

# A Study on the Self-Heating Water Bottle Using Embedded Temperature Control System

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## Abstract

**Aim:** To suggest a design for a self-heating water bottle that can heat water when needed without the use of external power.

**Method:** The system first considered a Peltier-based heating strategy, which was later enhanced with a nichrome wire-based system for increased efficiency. A microcontroller-based temperature monitoring system and automatic cut-off mechanism were suggested, along with a small battery setup utilizing a 3D-printed triangular holder.

**Results:** Although Peltier modules showcased successful heating and cooling capabilities (in 60 min, 1 L of water was cooled from 40°C to 16°C and another litre was heated from 25°C to 45°C) (Mazhar, Ubaid, Shah, Masood, & Alvi, 2023), a variety of studies have shown that nichrome is efficient because it is flexible, making it easy to fabricate the required component design, and because of its lower power consumption in comparison to the Peltier module. (Lim, Han, Thang, Lee, & Shin, 2024). This study was developed as a foundation for future design ideologies to pitch their innovation, experiment, and bring to the market a product capable of the aforesaid features.

**Keywords:** Self-heating Bottle, Nichrome Heating, Embedded System, Temperature Control, Thermal Insulation, Portable Heating Device.

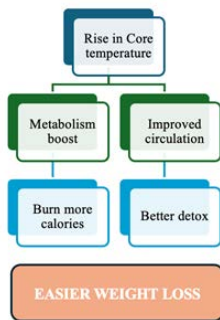
## Introduction

Recent studies and research papers show the latest trend in India for using warm water during lunch, breakfast, and heavy dinners. This also aligns with Ayurvedic health practices in India. Many dieticians prescribe warm water for gut health and weight reduction. The latest trend in India and other Asian countries is drinking warm water on an empty stomach, which has been proven to improve gut health and is highly influenced by traditional Indian Ayurvedic medicines and Japanese water therapy techniques (Suchitra, Balachandar, & Parthasarathy, 2023).

Water is used to control body temperature, helps transport oxygen and nutrients to cells in the body, enhances lubrication of joints, and helps flush out waste from the kidneys and liver in the human body. It is important to understand that water helps dissolve nutrients and minerals needed for growth and development (Suchitra, Balachandar, & Parthasarathy, 2023). Obesity has become a pandemic among teenage children and young adults worldwide.

Obesity causes metabolic changes and increases the risk of disorders such as diabetes hypertension, and various other disorders. Recent studies have shown that drinking water reduces weight and lowers total energy intake in the human body (Bhatia & Saraswati, 2019). As shown in most studies, water is a major catalyst for maintaining the body, shape, and figure and controlling weight management (Bhatia & Saraswati, 2019).

Studies show that warm water helps to raise the temperature, boosting metabolism, burning calories, and reducing weight. This enhances blood circulation and detoxification (Patel, Patel, Patel, & Sen, 2015).



**Figure 1.1 Wonders of Warm Water (Patel, Patel, Patel, & Sen, 2015)**

It is the most important catalyst in losing weight and maintaining a perfect body figure because it increases body temperature, resulting in a faster metabolism. Key benefits of drinking water identified in studies include reduced constipation through intestinal relaxation, potentially increased metabolic rates, and pain relief for ailments such as muscle spasms or cramps. Most French and Japanese traditions show that drinking hot water during and after meals reduces cancer risk and has great health benefits. Cold water consumption can change the oil particles in food and slow down the entire digestion process in the human body. The enzymes responsible for digestion break down and get absorbed in the intestine. (Goyal, 2016).

The self-heating water bottle comes into picture, by aiding the process of heating this water required by individuals. The dependency and requirement of an external device to heat water can be omitted, as the vessel that stores water can heat water. It makes it not only handy and a quick fix, but also a discipline marker, helping goal-oriented individuals (those that decide they are going to drink only warm water

henceforth) focus on the routine intake of warm water without having to find excuses or not having access to warm water in their day-to-day activities.

