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Design and Fabrication of Solar Powered Compact Air Cooler

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Abstract. Cooling may be defined as the process of achieving and maintaining a temperature below that of surrounding. An air cooler works on the principle of evaporative cooling wherein evaporation of water is used to cool the air. The domestic air coolers, which are cost effective, play a positive role in providing human comfort during hot weather. However the performance is dissatisfactory in the high humid regions and is not suitable for asthma patients. To overcome these problems our project will be good alternative for the present air coolers. The purpose of this project is to design thermoelectric air cooling using peltier effect with a portable arrangement at reasonable price. Our project mainly deals with renewable and eco-friendly type air cooler and the system works on both the solar energy and Household Electricity. The most important part of the system is the peltier module .The peltier module works on the principle of peltier effect. The potential difference given to the module creates a temperature difference which is the reverse of seebeck effect. The cold air gives cooling on one side and the hot air is dissipated out to the atmosphere by dc fan. The main advantage of this system is that it is a renewable energy based system, no electric charges in terms of cost, simpler and less costlier. The main purpose of this method is to provide air cooling to the remote areas where power supply is not possible.
Keywords: Solar Energy, Peltier module, House hold electricity, DC fan.

1. Introduction

Thermo Electric Module:A thermoelectric (TE) cooler, sometimes called a thermoelectric module or Peltier cooler, is a semiconductor-based electronic component that functions as a small heat pump. By applying a low voltage DC power source to a TE module, heat will be moved through the module from one side to the other. One module face, therefore, will be cooled while the opposite face simultaneously is heated. If a typical single-stage thermoelectric module was placed on a heat sink that was maintained at room temperature and the module was then connected to a suitable battery or other DC power source, the "cold" side of the module would cool down. At this point, the module would be pumping almost no heat and would have reached its maximum rated "Delta T (DT)." If heat was gradually added to the module's cold side, the cold side temperature would increase progressively until it eventually equalled the heat sink temperature. At this point the TE cooler would have attained its maximum rated "heat pumping capacity" (Q max). The Seebeck, Peltier, and Thomson Effects, together with several other phenomena, form the basis of functional thermoelectric modules. In 1821, Thomas See-beck discovered that there is a continuous flow of current when two wires of different materials are joined together and heated at one end and French physicist Jean Charles Peltier module discovered Peltier effect in 1834.He found that the application of a current at an interface between two dissimilar materials results in the release of heat without using of ozone depleting chlorofluorocarbons. This gave an alternative to the conventional air conditioners. The thermoelectric phenomenon has been discovered more than 150 years ago, but they are being tested to use commercially in recent decades, rectification is not possible.

Thermo-Electric Effect:Direct conversion of electric voltage to temperature differences and vice versa with the help of a thermocouple is known as thermo-electric effect. The voltage is created by thermoelectric device due to the difference in temperature on each side. Therefore, the voltage applied causes the heat transfer from one side to other creating a temperature difference. According to the scale of atom the applied temperature difference is caused by the electrons or holes they diffuse from hot side to cold side. The thermoelectric effect can used in generating electricity, for measuring temperature or it can be used in changing the temperature of the objects. The thermoelectric devices are for temperature controllers because the heating and cooling depends upon the polarity of the applied voltage. See-beck Effect :The electricity produced in the junction of different types of wire due to conversion of heat is known as See-beck effect. In this effect the voltage and thermoelectric EMF is created due to the temperature difference of two different metals or semiconductors which causes a continuous flow of current in the conductors. The See-beck effect used in a thermocouple for measuring the temperature difference by setting one end to a known temperature. When more than one thermocouple are connected in series it is called thermopile. Peltier Effect: It occurs due to the presence of heating or cooling in the electrified junction of two different conductors with the change in temperature is known as Peltier effect. The effect will be stronger when two different semiconductors are used instead of conductors in the circuit. Thomson Effect: The absorption of heat occurs due to the passing of electric current through the circuit has a temperature difference along its length. When the heat transfer is forced on the production of heat associated with the electrical resistance to currents in the conductors.

Solar Energy: Residential and commercial air-cooling consumes over 15% of all electric energy generated and creates two sources of environmental pollution: one is the ozone-depletion effect of traditional refrigerants belonging to CFC groups, and another is the emission of greenhouse gases connected with the electricity generation. Additionally, with energy cost rising constantly, industry is looking to reduce electricity expenses as a means of lowering their fixed costs in order to stay competitive. As a kind of renewable energy, solar energy is paid more and more attention in the world. Solar system can be classified into two categories; those are thermal systems which convert solar energy to thermal energy and photovoltaic systems which convert solar energy to electrical energy. However, more solar radiation falling which falling on photovoltaic cells is not converted to electricity, but either reflected or converted to thermal energy. This method leads to a drop of electricity conversion. In summer (hot) and humid conditions feel uncomfortable because of hot weather and heavy humidity. So it is necessary to maintain thermal comfort conditions. Thermal comfort is determined by the room's temperature, humidity and airspeed. Radiant heat (hot surfaces) or radiant heat loss (cold surfaces) are also important factors for thermal comfort. Relative humidity (RH) is a measure of the moisture in the air, compared to the potential saturation level. Warmer air can hold more moisture. When you approach 100% humidity, the air moisture condenses – this is called the dew point. The temperature in a building is based on the outside temperature and sun loading plus whatever heating or cooling is added by the HVAC or other heating and cooling sources. Room occupants also add heat to the room since the normal body temperature is much higher than the room temperature. Need of such a source which is abundantly available in nature, which does not impose any bad effects on earth. There is only one thing which can come up with these all problems is solar energy.

