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Incorporating Cooling system for Silicon Solar Panel and analyzing its various parameters

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Abstract: *Silicon solar cell is assembled in both series and parallel to form the panel where it produces the power and during producing the power 100 percentage sun rays are not utilized by the solar panel and some part of sun rays will be reflected back and only some part of the rays will be utilized by solar panel to produce the power. The cell efficiency can be increased by lowering the temperature of the panel; this can be achieved by passing continuously air with the help of a cooling the panel by the supply of water at the back side. This is also an effective method. In the present work water is passing through the copper channel. Then comparing with the results obtained for the newly modified panel with the normal solar panel. After some time solar panel frame gets heated same is transferred to the cell where it is having chances of breaking and Damaging the cell, So to reduce heat transfer the cooling system is incorporated for better performing of the solar panel, without effecting the solar panel power out put, One panel is arranged with the cooling system and other without cooling system and with the help of thermal sensor we will take the reading for every half an hour, Calculated the average non cooling system and Cooling system readings are 47.83 ^{0}C and 44.11 ^{0}C Respectively and then finally difference of the same is calculated to know actual average difference temperature that is 3.71 ^{0}C.*

Keywords: *GW, JNNSM*

1. INTRODUCTION

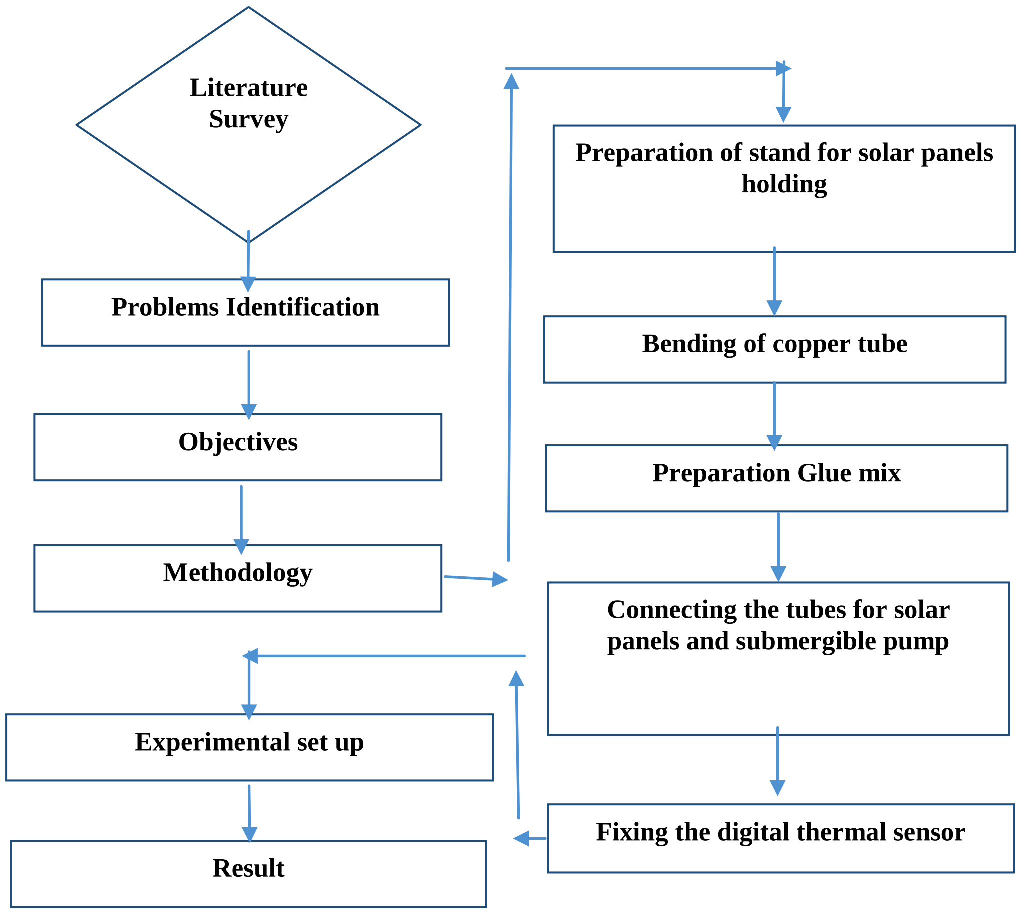
The other source of energy power generation are as using silicon soar cell as an alternative power generation.The Requirement of clean energy in India is necessary requirement ,India is one on of the largest power generation portfolio, India has established the Jawaharlal Nehru National soar Mission (JNNSM) on 11th January -2010, which is having the aim ,of producing the 227 Gigawatt (GW) of solar energy by 2022. India will explore new potential areas and ensure the maximum use of solar power get world leadership. The "*National Institution of Solar Energy in India"* has determined the country's solar power potential at around 750 GW. India is slowly going to get its dominion in the field of solar power generation due to ambitious state and centre's solar policies and projects. Nowadays India start switching to solar energy that is one of the best financial decision in today's world. As we can see the prices of fossil and fuel are increasing day by day so this is a perfect alternative of this problem. Although, India has huge scope in the field of solar energy in near future because solar power for home and industries are a cheap source of clean energy and secondly, it is available widely across the country without any interruption Today we are utilizing the solar rays to convert solar energy into an electrical energy, where the solar energy is an alternative power generation process. The research is going on in alternative resources for power generation in the field of renewable energy to fully utilize the solar energy into electrical energy in an effective manner. The solar energy may be converted into electrical energy by solar thermal energy into electrical energy or direct solar energy into electrical energy by using PV- cells. The PV cells absorption of solar energy is limited and Very Low Efficiency.

