

Design and Development of Multi Purpose Smart Water Bottle

Namrata Swargari*, Atharva Achrekar**, Parth Atulkumar Shah***

*(Masters in Integrated Product Design, Anant National University, Ahmedabad
Email: namrata.swargari@anu.edu.in)

** (Masters in Integrated Product Design, Anant National University, Ahmedabad
Email: atharva.achrekar@anu.edu.in)

*** (Assistant Professor, Manager Makerspace, Anant National University, Ahmedabad
Email: parth.atulkumarshah@anu.edu.in)

Abstract:

Travel enthusiasts who like to go to different places for hiking, trekking or for other outdoor activities often find it difficult to either have access to clean drinking water or to have the perfect water temperature. Especially in places with diverse temperature, one often struggles to have water in an ideal temperature; it is either too cold or sometimes too warm. This study experimented a possible way to help outdoor enthusiasts to consume safe drinking water in their preferred ideal temperature by having a smart water bottle with peltier module which enables a dual feature that allows to either warm or cool the water, along with an auto filtration device for purifying the water if some bad agents are found in the water. This paper presents the system architecture of the smart bottle and the results derived from the preliminary testing of the mock up prototype device.

Keywords — Travel, Smart bottle, Water bottle, IOT, Peltier, Filtration.

I. INTRODUCTION

With the passage of time, however, comes the necessity to upgrade and develop new technologies. While travelling, hiking, camping or trekking people consume both warm and cold water depending on the climatic temperature. To consume a hot liquid nowadays, we must either carry it in a thermos, purchase it fresh, or have access to a heating source and vice versa for having cold water. [1].

The proposed idea is to have a smart water bottle which has temperature sensors where it can sense the water temperature inside the bottle and with the help of peltier module it can cool down or warm up the water to a desired temperature. This desired temperature can be preset manually and the

temperature adjustments will be done automatically.

As an additional accessory we proposed to have a portable water filtration device that can be used as and when required in places where clean hygienic water availability is critical. It might be beneficial or rather necessary to disinfect the water to kill waterborne germs before using it.

II. PROBLEM IDENTIFICATION

Exposure to both very warm and cold temperatures could be harmful for certain health conditions and not having to drink water in a preferable temperature level might make a person fall sick. Purchasing hot water fresh or cold water is not always a viable option due to rising costs, a lack

of businesses to purchase a bottle, and the hot or cold liquid's own scarcity in certain locations.

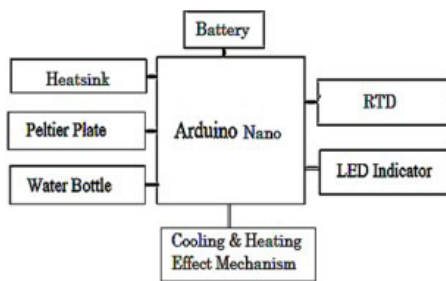
Because access to a heat source in a cold place is not always feasible and vice versa in a warm place, carrying a thermos or buying it every time cannot be relied upon as a long-term solution.[1]

There is high possibility of exposure to contaminated water in visiting remote places either for camping, hiking or travelling in general. Drinking polluted water might pose multiple health threats like diarrhoea, vomiting, and stomach pain. Treating these symptoms might be tough sometimes in case if it's in a remote location without having access to medical treatment.

III. LITERATURE STUDY

The rapid development of the Internet of Things (IoT) of smart devices with physiological sensors enable reliable monitoring of temperature. Peltier modules, also known as thermoelectric coolers (TEC) or thermoelectric modules (TEM), are solid state devices which transfer heat when electrical power is applied. [2]. Thermoelectric module can convert heat energy to electrical power directly. Compared with other methods Thermo Electric Modules (TEM) possesses the salient features of being compact, light-weighted, noiseless in operation, highly reliable, maintenance free, and involving no moving or complex parts. It is environment friendly operation, free of carbon dioxide emission and radioactive substances and does not contribute to the depletion of natural resources. [3]

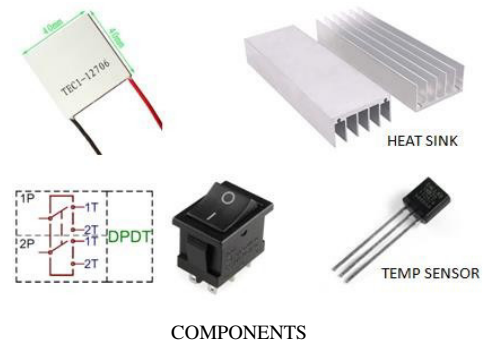
IV. WORKING PROCESS



SYSTEM ARCHITECTURE DIAGRAM

A. Components Used For Heating and Cooling System

- 1) Peltier Module(TEC1-12706)
- 2) DPDT switch
- 3) Aluminium Heat Sink
- 4) Arduino Board
- 5) Battery
- 6) Temperature Sensor (DS18B20)
- 7) Relay Driver
- 8) LED Display



