iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** XI **Month of publication:** November 2020

DOI: https://doi.org/10.22214/ijraset.2020.32245

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XI Nov 2020- Available at www.ijraset.com

Thermoelectric Blanket

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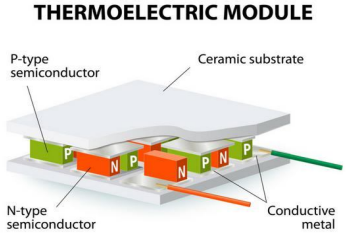
Abstract: ***As far as cooling is concerned, air conditioner is considered as most preferred choice nowadays. However, because of its expensiveness and impairment to environment, it becomes prominent to re-design and develop an equipment to overcome such flaws. This article aims inexpensive, reliable and eco-friendly way to dealing with hot summer. Peltier module consisted thermoelectric blanket could be a viable option for this. Operating principle is based on peltier effect. Direct application of electric current to peltier module, evolved heat at one junction and absorbed at other junction. As a results temperature difference is created on both side. Efforts have been made to use this phenomenon in blanket. Thermoelectric blanket consists of 16 pieces of peltier modules which absorbs heat from inner side of blanket and dissipate it into outside environment via heat sink. This project focuses on providing comfort at minimal cost.***
Keywords: peltier effect, peltier module, thermoelectric, blanket, inexpensive, cooling effect, substitute of air conditioner.

I. INTRODUCTION

Nowadays, global warming is the biggest concern of the world. earth is getting hotter day after days. This situation is created by humans. We have used material such as CFC that harm the ecosystem. 1 atom of the CFC can destroy 1,00,000 atom of the ozone. After so many years of using this, We have realized that we are suffering from the situation of global warming. The ice in Antarctica and Himalayas are melting. The temperature is rising. Emissions from power plants and automobiles are the main factor that causes global warming. Besides this, we are also going through energy crisis. One of the most revolutionary and influential invention in the history of science was that of “electricity”. This single invention is the base for the vast and unimaginable growth in scientific and technological field that we see today. At the same time when this became an inseparable part of our lives, world now is facing an acute “energy crisis”. A situation dealing with definite difference between power supply and power demand is termed as energy crisis. To fulfill this energy demand majority of country relies on coal fired power plants. Around 41% of total electricity generation across the globe uses coal fired power plants. This severe environmental threats leading to global warming via greenhouse gas effect. Refrigeration and air conditioning systems are directly and indirectly responsible of global warming and power crisis as their use in household, commercial and transportation sector is increasing rapidly. Using air conditioners and electric fans to stay cool already accounts for about a fifth of the total electricity used in buildings around the world – or 10% of all global electricity consumption today. So, we must have to find a way which is efficient and eco friendly as well. We have an option. Air conditioner. However, air conditioners are expensive and harmful way to get comfort. So what is the way that is not harmful to environment and affordable for everyone? The average temperature of summer in india is 48 degree centigrade. And it too hot. Air- conditioned can solve this problem but, what about the initial cost, operating cost and environment? The cost of air conditioner is around 30000 Indian rupees. After buying this it consumes lots of energy. It consumes 1 unit of electricity in every 30 minutes. With such a high initial as well as operating cost, it is not affordable to all. So, “thermoelectric blanket” is very reasonable way to solve this problem. And also because of its low operating cost everybody can afford it

II. PELTIER EFFECT PRINCIPLE

Peltier effect, the cooling of one junction and the heating of the other when electric current is maintained in a circuit of material consisting of two dissimilar conductors; the effect is even stronger in circuits containing dissimilar semiconductors. In a circuit consisting of a battery joined by two pieces of copper wire to a length of bismuth wire, a temperature rise occurs at the junction where the current passes from copper to bismuth, and a temperature drop occurs at the junction where the current passes from bismuth to copper.



When an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction. This is known as Peltier Effect. The Peltier effect is the presence of heating or cooling at an electrified junction of two different conductors and is named after French physicist Jean Charles Athanase Peltier, who discovered it in 1834. When a current is made to flow through a junction between two conductors, P and N, heat may be generated or removed at the junction.We can also generate electricity from it by put it in temperature difference it will produce EMF. But EMF that produce is not enough to fulfill our requirement.

