I. Compare efficiency vs. time of all system by placing efficiency of all system in a single graph. Then observation of performance of solar photovoltaic cell is taking according to this graph.

VI. EXPERIMENTAL READINGS

A. *Part: - 1 Solar PV cell without Reflector and Cooling System*

Table: 1 Solar PV cell without reflector and cooling system

Time	Voltage(V)	Current(A)	Radiation(W/m^2)	Temp(^{O}C)	Power(W)	Efficiency (%)
10:07	20.8	0.99	761.6	36	20.6	11.9
10:20	20.7	1.05	760.3	37.3	21.7	12.6
10:30	20.5	1.15	845.3	40.41	23.6	12.3
10:40	20.8	1.2	870.6	39.2	24.9	12.6
10:50	20.8	1.25	887.3	41.2	26	12.9

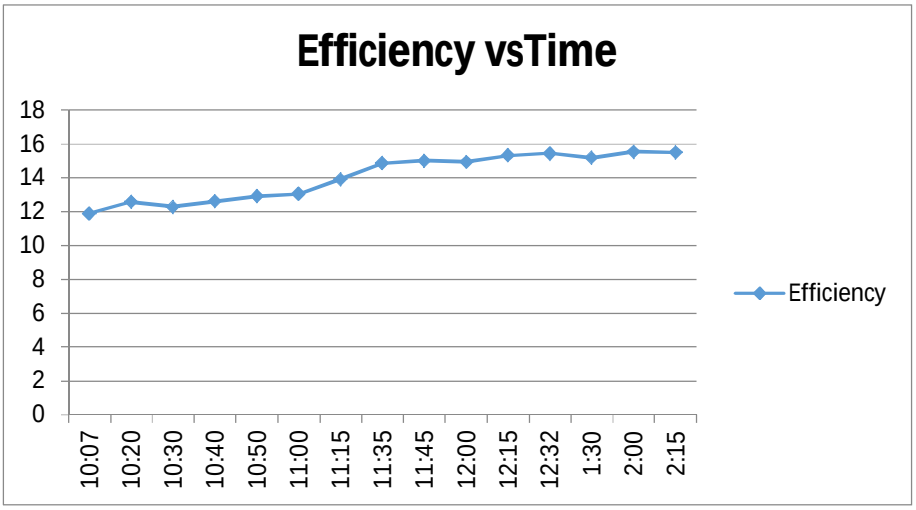


Figure 6.1. Solar PV cell without reflector and cooling system Efficiency vs. time

- By observing this graph, when time passes efficiency of solar panel is increases.

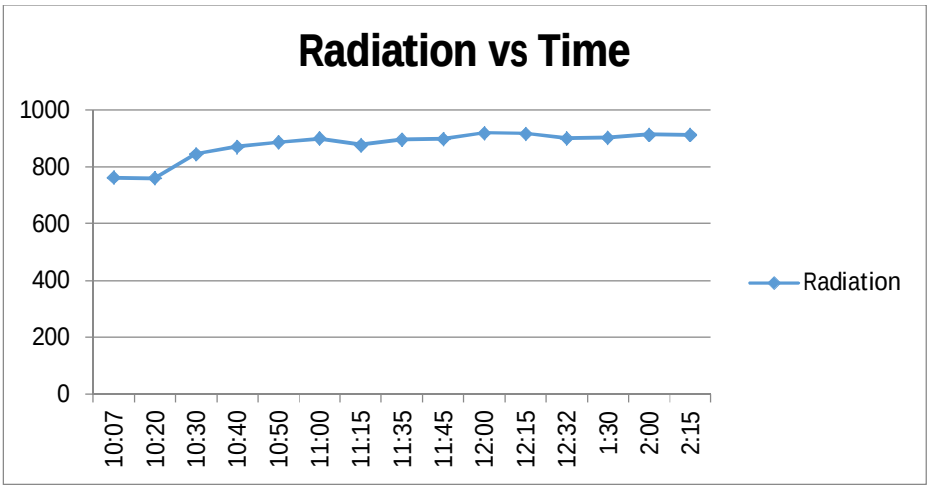


Figure 6.2. Solar PV cell without reflector and cooling system Radiation vs. time

- By observing graph, conclude that solar radiation is increases with increases in time interval

