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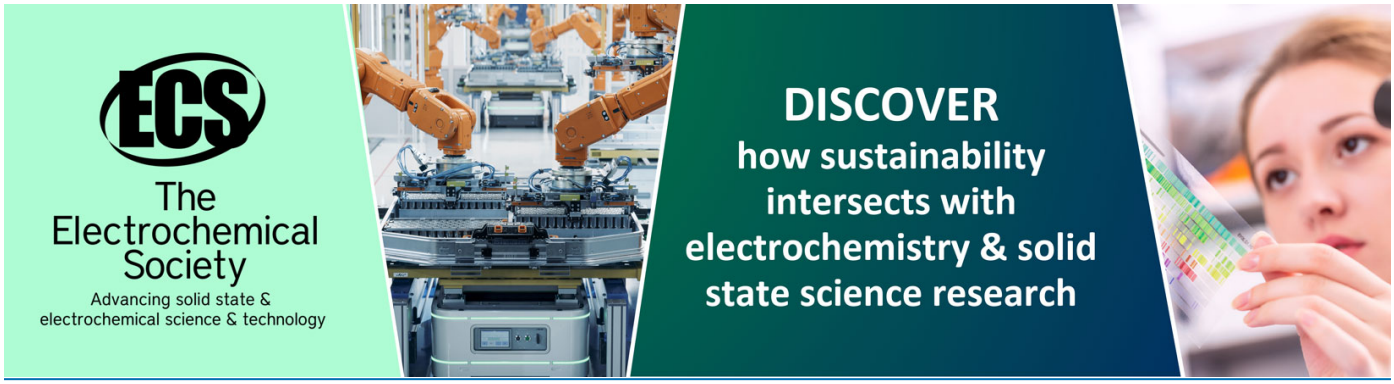

IOP Conf. Series: Materials Science and Engineering **864** (2020) 012216 doi:10.1088/1757-899X/864/1/012216

Portable Water Cooler with Water Heater Using Thermoelectric and Arduino Uno And Powered Using Power Bank

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Abstract. The purpose of this study is to use water cooler and water heater to improve the convenience of the user so that they can use the water cooler and mobile water heater properly and comfortably. This study focuses on how refrigeration and water heaters use thermoelectric pads as a cooling and heating medium. Peltier works when the voltage is flowing from the power bank. The temperature difference on the surface of the processor allows the heat to occur at a fast rate. Arduino uno is used as a voltage regulator and temperature sensor to improve product performance. concept designs are designed, created and evaluated. The final prototype will include some markers that will be used as temperature readings by cooling and heating. Based on the results shown, the prototype can achieve the desired result with optimized energy consumption. When the temperature supplier produces a good temperature, the amount of water temperature will rise and the heat in the water will reach thermal equilibrium until the cold and hot temperatures reach a better minimum. Therefore, the temperatures in the cold and hot areas are more efficient in achieving thermal equilibrium in rising water.

1. Introduction

Water is very important for the body in everyday life because our body uses water in all its cells, organs, and tissues to help regulate its temperature and maintain other bodily functions. This is because your body loses water through breathing, sweating, and digestion, it is important to rehydrate by drinking fluids and eating foods that contain water[1]. Or yourself, as a business owner, you should consider investing a bottle of water specially designed for cold water and warm water only using the power bank that we often use in the day.

This research is to design and produced a product to provide cold and lukewarm drinks in two separate containers and can be taken anywhere as well as operating on a power bank. The purpose of this product is to make it easier for users to use it. For example, in the workplace does not all have water coolers and water heaters. Often, office workers spend most of their working day viewing computer screens and complicated tasks that require a lot of focus. As a result, they are trapped in their task of forgetting the basics like having a glass of water. Focusing on tasks is not a bad thing, but not

getting enough water can affect one's ability to perform tasks while working. If you are worried about the health and well-being of your employees or yourself, as a business owner, you should consider investing a bottle of water specially designed for cold water and warm water only using the power bank that we often use in the day.