III.PROPOSED SYSTEM

A. Components and its Specification

Thermoelectric blanket required following list of component:

1) Peltier module
2) Power source
3) Heat sink
4) Thermometer
5) Voltmeter
6) Ameter

a) Peltier Module

Semiconductor Chilling Plate	TEC1-12706
Size	40*40*3.7
Internal Resistance	2.1 - 2.4Ω
Max Temperature Difference	67 Celsius
Rated Voltage	12 v
Rated Current	6 amp.
Refrigeration Power	60W
Working Range	55 – 83 Celsius
Sealing Process	704 silicon rubber

Fig 2: Peltier Module

b) Heat Sink: Heat sink is a heat exchanger, that transfer heat generated by electronics or mechanical devices, where heat is dissipated from the electronic or mechanical components. In this project we have used various types and various dimension of a heat sink for experiment purpose and heat sink with liquid cooling is used for the project.

- 95mm*43mm*22mm heat sink
- 115mm*100mm*22mm heat sink
- 95mm*43mm*22mm heat sink with liquid cooling
- 115mm*100mm*22mm heat sink with liquid cooling

Fig 3: Heat sink without liquid cooling

Fig 3: Heat sink with liquid cooling

c) Power Source: In this project we are using Peltier module which runs at 12 volts DC. And 6 amps. Each module. We are using 16 pieces of Peltier module so, technically we required 16*6= 96 amps. and 12*16= 192 volts DC power.This components are very sensitive, if volt or current will increases than parts could be burnout. And if voltage and current has low voltage than it could also damage the parts. So, we need to find out the maximum and minimum rating of the current and voltage. To boost or generate 96 amps power is huge challenge. So, we will use maximum or minimum rating of the Peltier module. It will save the part from damage, burnout or starving. This power source can power up to 38 amps and 5 volt DC each we are using 2 so, it can generate twice. It is very enough to power the all 16 modules. Power source is equipped with atmospheric temperature sensor and programmable relay as shown in figure.

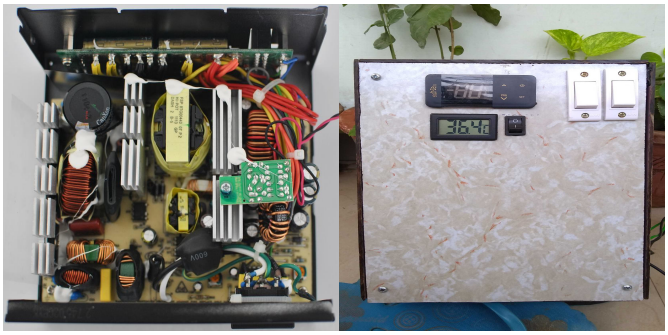


Fig 5: power source

In this power source there are two parts each can boost or convert 220 volt 5 amp. AC to 5 volt 38 amp. DC. There are two output and one input. Both output is 12 volt 15 amp. DC. So, net amount of usage is 24volts 30 amps. This power source is equipped with atmospheric temperature sensor. It measures the outside temperature and shows on display. This power source is also equipped with programmable relay. Programmable relay does multiple task. Programmable relay cut on and cut off the power when temperature is reached at certain level. It is also works in terms of time. Suppose, I want to start blanket at particular time it can set delay timer to start at the particular time. It works like simple domestic refrigerator works. You can set temperature in relay when blanket reach at the that temperature relay cut off the power and when blanket getting warm it will cut on the power to make it colder. Power source is protected by multiple fuses.

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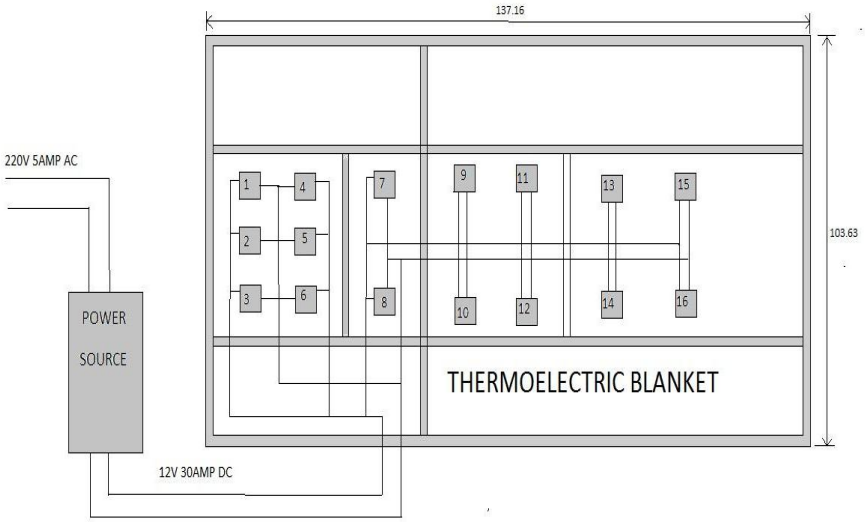
B. System Design