COMPONENTS

B. Components For Filtration Process

- 1) Activated Carbon Filter
- 2) Mini Water Pump



C. Figures and Results

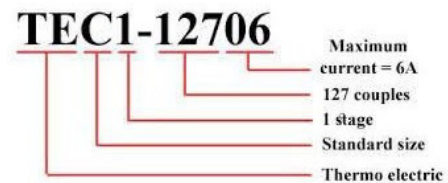


FIG 1. PELTIER MODULE NAMING[8]

Heating and Cooling through Peltier Module

The same peltier module [Fig 1] that was used for actual circuit modelling may be utilised to generate both heating and cooling modules. A Peltier module

is a thermoelectric semiconductor device that uses the Peltier Effect to operate. According to this effect “If DC voltage is supplied to the junction of two different types of semiconductor material, then due to movement of positive and negative charge carriers’ heat is transferred from one side to other side of module and because of this one side of module gets heated and other side gets cold. [4]

With the help an external H-bridge (here example, with the help DPDT relay switch) we can achieve heating as well as cooling on the same side of the peltier module.

This peltier module will be permanently connected to the bottom end of the bottle as seen in fig2.and on the other end of the peltier heat sink (alluminium) will be connected.



FIG.2

Water Filtration Process

With the help of activated carbon filter and water pump which will be an additional accessory to the bottle, which would pump the contaminated water in the bottle after filtration.

V. WORKING OF PROTOTYPE MODEL

Here we've one bottle purchased from the market. We've 3D printed the bottom red part according to the purchased bottles dimension to accumulate components and pack. In this case we are going to power the device by 5V power supply adopter.

With the help of DPDT switch heating and cooling is achieved. The Peltier module is connected with aluminium fins and bottle with the help of thermal conductive tape which will help to transfer the temperatures from Peltier to the components. The necessity of the fins is to transfer

heat to the surroundings so that it will achieve a cooling process inside the bottle.



FINAL WORKING PROTOTYPE MODEL



3D PRINTED BOTTLE BASE WITH COMPONENTS

VI. CONCLUSIONS

The experiment carried out in this proposed system with a focus on IOT and smart technology systems, and the results obtained helped in achieving the desired outcome of both heating and cooling of water within a single bottle structure. The study in this paper explains the application of peltier technology and how it's effects can be utilized. Peltier system having a low power impact and high output also makes peltier module a good electronic component for power saving. This concept of carrying a smart bottle with such dual feature might be quite beneficial to many travelers, hikers or trekkers who are always on a go to different places and faces the problem of having water in their desired ideal temperature. The whole process of working and experimenting with arduino boards, peltier technology and doing 3d printing to generate a working prototype gave us a detailed and practical insight into the functioning of a smart product. It also helped us understand the accessibility and usability of a smart product from a users point of view.

ACKNOWLEDGMENT

First, I would like to appreciate the constant support of my co-partner in this research study. The successful completion of this project would not have been possible without our senior mentor and

active assistance from Professor. Parth Atulkumar Shah who was quite detrimental in carrying out the project experiments from start to end.

I am grateful to have colleagues who extended their help in carrying out this project work.

I would also like to extend my appreciation to all the people who indirectly inspired us to carry out this research at the first place.

REFERENCES

- [1] J. Gupta, S.Paul,Dr.B.Bhattacharyya, "Implementation of a Smart Flask Using Induction Heating and Arduino Micro-Controller," International Journal of Electrical Engineering and Technology, 11(4), 2020, pp. 377-383
- [2] B.Rose, Reliability Considerations for Peltier Modules.[Online].Available:<https://www.cuidevices.com/blog/reliability-considerations-for-peltier-modules>
- [3] Prof. S.N Divekar, Dr. V.N. Patil, Prof. S.B Puri, R.R Pawar, S.A Shinde, M.R Ujagare , " Portable Water Bottle Heating and Cooling System ,"International Journal of Scientific Research in Science, Engineering and Technology(IJSRSET), Print ISSN : 2395-1990, Online ISSN : 2394-4099, Volume 7, Issue 3, pp.389-393, May-June-2020.
- [4] V.Waghmare1, S. Walujkar2, K. Patil3, Prof. D.Narsale, "Water Purifier using Peltier Module," International Research Journal of Engineering and Technology (IRJET), Vol: 06 Issue: 04 | Apr 2019
- [5] S.Vishwakarma, A.Goud, "A Literature Review on: Smart Bottle using IOT," International Journal of Computer Sciences and Engineering, Vol.7, Issue.6, pp.300-302, 2019.
- [6] Smart Water Sensors to monitor water quality in rivers, lakes and the sea, Libelium(2018,July 09)[Online] Available :<http://www.libelium.com/smart-water-sensors-to-monitor-waterquality-in-rivers-lakes-and-the-sea/>
- [7] L.Louis.(2016),"Working principle of arduino and using it as a tool for study and research", International Journal of Control, Automation, Communication and Systems(IJCACS), Vol.1, No.2.
- [8] Rakesh. B. K. , Anuj Shayan , Mithun Sharma. M. N. , Mohan. M. , Vinay Karthik, "Study, Analysis and Fabrication of Thermoelectric Cooling System", <https://www.ijedr.org/papers/IJEDR1605065.pdf>.