Materials Required

- Solar panel (20w, 12v)
- Solar controller (12v)
- Peltier module (tec1-12706)
- Heat sink
- Battery (12v 7.5ah)
- Power supply box
- Cooling pad

Dimensions

TABLE 1. Specification of the Air Cooler

S. NO	Parameters	Dimensions(mm)
1	Length	335
2	Width	340
3	Height	460
4	Material	(22 Gauge) Cast Iron Sheet
5	Thickness of the plate	2

TABLE 2. Specification of the Solar Panel

S. No	Parameters	Dimensions(mm)
1	Length	360
2	Width	290
3	Power Generating	20W

TABLE 3. Design Parameters of Copper Heat Sink

S. No.	Parameters	Dimensions(mm)
1.	Length	160mm
2.	Width	160mm
3.	Thickness	2mm
4.	Weight	22 (Gauge)
5.	No of Vertical Plates	9 plates

2. Working

- In the peltier module, when the current flows through the junction between two conductors high temperature is created in one junction and low temperature is created in another junction.
- The peltier module transfer the low temperature to the heat sink. Then the low temperature air is sucked out with help of blower fan.
- The water flows over the foam with the help of water pump, and it increasing the cooling effect.

- The solar panel is connected with the solar controller and battery, the switch is used to change the power supply mode either solar or house hold electricity.

LAYOUT

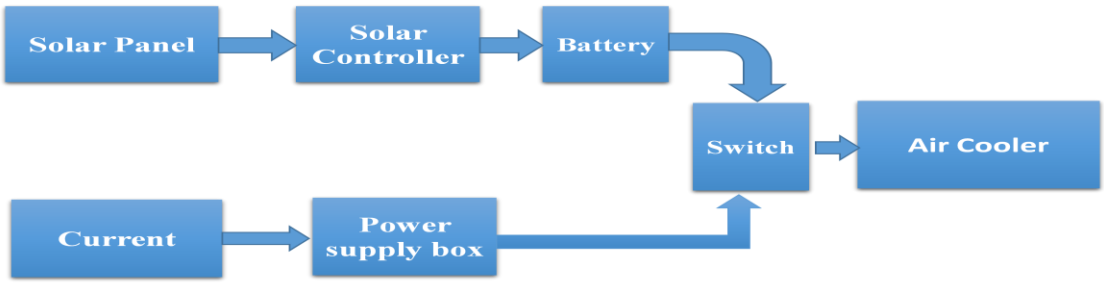

Figure 1 Layout

3D MODEL OF AIR COOLER

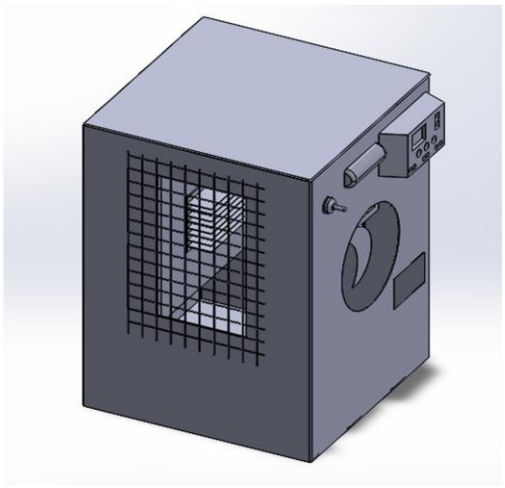

Figure 2 3D Model of air cooler

DESIGN FOR OUTER FRAME

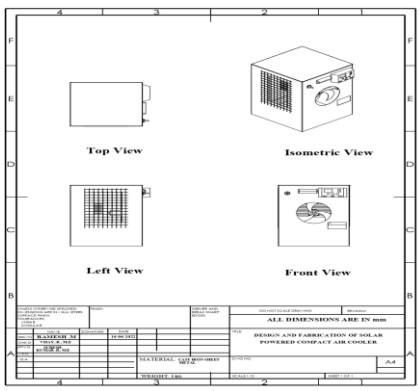

Figure 3 Design for outer frame

3. Advantages

- TE cooler has so many advantage like no moving parts, so wearance is negligible.
- Low power consumption.
- Occupies less space.
- In our project due to using both cooling effect of peltier module & water circulated cooling pads the humidity will decreases, so it does be harmful for asthma patients and for elders peoples.
- I will not be noisy

4. Applications

- It can be used for remote places where electric supply is not available.
- It can be use trekking place.
- It can be used in schools and offices.

5. Conclusion

Thermoelectric Air-Cooling system is eco-friendly and has noiseless operation compared to traditional air cooling systems. Moreover, this system is portable, and due to its compact design, this can be used in small spaces. Instead of using present air cooler we can use this portable air. Power consumption is lesser than the present air cooler. Space consumption is lesser. Our project is convenient to port from one place to another place. The primary design goal of our project is to make a solar powered compact air cooler.

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