The design of the project is shown below,



1) Dimensional Specification

Total length	137.16 CM
Total width	103.63 CM
Distance between each module(vertical)	12 CM
Distance between each module(horizontal)	10 CM
Distance between two modules(upper)	08 CM
Distance between two modules(lower)	12 CM

2) Weight Specification

Weight of the heat sink	49 grams * 16 pcs = 784 grams
Weight of the copper tubes	60 grams * 16 pcs = 960 grams
Weight of the peltier module	22 grams * 16 pcs = 352 grams
Net weight	2096 grams or 2 kg

3) Actual Experimental Setup

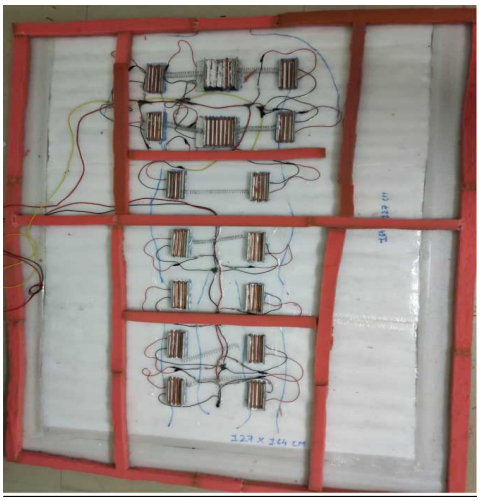


Fig 6: Actual experimental setup

IV. EXPERIMENTAL RESULTS

Before making this project we have conducted a bunch of experiments to examine the behaviour of peltier module and heat sink. We have applied various voltages, current and power. We have tried various heat sink like 115*110*22mm, 95*43*22mm heat sink with and without liquid cooling. Timing and consumption of the unit. Etc. There are two of them is given here.

A. Experiment no 1

Determining time required to reach at the minimum temperature with 115*110*22mm heat sink and 5v 2amp. Current.

1) Date : 3/3/2020
2) Atmospheric temp. : 25.5℃
3) Applied voltage : 5 volts
4) Applied current: 2 amps.
5) Applied power : 10 watt

No.	Voltage(volts)	Current(Amps)	Power(W)	Time(Sec)	T_{pm} (℃)	T_{hs} (℃)
1	5	2	10	00	25.5	25.9
2	5	2	10	05	23.3	26.9
3	5	2	10	10	20.7	27.0
4	5	2	10	15	19.2	27.2
5	5	2	10	20	17.1	27.7
6	5	2	10	25	15.6	28.2
7	5	2	10	30	13.9	28.8
8	5	2	10	35	12.6	29.2
9	5	2	10	40	11.7	29.5
10	5	2	10	45	10.9	30.1
11	5	2	10	50	10.5	30.7
12	5	2	10	55	10.1	31.3
13	5	2	10	60	09.7	31.9
14	5	2	10	65	09.4	32.4
15	5	2	10	70	09.3	32.8
16	5	2	10	75	09.2	33.3
17	5	2	10	80	09.2	33.9

B. Experiment no 2

1 hour experiment Final readings of the project after done with 95*43*22mm heat sink.

1) Date : 9/4/2020
2) Atmospheric temp: 34℃
3) Applied voltage: 12 volts
4) Applied current: 1.8 amps.
5) Applied power: 21.6 watt

No.	Voltage(volts)	Current(Amps)	Power(W)	Time(min)	T_{pm} (℃)	T_{hs} (℃)
1	12	1.8	21.6	00	34.8	34.8
2	12	1.8	21.6	0.5	28	34.9
3	12	1.8	21.6	1	22	35.6
4	12	1.8	21.6	2	20	36.2
5	12	1.8	21.6	11	20	37.8
6	12	1.8	21.6	20	20	39.1
7	12	1.8	21.6	29	20	41.7
8	12	1.8	21.6	38	20	45.4
9	12	1.8	21.6	47	20	49.3
10	12	1.8	21.6	55	20	50.9
11	12	1.8	21.6	60	21	51.7
12	12	1.8	21.6	68	21	52.2

Now we will find the operating cost of the project. In order to find operating cost we have to gather electrical data.
Voltage : 220v
Current : 1.1 amp.
Power consumed by power source, $P = V^2/R$
Now we have voltage (V) and current (I) but we do not have resistance (R) so, we have to find resistance in order to find power.
So, resistance, $R = V/I = 220 / 1.1 = 200\ \Omega$
Now power, $P = V^2/R = 220^2/ 200 = 217.8$ Watt. OR 0.217.8 kwh
The price per unit is 5 rupees. Now every 5 ours blanket will consume only 1 unit it is far less than air conditioner. So it consumes less as compare to the AC.