1) The present PV cells are not 100% efficient

2) Heating of solar panels results in ineffective utilization of solar energy

Quality of the cell need to be addressed, Based on the above Gaps there is very scope to take up a research work in the area of Providing the cooling system for silicon solar panel to improve the efficiency of the silicon solar panels by that automatically the temperature of the solar panel will reduces

2. Methodology



Figures no 1: Process Flow Diagram

2.1 Components and binding materials required

a) **Stand to hold the solar panels**

b) Submergible pump

c) Coper tube

d) Thermal sensor

e) Connecting plastic tube

f) Solar panels

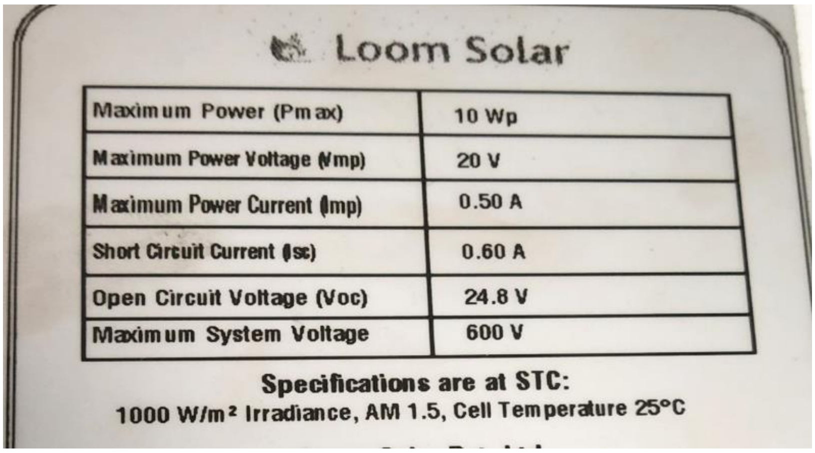
g) M-Seal ,Bond tite tape Double side

h) Cello tape

Figures no 2: Components and Binding materials required

2.2 Construction

Take 2 Number of solar panel having the specification as shown in the Tabular column no 1. Take the solar stand which is prepared with small channels and welded as shown in the figure (2.a), Take one solar panel take the copper wire make the bending arrangements as shown in the figure (5a), apply the binding glue as shown in the figure (5b) mix with one of the other and mix it well with the mixer and apply, for better use the M-Seal to stick more as shown in the figure (5b), after that leave for half an hour to stick and mean while take the another solar cell place it right side of the frame as a non-cooling provided part,



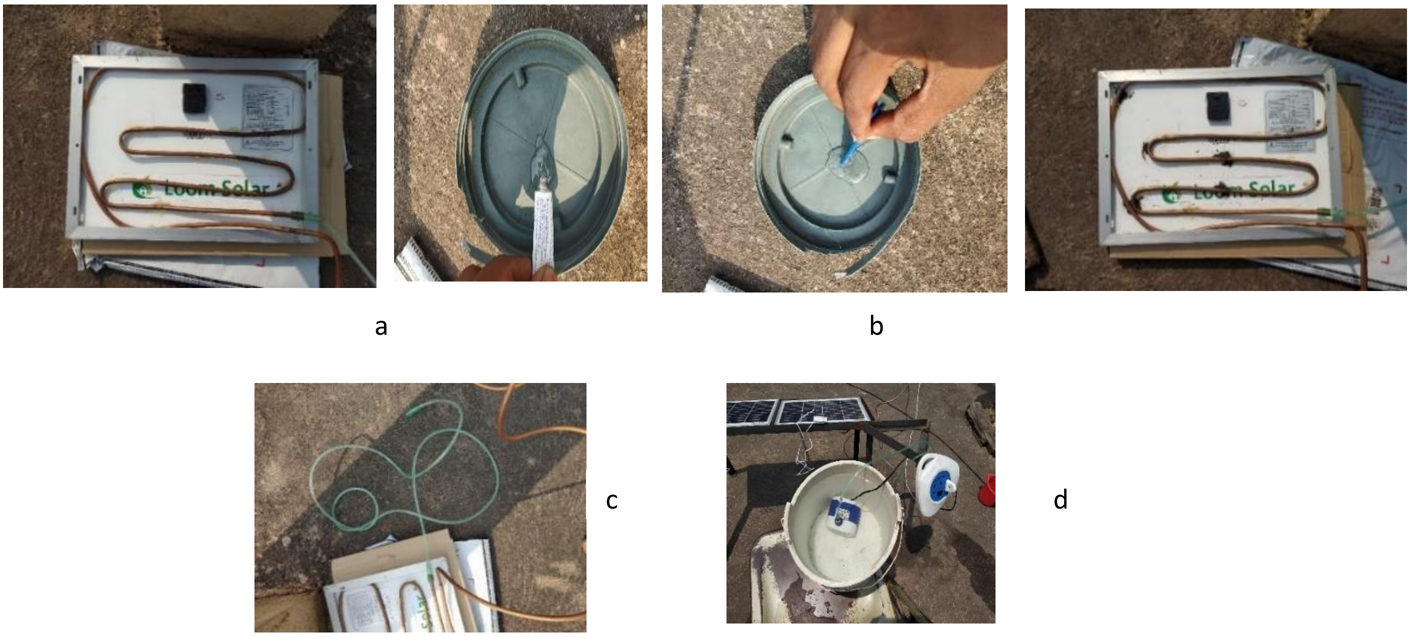
Loom Solar

Maximum Power (Pmax)	10 Wp
Maximum Power Voltage (Vmp)	20 V
Maximum Power Current (Imp)	0.50 A
Short Circuit Current (Isc)	0.60 A
Open Circuit Voltage (Voc)	24.8 V
Maximum System Voltage	600 V