### Literature Review

Suchitra, Balachandar, & Parthasarathy. (2023). Intake of hot water after each meal as a weight reduction strategy – a prospective randomized controlled trial. *An International Journal of Biomedical Sciences*. This journal explains an experimental study about how warm water after meals plays key role in the reduction of body weight and BMI. This study shows two groups of people classified as warm water drinkers (group H) and regular water drinkers (group C). The study concluded that warm water helps in the reduction of body weight and, thereby, BMI. This journal supports the idea of self-heating design, as every individual in the H group was required to drink warm water after every meal. The bottle aims to reduce the hassle and make hot water readily available, without waiting over an induction stove or kettle.

Bhatia, S., & Saraswati, S. (2019). Effect of Japan Water Therapy Infused with Cinnamon on Body Weight, Waist/Hip Ratio, And Body Mass Index Of Overweight And Obese Subjects. *Asian Journal of Pharmaceutical and Clinical Research*. This journal proposes an experimental study to test the efficiency of the intake of water; water infused with cinnamon(A), warm water(B), and regular water(C). Based on the type of water consumed, the groups were divided into A and B as the test groups and C as the control group. The experiments confirmed that infusing cinnamon with warm water helped reduce body weight and waist-hip ratio to a significant level compared to those consuming regular water. Here, the study proves the necessity of warm water for better digestion and metabolism, helping in weight loss and body fat reduction.

Goyal, N. N. (2016). Srijan. Retrieved from Srimca.edu.in: <http://srimca.edu.in> This article discusses the significance of drinking water in general and comments on the practice of drinking water during and after meals. Although cold water is a good drink after a heavy meal, the author throws light on the effects of cold water on food. Cold water solidifies the oils and fats in the food consumed, and the intestine is quick to absorb this over the actual solid food consumed. This forms a fatty layer in

the intestine, causing various degrees of ailments, including heart attacks. French and Japanese women practice drinking warm water, tea, or soup with meals to ease and aid the digestion process rather than interrupting and causing adversities. The design of the self-heating water bottle takes inspiration from the article, making it easy to access hot water quickly without having to rely on other electrical devices.

Patel, S., Patel, J., Patel, M., & Sen, D. (2015). Say Yes to Warm for Remove Harm: Amazing wonders of two stages of water! *European Journal of pharmaceutical and medical research*. This study explains the benefits of consuming warm water and its healing effects on individuals. Traditional Ayurvedic medicine promotes the drinking of warm water, especially in the morning, as it helps clear buildups, eases the intestines, and helps in bowel movement. The authors mentioned five key advantages of drinking warm water: cleansing digestion, aiding constipation, alleviating pain, shedding excess pounds, and improving blood circulation. The design aims to help deliver warm water or water at desired temperatures for the suggested benefits of Ayurvedic medicine.

Piggott, A. (2025). How Thermoelectric Cooling Works. This source explains the efficiency of thermoelectric systems (Peltier module), and the real world limitations faced while experimenting with them. Few common issues are thermal and electrical constraints. Even though there are major trade-offs, the source explains its technical fit in engineering experiments and has succeeded in achieving cooling mechanisms.

Popkin, B., D'Anci, K., & IH, R. (2010). Water, hydration, and health. *Nutrition Reviews*. This study highlights the importance of water and regular hydration. Water intake affects the body more than what we presume. Various levels of water intake affect health, energy, and overall human functioning. The significance of regular hydration in the prevention of immune-related diseases reveals the shift of a large population to choosing water over caloric beverages. Regular hydration, along with a few health-cautious steps, such as the preference of warm water over cold water, facilitates a healthy and balanced lifestyle. (Popkin, D'Anci, & IH, 2010)

## Methodology

This study is an experimental investigation that

used a review-based model to constantly review concepts of existing literature with empirical tests. This study proposes a model for testing under controlled conditions.

