

Design and Development of BLDC Motor Operated Solar Based Peltier Cooling

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Abstract - The air cooling techniques that are present currently are evaporative coolers, air conditioning, fans and dehumidifiers. But running these products need a power called electricity. The producing of electricity is ultimately responsible for hot and humid conditions i.e. global warming. Due to the hotness of the weather and the increasing humidity in the environment the usage of Air Conditioners and dehumidifiers has increased significantly. These systems are most of the time not suitable for villages due to longer power cut time and high cost of products. Solar power systems being considered as one of the way towards more sustainable energy systems, considering solar-cooling systems in villages would comprise of many attractive features. In the current scenario where peak demand of the electricity is increasing even after more reliable and efficient working of the equipment. The solar energy usage techniques are still not used upto the level in the residential homes, schools, offices. In addition to this, usage of BLDC motor for the purpose gives us the significant amount of decrement in the power consumption as low as the power consumption of a mobile charger. The use BLDC motor gives us the freedom of speed change and the noise free operation in addition. The peltier cooling device in the assembly helps to boost the cooling capacity. This paper reviews solar powered BLDC operated and peltier air cooler for residential and industrial applications.

Key Words: BLDC motor, Centrifugal fan, cooling pad, PMMC motor, Solar battery C10, solar energy.

1. INTRODUCTION

This paper shows the comfort conditions achieved by the device for the human body. In summer (hot) and humid conditions we feel uncomfortable because of hot weather and heavy humidity. So it is necessary to maintain thermal comfort conditions for living. Thermal comfort is determined by the room's temperature, humidity and air flow in the room. Radiant heat (hot surfaces) or radiant heat loss are also equally important factors for thermal comfort. Relative humidity is a measure of the moisture in the air, compared to the potential saturation level of it. Warmer air can hold more moisture than dry air. When

you approach 100% humidity, the air moisture condenses and is called this is as dew point. The temperature in a building is based on the outside temperature and sun loading addition to 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 temperature of body is much higher as compared to the room temperature. There is a need of such a source which is abundantly available in nature, which does not impose any bad effects on earth. Only one thing which can come up with solution for all these problems is solar energy.

2. PROBLEM STATEMENT

The production of electricity is mostly responsible for hot and humid conditions i.e. global warming. As in below shown chart it is clear that major part of electricity is produced by coal (fossil fuel). Fossil fuels also contain radioactive materials, including uranium and thorium, which are released into the atmosphere, which contribute to smog and acid rain, emit carbon dioxide, which may contribute to dangerous climate change. BLDC is more reliable than conventional motor. Single phase induction motor is not self-starting, while this problem is not occur in BLDC motor. Induction motor requires more starting power than BLDC motor. There is no brushes and commutator errors [1]. BLDC motor eliminates ionizing spark from the commutator and overall reduction of electromagnetic interference. [4]

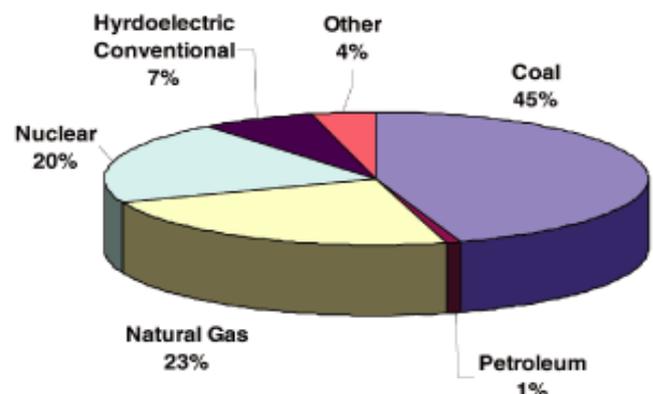


Fig -1: Production of electricity from different energy sources

3. PROPOSED SOLUTION

There is a need of such a source which is abundantly available in nature, which does not impose any bad effects on earth. Only one thing which can come up with solutions to these all problems is solar energy. [2]

3.1 Objective of the Project

To be aware of nonconventional energy source usage to reduce environmental pollutions. Provide solution for power cut problems in villages. With replacement of existing costlier and high energy consumption cooling methods. Reducing the overheads creates by the electricity pump to lift the water when the voltage supply is low. Addition to this reduce the electricity bills and minimizing the need of season wise servicing.

4. WORKING METHODOLOGY

This assembly mainly consist of two sections:

4.1 Solar Energy Conversion

Solar energy conversion is done by using rectifier and charge controller. As sun light falls on solar panel, which converts solar energy into electrical energy by photoelectric effect. This electrical energy stored in the battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents it from overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may feature a safety risk. The stored energy directly can use for DC loads by using rectifier. [3]

4.2 Cool air generation by centrifugal fan

This converted energy is used to run the centrifugal fan. This fan covered with cooling pads, through which water is passed at a specific rate flow. As the fan sucks the hot air through cooling pads, the heat transfer occur between air and water thus generated cooled air enters into the room.