Specifications are at STC:
1000 W/m² Irradiance, AM 1.5, Cell Temperature 25°C

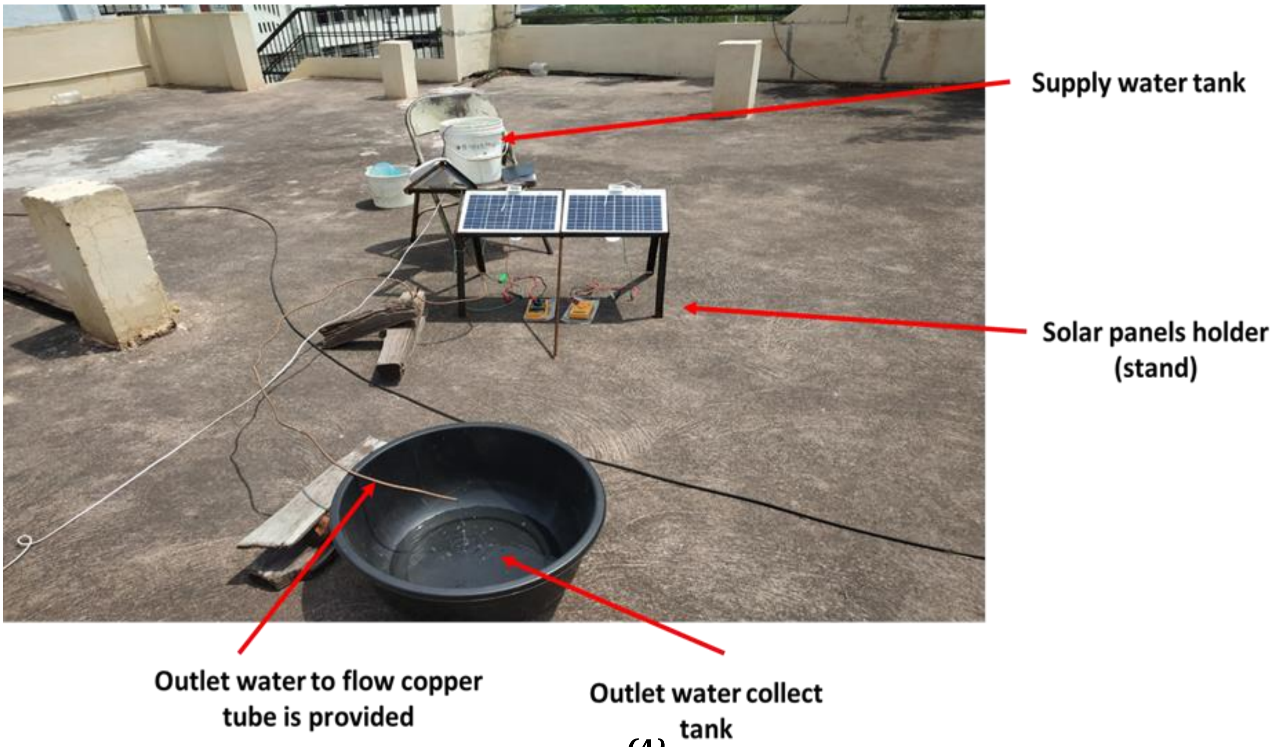
Tabular column no 1: Specification of solar panel

After half an hour take the copper tube provided, fix plastic tube having larger diameter rather than the copper tube diameter fix it copper tube one end as shown in the figure (3a) and other to the out let of the submergible pump as shown in the figure (3d), the submergible pump is immersed in a water tank which is provided to supply water to flow through the copper tube (here we have taken small bucket), the copper tube other end is connected to collecting tank (here we have taken one more small bucket),with the help of junction box power is provided (power used is very low). fix digital thermal sensor by using the double sided tape and cello tape (one one for each solar panel stand as shown in the

