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Design and Implement Power Efficient Aero-Refrigerant Cooling System

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Abstract - *The working principal of evaporative cooler was analyzed for heat and mass transfer performance of evaporative cooler. The impact of face velocity and spray quantity in the evaporative cooler for heat transfer performance requires large amount of water. While on the other hand Air Conditioners uses cooling gas instead of water. The demand for air conditioning increased greatly during the last decade and hence air conditioners consume large amount of electric power. Most of the electric power is producing by fossil fuels but the reserves of fossil fuels are degrading gradually in Environment, so there is a serious need to find alternative ways to condition the room air. One of the methods, which replace air conditioner or decrease load on the air conditioner is the Evaporate air cooler. But it uses a lot of water and not so good as it also creates Humidity. Thermoelectric devices provides solution to such problems. Thermo electric devices are very small in size and requires less power for working as compare to Air Conditioner. This project begins with fundamental concepts of Thermoelectric Peltier module for cooling purpose. Thermoelectric Peltier provides cooling on it's one face and heats up on another when the supply is provided to it. By using Thermoelectric Peltier Module for cooling purpose the amount for usage of water in Evaporate Air Cooler is also reduced as the amount of water for cooling purpose is going to reduced. It is also efficient in power consumption as compare to Air Conditioner. This system is using Thermoelectric Peltier Module for cooling the water, by doing this the system requires less water for cooling operation. Temperature sensor helps to continuously monitor and maintain the room temperature.*

Key Words: Cooling, Thermoelectric, Power Efficient.

1. INTRODUCTION

Nowadays global warming is increasing day by day as the use of Air Conditioners is increasing for Human Comfort and for that, we have to face harmful effects. Human beings throughout many years have tried various methods to get comfort in different climatic conditions. This cooling system uses water for cooling operation by taking the concept of Evaporative Air cooler but in this system, the quantity of water used is very less than Evaporative Air Cooler. This system cools the water by passing it through the cooling unit. The cooling unit is designed by using Electronics Components and does not use any refrigerant Fluid.

2. Literature Survey

2.1 Demand Response from the Control of Aggregated Inverter Air Conditioners. [1]

A virtual energy storage system (VESS) model that encapsulates the room with an inverter AC was established based on the electric model of an inverter AC and the thermodynamic model of a room. Based on the VESS model, a virtual state of charge (VSOC) priority-based load reduction control method with temperature holding and linear recovery strategies was proposed. The VSOC priority based control was designed to decrease the negative impact of load reduction on customers' thermal comfort from the perspective of the whole AC population. The temperature holding strategy was designed to reduce the electric power of an AC while ensuring that the indoor temperature is always below the allowable limit. The linear recover strategy was proposed to reduce the load rebound after load reduction.

2.2 Design and Development of Portable Air Conditioner. [2]

In Air conditioner the only source of power is a 23-watt fan which needs less energy than the electric bulb in your room and can be run for a virtually unlimited period on an inverter or a car battery to bring down the room temperature by at least seven degrees centigrade. The portable Air conditioner system satisfies the need of user at the most economical cost. The portable air conditioner is having very low manufacturing and maintenance cost. Its cooling power is comparable to wall air conditioner.

2.3The Comparison Between Traditional Air Conditioning System and Wearable Cooling/Heating Devices. [3]

Human body needs to be maintained at specific temperature limit. This temperature control is done by a proper cooling/heating system. Till now majorly used cooling/heating system is Vapour Compression refrigeration system (V.C.R.S) based devices. These devices use a Vapour Compression refrigeration cycle in which a refrigerant flows and carries heat from low temperature region and rejects heat at high temperature region or vice-versa.

A recent study shows that traditional air conditioning system is one of the basic necessities of living. Air conditioning consumes a lot of power to operate and also cause harm to

the environment, lacks portability and unable to operate at extreme conditions where proper supply of electricity is not possible. Due to all these limitations of traditional air conditioning system, new devices has been developed which have potential of eliminating these limitations of traditional air conditioning systems.

2.4 Performance Improvement Techniques for Evaporative Air Cooler. [4]

Human beings throughout the ages have tried various methods to achieve comfort in various climatic conditions. The very basic type of cooling system was initially developed thousands of years ago in Persia presently known as Iran and was named as "badger" in traditional Persian language and bad means air, "gir" means catcher together known as "Wind Catcher" commonly. Central Iran shows large diurnal temperature variations and arid climatic conditions and to overcome this the air catcher were used which had an opening on the roof top which trapped the air flowing above and send it to the subterranean water and discharged the cooling air into the building. Now this air catchers have been replaced by evaporative air cooler and they are being used very widely.

3. Components and Description

3.1 Peltier Module: -

The Peltier elements, which are also called thermoelectric modules or TEC, are an electrically operated heat pump. Here, energy in the form of heat is transferred from one side of the module to the other side and has to be dissipated there. The Peltier module is based on the so-called Peltier effect.

