Thermo-Electric Energy Conservator

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Abstract— The conventional cooling systems which uses compression technique to cool the surface has many disadvantages like risky CFC filling, the leakage of CFC to the atmosphere and high power consumption. These systems are in mobile and hazardous. Conventional water boils which uses electric heating coils to boil the water consumes high power and required more space. The demerits of these systems led us to innovatively invent a system which couples both heating and Cooling together. Here we make use of peltier module as the basic block. Both the heat and cold liberated from the module are wisely transformed in to useable form. With the help of microcontrollers and other electronic circuits, we increase the efficiency of the system. We also incorporated safety measures to make our product a cost efficient and a reliable one.

Key words: Peltier Module, Cooler, CFC

I. INTRODUCTION

Conventional cooling systems such as those used in refrigerators utilize a compressor and a working fluid to transfer heat. Thermal energy is absorbed and released as the working fluid undergoes expansion and compression and changes phase from liquid to vapor and back, respectively. Semiconductor thermoelectric coolers (also known as peltier coolers) offer several advantages over conventional systems. They are entirely solid-state devices with moving parts; this makes them rugged, reliable and quiet. They use no ozone-depletion chlorofluorocarbons, potentially offering a more environmentally responsible alternative to conventional refrigeration. They can be extremely compact, much more so than compressor-based systems. Precise temperature control (<=0.1 degree C)can be achieved with peltier coolers. However their efficiency is low compared to conventional refrigerator. Thus, they are used in niche applications where their unique outweigh their low efficiency. Although some large-scale applications have been considered (on submarines and surface vessels), peltier coolers are generally used in applications where small size is needed and the cooling demands are not too great, such as for cooling electronic components (Astrain and Vian 2005)- objective of this project is to design thermoelectric refrigerator utilizer peltier effect to refrigerate and maintain a specified temperature, perform temperature control in the range 5 degree C to 25 degree C. Interior cooled volume of 5 liter and Retention for next half hour. We are also using heating property of peltier for heating the water. Basically our fridge has two functions, one is common function of all refrigerator that is cooling and other is to heat the water for heating purpose we are using a tank, aluminium tube, water level indicator and the main component required in-order to carryout heating process. It has several advantages such as less space required, low power consumption etc

In [1] paper which are mainly used in the field of refrigeration air conditioning, food preservation, vaccine storages, medical services and consequently more release of CO2 all over the world which it is contributing factor of global warming of climate change. Thermoelectric refrigerator is new alternative because it can convert waste electricity into useful cooling, is expected to play an important role in meeting todays energy challenges. And it is greatly needed, particularly for developing countries where long life and low maintenance are needed. But in this method compared to our proposed method here there is only cooling but in our method we are providing cooling as well as heating and is low of cost

In [2] the paper composes comprehensive review on existing technologies based on solar thermoelectric cooling applications. The primary objective of this portable solar thermoelectric refrigerator cum cooler is to provide a comparatively low cost alternative to existing cooling systems. Refrigerators in the confines of our homes are traditional, besides a portable refrigerator with a cooler which runs on solar energy as an alternative is a better choice. Solar energy is widely available as compared to other renewable energy sources. The system will utilize solar energy, where supply of conventional electricity is not dependable. Comparison has been made based of existing system and feasibility. The system works on peltier and seedbeck effect. Thermoelectric modules are incorporated for space cooling applications. The cold side of the thermoelectric module is utilized for space cooling, and the heat generated in the thermoelectric module is removed using heat sinks and arrangement of fans. The coefficient of performance of the system is a criterion for evaluating the performance of the cooling system. The absence of compressor leads to noise-less operation and lowered maintenance cost. It is an energy efficient initiative, consuming less power.The previous paper which make use of peltier module only uses it cold side for cooling. But here we make use of every possible outputs and convert it into usable form. We have invented a water boiler and cold freezer, which has additional features like temperature regulated fan, PIR controlled automated tap and also provide temperature controller by a display. Which has a automatic cutoff switch to prevent excess temperature. We have designed a temperature controlled circuit, which has variable cutoff point which can be set by the user

II. PROPOSED SYSTEM

The main building block of this project is the peltier module. We have 2 peltier modules. They are separately controlled by 2 controllers.1st temperature controller controls the freezer temperature and 2nd temp controller controls the boiler temperature