B. Part: - 2 Solar PV Cell with Cooling System and without Reflector

Table 2. Solar PV cell with cooling system and without reflector

Time	Voltage(V)	Current(A)	Radiation(W/m^2)	Temp(^{O}C)	Power(W)	Efficiency (%)
12:30	21.6	1.47	805.2	37.2	31.7	17.4
12:45	20.4	1.57	868.6	57.4	32.0	16.2
1:00	20.3	1.58	872.4	56.3	32.14	16.1
1:00	21.3	1.57	872.4	38.2	33.4	16.9
1:15	20.4	1.56	869.7	55.4	31.8	16.1

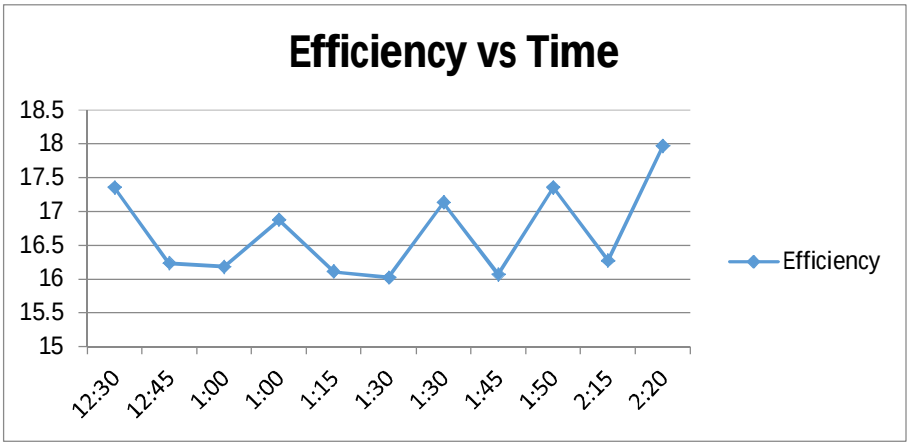


Figure 6.3. Solar PV cell with cooling system and without reflector Efficiency vs. time

- By observing this graph when cooling is applied efficiency is increases. It will change according to time changes.

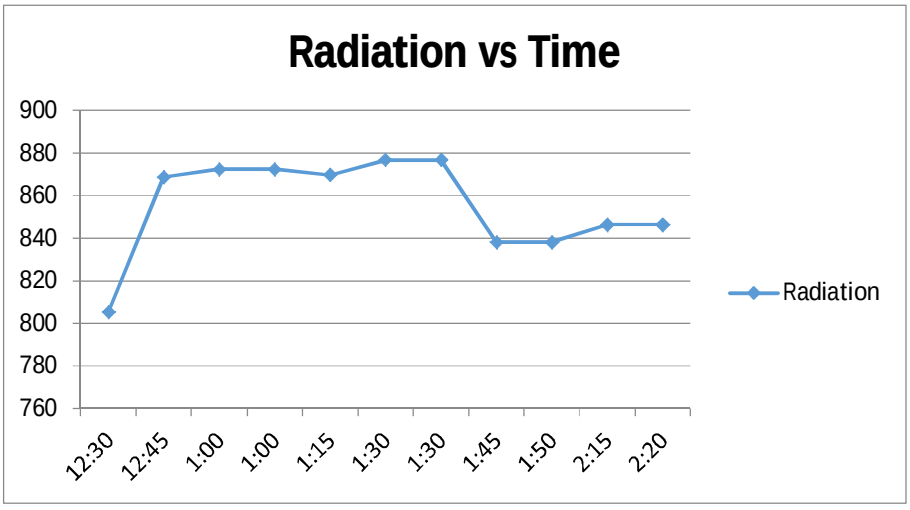


Figure 6.4. Solar PV cell with cooling system and without reflector Radiation vs. time

- At morning time solar radiation is low and at noon time solar radiation increase up to 3:00 pm

C. Part:-3 Solar PV Cell with Reflector and without Cooling System

Table 3. Solar PV cell with reflector and without cooling system

Time	Voltage(V)	Current(A)	Radiation(W/m^2)	Temp(^{O}C)	Power(W)	Efficiency (%)
9:40	20.8	1.07	514.7	39.2	22.3	19.1
9:50	20.8	1.02	556.3	42.2	21.2	16.8
10:00	20.9	1.06	582.4	47.3	22.2	16.7
10:10	20.7	1.1	620.2	48.6	22.8	16.1
10:20	20.8	1.19	642.6	50.2	24.7	16.9

