Design and development of Solar Air Cooler system with auto tracking system

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Abstract: The objective of this concept is to design the Automatic solar air cooler with auto tracking system. Solar electricity is the technology of converting sunlight directly in to electricity. It is based on photo-voltaic or solar modules, which are very reliable and do not require any fuel or servicing. Solar electric systems are suitable for plenty of sun and are ideal when there is no main electricity. Our objective is to design and develop a solar system normally Solar Air Cooler.

Index Terms – Solar powered, Auto Tracking system, Impeller, AC System.

I. INTRODUCTION

Solar Tracking System" is a power generating method from sunlight. This method of power generation is simple and is taken from natural resource. This needs only maximum sunlight to generate power. This paper helps for power generation by setting the equipment to get maximum sunlight automatically. This system is tracking for maximum intensity of light. When there is decrease in intensity of light, this system automatically changes its direction to get maximum intensity of light.
To track the sunlight, it is necessary to sense the position of the Sun and for that an electro-optical sensor is needed. The proposed Sun tracker uses the electro-optical sensor for self-calibration. A LDR or photo resistor is a variable resistor whose electrical resistance depends on the intensity of the light falling on it. The LDR resistance decreases with incident light intensity increasing. The LDR sensor is a part of the voltage divider circuit in order to give an output voltage

II.COMPONENTS/MATERIALS REQUIRED

2.1. SOLAR CELL

A solar cell works on the principle of photo-voltaic principle, the photo-voltaic solar energy conversion is one of the most attractive non-conventional energy sources of proven reliability from the micro to the Megawatt level. Figure.2. solar cell arrangement in series and parallel Cells may be connected in parallel to achieve the desired voltage. The optimum operating voltage of a photo voltaic cell is generally about 0.45 volts at normal temperatures, and the current in full sunlight may be taken 0.270 amperes / sq. mm. If the exposed area of the cell is 40 square cm (6.2sq.in) or 40*10^-4 sq. m, the current and power are decreased or increased proportionately. By combining number of solar cells in series that is in a string, the voltage is increased but the current is unchanged. In this case, if one cell get damaged then the whole string would become inoperative, similarly by combining number of solar cells in parallel, the current is increased but the voltage is unchanged, in this change one cell get damaged than it does not affect the other cell in the string. To get a voltage of 0 to 36 V we require 72 cells to be connected in series so that we connected 72 cells in series to a required voltage

2.2. BATTERIES

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern.

2.3. BLOWER, DC MOTOR, IMPELLER

The fan (impeller) rotates inside the shell. The shell is so designed that the air is rushed out forcedly. The D.C motor is directly coupled with Impeller blades. The water pump is used to circulate the water to the blower. The cool air is rushed out forcedly. The battery is connected to the D.C motor, so that D.C motor runs directly. The D.C motor is used to control the direction of hot air flow. In our project the hot air is distributed in all direction with the same rate by using D.C motor tilting mechanism. Impeller consists of more number of blades. The number of blade increases the cold air rushed out forcedly. The impeller blades are slightly bent.

2.3. PHOTOVOLTAIC PRINCIPLES

The photo-voltaic effect can be observed in nature in a variety of materials that have shown that the best performance in sunlight is the semiconductors as stated above. When photons from the sun are absorbed in a semiconductor, that create free electrons with higher energies than the created there must be an electric field to induce these higher energy electrons to flow out of the semi-

conductor to do useful work. A junction of materials, which have different electrical properties, provides the electric field in most solar cells. To obtain a useful power output from photon interaction in a semiconductor, three processes are required.

III. DESIGN CALCULATIONS

3.1. Size of Cooler

Air delivery or Air displacement(in Cubic feet per minute CFM)
= [Area of room in square feet] x [height of room] 2
= 10*10*10 = 500 CFM 2
i.e. V1 = 14 cub m/min [1 CFM = 0.028 cub m/min]
The factor 2 in denominator denotes that the air in the room is changed once in every 2 minutes.

3.2. Heat Load Calculation

1BTU/hr=0.293 Watt Area of room (BTU)
= L*W*31.25 = 10*10*31.25
= 3125 BTU/hr = 915.625 Watt
North window without shading(BTU) = L*W*1.4 = 2*2*1.4 =5.6 BTU/hr
= 1.6408 W
South window without shading (BTU) = L*W*1.4
=2*2*1.4 =5.6 BTU/hr = 1.6408 W
Occupant (BTU) = No. of People *600 = 3*600
=1800 BTU/hr = 527.4 W
Note:- assuming 600 BTU per person Heat gain:-
Equipment (BTU) = Total equipment Watts*3.4
=(4.1667+6.25)*3.4 = 35.4167
BTU = 10.3771 W
Lighting (BTU) = Total Lighting Watts*4.25
= 3.5*4.25 = 14.875 BTU
= 4.3583 W 7. Total (BTU)
= eqn (1+2+3+4+5+6) = 1461.042 W
Air delivery = 500CFM
Through air cooler = 500*163.17 BTU/hr
= 500*16317*0.293
=23904.405W >HeatLoad
RH Std. air condition = 40 degree c DBT & 20 Degree c WBT Expected / Required condition
=20 degree c DBT & 55%.

