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Generation of electricity using footsteps on floor tiles

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Abstract— Electricity is critical and increasingly demanded. A great deal of energy was lost and depleted. When walking on a population of humans, an alternative means of generating energy was found; the vibration between the surface and the move was wasted. The use of this wasteful energy will create and satisfy demand for electrical energy. An electric transducer is the transducer that detects the vibration. This transducer turns mechanical energy into power. If the pressure is applied from the footstep to the electric transducer, the pressure or force is converted into the electricity. In series parallel communication the electric transducer is connected. Then, the electric transducers are mounted on the tile made of wood as a model for phase tiles. This tile can be positioned in a crowded environment, on foot or on training tools. Power up low power devices can produce electricity from this electric tile.

Keywords— Electricity, electrical transducer, pressure, electric tile

I. INTRODUCTION

A growing fossil-fuel and non-renewable energy depletion has been called for a critical need to replace the depletion with an alternative source of energy, and for the continued increase of the energy demand. The desire to do business is energy [1]. Electricity is one of the common energy uses and grows according to the population. The purpose of this innovation is to use the increase of the human population and to increase energy while at the same time reducing the environmental impact. Equally, the energy used does not rely on or depend on the environment [2]. The excess of energy must be used to produce the electricity required. The energy is lost by walking human activities to produce electricity. The energy is used. In the form of vibration to the ears, the walking energy is wasted [3, 4]. An average of 3000-5000 steps a day is possible [5-6]. This move will generate more power to meet the required demand. The energy from the foot step can be derived by vibration and the three forms of vibration are electromagnetic, electrostatic and electric [7]. In general, different electrical energy generation techniques are obtained by movement of people or by movement of vehicles on the roads. An unknown mechanism is employed to fluctuate the pressure in the field, which consists of the crossing of exposed persons or vehicles resulting in fixed pressure amplification [8]. In the Netherlands, for example, the electromagnetic generator generates energy on the dance floor. However, for the generation of significant electric energy a relative larger deflection of the floor up to 10mm is needed. Furthermore, its function and demand are complex and costly to assemble [9]. In Japan, the electric transducer was mounted in the floor of the electricity generating subway ticket machine and requires only ceramic tiles without a complex mechanical structure [8-9].

This approach is based on the electric effect of energy conversion. Electric effects are two types that are directed electric and tiles [10, 11]. The ability of the electric transducer to transform mechanical power into electrical energy is the direct electric effect [12-14]. If the electric transducer is subjected to vibration or mechanical stress, the electric charge is deformed and generated. The generator or transducer effect is also known [15]. Piezo electrical transducers are known as conversion electric efficient to transform electrical power into mechanical energy [14, 15] when the electric transducer is submitted to the electrical field or the electrical field is applied to the electrical field, the electric transfer is deformed. The action or motor effect is also called [13, 14, 16]. The vibration energy collection process begins when mechanical vibratory energy is extracted from the atmosphere and the produced alternating current (AC) voltage is remedied and converted to direct

current (DC) voltage. The wasteful energy can be used to produce electricity using the electric effect. Pressure and stress can produce electric power by transferring mechanical power from footstep [17-19] when the electric material is applied. The mechanisms of mechanical energy transmission, generally ambient vibration, into electrical energy can be used as electric substances which can be stored and used to power other equipment [20]. Depending on the load and AC source produced, the electronic energy from aelectric transducer coupled with a vibration system is generally very low. An interface circuit that allows the conversion to DC is therefore needed. To convert AC to DC, and then filter the waveform, the complete-wave bridge rectifier is used and stored on the condenser that acts as storage. This electric transducer is linked to one another and positioned in or in populated areas on footpaths, escalators and platforms. The voltage generated by this electric transducer can be used to power low-power devices, including street light and street lighting [2]. Until using the voltage produced from the electric, it is possible to store the voltage in the battery as well as in the condenser.

Electric transducer research has been carried out in generating electricity. Arvind et.al suggested generating electricity through human locomotive [21]. Set the circular electric transducer in the pedestrians and use it to light the lights of the street to produce electricity. Ghosh et al. conducted more research and suggested the production of electricity by using footprints for application of energy in urban areas [23]. In this study, the origins of human movement are used to press the equipment and the shaft to generate electrical energy by rotating movement and using the principle of the Faraday Law. In addition to the electric transducer, it can also be used for medical use. Meirer et al. proposed aelectric power harvesting method for podiatric sensing for this study [23]. For this purpose, this research uses the circular, electric, heels of the shoes transducer and focuses on athletes, patients with physical therapy, amputees and conditions in the muscles or nervous systems [23]. Akshat Kamboj et.al, designing a power generator footstep with electric sensors, conducted another research [24]. This study has also been used to generate electricity with a circular electric transducer through phase. The electricity generator is contained in a double battery of 6 volts per battery before the charge, such as light, is used [24]. In Bangladesh, electricity can be produced by means of the electric material which was investigated by Nayan HR using its population density. In this analysis, the minimum voltage per phase is 1 V [25] and 12 electric sensors in 1 square ft are used and with a weight pressure of 50 kilos per person. 800 steps are required to increase battery charge by 1V, so that battery charge increases by 12V and requires 9600 steps. If the average footstep is 2 steps in 1 second, then 9600 steps take 80 minutes [25].

