Role of Robotic In Different Platform of Agriculture: Challengesand Future of Robotic

Lalit Bansal[1] Nitesh Kumar Jha[2] Rohan Kanodiya[3] Sandeep Jhamb[4]
[1,2,3,]Student [4]Head of Department
[1,2,3,4]Department of Mechanical Engineering
[1,2,3,4]Arya Institute of Engineering and Technology, Jaipur, India

Abstract— This paper focuses on the eco-friendly refrigerator as there is no refrigerant in this refrigerator. Traditional type refrigerators consist of moving parts or rotating parts like condenser, compressor, expansion valve, evaporator, refrigerant, etc. which produce vibrations and noise. Many of the time the refrigerant is not eco-friendly. In this thermoelectric refrigeration system these mechanical parts and refrigerant are replaced by the thermo-electric cooler also known as Peltier module. Many people face problem of carrying medicine which are stable at low temperature than room temperature, this module will be helpful to these people. Medicine, beverages, fruits, vegetables, and other food items can be stored. Thermoelectric refrigerator consists of Thermo-electric cooler, cold side heat sink, hot side heat sink and the heat rejection fan, the heat sink are placed on each side of thermo-electric cooler and the heat rejection fan is place on the hot side heat sink for rejection of heat produce by thermo-electric cooler. Features involved are: for charging the battery we have installed a switched-mode power supply so that we can use 220-240 Volts alternating current of frequency 50-60 Hz, we can also use direct current straight forward to charge the battery.

Keywords: Peltier Module, Refrigeration, Thermo-electric cooler, Refrigerator, Medicine

I. INTRODUCTION

Thomas Seebeck is the first to find that two dissimilar materials joined together produce the electromotive force when the heat is applied at one its end. Rakesh B. K e t on [1] a French physicist Charles Peltier discovered Peltier effect, this effect states that when we apply current at the interface of two dissimilar material and this result in the absorption of heat at one of the sides and release of heat at the other sides of the joined dissimilar material. He uses no refrigerant (Chloroflurocarbon) in this so there is no ozone depletion and this makes it more eco-friendly. They are extremely small in size compare to compressor-based refrigerator.

Peltier effect help us to make the thermoelectric cooler and this device is helpful in making thermoelectric refrigeration. The thermoelectric cooler works on the Peltier effect in which a temperature difference is produce between the junction of thermocouple due to which one side of cooler becomes cold and the other side becomes hot (as shown in figure1). In refrigerator the thermoelectric cooler cool side is placed inside the refrigerator and hot side outside of its to release the heat in the atmosphere with the help of heat side heat sink.

II. OBJECTIVE

Thermoelectric refrigerator is an eco-friendly refrigerator and it is easy to carry and do not cause ozone depletion.

It can be operated by alternating current as well as direct current.

III. FABRICATION

Solidworks software is used for the designing of the refrigerator as shown in figure 1. Take Thermocol box shaped cube or cuboid then cut two slots on opposite faces of the box so that the peltier module (as shown in figure 3) can be placed. The heat sink cold side is placed inside the box and cold side of peltier is on the cold heat sink and they are inside the box. The opposite side that is hot side of peltier the hot heat sink is placed over which the heat rejection fan is placed so that it transfers the heat in the atmosphere. The peltier module is now sandwiched between the hot and cold heat sink. Now completely insulate the thermocol box from the inside, so to avoid heat transfer. The peltier gets power from the two source the first one is SMPS (which convert alternating current into direct current) and the second one is battery. All electrical apparatus is of 12 volts direct current.

