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Implementation of Piezoelectric Tiles to generate Electricity

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***Abstract*: -- Many researchers on developing new energy sources are being actively conducted recently. These new energy sources include renewable energy sources such as solar, wind, rain or wave energy and harvesting energy, especially from human activities. In this research paper, we developed energy harvester by using human footstep among various sources of energy. The generation of electric energy when some load is applied on the sensors either in the form of direct strain or ambient vibration depends upon various factors such as transducers, number of piezoelectric, electromechanical coupling coefficient of the piezoelectric sensors, amount of load applied and also on the scheme of arrangement. The model design and testing were purely for studying the energy generation and capturing phenomenon inefficient manner.**

***Keywords*— Piezoelectric energy harvester, Renewable energy, Rectifier.**

I. INTRODUCTION

At present, electricity has become a lifeline for the human population. Its demand is increasing day by day. Modern technology needs a huge amount of electrical power for its various operations. Electricity production is the single largest source of pollution in the whole world. On one hand, rising concern about the gap between demand and supply of electricity for masses has highlighted the exploration of alternate sources of energy and its sustainable use. An alternate method to generate electricity there are a number of methods by which electricity can be produced, out if such methods footstep energy generation can be an effective method to generate electricity. While people walk they lose a huge amount of energy that their weight energy of foot may be used and converted into electrical energy. The actual electro-kinetic floor is really an approach to make electrical energy by using the kinetic energy of a person who walks on the floor. The energy that is usually produced by the floor which can make the environment sound without any pollution such kind of energy will cost effective indeed the power floor does not need any fuel or any type of energy source only by using the kinetic energy which based on the person weight who moves on the floor. Regarding this modern world nowadays energy and power are the basic key factors as the energy demand is increasing day by day so ultimate solutions of renewable energy are implemented. In case of our paper, we have used a technique of Generating power through footstep which is the source of renewable energy that is obtained by walking on footpaths, stairs, platforms and such a system is installed mainly in populated areas. Hence, they are used as transducers in many applications. They are called as piezoelectric materials.

II. RESEARCH ELABORATIONS

A. STUDY OF PIEZO MATERIALS

Piezoelectric ceramics belong to the group of ferroelectric materials. Ferroelectric materials are crystals which are polar without an electric field being applied. The main component we are using is the piezoelectric material. The proper choice of the piezo material is of prime importance. Next, to check the connection that gives considerable voltage and current necessary, for that six piezo transducer are connected in series.

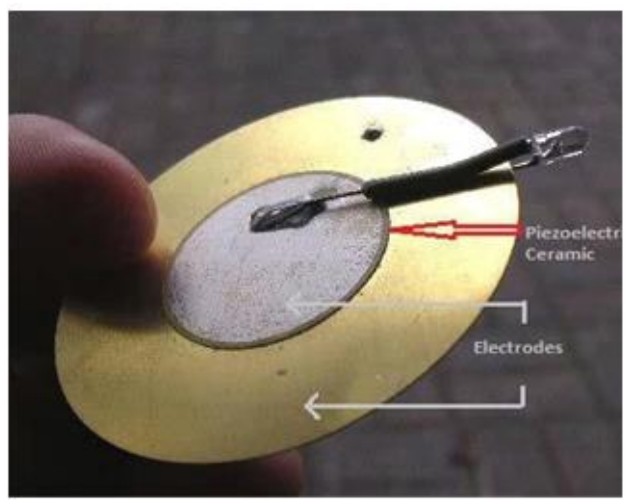

Fig 1: Piezo Electric Transducer

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The process 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, Piezo transducer were plotted. For this the Piezo transducer material under test is placed on a wooden base. Voltmeters are connected across both of them for measuring voltages and an ammeter is connected to measure the current. As various 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.

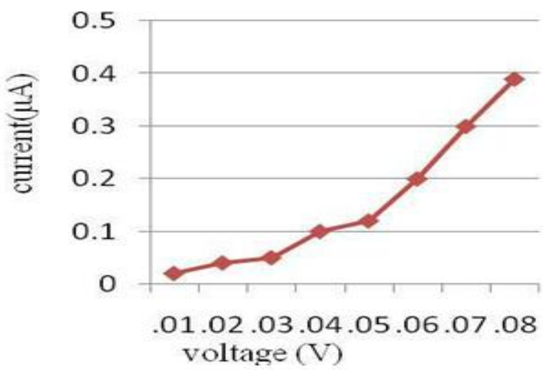

Fig 2: V-I graph of PZT material

B. STUDY OF CONNECTIONS

Next, to check the connection that gives considerable voltage and current necessary, for that six piezo transducer are connected in series

