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Review on Android Application Based Peltier Cooling System for Medicine Safety

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Abstract: ***As the demand for heat-sensitive chemicals continues, ensuring their storage and transportation becomes increasingly important to maintain their effectiveness and safety. This article describes the Peltier cooling system as an Android application designed to improve the safety and reliability of drug storage during transportation. The proposed system combines the Peltier cooling module with a purpose-built Android application to monitor and control the temperature in the storage chamber. Peltier cooling components actively control the internal temperature based on instantaneous feedback from the temperature sensor. The Android app gives users an easy way to set the temperature, monitor the current temperature, and get instant notifications when there is a difference. The basic features of the system include fever measurement, temperature control and instant notifications. The Android app communicates with the Peltier cooling system using Bluetooth or Wi-Fi connection, allowing users to easily access and control the system from their smartphones. This allows doctors and staff supervising the delivery of temperature-sensitive medications to constantly monitor and control storage conditions.***

Keywords: Peltier effect, Thermoelectric energy, Thermoelectric cooling, Thermoelectric refrigerator, Thermoelectric generator, Thermoelectric effect.

I. INTRODUCTION

Android application-based Peltier Cooling System offers real-time temperature monitoring, alerting users to any deviations from the set parameters. The intuitive interface allows for easy customization of temperature settings, enabling healthcare professionals and facility managers to adapt to specific storage requirements. The system's energy-efficient Peltier modules contribute to sustainability efforts by minimizing power consumption while maintaining a consistent and precise temperature environment. In addition to temperature control, our application provides comprehensive data logging and analytics features. Users can access historical temperature records, aiding in compliance with regulatory standards and facilitating quality assurance. The seamless integration of the Peltier Cooling System with the Android application creates a cohesive and intelligent solution for pharmaceutical storage, ensuring that medications remain safe and effective throughout their shelf life. This innovative technology not only addresses the immediate needs of pharmaceutical storage but also aligns with the evolving landscape of healthcare digitization. With its user-friendly interface and robust features, our Android application-based Peltier Cooling System sets a new standard for medicine safety, offering a reliable and advanced solution for the storage and preservation of critical medications in diverse healthcare settings.

II. PROBLEM IDENTIFICATION

The pharmaceutical industry faces many challenges in ensuring the safe transportation and storage of heat-sensitive drugs. The current system's attempt to provide temperature control during transport raises concerns about the effectiveness and safety of important drugs. The lack of specialized monitoring resources in the current system leads to a gap in the ability of medical professionals to monitor and manage storage conditions. Manual intervention is a common practice that increases the risk of human error and the possibility of delays in responding to critical temperature. In addition, the complexity of existing systems and the lack of user relations prevent the effective use of technology. Lack of historical access and analysis can make it difficult to identify trends or potential problems in temperature control and impact assessment methods in a timely manner. Additionally, dependence on other factors (e.g. temperature) can lead to uncertainty about the storage conditions that should be used to control the drug. This combination of challenges underscores the urgent need for new solutions to improve the safety and efficiency of temperature-sensitive chemicals during transportation. Being aware of this requirement, the Android application-based Peltier cooling system emerged as a good way to solve the identified problems. The system brings a user-friendly and technological approach that aims to increase safety during transportation by closing existing gaps in control system, temperature, monitoring and data analysis.

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III. OBJECTIVES

The main goals of creating a Peltier cooling system as an Android application for medical safety are:

1) Create a Peltier cooler for chemical temperature control using an Android app.
2) Provides immediate notification for timely intervention to ensure drug safety during transport.
3) Contact your doctor remotely to check your temperature.
4) Record and review history using reliable data.
5) Explore integration with health systems to share data.
6) Optimize Peltier systems to improve energy efficiency and cost-effectiveness.
7) Make sure you comply with regulatory standards when storing your medicines.
8) Customized system for various temperature sensitive drugs.
9) Improve the safety of all pharmaceuticals in transit through technological innovation.

IV. LITERATURE SURVEY

1) Prof.Priti B.Ramteke, Mr. Chandan R Ojha, Mr.Balwant .R.Singh, Mr.Vivke Kumar, Mr. Paras. T. Patle(2017).
Design and Fabrication of Peltier Cooling System. International Journal for Scientific Research & Development(IJSRD)
Thermoelectric cooling system does not require working fluids or any moving parts. Thermoelectric refrigeration devices have a distinct place in medical applications, electronic applications, scientific equipment and other applications .The difference between the existing methods and this model is that a thermoelectric cooling system refrigerates without use of mechanical devices (Conventional Condenser fins and Compressor) and without refrigerant. The system consisted of the refrigeration chamber, thermoelectric modules, heat source and heat sink. A result which is a criterion of performance of such device is a function of the temperature between the source and sink

2) Saurabh Singh, Shubham Sharma, Soniya Gadwal, Swati Sharma, Tarun Kumar Chheepa (2018).
Utilization of Peltier Technology as Cooling System. International Journal of Creative Research Thoughts (IJCRT).
The characteristics of the cooling box are its simple application, maintenance, safe performance with autonomous power supply, convenient energy storage, no environmental pollution etc. In addition, comparing Peltier refrigeration system to the conventional refrigeration system, it makes the use of Peltier effect that doesn't require pumps, compressors and other moving parts and so there is no noise in the operation. A number of researches have been investigated to provide different cooling systems without use of chlorofluorocarbons as refrigerants.

