

Footstep Electricity Generation by using Piezoelectric Sensor

Aditya Chauhan, Abhishek Vashishtha, Adil Rayees Ansari, Akshat Joshi, Ankit Meena

Department of Electrical Engineering, SKIT, Jaipur, 302017 (India)

Abstract – Human civilizations have been using electricity since last 18th century according to the pace of invention of equipment and later industrialization gave the boom to extent of its use. The aim of this paper is to present a suitable method which can employ the waste energy i.e. energy which is being lost due to human locomotion to produce electricity using piezoelectric sensor (PES). While observing the large energy demands in highly populated countries like INDIA, CHINA, AMERICA energy generation through the non-conventional source is of prime concern. Piezoelectric sensor are used so that the human locomotion energy is concentrated and confined to use according to the demand. The energy stored can easily be used for domestic application.

This framework being used at public places such as platforms, footpath, temples, ticket counter can proved to be of great significance for the mankind and also the mother nature as this method of electricity does not required any fossil fuel .

Our innovation can be made industrially relevant particularly in remote area where it is uneconomical to transmit electricity by traditional means.

Keywords – PES, Diode (P-N junction), Energy Harvesting.

I. INTRODUCTION

Today energy crisis are very common almost in every country hence some new conventional method had to be used. Out of which proposal for the utilization of footstep energy generation method is a better option. Human locomotion or simply walking is one of the most basic activity of human race. When a person work exerts pressure on the surface on whom he is working and this energy exerted by foot is being released in the form of any of this ways-vibration, sound in the form of impact etc. Hence energy step a man moves involves loss of energy. This energy can be utilized into electrical form. This method of generation can also be justified by the fact that energy is something that can be converted from one energy form to other form. It can be justified as energy harvesting as waste energy by the use of PES can be used to charge a Lithium ion polymer battery by using a suitable arrangement by nearly utilizing the pressure exerted by humans. Piezoelectricity is the property by virtue of which when a stress is being applied on a object , electric charge is being produced here in our case a large number of piezoelectric transducer are being used. Piezoelectric transducer is a sensor that convert mechanical stress applied to it into electric energy specially if the pressure is exerted on the most active sensitive point of the sensor, a sustainable amount of energy can be generated.

Another concept of using PE is that other non conventional sources of energy such as solar energy , tidal energy, wind energy are largely dependent on

constraints to a specific reason or is being dependent on nature i.e. wind speed, cloud cover etc.



Fig .1. Piezoelectric setup.

II. PRINCIPLE

The basic principle of working is that when the foot while walking gets on a piezoelectric tile ,this is a piezoelectric tile consists of large number of sensor connected in series and parallel connection between the two rigid bases which can wear human weight without the breakage of piezoelectric sensor or the tile base itself. When pressure is exerted on sensor the charge gets separated at two end & by the connection of several sensor together a potential difference occur at the two most extreme point . These points of wires are connected to a rectifier. This rectifier gives a pulsating DC which is fed to battery which a interconnection of PN junction diode which prevents reverse flow of current i.e. discharge of battery back to the sensor tile. Battery is then connected to the

inverter circuit. This inverter circuit convert the stored DC voltage into AC so that AC source can be connected to it without any impact on the equipment process. The systematic explanation of major part is as follows.



Fig.2. Setup of Piezoelectric on Board.

III. PIEZOELECTRIC SENSOR

The major component of this experiment is piezoelectric sensor, this piezoelectric sensor fits to the group of ferroelectric material i.e. generating charge separation ,this piezoelectric effect discussed above is generally observed in crystal of $PbTiO_3$, $PbZrO_3$, PZT.

In the present foot step electricity generation we have used piezoelectric sensor since it is considerable economical and easily available. Also piezoelectric sensor are extensively used in several industrial process they are used for Quality Assurance, Process Control and for Research Development at different stage of process. The extensive use of piezoelectric sensor is because of the reason that it has very high modulus of elasticity which is the high as 10^6 N/m also PES are also insensitive to radiation or electromagnetic waves during its operation Tourmaline or Gallium phosphate are among is piezoelectric material with temperature with stand ability upto 1000 degree centigrade, it is observed that on increasing temperature and simultaneously increase in pressure loads the sensitivity is reduced significantly due to twin formation.