IV. WORKING PRINCIPLE

Solar energy conversion is done by using battery, inverter and charge controller. As sunlight falls on solar panel, which converts into electrical energy by photoelectric effect. This electrical energy stored in battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. The stored energy directly can use for DC loads or else need to be converted AC (alternate current) by the help of inverter. Below shown figure explains solar energy conversion. As the electrical energy supplied to the fan from inverter, it starts to produce airflow to the room at the same time water passed through the cooling pads. As AC blower is used for cooler, so need to convert DC load from the battery to AC load by the help of inverter. Inverter converts DC load to AC. Load, now AC power can be supplied to the blower. This blower is surrounded by cooling pads through which continuous water supply is provided. When the blower is switched on, blower sucks atmospheric air into the cabin through the cooling pads, mean time heat transfer occur between water and air, so the cool air enters into the room thus providing required thermal comfort conditions. Fan sucks the outside air through the cooling pads, so heat transfer occur between air and water. So the cool air enters into the room. Next thing is cooling cabin provided just below the air cooler section. This cabin built is up with cooling pads and ceramic slabs. Ceramic slabs are surrounded by cooling pads through continuous water supply is provided. This process leads to producing cooler environment in the cabin. So this cabin can be used for preservation of food.

V. EXPERIMENT RESULTS

The measurement results of generating voltage and current waveforms for the fixed and tracking PV systems. In order to give a clear explanation on the energy productivity, the generating instantaneous powers of the both systems were further calculated.

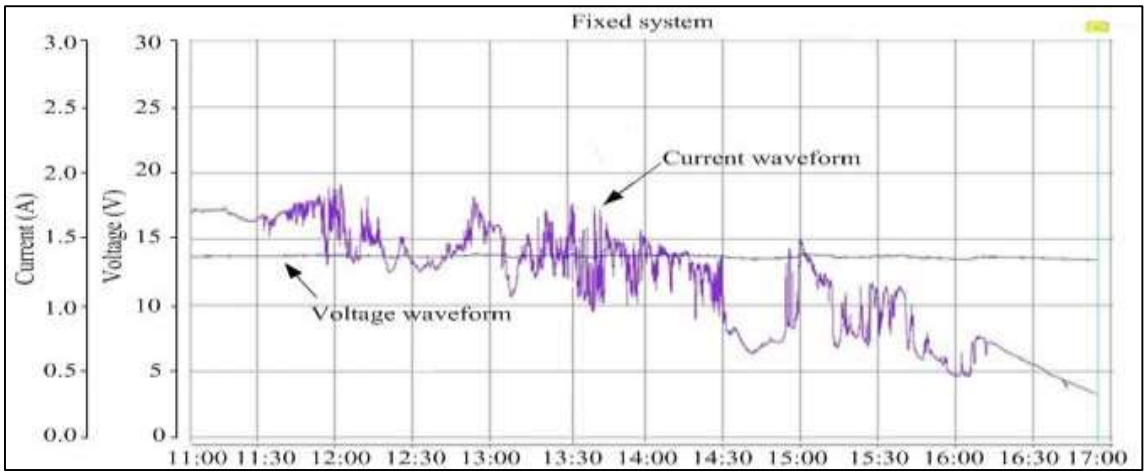


Fig.1. Output of a Fixed System

Double axis solar trackers have both a horizontal and a vertical axle and so can track the sun's apparent motion exactly anywhere in the world. This type of system is used to control astronomical telescopes, and so there is plenty of software available to automatically predict and track the motion of the sun across the sky. Dual axis trackers track the sun both east to west and north to south for added power output and convenience.