With two different water temperatures, you can choose according to the temperature of your body to drink. There are two conditions to drink when cold water or warm water is for example Dr Neha says, 'Never drink cold water while eating food. When you drink cold water immediately after meals or along with a meal, your body spends a lot of energy in increasing its temperature [2]. This slows the digestion process, which may cause indigestion. Warm water is also important for the body. Besides, not the warm water only has its advantages and disadvantages, but the cold water also has its own goodness and disadvantage. For example, 'Avoid drinking warm water after a bout of exercise. As your body temperature is already high post workout, drinking cold water will lower the temperature of your body.' explains Dr Neha [2]. Therefore, this product is very suitable in the various conditions and temperature of your body.

There are plenty of collections of multifunctional water bottles in various facilities. We choose the essential savings base to become our target product category. Because of this category, all our multifunctional products are lightweight, able to carry anywhere and easy to prototype. All product functions are easy to understand and control.

1.1. Problem Statement

Water is very important for the human in everyday life. This is because your body loses water through breathing, sweating, and digestion, it is important to rehydrate by drinking fluids and eating foods that contain water [3]. This product is created in smaller sizes, so it is easy to handle by the user. This product is made in smaller sizes for easy operation by the user. This is because size factors also as a role for the user. If it has a portable water container it has made it easy for users to use it anytime and anywhere. In summer, people need cold water to do their work in a comfortable environment. So, we need a portable soft drink cooler. Not having enough water can affect a person's ability to perform a task. Instead of, if you are working in a very cold environment like in the office, it needs warm water to lower your body temperature. Therefore, this product is suitable for all conditions and your body temperature. In addition, if you have portable hot water, it can also help you get warm water everywhere.

1.2. Example of Existing Design

Product designers should instead modify existing designs, rather than design new ones. This modification to produce high quality products whether previously successful or unsuccessful design.
The cooling and heating effect produced by thermoelectric cooling performance analysis (TEC) for high power electronic packages such as processors. Two sets of analytical solutions for TEC is based on the TEC module parameters. The system constraint in intended is the junction temperature Tj at constant cooling power Qc and for Qc at constant Tj, respectively. Besides that, the iterative procedure that are often reported in literature. The fact that the solutions can be obtained without using the pellet thermoelectric parameters and geometric details [4, 14, 18].

Udo FritschJames J. J. Costello Et al has made the product thermoelectric cooler and warmer. The thermoelectric and heat-resistant system with a unique ventilation system to distribute cool or warms air throughout the unit so that there is no hot or cool place, the door are installed so that they can be easily opened with either front or front door, lids or door handles that can be operated easily and reliably, and or the configuration of the unit does not balance the unit so that it can be easily mounted with a door or end with a lids or front door so that it can be used gradually as a conventional chest or as a mini fridge mobile or heating unit. As such, these invention assemblies are designed to provide unique combinations of components that allow selected units to be placed at the end as refrigerators [5]. Figure 1 show application of thermoelectric cooler and warmer customized for food storage.

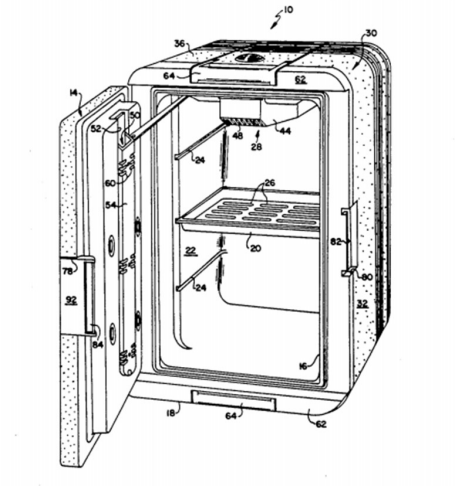

Figure 1. Application of thermoelectric cooler and warmer for food storage [5].

1.3. Summary of Existing Design

The product has been studied and analysed with the product creator and as the product creator to enhance the existing product. The idea has been adopted to make a product more sophisticated and more comfortable for consumers.

The concept of temperature control consists of two concepts: cooling / heat thermoelectric and Arduino Uno. Both concepts are very important in the success of cold / hot water products. Thus, the thermal conductor of the peltier plays a role in cooling and heating the water so that the target temperature is reached. Arduino Uno also acts as a programming medium for product control systems. Among the advantage of Arduino Uno are:

Cheap – Arduino board (hardware) is usually sold relatively cheap compared to other pro microcontroller platforms. If you want to be cheaper, you can certainly make it yourself and it is very possible because all resource to make your own Arduino are available on the Arduino website even on other Arduino community websites. Not only suitable for Windows, but also works well on Linux.