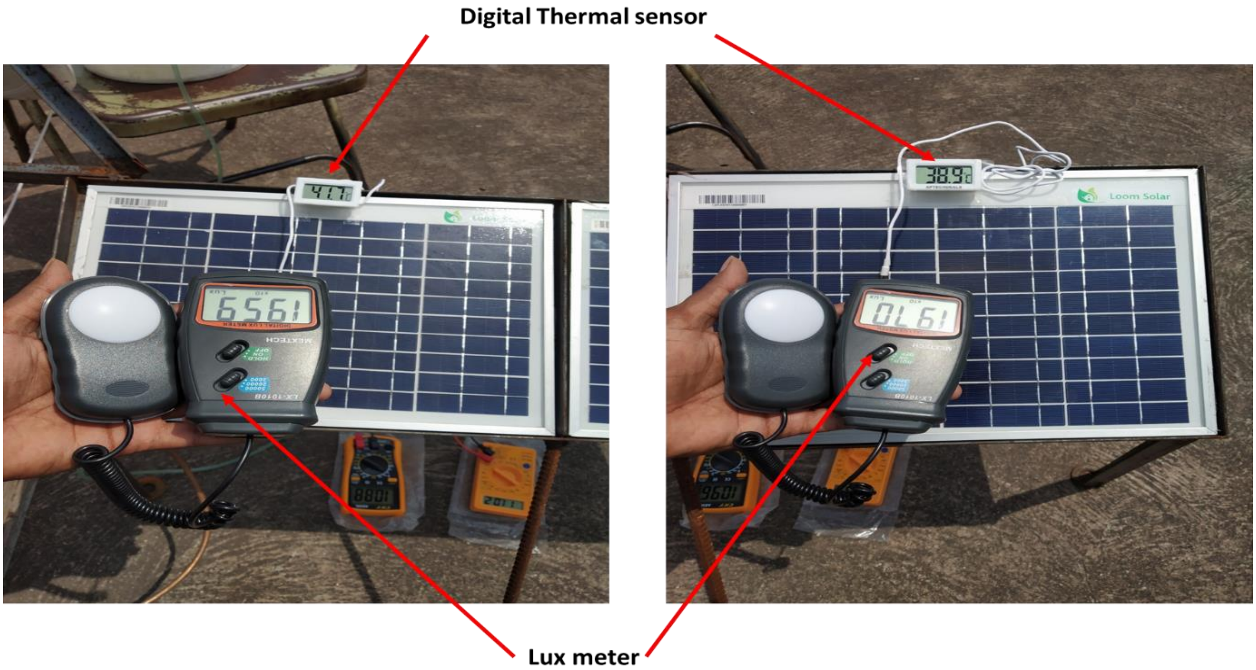


Figures no 3: Assembling of cooling system

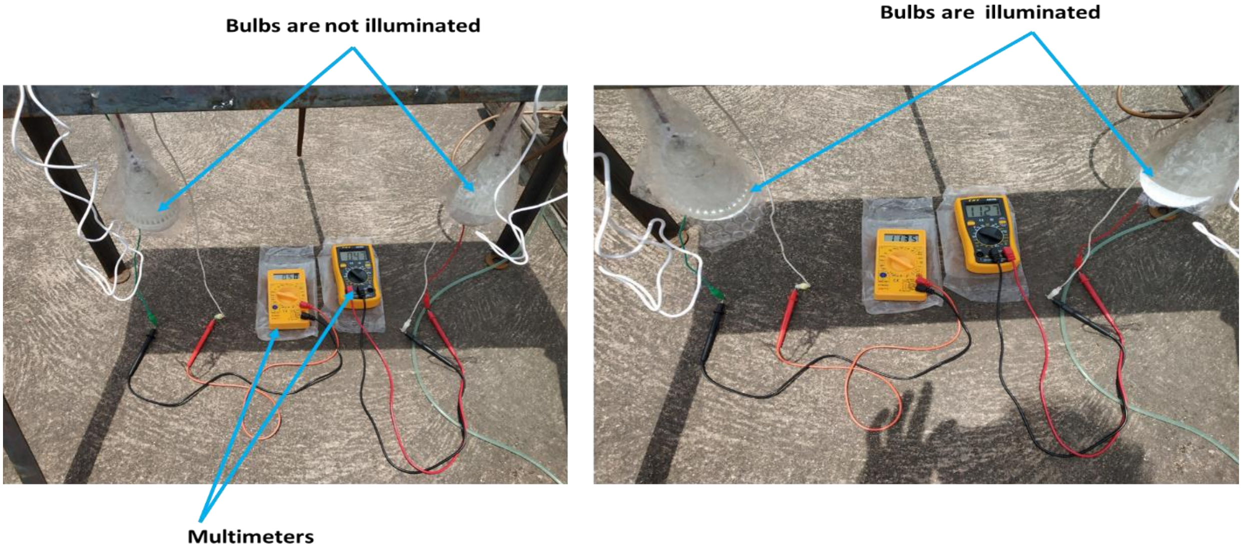
figure no 4). Figure no 4 shows the arrangement of setup of front view and figure no 5 shows the back view of the experiment


Supply water tank
Solar panels holder (stand)
Outlet water to flow copper tube is provided
Outlet water collect tank

(A)

