Peltier Device thermoelectric Generator Based on IoT

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ABSTRACT:

In recent years, with the increase awareness towards environmental degradation due to the production, use and discharge of ChloroFluoro Carbons (CFCs) and Hydro Chlorofluorocarbons (HCFCs) as heat carrier fluids in conventional refrigeration systems has become a subject of great concern and resulted in extensive research into development of refrigeration technologies. Thermoelectric operated cooler provides a best alternative in refrigeration technology due to their distinct advantages. While using thermoelectric effect in system the efficiency of the system also increases. A small introduction of principal of thermoelectric cooling and thermoelectric materials has been presented in this paper. The purpose of this paper to review on application of thermoelectric phenomenon by using thermoelectric module technology.

Keywords: *Peltier Device, Thermoelectric Generator, Microcontroller (ATMEGA16), Temperature Sensor (LM35), Bluetooth Module.*

1. INTRODUCTION:

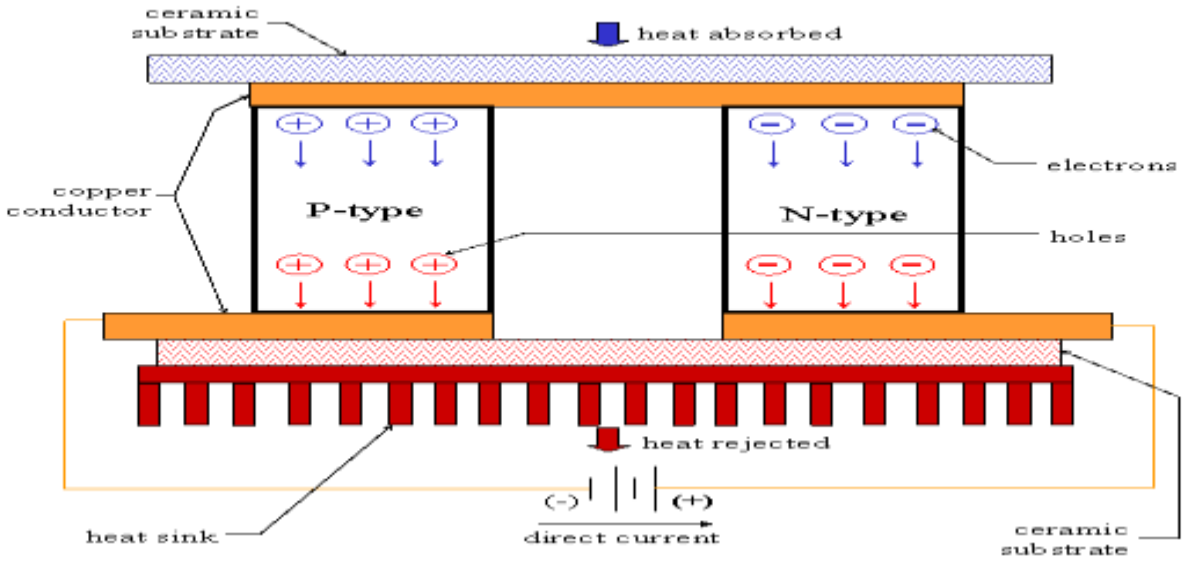
Thermoelectricity can be used for electric power generation (Seeback effect) or for heating/cooling application (Peltier effect). Thermoelectric camping coolers are because the lack of fluids and pumps makes TE option the most robust and reliable alternative for portable equipment. We make use of the property that when we apply a voltage to a thermocouple; a temperature difference develops between two junctions of the thermocouple. The direction of heat transfer is controlled by the polarity of the applied voltage. When a direct current is passed through a Peltier Module, the low temperature the low temperature side absorbs heat and the high temperature side emits heat, so that a temperature difference exists across the surfaces.

Although Peltier effect was discovered more than 150 years ago, thermoelectric devices have only been applied commercially during recent decades. Lately, a dramatic increase in the application of TE solutions in optoelectronic devices has been observed, such as diode lasers, photo detectors, solid- state pumped lasers, charge-coupled devices (CCDs) and others. The thermoelectric module consists of thermocouple formed by pairs of P-type and N-type semi-conductor thermo element which are electrically connected in series configuration and thermally connected in parallel configuration. Due to their solid state construction the modules are considered to be highly reliable. For most application they will provide long, trouble free service. For cooling application, an electrical current supply is given to the module, heat is transferred from one side to the other, and the result is that the module will become cooler at one side and hotter at the other side.