Fig.1: 12715 Peltier Module

3.2 DC Motor: -

A DC motor is an electric motor that runs on direct current. A . The DC motor is 30% more efficient than AC motors due to the secondary magnetic field being generate from the lasting magnets slightly than copper windings. It prefer copper winding.

Fig.2: DC Motor

3.3 DC Water Pump: -

A pump is a device that moves fluids or at times slurries, by mechanical act. DC powered pumps utilize direct current from motor, battery, or solar power to shift fluid in a variety of behavior and small in dimension and size.

Fig.3: DC water pump

3.4 ATMEGA328p Microcontroller:- ATMEGA328P is high performance, low power controller. It is the most popular of all AVR controllers as it is used in ARDUINO boards. The coding language used for ATMEGA328p is simple to write for Performing Operations.

Fig.4: ATMEGA328p

3.5 TSOP 1738:-

TSOP1738 is a commonly used IR receiver for Infrared PCM remote control systems. It is used in TVs, DVD Players, Burglar Alarms, Home-automation etc. This component is built with PIN Diode.

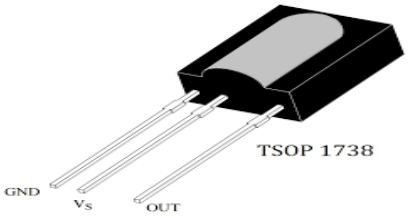

Fig.5:TSOP-1738

3.6 Relay:-

A relay is basically electro-mechanical switch. It reacts as Automatic switch to control (just ON/OFF) large voltage load by using low voltage signal. A Relay can be referred to as AC or DC Relay by referring the supply used to energize electromagnetic coil placed in the Relay.

Fig.6: Relay

3.7 Power Supply: -

A power supply is an electrical device that supply electric power to an electrical load. The main function of a power supply is to convert electric current from a source to the right voltage, current, and frequency to power the load.

Fig.7: Power supply

3.8 DC Fans:-

The direct current fans, or DC fan, are power-driven with a potential of fixed value such as the voltage of a battery. Characteristic voltage ideals for DC fans are, 5V, 12V

Fig.8: DC Fan

4. Working: -

This is a system that is to be designed to make the system power efficient and reduce the usage of water. For achieving this the system is designed in such a way that it uses Thermoelectric Peltier which is the basic component of the cooling unit. ATMEGA 328p microcontroller IC by which the operation of turning the system ON/OFF, temperature control can be done. DC Motor, DC water pump, DC Fans, Copper/Aluminium pipe, water container, solar panel, TSOP 1738,Relay, IR Remote The DC Motor is used in it over AC Motor as it can also be powered by using Solar panel and the DC water pump as well for water pumping process. As mentioned the solar panel is available here to provide the power to the system. the Copper/Aluminium pipe is used to make the inner covering of the body through which the cooled water is going to pass and then the water is kept passing through it by the pipe which is connected to the Peltier Device Cooling Unit and the water container. The water container is made up of Thermocol as it helps to keep the water cool. Temperature sensor is used to continuously monitor the temperature of the output air. The system gets the required power for working principle from the power supply or by the introduced solar panel. The output of the power supply is suitable to run the ATMEGA Micro-Controller circuitry and also for the working of the Peltier device cooling unit, DC Motor, DC water pump, DC Fans. The ATMEGA Micro-Controller Circuitry gets the input from the TSOP 1738 for Turning ON/OFF operation of the system by triggering the Relay, it also takes analog input from the Temperature sensor to monitor the temperature of outlet air for maintaining the temperature. ATMEGA Micro-Controller Circuitry controls the supply of power to the Peltier Device so as to keep the cooling process in such a way that the required temperature is kept steady as well as the supply of DC Motor and DC water pump. The Cooling process of water takes place in the Peltier Device Cooling Unit and the flow of water through it is continuous, the Copper/Aluminium pipe is used for the medium by which the water flows and gets stored in the Thermocol made water container as Thermocol made container is good for keeping the water chilled. The pipe is placed in such a way that it forms a structure which covers the inner part of the system just before the outer body of it.

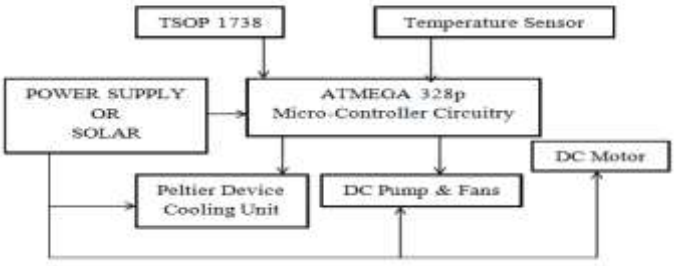

Fig.9: Block diagram of cooling system

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