V. CONCLUSION

After conducting several experiment we have determined the power required, time required, minimum and maximum temperature range of heat sink, consumption of power and operating cost of thermoelectric blanket. After all these experiment we have concluded that 15℃ temperature could be reduced by thermoelectric blanket and power consumption is far less than air conditioner only 0.217 kwh which is very inexpensive way of getting comfort.

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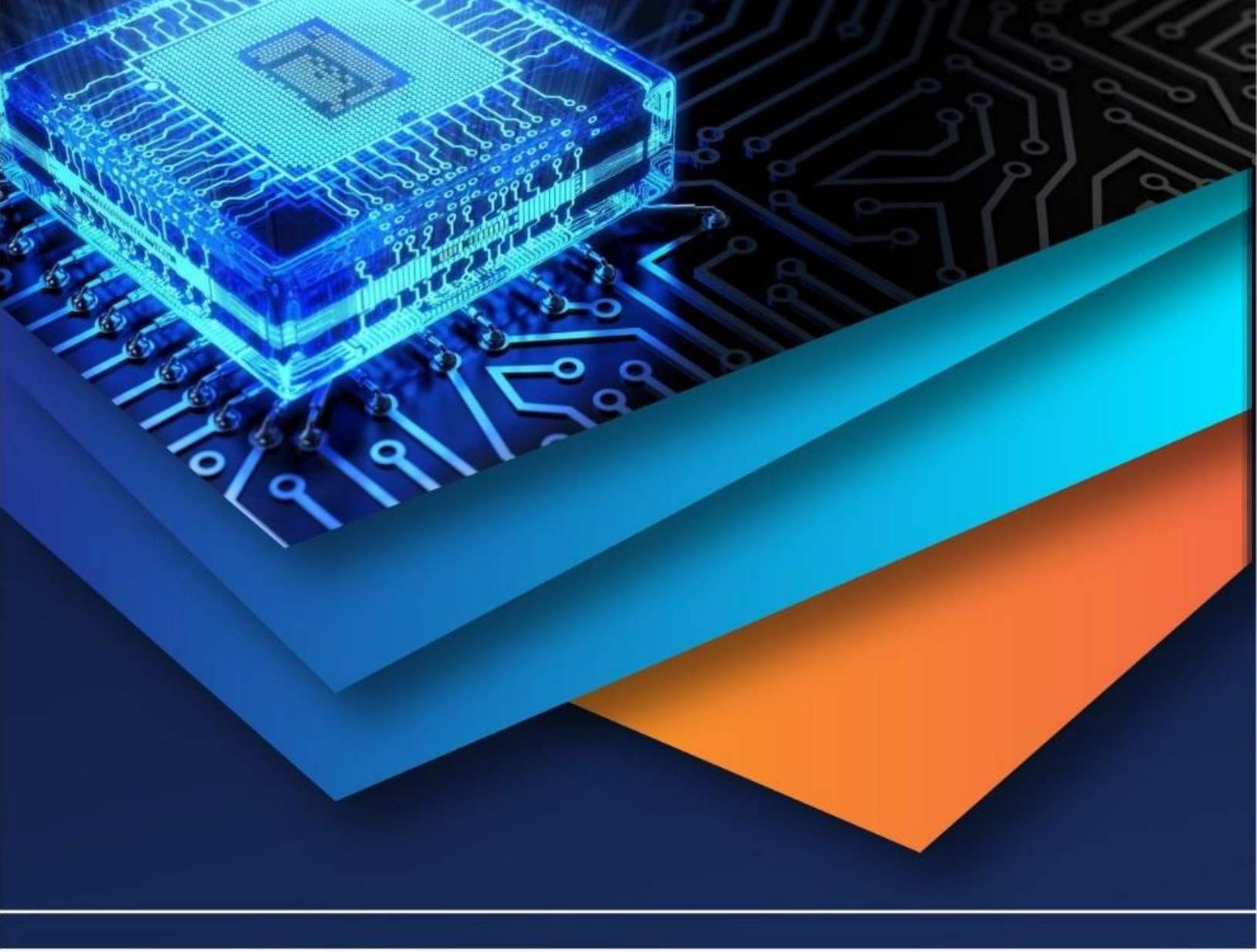

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