Simple and easy programming – Keep in mind that programming environments in Arduino are easy to use for beginners and are flexible enough for these who are advanced. For teachers/lecturers, Arduino is based on a Processing Program environment, so if a student or students are accustomed to using Processing, of course it will be easy to use Arduino.

2. Methodology

First and foremost, the first step in the methodology is to select the title and statement of the current problem of the selected title. Then set the project objectives and scope for the project to work well. The next step is to review the literature, which is important to study information related to water cooling machine products. If the information obtained is inappropriate, it should refer to the title. If the information obtained is appropriate, the next step is to implement the methodology. After that we had 3 ideas and one idea was selected by Pugh Method. The best ideas cover 3 concepts namely cooling systems, electrical controls and frames or casing. Subsequently, these ideas were translated into technical drawings for material selection and fabrication. After fabrication is complete, performance testing and verification can be done.

The design process is very different between different project and designs [6-10, 12, 16, 20]. Most of the designs created have their own description of the design process but most resemble the other design. Thinking is a design methodology that provides a solution-based approach to solving

problems. It is useful in dealing with complex or unknown problems, by generating many ideas in brainstoming sessions and by using a hands-on approach to prototyping and testing [13, 15,17].

2.1. Concept of Idea Generation

Concept A use only the thermoelectric peltier cold part only and use a 12V fan to blow the hot air out of the cooler parts is more efficient. This concept does not use arduino uno control where more efficient cold temperatures depend on blowing hot air. This container concept uses plastic and creates low cost for water containers. Figure 2 shows concept A for idea generation.

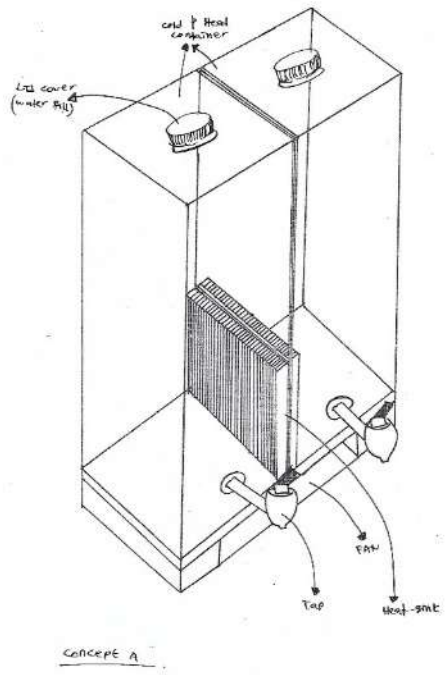

Figure 2. shows concept A for idea generation.

Concept B uses a peltier thermoelectric with cold and hot parts that produces cold and hot water. Heat containers are made from perspex while containers for cold water are made from plastic containers. In addition, the concept uses the arduino uno control to achieve stable temperatures. The concept also uses a 12V water pump to transfer water through a block of water in cold and hot sections. Figure 3 shows concept B for idea generation.

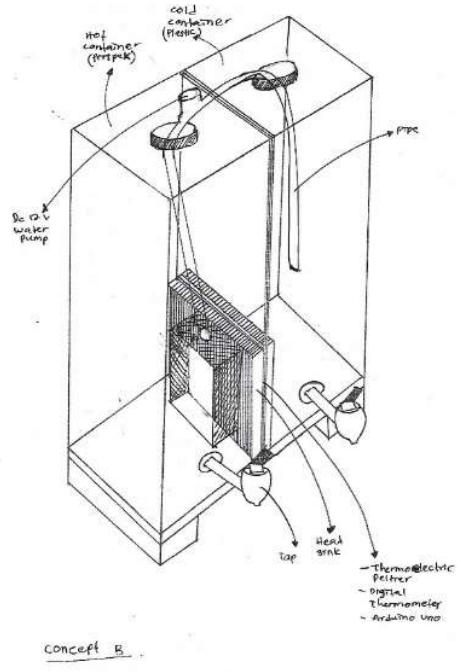

Figure 3. shows concept B for idea generation.

