# EFFICIENT POWER GENERATION METHODOLOGY WITH THERMOCOUPLE

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***Abstract:*** This work introduces the proficient generation of power, utilizing the Seebeck's effect which is a principle in which a temperature contrast between two divergent semiconductors delivers a voltage between the two substances. The higher the temperature contrasts, the higher the voltage it produces. Here the total generated power is divided into two sections, which is one for application purpose and the other for cooling the other side of thermocouple with a motor pump. Creating power with wind energy and sunlight based is regular these days and in addition the cost is high. The point of this paper is to produce power in remote territories where power supply is still sporadic and lacking. The planned module produces power in little wattage for application in low power consumption electronic items even at the absence of wind and sun energy. The aggregate yield voltage of the plan module when utilizing flame as heat source and coolant as cooling agent, create 35V dc with no load and constant 5V regulated dc with temperature difference of $63^0$C. It yields a max current of 299mA with 1k ohms as load from the peltier module. The generated power is sufficient to light low power 12 LEDs and charging of cell phone.

***Keywords—Peltier module, pump, coolant, seebeck effect, thermocouple, heat sink, DC booster.***

## I. INTRODUCTION

Nowadays the power consumption is rising massively with the expansion of factories, industries and utilization of household electrical apparatuses. To satisfy these every day prerequisites diverse power sources like coal, water, wind and sun energy are utilized at a high cost. Despite the fact that the world is quick changing and developing there are as yet numerous towns and far flung regions where power isn't come to and still a demand. From some of the energy generation method after harvesting energy, heat is merely wasted as by-product to the environment. If such heat could be converted back even yet in a small power in mill watt range, it could be reuse in domestic low power lighting and in driving low power consumption electronic products. In accordance with thermodynamics law of energy also referred to as law of conservation of energy, energy cannot be created nor destroy but can be transform from one form to another form. Thermocouple module using the principle of seebeck effect converts temperature difference between both junctions into voltage and vice versa can be utilize to harness electricity from heat. In Fig. 1 the fundamental generation of electric power from thermocouple is shown where both junctions is maintained at different temperature gradient i.e one side is heated with a heat source and the other side is attached with heat sink and coolant. The output voltage is directly proportional to the temperature difference between the 2 sides of the module. Since the direct output of the module is generally low, it is further amplified with a booster circuit for further applications.

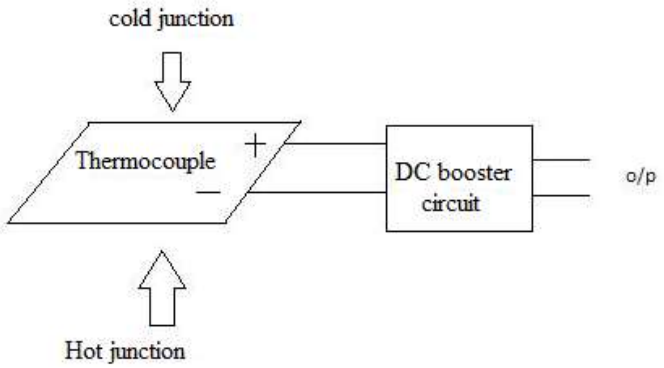


Fig.1Power generation with thermocouple

Distinctive work has been reported by various groups to produce power from thermocouple. When one side of the Peltier module is cantered and heated by Fresnel focal point and the opposite side is joined with heat sink DC voltage can be gotten as announced by [1]. Another creative and successful approach to collect power at day time is by utilizing parabola dish to heat the hot junction of peltier module as recommended by [2]. To beat the issue of exhaustion of battery charge of Cell telephones while travelling, body warm is additionally changed over into voltage to charge the battery [3]. What's more, besides in cooking gas the upper fire of the burner is use for directing warmth and the encompassing piece of the fire around the burner is squandered typically. This squandered heat can likewise be converted into electrical as reported by [4].This paper is likewise proposed and executed with a

Straight forward set up which yield as high as 35V unregulated and 5V regulated DC voltages for genuine application which is explain and implemented in the subsequent section.

**II. MODULE OPERATION and IMPLEMENTATION**

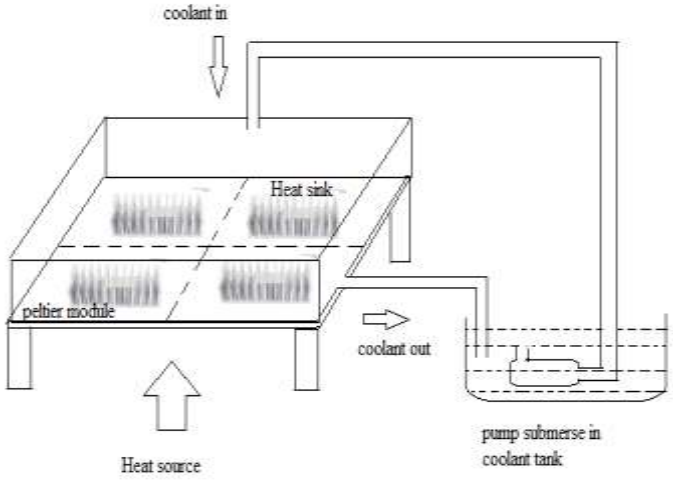


Fig. 2 set up module configuration

The complete arrangement of the propose module is shown in Fig.2. Four Peltier devices are used along with four heat sink for each module. It is mounted in a thin tin sheet as tin has a low specific heat [5]. Heat is given from the bottom of the tin sheet where it distributes the heat uniformly at the hot junction of the peltier module. Two Peltier modules are connected in series and its output is used for application purpose like lighting of LEDs or charging of mobile Phone through USB port as shown in Fig. 3 and Fig. 4 respectively. A Joule Thief is a DC voltage booster circuit. It converts a steady low voltage signal into a series of high frequency pulses at a higher voltage by switching the transistor into on and off condition repeatedly.

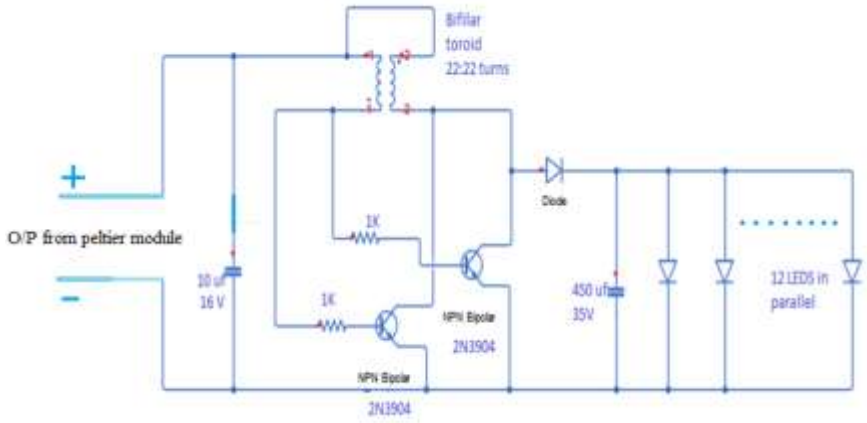


Fig. 3 Joule thief circuit for powering LEDs

For lighting an array of LEDs two joule thief circuit is design with two transistors using the same toroid core as shown in Fig. 3. The total output voltage is than stored in a capacitor through a diode. Finally 12 LEDs are connected in parallel as load at the output.

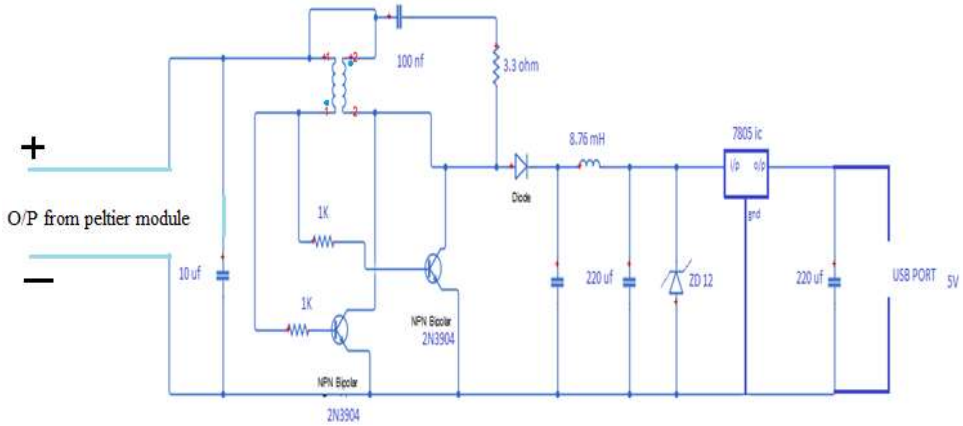


Fig. 4 Constant 5V USB power supply

But to charge any electronic device a pure DC signal is required. As the direct output of the joule thief circuit is not a pure DC, filtering is done and the voltage is regulated for a constant output voltage of 5V as shown in Fig. 4. The realization of the complete hardware system of the circuit and its components required is also shown in Fig.5 and Fig. 6 respectively. The other two peltier devices is used for running a small voltage water pump to circulate the coolant at the cold junction as heat sink alone cannot keep the temperature difference for longer duration.

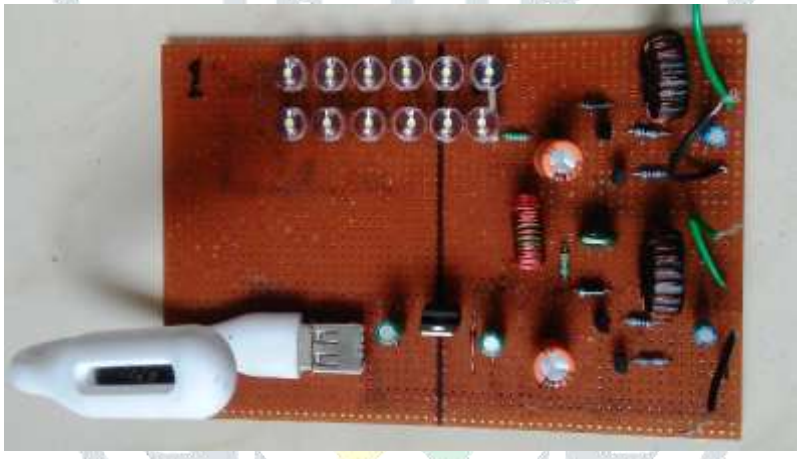

Fig.5 Hardware implementation

Since Peltier module thickness is very small in dimension heat from the other side can penetrate easily and heat both side producing a very small voltage. To overcome this problem heat sink is attached at the cold junction and coolant is circulated with the help of a submerge pump to maintain huge temperature difference for more and steady output voltage. Heatsink is a passive device use for transferring heat energy generated by electronic components into the surrounding air medium to control the temperature of the components and preventing from overheating.

LIST OF COMPONETS USED:

| COMPONENT | VALUE | QUANTITY |
|---|---|---|
| NPN TRANSISTOR | 2N3904 | 4 |
| FERRITE TOROID CORE | 2cm OUTER DIAMETER, 0.8cm EXTERNAL DIAMETER | 2 |
| PELTIER PLATES | 4V,650 mA(AT 150°C TEMPERATURE DIFFERENCE) | 4 |
| ZENER DIODE | 12V | 1 |
| DIODE | 1N4007 | 2 |
| RESISTORS | 1K | 4 |
| | 650 ohm | 1 |
| | 3.3 Kohm | 1 |
| CAPACITORS | 470 uF | 2 |
| | 220uF | 2 |
| | 10 uF | 2 |
| | 100 nF | 1 |
| VOLTAGE REGULATOR IC | 7805 | 1 |
| USB PORT | - | 1 |
| MATRIX BOARD | - | 1 |
| SOLDERING WIRE | | |
| LEDS | 3V | 12 |
| SUBMERGIBLE PUMP | 3V-5V, 100mA | 1 |

Fig. 6 Components list

The entire set up for the operation of the prototype is shown in Fig.7 by using candle as a heat source and water as coolant.

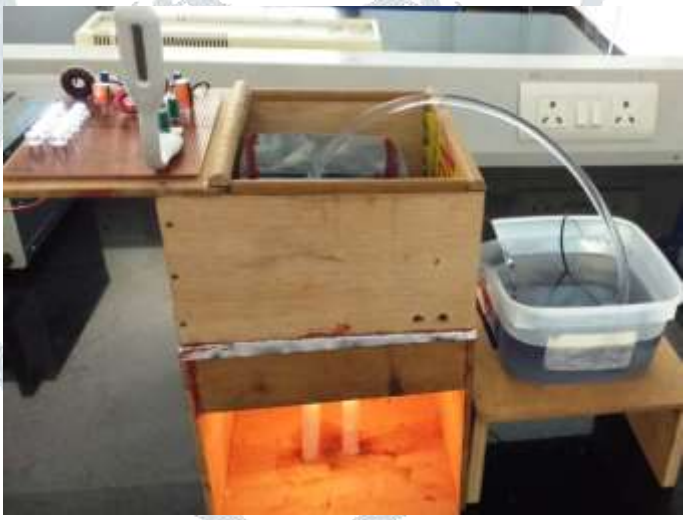

Fig.7 The complete set up configuration

The different output voltages for different temperature differences are listed in Fig. 8. Observation is taken by connecting two peltier devices in series. Maximum current of 299 mA is obtained with 1k ohm as load across the thermocouple. The joule's thief circuit produces unregulated voltage of 35V where LEDs are connected across it and a regulated supply of 5V across a USB port.

| Sl.No | cold junction TEMPERATURE(°C) | hot junction TEMPERATURE (°C) | TEMEPERATURE DIFFERENCE (°C) | PELTIER OUTPUT IN VOLTS | CURRENT OUTPUT with 1k? load (in mA) |
|---|---|---|---|---|---|
| 1. | 35 | 60 | 25 | 1.1 | 50 |
| 2. | 35 | 65 | 30 | 1.2 | 56 |
| 3. | 36 | 70 | 34 | 1.37 | 158 |
| 4. | 36 | 75 | 39 | 2.02 | 195 |
| 5. | 36 | 90 | 54 | 2.20 | 255 |
| 6. | 37 | 100 | 63 | 2.35 | 299 |

| CIRCUIT: | JOULE THIEF OUTPUT( IN VOLTS) |
|---|---|
| CIRCUIT FOR LIGHTING LEDS | 36V( without load) |
| CIRCUIT FOR USB APPICATION | 5V (regulated output) |

Fig.8 different observation table

The plot of temperature differences and output voltage of the device used is also shown in Fig.9. The output voltage rises initially and then attains a constant voltage of 2.35 V when the temperature difference is held constant at $63^0$C approx. by using a candle as heat source and water as cooling agent. For safety operation the hot junction is not overheated.

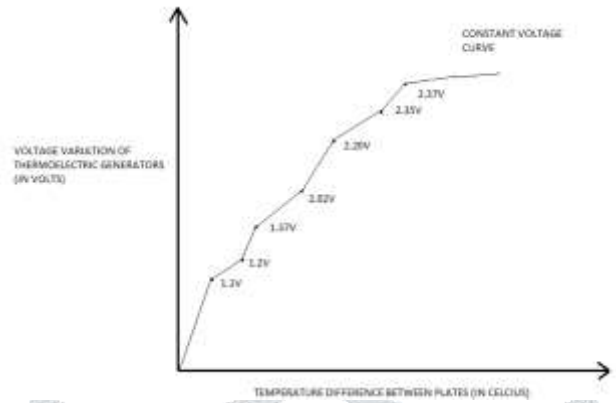


Fig .9 Temperature difference Vs output voltage

## III. CONCLUSION

This proposed design setup is creatively intended to produce constant power efficiently. Electricity will be generated as long as the condition of maintaining temperature difference between the two sides of thermocouple is satisfied. Heat from the candle flame or charcoal can be use as hot source with heat sink and coolant as cooling agent to illuminate low power LED's. The more the temperature contrast between the chilly and hot intersection the more the output voltage it will give. The output from Peltier module is further venture up by a DC to DC booster circuit which can drive LEDs proficiently and can even charge cell phone through USB port as appeared in Fig 7. The various observed values and the plot of output voltage Vs temperature contrast are likewise appeared in Fig. 8 and Fig. 9 respectively. This module can be proficiently and adequately use in remote regions where they are totally cut off from the cutting edge and created urban areas.

## IV. REFERENCES

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