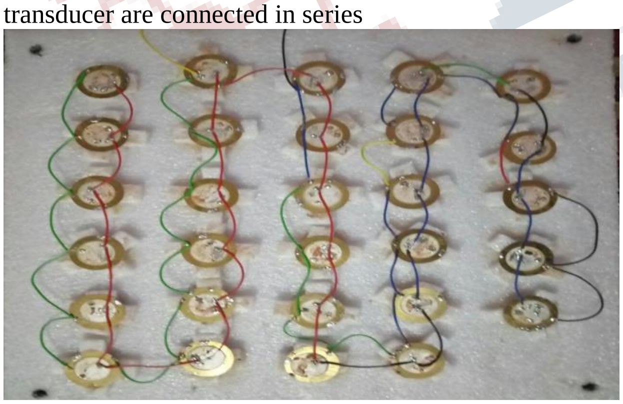

Fig .3: PZT in series and parallel connection

A voltmeter is connected to this series combination. As various forces are applied on tiles connection, different voltages are noted. Also the voltage produced across the series connection and the current is measured. Similarly the connections of 29 PZT are done for parallel and series-parallel connections are done and the graphs are as in figures 2 and 3.

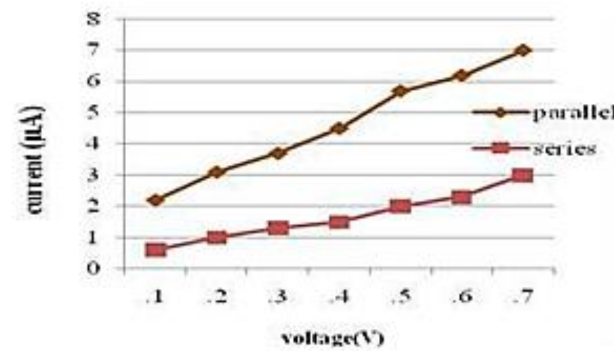

Fig 4: V-I graph of parallel and series connection

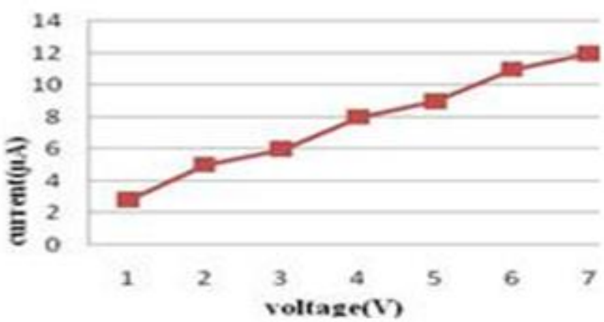

Fig 5: V-I graph of parallel and series combination

It can be seen from the graph that the output voltage from a series connection is good but the current obtained is poor, whereas the current from a parallel connection is good but the voltage is poor. But this problem is rectified in a series-parallel connection where a good voltage, as well as the current, can be obtained.

III. HARDWARE IMPLEMENTATION

The hardware set up is as shown in figure 5. A tile made up of wooden base of 12mm on which foam sheet of 3mm is placed to protect the piezoelectric material from damage. On foam sheet 29 piezoelectric transducer is connected in series and parallel combination. To avoid excessive pressure directly on piezo material springs are implemented between the top and base of tile. The top is made up of fiber sheet of 2mm on which the pressure is applied. The fiber is bolted to the wooden base. The tile is of 1*1m. The storage battery is connected below the fiber sheet. Then voltage generated across a piezoelectric tile is supplied to a storage battery to recharge and supply the dc loads.

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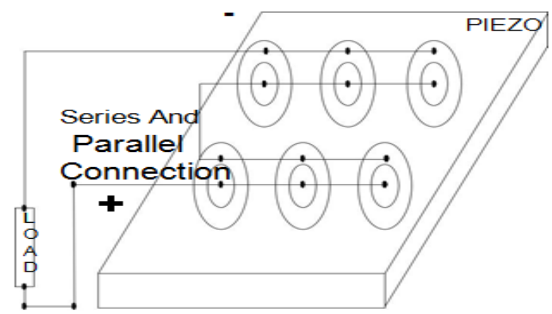

Fig 6: Hardware setup

IV. WORKING

The working principle of piezoelectric tiles is a follows. When a load is applied to the tile surface it moves in the downward direction. The projections on the tile surface come in contact with the piezo material.