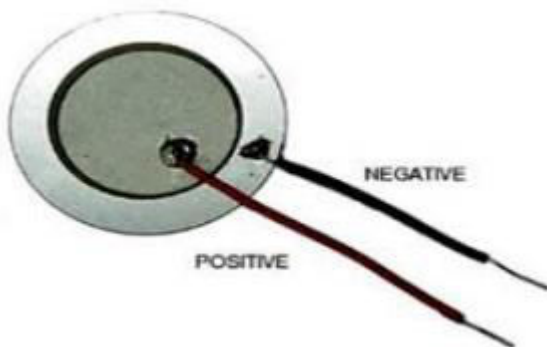


Fig .3. Piezoelectric Sensor.

IV. CONNECTION BETWEEN SENSOR (SERIES AND PARALLEL)

As we know two possible connection are there- series combination or parallel combination. While taking reading the observation we made is that parallel connection did not give significant increase in the voltage where as with series connection. The output is increased but in irregular pattern hence we had used the combination of both series and parallel.



Fig.4. Series and Parallel connected sensor.

V. RECTIFIER

The output from the piezoelectric sensor tile which is pulsating in nature it fed to the rectifier. It converts pulsating DC to the uniform DC. Out of bridge and half wave type rectifier be used Bridge type rectifier because of better efficiency and higher stability to input wave. It has four diode connected to form a bridge. The AC input voltage is applied to the diagonally opposite ends of the bridge. For positive cycle D1 and D3 conduct , where as diode D2 and D4 does not conduct and vice versa for the negative half cycle.



Fig .5. Bridge Rectifier.

VI. P-N JUNCTION DIODE - UNIDIRECTIONAL CURRENT CONTROLLER

This arrangement allows only unidirectional current flow. Devices that can be used our diode or SCR (Thyristor) we use diode (P-N) due to simple circuitry and no requirement of pulse or gate ,it allow flow of current from piezoelectric tile to the battery (which is forward conduction) while it block the current flow from battery back to the sensor tile while it is not operating. Here the diode act as check valve, we used 1N4007 as check valve.



Fig. 6. Diode.

VII. INVERTER

It is a semi conductor device that convert the input DC signal to the AC signal at output side. We have used solid-state inverter having no moving part for its operation. The objective of using inverter is that almost every domestic load or commercial load is ac in nature. The function of inverter is opposite to that of rectifier.

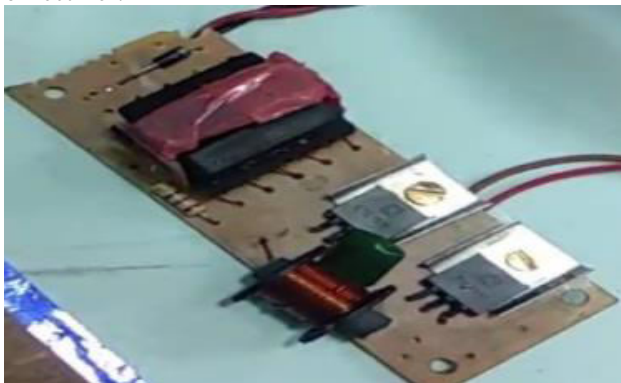


Fig .7. Inverter Circuit.

VIII. ENERGY STORAGE DEVICES BATTERY

Battery is used to store energy that is produced by the piezoelectric sensor. Battery we can be used to

convert stored chemical energy into electrical energy. We have used a Lithium ion battery of 12 V in our setup which is enough to glow the domestic LED bulb of 5 watt.



Fig .8. Battery.

IX. FUTURE ASPECT

Energy generated by foot step can be provided to be of immense use as this is the most versatile method of energy generation as compared to what are being used till date .The biggest advantage of this method cover up the loop whole of the other non conventional energy sources i.e. they are whether dependent on their performance can't be predicted. Where as footstep generation only required human locomotion hence it can be used very easily and upto as much higher efficiency if it is installed at public places, platforms, dance floor, road etc. Countries like China had already started using this technique to produce electricity at railway station thus decreasing there dependency on conventional sources it has become a very demanding research domain and premier Institute like MIT had already started working on this method of generation. Countries like India see a major scope of this technology is used to the best of its efficiency and at suitable position.

X. CONCLUSION

Energy generation by footstep can you proved to be a promising Technology if it is used efficiently to counter up the currently rising energy crisis. Thus our study and experiment of piezoelectric tile generating 20 to 30 volt has been designed and its proper and frequent use can definitely bear some part of domestic load demand. If a series of such tiles are used in public area then large load can be balanced several future exploitation of this energy involves use of this concept in vehicle tyre, shoe base , speed breaker on the road or even in the railways track as they bear continuous forced vibration and with considerable weight over it. This technology can be used very efficiently to the remote areas where transmission or generation of

power by conventional method is not possible due to geographical or technological barriers.

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