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Air Conditioning System in Car using Peltier Plate

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***Abstract*: -** According to the esteemed International Institute of Refrigeration, the utilization of air conditioning and refrigeration systems accounts for approximately 15% of the total global electricity consumption, contributing significantly to the emission of environmentally harmful substances such as CFCs, HCFCs, and CO2. The consequential effect of employing such REFRIGERANTS has been the exacerbation of detrimental consequences on our environment, most notably the exacerbation of global warming. Moreover, the use of fuel for air conditioning purposes further compounds these issues, ultimately impacting the efficiency of automotive systems. To surmount these challenges of emissions and address the imbalance between energy demand and supply, the application of thermoelectric air conditioning emerges as a viable solution. Notably, this innovative system boasts a multitude of merits, including its noise-free operation, absence of hazardous emissions, and overall eco-friendly nature. Furthermore, the compact dimensions of the Peltier module facilitate facile acquisition, enabling tailored designs that suit specific spatial and functional requirements.

. Keywords: Peltier module, Thermoelectric air conditioner

1. INTRODUCTION

The increasing demand for comfort and climate control in automobiles has led to the ubiquitous presence of air conditioning systems in modern vehicles. However, conventional air conditioning systems rely on refrigerants that contribute to environmental degradation and pose significant challenges in terms of efficiency and sustainability. As the automotive industry strives to reduce greenhouse gas emissions and enhance overall energy efficiency, alternative solutions are being explored. In this research paper, we delve into the realm of utilizing Peltier plates as a promising technology for air conditioning in cars.

Peltier plates, also known as thermoelectric modules, harness the Peltier and See-beck effects to provide cooling capabilities without the need for refrigerants or complex mechanical components. These solid-state devices offer several advantages, including compact size, lightweight design, high reliability, and reduced environmental impact. By leveraging the temperature difference generated by the Peltier effect, these modules can efficiently transfer heat from the passenger compartment to the surrounding environment, thereby achieving effective cooling.

The objective of this research is to investigate the feasibility and potential benefits of implementing Peltier plate-based air conditioning systems in automobiles. We aim to explore their cooling performance, energy efficiency, environmental impact, and overall suitability for automotive applications. Additionally, we will examine the integration of Peltier modules with existing car air conditioning systems and evaluate the impact on passenger comfort and system operation.

To accomplish these goals, comprehensive experimentation and testing will be conducted on a representative vehicle, considering various operational conditions and environmental factors. The collected data will be analysed to assess the cooling performance, energy consumption, and thermal comfort provided by the Peltier plate-based system. Furthermore, economic considerations and feasibility for large-scale implementation will be evaluated to determine the practicality of this technology in the automotive industry.The findings of this research paper aim to shed light on the potential benefits and challenges associated with incorporating Peltier plate-based air conditioning systems in cars. By exploring alternative cooling solutions, we strive to contribute to the development of sustainable and efficient automotive technologies that address environmental concerns while ensuring passenger comfort and safety.

2. LITERATURE SURVEY

- **Vrushali Deshmukh, Abhishek Dharme, Manish Gaikwad; Air Conditioning System in Car Using Thermoelectric Effect, (Volume 5) Issue 6, June 2017:**

The current HVAC system, widely used in air conditioners, is efficient but has drawbacks due to its use of harmful refrigerants like freon and ammonia, contributing to global warming. This has sparked the need for an alternative, namely thermoelectric cooling and heating systems. This research focuses on studying a thermoelectric air conditioner using TEC modules. Thermoelectric cooling offers benefits like compact size, lightweight design, affordability, high reliability, absence of moving parts, and no need for working fluids compared to conventional cooling devices.

- **Akshay Thalkar, Pranav Vaidya, Sagar Nikam, Swapnil Patil, Lalit Shendre Study of Thermoelectric Air Conditioning for Automobiles Volume: 05 Issue: 01 Jan-2018 p-ISSN: 2395-0072:**

Air conditioning systems is used in many automobile applications. The conventional process using refrigerant can cause serious problems to the environment. In this study we developed an air conditioning system based on thermoelectric properties. In this air conditioning, there is no use of compressor and pump for the refrigeration. A Thermoelectric module is an electrical module, which produces a temperature difference during current flow. The emergence of the temperature difference is based on the Peltier effect. The thermoelectric module is a heat pump and has the same function as a refrigerator. The heat flow can be turned by reversal of the direction of the current. Our aim is to introduce the new HVAC system using a thermoelectric module which shall overcome all the disadvantages of the existing HVAC system.

3. Components

- Thermoelectric Generator
- Battery
- Peltier Plate
- Heater
- Switch mode power supply
- Temperature sensor
- Cooling Fan
- Thermocol Ice Box
- Heater Heating Plate

4. Design

1]

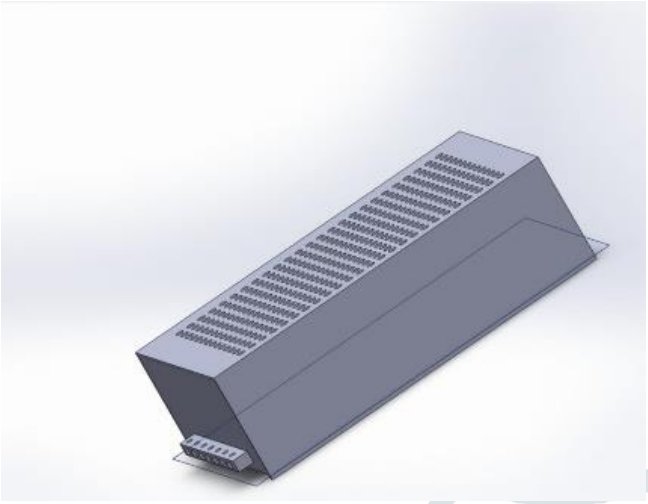


Fig. 1. Switch mode power supply

2]

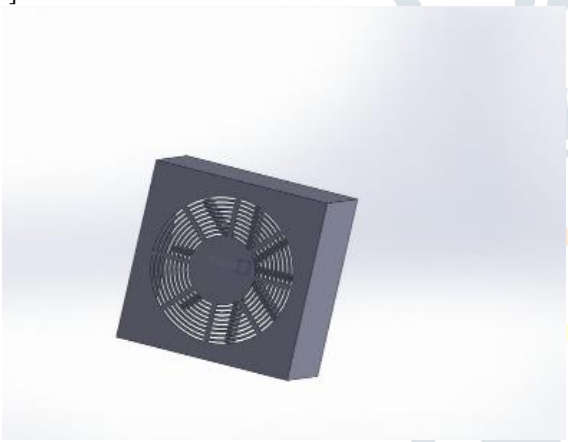


Fig. 2. Cooling fan

3]

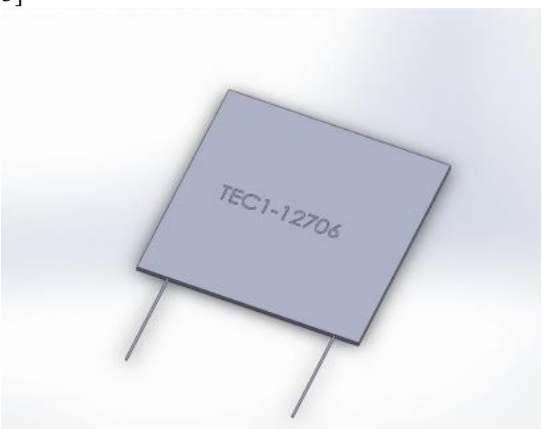


Fig. 3. Peltier Plate

4]

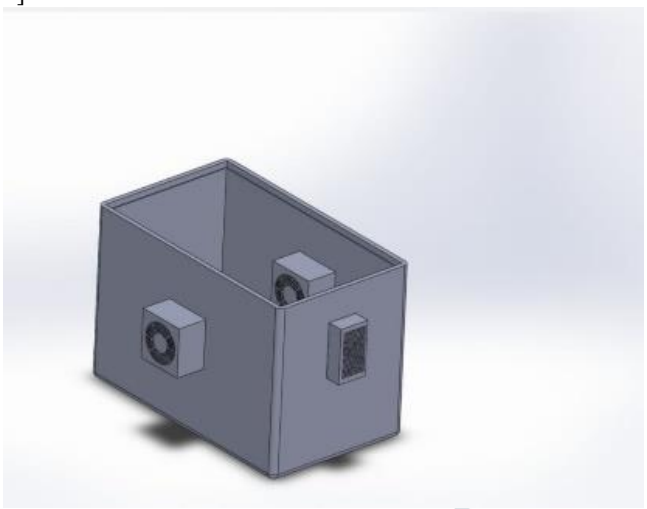


Fig. 4. Thermocol Ice Box

IV. RESULT & CALCULATION

1] Temperature difference vs. voltage result –

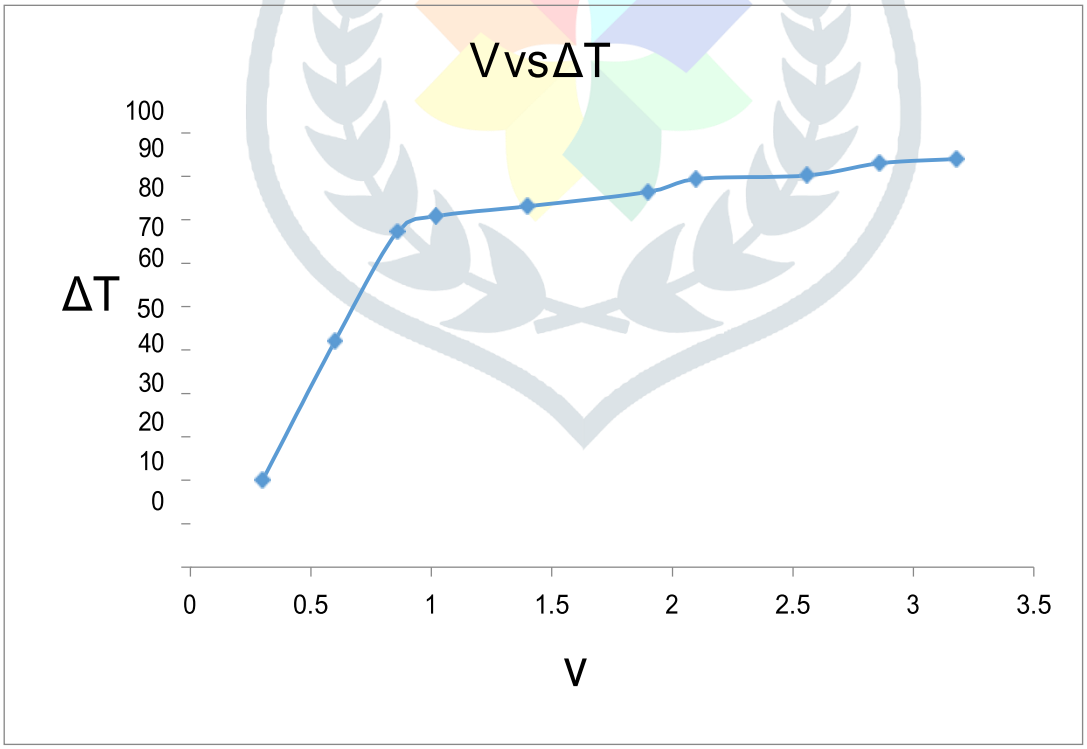


Fig. 5.Temperature difference vs. voltage graph

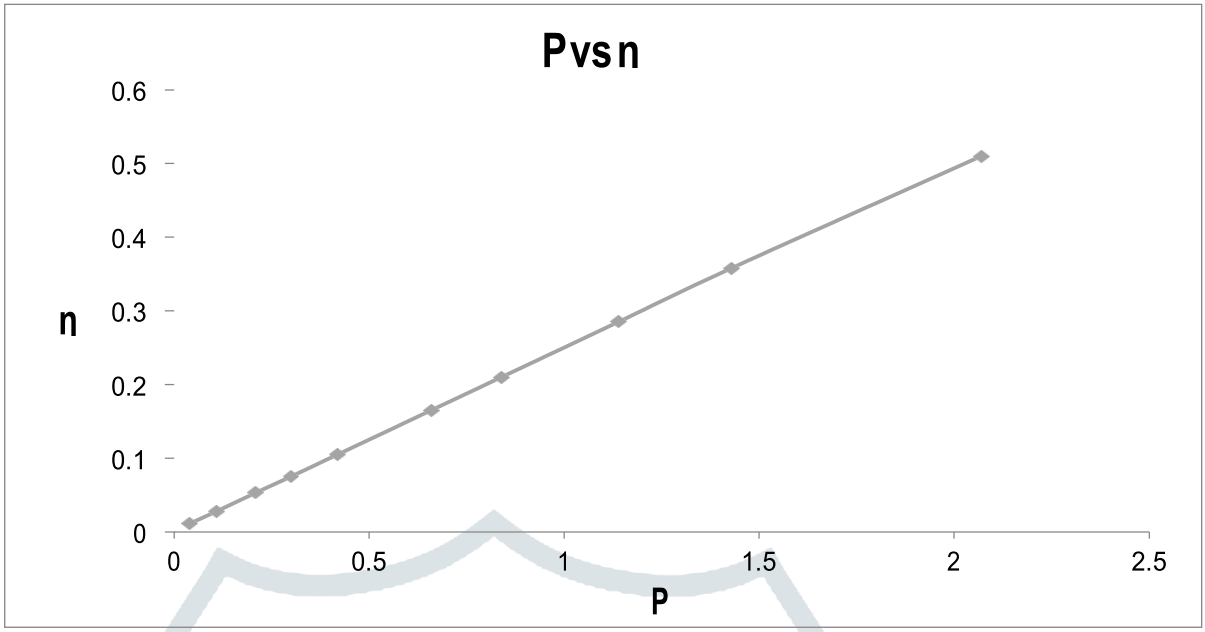
SR.NO	V(Output voltage),V	(Temperature difference)
1	0.30	20.0
2	0.60	52.0
3	0.86	77.3
4	1.02	80.8
5	1.40	83.1
6	1.90	86.4
7	2.10	89.4
8	2.56	90.2
9	2.86	93.0
10	3.18	94.0

[Reading of Temperature difference vs. voltage graph]

2] Power output vs. efficiency -

SR.NO	P(Output power),W	Qin(Input heat added),W	Efficiency, η=P/Qin
1	0.04	400	0.011
2	0.11	400	0.028
3	0.21	400	0.053
4	0.30	400	0.075
5	0.42	400	0.105
6	0.66	400	0.165
7	0.84	400	0.210
8	1.14	400	0.285
9	1.43	400	0.358
10	2.07	400	0.510

[Reading of Power output vs. efficiency]

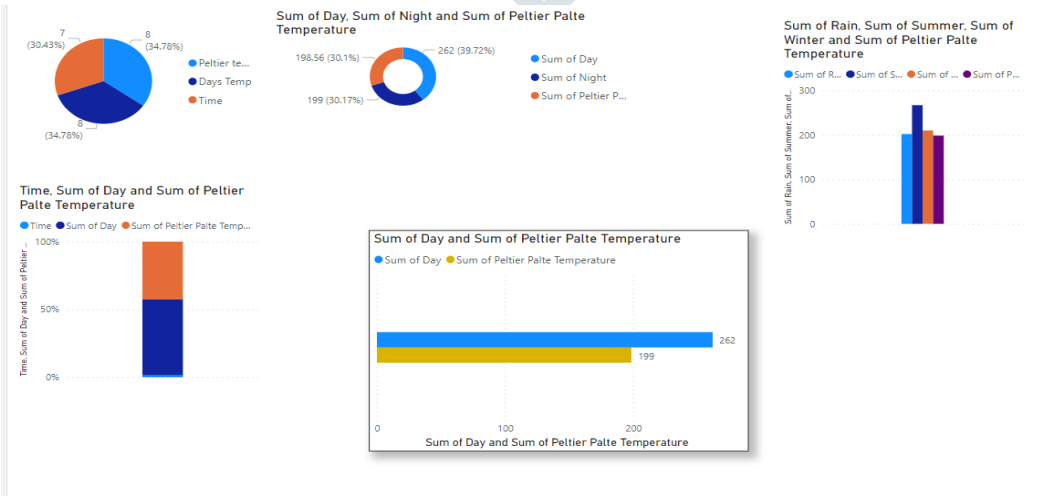


[Fig. 6. Power output vs. efficiency graph]

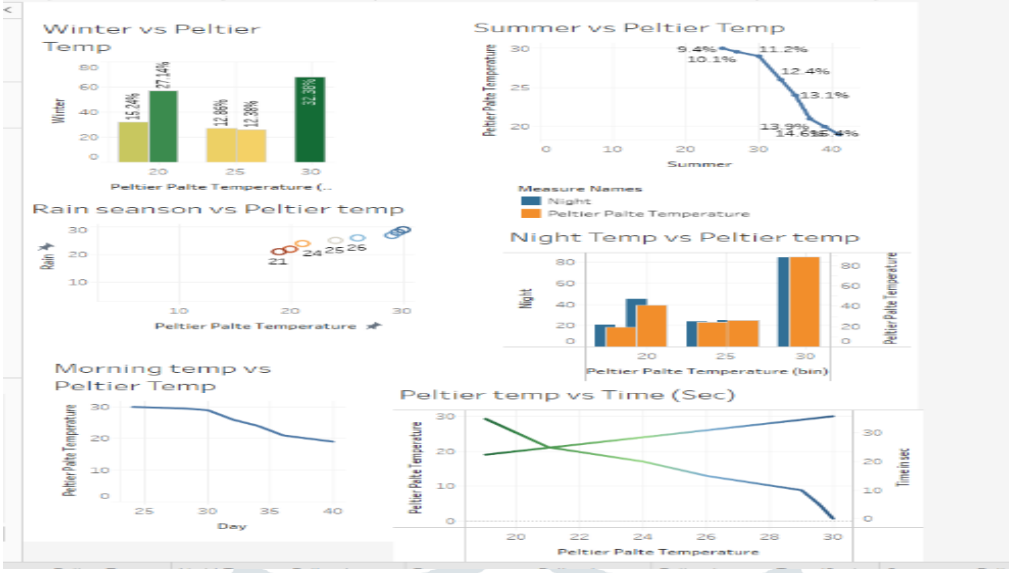
3] All weather conditions result -

Day	Night	Summer	Winter	Rain	Peltier Palte Temperature	Time in sec
24	30	25	21	29	30	0
28	28	27	23	28	29.56	5
30	26	30	24	27	29	10
32	25	33	26	26	26	15
34	24	35	27	25	24	20
36	23	37	28	24	21	25
38	22	39	29	22	20	30
40	21	41	32	21	19	35

[Reading of All weather conditions]



[Fig.7. Day-Night vs Peltier plate Graph]



[Fig. 8. All weather conditions graph]

V. CONCLUSION

Thermoelectric generation presents a viable energy source for space applications where other power sources are impractical. Photovoltaic systems offer higher efficiency than thermoelectric generators, but the latter are cost-effective, durable, and require minimal maintenance due to their solid-state nature. These generators find utility in electrical systems such as satellites, robots, and automobiles. Thermoelectric modules (TEMs) consist of numerous thermoelectric elements connected in electrical series and thermal parallel, generating high voltage proportional to temperature differences. However, thermal losses limit current flow between the hot and cold sides of the module. This research focuses on identifying TEM types and cooling systems that maximize power output by ensuring higher stability and efficiency. The proposed water-based cooling system exhibits superior stability and temperature maintenance capabilities, complementing the high-performance and efficiency of TEMs.

VI. REFERNCE

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