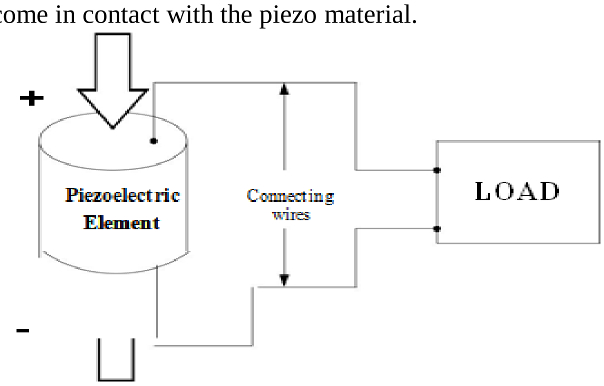

Fig 7: Block Diagram

The applied force produces stresses inside piezo material which will produce electricity. There is clearance in between the springs and tile surface in order to provide free deflection. The spring is provided for stability as well as protecting the piezo material from getting damaged by an excess load applied. The base plate is fitted inside the frame firmly to provide support to the piezo material while compression.

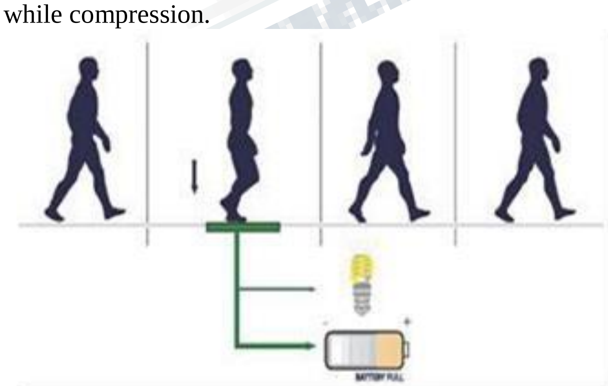

Fig 8: Schematic representation of the working model

The energy generated depends upon the weight of the person, type of movement, and maximum deflection. This kinetic energy is converted into electricity. This generated electricity is stored in the form of batteries.to which the rectifier is connected to get pure dc supply. It is observed that the voltage generated from one tile containing 29 piezoelectric transducers can generate up to 12V and current up to 1.5µA instantly.

V. ANALYSIS DONE ON THE PIEZO TILE

People whose weight which is varying from 40kg to 75 kg were made to walk on the piezoelectric tile to test the voltage generating capacity of the Piezo tile. The relation between the weight of the person and power generated is plotted in figure 9. From the graph, it can be seen that, the maximum voltage is generated when maximum weight/force is applied. Therefore, the peak voltage of 12V is generated across the tile when a weight of 75 Kg is applied on the tile.

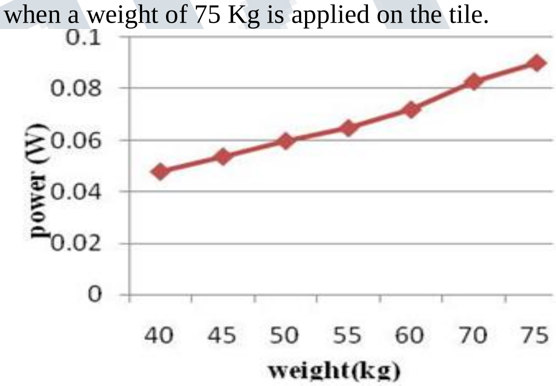

Fig 9: Weight V/s power graph of piezo tile

Piezoelectric flooring is ideal for places that receive heavy foot traffic. It can be placed at tourist attractions, dance floors or town halls, schools, stadiums,. In fact, the hard Energy Floors has a product called the Sustainable Dance Floor especially designed for clubs. Piezoelectric tiles can also be placed in other busy places such as subway stations, airports, universities, and malls. The technology of using piezoelectric tiles to generate electricity using pressure is new, companies in this sector are still looking for venture capitalists and investors. It would be interesting to see if any automotive companies develop an interest in this technology to harvest electricity from the movement of cars and other vehicles.

VII. CONCLUSION

A piezo tile capable of generating 12V has been devised. Comparison between various piezoelectric material shows that PZT is superior in characteristics. Also, by comparison, it was establish that series-parallel combination connection is more suitable. The weight which is applied to the

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piezoelectric tile and corresponding voltage generated is studied and they are found to have a linear relation. It is especially suited for implementation in crowded areas. This can be used in street lighting without the use of long power lines. It can also be used as charging ports, a lighting of pavement side buildings.

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