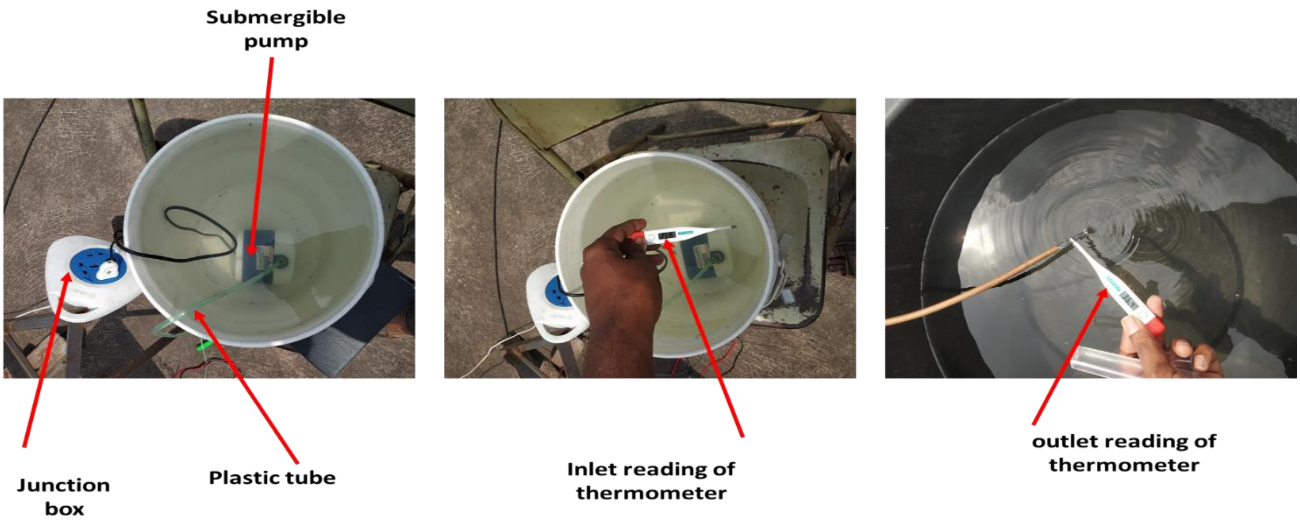

Digital Thermal sensor
Lux meter

(B)



(C)

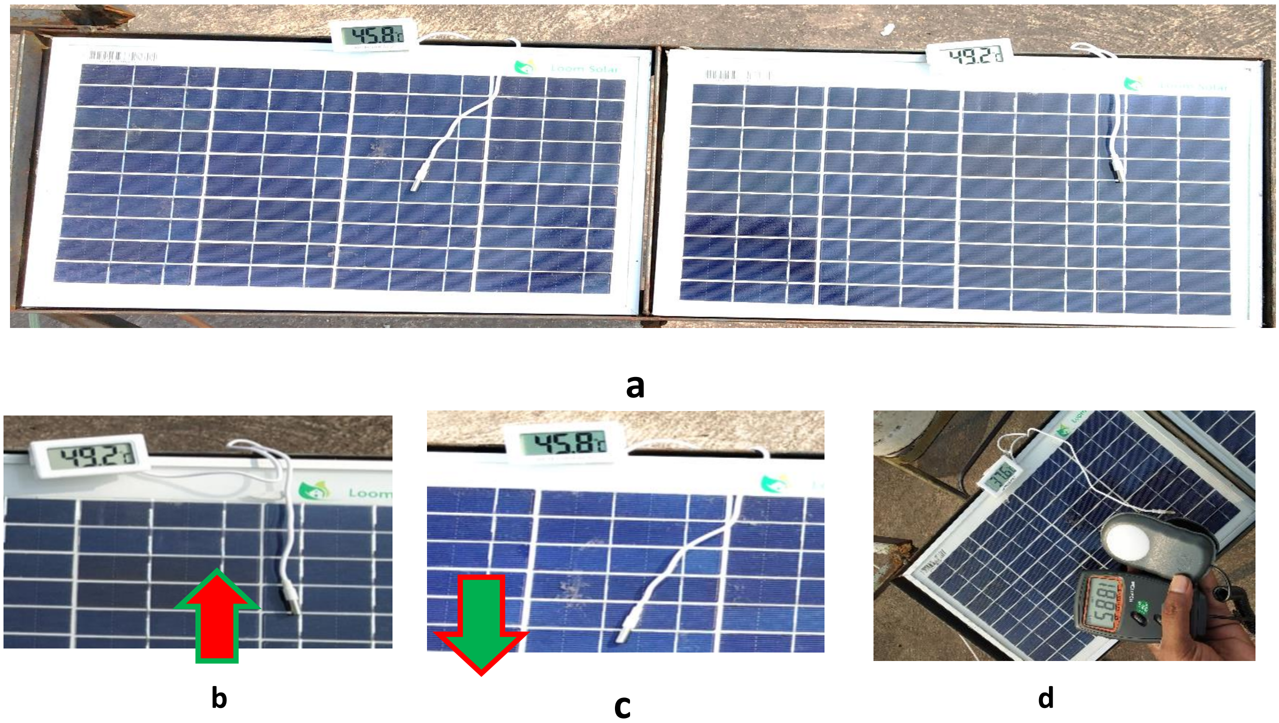
(D)



Figures no 4: Experimental setup

2.3 Working and Experimental readings

Ensure both the digital thermal sensor is switched on, displaying the reading and the lids are kept of the frames for both sides as shown in the figure (5a) and then switch on the water supply to the tank and water is flows through the copper tube from submergible pump it allows to pass through it to copper tube and passes through the copper tube and then it will have collected in the collecting tank. Time is noted and reading is noted as shown in the figure (5b) & (5c) and every half an hour this taking of reading is noted along with the time both cooling system and non-cooling system, here and there lux intensity is measured as shown in the figure no (5d). Readings are recorded in the tabular column no 2.And the readings are plotted in the Graph no 1 which indicates the readings of both the cooling and non-cooling system.



