Advanced Footstep Power Generation

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Abstract- *More than 50% of the electricity that is generated in India is generated from coal mines which are a non-renewable source of energy According to governments rural electrification policy most of the villages in the country are electrified. But, this now here speaks of the actual electricity connection or the supply to the household. Providing electricity to each and every house hold will still take much time and also the cost and infrastructure would be more Advanced footstep power generation this will be cost effective as well as efficient which will generate electricity from footsteps. The electricity or in other words the energy stored can be used for AC as well as DC applications.*

Keywords- Energy conservation, Piezoelectric material, Power generation.

I. INTRODUCTION

For an alternate method to generate electricity there are number of methods by which electricity can be produced, out of which footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses energy to the road surface in the form of vibration, sound, etc. due to the transfer of his weight on to the road surface, during every step. This energy can be converted in the usable form such as in electrical form.. Human-powered transport has been in existence since time immemorial in the form of walking, running and swimming. However modern technology has led to machines to enhance the use of human-power in more efficient manner. In this context, pedal power is an excellent source of energy and has been in use since the nineteenth century making use of the most powerful muscles in the body. Maximum of the exertion put into pedal power is converted into energy. Pedal power can be applied to a wide range of jobs and is a simple, cheap, and convenient source of energy. However, human kinetic energy can be useful in a number of ways but it can also be used to generate electricity based on different approach and many organizations are already implementing these technologies to generate electricity. It uses the piezo electric effect which is the effect of specific materials to generate an electric charge in response to applied mechanical stress.

II. RESEARCHELABORATIONS

A. STUDYOF PIEZOMATERIALS

Piezoelectric ceramics belong to the group of ferroelectric materials. Ferroelectric materials are crystals which are polar without an electric field being applied. The piezoelectric effect is common in piezo ceramics like $PbTiO_3$, $PbZrO_3$, PVDF and PZT. The main component of the project is the piezoelectric material. The proper choice of the piezo material is of prime importance. For this, an analysis on the 2 most commonly available piezoelectric material - PZT and PVDF, to determine the most suitable material was done. The criterion for selection was better output voltage for various pressures applied. In order to understand the output corresponding to the various forces applied, the V-I characteristics of each material namely, PZT and PVDF were plotted. For this the Piezo transducer material under test is placed on a Piezo force sensor. Voltmeters are connected across both of them for measuring voltages and an ammeter is connected to measure the current. As varying forces are applied on the Piezo material, different voltage readings corresponding to the force is displayed. For each such voltage reading across the force sensor, various voltage and current readings of the Piezo test material are noted.

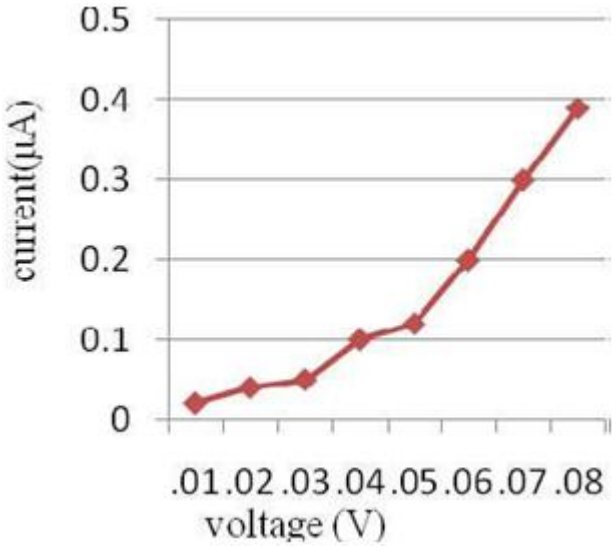

Figure1:V-IgraphofPVDFmaterial

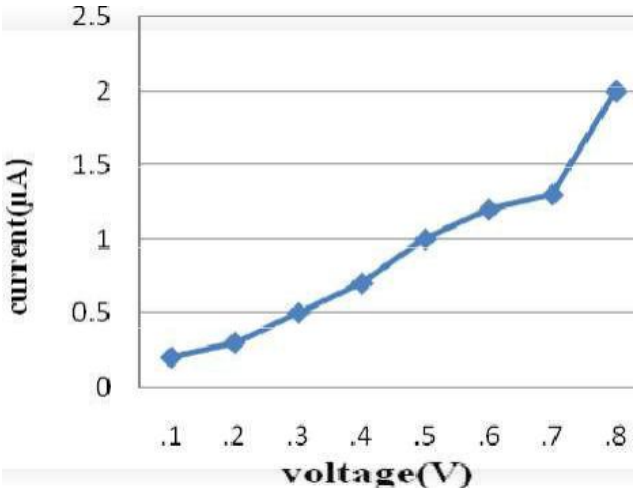

Figure2:V-IgraphofPZT

The voltage from PZT is around 2 V where as that of PVDF is around 0.4V.We can thus conclude that better output is obtained from the PZT than the PVDF.