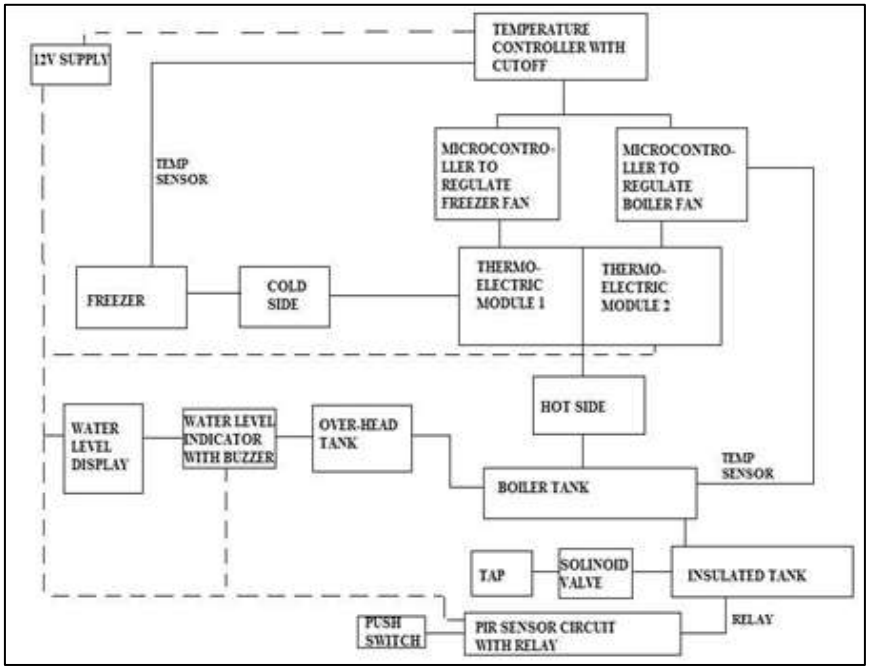

Fig. 1: Block diagram

The boiler tank is attached to a heat sink connected with a temperature regulator fan at the other end. When a critical temperature which is preset is reached, the relay attached to the microcontroller will turn of the peltier module. As the same time the relay will turn on the temperature regulated fan. The speed of the fan will vary according to the temperature. When the boiler tank gradually cools down, the microcontroller will detect it and then turn on the module

The output at the boiler tank is connected to insulated tank. This tank will maintain the temperature. Output of this is controlled by a 12V solenoid valve. A PIR sensor circuit activates the valve when body temperature is sensed. For safety an alternate push switch is placed under the tap where the glass is kept. The push switch controls the power to the PIR sensor. So only the glass is placed in position, the sensor activates the solenoid valve. This is done as part of safety

The overhead tank which provides water to boiler contains a water level indicator. In order to provide the dry run which might damage the peltier module. A led indicator circuit indicating different level of water provides good survivalence. The lower critical level of the water level indicator has a buzzer connected to it. Which will provide maximum safety against dry run

III. INTERNAL SYSTEM ARCHITECTURE

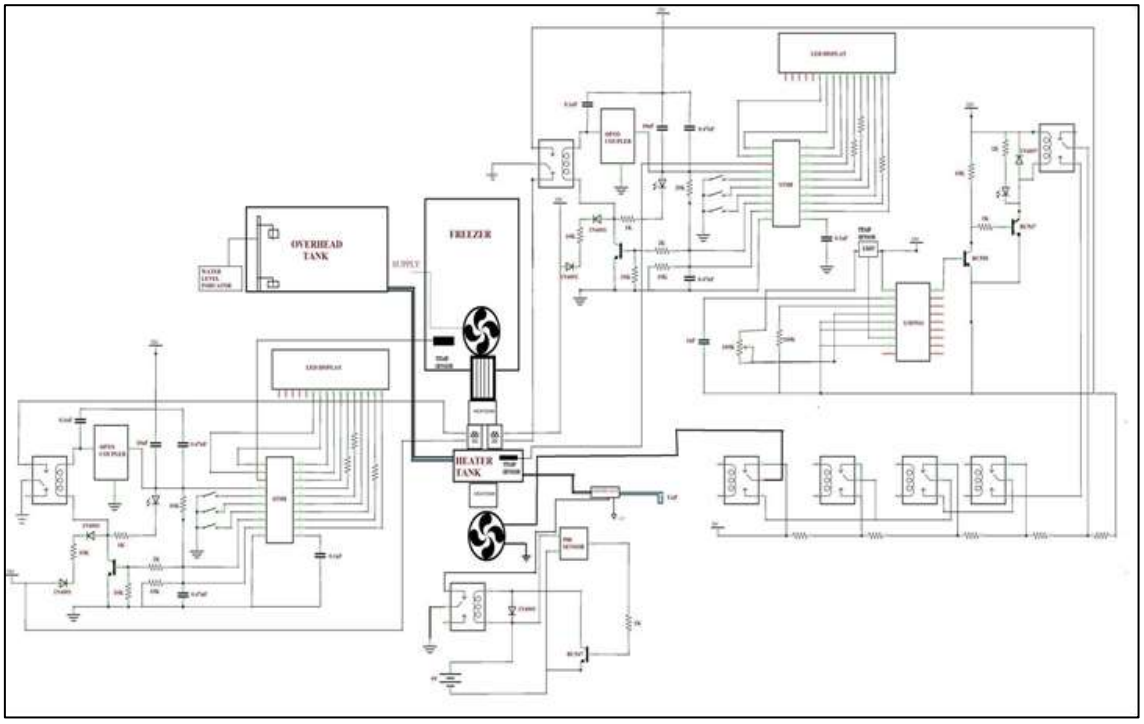

Fig. 2: Circuit diagram

The main part of the circuit is 2 peltier modules. They are separately controlled by two microcontroller based temperature monitor circuit The STM8S003F3/K3 value line 8-bit microcontrollers offer 8 Kbytes of flash memory, plus integrated true data EEPROM. They are referred to as low density devices in the STM8S microcontroller. The STM8S value line devices provides high performance, robustness and reduced system cost. Device performance and robustness are ensured by true data EEPROM supporting up to 100000 write/erase cycles, advanced core and peripherals made in a state of the art technology at 16 MHZ clock frequency, robust I/O's, independent watchdogs with separate clock source and a clock security system. System cost is very low due to high integration level

