Fabrication of Thermoelectric Refrigerator cum Oven

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Abstract

The project is to fabricate thermo electric refrigerator cum oven. In this project the heat of refrigerator cooling coil is used for heat the oven. The refrigerator is also used as oven. So it also works as oven and the waste heat of refrigerator cooling coil is used for heat the oven. It saves the electricity. As this way the heat is used for the cooking and this works as refrigerator as well as oven. It is pollution less project, made by using thermoelectric module. It supports for both heating and cooling. Hence it proves to be very helpful. Exhaust fan is attached to the system to spread the cooling to the surroundings. Micro controller reads the temperature sensor values which are connected to the thermoelectric plate. The temperature values displayed on the LCD.

Keywords: PIC microcontroller, Temperature sensor, LCD display, Exhaust fan, Thermo electric plate, SMPS.

1. Introduction.

Thermoelectric refrigerator also called as thermoelectric cooler module. Heat will moved through module from one side to other, by applying low voltage DC power source to the thermoelectric module. As a result, one face of module gets heated and other face will be cooled. Thermoelectric refrigerators and conventional refrigerators are governed by the laws of thermodynamics and both refrigeration systems are works on same principles but different in forms. Till now scientists have discovered, many laws effect are one of them. A Thermoelectric module is a solid state energy converter composed of two ceramic substrates that serve as a foundation from dissimilar semiconductor material (P-N type). Which on joining, they will appear thermally in parallel and electrical in series. This module can be used for cooling and heating. The cooling effect generated by TEM has various applications in thermal management and control of microelectronic devices. The study shows how the manufacturer's data for thermoelectric cooler as well as for thermoelectric generators can be used to extract parameter of the proposed model. The model could be helpful for analyzing the drive requirement of TECs and loading effect of TEGs. Another important application of proposed model is when the performance of the TEM needs to be analyzed under specific conditions such as heat leakage, non-ideal thermal insulation etc. Using the model can analyzed not only existing modules, but also specify an optimal module for a specific problem. The present model is compatible with PSPICE or other electric circuit simulators for DC, AC, and TRANSIENT simulation types and will thus be an excellent tool for solving problems of temperature control.

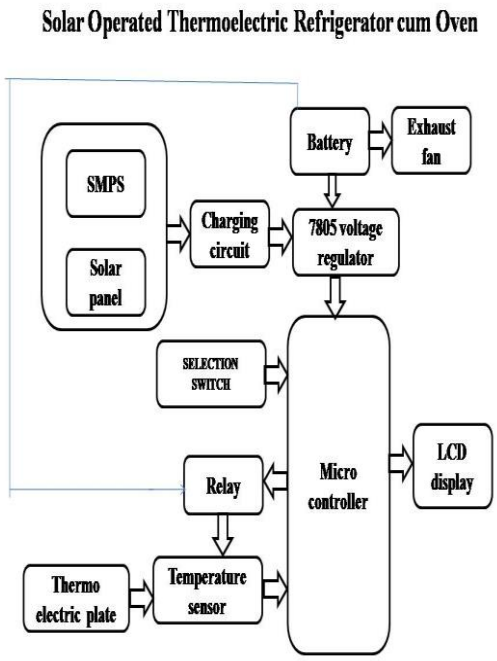
2. LITERATURE SURVEY

Jincan Chena et al.,[1]:-According to non equilibrium thermodynamics ,cycle models of single stage and two stage semiconductor thermoelectric refrigeration were experimentally investigated. By using the three important
Parameters which governs performance of thermoelectric refrigerator i.e. coefficient of performance (COP), the rate of refrigeration, and

the power input, development of general expressions performances of the two stage thermoelectric refrigeration system took placed. It was concluded that performance of thermoelectric refrigerator depends on temperature ratio of heat sink to cooled space. When this ratio is small, the maximum value of COP of a two stage
Thermoelectric refrigeration system is larger than COP of a single stage thermoelectric refrigeration system; however maximum rate of refrigeration is smaller than that of a single stage thermoelectric refrigeration system. Hence it is convenient to use single stage thermoelectric refrigerator when ratio is small. When temperature ratio is large two stage thermoelectric refrigerators is observed to be superior to single stage by both parameters i.e. maximum value of
COP and maximum rate of refrigeration.

X.C. Xuan ETal., [2]:
In this paper Two stage thermoelectric refrigerator was investigated with two design configurations. Two configurations were pyramid style and cuboids style as shown in respective figures. In pyramid style configuration top side is being coldest as current is unidirectional. In cuboid style configuration current can be alternated causing top and bottom side to be switched between heating and cooling mode. To obtain optimization methods other multi stage designs can be used. The point of maximum cooling capacity and maximum COP both were taken into consideration while investigation for optimization for the two stage TE coolers. It was concluded that value lies between 2.53 for both parameters that is optimum limit of ratio of number of
Thermo electric modules of two stages in pyramid style TE cooler and optimum limit of ratio of electric current between stages of cuboid style TE cooler. Maximum temperature difference of pyramid style cooler is greater than single stage cooler.