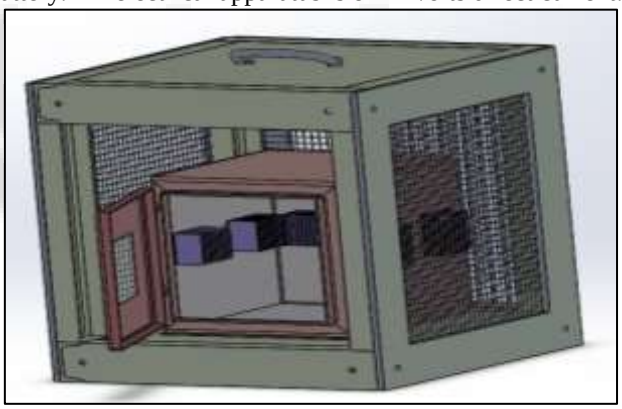

Fig. 1: Thermo-electric refrigerator

IV. DESIGN CONSIDERATION

A. Thermo-electric Module-

Thermoelectric module is made up of thin ceramic plate wafer with positive and negative bismuth telluride semiconductor connected in series. A peltier module is of 4*4 cm^2 (as shown in figure 2). By the application of continuous flowing of current to this module one side of ceramic plate is heated and the other side of ceramic plate is cooled. The direction of current flowing in this module decides which side become cool and which side become hot. Cooling capacity of module depends upon the current ampere. The maximum current input to the module is depicts by its name (as shown in figure 3).

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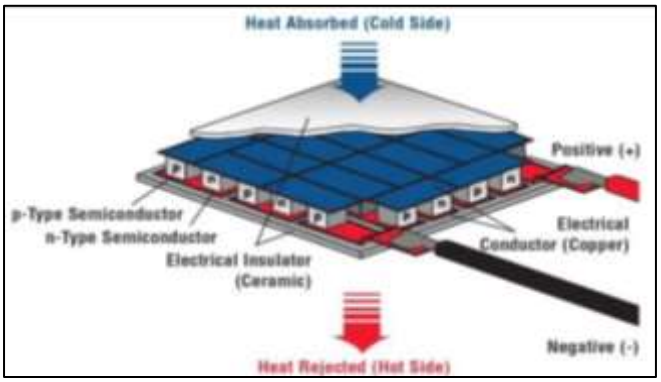

Fig. 2: Thermoelectric Module

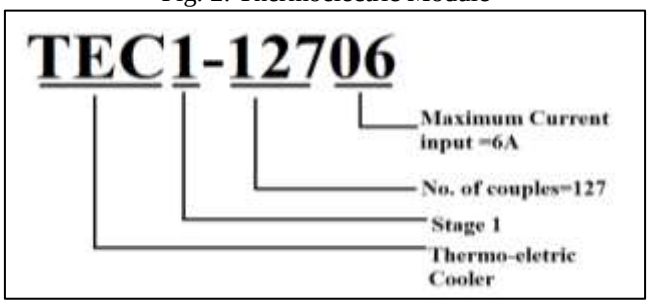

Fig. 3: Classification of name of Thermoelectric Module

B. Heat Sink -

The heat sink is a device used to transfer the heat. The heat sink is applied on both the sides of thermo-electric cooler and known as hot side heat sink and cold side heat sink. The heat sink is generally made up of Aluminium. The hot side heat sink is placed on the hot side of module and the other side is attached to the heat rejection fan, the cold side heat sink is placed on the cold side of module and the other side is placed in the refrigerator. The sandwich arrangement of heat sink and thermoelectric module is represented in the figure 4.

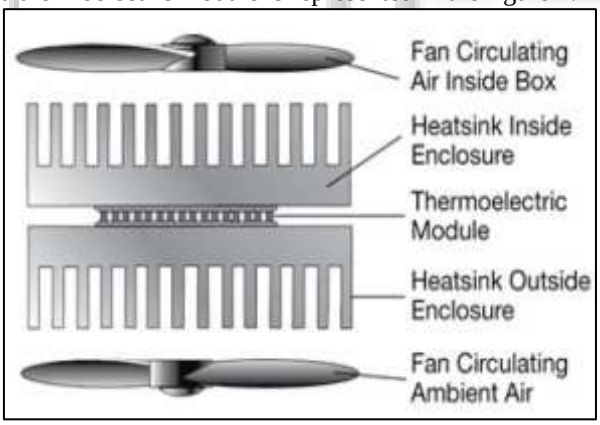

Fig. 4: Sandwich arrangement of Peltier and heat sinks [1]

