WASTE ENERGY REFORMATION OF HUMANOID KINETIC FORCE INTO ELECTRICAL ENERGY

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Abstract:The work done on this paper represents the regeneration of locomotive force into electricity based on piezoelectric transducers using footsteps with practical implementation. Every person releases energy when they move or walk on this planet. Therefore a large number of energy has been produced and wasted. To convert this waste energy into electricity a power generation system is designed with the help of piezoelectric transducers. In this system transducers are used to convert the force applied to the transducers into electricity. This type of arrangement has vast applications in home, street lighting etc. The surface designed with piezoelectric technology, converts the pressure of locomotive force into electricity by a piezoelectric transducer (PZT).

IndexTerms **-**Piezoelectricity, PZT, Energy consumption, sustainable.

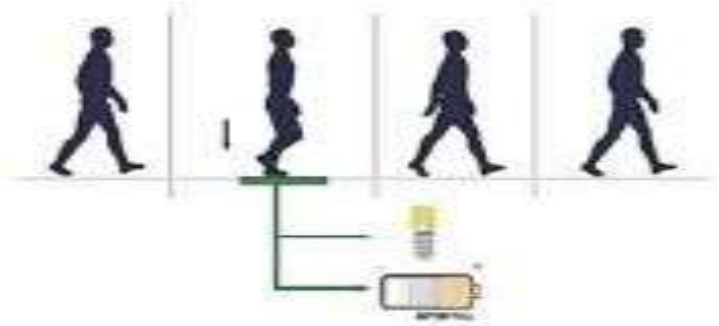
I. INTRODUCTION

The need for electric power is rising continuously as it is considered an integral part in our daily life. Since the conventional sources of production of electricity are gradually reducing, we must think of using alternative sources of electricity production. Non-conventional sources of electricity production are widespread across the globe. We in this paper have presented another source of electric energy production from our day to day life. Advantage or feature of this alternate form of energy production is, it is very simple, clean, effective, economic and can be used by any individual for producing electrical energy by their own means(may be for domestic lighting purpose). We all know that regular human activities like walking, jumping, and running requires a lot of loss of energy. So we can utilize this lost energy into electrical energy with an arrangement of piezoelectric plates. This power generation technology uses the principle of piezoelectric effect, where piezoelectric materials are used to produce an electric charge when pressure or force is applied on it. Most of the Research groups are working to develop footstep power generation using piezoelectric methodology. Power generation using floor sensor and also the comparison between various piezoelectric materials has been studied [1]. Advance piezoelectric energy harvesting technologies include materials, fabrications, unique design, and properties have been studied [2]. Analysis and design of a vibration-based energy harvesting for rotary motion application has been studied [3]. Performances of the reported piezoelectric energy harvesting from vibration has been studied [4]. High power wing energy conversion system using emerging technologies has been studied [5]. Wireless transmitter module to detect user's condition using piezoelectric floor on intelligent building has been studied [6]. Micro-rotational energy harvesting from human body using sensors has been studied [7]. Power generation techniques based on piezoelectric sensor has been studied[8].

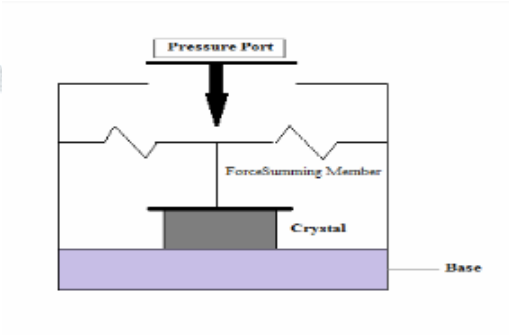
II. PRINCIPLE OF PIEZOELECTRICITY

A material used in piezoelectric crystal is the one in which an electrical voltage materializes across the surface of a solid crystal whether the dimensions of the crystalline structure are changed by the requisition of the mechanical force applied. The generation of this voltage is due to the dispersion of electric charges. This effect is termed as a reversible process if the voltage is unlike that is applied to the appropriate axis of the crystalline structure, thus there will be changes in the magnitude of the solid crystal by deforming its structure. The effect is concluded as piezoelectric effect. Elements exhibiting piezoelectric qualities are called electro resistive elements. The voltage produced from the transducers is alternative in nature [2].

Some common piezoelectric material includes Lithium Sulphate, Rochelle Salt, Quartz, ceramics A and B and phosphates. The material used as significant effect of piezoelectric effect are classified as natural group and synthetic group.