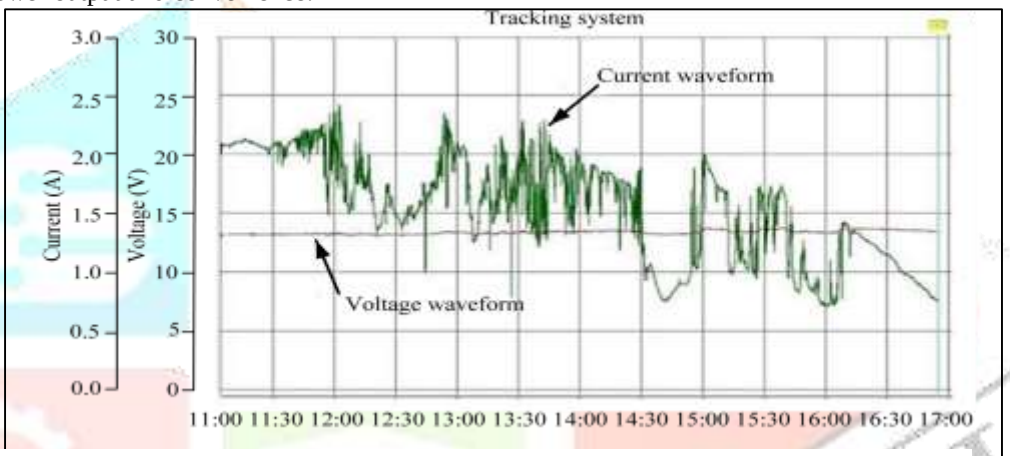
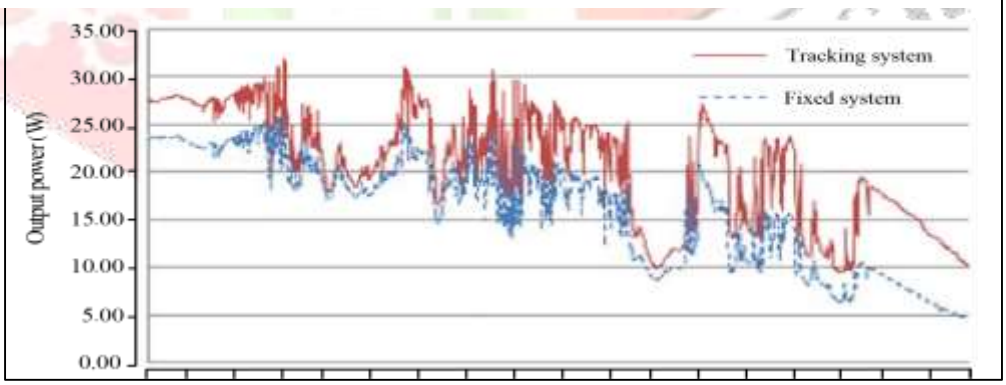


Fig.2. Comparisons of the generating power for the tracking and fixed system



VI. CONCLUSION

Comparing the cost of this product with the existing products in the market is solar product appeals better and affordable by common people. This solar product perfectly suits for villages, schools and offices and thus an alternate to the power cut problems. It comprises of many attractive features such as usage of solar energy, cooler and cooling cabin at lower cost. It is eco friendly and natural, electricity savers. Durability of the product is more thus minimizing the cost. No electricity is used so this product saves the energy and saves environment from getting polluted.

So as comparing the cost of this product with the existing products in the market is, solar product appeals better and affordable by common people. This solar product perfectly suits for villages, schools and offices and thus prevention from the power cut problems. It comprises of many attractive features such as usage of solar energy, cooler and cooling cabin at lower cost. The above method is eco friendly and natural, electricity savers.

Fig.3.Fabricated Model of Solar Air Cooler

REFERENCES

[1] Farhan Khmamas (2012), "Improving the Environmental Cooling for AirCoolers by Using the Indirect-Cooling Method", ARPN Journal of Engineering and Applied Sciences, Vol. 5, No. 2, pp. 66-73.
[2] SERI (1982), "Basic Photovoltaic Principles and Methods", SERI/SP-290- 1448, Solar Information Module 6213.
[3] Farhan a. khmamas, 2012, "Improving the environmental cooling for air-coolers by using the indirect-cooling method" ARPN journal of engineering and applied sciences, vol. 5, No. 2, page No. 66-73.
[4] A S Alosaimy, 2013 "Application of Evaporative Air Coolers Coupled With Solar Water Heater for Dehumidification of Indoor Air" International Journal of Mechanical & Mechatronics Engineering, Vol:13 No:01 page no. 60- 68.
[5] "Basic Photovoltaic Principles and Methods" SERI/SP290-1448 Solar Information Module 6213 Published February 1982 page. No. 9-15.
[6] Alosaimy A S (2013), "Application of Evaporative Air Coolers Coupled with Solar Water Heater for Dehumidification of Indoor Air", International Journal of Mechanical & Mechatronics Engineering, Vol. 13, No. 01, pp. 60-68.
[7] Farhan Khmamas (2012), "Improving the Environmental Cooling for Air- Coolers by Using the Indirect-Cooling Method", ARPN Journal of Engineering and Applied Sciences, Vol. 5, No. 2, pp. 66-73.