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# Triangle-Shaped Peltier Water Cooler for Temperature Control

**Triveni Asapure, Zaiba Telgi, Shabnam commissioner**

Department of Electronics and Telecommunication Engineering, VVP Institute of Engineering, Solapur, India

Department of Electronics and Telecommunication Engineering, VVP Institute of Engineering, Solapur, India

Project Guide, Department of Electronics and Telecommunication Engineering, VVP Institute of Engineering, Solapur, India

**ABSTRACT:** This paper presents a compact and eco-friendly triangular water cooling system utilizing a Peltier thermoelectric module. The triangular design enhances space efficiency and thermal management. A microcontroller monitors temperature and controls the cooling operation. The prototype demonstrates a cost-effective and refrigerant-free cooling solution applicable for laboratories and portable devices.

**KEYWORDS:** Peltier effect, thermoelectric cooler, temperature control, microcontroller, energy efficiency.

## I. INTRODUCTION

The demand for compact and sustainable cooling systems is increasing in modern applications. The thermoelectric effect, also known as the Peltier effect, enables direct conversion of electrical energy into a temperature gradient. Unlike vapor-compression systems, Peltier coolers are solid-state, eco-friendly, and reliable. This work focuses on designing a triangular-shaped water cooling system that leverages the Peltier effect to achieve efficient heat transfer and automated temperature control.

## II. SYSTEM DESIGN AND COMPONENTS

The proposed system comprises a Peltier module (TEC1-12706), aluminum triangular cooling block, heat sink with fan, microcontroller unit, temperature sensor, and power supply. The triangular structure improves water flow and compactness. The system layout ensures effective heat dissipation from the hot side using a fan-assisted heat sink, while the cold side cools the water in the reservoir.

| Component | Specification |
|---|---|
| Peltier Module (TEC1-12706) | 12V, 6A |
| Cooling Block | Triangular aluminum plate |
| Heat Sink + Fan | For hot side cooling |
| Microcontroller | Arduino UNO |
| Temperature Sensor | LM35 / DHT11 |
| Power Supply | 12V, 10A |
| Water Pump | DC 5–12V |

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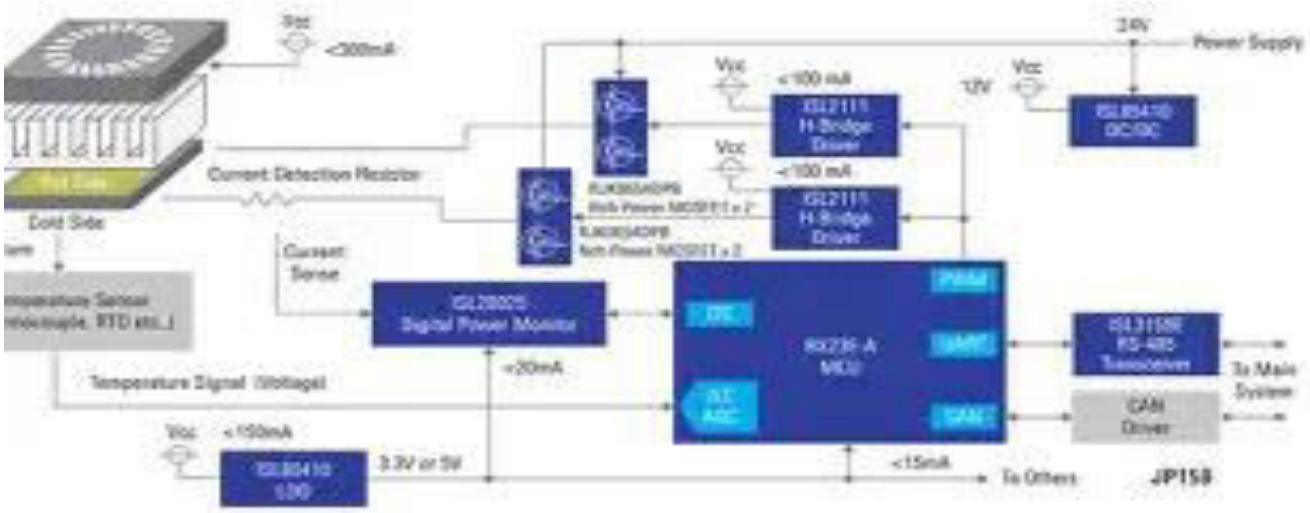


## III. WORKING PRINCIPAL

When DC voltage is applied to the Peltier module, heat is absorbed on the cold side and released on the hot side. The cold side is attached to the water block, reducing the water temperature. The hot side heat is dissipated via a heat sink and fan. A temperature sensor continuously monitors water temperature and sends feedback to the microcontroller, which activates the Peltier through a relay when the temperature exceeds a threshold.

## IV. APPLICATIONS

- Portable beverage coolers
- Laboratory sample preservation
- Cooling for electronic components
- Medical specimen storage
- Compact personal coolers

## V. RESULTS AND DISCUSSION

Experimental evaluation showed that the system achieved a cooling difference of approximately 10–15°C below ambient within 15 minutes. The triangular design improved heat transfer and minimized thermal losses. However, efficiency remains limited by Peltier module constraints, requiring effective heat dissipation for optimal performance.

## VI. FUTURE SCOPE

Further research can enhance efficiency using multi-stage Peltier configurations and advanced fin geometries. Integration with IoT modules would enable remote monitoring, while renewable energy sources like solar power could improve sustainability.

## VII. CONCLUSION

The triangular Peltier-based water cooler successfully demonstrates a low-cost, compact, andeco-friendly cooling mechanism. Its performance and design make it suitable for small-scale cooling applications where portability and simplicity are prioritized.

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