The C concept also uses both cold and hot peltier parts. This concept uses arduino uno control achieve stable temperatures. In fact, this concept uses the power bank as a power supply. Both cold and hot containers made from Perspex cost higher than concept B for water containers. Figure 4 shows concept C for idea generation.

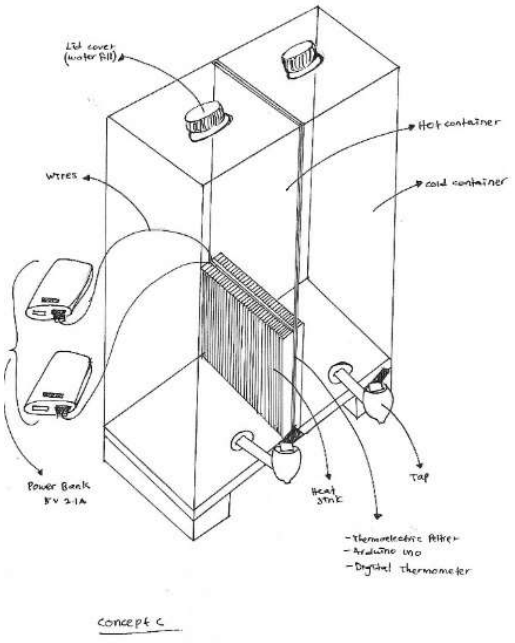

Figure 4. Shows concept C for idea generation.

2.2. Concept of Idea Generation

The method used in the idea selection is the Matrix Assessment Method. During the scale evaluation process 0 to 3 are used. Scale 4 represents the highest score while scale 0 shows the lowest score. The overall score calculation for each design concept is shown in the table below. Table 1 shows the Pugh method for selecting the best idea [6].

Table 1. Pugh Method for Select The Best Idea

Selection Criteria		Design Concept		
		Idea A	**Idea B**	**Idea C**
Using Thermoelectric Peltier	1. Arduino Uno	0	0	3
	2. Controlled via relay module	0	0	3
	Rating = 4	0	0	24
Portable	3. Capacity of the water cooler	1	3	2
	4. Able to carry the water cooler to anywhere	3	3	3
	Rating = 3	12	18	15
Cost	5. Manufacturing cost	3	2	1
	6. Casing cost	1	3	2
	Rating = 2	8	10	6
Flexibility	7. Cold water	3	3	3
	8. Hot water	0	3	3
	Rating = 1	3	6	6
Total of Pluses		**23**	34	51

From design evaluation, idea C has the highest score compared to others. Therefore, this design will be selected among other design concepts. The reason why the concept is chosen is because it uses a thermoelectric peltier system where the temperature can be controlled for cooling or heating while the B and C concepts do not use a thermoelectric peltier system that can produce two different temperatures at the same time. Therefore, the score for using a thermoelectric peltier is 24. For mobile scores, the concept C is 15 while the cost and flexibility score are 6.

3. Results and Discussions

3.1. Water Temperature Using Power Bank

The beginning of the test process was to include a power supply connected to a thermistor, Arduino UNO and a temperature sensor. In the process of testing this product, the Arduino UNO is used to detect temperatures in the cold and heat. This process is performed by the Arduino UNO which is a microcontroller used. After power supply is turned on, readings on hot and cold boats are recorded to obtain data from the test process.

This is the data of the result testing which combined both data of hot and cold side of the temperature measurements. Below shows data of temperature testing in Table 2.

Table 2. Data of Temperature Testing

Time (minutes)	**Temperature (Degree Celsius) / %Power Bank**	
	Cold Side	Hot Side
0	23.80	23.80
1 (9:24 P.M)	26.69 (%100)	26.56 (%75)
2	26.50	26.50
4	26.19	26.69
6	25.81	27.00
8	25.50	29.00
10	25.12	31.50
12	25.00	32.88
14	24.00	33.15
16	24.94	33.19
18	24.94	33.25
20	24.94	33.50
22	24.94	33.75
24	24.94	33.88
26	24.87	34.50
28	24.87	34.75
30 (9:50 PM)	25 (%74)	37.38 (%70)

From table 2, the data of water temperature is the same water temperature in the first minutes at 0 minutes of the reaction for all two different temperatures in the cold site and hot side that are 23.80ºC. At 1 minutes the temperature started to change with using power bank 100% at cold site and 75% at Hot Side. In the 6 minute the cold side temperature begins to decline, while the hot side temperature begins to rise. The final record data temperature, at 30 minutes can record the percentage of power bank used and the temperature of both sides. A programmable microprocessor for controlling the temperature type and length of cycle, quick disconnects for the therapy pad, a thermoelectric cooler with a liquid heat exchanger and a pump for circulating the fluid through the system[6, 19].