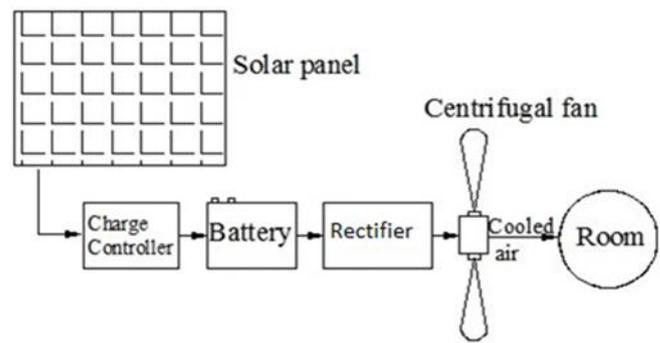


Fig -2: Solar powered air cooler

The concept is driven by solar energy. Components involved in this concept are solar panel, battery, charge controller, battery, rectifier, blower, and cooling pads. Solar panel is employed to convert solar energy into electrical energy by way of photovoltaic effect. The generated electrical energy is supplied to the battery for storage purpose through charge controller which prevents it from power fluctuations. As DC blower is used for cooler, so need to convert DC load from the battery to DC load by the help of rectifier. Rectifier converts AC load to DC. Load, now DC power can be supplied to the blower. This blower is surrounded by the cooling pads through which continuous water supply is provided. When the blower is turned on, blower sucks atmospheric air into the cabin through the cooling pads, mean time heat transfer occur between water and air, so the cold air enters into the room thus providing required thermal comfort conditions for living. PMMC (Permanent Magnet Moving Coil) is used for pumping the water to the top.

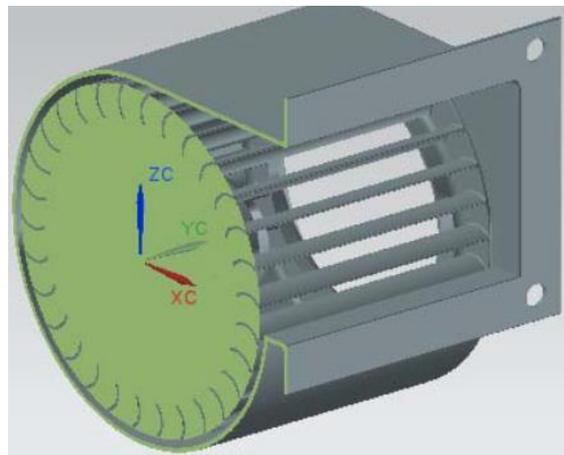


Fig -3: Sectional view of the fan

Solar cooler provides cool air for human comfort. For increasing the cooling efficiency, we use various mechanical devices such as Peltier device in solar cooler to provide extra cooling. Peltier device. These device has capacity to cool water. Peltier device may itself decrease its temperature upto -15°C . So extra cooling air is supplied for and thus provide comfort for human being. Thermoelectric cooling uses the Peltier effect to create the heat flux between the junction of two different types of

the materials. A Peltier cooler , heater or thermoelectric heat pump is a active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, which depends on the direction of current. Such a device is called as Peltier device. [5]

The ambient temperature, versus time of the day in which the experiment was carried out is presented in variations of ambient temperature which found in between 26°C to 33.4°C. The highest ambient temperature is obtained at 1.00 p.m. i.e. 33.4°C. In general, the input temperature was found to be increasing from the morning to afternoon and then it is decreasing with little variations during evening. The maximum temperature difference was found to be 42 °C at 12.30 p.m. The temperature difference was increasing from morning to a peak value at noon and then was decreasing in the afternoon until sun sets, in a similar manner as the solar radiation and energy. The maximum temperature difference found to be about 40°C at 2.00 p.m. [9]

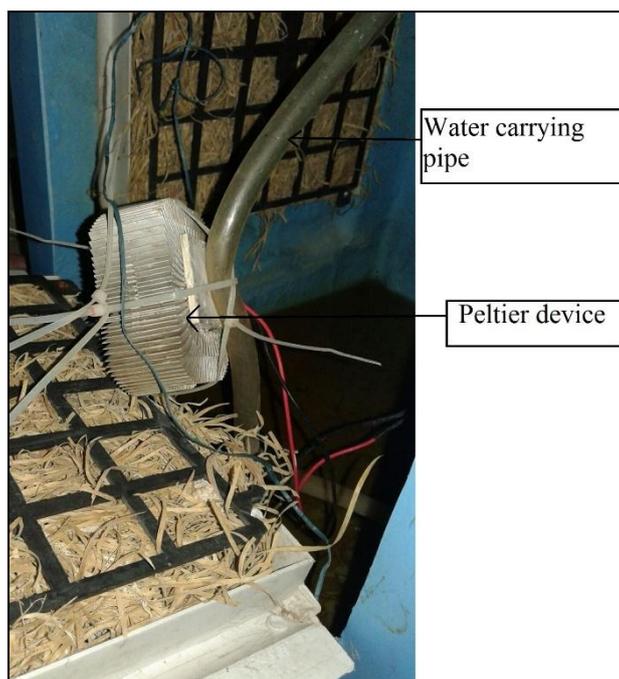


Fig -4: Peltier device

5.1 RESULT AND DISCUSSION

The output of the project is to achieve the comfort level for the human living in the rural areas where it is difficult to be dependent on the electricity for all the time. That is room temperature up to 25°C or less and relative humidity of 60%. Earlier in the traditional cooler, pump was used to lift the water up but in above stated concept of solar cooler the water flows down from the higher potential to downwards making the cotton and cooler grass wet. Thus this wet grass makes the air cool; even if the potential of water get lowers it does not create any

kind of noise in the smooth working of the solar cooler. Therefore from the above mentioned facts we can conclude that the concept of solar cooler is so cost effective that it do not creates the overheads of maintenance or purchasing of pump neither it has to be sent for servicing for every season. So, we can say that the concept of solar cooler sounds good and economical hence almost every class of our society especially rural classes can bear its expenses.

6. CONCLUSIONS

Comparing the cost of this product with the available products in the market is solar product appeals better and affordable by common people. This solar product perfectly suited for villages, schools and offices and electrical crises facing 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, BLDC motor employment for noise free operation and peltier cooling booster. It is eco-friendly and natural electricity saver. Durability of the product is more which minimizes the cost. No electricity is used for assembly consumption, so this product saves the energy and saves environment from getting polluted.

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