

A Review: Power Harvesting From Piezoelectric Materials

Prachi Chaware¹, Saurabh Bhusate², Ankush Bole³, A. B. Nagdewate⁴

^{1,2,3}UG Scholar, Dept. of Electrical(E&P) Engineering ,DES'S College of Engineering & Technology, Dhamangaon (Rly), Amravati (MAH.)

Email: ¹prachichaware84@gmail.com, ²saurabhbhusate1996@gmail.com, ³ankushbole94@gmail.com

⁴ Assistant Professor, Dept. of Electrical(E&P) Engineering ,DES'S College of Engineering & Technology, Dhamangaon(Rly), Amravati (MAH.)

Email:ashvini.bhaskar@gmail.com

Abstract - This review paper focuses on one of the progressive method of energy harvesting using piezoelectric material. Energy Harvesting is a process of capturing energy surrounding system such as vibration and converted that vibration into electrical energy. In this paper we are using a piezoelectric material for harvesting a power. There are two types of piezoelectric material such as crystal and ceramics. Piezoelectric material has two properties, first one is when a mechanical force is applied on any piezoelectric material it produces an electric charge on it and another one is when a electrical force is applied on piezoelectric material it produces a mechanical distortion. I.e. it converts a mechanical vibration into electrical energy. Energy generation from conventional sources it being polluted hence power generation from piezoelectric material is free from environmental pollution.

Key Words: Piezoelectric material, Energy Harvesting, Mechanical energy, Electrical Energy

1. INTRODUCTION

Now a day's most of research is done in the electric field which is used to develop energy sources for future. In this review paper we used piezoelectric material as an energy developing source. Piezoelectricity is defined as a change in applied stress i.e. termed as direct piezoelectric effect and Converse piezoelectric effect is change of strain in material due to an applied electric charge. This stress or strain can be come from different sources such as human motion, ambient vibration. Energy harvest from piezoelectric material is alternating in nature so we are using a rectifier circuit to convert AC signal into DC. Power produced from piezoelectric electricity sources is in order of militant range. Piezoelectric materials are commonly referred as piezoelectric energy harvester. This harvested energy is used to power the portable devices such as mobile phones, laptops, wristwatches and in charging device etc

2. OVERVIEW

Energy is the basic need for economic development of our country. In our day to day life man uses energy in more

quantity for various purposes like domestic, industrial and commercial purpose. Electrical energy is generating from energy available in various forms in nature. We can generate electricity by using different renewable and non renewable sources. These sources are wind, sun, water, fuel, tidal, ocean etc. By using such conventional sources for the generation of electrical power it will pollute atmosphere. Hence we are using three energy harvesting techniques which are free from pollution. These techniques are Electrostatic, Electromagnetic and Piezoelectric. In electrostatic energy harvester, a change occurs in capacitor which will cause voltage and generates electricity. In electromagnetic energy harvester, power is produced by using an electromagnetic faradays law. Faraday's law states that "Whenever a change in the magnetic flux link with the coil an electromagnetic force (emf) will generate across coil". Now third energy harvester is piezoelectric energy harvester which is most popular method of harnessing electrical energy. The main aim of this paper is to harness vibration energy from wasted energy. Here we are using piezoelectric generator for capturing a power. The Piezoelectric materials are used as actuator or sensor also. The characteristics of piezoelectric material having high voltage, low current, high impedance and hence low output power. Piezoelectric energy harvester has number of advantages over electrostatic and electromagnetic harvester. Separate voltage source is not required in piezoelectric energy harvester.

3. BLOCK DIAGRAM

Fig.1. shows the block diagram of whole process. It consists of three blocks. These are (a) Generation of power using piezoelectric effect (b) Rectifier and (c) Battery.

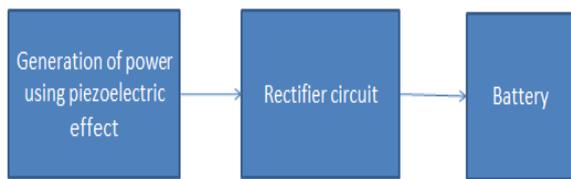


Fig. 1: Block Diagram

Piezoelectric material is used as an input. When any pressure is exerted on piezoelectric material it produces a mechanical stress on it. And piezoelectric materials have an ability to transform mechanical stress into electric charges. Hence power is generated from piezoelectric material but generated power is in A.C. form. So we are using a rectifier circuit to convert an A.C. voltage into D.C. voltage. Then this DC voltage is stored in a battery's.

IV. CIRCUIT DIAGRAM

Fig. 2 shows a circuit Diagram for energy harvesting process. It consists of Rectifier, Boost converter and storage device. Rectifier storage is used to rectify ac to dc signal. Boost converter is used to step up a voltage and storage device is used to store the energy which is being harvested.