3.2. Effect of Reaction Conditions on the Reaction Rate of Water Temperature Using Power Bank

From Table 2, it shows that reaction temperature at 30 minutes in the cold side of 25ºC, while in the hot side of 37.38ºC. The recorded data is then transformed into a 2-line graph representing hot and cold side data.

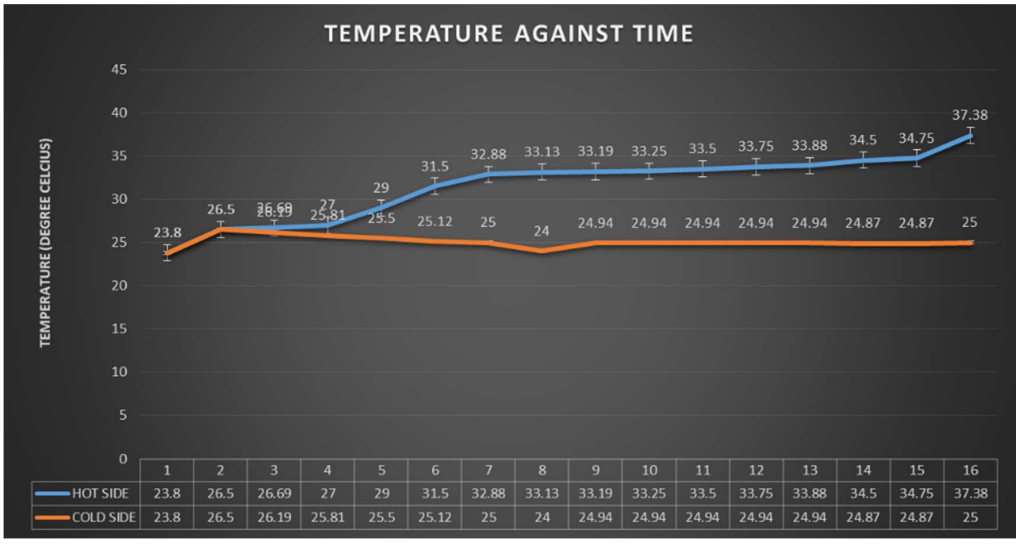

Figure 5. Effect of different temperature of the temperature over time.

The graph temperature against time for this hot and cold side shows the difference temperature readings that occur when the thermoelectric peltier is connected to the power supply. In the beginning, the graph shows the temperature on the cold side decreased while the temperature on the hot side increase. This is due to the opposite of temperature movement from both data. On the hot side, the graph starts with room temperature and uniformly ascending from the first minute to reaching 34ºC in 15 minutes. While on the cold side, the graph starts from room temperature in the first minute and decrease to 24ºC after 8 minutes. After 9 minutes, the cold side temperature become higher. This is because the heat does not release well. Figure 5 show graph temperature over time.

The result is same with previous research. The method for this product to be tested and the results of the difference temperature generated by the temperature peltier. The difference between both side of the temperature can be clearly seen based on the graph temperature against time. Therefore, the project was ready to test and retrieve both temperature data.

4. Conclusions

Through the temperature tested, we can find that, the cooling temperature would increase slowly after reaching a minimum of 24ºC, while the heating temperature would increase slowly after reaching a minimum of 31.5ºC. Therefore, the recommendation to maintain a lower temperature in the cold / hot areas is to use a more efficient peltier on both containers. This is because when the peltier is more efficient, the cold and hot temperatures will reach a higher level of capability. When the temperature supplier produces a good temperature, the amount of water temperature will increase and the heat in the water will reach the thermal equilibrium resulting in the cold / hot temperatures reaching a better minimum. Therefore, the temperature in the cold / hot section will be more efficient in achieving thermal equilibrium in rising water. For the second proposal, heat sinks are also a factor in changing the temperature because as the heat sink size increases, heat will have more space to flow in the heat sink. This causes both temperatures to flow into the container more effectively.

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