National conference on Engineering Innovations and Solutions (NCEIS – 2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 6 | ISSN : 2456-3307

Solar Based Air Conditioning Using Peltier.

Arpitha. V[1], Geeta. S. Rudagi[1], Mukta. Hombaradi[1], Prameela.m[1], Dr. Vagdevi. S[2]
[1]Students, Department of Electrical and Electronics Engineering, GSSSIETW, Mysuru, karnataka, India
[2]Dean Academics, Professor and Head, Department of Electrical and Electronics Engineering, GSSSIETW, Mysuru, karnataka, India

ABSTRACT

In view of depletion of the conventional energy resources like coal, petroleum etc., it is necessary to utilize renewable energy resources to meet the world energy demand. The objective of this project is to draw a picture about a promising solar cooling concept, based on the use of solar panel and to define the aspects that need to be considered in future development. The total energy emitted from the sun is around 5200 times that of the global energy requirement. According to International Institute of Refrigeration, air conditioning and refrigeration consumes around 15% of the total worldwide electricity and also contributes to the emission of CFCs, HCFCs, CO2 etc. Solar energy is typically used to heat water or generate electricity. This work is based on the Peltier effect with which we can cool a specific area without using compressor which take a huge consumption of electricity.

Keywords. Solar panel, Arduino, Peltier, Battery

I. INTRODUCTION

As day by day increasing in the consumption of energy due to modernization in living standard of human being, due to industrialization globally. Because of this rate of consumption of energy is going high day by day and that is why the available limited fossil fuels like coal ,petroleum etc. is consuming at high rate all over the world. To overcome the environmental problem of pollution, global warming, ozone layer depletion research on the free available energy sources like solar, wind, hydro, geothermal etc. are been area of interest. Solar energy is a clean source of energy for power generation and most abundant available. Solar energy is the energy obtained from the sun that can be utilize in both way as thermal as well as electrical energy after conversion. Thermal energy is obtained from solar collectors and electrical energy is obtained from photo voltaic cells. The energy emitted from the sun on the earth in an hour is quite larger than the total energy consumed by the entire population on earth in one year factories, business etc. which consumes large electricity for running their machines, equipments, lightening, air conditioning and refrigeration system. During the same peak time the solar energy available, so its proper utilization may play a great role to fulfil the future demand as well clean source of energy. The demand for cooling may be driven by different aspects, comfort and refrigeration being the most common uses. In fact, the cooling demand is growing worldwide, even in colder climates, as comfort demand rises. This results in an increase in air conditioning mainly for tertiary buildings but also for residential applications. Solar energy technologies can provide electrical generation by heat engine or photovoltaic means, space heating and cooling in active and passive solar buildings;

potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes. Sunlight can be converted into electricity using photovoltaics (PV), concentrating solar power (CSP), and various experimental technologies. PV has mainly been used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array. A solar cell, or photovoltaic cell (PV), is a device that converts light into direct current using the photoelectric effect. The first solar cell was constructed by Charles Fritts in the 1880s. Although the prototype selenium cells converted less than 1% of incident light into electricity, both Ernst Werner von Siemens and James Clerk Maxwell recognized the importance of this discovery. The system is equipped by heat sinks, peltier (thermoelectric module) element, etc. It is the system which is designed to produce cooling but the main objective behind the project is that the thermoelectric module (peltier module) to produce cooling effect. This means that cooling of space is done without the use of greenhouse gases which would ultimately reduce the global warming which is usually caused by other air conditioning system which uses coolants. Thermoelectric cooling, also known as "The Peltier Effect", is a solid-state method of heat transfer through dissimilar semiconductor materials. Thermoelectric cooler (TEC), or Peltier Cooler uses the Peltier effect for the exchange of heat.The modern commercial TEC consists of a number of p- and n- type semiconductor couples. The heat pumping direction can be altered by altering the polarity of the charging DC current. Heat will be rejected through the module from inner side to the outer surface. Inner module face will be cooled while the outer face is simultaneously heated.

II. LITERATURE REVIEW

Riffat and Qiu compared the performance of the thermoelectric based air conditioning system with the conventional vapor compression and vapor absorption air conditioning and found that the COP was quite low than that of the conventional one.