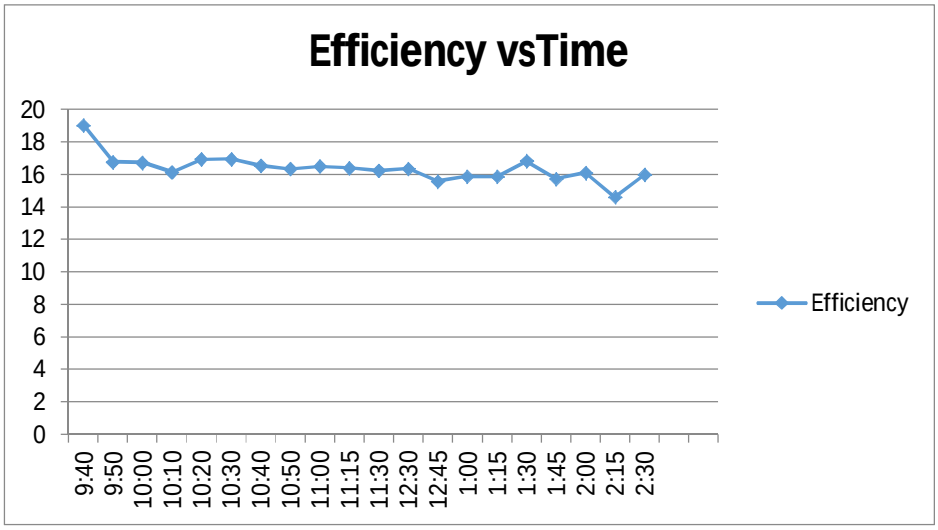


Figure 6.5. Solar PV cell with reflector and without cooling system Efficiency vs. time

- Efficiency of solar panel is increase with increase in time interval by using combined system.

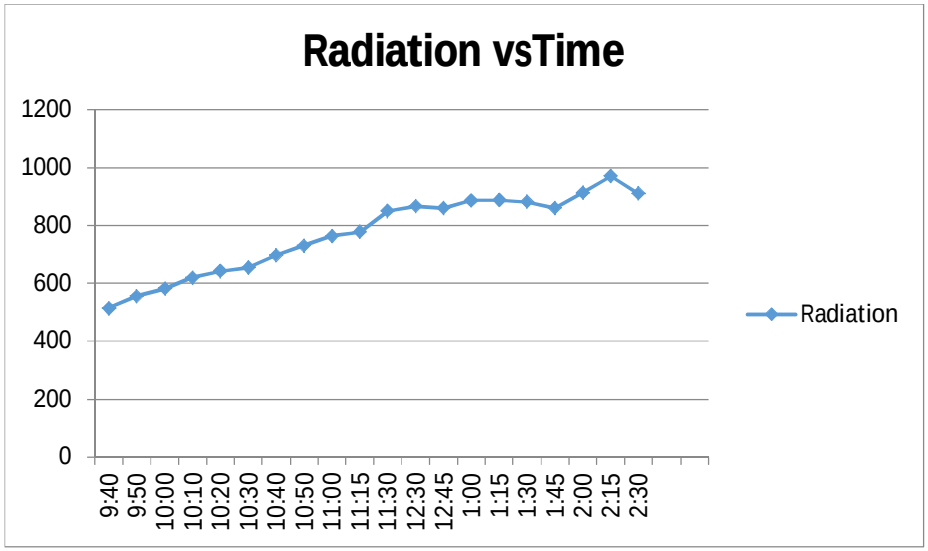


Figure 6.6. Solar PV cell with reflector and without cooling system Radiation vs. time

- At morning time solar radiation is low and at noon time solar radiation increase up to 3:00 pm

D. Part: - 4 Solar PV Cell with Reflector and Cooling System

Table 4. Solar PV cell with reflector and cooling system

Time	Voltage(V)	Current(A)	Radiation(W/m^2)	Temp(^{O}C)	Power(W)	Efficiency (%)
11:20	21.7	1.44	772.2	40	31.2	17.8
11:35	21.4	1.46	781.1	45	31.2	17.6
11:40	21.8	1.46	791.1	38.5	31.8	17.7
11:55	21.6	1.51	820.8	36.1	32.6	17.5
12:05	21.4	1.54	817.4	39	32.9	17.7