The microcontroller circuit works on the basis of condition check once the circuit is opted to the hot or cold mode, the relay will be turned ON or OFF according to the temperature applied by the user. It consist of a temperature sensor and two 7 segment displays attached together to form the display unit. It also has three input switches, one to set the desired temperature and the other two is to vary the temperature up or down repeatedly. The microcontroller circuit which controls the heater part has a temperature controlled fan attached to the relay at the other terminal. So when a critical temperature is reached, the peltier module gets automatically cutoff by the relay at the same time the relay will turn ON the temperature controlled fan circuit
The other circuits of the project are explained separately

A. Auto Regulated Temperature Controlled Fan

The circuit works on the basis of the heat generated or initial condition, the fan will be OFF and when the heat of the transistor increases, the potential difference of the input voltage will decrease, as the result more current will flow to the circuit so as the heat increases, the speed increases. The increasing voltage is divided into 5 level, each levels are controlled by relays. So as the voltage increases the threshold level of voltage dedicated to each relay will change and thus the relay will start to conduct serially. So the 5 level speed fan will have maximum speed once all the relays start to conduct, when the heat at the transistor is maximum. Here the transistor is attached to the heat sink to monitor the temperature. The whole circuit works based on the heat received at the transistor. The main power supply to the auto-regulated fan is controlled by the second half terminal of the relay which is controlled by the microcontroller controlling the heater

B. PIR Sensor Tap

The tap for the hot water is made as an automatedOne, once the user places the hand near the PIR sensor the water automatically flow. The output of the PIR sensor is given to the relay of the 12V solenoid valve. So when the PIR sensor detects a human temperature, the solenoid valve will automatically change to one position. This tap is basically used to ensure maximum safety. Another safety mechanism used is that the power to the PIR sensor circuit is turned on only when a glass or cup is placed on to the push switch which is placed below the cup holder

C. Water Level Indicator

The water level indicator has two levels, one is the high level which indicates when the tank is about to over flows. The lower level indicates the minimum water level. Once the water is below the minimum level, a buzzer is activated to make aware the user to fill the tank with water

IV. CONTROLLER LOGIC

The microcontroller has 2 modes, C and H. the C indicates cool and H indicates hot. When the microcontroller is set to mode C, the logic of instruction favors the cooling applications. We can preset a threshold level, for example for 10 degree threshold, the relay will cutoff automatically once it reaches 10 degree. Another feature we have included is the user define temperature setting. In a user sets the temperature to 10 degree and press the set button, then the relay with peltier module will be active until the temperature becomes 10 degree. And when the desired temperature is attained, the relay will cutoff the supply. It will remain in OFF stage until the temperature again increases. As a result, the 10 degree will be maintained throughout

When the microcontroller is set to mode H, the logic of the instruction favors heating applications. We can preset a threshold level, for example for 40 degree threshold, the relay will cut-off automatically once it reaches 40 degree. Another feature we have included is the user define temperature setting. In a user sets the temperature to 40 degree and press set button, then the relay with 2 peltier module will active until the temperature becomes 40 degree. And when the desired temperature is attained, the relay will cutoff the supply. It will remain in OFF stage until the temperature is again decreases. As the result, the 40 degree will be maintained throughout

V. ADVANTAGES AND DISADVANTAGES

It is a solid state devices with no moving parts, Rugged, Reliable and quiet. No need of CFC hence we can reduce the depletion of ozone layer. Potentially offering a more environmental responsible alternative to conventional refrigerator. Extremely compact and easy to use and maintain.

Cooling capacity of peltier based refrigerator is less compared to conventional refrigerator. Not effective for large scale use.

VI. FUTURE SCOPE

- More innovation in the field of air conditioning and refrigerator speed
- Decrease in power consumption and energy lost during the refrigerator process

– More experiments and researches in the field of semiconductor thermo-electric modules can innovative more efficient equipment

VII. RESULT AND CONCLUSION

Thermoelectric modules are the future- hope to improve the air conditioning and refrigeration industry. Since governments are taking innovative steps to decrease pollutions. In future there is chance for the CFC compressed machines to be banned.

Project like these innovate the new developments in the thermoelectric semiconductor field. With further developments in these fields which has maximum energy conservation efficiency will be lose in the form of heat and power

Fig. 3: Temperature controlled by a display

Fig. 4: Freezer

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