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ELECTRIC POWER GENERATION BY SHOES
A REVIEW

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Abstact: converting Mechanical Energy into electrical energy by using body weight and power wearable sensors.This paper studies a Piezoelectric electric sensor which helps in conversion of energy.The design of the piezoelectric material is as such that it can be fitted inside the sole of the shoes without compromising with the comfort of the user.It is durable as it is fitted inside the shoe .Furthermore with help of dc circuit power transmission takes place.

Keyboards: Piezoelectric Material; comfort; DC circuit.

1. Introduction

The fast few decades emphasized on inventingnew devices such as mobile phones,Laptops,MP3 players etc.These objects nowdays are not luxuries but they have become of our need.This Devices cannot be connected to a constant Ac source because of their portable nature .The battery capacity have been increased to reliable extent but still the devices suffer from limited storage due to their additional use and multiple operations performed on them.One way is to carry additional batteries and other is to convert easily available energy into electric energy.

The human body has also been considered as an excellent platform for applying such technologies, since the body contains a lot of ambient energy .There have been many attempts to supply power to mobile devices in real-time using the energy generated by the human body .They include shoe-mounted generators, knee-mounted generators , energy harvesting on a backpack and harvesting energy from breathing .They accomplished huge improvement in economic and effective use of human motion by designing sophisticated structures mounted on unique locations on the human body or wearables. Some of them even suggested that waste energy in human motion can be utilized to generate electricity. However, since their implementation requires delicate manufacturing depending on the mounting configuration, there are still many problems to be tackled for practical development and further commercialization. Also, the level of output power and operating schemes are not yet suitable for an instantaneous self-powering generator.The human-powered self-generator still provides the best solution for individuals who are in need of an immediate and reliable power supply since it is less dependent on weather conditions and occupies smaller volumes than any other

renewable energy source. With much improved designs of practical mechanical power transmission and electromagnetic configurations as well as simple operating schemes and structures, it should be possible to realize a practical portable human-powered generator.

Use of batteries as a Power source is a common in day-to-day life for power generation.But,the use of batteries helps in transmitting only limited energy.Hence it is important to find a independent source of power generation.This helps in generating clean and sustainable energy.Several concepts of piezoelectric material for power generation are studied, such as such as electromagnetic, electrostatic , thermoelectric , nano-triboelectric and piezoelectric.Piezoelectric energy harvesters and nano-triboelectric generators can convert mechanical energy into electric energy.These Piezoelectric material can be easily found as well as their design is more compact and simple.

2. Literature Survey of Piezoelectric material

The survey considered in this work are categorized in the following subsections separately as generating electric power using human efforts by integrating piezoelectric sensors in shoes.

2.1.1 Literature Survey onelectricity generation by pizoelectric material:

The following literature review is based on the electricity generation by piezoelectric material on various materials such as Titanium alloys; Ceramics etc.J Jhon Livingstone [1] presented an experimental study of piezoelectric materialbelow the shoes, which convertes human efforts/kinetic energy into electric energy. Electric energy is ussed to charged mobiles and wearable electronics, but positioning of piezoelectric sensor below the causes damage of the sensor and produces less voltage.Jingjing Zhao-Zheng you [2] they manufacture energy harvester design which is sandwich structure, where multilayer PVDF flim is sandwiches between two wavy structures of movable upper plate ans lower plate. When upper plate is subjected to a compressive force produce by foot, the upper plate moves down and PVDF stretch aixs simultaneously. This leads to piezoelectric field inside PVDF layer. And one with without PVDF layer prototype is created. In which without PVDF layer prototype produce large electric energy where other with PVDF layer produces less energy.

Henry A. sodano-Daniel inman [3] in this the piezoelectric material is excited by mechanical vibration.Which generated embbeded in vibrating environment for their evolution and electromagnetic transducer was chosen. Harmonic analysis of the generator was

performing in order to evaluate the viability of device and optimization of device. The predicted power generation was one mcW. At an excitation frequency of 70 Hz.Nayan HR [4] They connected piezoelectric sensor to the floor so as man walks on the floor electric charge is created. The main limitation is they could not amplify the current or power from source to charge battery faster with less step therefore they use buzzer as piezoelectric sensor,which has little amount of piezoelectric sensor on their surface.MR.nishant K. Mehta[5] The vertical load of vehicle wheels yield compression stress diminishing with depth. They embedded piezoelectric material under the asphalt. The generators are placed under the upper layer asphalt. The piezoelectric generators do not increase the asphalt deformation as well as the quality of road; hence as vehicle moves over the road electricity is generated. Anil Kumar [6] They used PZT wafers and PVDF film inside the shoes to convert mechanical energy into usable electrical energy. They added double actuators in parallel which reduces charging time of the battery and increase the power generated by the piezoelectric device. By using parallel combination they overcome problem like impedance matching and low power generation. P Glynne-Jones, NM White [7] A method has been described for modelling the power than can be produced from piezoelectric inertial generators. Analytical methods have been shown to be too complex to produce useful results. The methods uses a combination of FEA and complex stiffness model of a resistively shunted piezoelectric element. Comparing the model of experimental results, accurate predictions are seen at low beam amplitudes due to non linear responses. The power output from the prototype generators reaches a maximum of only a few microwatts. This power outputs is too low to be of practical use. The reason for this low power, compared to initial prediction for resonant generators is due to the low electromagnet coupling produced by thick-film piezoceramics when they are operated in a 3-1 coupling mode. Thus, orders of magnitude increase in the power output are possible with other piezoelectric system. Vinnet kumar Yadav, Rajat Kumar [8] In this mechanism of generating the electricity can be placed on railway station. The power is generated when people pass through it which is stored in the battery. This power can be used in many places such as malls collages e.t.c. aftervusing the inventer.K.Ramakrishnan [9] In this set up old, worn flooring is replace are in certain high traffic area as an experiment for determining feasibility in airport terminal in similar option to the implementation in the Tokyo train