Abdullah et al. They performed experimental study on a combined solar thermoelectric-adsorption cooling system for eight days. During the day time the cooling effect was produced by peltier effect by means of thermoelectric element. On the other hand the cooling effect during night time is produced by the adsorption cooling system. The overall COP of the system was average of the two combine system i.e. thermoelectric cooling (COP=0.152) and adsorption (COP=0.131).

Luo.et al performed an experiment and found that the heating effect produced by the thermoelectric based system is quite more efficient than the electrical heating system.

III. METHODOLOGY

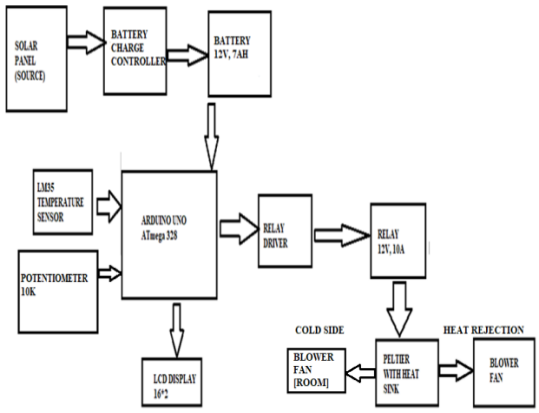


Figure 1. Block diagram of solar based air conditioning using peltier.

In this the hardware electrical elements being used are shown with proper connection. A 12 Volt 7Ah battery is used. Peltier/thermoelectric module model no. TEC1-12706 including the DC fan for cooling the heat side are used, all the connections are made parallel with the battery. Thermal sensor LM35 is used to notify the temperature inside the cabin which will be display on the LCD, relay is being used to control the temperature.

WORKING PRINCIPLE.

The cooling effect produced by the system is basically based on Peltier effect. Peltier effect is a temperature difference obtained by applying a voltage between two electrodes connected to a sample of semiconductor material to create a hot side and a cold side. Basically the heating and cooling effect is produced because of the electron-hole presented inside the P- N type superconductor. Thus the electron-hole are the heat carrier here in the system same as the refrigerant in conventional AC. The cold side of the peltier module is kept inside the chamber to be cooled while the Hot side is kept outside for removal of heat. DC fan with fins are assembled toward hot side for easily and quick removal of heat.

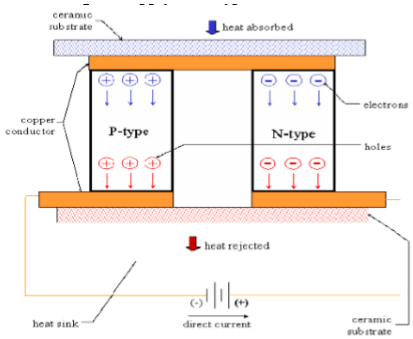


Figure 2. Working of peltier module

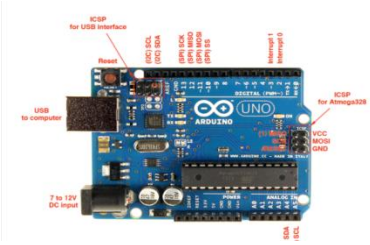
IV. HARDWARE DESCRIPTION

SOLAR PANEL

Solar photovoltaic module is the array of number of electrically connected solar cell mounted on a frame. Modules are designed to supply the electricity at certain voltage. The efficiency of the module and current supply by it is totally depend upon the amount of solar radiation fall on the surface of the PV module. Solar panel of 5watts, 12volts is used here.

ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino are able to read input light on a sensor, a finger on a button,activating a motor, turning on an LED, publishing something online.The arduino uno is microcontroller board based on ATmega328(datasheet).it has 14 digital input/output,16 MHz ceramic resonator,a USB connection, power jack and ICSP header and reset pin it contains everything needed to support the microcontroller.



PELTIER MODULE

A thermoelectric module consists of arrangements of number of P-type and N-type semiconductor which are heavenly doped with electron carrier and sandwiched between two ceramic substrates.

