Wireless Thermal Charging Device

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Introduction

The project title is wireless thermal charging device. The purpose of this project is to convert body heat to electrical energy to power LED. Simply by skin contact, LED can be powered by body heat. Thermal energy is converted to electrical energy. Then, the electrical energy is further processed to power the LED. To convert Thermal energy to electrical energy, Peltier tiles were used. Peltier tiles have two types of semiconductor blocks. There are P and N types between two ceramic boards. When one side is heated, the temperature difference causes electrons to move, resulting in a current. The circuit has an oscillator circuit, a transformer and a LED.

Design

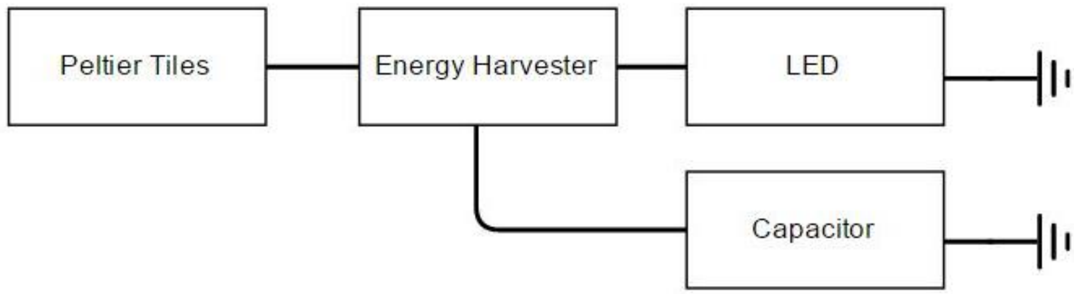

Figure 1: Block Diagram of Wireless Thermal Charging Device

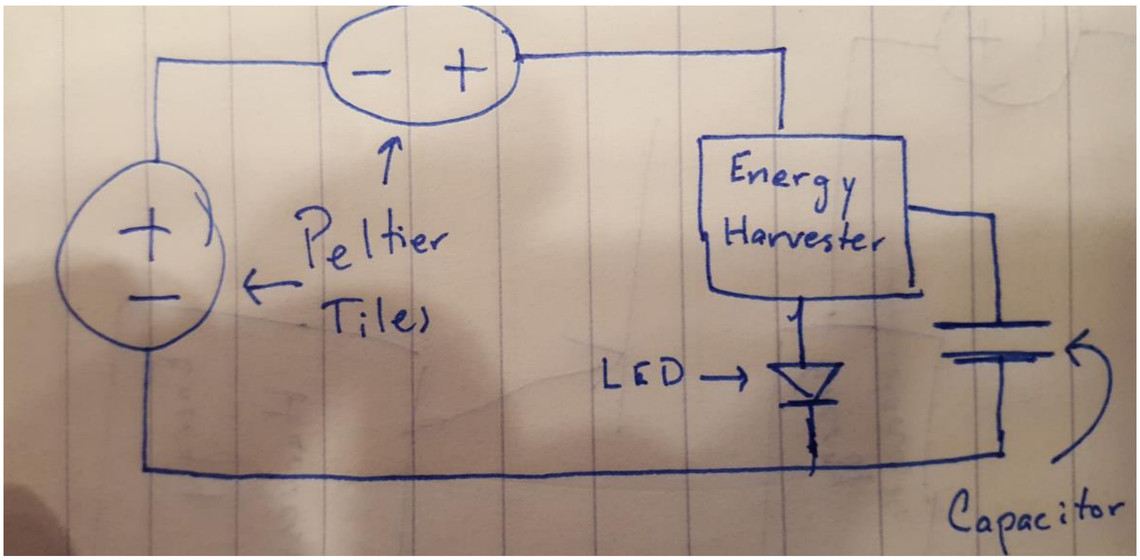

Figure 2: Circuit Schematic

Figure 1 shows the basic block diagram of Wireless Thermal Charging Device. Figure 2 shows the basic circuit schematics of the device. The two Peltier Tiles in series are connected to the Energy Harvester Chip. The chip boosts up the voltage and turns on the LED. The left over voltage charges the capacitor. When the Peltier Tiles no longer supply voltage to the chip, the capacitor powers the LED.