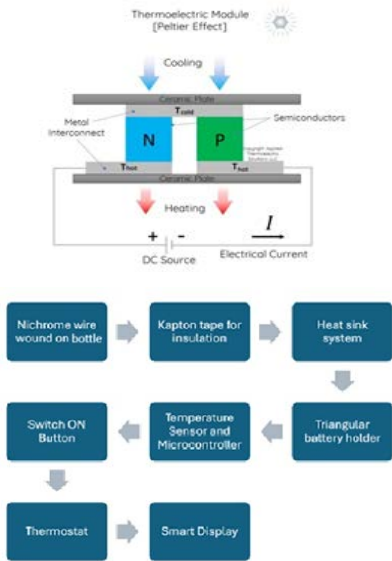
The authors have attempted to develop a prototype of a self-heating water bottle that can be used for lifestyle changes towards improving the living standards and quality of life of the GenZ population and across all milestones in human development. The main aim of this research is to enable the user not to depend on an external system for the immediate implementation of a healthy lifestyle.

The main component of the first pitch was a Peltier module. Owing to the conclusions that rendered the module not feasible, a new element was introduced. Nichrome wire, used in the well-known home appliance kettle, is utilized here as the next key component.

## The Peltier Module Explained

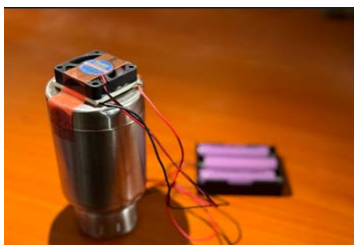
In 1834, Jean Charles Athanase Peltier discovered the Pelletier effect. In the original experiment, the construction included two variants of metal connected and electrical current passing through it. This connection resulted in the heating or cooling of the junction, depending on the direction of the electric current. Currently, all thermoelectric modules utilize semiconductors instead of metals. In this study, the researchers used a Peltier module to explain their prototype of a self-heating water bottle (Piggott, 2025).

The Peltier effect, a semiconductor phenomenon in which heat is transferred between two surfaces of a device when an electric current flows through it, is the basis of thermoelectric cooling and heating. A Peltier module comprises several pairs of P-type and N-type semiconductor elements (referred to as couples). One side of the module absorbs heat (becomes cold), and the other side releases heat (becomes hot) as current flows between these couples. By altering the direction of the current flow, this impact can be reversed. The ceramic plates enclosing the semiconductor couples offer effective heat transfer, electrical insulation, and structural support. To increase the overall heating or cooling capability of the module, hundreds of these couples are usually coupled. Researchers can investigate applications such as self-heating or self-cooling water bottles, where regulated heat transfer can be employed to manage the temperature of the liquid, by comprehending this idea. (Piggott, 2025).



**Figure 1.1 Wonders of Warm Water (Patel, Patel, Patel, & Sen, 2015)**

The initial idea used a Peltier module for heating, a heat sink system to prevent the Peltier module from being overheated and damaged, a temperature sensor and microcontroller to monitor the temperature and turn off the heating at a predetermined threshold, and a power supply to power the entire system. It was only partially successful because it required frequent charging and the power supply backup was the problem. If the power supply was larger, it became heavy and challenging to fit into the bottle's design. Moreover, the heat sink required for the apparatus kept becoming larger as internal heat is a parameter that is to be kept checked. This disabled the idea of portability and therefore the concept of the Peltier module was in vain. (Lim, Han, Thang, Lee, & Shin, 2024)



**Figure 3 Showing the Self-heating Water Bottle Prototype**

A novel heating system comprising nichrome wire and Kapton tape for insulation was developed.

The nichrome wire was coiled around the bottle in a helical manner and sandwiched between the Kapton tape layers. This system is effective because it does not use a lot of power, is flexible, and is lightweight. A unique 3D-printed architecture for the battery enclosure was created to fit the batteries. More space would be saved if the batteries were arranged in a triangle rather than a straight line. Therefore, it was decided to 3D print a battery holder that was shaped like a triangle. Here, the same heat sink system but not a very bulky one—fan and heat sink paste—was employed, as the heat management here was minimal.