2. SURVEY ANALYSIS

Sr. No	Year of Publication	Title ,Publisher, Author	Abstract (Methodology followed)	Findings
1	1821	J.T. Seeback	dissimilar metals that are connected at two different locations will develop a micro voltage if the two junctions are held at different temperatures.	Seebeck discovered that making one end of a metal bar hotter or colder than the other produced an EMF between the two ends.
2	1834	Peltier	Inverse of Seeback effect. If you take a thermocouple and apply voltage this causes a temperature differences between two junctions	Small heat pump as well as thermoelectric cooler is a combination of two semiconductors Bismuth and telluride.
3	January 2009	Rohit Sharma, Vivek Kumar Sehgal, Nitin, Abhinav Thakur, Ashish Sharma, and Pankaj Sharma	This paper demonstrates an environmental friendly methodology for implementing an air conditioning or refrigeration system.	Thermoelectric camping coolers are successful because the lack of fluids and pumps makes TE option the most robust and reliable alternative for portable equipment.

Schematic of a Thermoelectric Cooler



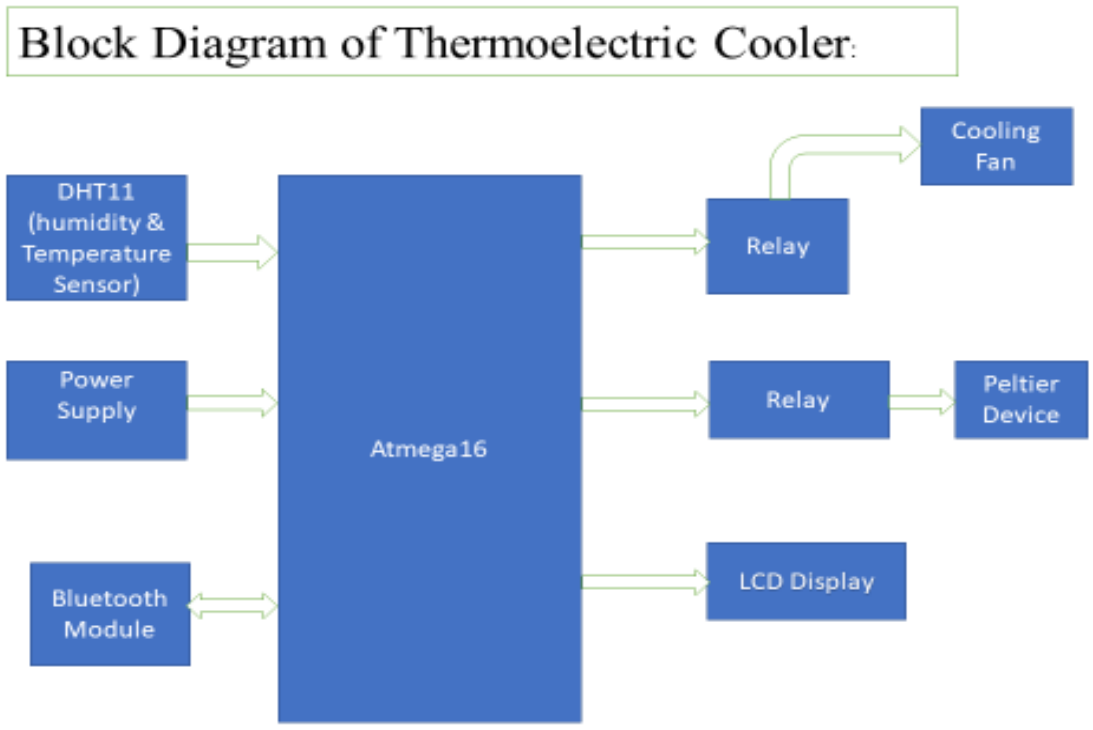
When a p type semiconductor (doped with holes) is used instead, the holes move in a direction opposite the current flow. The heat is also transported in a direction opposite the current flow and in the direction of the holes. Essentially, the charge carriers dictate the direction of heat flow. One side is attached to a heat source and the other a heat sink that convicts the heat away. The side facing the heat source is considered the cold side and the side facing the heat sink the hot side.