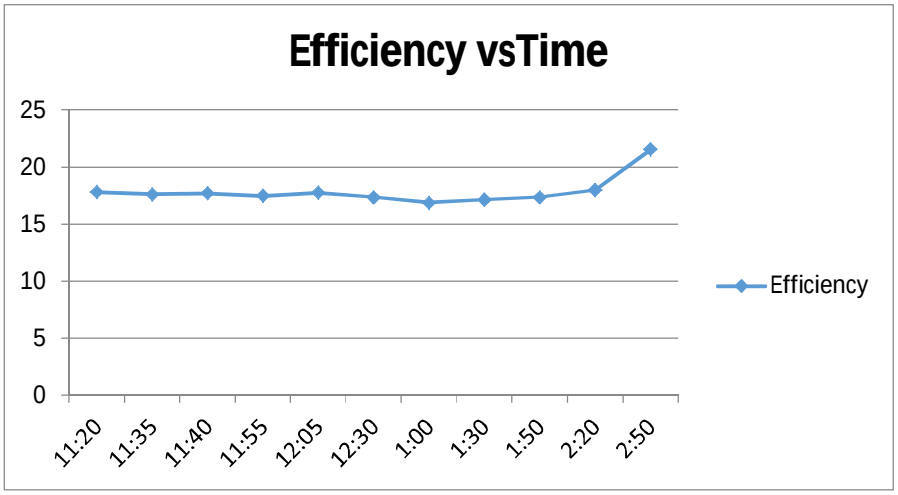


Figure 6.7. Solar PV cell with reflector and cooling system Efficiency vs. time

- By observing this graph, when time passes efficiency of solar panel is increases.

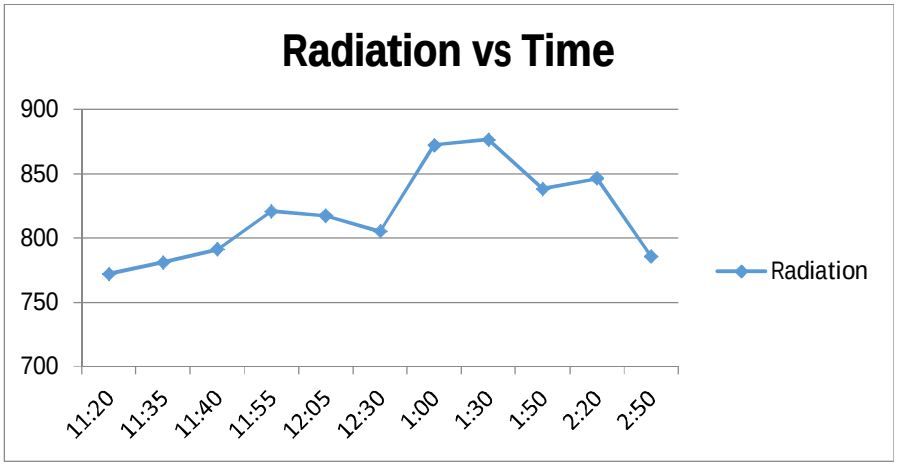


Figure 6.8. Solar PV cell with reflector and cooling system Radiation vs. time

- By seeing graph observe that solar radiation is change at every single level of time and it is peak at noon hour.