The production of power by electric tiles was studied in this research. By transforming the pressure applied to it, the electric transducer produces electrical energy. The weight of people walking over it is the sources of pressure. In series parallel, the 6 cell of electric transductions' is fastened together. In AC voltage and not a stable output the output of this electric transducer. The AC voltage is converted into a DC voltage by using a complete wavy bridge rectifier, and then the voltage is filtered through the smoothing condenser to filter out any output fluctuations. The output is ready to be stored in a condenser or in low power supplies after correction and filtering.

II. RESEARCH METHOD

The electric transducers of plum zirconate titante (PZT) were used in this study for the collection of the film energy. The output tension of this electric transducer depends on the ceramic structure and stress size that is applicable to its structure. The diameter of this transducer is 5 cm crystalline. The frequent output voltage is 0-12 V. It can however reach up to 30 V at immediate impact on this transducer, while the output current is approximately 5 mA. In this analysis, there are two forms of the electric transducer PZT, the circular and the square. The circular form of the electric transducer is better suited to stress or stress the transducer center stress meanwhile, when straining or tension on the tip of the transducers, the square form of the electric generates high voltage.

This electric circular form transducer has been chosen because it is the most suitable electric transducer instead of square. When testing an oscilloscope, the circular form of the electric gives greater output voltage. This is because of the deflections on the structure of the foot press. The electric transducer is connected in serial parallel connections with both the voltage value and the current output. The electric output is AC-shaped. It must be revised in DC form and given to DC loads before it is deposited in storage components such as battery or condenser. The full wave rectifier for the output of the electric tile was used in this study as shown in Figure 1, the entire wave bridge used for the analysis comprises 4 diodes and 2 condensers. One condenser serves as a fluid condenser for filtering the waveform output, and another for storing steam.

This operation is split into 2 cycles with a positive half-cycle and a negative half-cycle. This operation is complete. The four D1 to D4 diodes are grouped in "series pairs." Each half cycle only has two diodes that lead to current. The diodes D1 and D2 perform in series during the positive half-cycle of supply, while D3 and D4 diodes are in OFF condition as they are now in reserve bias and the current flows through the two condensers. The D3-D4 diodes are performed in series in a negative half-cycle of the supply, but the D1-D2 diodes are in reverse direction. Strom is in the same direction as before through the condensers. One of the condensers acts as a smoothing filter, the other as a storage element. Both are in parallel with each other. The voltage of AC is adjusted in the DC form in full bridge adjuster, then the smoothing condenser is used to eliminate a ripple factor that is still in the DC tension form following the rectifier. Finally, in the storage condenser, the output from the electric tile is saved to the other low-power units. the experimental arrangement of the electric tile as shown in figure 2.

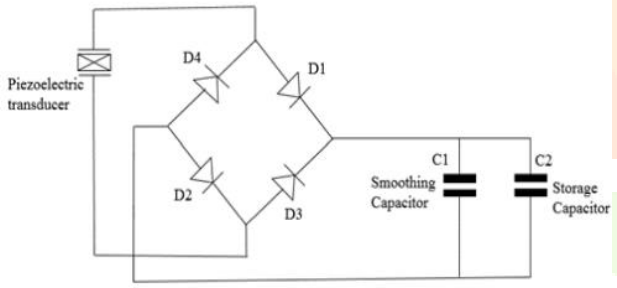


Figure 1. Diagram of the full-wave bridge rectifier with smoothing and storage capacitor

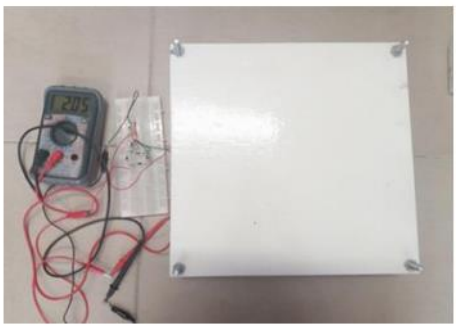


Figure 2. The experiment setup of the electric tile

III. Results and Analysis

The electric transducer output is in AC waveform. The output of the transducer needs to be rectified and filtered before being used to the storage or to the DC loads. Figure 3 shows the output of the electric transducer before being inserted to the full bridge rectifier.