C. Cooling Load -

The amount of heat absorbed and to be removed by the cooled side of the TEC is cooling load (Q_c). Q_c was calculated by the product of mass flow rate of air and specific heat capacity at constant pressure and the temperature difference. The temperature difference is dT which is the difference in temperature of the inside refrigerator and outside the temperature.

$$Q_c = mc_p dT \quad (1)$$

V. CALCULATION

For the peltier module (TEC1-12706)

T_h =303K
T_c =291K
Q_{cmax} =70W
dT_{max} =66K
I_{max} =6A
V_{max} =12V

Where T_h and T_c are the temperature at hot side and cold side of Peltier heat sink respectively. $Q_{c\,max}$ is the cooling load capacity at the cold side of heat sink when dT=0. dT_{max} is the maximum possible temperature difference between the heat sink of peltier module. I_{max} is the maximum current input and V_{max} is the maximum voltage of direct current at Q_c=0.

In the below equation α_m, K_m, R_m are the device seebeck voltage, thermal conductance and electrical resistance assuming that all identical couple and unidirectional heat flow.

$$\alpha_m = \frac{V_{max}}{T_h} = \frac{12}{303} \quad (2)$$
$$= 0.0396039 \text{ V/K}$$

$$R_m = \frac{T_h - dT_{max}}{T_h} \times \frac{V_{max}}{I_{max}} = \frac{303-66}{303} \times \frac{12}{6} \quad (3)$$
$$= 1.564356\ \Omega$$

$$K_m = \frac{T_h - dT_{max}}{2dT_{max}} \times \frac{V_{max} \times I_{max}}{T_h} = \frac{303-66}{2*66} \times \frac{12*6}{303} \quad (4)$$
$$= 0.426642 \text{ W/m K}$$

$$Q_c = (\alpha_m \times T_c \times I) - \left(\frac{I^2 \times R_m}{2}\right) - \left(K_m(T_h - T_c)\right) \quad (5)$$
$$= (0.0396039 \times 291 \times 6) - \left(\frac{6^2 \times 1.564356}{2}\right) - \left(0.426642(303-291)\right)$$
$$= 39.1484 \text{ W}$$

$$W = \alpha_m \times I \times (T_h - T_c) + I^2 R_m \quad (6)$$
$$= 0.0396039 \times 6 \times (303-291) + 36 \times 1.564356$$
$$= 59.168216 \text{ W}$$

Theoretical COP

$$COP = \frac{Q_c}{W} = \frac{39.1484}{59.168216} \quad (7)$$
$$= 0.66$$

Actual COP

RE= Refrigeration Effect

$$RE = \frac{mC_p dT}{t} \quad (8)$$

Here we have taken in practical,

m=500 ml of water = 0.0005 m^3
C_p= 4.187 KJ/Kg
dT=12 ℃

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t=40 minutes

$$RE = \frac{0.5 \times 4.187 \times 12}{40 \times 60} \quad (9)$$
$$= 0.0104675 \text{ KW}$$
$$= 10.4675 \text{ W}$$

$$COP = \frac{RE}{W} \quad (10)$$
$$= \frac{10.4675}{59.168216}$$
$$= 0.1769$$

The actual COP is less than the calculative COP, we can achieve it by increasing the more insulation and the number of stages in module as well as by higher current input rating module.

VI. Application

It is used as a life saving device by storing the pharmaceutical drugs which is given to patients in sudden and emergency situation to overcome the medical situation such as preservation of insulin and other drugs. It can be used as preservation of food stuffs, cold water, beverages.

VII. Conclusion

In the end we can conclude that this portable type of refrigerator has many advantages than the conventional refrigerator. It has low voltage consumption (pprox.. 12 Direct Current Volts). This system is completely ecofriendly since here no refrigerant for the cooling purpose. This system is compact in design. We can vary temperature range in very simple and easy way by charging the amount of current. This system can be very beneficial for travelling purpose and for storing the medicine and drugs for the people who are suffering from several diseases. The coefficient of performance can be increased by using stage 2 Peltier module and using the higher rated current input module, which help in further reduction of temperature in less time.

VIII. Future scope

In the rural areas the frequent power cut is there so solar energy, which is a renewal energy can be used to charge the battery or else direct supply the direct current to the module.

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