Thermoelectric refrigeration is new alternative because it can convert waste electricity into useful cooling, is expected to play an important role in meeting today energy challenges. Therefore, thermoelectric refrigeration is greatly needed, particularly for developing countries where long life and low maintenance are needed. The objectives of this study is design and develop a working thermoelectric refrigerator interior cooling volume of 5L that utilizes the Peltier effect to refrigerate and maintain a selected temperature from 5 °C to 25 °C.

3. OBJECTIVE BEHIND THIS PROJECT

1. Our project is the best alternative for conventional refrigerators
2. Temperature can be maintained as our requirement.
3. Less time required for cooling than conventional cooling system.
4. For biomedical purposes, for keeping medicines device can be used.

4. SYSTEM ARCHITECTURE:



This section gives the detailed description of the different modules used in the project. The different Modules are:

- Refrigeration unit(Aluminium cage)
- Temperature sensor unit
- Peltier control unit
- Power Supply unit
- Bluetooth Module unit

The Refrigeration unit consists of a Peltier element attached to an insulated aluminum enclosure. The Peltier element is attached to a heat sink to dissipate the heat generated during TE cooling. A

switching circuit is also used to change the polarity of the current being given to the Peltier element. This enables the user to use the device for cooling as well as for heating, according to his requirements. A 12 volt fan is also fitted in the enclosure to blow the cool air from inside the enclosure to its immediate surroundings. Moreover an LM35 temperature sensor is placed inside the enclosure to sense the temperature.

The Temperature sensor circuit consists of a LM35 temperature sensor that is connected to an LCD, after interfacing it with microcontroller ATMEGA16, to display the temperature in the enclosure. The Peltier device connected to circuit is used for cooling as well as heating effect. Different Relays are used for switching purpose.

Bluetooth module is used in model for controlling the temperature wirelessly by using mobile application. A Mobile device which includes application for controlling temperature is connected to Bluetooth module. Bluetooth module is connected to microcontroller. LCD display is connected to microcontroller for displaying the temperature of model. It will show

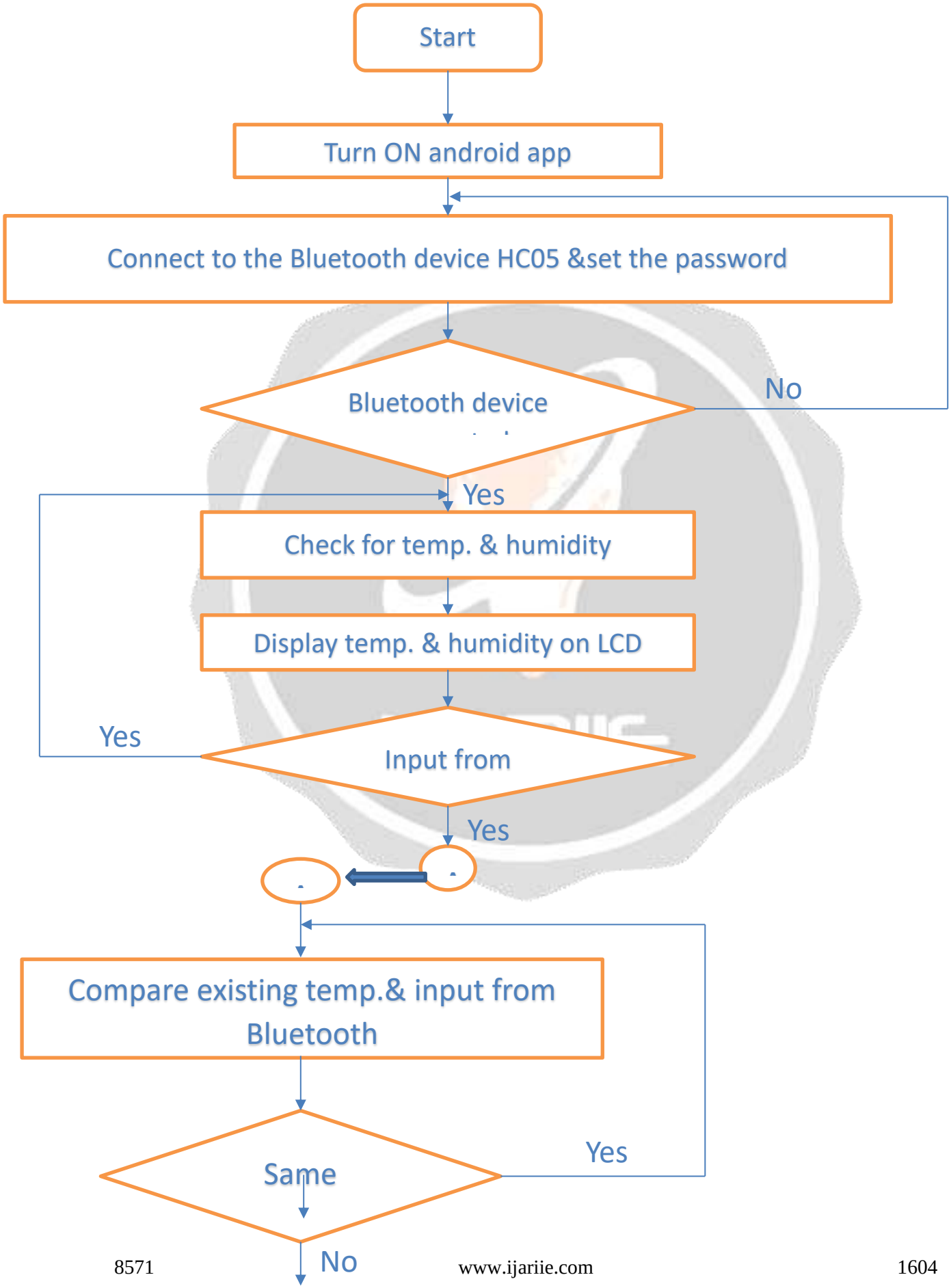
List of components used are:- minimum as well as maximum temperature of the model.