Figures no 5: Reading taking

2.4 Mathematical Relations

The thermal efficiency of the PV module can be calculated by using the below following equations

$$\eta_{thermal} = \frac{mC_p(T_0 - T_1)}{HA}$$

Where

m is mass flow rate in kg/s ,m=(v*ρ)

Cp is specific heat in J/Kg K. (4.18 KJ/kg-deg centigrade)

V= Water tank volume

ρ = Density of fluid (1000 kg/m^3)

To is the outlet temperature in K,

Ti is inlet temperature in K

A is area of the panel in M^2 and

H is the solar radiation in W/ M^2.

The variation of thermal efficiency is a function of mass flow rate, temperature difference and incident solar radiation. The temperature difference depends on the ambient temperature of air. The electrical efficiency of PV module is found out using the formula, (2) Fill factor of solar cells can be calculated by using the following relation,

$$\eta_{electrical} = \frac{FFV_{oc}\, I_{sc}}{HA}$$

$$\eta_{electrical} = \frac{V_m\, I_m}{HA}$$

The fill factor is defined as the ratio of the actual maximum obtainable power to the product of the open circuit voltage and short circuit current. This is a key parameter in evaluating the performance of solar cells.

Here

Voc is open circuit voltage of PV module in Volts and

Isc is short circuit current of PV module in ampere.

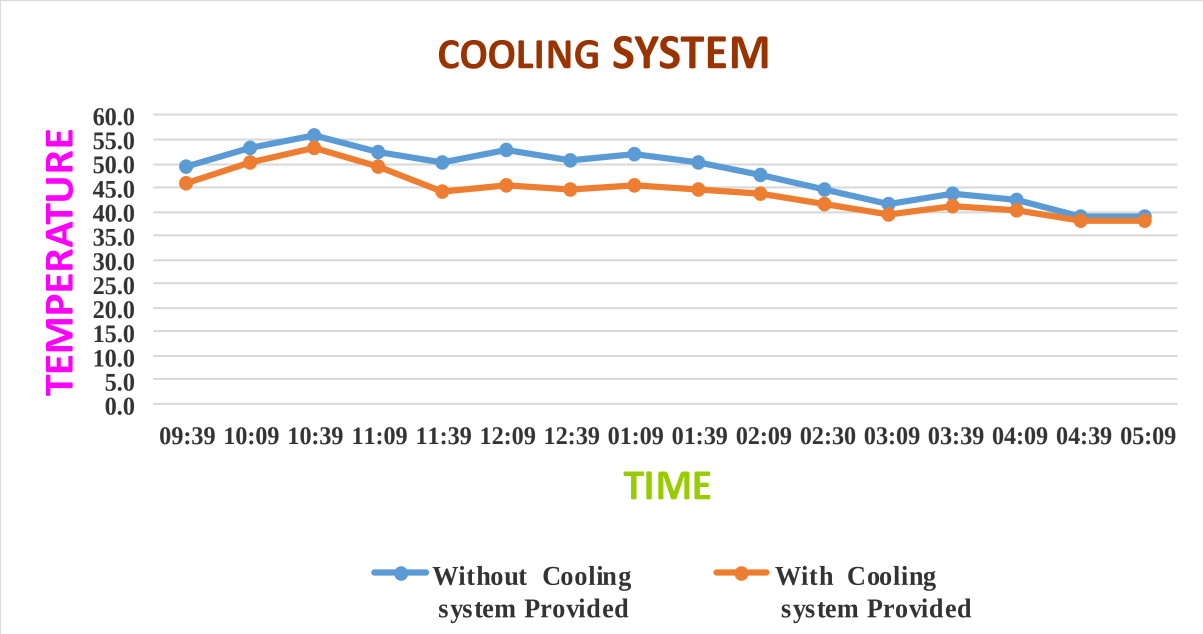
FF is fill factor of the PV module.

$$FF = \frac{V_m\, I_m}{V_{oc}\, I_{sc}}$$

3. Results and Discussion

Cooling System			
Slno	**Time**	**Without Cooling system Provided**	**With Cooling system Provided**
1	09:39	49.2	45.8
2	10:09	53.4	50.3
3	10:39	55.8	53.1
4	11:09	52.5	49.2
5	11:39	50.3	44.1
6	12:09	52.8	45.6
7	12:39	50.8	44.8
8	01:09	51.8	45.5
9	01:39	50.4	44.4
10	02:09	47.8	43.9
11	02:30	44.4	41.7
12	03:09	41.5	39.6
13	03:39	43.8	41.1
14	04:09	42.6	40.3
15	04:39	39.1	38.3
16	05:09	39.0	38.1
Average		**47.83**	**44.11**
Average Reduced Temperature			**3.72**