These elements are arranged in a way that is electrically connected in series but thermally connected in parallel. In this project we have used the Peltier module model TEC1-12706.

BATTERY

Battery used in the solar based air conditioning using peltier is having the following specification - 12 Volt DC and 7 Ampere hour. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current.

DC FAN AND HEAT SINK

Cooling fan works on 12V DC been used here to remove the heat from the hot side. Heat sink is a passive heat exchanger that cools a device by dissipating the heat into surrounding medium, it consists of fin blade due to which the surface area for cooling increase and hence the cooling effect obtained.

V. SOFTWARE DESCRIPTION

ARDUINO COMPILER

The open –source arduino software(IDE) makes it easy to write code and upload it to the board. It runs on windows, mac OS X, and linux. The environment is written in java and based on processing and other open-source software. This software can be used with any arduino board.

The program is dumped to arduino board to run it. The programing part is done in a way which displays the cold temperature and set temperature.

ADVANTAGES OF PELTIER MODULE

1. Direction of thermoelectric heating pump is reversible by changing the polarity of current, so it can work as cooler and heater too.
2. Thermoelectric module does not have moving part to wear and tear; therefore there is no need of any maintenance.
3. It has capacity to work for more than 200,000 hours in steady state.
4. It resists shock and vibration.
5. It can work in too severe or sensitive environment.
6. It does not contain any harmful material like chlorofluorocarbons (CFCs) which can damage environment.
7. It does not dependent on gravity. Thus, it can be placed in any direction.
8. Temperature can be maintained in fraction of degree, even below ambient temperature using thermoelectric module by controlling the power load provided to the module.
9. Temperature can work between 100ºC to 100ºC of heat sink temperature.

DISADVANTAGES

The main disadvantage of thermoelectric module is lower efficiency when compare to non-thermoelectric modules when working as power generator. It is usually 0.3 or lower.

VI. RESULTS

Once the whole hardware component is installed with proper connection, the system can be operated and the desired effect can be obtained. Following result is obtained after the designed system is switch on.

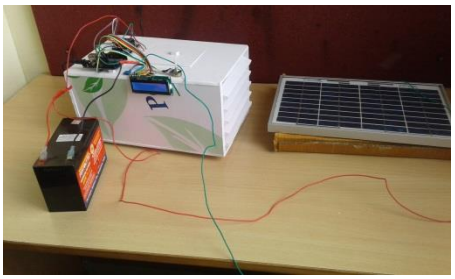


Table 1

SET TEMPERATURE (℃)	COLD TEMPERATURE (℃)
18	20
20	25
30	35
40	37

VII. CONCLUSION

A solar thermoelectric air cooling system is designed which can be better for use in remote areas where unavailability of electricity is there and also the designed system is good for cooling small area with good efficiency. It is shown in the result that the above designed system is cooling the desired space from the ambient temperature of 35°C to final temperature of 18°C.Thus the designed system attains the temperature difference of 17°C, which can further improved by using more number of peltier module. As the system is eco-friendly it can be better alternatives for the future use as considering the depleting of non-renewable sources.

VIII. FUTURE SCOPE

The units of energy production can be developed in the various regions by these days the society face the energy crisis and also the harmful effects of pollution. The thermoelectricity generate electricity without any harmful effects. Thermoelectric devices achieve an importance in recent years and in future it still increase a variable solution for application such as spot cooling of electronic components, remote power generation in space station and satellites etc. The low cost, eco friendly nature are enough inputs to motivate the engineers for their implementations in almost all the suitable application of daily life in near future.

IX. ACKNOWLEDGMENT

Any project completed successfully gives a great sense of achievement and satisfaction. The project would remain incomplete if the people who made it possible and whose constant guidance and encouragement go without mention.

We wholeheartedly thank our Guide, **Dr. Vagdevi S** Dean Academics, Professor and Head, Department of Electrical & Electronics, GSSSIETW, Mysuru for having shared a genuine desire to make a positive contribution to address the challenges associated with every element of the project.