''Fig.1'':Production of electrical energy when kinetic force is applied on floor[6]



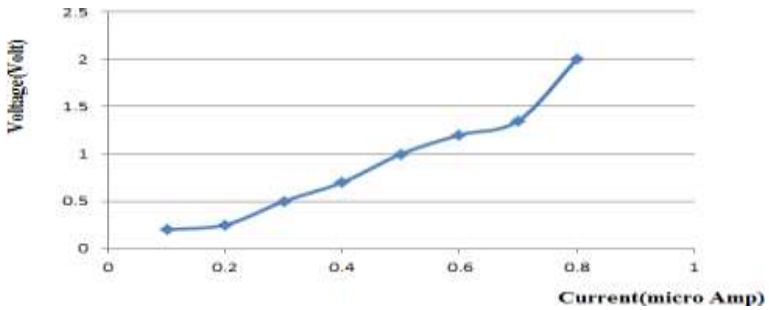
''Fig.2'': Piezoelectric Transducer [8]

The effect of piezoelectricity is proposed to respond to the mechanical deformation of a material in various of operational modes. The type of modes are- transverse expansion, thickness shears, thickness expansion, and face shear. For converting mechanical motion to electrical signals by piezoelectric transducers is sometimes considered as charge generator and capacitor. Deformation generates a charge and the generated charge is visible as a voltage across the electrodes. Voltage generated is $E = \frac{Q}{c}$

Piezoelectric materials are of three types,

I. Barium titanate.
II. Lead zirconatetitanate(PZT).
III. Rochelle salt.

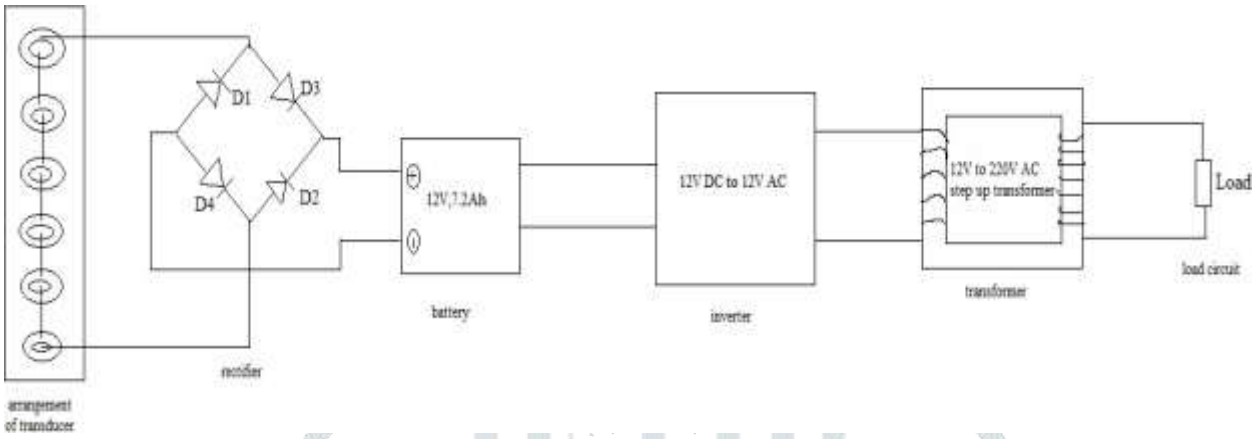
The main part of the footstep power generation is the Piezoelectric Crystal material. For the purpose of analysis we are using Lead ZirconateTitanate (PZT) as a piezoelectric material. Depending upon the type of applied pressure on a solid plate a better output voltage can be obtained. It has a compact small size, and volume fraction, and has wide range of characteristics.



''Fig.3'': Voltage vs. Current characteristics of PZT

3.SYSTEM DESIGN

When pressure is applied to the piezoelectric plates (pressure can be given to the plates by means of walking, running, etc.), reasonable voltage (alternating in nature) is produced as proportional to the pressure applied on the plates. The AC voltage produced, is then transformed into DC voltage by the help of a rectifier, a battery is connected for storing purpose of the obtained voltage. The stored DC voltage is then converted into AC voltage using inverter and fed to the transformer to produce a reasonable output for the practical application.

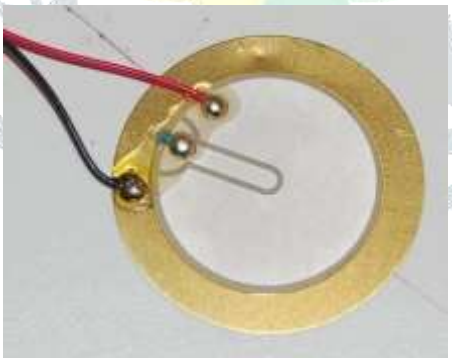


''Fig.4'': Representation of the System using Blocks

4EQUIPMENT

4.1 Piezoelectric plates

These plates are considered as the main part of the design, when any pressure is subjected to the plates it produce alternative voltage. Piezoelectric materials are fitted with the group of ferroelectric material. The piezoelectric effect in piezoelectric material like PbTiO, PZT, PbZrO3 is correspondingly similar to the effect occurring is piezo materials.. For power generation analysis piezoelectric plates of PZT material is used [1].