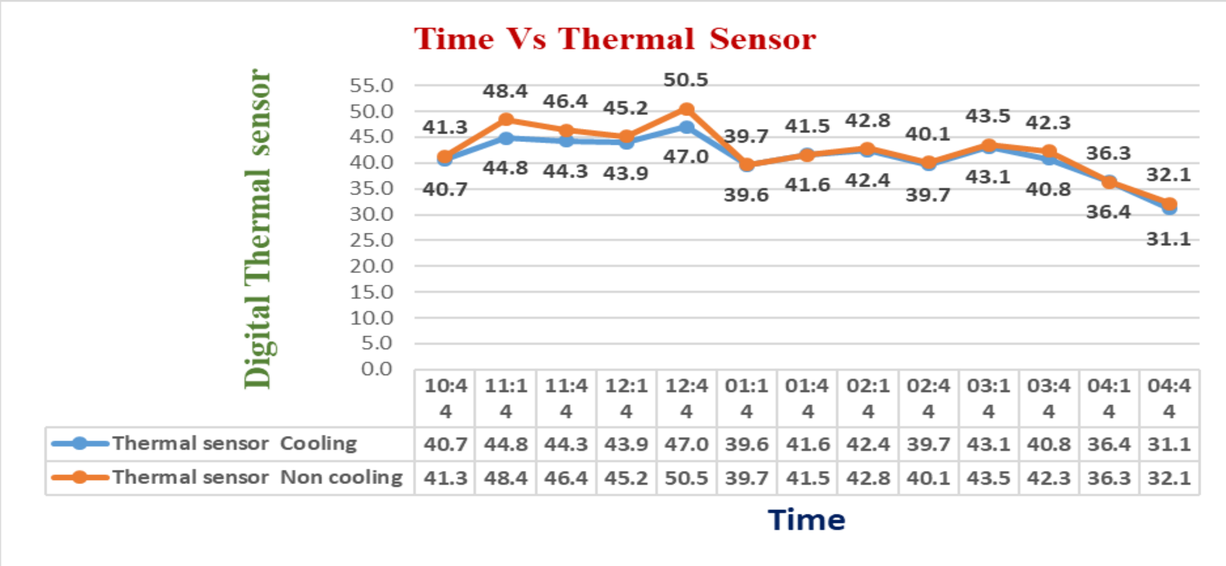
Table no 2 : Readings tabulated for both the cooling and non-cooling system (11-5-2021)



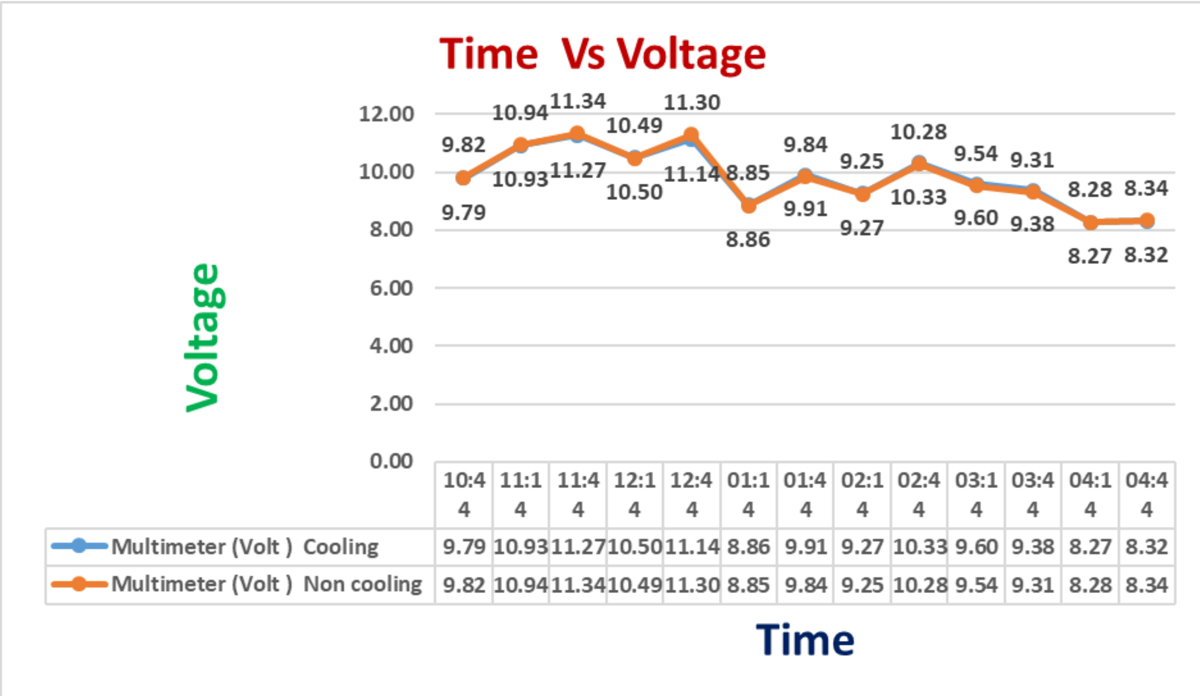
Graph no 1: Temperature vs Time of cooling system

