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Smart Refrigeration System Based On Embedded System

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ABSTRACT: The aim of this paper is to design the smart refrigeration system. The global increasing demand in the field of refrigeration, air conditioning, food preservation, vaccine storage, medical services and cooling of electronic devices leads to production smart refrigerator. Consequently more release of co2 all over the world which it is contributing factor of global warming and climate change. Thermoelectric refrigeration is new alternative because we can also use solar energy instead of AC or Dc supply for useful cooling. Effectiveness of single-stage thermoelectric refrigerator may decrease with increase in the temperature ratio of heat source and heat sink. This initiates development of various ways to improve coefficient of performance (COP) of the thermoelectric refrigeration system. One of the most effective method to improve the co-efficient of performance is improving effectively the dissipation of heat at the sink. This can be done by applying various methods such as use of phase change materials, multi-stage combined thermoelectric refrigerator etc. In this paper we are using multi-stage combined thermoelectric refrigerator

KEYWORDS: Microcontroller, Thermoelectric device, Heat sink

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 vapour and back, respectively. Semiconductor thermoelectric coolers (also known as Peltier coolers) offer temperature control (< ± 0.1 °C) can be achieved with Peltier coolers. However, their efficiency is low compared to conventional refrigerators. Thus, they are used in niche applications where their unique advantages 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 (A strain and Vin, 2005). Objective of this paper is to design thermoelectric Refrigerator by Utilizing Peltier effect to refrigerate and maintain a specified temperature. It perform temperature control in the range 5°C to 25°C. Interior cooled volume of 5 Litre and Retention for next half hour. Several advantages over conventional systems. They are entirely solid-state devices, with no moving parts; this makes them rugged, reliable, and quiet. They use no ozone depleting chlorofluorocarbons, potentially offering a more environmentally responsible alternative to conventional refrigeration. They can be extremely compact, much more so than compressor-based systems.

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II. RELATED WORK

Mr. Swapnil B. Patond analysed an Irreversible multi-couple thermoelectric refrigerator, which operates between two reservoirs maintained at constant temperature. Effect of other factors like external and internal irreversibility of thermoelectric refrigerator on performance was also studied in "Experimental Analysis of Solar Operated Thermo-Electric Heating and Cooling System",

Mayank Awasthi and K V Mali In studiedTwo stage thermoelectric refrigerator . this 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 cuboids style configuration current can be alternated causing top and bottom side to be switched between heating and cooling mode this is explained in "Design and development of thermoelectric refrigerator",

Palash Nakhate , Niraj Pawaskar , Purva Vatamwar , Saurabh Kalambe have worked on Ecofriendly Refrigerator Using Peltier Device they given 12v supply through a Switch Mode Power Supply(SMPS) Peltier plate and heat sink fan module,they did not used a solar energy for supply unit of project hence a suitable temperature range for perishable food storage is 3 to 5 °C (37 to 41 °F), with the use of microcontroller designed a feedback unit for unit where the container is cooled to required temperature at that point supply automatically turn off.

Nandini K.K., Muralidhara worked on Peltier Based Cabinet Cooling System using heat sink as well as using heat pipe, The hot side of both the peltier device is attached to same liquid based heat sink and cold side is attached to heat pipe based heat sink the system had 10 fins on top and bottom side of cover plate was designed and fabricated using aluminium material.

Ganesh S. Dhumal, P.A. Deshmukh, M. L. Kulkarni has work on thermoelectric refrigeration system running on solar energy and development of mathematical model the study showed about Mathematical and theoretical characteristics of thermoelectric module the experimental capacity of refrigerator is 0.5 litter using two peltier plate and heat sink module beside the platier plate to element the maximum number of heat from hot side of plate as per analysis result decreased the temperature is up to 240 C in 7 minutes

Kshitij Rokde,Mitali Patle,Tushar Kalamdar,Radha Gulhane,Rahul Hiware has work on Peltier Based Eco-Friendly Smart Refrigerator for Rural Areas studied in This solar powered peltier refrigerator is more reliable than other portable refrigerators. It is cost efficient and eco-friendly which is the most wanted requirement of today's era. By controlling the temperature range of the cooling unit, it can be used in various sectors like for in the rural areas where dairy products need a lot of attention, near the coasts from where the marine edibles need to be transported to the market area, medical area for storing blood and pharmaceuticals. The efficiency of the refrigerator can be increased by increasing the number of peltier plate module which will eventually help in decreasing the temperature in less time.Number of peltier plate modules used can be calculated using the heat transfer formula.

III.WORKING

Thermoelectric refrigeration is new alternative because it can convert waste electricity into useful cooling is expected. Effectiveness of single-stage thermoelectric refrigerator may decrease with increase in the temperature ratio of heat source and heat sink. This initiates development of various ways to improve coefficient of performance (COP) of the thermoelectric refrigeration system. One of the most effective method to improve the co-efficient of performance is improving effectively the dissipation of heat at the sink. This can be done by application various methods such as use of phase change materials, multi-stage combined thermoelectric refrigerator etc.