An automatic heat supply cutoff was also designed to prevent overheating and heating system damage. It comprises a microprocessor and a temperature sensor. A button is used by the user to turn on the heating system. The microprocessor turns off the supply when a predetermined threshold is reached. This procedure can also be simplified by applying the thermostat principle. A display that shows the time, temperature, and other information can be added to the user interface to make it more aesthetically attractive.

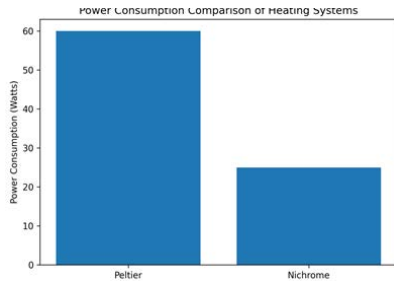
**Table 1 Listing the Components**

Component	Function
Nichrome Wire	Heating element
Temperature Sensor	Monitors water temperature
Microcontroller	Controls heating + cutoff
Battery	Provides power
Heat Sink + Fan	Prevents overheating
Kapton Tape + Mica	Thermal insulation

**Conclusion and Limitations of the Study**

This study provides an alternative to the primitive idea of heating water in a bottle. The initial idea was to use the heating ability of the Peltier module to heat the water on demand. While showing results to an extent, the construction had its own limitations, which included the bulky nature of the entire construction, the requirement of more power and the heating up of the Peltier module itself. To rectify and solve the above challenges, a new Smart Self-Heating Water Bottle was constructed. This prototype can be used by other research students and scholars to experiment, improvise, and prove the

model's feasibility for market use. The Nichrome wire used in the Smart Self-Heating Water Bottle requires precision during handling. More limitations can be observed if the experiment is conducted with many users.



**Figure Showing Power Consumption Comparison**

**Table 2 Comparison for Peltier and Nichrome Wire**

Parameter	Peltier Module	Nichrome System
Power Consumption	High	Low
Weight	Heavy	Lightweight
Efficiency	Moderate	High
Portability	Poor	Good
Cost	Expensive	Affordable

### Future Scope and Suggestions

The proposed design is a cornerstone for further experiments and developments. This can include the integration of IoT and a few ML algorithms to make it both smart and intelligent. The current conception of battery design and utilization can be upgraded to solar chargeable batteries and kinetic energy harvesters, optimizing the power consumption and bulkiness of the entire product.

The aesthetics of the product can also be

engineered to make it look appealing while considering the ergonomic improvements of the device. Moreover, safety-related mechanisms, such as power shut-off, thermal fuses, pressure-releasing systems, and water-resistant electricals, can be added to ensure safe operation.

Proper insulation of the bottle enabled the temperature to last longer, thereby saving the extra battery and power needed for repeated cycles.

### References

- Bhatia, S., and S. Saraswati. "Effect of Japan Water Therapy Infused with Cinnamon on Body Weight, Waist/Hip Ratio, and Body Mass Index of Overweight and Obese Subjects." *Asian Journal of Pharmaceutical and Clinical Research*, 2019
- Goyal, N. N. Srijan. 2016, Srimca.edu.in.
- Lim, J., et al. "Customizable Nichrome Wire Heaters for Molecular Diagnostic Applications." *MDPI*, vol. 14, 2024
- Mazhar, A., et al. "Investigation of the Simultaneous Cooling and Heating Using a Thermoelectric Peltier." *MDPI*, 2023, p. 4.
- Patel, S., et al. "Say Yes to Warm for Remove Harm: Amazing Wonders of Two Stages of Water!" *European Journal of Pharmaceutical and Medical Research*, 2015
- Piggott, A. "How Thermoelectric Cooling Works." 2025.
- Popkin, Barry, et al. "Water, Hydration, and Health." *Nutrition Reviews*, Aug. 2010, p. 30. PubMed
- Suchitra, Balachandar, and Parthasarathy. "Intake of Hot Water after Each Meal as a Weight Reduction Strategy – A Prospective Randomized Controlled Trial." *An International Journal of Biomedical Sciences*, 2023.

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