B. STUDYOFCONNECTIONS

We will be implementing both series and parallel connection of PZT to determine the appreciable voltage and current necessary. Firstly, three PZT are connected in series. We connect a sensor which will sense the force and a voltmeter to this series combination. As different force is applied at different times the corresponding voltage is measured across the voltmeter. Also the current is measured. Similarly, we implement the parallel connection and then the series-parallel connections are done and the graph is plotted. Implementing only series or only parallel will have the problem of poor current or poor voltage. To overcome this problem we use a series- parallel combination which provides good voltage as well as current.

Figure3:PZTinseriesconnection

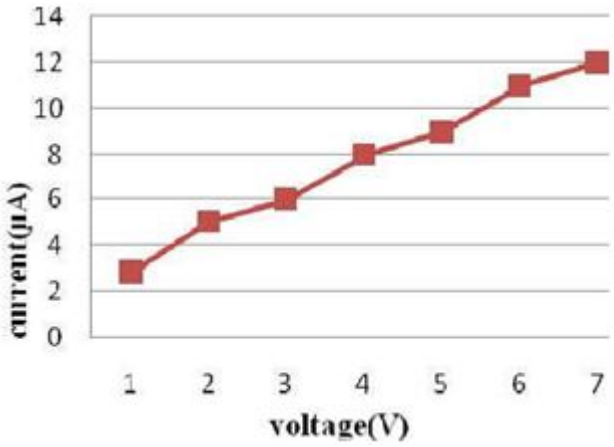

Figure4: V-Igraph of parallel and series combination

III. HARDWAREIMPLEMENTATION

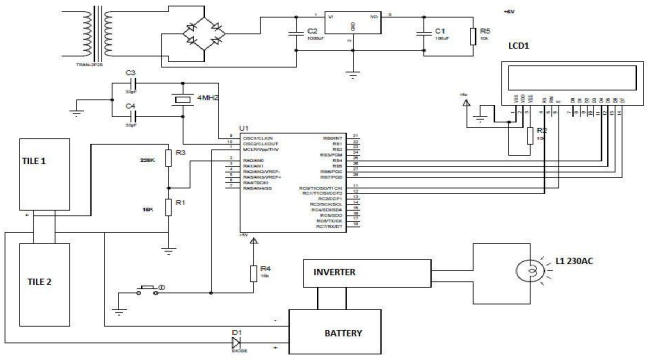

Figure5:Hardwaresetup

A tile is made using piezoelectric material which converts the applied mechanical stress to electric energy. The voltage generated across the tile is displayed on the LCD. The LCD is interfaced with the tile using a PIC microcontroller. The voltage is used for recharging the battery and storage which is further used in DC applications. Inverter is used for converting DC to AC which can be further used in AC applications

IV. WORKING

A. PIEZOELECTRICEFFECT

The piezoelectric effect is of two types: direct and indirect effect. In direct effect the applied mechanical stress is converted into electrical energy whereas in indirect form the electric input is converted into mechanical strain or stress. In this project, we will be using the direct effect. The applied weight on the piezo tile will be converted into electrical form.

The inverter used in this circuit uses the IC CD4047. It is used to convert the DC voltage stored in the battery to AC voltage. IC CD4047 produces two pulse trains phase shifted

by 180°. These pulse trains are used to switch transistors configured in common emitter mode producing pulse trains of 12V, which is capable of switching a MOSFET. The sources of the two MOSFETs used in the inverter circuit are supplied with a 12V supply. When the MOSFETs are switched on by the outputs of the transistors, two output pulses of 12V are obtained. These pulses are connected to a step up transformer from whose high voltage side; we obtain the 220V AC supply.

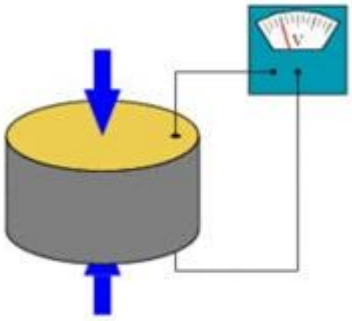

Figure6:PiezoOutputConnection

d toconverttheDC voltagestoredinthe batterytoAC

FULL WAVE BRIDGE RECTIFIER ALONG WITH AC RIPPLE FILTER

There as on forusing a full wave rectifier along with an pulse trains of 12V, which is capable of switching a RC filter is to remove the unwanted fluctuations in the MOSFET.The sources of the two MOSFETs used in the inverter circuit are supplied with a 12V supply.When the voltage. The full wave rectifier gives output for both the MOSFETs are switched on by the outputs of the cycles of AC input. During the positive half cycle, the diodes D1 and D2 are ON while diodes D3 and D4 are OFF (reversed biased). During the negative half cycle, diodes D3 and D4 are ON while D1 and D2 are OFF. In both the cycles current flows through the load at which the output is obtained. The reason for using a capacitor in parallel to the load is that capacitor is a high pass filter. It passes the high frequency components such as noise, etc.

So, at the output, across the load only low frequency components are obtained.

