Piezo Electricity Generation

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Abstract

Now day's use of energy is increasing day by day and for that we have to develop different methods for producing energy for it. For that purpose we have to use the sources like solar, wind, pressure for production of energy. Piezoelectric materials are excellent pressure power generation devices because of their ability to couple mechanical and electrical properties. In this study paper we are representing the electrical power generation using human footstep. This is about how we can generate electricity using human's waste foot energy and applications for the same. When human walk in surroundings some force exerts on surface this force can be used to generate electricity. The idea of converting pressurize weight energy into the electrical energy is possible by Piezo-electric crystal.

Keywords: Pressure, Piezo-effect, Power Generation

I. INTRODUCTION

In developing word electricity has become a necessity of every single human, requirement of electricity increasing day by day. For the new generation, needs of the electrical power increasing for their lots of different operations. For that many sources are wasted and exhausted in a large amount. There are many more ways to generate electricity. The most energy we waste is human foot energy. This energy we can use for production of energy, this would be a great evolution in electricity generation. Normally the average human can take 3,000 -5,000 steps per day. This technology is based on a principle called the piezoelectric effect, in which certain materials have the ability to build up an electrical charge from having pressure and strain applied to them. Piezoelectricity refers to the ability of some materials to generate an electric potential in response to applied pressure harvesting of energy which means energy is already available, but is going to waste if not utilized. Embedded piezoelectric material can provide the magic of converting pressure exerted by the moving people into electric current due to pressure applied on the piezoelectric material. This paper comprises of four section namely study of piezoelectric material, application of energy harvesting via piezoelectric material, locations for generating large scale electricity and conclusion.

II. STUDY OF PIEZO ELECTRIC MATERIAL

The piezoelectric effect was discovered by Jacques and Pierre Curie brothers in 1880, who observed that certain materials generate electric current when they are deformed. The material which converts mechanical strain or force to electrical current or voltage is known as piezoelectric. The everyday examples of force or strain are Human motion and vibrations are the different types of mechanical strain. The piezoelectric effect exists in two properties first the piezoelectric effect is a reversible process in that materials exhibiting the direct piezoelectric effect (the internal generation of electrical charge resulting from an applied mechanical force) second it also exhibit the reverse piezoelectric effect (the internal generation of a mechanical strain resulting from an applied electrical field) this is the best way of power harvesting.

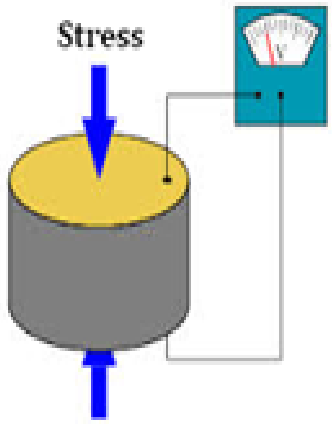

Fig. 1: Piezo Electrical Effect

III. APPLICATIONS OF ENERGY HARVESTING VIA PIEZOELECTRIC MATERIAL

A. Flooring Tiles

In these types of application rubber is used to make the flooring tiles which can sense vibration under these the piezoelectric materials are placed. When any movement is felt by this Piezo, they generate electricity. These types of flooring are installed in location where large crowd movements are expected such a places like railway station, Bus stations, Airports, Malls, footpaths etc, when people steps on them, then by piezoelectric effect small charge is built up and the energy generated. The generated energy by one human is too less but if number of steps on these kinds of tiles increase then energy produced by it is increase. When a human steps on such tiles piezoelectric crystal under the tiles is sense some mechanical stress and that makes electric charge to build up on crystal's surface which can be collected by use of electrodes. The generated energy can be stored by capacitor and this energy can be transferred as per requirements. Japan has already started experimenting use of piezoelectric effect for energy generation by installing special flooring tiles at its capitals' two busiest stations. Tiles are installed in front of ticket turnstiles. Thus every time a passenger steps on mats, they trigger a small vibration that can be stored as energy.

Fig. 2: Flooring using Piezo Electrical Material

B. Road Side to Power Street Lights

Constructing special types of roads that generate electricity just by driving over them. With the help of traffic on existing roadways we can generate electrical energy by using the electrical generator. The plan of constructing the special types of roads which generate the electricity is a unique application in power harvesting methodology. This system works by embedding small piezoelectric crystals into the road. Though small charge is generated by single car but 1 km stretch of such road could generate around 400kW-enough to run eight small cars. If such system was installed one very stretch of British motorway it would generate enough energy.