Cooling system for Silicon (25-5-2021)												
Sl.No	Time	Lux meter		Thermal sensor		Multimeter (Volt)		Multimeter (Current)		Water temperature	
		Cooling	Non cooling	Cooling	Non cooling	Cooling	Non cooling	Cooling	Non cooling	Inlet	outlet
1	10:44	1959	1970	40.7	41.3	9.79	9.82	0.11	0.15	33.1	34.7
2	11:14	1960	1971	44.8	48.4	10.93	10.94	0.13	0.16	32.7	35.2
3	11:44	1960	1971	44.3	46.4	11.27	11.34	0.47	0.50	32.7	35.2
4	12:14	1950	1946	43.9	45.2	10.50	10.49	0.49	0.48	35.8	36.2
5	12:44	1953	1953	47.0	50.5	11.14	11.30	0.21	0.20	35.4	37.2
6	01:14	1855	1857	39.6	39.7	8.86	8.85	0.14	0.13	36.2	35.6
7	01:44	1925	1925	41.6	41.5	9.91	9.84	0.27	0.25	36.5	37.1
8	02:14	1925	1925	42.4	42.8	9.27	9.25	0.18	0.17	34.6	36.2
9	02:44	1896	1891	39.7	40.1	10.33	10.28	0.19	0.17	35.6	36.4
10	03:14	1894	1897	43.1	43.5	9.60	9.54	0.25	0.26	35.7	37.3
11	03:44	1879	1878	40.8	42.3	9.38	9.31	0.19	0.16	39.8	40.5
12	04:14	760	554	36.4	36.3	8.27	8.28	0.06	0.05	35.3	37.2
13	04:44	790	750	31.1	32.1	8.32	8.34	0.06	0.05	32.0	32.3
				535.4	550.1	127.57	127.58	2.75	2.73		
				14.7		0.01		0.02			

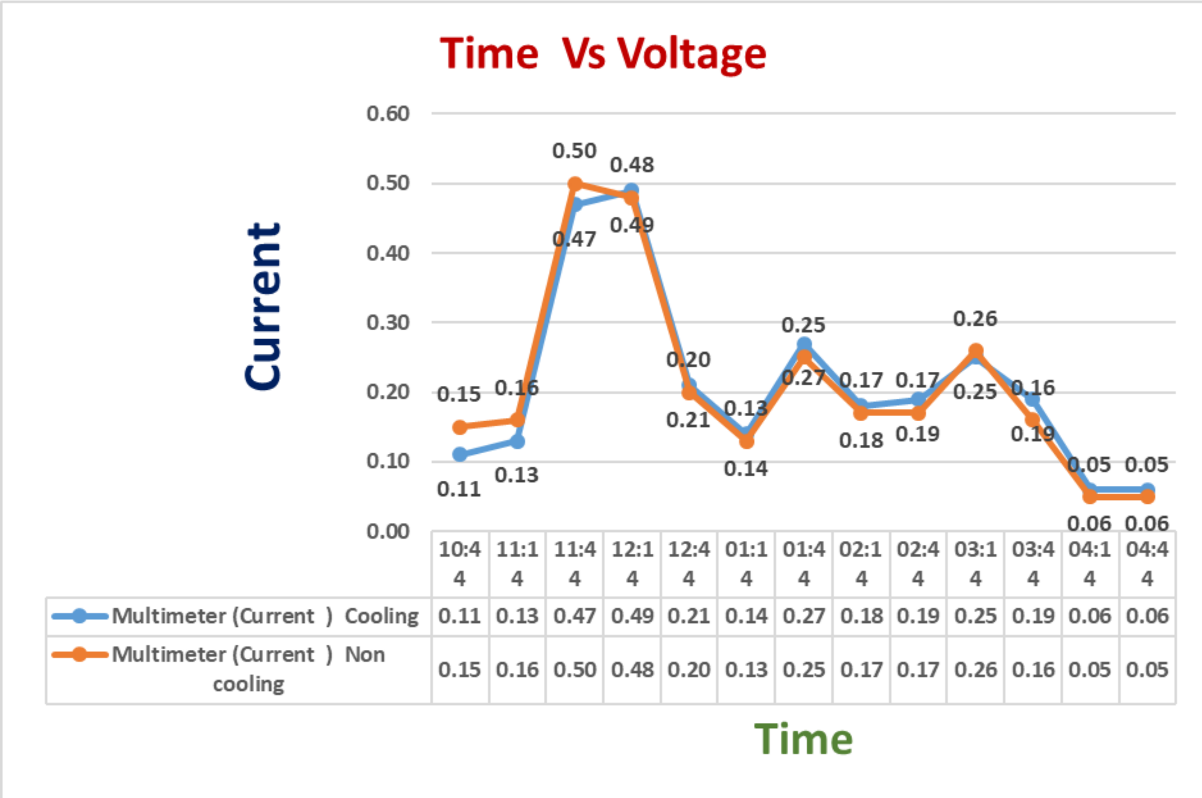
Tabular column no 3 : Readings tabulated for both the cooling and non-cooling system (25-5-2021)



Graph no 2: Time Vs Digital Thermal Sensor Reading



Graph no 3: Time Vs Voltage



Graph no 4: Time Vs Current

Conclusions

1) From the graph no 1 we can see that blue line indicates without cooling system provided and red with cooling having the average reading of both are 47.83 and 44.11 degree respectively.

2) From graph no 1 The average reduced temperature difference is 3.71 degree centigrade .

3) From the graph no 2 we can see the difference in the digital thermal sensor reading difference 14.7 degree centigrade .

4) From graph no 3 multimeter volt meter reading difference of the cooling and non colling system provided is 0.01volt

5) From graph no 4 multimeter current meter reading difference of the cooling and non colling system provided is 0.02 amps

6) From the above graphs no 2,3,4 we can say that the cooling system is successfully raises the panel life, reduces the panel temperature, increases the current by keeping the minimum increase of the volt ,it also indicates that the panel design will not be effected to reduce for designed rate capacity instead it will helps to increase the power development.

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