3. Implementation:



In this project temperature sensor and LCD are interfaced to the Micro controller. These sensors connected to the thermo electric plate, Micro controller reads the temperature sensor values which are connected to the thermoelectric plate. The temperature values displayed on the LCD. Thermo electric plate works with peltier effect, On applying DC using battery, the array of pellet having positive and negative charge carriers absorb heat energy from one substrate and eventually release it to the substrate at opposite side . In this process, cold surface appeared due to absorption of heat energy. This absorbed heat energy is being released to the opposite surface, becomes hot. Exhaust fan is attached to the system to spread the cooling to the surroundings.

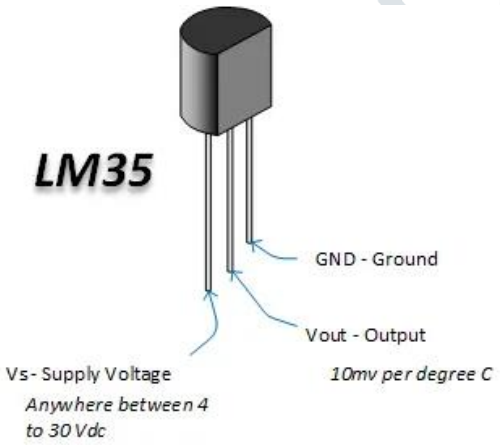
4. Related Work:

The brief introduction of different modules used in this project is discussed below:

PIC Microcontroller:

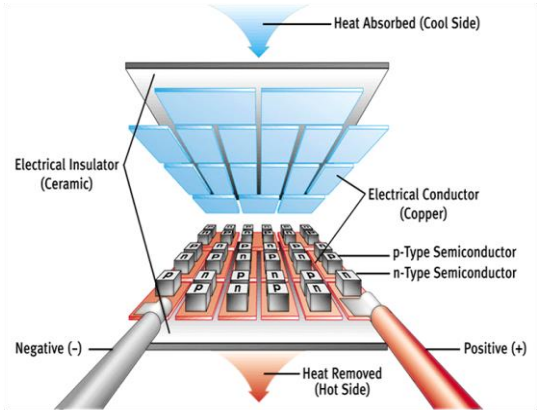
This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F872 features 64 bytes of EEPROM data memory, self programming, an ICD, 5 channels of 10-bit Analog-to-Digital (A/D) converter, 2 additional timers, a capture/compare/PWM functions and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

Temperature sensor (LM35):



The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.

THERMOELECTRIC PLATE:



PRINCIPLES OF OPERATION

The Peltier effect is named after Jean Charles Athanase Peltier who discovered it by accident while investigating electricity. In the eventful experiment, Peltier joined a copper and a bismuth wires together and connected them to each other, then to a battery. When he switched the battery on, one of the junctions of the two wires got hot, while the other junction got cold.

The Peltier effect is the heat exchange that results when electricity is passed across a junction of two conductors, and is a close relative of the Seebeck effect (effectively the same phenomenon in reverse, used in thermocouples used to measure temperature), and the Thomson effect (generation of electricity along a conductor with a temperature gradient). Sparing ourselves the maths, conduction electrons have different energies in different materials, and so when they are forced to move from one conductor to another, they either gain or lose energy. This difference is either released as heat, or absorbed from the surroundings.

When two conductors are arranged in a circuit, they form a heat pump, able to move heat from one junction to the other. Unfortunately, though, it's not always this simple, as the Peltier effect is always up against the Joule effect – the 'frictional' heating that results from electrons bouncing off the atoms. In most systems, this swamps the Peltier effect, and means that all that you get is a bit more heating at one junction, and a bit less heating at the other. Nonetheless, the Peltier effect has a lot of technological potential. It is very reliable, and since it has no moving parts, it rarely needs maintenance while being mobile.

LCD:

One of the most common devices attached to a micro controller is an LCD display.

An **LCD** is an electronic **display** module which uses liquid crystal to produce a visible image. The **16×2 LCD display** is a very basic module commonly used in DIYs and circuits. The **16×2** translates o a **display 16** characters per line in **2** such lines.

Exhaust fan:

DC 12V cooling fan uses a motor to turn its blades, which function to pull air out of the space. We can fix this fan peltier plate heat side so the fan pulls the air out.

SMPS:

AC to DC Converter **SMPS Working** Principle. The AC to DC converter **SMPS** has an AC input. It is converted into DC by rectification process using a rectifier and filter. We are using SMPS to run the project.

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