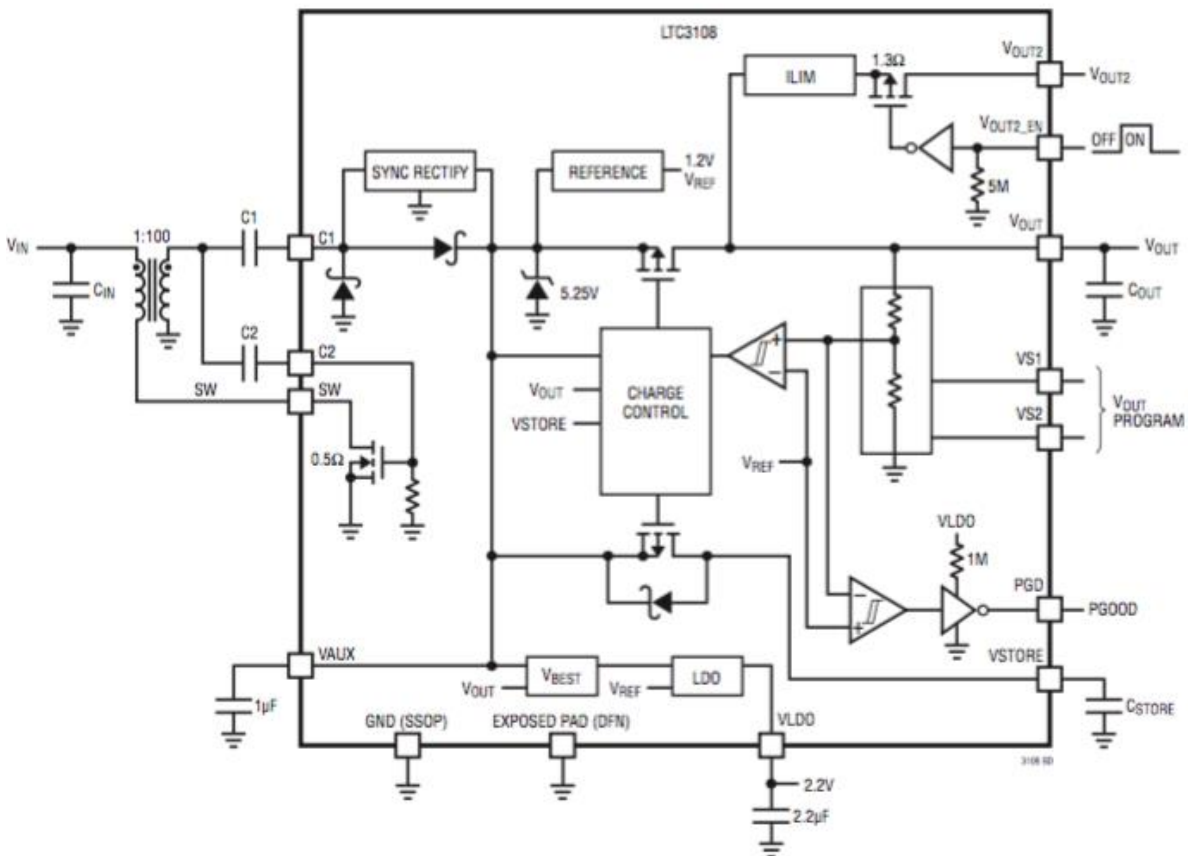

Figure 3: Circuit Schematic of Energy Harvester

Figure 3 shows the circuit schematic of the Energy Harvester Chip. This chip was very complicated. From what could be deciphered, the Peltier Tile powers the chip at the utmost left part, where it says "Vin." Then the voltage goes through the transformer, turning the DC Voltage into AC. Here the voltage charges the capacitors. It was also learned that the Sync Rectify turns the AC Voltage into DC. Also, by connecting the Energy Harvester Chip in different ways, output voltage could be changed. By changing the connections of VS1 and VS2 to Ground and/or VAUX, we can change how the current flows through the circuit. This in turn changes the output voltage.

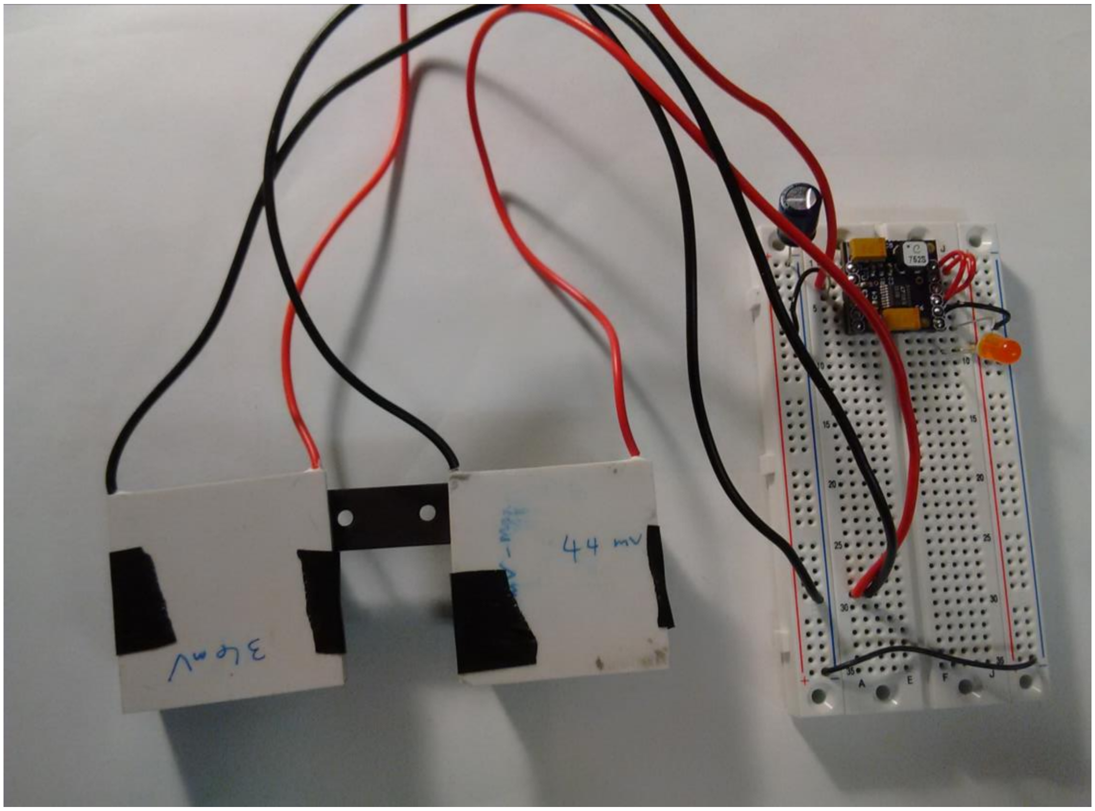

Figure 3: Picture of Wireless Thermal Charging Device

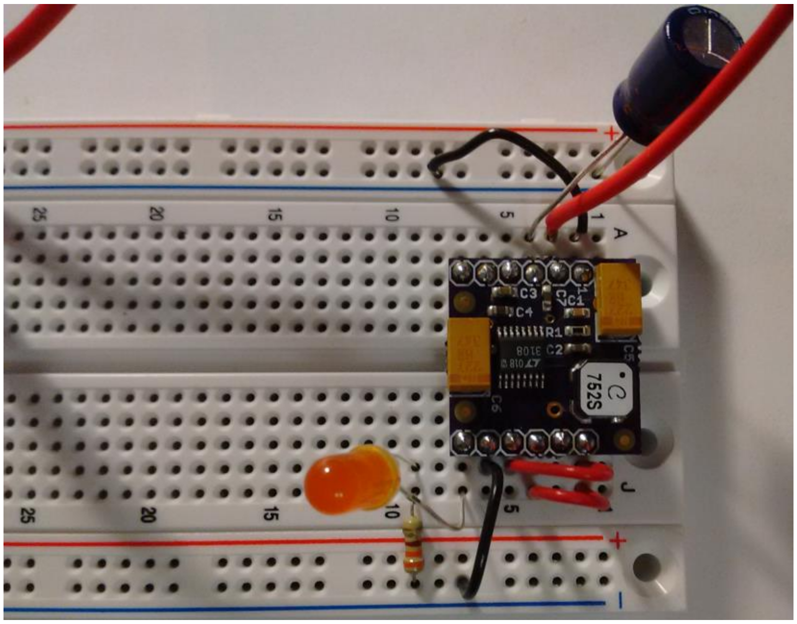

Figure 4: Close-up of Circuit Components

Results

The maximum voltage was measured from Peltier Tiles. On average, Peltier Tiles produced about 40mV when one side is heated with hands and the other is in the ambient air. This was nowhere near what is needed to power an LED. So, an Energy Harvester chip was obtained. By configuring the wiring for the chip, the Energy Harvester chip was able to produce anywhere from three to five Volts when there is input of about 80 mV. As a result, with two Peltier tiles, an LED was powered.

Future Work

This is actually a very crude and initial exploration. There are many possible applications in the future. First, only a LED was powered in the project. In the future, a real thermal charging battery can be designed. Such a device would convert body heat energy to electrical potential energy and store the energy in a rechargeable battery. This battery would then be used for other purposes. An application of this would be a digital watch that is powered by the heat on the wrist. Nike fuelband and fitness tracker also can be powered by our body heat. In addition, if material scientists provide robust material for the shell of Peltier tiles, larger construction can be done. Chairs can be made that harvest body heat. These Peltier tiles can be applied to walls of buildings to power the light and air conditioning systems in summer. Also, if Peltier tiles can be manufactured with a strong material, they can be used as a door handle.

One of the most important factor for future work is that the voltage must be boosted up to a larger scale. The voltage produced in this project was not enough to power things in daily lives. If this can be done in a larger scale, Peltier tiles will prove to be very powerful. Clothes can be made with Peltier tiles which would be in direct contact with the skin. If one hand produces enough energy to power a watch, then heat from the entire body can do more. Phones could be charged while walking. Any temperature difference in ambient air can produce voltage. This is truly a powerful technology once made efficient and cost-effective.

Conclusion

Each Peltier tile produces on average 40mV when one side is heated with hands and the other is cooled by ambient air. When this voltage is amplified enough, Peltier tiles can be used as a renewable energy source. There are two ways to boost up the voltage. First, the voltage can be boosted up using DC-DC Boost Converter. Second, the voltage can be boosted changing DC to to AC and using a transformer. The method chosen in this project was to change DC to AC and use a transformer to boost up the voltage. With materials available, voltage from Peltier tiles could be boosted up to about 1.5V. However, because of lack of materials and time constraint, Energy Harvester Chip was purchased. This chip used the same concept except that the IC Chip mounted on the Energy Harvester (LTC3108) outputs a selectable voltage. These voltages are 2.35V, 3.3V, 4.1V, and 5V. Using the Energy Harvester Chip, an LED was successfully lit bright with hand heat energy.