3) Shaik Ahmad, Parankusum Chandra Sekhar, Ommi Srinivasa Rao, Mulampaka Bhaskar, Sirugudi Kiran Kumar(2019).
Design and Investigation on Portable Thermoelectric Air Chiller . International Journal of Engineering Trends and Technology (IJETT)
Environment friendly solutions are becoming more prominent as a concern regarding the state of our deteriorating planet. This paper introduces a new method of Refrigeration system which removes heat from the space in order to bring it to a lower temperature than surrounding temperature. This system uses "Thermoelectric cooling module(TEC)"which works on thermoelectric refrigeration, aims to provide cooling by using thermoelectric effect which states that when D.C voltage is applied across two junctions of dissimilar electrical conductors, heat is absorbed from one junction and heat is rejected at another junction which creates a temperature difference.

4) Narendra patil , Munot Hrushabh , Chetan Patil , Omkar Patil , Tushar Mahale , Deepesh Kumbhakarna(2019).
Design & Development of Thermoelectric Cooler Using Peltier Plate. International Advanced Research Journal in Science, Engineering and Technology(IARJSET)
The increase in demand for refrigeration globally in the field of air-conditioning, food preservation, medical services, vaccine storages, and for electronic components temperature control led to the production of more electricity and consequently an increase in the CO2 concentration in the atmosphere which in turn leads to global warming and many climatic changes. Thermoelectric refrigeration is a new different because it can reduce the use of electricity to produce cooling effect and also meet today's energy challenges. Therefore, the need for thermoelectric refrigeration in developing countries is very high where long life and low maintenance are needed. The objectives of this study is to develop a working thermoelectric refrigerator to cool that utilizes the Peltier effect to cool and maintain a selected temperature range .

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5) Yadav Harsh, Patel Abhishek , Moghariya Jainam, Trivedi Parth, Prof Amit Pandey(2021).
Study and Development of Refrigeration System by Using Peltier Module. International Research Journal of Engineering and Technology (IRJET)
The conventional refrigeration system gives high COP but releases harmful gases which leads to global warming. This issue can be solved using Peltier devices which are used as element for cooling, heating, power generation and has its name for many researches as it has simple structure, less mechanical moving parts, no refrigerant needed, possible to manufacture in small sizes. This present review paper deals with the study of thermoelectric refrigeration system compared to conventional refrigeration system available in the market and presents various literature review of many researchers in the field of thermoelectric refrigeration.

6) Prof. Ravindra Karwande, Mohammad Irfan Sumit Khandizod (2022).
Solar Air Conditioning System by Using Peltier Effect. International Research Journal of Modernization in Engineering Technology and Science. (IRJETS)
Solar air-conditioning is the way to reduce the demand for electricity, because this is based on the Peltier effect with which we can cool a specific area without using compressor which take a huge consumption of electricity. And this system is driven by solar energy using solar plates, battery, transformer Peltier module and heat sink. Air-conditioning is one of the major consumers of electrical energy in many parts of the world today and already today air-conditioning causes energy shortage. The demand can be expected to increase because of changing working times, increased comfort expectations and global warming. Air-conditioning systems in use are most often built around a vapour compression system driven by grid-electricity. However, most ways of generating the electricity today, as well as the refrigerants being used in traditional vapour compression systems, have negative impact on the environment.

7) Prof. N. B. Shaikh, Prajwal Bhausaheb Kandekar, Prajyot Bhagwan Kardak, Rushikesh Hiraman Jejurkar, Rameshwar Jadhav(2023). Smart Peltier Thermoelectric Cooling System. International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Refrigeration, including air conditioning and other conventional cooling systems are necessary in life and will continue to expand worldwide. But its impact on environment is huge as compare to its cooling purpose. In fact, one kilogram of the refrigerant has the same greenhouse impact as two tons of carbon dioxide, which is the equivalent of running your car for six months. Many efforts have already been made. However, reduction in CO2 emissions and fluorinated gas emissions are challenges to be addressed on an ongoing basis. 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. It is found by some researchers that Thermoelectric operated devices can be the best alternative in refrigeration technology due to their distinct advantages.