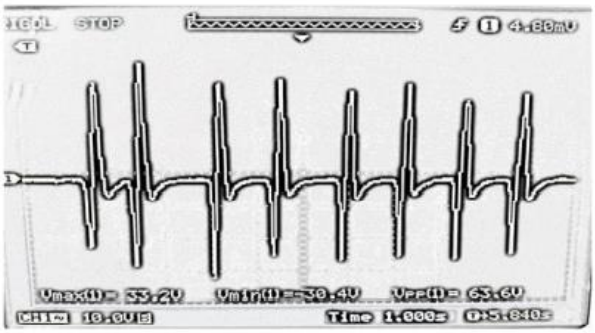


Figure 3.The output of the electric transducer before being rectify

Connection of Electric

The electric transducer was connected in series and parallel connection. Before using the electric transducer to generate electric energy, the connection needs to be determined to choose the better output from the electric transducer. Figure 4 shows three electric transducers were connected in series. Figure 5 shows, three electric transducers are connected in parallel connection. Two sets of three electrics that connected in series were attached in parallel for series-parallel connection as shown in Figure 6. The multimeter was connected to the electric transducers to measure the voltage and current across the connection. A double-sided tape 3mm is placed on the top and the bottom of the electric transducer to maximize the output of this transducer. Figure 7 and Figure 8 shows the output of the electric based on the connection that being done.

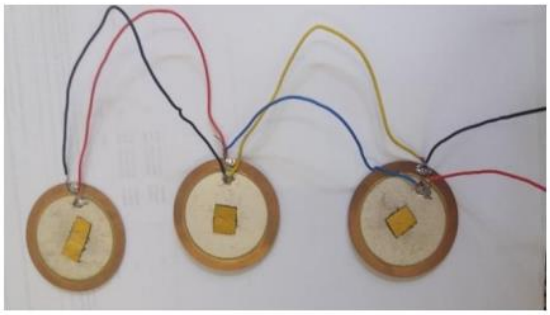


Figure 4.The series connection of electric transducer

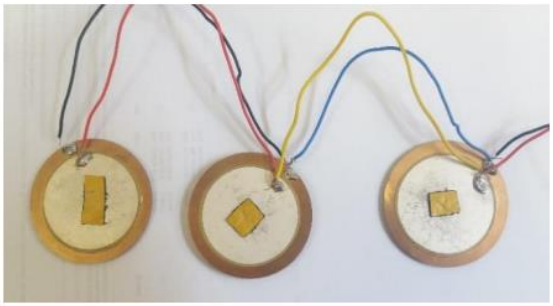


Figure 5.The parallel connection of electric transducer

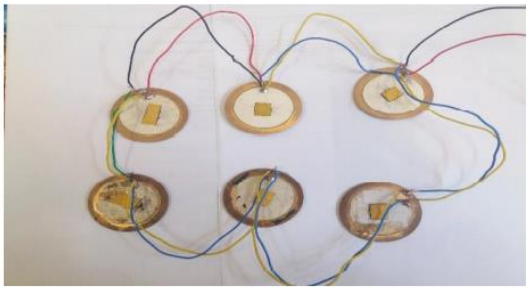


Figure 6.The series-parallel connection of electric transducer

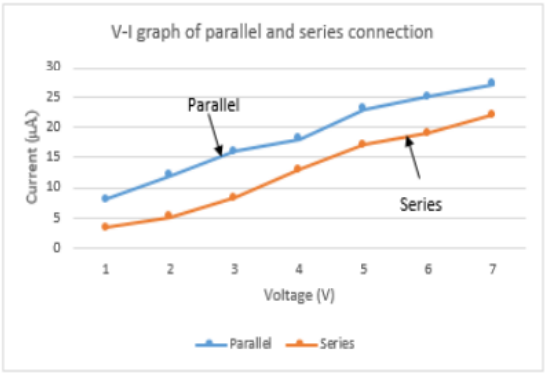


Figure 7.Voltage – Current graph of parallel and series connection of electric

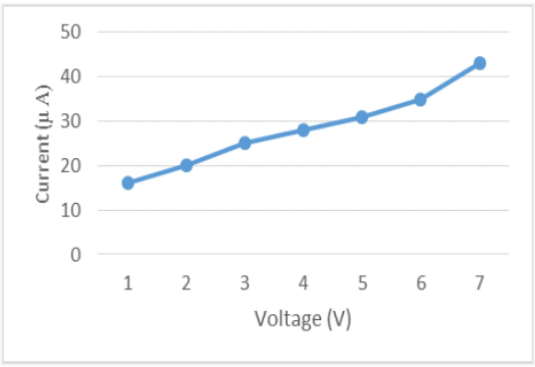


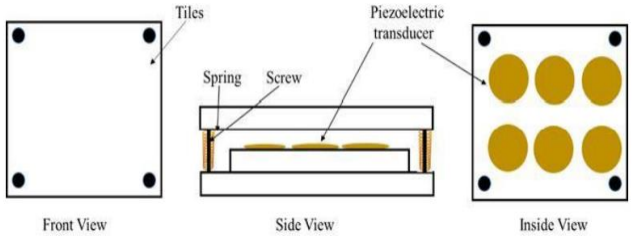
Figure 8.Voltage – Current graph of series-parallel connection of electric