''Fig.5'': PZT Plate

4.2Full wave Rectifier

Generally a rectifier is a device which is proposed for converting AC power into DC power. In this analysis a full wave rectifier is used to convert the produced AC power from the piezoelectric plates into DC power.

4.3 Battery

The energy generated from the piezoelectric plates is not sufficient enough for direct application. This leads to the introduction of a battery for storing the produced energy and also for the better use of the produced energy. While designing our arrangement we used a 12V, 7.2Ah rechargeable battery made of lead acid for storing purpose.

4.4 Inverter

An inverter is an electronic device that changes a DC input voltage to a symmetric AC output voltage of certain magnitude and frequency. In this design an IC based inverter is used to convert the DC power into AC. Waveform of practical inverter can be non-sinusoidal and can contain harmonics which needs additional equipment in order to reduceit.

4.5 Transformer

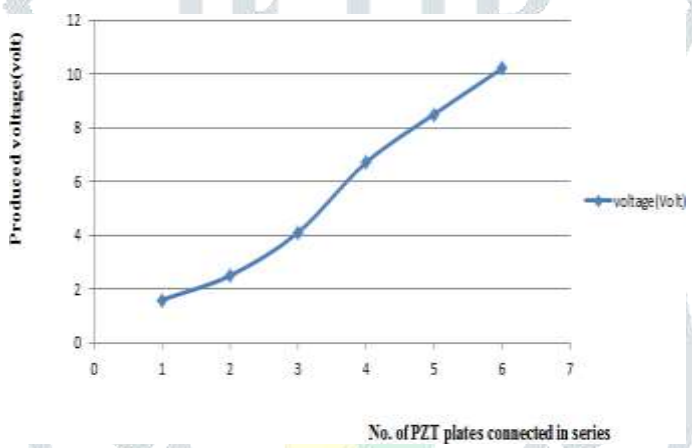
A step up transformer is used to produce a 230V AC from 12V AC that is converted from a 12V dc battery using an inverter.

4.6 Load Circuit

In this analysis a bulb of 0.5W is used as a load.

5 METHODOLOGY

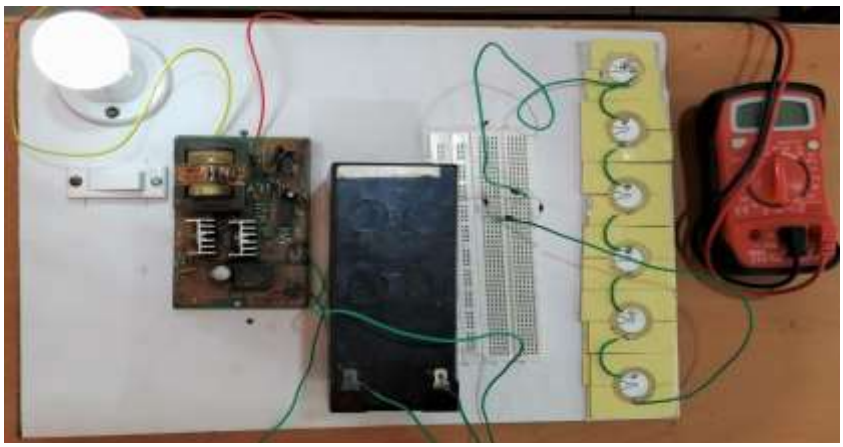
Six transducers are associated with series connection for producing a reasonable voltage, and it is detected that when plates in series increases, the production of voltage increases. From this analysis a maximum voltage of 10 volt is obtained as the production of voltage is directly proportional to the pressure applied on the transducers.



''Fig. 6'': Voltage vs. No of plates connected in series

6 SYSTEM IMPLEMENTATION

The voltage produced from the transducer arrangement is fed to the rectifier in order to produce a DC voltage for storing purpose. The output of the battery is connected to the inverter to produce a constant 12V AC voltage for the operation of transformer. A load circuit of 0.5 W LED bulb is connected to the secondary winding of the transformer to observe result of the hardwarearrangement.



''Fig.7'': Implementation of proposed design

7 CONCLUSION

In this era the demand of renewable energy is increasing day by day and in this paper we have concluded a simple and effective methodology for the production of electricity from human locomotive force. From the above implementation current obtained is small (micro Amp). So to amplify the current Darlington Pair can be used. This implemented system is a resource of environmental friendly, renewable, safe and cost effective system. If future research is done on this design, this can be viewed as a next favorable source of power generation.

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