V. PROPOSED SYSTEM

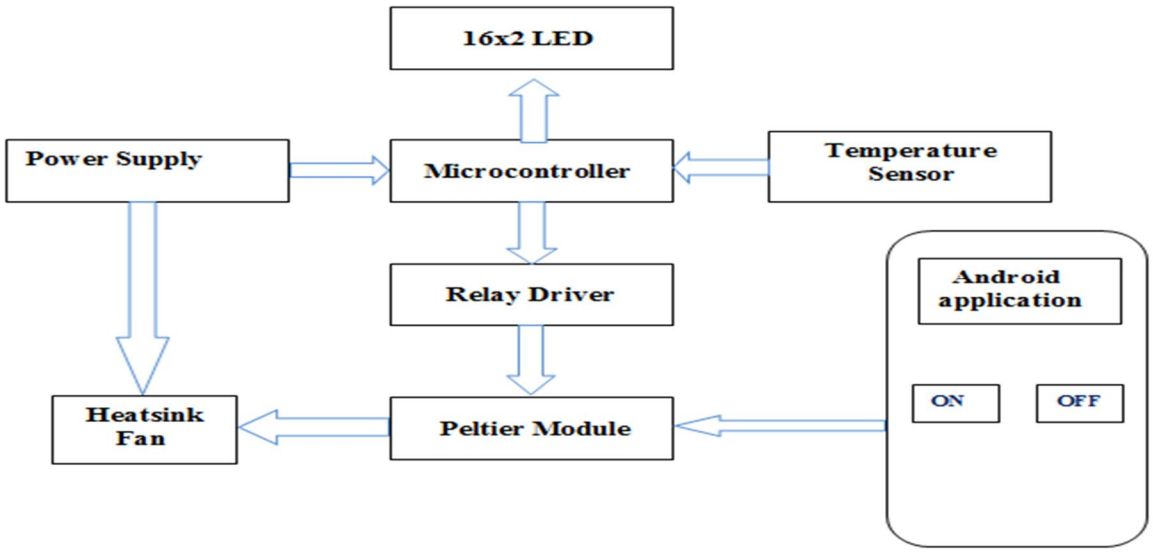

Fig. 1.1: Block diagram of the system

The Android application-based Peltier cooling system comprises an intuitive user interface on the mobile application, serving as the primary control hub. This interface communicates with a dedicated temperature control unit, responsible for managing the Peltier cooling modules. These semiconductor modules actively regulate the temperature within the medicine storage unit, monitored by strategically placed temperature sensors. The system includes a communication module facilitating seamless interaction between the Android application and the hardware components. A power supply unit provides energy to the Peltier modules, with the application potentially featuring power management capabilities. The integration of a data logging and analytics unit allows for the recording and analysis of temperature trends over time, supporting compliance and performance evaluation. An alarm system alerts users through the Android application in the event of temperature deviations beyond prescribed limits. This cohesive block diagram ensures precise and user-friendly control, real-time monitoring, and data-driven insights for optimal medicine safety.

VI. ADVANTAGES

The Android application-based Peltier cooling system for medicine safety offers several advantages:

1) Remote Monitoring: Users can monitor the medicine storage remotely through the Android application, providing real-time updates on temperature conditions.
2) Remote Control: The system allows users to adjust and control the temperature settings of the storage unit remotely using the Android application.
3) Real-Time Alerts: Immediate notifications are sent to the application in case of temperature deviations, enabling quick response to prevent damage to medications.
4) User-Friendly Interface: The Android application provides an intuitive interface, making it easy for healthcare professionals to manage the system efficiently.
5) Data Logging and Analytics: The system records temperature data over time, aiding in compliance with regulations and providing valuable insights into temperature trends.
6) Energy Efficiency: The application may include features to optimize power usage, contributing to energy efficiency in healthcare settings
7) Customizable Settings: Users can customize temperature settings based on the specific requirements of different medications, ensuring optimal storage conditions.
8) Integration with Healthcare Systems: The system can be integrated with broader healthcare information systems, enhancing coordination with other medical devices.
9) Enhanced Medicine Safety: Precise temperature control and monitoring ensure the safety and efficacy of stored medicines, especially for temperature-sensitive medications, vaccines, and biopharmaceuticals.
10) Adaptability: The system is adaptable to various healthcare settings, providing a versatile solution for medicine safety in hospitals, clinics, pharmacies, and research facilities.