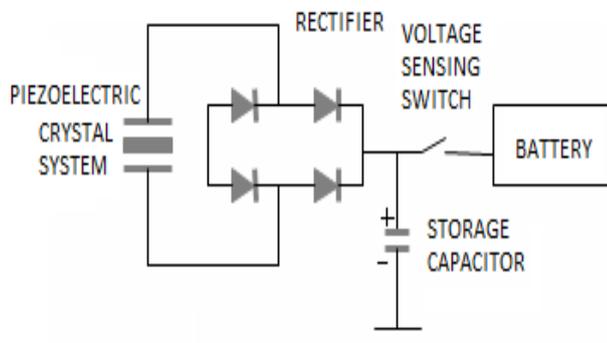


Fig-2: Circuit Diagram

Piezoelectric Material

There are many piezoelectric materials are used for power generation. Such as quartz, ceramic, belemnite, gallium orthophosphate, tourmaline and Barium Titan ate etc. The most commonly used piezoelectric material is quartz.

Rectifier

Rectifier is used to rectify ac single into dc. Here we can use Half Wave Bridge and full wave bridge Rectifier also. In this rectifier shottkey or p-n junction diode can be used. If shottkey diode is used instead of p-n diode it will reduce. Power consumption and increase the electrical charges. Full wave Bridge Rectifier is used instead of half wave bridge

rectifier. Full Wave Bridge Rectifier consists of four diodes connected in closed manner. It will produced desired output. Full wave bridge Rectifier rectifies alternating current without blocking any part of it. Fig. 3 shows full wave bridge rectifier.

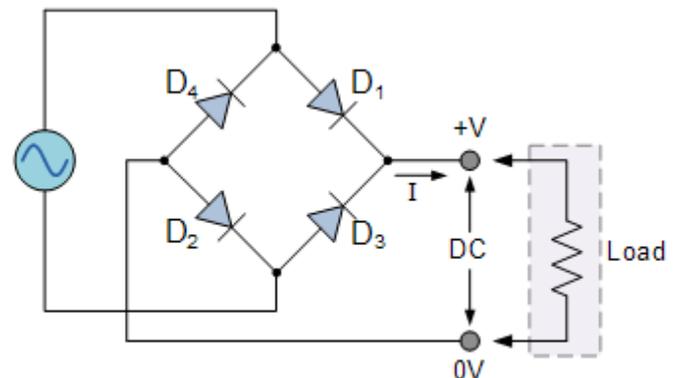


Fig. 3: Rectifier Circuit

Boost converter

Boost converter is acts as a step up transformer because it is used for step up the voltage level. Step up converter means output voltage is greater than input dc voltage. Fig.4 below shows boost converter.

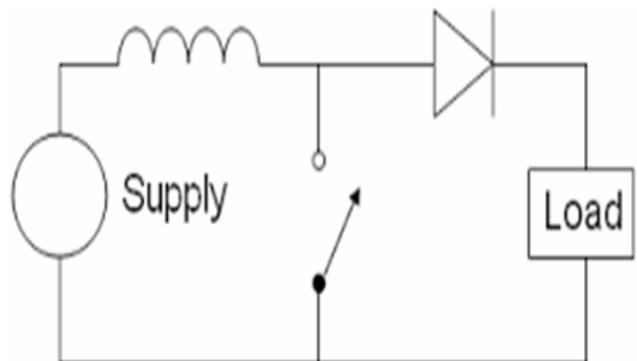


Fig-4: Boost Converter

Boost converter can be operates in continuous and discontinuous mode. In continuous mode switch is closed, due to closed circuit inductor current increases. In continuous mode inductor current never falls to zero value. In discontinuous mode switch is open, due to open circuit there is no current flow through inductor.

Battery

Battery is used to store the some amount of energy which is to be harvested. Some batteries are used for storing purpose such as nickel cadmium, lithium ion

CONCLUSION

The objective of this paper is to harvest energy from wasted energy. Harvesting energy from piezoelectric material, reduce the environmental impact and reduce hardware cost. It is very reliable and efficient method.

REFERENCES

- [1] Yamuna M.B., K.Shanmukha Sundar, "Design of Piezoelectric Energy Harvesting and Storage Devices", *International Journal of Advanced Research in Electrical August 2014, Vol.3 issue 8, ISO 3297, pp.10945-10953.*
- [2] Prabaharan R ,Jayaramaprakash A , VijayAnand L, " Power Harvesting By Using Human Foot Step", *International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 7, July 2013*
- [3] Parul Dhingra, Jhila Biswas, Anjushree Prasad, Sukanya S. Meher, "Energy Harvesting using "Piezoelectric Materials", International Conference on Electronic Design and Signal Processing (ICEDSP) 2012.
- [4] Pramathesh.T, Ankur.S, "Piezoelectric Crystals: Future Source of Electricity" *Volume 2 Issue 4, pp : 260-262.*

BIOGRAPHIES



Pursuing B.E. in Electrical (Electronics & Power) Engg. In DES college of engineering & technology from S.G.B. Amravati University, India.



Pursuing B.E. in Electrical (Electronics & Power) Engg. In DES college of engineering & technology from S.G.B. Amravati University, India.



Pursuing B.E. in Electrical (Electronics & Power) Engg. In DES college of engineering & technology from S.G.B. Amravati University, India.

Received B.E. &M.E. degrees from S.G.B. Amravati University, India in electrical(electronics &power) Engineering and electrical power system in 2011 & 2015 resp., her main research interest includes in Electrical Power System.