Figure 7 shows that when the electric are connected in series the output voltage is high but the output current is low, however vice versa happened for the parallel connection of the electric transducer. It gives high current but low output voltage. In order to solve this problem, the combination of this connection needs to carry out. Two set of three electric transducers that connected in series was attached together in parallel to form series-parallel connection. The value of voltage as well as current output is both satisfactory.

Analysis on the Electric Tile

The electric tile that shows on the Figure 9 is used for foot press or pumping activates in order to collect the voltage. The 6 cell of electric transducers is placed between the upper and lower of this electric tile. This electric tile is design in a square shape with wood block. This tile is screw at its four edges and combines with the spring to make the upper tile bounce back after the person step on it. The electric transducer is placed between the gaps of the two tiles.The subjects are asked to do the foot press or pumping activities on this electric tile to collect the voltage produced by the 6 cell electric transducers during those activities. Figure 10 show the model of the electric tile from front, side and inside view.

The tile that used for foot press activities



Model of tile with 6 cell tile

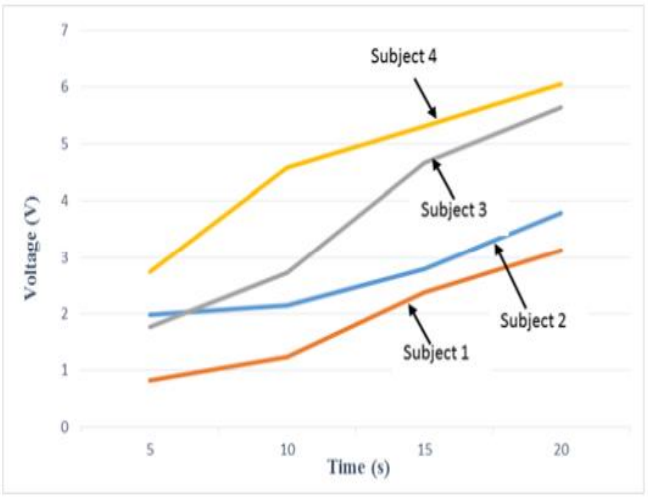
Subject	Weight (kg)	Time (sec)			
		5 sec	10 sec	15 sec	20 sec
Subject 1	45	1.98 V	2.15 V	2.80 V	3.78 V
Subject 2	50	0.83 V	1.23 V	2.38 V	3.12 V
Subject 3	55	1.76 V	2.73 V	4.66 V	5.65 V
Subject 4	60	2.75V	4.59 V	5.31 V	6.06 V

The Weight and the Voltage Taken based on the Jump on the tile

Study using foot press or pumping is conducted to determine the voltage output of a 6 cell of the electric transducer that connected in series-parallel connection. Table 1 shows subject with 45 kg, 50 kg, 55 kg and 60 kg body weight are used to test the electric tile. They are asked to step on the tiles to do the foot press or pumping activities to test the voltage generating capacity of the electric tile.

The voltage generated is based on the different times recorded, which are 5 sec, 10 sec, 15 sec, and 20 sec. The relation between the time taken and the voltage being generated is plotted in the graph for each weight. From Figure 11, it can be seen that maximum voltage is generated when the person pumps about 20 seconds on the electric tile. It also can be concluded that the force that is applied by every subject are variant. The voltage generated depends on the force that being applied to the electric tile. In theory when a bigger person pumps on this electric tile, the voltage that is generated is higher compared to the smaller person. There are a

linear relation between the force and the voltage generated. Figure 11 shows that the theory is proved. The weight of subject 4 is bigger than other subjects so it the voltage that generates by this subject is the highest when the subject pumps on the tile.



Voltage against time measured during subject press on the tile

V. CONCLUSIONS

An electric tile is capable of generating more voltage when longer the time taken. The longer the time taken means more footstep/force are applied on the tile. The linear relation is found between the voltage generated and the time taken. This electric are specifically suitable for the implementation in the crowded area such as pavement street, train ticket counter, stairs and dance floor. The electric tile is also suited for the exercise tile such as for skipping or on the treadmill. The power that is generated from this electric tile can be used to power up the light street, light along the stairs and also low power appliances.

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