station. This could be installed in terminal to converts DC power from piezo devices into AC power using lighting system at airport.Mrs.Salunkhe Aarti L, Mrs.Gaikwad Sayli S [10]They design prototype to give better voltage and current PZT are connected in series. A force sensors and voltmeter are connected to this combination the produce output is in variable form so bridge circuit is used to convert variable voltage into linear voltage and an AC filter is used to filter out the output voltage and it is stored rechargeble battery two possible connection tested parallel and series for producing 40 volt output .Fakhzan,M.N.Muthalif[11]The experiment was carried out using four different proof masses;0.24gm,4.8gm and 7.2gm shows the voltage generated for the first two modes with different proof masses. It observed that the voltage produced at the first mode increases with the weight of the proof masses; hence the proof mass has the ability to tune natural frequency of the beam. The experimental results are then compared with the analytical simulation.the correction factor is taken from the impedance of the HP dynamic anlyzer .S.R. Platt, S.Farritor [12] The power generated by piezoelectric material is very less so they have added knee attachment of energy harvesting which produced electric energy when swaing locomotion of human body therefore the total power generated is increased. Mahind S.M and M.N. Ghuge[13] The project is developed for much cleaner cost effective way of power generation methods.The controlled mechanism carries the piezoelectric sensor AC ripples neutralizer and unidirectional current controller and 12volt,1.3Amp lead acid DC rechargeable battery. The working is base on the concept of converting unused energy in surrounding into electric energy. The piezoelectric platsis placed under the nonconducting material and the pressure created by foot step and water fall. Jedeol Dayou [14] There are to theoretical models normally used to predict the power output from piezoelectric film attached to a beam namely pin-force and Euler-Bernoulli method. Their main difference is the way to model the interaction between host structure and piezoelectric-film.Output of this Euler-Bernoullis method was proven to be the most appropriate method. Renato Calio [15] They used piezoelectric material like d_{33} and d_{15} which have very complex structure. Where d_{33} have highest output where d_{31} best solution found in terms of the fabrication process. Ashish Gupta [16] The human motion vibration are converted into electricity via piezoelectric element. The electricity produced is converted by an AC-AC rectifier circuit and DC-DC step up converter before applying to a storage device.Jose Ananth Vino [17] In this

experiment the control mechanism carried the rack and pinion setup, DC generator, Battery and inverter. In this method instead of using piezoelectric material an mechanical setup of rack and pinion is used. In the rack and pinion is connected to the larger sprocket which is connected to smaller sprocket which rotates the generator shaft. Thus generates 12Volt D.C.voltage. Shiraz Afzal [18] In this project system is attached with flywheel which causes to rotate the dynamo as the tile on the deck is pressed. The power generated is saved in battery. Energy saved in battery an inverter circuitry is implemented to convert DC to AC, so the home electrical load is sprinted. Further a microcontroller based home mechanization framework is imlemented which control rooms prudently. C.R. Saha [19] In this project based upon generating energy by human body motion using electromagnetic setup. The setup is consist of axially magnetized permanent magnet

are placed vertically inside a tube so that facing surfaces have same polarization. A coil is wrapped outside of so that they move as a single object. The difference in flux between single moving magnet and double moving magnet plus pole. J.M. Donelan[20] Unlike conventional human-powered generator that use positive muscle work, This project demonstrate energy generation by muscle performing negative work, analogous to regenrative braking braking in hybrid cars. The energy harvester are mounts at knee and selectively engages power generation at the end of swing phase. Qiang Zheng[21] They integrated the energy produced by the human effort using piezoelectric sensors with biomedical devices. The reduced the space used by the battery of IMD by charging it using piezoelectric sensors.By harvesting in vitro and in vivo biomechanical energies, self powered medical electronics for nearly lifetime can be attained.N.Gure[22] For energy being sufficient to all sophisticated electric sensors on human body its necessary to apply hybridization. They produced the Four multi source powered HEH in which the classic HEH produced better output. Andrezej Tylikowski [23] The piezoelectric material cannot be modeled as point force excitation and partial differential equation is used to describe the response of the structure driven by them. A discrete model of piezoelectric ceramics elements as part of device stiffness. Crawley [24] The presented a comprehensive static model of piezoelectric actuator glued on the beam then it is used to predict dynamic behaviour. A. Erturk [25] The SDOF modeling approach considers the cantilevered beam as mass spring damper system which is very convenient for coupling the mechanical part of

harvester with a simple electric harvesting circuit. It lacks of several important aspects of physical system. Analytically obtained expression is then used in parametric case study.

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