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## e-PROCEEDING

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## Thermoelectric Powered Watch

Nur Allysa Sofea Muhammad Jeet Iskandar, Nur Shahirah Sohaimi, Nurul Iman  
Mohamad Zaki, Zulisha Sofia Zulkifli and \*Nurkhaizan Zulkepli

Centre of Foundation Studies, Universiti Teknologi MARA, Cawangan Selangor,  
Kampus Dengkil, 43800 Dengkil, Selangor, Malaysia

\*Corresponding author: [khaizan2821@uitm.edu.my](mailto:khaizan2821@uitm.edu.my)

### ABSTRACT

Nowadays, wearing a watch is like an essential item for everyone, whether it is to remind people of the time or for accessories. However, watches sold on the market are still using non rechargeable batteries, which could lead to an increase in e-waste as users have to change their watches' batteries every time they run out of energy. Moreover, if these e-wastes aren't disposed of properly, they will harm the environment. Therefore, we have decided to create a ZAIS watch, a thermoelectric-powered watch where a thermoelectric generator will be installed within our watch mechanism. Then, it will collect the heat from our body, generate the heat energy to electric energy, and power the watch. Next, the electric energy will be stored in a rechargeable battery that will also be installed in our watch mechanism. This product is made to reduce the cost of changing our watches' batteries, reduce e-waste, and practice the usage of renewable energy sources in daily appliances. We believe that this innovation would bring a lot of benefits to everyone.

**Keywords:** thermoelectric; electric generator; rechargeable battery.

### 1. INTRODUCTION

A thermoelectric generator module is a solid-state device that converts thermal energy directly into electrical energy (Progress in Energy and Combustion Science, (2022)). Thermoelectric is defined as relating to, or dependent on phenomena that involve relations between the temperature and the electrical condition in a metal or in contacting metals. When two metals are placed in electric contact, electrons flow out of the one in which the electrons are less bound and into the other. There will be a current if the temperature of one of the junctions is raised with respect to that of the second. To maintain the temperature difference, heat must enter the hot junction and leave the cold junction. The problem statements are battery dies quickly and e-waste will increase. Battery waste is one of the problems that the world faces today. Based on watches sold in the market, the batteries that power the watch don't really last long, for this reason we created this thermoelectric powered watch. This watch will convert thermal energy directly into electrical energy. Aside from that, the cost to recycle e-waste will increase is one of the problem statements. If these E-wastes aren't disposed of properly, it will harm the environment. Our lives are becoming ever more electrified. All of those electronic devices will end up as e-waste sooner or later, letting the e-waste stream grow immensely and making it the fastest-growing waste stream worldwide. If the amount of e-waste is increasing, we need to use a lot of energy and money to make sure the e-waste is disposed of properly.

## 2. METHODOLOGY

For the mechanism of our thermoelectric powered watch, thermoelectric generators are used. Thermoelectric generators are solid-state semiconductor devices that convert a temperature difference and heat flow into a useful DC power source (Alfred, 2022). These thermoelectric generators are placed at the base of the watch and under the watch strap. The base of a thermoelectric generator is a thermocouple. A thermocouple is made up of one p-type semiconductor and one n-type semiconductor. The semiconductors are connected by a metal strip that connects them electrically in series. The thermoelectric generator utilizes the Seebeck effect. The Seebeck effect is the direct energy conversion of heat into electrical energy. The Seebeck effect occurs due to the movement of charge carriers within the semiconductors (Alfred, 2022). In doped n-type semiconductors, charge carriers are electrons and in doped p-type semiconductors, charge carriers are holes (Libre texts, 2021). Charge carriers diffuse away from the hot side of the semiconductor to the cold side of the semiconductor. This diffusion leads to a buildup of charge carriers at one end. This buildup of charge creates a voltage potential. The voltage potential is then stored in the rechargeable battery. The voltage that is stored in the rechargeable battery is then used to power the watch. Through our invention, the problem of needing to change watch batteries often and increasing e-waste can be reduced.

## 3. RESULTS AND DISCUSSION

Thermoelectric powered watch has a thermoelectric generator and a rechargeable battery that allows us to generate electricity continuously without needing to change the battery at all. This battery can be charged with the renewable energy source which is our own body heat. The thermoelectric generator converts heat flux (temperature differences) directly into electrical energy. Using a thermoelectric generator as an electricity generator has many benefits. First of all, thermoelectric generators are the direct energy conversion. This makes thermoelectric generators less mechanically complex than some other energy conversion technologies (Alfred, 2022). Other than that, thermoelectric generators are more reliable. Thermoelectric generators are solid-state devices. Having no moving parts to break or wear out makes them very reliable. Plus, thermoelectric generators can last a very long time (Alfred, 2022). To add on, thermoelectric generators are also compact in size (Alfred, 2022). This leads to greater design flexibility and saves more space. So, by using a thermoelectric generator as an electricity producer for our watch we can create a better watch that can work more efficiently and productively in our lives. Our target people for this product are nature lover people and people that do not have time to spare for changing their battery. This product has high marketability since watches are always growing in its versatility and function throughout the passage of time. Our product offers a great innovation that can contribute a great impact in protecting our world.



**Figure 1.** Front view



**Figure 2.** Side view

#### 4. CONCLUSION

To conclude, this watch innovation was created to reduce the cost to change our watches' batteries as we are using a thermoelectric generator powered directly by our body's heat. After that, this innovation can reduce e-waste because this watch is generated by a thermoelectric generator instead of batteries. Then, this innovation could practice the usage of renewable energy as the thermoelectric generator is powered by heat which is a renewable energy as we could obtain it through our body's heat. This watch could be more convenient for users as they won't need to change their watch's batteries every time the batteries run out of power.

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