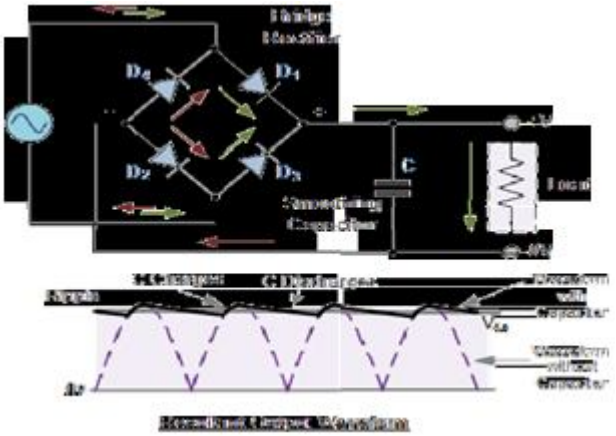

Figure7:Full wave Rectifier

II. FURTHERWORKING

We use a combination of both parallel and series connection is employed for producing 40V voltage output with high current density. From battery provisions are provided to connect dc load. Aninverter is connected to battery to provide provision to connect AC load. The voltage produced across the tile can be seen in a LCD. For this purpose microcontroller PIC 16F873A is used. The microcontroller uses a crystal oscillator for its operation. The output of the micro controller is then given to the LCD which then displays the voltage levels.

The inverter used in this circuit uses the ICCD4047. It is use to convert the DC voltage stored in the battery to AC voltage. IC CD4047 produces two pulse trains phase Shifted by 180°. These pulse trains are used to switch transistors configured in common emitter mode producing Pulse trains of 12V, which is MOSFET. The sources of the two MOSFETs used in the Inverter circuit are supplied with a 12V supply. When the MOSFETs are switched on By the outputs of the transistors, two output pulses of 12V are obtained. These pulses are connected to a step up transformer from whose high voltage side; we obtain the 220V AC supply.

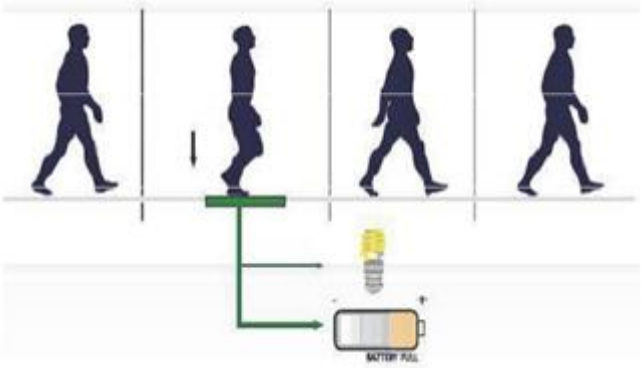

Figure8:Schematic Representation of the Working Model

V. MAXIMUM THEORETICAL VOLTAGE GENERATED

When a force is applied on piezo material or piezo tile, an electric charge is generated across it. Thus, it can be assumed to be an ideal capacitor. Thus, all equations governing capacitors can be applied to it. In this project, on one tile, we connect 3 piezo in series.10 such series connections are connected in parallel. Hence, the net voltage generated in series connection is the sum of individual voltages generated across each piezoelectric disc. Output voltage from 1 piezo disc is 13V.

Thus,

Veq=V1+V2+V3

=13+13+13

=39V

Thus the maximum voltage that can be generated across the piezo tile is around 39V.

VI. ANALYSIS DONE ON THE PIEZOTILE

People whose weight lies between 39kg to 75kg were asked to walk on the tile. When we plot the graph we see that, maximum voltage can be generated only when maximum weight is applied.

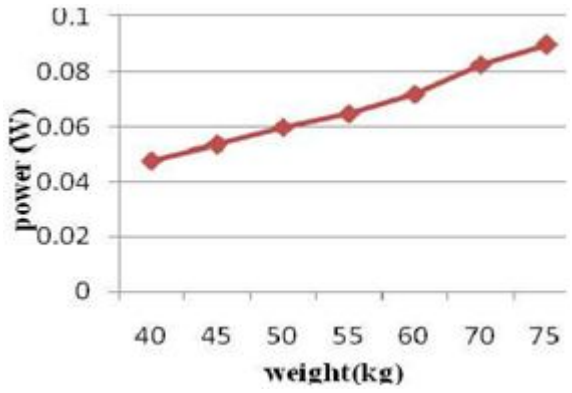

Figure 9: Weight V/S Power Graph of Piezo Tile

VII. COMMERCIALUTILITY

1. Foot step generated power can be used for agriculture, home appliances, street lighting,etc.
2. Foot step power generation can be used in emergency power failure situations.
3. Metros,rural applications,etc.
4. It can be used as a source for both AC as well as DC applications.

VIII. CONCLUSION

Thus a Piezo tile is capable of producing of 40V has been devised. Also a comparison between various Piezo materials shown that PTZ is superior in characteristics and so, we used PTZ. A SERIES- parallel combinations of Piezo sensors is more suitable. It is used for both DC as well as AC applications.

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