Fig. 3: Roads using Piezo plates

C. Dance Floors

Piezoelectric effect is also being used in the dance floors same as roads and railway stations. These floors are using the piezoelectric effect. As the floor is compressed by the dancers feet the piezoelectric material makes contact and generate the electricity around 2-20 watts. The generation of electricity depends on the force of the feet. When particular arrangements of molecules are pressed together, the proximity of one atom to another changes enough that there is a change in the configuration of the valance electrons. When the pressure is released, the electrons return to their previous places. When piezoelectric compounds are fitted with an auxiliary circuit, these electrons can be captured and used to create a micro circuit. The constant compression of piezoelectric crystals causes a huge amount of energy to be generated, which can comfortably drive the remotely placed low power consuming devices.

Fig. 4: dance Floor using piezo Electricity

D. Inside the Footwear Heel

Same like tiles, roads, dance floors, attempts are made to produce energy from our daily movements by installing piezoelectric crystals in the shoes also. These shoes would have piezoelectric crystals at the rear end or near heel. Thus with each step piezoelectric crystal would go through pressure and force which in turn can generate enough energy to power cell phones, mp3 players etc. If these shoes go through movements daily then these will be able to generate electricity enough to charge up the small electronic devices or gadgets. Often we can do that with a piezoelectric transducer, a transducer is simply advice that converts small amount of energy from one kind to another for instance converting light, sound or mechanical pressure into electrical signals.


Fig. 5: Piezo Crystal Installed in Shoes

IV. LOCATIONS FOR GENERATING LARGE SCALE ELECTRICITY

E. Roads and Highways

The traffic is more in day than the night and sometimes traffic run 24hrsand the traffic varies throughout the day. The total force exerted by moving automobiles on the road surface can be calculated by considering the average number of vehicles passing through certain point, for a certain time period. In a survey Israel is putting PEG 6cm under the road level and at a distance of 30cm apart. From this trial, it has been seen that a vehicle weighing at around 5 tons can generate 2000V, and a 1Km cluster of such generator can generate 400Kwh energy. If 600 vehicles are allowed to go through this road for an hour, it can power up to 600-800 homes.

F. Power Generating from Footpaths

Footpath is most common place on where we embed the piezoelectric tiles to produce the small amount of energy by utilizing the human footstep over it. The produced charge is stored in battery and then that stored charge can be use for charging low power electronic devices.

G. Power Generating Railway Tracks

The railway tracks are the important place which is responsible for generation of large energy as the huge amount of pressure is exerted by trains on the railway tracks. The embedded piezoelectric crystals at the railway tracks where wheels make contact with the tracks and these materials get excessive pressure and force, because of this greater amount of energy is stored.

H. Power Generating Airport Runway

In large amount of pressure is exerted on runways, when the aircraft takes off or lands. If we place the piezoelectric clusters here then we can convert this mechanical energy. The efficiency of system can be improved by placing the stacked structure which is consist of several layers of piezoelectric clusters and have the capacity to handle the huge amount of pressure.. The maximum takeoff weight for the airbus aircraft (A380) is 560 tones, which can produce 224 KV, so if one considers the total number of landing in the runway a large amount of energy could be produced. Nearly 8138 kWh energy could be produced which can power up to 12207-16276 homes.

I. Schools, Colleges, Shopping Malls and Gyms

Having the flooring of piezoelectric material will cause to produce the more energy in the malls and schools. We can embed the piezoelectric tiles at the entrance of the malls and schools. The idea of utilizing the vibrations caused by the machines in the gym and at workplaces also while sitting on the chair, this energy can be stored in the batteries by putting the piezoelectric crystals in the chair

V. CONCLUSION

This statement of Albert Einstein is true "Energy can neither be created nor be destroyed it can be transferred from one form to another." This method of generating electricity by the use of piezoelectric material has already being started in many countries viz Japan, Israel, Netherlands. Use of piezo-electric material is eco-friendly causes no pollution. It is an inexpensive way of generating electricity and is easy to install. In future this method will be a promising method for generating eco-friendly electricity. We also contribute this method at common places like home entrance gates, parking area, bus stands etc. This method will exploits different areas of electricity generation.

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