X. REFERENCES

[1] Riffat, S. B., Qiu, G. (2004). Comparative Investigation of Thermoelectric Air-Conditioners versus Vapour Compression and Absorption Air-Conditioners. Applied Thermal Engineering, 24, 1979–1993.

[2] Abdullah M. 0., J. L. Ngui, K. Abd.Hamid, S. L. Leo, and S. H. Tie, (2009).Cooling Performance of a Combined Solar Thermoelectric Adsorption Cooling System. An Experimental Study, Energy Fuels, 23. 5677-5683.

[3] Luo, D., Zhao, F. Y, Yang, H. X., & Tang, G. F. (2015). Thermoelectric mini cooler coupled with micro thermosyphon for CPU cooling system. Energy, 83, 29-36.

[4] Gillott Mark, Liben Jiang and SaffaRiffat, (2010).An investigation of thermoelectric cooling devices for small-scale space conditioning applications ill buildings, International Journal ofEnergy Research, 34. 776-786.

[5] Bansal, P.K.Martin, A (2000).Comparative Study of Vapour Compression, Thermoelectric and Absorption Refrigerators. International Journal of Energy Research, 24, 93–107

[6] Mayank Awasthi, K V Mali (2012), —Design And Development Of Thermoelectric Refrigerator, International Journal of Mechanical Engineering and Robotics, Vol. 1, No. 3, October 2012.

[7] Manoj kumar Rawat,et al. "Developed and experimental study of solar powered Thermoelectric Refrigeration system" July-august 2013 ,International Journal of engineering research and application page 25432547.

[8] Rao, A.M., et al., "Properties of Nano-structured OneDimentional and Composite Thermoelectric Materials", MRS Bulletin, March 2006, Vol. 31, No. 3, pp. 218 – 223

[9] Zhang, L.Z. and Niu, J.L., 2002, "Performance comparisons of desiccant wheels for air dehumidification and enthalpy recovery", Applied Thermal Engineering, Vol. 22, pp.1347-1367.

[10] Riffat and Guoquan, "Comparitive investigation of thermoelectric air-conditioners versus vapour compression and absorption air- conditioners", Journal of Applied Thermal Engineering, vol .24 , pp. 1979-1993,2004.

[11] Huang.B, C.J. Chin and C.L. Duang, "A design method of thermoelectric cooler", International Journal of Refrigeration 23, pp. 208-218,1999

[12] Edson and jose, DW,"Performance analysis of a thermoelectric air conditioning", Applied Thermal Engineering, vol. 9-10, pp. 9-11,2004

[13] Sujin ,Vora and Seetawan, "Analyzing of Thermoelectric Refrigerator Performance", Proceedings of the 2ndInternational Science, Social-Science, Engineering and Energy Conference, pp. 154–159,2010

[14] Alfred Erhard and Erich Hahne, "Test and simulation of a solar-powered absorption cooling machine", Energy. Vol. 59, No. 4-6, pp. 155-162, 1997

[15] A. De Francisco, R. Illanes, J. L. Torres, M. Castillo, M. De Blas, E. Prieto and A. García, "Development and testing of a prototype of low-power water–ammonia absorption equipment for solar energy applications", Renewable Energy, vol. 25, No. 4 , pp. 537-544, 2002.

[16] Adnan SOzen and Mehmet Ozalp, "Solar-driven ejector-absorption cooling system", Applied Energy, vol. 80, No.1, pp. 97-113, 2005.

[17] Velmurugan V., RajaBalayanan S.R., Surendhra Babu K. and Sakthivadivel D., "Investigation of a Novel Solar Powered Absorption Refrigeration System with Solar Point Collector", Research Journal of Chemical Sciences, Vol.1(7), pp. 51-56, 2011.

[18] Dr. Nimai Mukhopadhyay and ER. Someshwar Chowdhury, "Performance Analysis of Solar Assisted Cascade Refrigeration System of Cold Storage System", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, No.4, pp.1248-1254, 2013.

[19] ASHRAE Handbook. Fundamental volume,1993.

[20] Hara T, Azum H. Cooling performance of solar cell driven, thermoelectric cooling prototype headgear. Applied Thermal Engineering 1998; 18.1159–69.