VII. RESULT

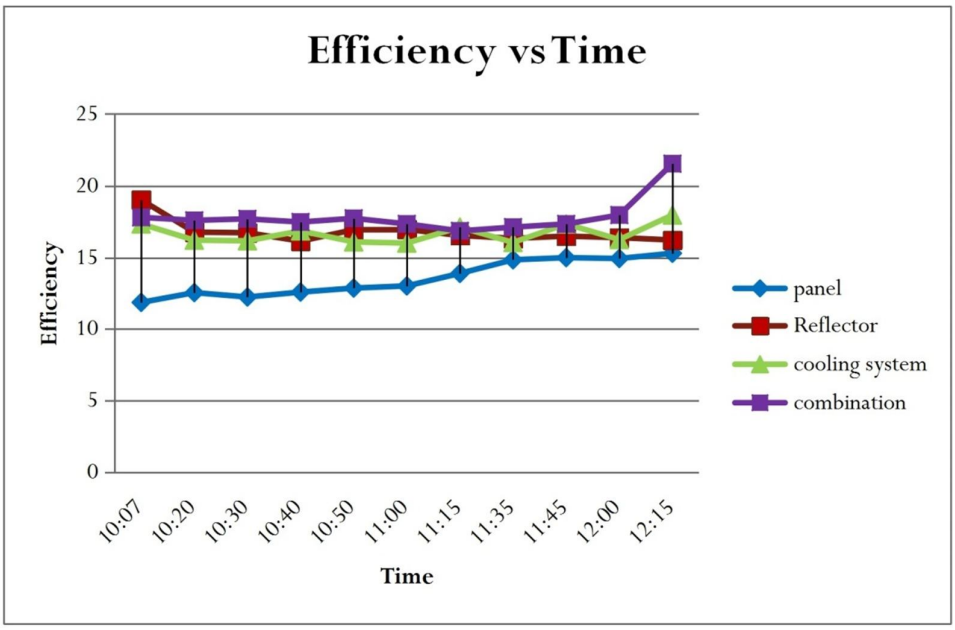


Figure 7.1. Efficiency Comparisons of different systems

Above graph show the efficiency of solar photovoltaic cell on applying different systems. Here by observing above graph we conclude that efficiency of solar panel is lesser that all other system. A blue colour line show efficiency of solar panel without reflector and cooling system. Red colour line shows efficiency of with reflector. Green colour line show efficiency of solar panel with cooling system. And purple colour line show efficiency of solar panel with combination of reflecting system and cooling system. Then observe that efficiency line of combination of reflecting system and cooling system is at high level and efficiency of solar panel with any system at low level. So that graph show increase in efficiency of solar panel by applying combination of water cooling system and reflecting system. This graph is prepared on efficiency vs time parameters at different times and different systems how efficiency change or efficiency lines were followed.

VIII. CONCLUSIONS

This system is introduced to enhance the performance of solar photovoltaic cell. Reflecting system is made by using reflecting mirrors which used to increase sun radiation strikes on solar panel. After applying that we get that, the efficiency of solar panel is increase. By reflecting mirrors current is increase so directly power is increase. When we used reflecting system it will increase, due increase in surface temperature efficiency is not increase that much so cooling system is introduced for reduce the surface temperature. After applying, we get efficiency of solar panel is increases. We prepare a graph for this; it gives the comparison of efficiency of simple panel, with reflector, cooling system and with combination of reflector and cooling system. So we conclude that by using combination of reflecting system and cooling system it will increase efficiency.

IX. ACKNOWLEDGMENT

We would like to take this opportunity to bestow our acknowledgements to all the persons who have directly or indirectly been involved with us in making our project feasible and to run it up into a successful piece of work. It is the product of many hands, and countless hours from many people. Our thanks go to all those who helped, whether through their comments, feedback, edits or suggestions. We express a deep sense of gratitude for providing a suitable environment, where we can implement our work. Moreover, we would like to thank our guide Dr. Jignesh Vaghasia who has helped us throughout our project development.

REFERENCES

[1] https://www.vivintsolar.com/
[2] https://energyeducation.ca/
[3] https://www.trace-software.com/
[4] Zainal Arifin , Shafiqur Rehman and Ibrahim El-Amin, “Performance evaluation of an off-grid photovoltaic system in Saudi Arabia”, Energy 46, pp. 451-458, 2012.
[5] K.E. Park , G.H. Kang, H.I. Kim, G.J. Yu and J.T. Kim, “Analysis of thermal and electrical performance of semi-transparent photovoltaic (PV) module”, Energy, pp. 2681–2687, 2012.

[6] Omubo-Pepple V B, Israel-Cookey C and Alaminokuma G I,"Effects of Temperature, Solar flux and Relative Humidity on the Efficient Conversion of Solar Energy to Electricity", European Journal of Scientific Research, vol.35 (2), pp. 173-180, 2009.

[7] Kawamura T, Harada K, Ishihara Y, Todaka T, Oshiro T, Nakamura H, and Imataki M, stics in Photovoltaic power system", Solar Energy Materials and Solar Cells, vol.47, pp. 155-165, 1997.

[8] E. Skoplaki and J.A. Palyvos, "On the temperature dependence of photovoltaic module electrical performance: A review of efficiency/power correlations", Solar Energy 83, pp. 614–624, 2009.

[9] Ben Richard Hughes, Ng Ping SzeCherisa, and Osman Beg, "Computational Study of Improving the Efficiency of Photovoltaic Panels in the UAE", World Academy of Science.2014