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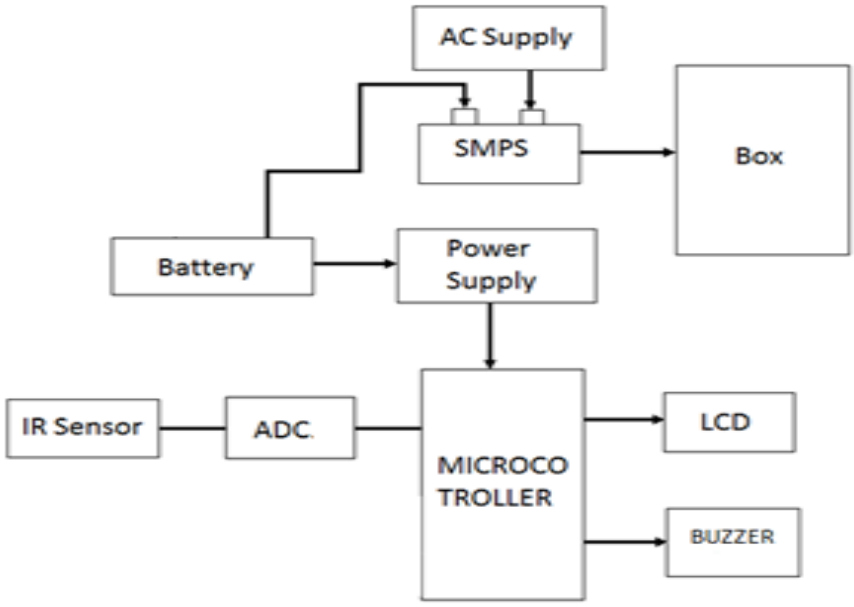

Fig1: Block Diagram of Smart Refrigeration System

ATMEGA16 Controller

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals

Thermoelectric Module

A thermoelectric module is a circuit containing thermoelectric materials which generates electricity from heat directly. A thermoelectric module consists of two dissimilar thermoelectric materials joined at their ends: an n-type (negatively charged), and a p-type (positively charged) semiconductor. A direct electric current will flow in the circuit when there is a temperature difference between the ends of the materials. Generally, the current magnitude is directly proportional to the temperature difference.

i) Thermoelectric system

Using thermoelectric modules, a thermoelectric system generates power by taking in heat from a source such as a hot exhaust flue. In order to do that, the system needs a large temperature gradient, which is not easy in real-world applications.

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ii) Peltier Effect

The Peltier effect is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material.

Heat Sink

There are several methods which can be employed to facilitate the transfer of heat from the surface of the thermoelectric to the surrounding.

These methods are described in the following three sections. Natural convection, Liquid cooled, Forced convection when the co-efficient of thermal transfer (K)was investigated, the K for natural convection was approximately 25 W/mK. This value compared to 100W/mK for forced convection.

Liquid Crystal Display

A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image.

IR sensor. An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor

Buzzer

A buzzer or beeper is an audio signalling device which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

IV.RESULTS

Table I: Observation for Cooling

Sr.No	Time (15 minutes delay)	Temperature in degree Celsius
1	9:30 am.	35ºC
2	9:45 am.	30 ºC
3	10:00 am	25 ºC
4	10:15 am.	20 ºC
5	10:30 am	15 ºC
6	10:45 am	10 ºC
7	11:00 am	05 ºC

Table I Observation for Cooling shows the result of our paper for cooling, after every 15 minutes the temperature decreases and the refrigeration starts cooling. The temperature decreases from 35ºC to 05 ºC from 9:30 am to 11:00 am.

Table II: Observation for Heating

Sr.No	Time (15 minutes delay)	Temperature in degree Celsius
1	11:00 am	05 ºC
2	11:15 am.	10 ºC
3	11:30 am	15 ºC
4	11:45 am.	20 ºC
5	12.00 pm	25 ºC
6	12:15 pm.	30 ºC
7	12:30 pm.	35 ºC

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Table II Observation for Heating shows the result of our paper for Heating , after every 15 minutes the temperature increases and the refrigeration starts Heating .The temperature increases from 5ºC to 35 ºC From 11:00 am to 12:30 pm.

Means our system is used for Cooling as well as Heating, whenever it is required. We can heat or cool the system through manual switch.

V.CONCLUSION

The objective of the paper is to achieve the long term cooling in case of power failure for refrigerator. After cooling system has been designed and developed to provide active cooling with help of single stage 12 V Thermoelectric module is used to provide adequate cooling. First the cooling load calculations for this Thermoelectric refrigerator compartment considered under study were presented. Simulation tests in laboratory have validated the theoretical design parameters and established the feasibility of providing cooling with single stage thermoelectric cooler was tested in the environmental chamber. As Thermoelectric refrigerator not available in open market which we can retain cooling in case of power outage due to high current carrying capacity.

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