VII. CONCLUSION

In conclusion, the Android application-based Peltier cooling system emerges as a sophisticated and indispensable solution for ensuring the safety and efficacy of stored medicines. The system's integration with a user-friendly Android application enables seamless remote monitoring and control, empowering healthcare professionals with real-time insights into temperature conditions. The provision of immediate alerts in case of deviations, coupled with customizable settings and energy-efficient features, enhances the adaptability and efficiency of pharmaceutical storage. The data logging and analytics capabilities not only contribute to regulatory compliance but also offer valuable data-driven insights for continuous improvement. Overall, this innovative system represents a significant advancement in medicine safety, providing a comprehensive and user-centric approach to temperature control in diverse healthcare settings. As we navigate an increasingly digitized era in healthcare, the Android application-based Peltier cooling system stands as a reliable and intelligent ally in safeguarding the integrity of medications critical to patient health. The user-friendly interface of the Android application ensures that healthcare professionals can easily navigate and customize temperature settings based on the specific requirements of different medications. This level of customization is paramount in preserving the optimal conditions for diverse pharmaceuticals, contributing to overall medicine safety and efficacy.

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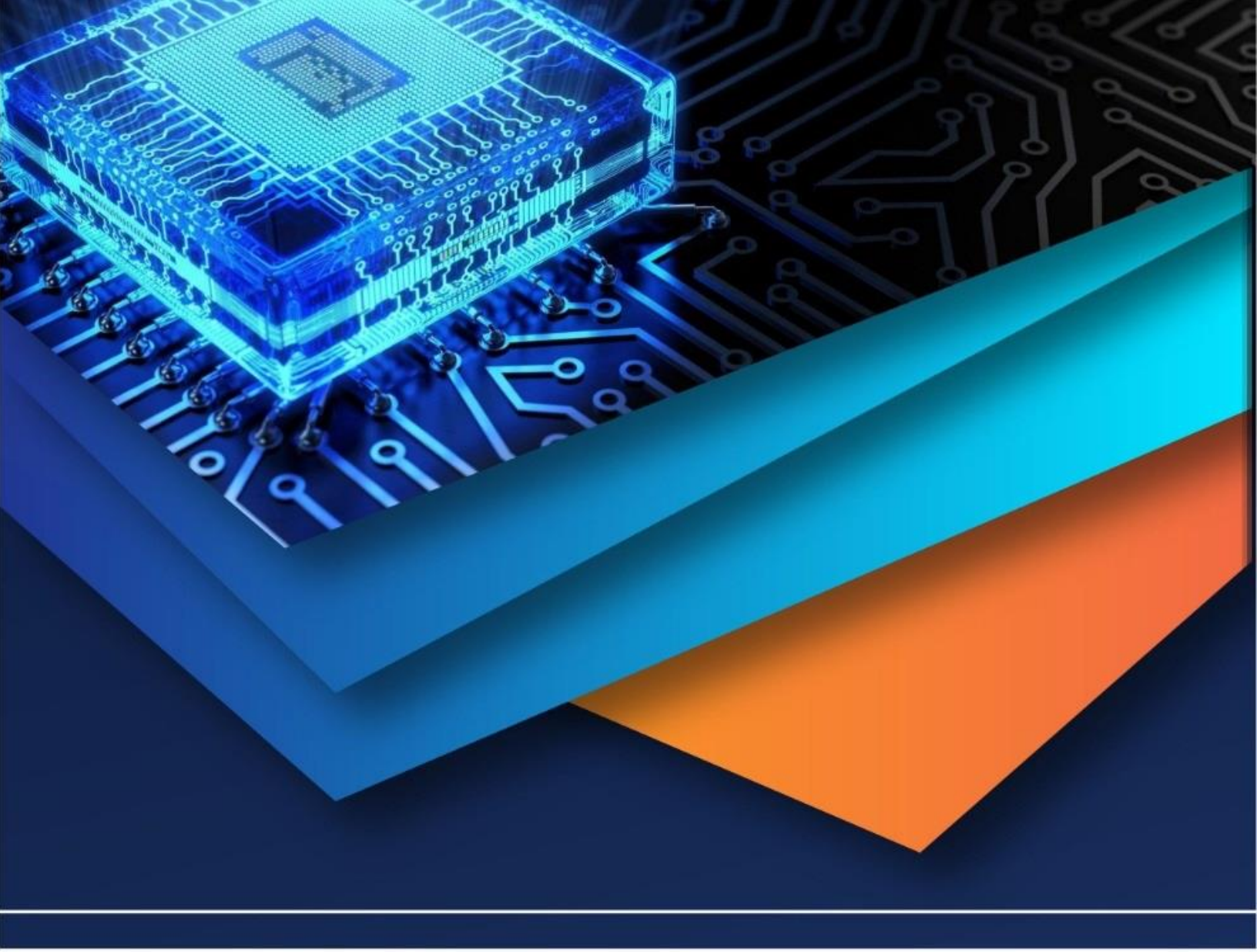

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