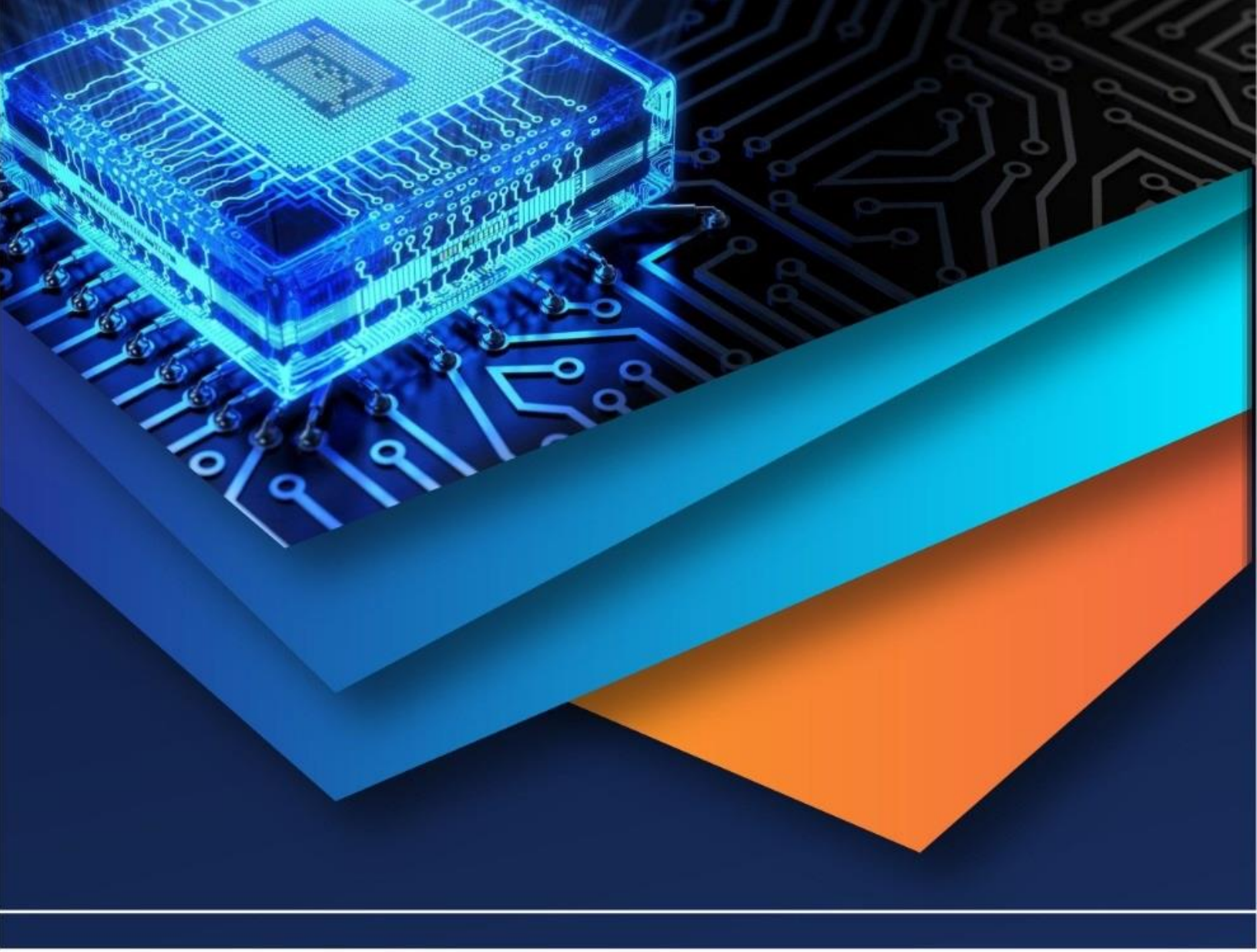
[10] Sandstorm JD, "A method for predicting solar cell current-voltage curve characteristics as a function of incident solar intensity and cell temperature", National Aeronautics and Space Administration, series technical report; pp. 32-1142, 1967

[11] Osterwald CR, Glatfelter T and Burdick J., "Comparison of the temperature coefficients of the basic I-V parameters for various types of solar cells" In: Proceedings of the 19th IEEE photovoltaic specialists conference; pp. 188-193, 2008.

[12] Makrides G, Zinsser B, Georghiou GE, Schubert M. and Werner JH. "Outdoor effi-ciency of different photovoltaic systems installed in Cyprus and Germany", the 33th IEEE photovoltaic specialists conference;11-16 May 2008, pp. 1-6, 2008.

[13] L. Dorobanțu, M. O. Popescu, C. L. Popescu, and A. Crăciunescu, "Experimental Assessment of PV Panels Front Water Cooling Strategy", International Conference on Renewable Energies and Power Quality (ICREPQ'13) Bilbao (Spain), 20th to 22th March, 2013.

[14] M. Abdolzadeh, M. Ameri, "Improving the effectiveness of a photovoltaic water pumping system by spraying water over the front of photovoltaic cells", Renewable Energy, vol. 34, no. 1,2017



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY