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GENERATION OF POWER FROM WASTE HEAT SOURCE

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ABSTRACT

The Thermoelectric power generation is a low budget source of power generation. With the backing of thermocouple electricity can easily be generated. There are various areas in our country where there's no electricity available and various areas where there's is limited amount of electricity available for the entire day. To counter these difficulties our project is extremely useful.It's also very easy to work our project as we just need a heat source to generate electricity with the assistance of a thermocouple. Applying the warmth to at least one end of thermocouple can produce electricity. That the electricity generation by thermocouple is incredibly cost efficient and easy to operate. It also has less maintenance cost and simple to control. It also has less maintenance cost and might easily be repaired. This project involves the event of a prototype electrical generator for delivering and storing small amounts of electricity. Power is generated using the thermoelectric effect. One thermoelectric generator (TEG) is employed to convert a tiny low portion of the warmth flowing through it to electricity. The electricity produced is employed to charge one rechargeable 3.3 Volt lithium- iron phosphate battery. This study investigates methods of delivering maximum power to the battery for a spread of temperature gradients across the thermoelectric module. The paper explores load matching and maximum tracking techniques. It absolutely was found that, for the TEG tested, a SEPIC DC-DC converter was only beneficial for temperature gradients less than 100 ^{0}C across the TEG. At a gradient of 150 ^{0}C, the effective resistance of the battery was near the inner resistance of the TEG. For temperature gradients in more than 100°C a DC-DC converter isn't suggested and a straightforward charge protection circuit is sufficient.

1. INTRODUCTION

Now a day, with increasing concern of world warming and also the depletion of fuel reserves, many are observing at sustainable energy solutions to preserve the planet for the longer term generations. Apart from hydro power, heat and photovoltaic energy holds the fore- most potential to fulfill our energy demands. Alone, heat is capable of supplying large amounts of power but its presence is extremely unpredictable because it will be here one moment and gone in another. Similarly, energy is present throughout the day but the warmth irradiation levels vary because of energy generation system intensity and unpredictable shadows cast by clouds, birds, trees, etc. The common inherent disadvantage of warmth and photovoltaic systems area unit their intermittent natures that built them unreliable.

When a supply is unavailable or insufficient or light in meeting the load demands, the opposite energy source can at one for the difference by combining these two intermittent sources. Heat is that the viable source of renewable energy over the last two- three decades. It's now employed in sort of fields like industries, domestic purpose. Heat system is meant to gather maximum power from heat generation system and to convert into power.[1]. Another sort of energy is energy (mechanical energy) is converted into electric energy by thermoelectric generator peltier effect. To implement the project more efficiently, the concept of thermoelectric generator peltier are introduced.

During this system, thermoelectric generator peltier based energy-harvesting technology is applied to come up with electricity from heat. Thermoelectric generator peltier is that the electrical phenomenon that accumulates in certain solid material in response to applied mechanical stress. The propose system, is to form power generation more sustainable, economical and ecological by utilizing the advancement within the technology.

This project introduced two methods and regarded its output performance provided input heats, by using Thermoelectric generator peltier materials like PT for electro mechanical conversion using Mass- spring system as medium of conversion of force from heats applied on PT materials and by using spring-magnet system where relative displacement of magnet with reference to coil, provided input heats generates voltage.

2. LITERATURE SURVEY

In the times we are able to get power from many sources it's going to be either renewable or non renewable form. In non renewable energy generation we are able to generate more amounts of green houses and more toxic materials that are harmful for human resources additionally as pollute the environment. So it's an must to move some renewable form for power production.

But the renewable resources also are pollute our surroundings, so we'd like to scale back it. But it's impracticable within the industrial world. There's an option for us that's we will reduce the assembly of more waste. A thermoelectric power generator might be a solid state device that has direct energy conversion from thermal energy (heat) due to a temperature gradient into electrical energy based on "Seebeck effect". The thermoelectric power cycle, with charge carriers (electrons) serving because the working fluid, follows the basic laws of thermodynamics and intimately resembles the power cycle of a conventional engine. Thermoelectric power generators provide many offer several distinct advantages over other technologies.

3. PROPOSED SYSTEM FUNCTIONPROPOSED METHOD

Thermoelectric power generation is depends on a miracle known as "Seebeck effect" discovered by Thomas Seebeck in 1821 . When a temperature difference is established between the recent and cold junctions of two different accoutrements (metals or semiconductors) a voltage is generated, i.e., Seebeckvoltage. In fact, this miracle is applied to thermocouples that are extensively used for temperature measurements. Based on this Seebeck effect, thermoelectric devices can act as power generators.

A schematic diagram of a straightforward thermoelectric power generator operating supported Seebeck effect is shown in Fig. (1). As shown in Fig.(1), heat is transferred at a rate of QH from a high temperature heat source maintained at TH to the hotjunction, and it's rejected at a rate of QL to a low-temperature maintained at TL from the cold junction. Grounded on Seebeck effect, the heat suppliedat the recent junction causes an electrical current to flow withinthe circuit and power is produced. Usingthe first-law of thermodynamics (energy conservation principle) the difference between QH and QL is that the electric power output.

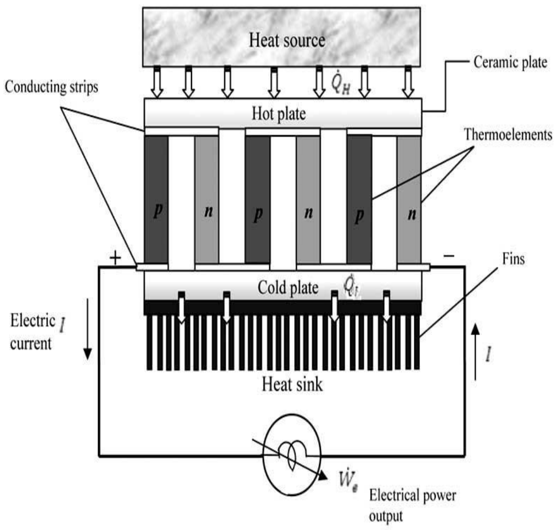


Figure 1.Schematic diagram for TEG in single stage

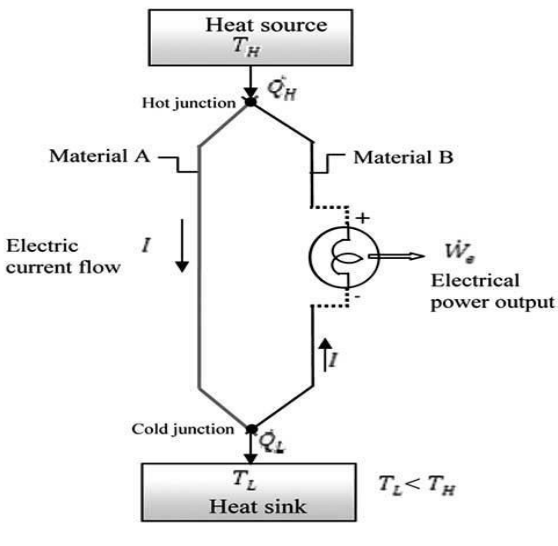


Figure 2.Schematic diagram for basic TEG

It is composed of two ceramic plates (substrates) that serve a foundation, furnishing mechanical integrity, and electrical insulation for *n*-type (heavily doped to make excess electrons) and *p*- type (heavily doped to create excess holes) semiconductor thermo elements. There are only a few modules without ceramic plates, which could eliminate the thermal resistance associated with the ceramic plates, but might result in mechanical fragility of the module.

The ceramic plates are commonly made up of alumina (Al_2O_3), but when large lateral heat transfer is required, materials with higher thermal conductivity (e.g. beryllia and aluminum nitride) are desired. The semiconductor thermo elements (e.g. silicon-germanium SiGe, lead-telluride PbTe based alloys) that are sandwiched between the ceramic plates are connected thermally in parallel and electrically nonparallel to make a thermoelectric module. The junctions connecting the thermo elements between the recent and cold plates.The sizes of conventional thermoelectric devices vary from 3 mm^2 by 4 mm thick to 75 mm^2 by 5 mm thick. Most of thermoelectric modules don't seem to be larger than 50 mm in length because of mechanical consideration.

4. FUNCTIONAL BLOCK DIAGRAM

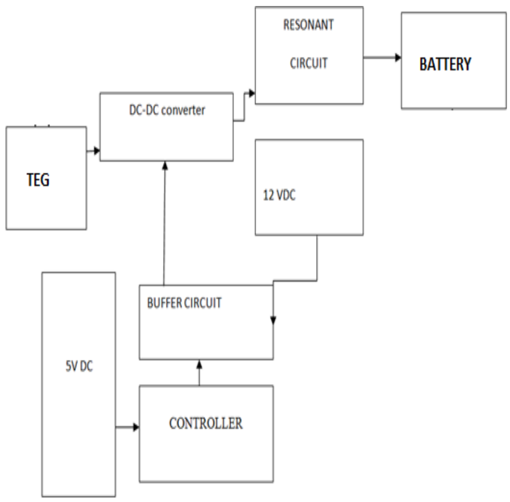


Figure .3.Block diagram for implemented system

SEPIC DC-DC converter that was controlled bymicrocontroller to optimally charge a battery from thermoelectric modules. Most power was transferred to the battery once the input restivity of the DC-DC converter matched the impedance of the battery. The input resistivity of the DC-DC converter modified by varied the duty cycle of the pulse width modulated (PWM) signal applied tothe gate of the MOSFET.

TEGs (TEP-1264-1.5) were connected in serial to give a combined internalresistance of 17.8 Ω at 140 °C. These were then accustomed charge a 6 V battery with internal resistance of 0.1 Ω. Three experiments were set up: within the first experiment, the TEGs were directly connected to thebattery. During this case the power transferred to the battery was 7.63 W. Within the third experiment, theduty cycle of the MOSFET was varied throughout the experiment so as to deliver maximum power to the battery. This was implemented by measuring the current into the battery and vary the duty cycle until maximum current flowed into the battery.

The Perturb and Observe maximum power point tracking (MPPT) technique was used, however onlythis current was measured because it was assumed that thebattery voltage remained relatively constant. During this scenario 7.99 W was transferred to the battery and also the SEPIC was found to be 95.11% efficient. The maximum power point tracking circuit was resolute to be 15% more efficient than direct charging. It had been also observed that in direct charging, if there was no temperature difference across the TEG, the TEG acted as a load and discharged the battery. This didn't happen when theSEPIC was inserted. In the developed a buck-boost based maximum power point tracker to scale back the impedance mismatch between an array of thermoelectric modules and also the load.

The primary rig consistedof 4 strings of TEGs held at different temperaturegradients: 40 °C, 70 °C, 100 °C and 130 °C. In the second rig, most electrical outlet trackers were placed on every string of TEGs. Compared the output power of each system with a range of load resistances .Once a load of five ohm was applied, direct charging delivered a lot of power than the MPPT methodology for the string of TEGs command at 70 °C and 100°C.

This highlights that while the internal resistanceof the TEGs is temperature dependent, the resistancechanges only slightly with temperature and therefore if the load is matched at a given temperature, direct charging is optimal whether or not if this temperature fluctuates within a particular range. Chen et al. [11] investigated power acquistion for electricity modules.

Ten TEGs were connected in nonparallel and a 40 Ω load was attached, which was near to the totalinternal resistance of the TEGs. At a temperature gradient of 119 °C, the output power of the TEGs was calculated to be 50.6 W. The 40 Ω load was thenreplaced by a light bulb and also the TEG output power dropped to 23 W. The MPPT was supported a SEPIC circuit working in continuous conduction mode and therefore the Perturb and Observe method was employed to seek out the maximum power point.

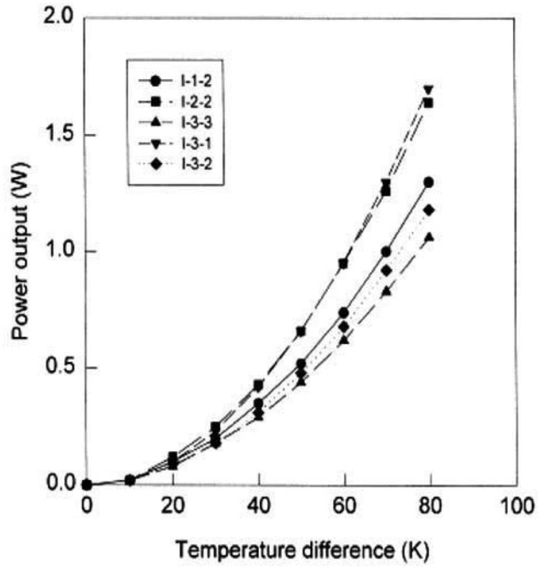
In the algorithm, chargeprotection was also enforced to cover the lead acid battery from over-charging. The experimental results showed that if the 12 V battery was directly connected to the TEG, the TEG generated 19 W, whereas if the MPPT was fitted between the TEGand the battery, the TEG produced 28.5W. The MPPT circuit created 33% more power from the TEG than direct charging. This paper focuses on charging a rechargeable battery victimization just one thermoelectric creator.

5. THERMOELECTRIC POWER GENERATORSPERFROMANCE

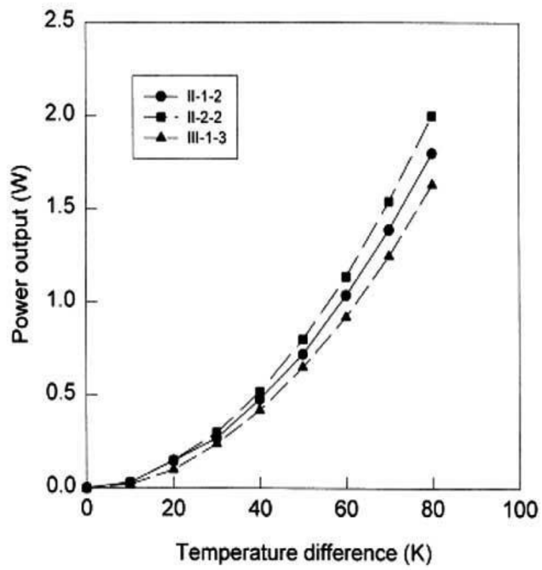
R is that the electric resistivity (inverse of electricalconductivity) and *k* is that the total thermal conductivity.

$$ZT = \alpha^2 T / Kr$$

The term α^2 / R is referred to as the power factor. In general, a thermoelectric power generator exhibits low efficiency due to the relatively small dimensionless figure-of-merit ($ZT \sum 1$) of currently available thermo- electric materials.



(a)



(b)

6. HARDWARE COMPONENTS

A) Arduino

Arduino is an open source tool for creating programs that are far superior to desktop computers. The physical world will be sensed and controlled by sensorsprogrammed using Arduino programming.It are often powered by a USB cable or an external 9 volt battery, but accepts a voltage of seven to twenty volts. This open-source computing platform relies on a simple micro-controller board, and a developmentenvironment for implementing software onthe board.

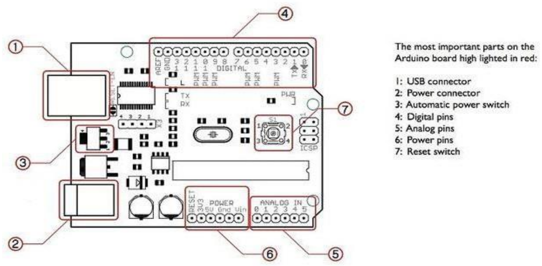


Figure 3.Arduino parts

B) ATmega328PMicrcontroller

ATmega8 is a low-power CMOS 8-bitmicrocontroller supported AVR RISC architecture. By executing powerful instructions in avery single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowingthe system designer to optimize power consumptionversus processing speed.

The device is factory-made mistreatment Atmel's high density non-volatile memory technology. The Flash Program memory square measure usually reprogrammed In-System through associate SPI serial interface, by a traditional non-volatile memory computer user, or by associate On-chipboot program running on the AVR core. Code package inside the Boot Flash Section still run whereas the Appliance Flash Section is updated, providing true Read-While-Write operation. By combining associate 8-bit reduced instruction set pc processor with In-System Self-Programmable hip, the Atmel ATmega8 may be a powerful microcontroller that offers a highly-flexible and cost-effective solution to many embedded management applications. The ATmega8 is supported with a full suite of program and system development tools, as well as C compilers, macro assemblers, program simulators, and analysis kits.

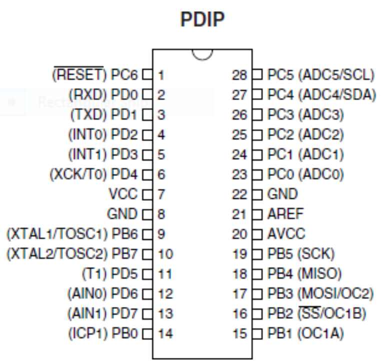


Figure 4.Microcontroller pin diagram

C) TRANSFORMER

The potential electrical device can step down the facility offer voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which isbuilt with the help of op–amp. The benefits of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

D) BRIDGE RECTIFIER

The negative potential at purpose B can forward bias D1 and reverse D2. At now D3 andD1 are forward biased and can permit current flow to pass through them; D4 and D2 are reverse biased and may block current flow. The trail for current flow is from purpose B through D1, up through RL, through D3, through the secondary of the device back to purpose B this path is indicated by the solid arrows.

Waveforms is also determined across D1 andD3. One-half cycle later cycle later the polarity across the secondary of the electrical device reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow can currently be from purpose A through D4, up through RL, through D2, through the secondary of T1, and back to purpose A. Waveforms will be discovered across D2 and D4. The current(I) flow through RL is often within the similar direction.

E) DC-to-DC converter

DC-to-DC converter is employed to convert one level of DC voltage to different level. The operating voltage of different electronic devices like ICs, MOSFET can vary over a wide range, making it necessary to produce a voltage for every device. A buck Converter outputs a lower voltage than the original voltage, while a Boost Converter supplies ahigher voltage.

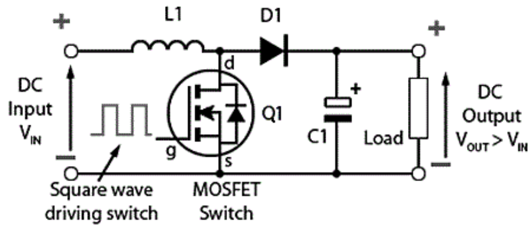


Figure 5.Circuit diagram of DC to DC converter

The step-up or step-down DC-to-DC Converters are helpful in applications wherever the battery voltage will be top of or below the regulator output voltage. The DC to DC converter must be ready to operate as a step up or down voltage supplier to provide constant load voltage over the complete batteryvoltage range through the operation.

7. SOFTWARE SPECIFICATION

A) MATLAB

MATLAB, which stands for Matrix Laboratory, could be a software package developed by Math Works, Inc. to facilitate numerical computations in addition as some symbolic manipulation. The collection of programs (primarily in FORTRAN) that eventually became MATLAB ("Matrix Laboratory") is a tool for numerical computation and visualization.

The basic knowledge component may be a matrix, therefore if you would like a program that manipulates array-based data it's typically quick to write down and run in MATLAB (unless you have got terribly massive arrays or many of computations, within which case you're better off using C or Fortran).

- High level language for technical computing
- Stands for Matrix Laboratory
- Everything may be a matrix – straightforward to try and do algebra

8. CONCLUSION

In-depth analysis was dispensed out to deliver maximum power from one thermoelectric module to a rechargeable lithium iron phosphate battery. It was discovered that at temperature gradients below ΔTTEG = 100 °C, it had been beneficial to employ a SEPIC DC-DC converter. However above ΔTTEG = 100 °C more power was delivered to the battery by direct charging. For temperature gradients of 150 °C to 200 °C, the charge protection circuit provides a simple, inexpensive and robust charging solution. This circuit has been used recently by the current authors for a development project whereby a TEG generator system was designed to generate electricity from biomasscookstoves within the developing world [2].The circuit has proven to work as designed for extended periodsof time and the end users charged mobile phones and LED lanterns.

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