

Conversion of Energy using Footstep: A Review

Dipti Bansal¹, Mandeep Kaur²

¹Department of Electronics and Communication Engineering, Punjabi University, Patiala, India

²Department of Electronics and Communication Engineering, Punjabi University, Patiala, India

Abstract- Energy saving and power saving are the basic requirement in this world. Power sources such as non-renewable & renewable sources are available but still energy and power disaster cannot be overcome. In this paper, one of the non conventional methods has been discussed known as walking or running on the footstep. Non-conventional method that is from foot step, kinetic energy from foot step is converted into the electrical energy. This can be possible with the help of piezoelectric transducer which convert the kinetic energy into the electrical energy [1]. The power generated floor intends to translate the kinetic energy to the electrical power. This power generating floor can produce 100W on just 10 steps, then for 100 steps, it produces 1000W and for 100 floors within the system, it will produce 1MW

I. Introduction

This paper illustrates about the generation of electrical energy by using the weight or pressure energy of human beings. It is a fact that a human can generate large amount of energy by simply walking on a floor in a normal speed. The energy which is obtained from the motion of a human is actually absorbed by the floor which in turn can able to generate large amount of power. This power can be utilized in various processes and can be converted to ambient energy harvesting [1]. In this process of ambient energy, harvesting the power is generated with the help of piezoelectric material. Machines Vibrations, mechanical stress, strain produced from high pressure motors can be captured and used as ambient mechanical power sources for electricity generation [2]. Piezoelectric material used as a method to transfer ambient vibrations into electrical energy. This energy can be stored and utilized to provide power for electrical and electronics devices.

II. General architecture of power harvesting system using Foot step method

Energy harvesting is the process by which energy is obtained from any external sources like solar power, wind energy, kinetic energy etc. It is also known as power harvester or energy scavenging [7]. Electricity is most commonly used energy resource. Electricity can be generated from different natural resources like water, wind etc. Walking is the common activity done by human. The energy produced from foot get wasted in the form of vibration to the surface. The wasted energy can be converted into electricity using the principle called piezoelectric effect. In the piezoelectric effect, pressure or strain applied to piezoelectric material which is further converted into electrical form.

Piezoelectric effect

Piezoelectric effect generate an electric charge in response to applied mechanical stress [10]. The piezoelectric is placed under insulating material and pressure created by the foot step will produce electrical energy that will be stored and used for domestic purpose. The pressure is applied along the mechanical axis of piezoelectric that generates power. Piezo stands for generating the electrical polarization of a material with respect to mechanical strain. The fact is known as direct effect.

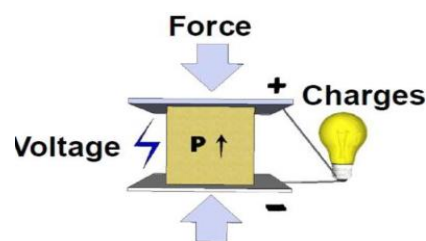


Fig 1: Effect on ecosystem by different methods of electricity generation [5]

The use of piezoelectric crystal is to generate electric output from vibration of strain. These materials have crystalline structure. They can convert mechanical energy into electrical energy and vice versa. The produced electrical energy from piezoelectric crystal is very low in the order of 2-3 volts and is stored in battery to charge controller, since it is not possible to charge 12V battery through crystal output. To increase the voltage, the boost converter circuit is used. The level of voltage ranges 12V and it is stored in 12V battery [4]. The piezoelectric effect has two properties; first one is the direct piezoelectric effect which means that material has ability to convert mechanical strain into electrical energy. Secondly, the applied electrical potential converted into mechanical energy. The piezoelectric plates are placed under the non-conducting material (hard rubber) and the pressure created by footsteps that will produce energy which can be stored and utilized.



Boost converter

It is a power converter which is having greater output DC voltage compare to its input DC voltage. It just act like switching mode power supply which is having two semiconductor switches (a diode and a transistor) and one is used as energy storage element. Capacitor filter is used in the the output of converter to reduce the ripple in the output voltage. A enhance converter is also known as step-up-converter.

DC to AC Inverter

The boost converter will step up the voltage from 3V to 12 V. after this the boost converter voltage is provided to DC to AC inverter. 12V DC voltage is given to the circuit it goes to diode which produce reverse voltage then first transistor will come in conduction. At that time, positive cycle of 230V is obtained in the output from transformer side. Then after some time it gets saturated and another transistor will conduct. This switching makes reverse polarity at output side. After some seconds second transformer gets saturated and first transistor will conduct. Likewise alternating switching takes place. Hence, this system is arranged for the requirement of taking 230V AC from 12V DC input.

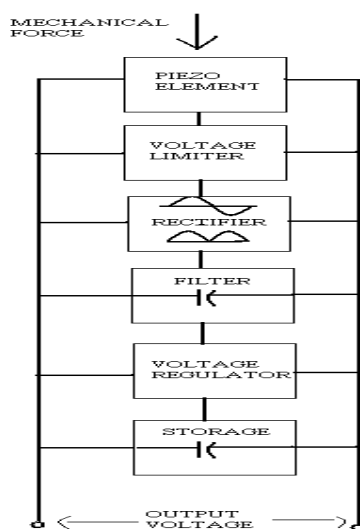


Fig 2: Flow chart for the system [3]

When someone walks on the floor, the floor pressed on the mechanical setup. The piezoelectric material converts the pressure, stress applied into electrical energy. The source of stress is from the weight of the people step on the floor. The voltage produced from a small piezo-crystal is extremely very low, thus combination of few piezoelectric is used. The output of the piezoelectric material is stored in a battery and further applied to AC ripple neutralizer. The AC ripple neutralizer is used which will reduce the ripples of the piezoelectric output. The AC ripples neutralizer work just opposite to rectifier and ripple filter. This will convert the stored direct current in battery back in to the alternating current. Then the output of AC ripple neutralizer further passed to the voltage regulator. The output of the voltage regulator is send to the unidirectional current controller. Unidirectional current controller means it allows flow of current in only one direction. An inverter is connected to battery to drive AC load. Here, also microcontroller AT89S52 can be used which can interface with an LCD which will display the voltage level. [8]

Advantages of foot step method:

- It is very economic. The cost of one piezoelectric crystal is about 11-16 Rupees only and hence it is a economical method.
- This method is pollution free and uses waste energy,
- This method can be employed to recover the society from energy crisis and can be used for providing energy to far of places
- This method will also enable us to store power which can be used in case of power failures and for running various systems.

Disadvantages of foot step method

This technique has a few disadvantages that includes that this technique cannot be used as a primary energy source in places where uninterrupted supply is required. This is because of the fact that energy is produced only if there is motion on the floor. Storing charge is also quite complex. The conversion from AC to DC involves convertors. The diodes used are temperature sensitive and can even be destroyed at high temperatures.

III. Conclusion and future scope

Usage of wasted energy is described in this paper. This idea can be used in the floors of crowded places as footpaths, railway platforms etc, other useful place where this idea may be implemented is dance floors. Stairs can be also used for production of energy by mere walking. This method can also be used for security purposes and in various alarms. This method has already



applied in many countries like China and Japan .They started the use of piezoelectric effect for energy production. and implement piezoelectric effect on the stairs of the bus. Thus every time passenger steps on the tiles; they trigger a small vibration that can be stored as energy. Similarly, Europe also started experimenting use of piezoelectric crystal for energy generation in night clubs. Floor is compressed by the dancer's feet and piezoelectric materials makes contact and generate electricity.

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