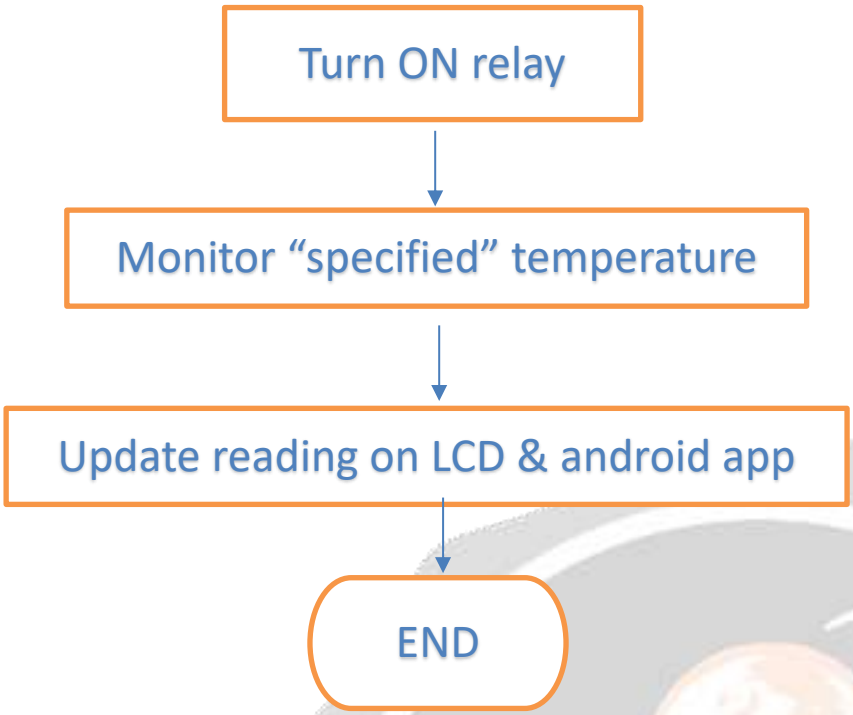
- Microcontroller ATMEGA 16
- Peltier device TEC1-12706TEC125
- Temperature Sensor LM35
- LCD Display
- Bluetooth module
- Relays
- 5 V and 12 V Power Supply
- Cooling Fans
- Aluminium Cage with Heat Sink

5.Advantages & Disadvantages:

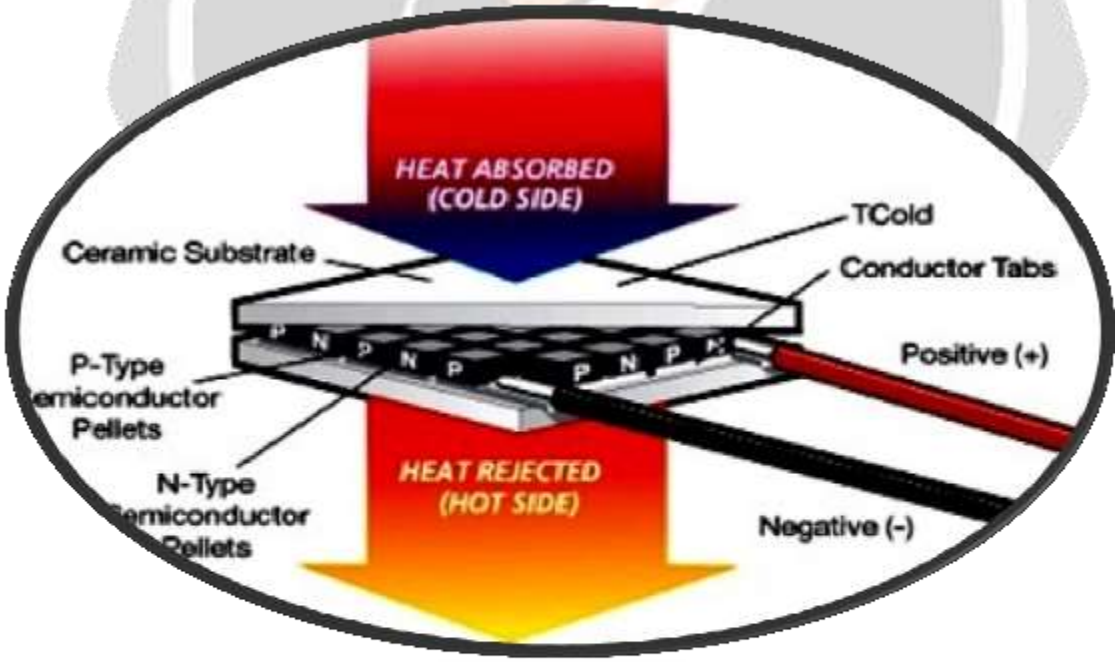
- Advantages
  - Solid state (no moving parts)
  - No maintenance
  - Long service lifetime
- Disadvantages
  - Large electrical power requirements
  - Inefficient compared to phase change cooling

6..FLOW CHART:


Start
Turn ON android app
Connect to the Bluetooth device HC05 &set the password
Bluetooth device
No
Yes
Check for temp. & humidity
Display temp. & humidity on LCD
Yes
Input from
Yes
Compare existing temp.& input from Bluetooth
Same
Yes
No



7.Heart Of the System



7.1 PELTIER CONTROL UNIT(TEC1-12706TEC125)

The Peltier device connected to circuit is used for cooling as well as heating effect. Different relays are used for switching purpose. The peltier device consists of two different metal plates for conducting maximum as well as minimum temperature. P and N type of semiconductors are placed between these two metals. By combination of holes and electrons there is absorption and dissipation of heat from two sides of peltier plate. Peltier plate requires minimum 10 mW current supply for heating and cooling operation. It takes very less time for cooling as well as heating. Peltier plates can generate maximum of 80 to 100 degree C and minimum of 1 to 5 degree C temperature.

7.2 EXPERIMENTAL INVESTIGATION

The test was conducted at different ambient21 °C, 15 °C, 32 °C and 43 °C represented in Figure 7. The temperature vary from 15 °C to 5 °C with temperature variation within the TEC is less than 1 °C as this was the proto sample with improvement in prototyping we can achieve even lower temperature.

8.FUTURE SCOPE

- Electronic enclosures
- Laser diodes
- Laboratory instruments
- Temperature baths
- Portable DC refrigerators
- Automotive seat cooling/heating
- Telecommunications equipment
- Temperature control in missiles and space systems

9.Conclusion:

- The available literature shows that thermoelectric cooling systems are generally only around 5–15% as efficient compared to 40–60% achieved by conventional compression cooling system.

- From the above data we can conclude that Thermoelectric cooling added a new dimension to cooling. It has major impact over conventional cooling system. It is compact in size, no frictional elements are present, no coolant is required and weight of the system is low.

- From the review of the pertinent literature presented above, it can be inferred that thermoelectric technology using different modules used for cooling as well as heating application has considerable attention. Many researchers try to improve the efficiency of the thermoelectric air-conditioner using different material.

- The temperature vary from 15 °C to 5 °C with temperature variation within the Thermoelectric cooler is less than 1 °C as this was the proto sample with improvement in prototyping we can achieve even lower temperature.

10.REFERENCES:

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