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Piezo based Door Mat

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ABSTRACT

With the advancements in newer electronic technologies, the need for power/battery charges has risen exponentially. Harvesting renewable energy, which can be subsequently be used to power these devices is the solution to the power consumption problem. In this work, we develop a piezo electric generator, which produces energy when a person walks on it or presses it with his/her feet. This energy or the power generated is then used to light up the LEDs mounted on the floor along with the piezo. The implemented work is cost effective and easy to implement

Keywords: Renewable Energy, Piezoelectric Material, Energy Harvesting

I. INTRODUCTION

With the increase in the demand for energy, renewable energy harvesting provides a possible solution. Solar power, wind power and hydroelectric power are some of the systems which generate energy in an environment friendly way. A form of a system which can convert mechanical energy into electrical energy is highly desirable, so that this electrical energy can be used to drive other electrical circuits. This work takes advantage of the fact that when a person walks on a road, he exerts energy on the surface of the earth. This human powered energy can be used to drives simple LEDs which can be embedded on the roads and footpaths. The main motivation for this work is to utilized the '*foot power*' of the pedestrians in densely populated areas. Piezoelectric materials have been traditionally used for power generation [1,2]. The efficiency of the power generation using the piezoelectric material is shown by the authors in [3]. The use of piezoelectric nanogenerators was shown by the authors in [4].

II. METHODS AND MATERIAL

The arrangement for the implementation of this work is shown in Figure 1. A 6W, 12V bulb is connected to alternator. It glows to indicate the foot pressure applied. The prototype is designed to generate a full power pulse with an application of foot pressure from a person weighing around 60Kg. For the prototype to be durable and to withstand the pressure of the human foot, wooden plates are placed below the sensors' arrangement. A durable glass, capable of

withstanding a human body weight is placed above the arrangement, so that the piezos and the LEDs are seen clearly through it. This arrangement has 9 piezos connected in parallel. With this arrangement the maximum voltage obtained is 39 volts DC measured through a multimeter. The obtained voltage is enough to drive 12 LEDs which are also mounted in the circuit. In a further extension of this work, this energy can be converted to a 230V AC using an inverter circuit. Since we cannot expect the footsteps to be constant, the output of the piezos is not steady. This can be converted to a steady or linear voltage using a bridge circuit. Any further fluctuations or the ripples can be removed using a rectifier and filter circuit. This output DC voltage is then used to drive the LEDs. At the same time, this can also be stored in a rechargeable battery. The components are explained briefly in the next subsections.

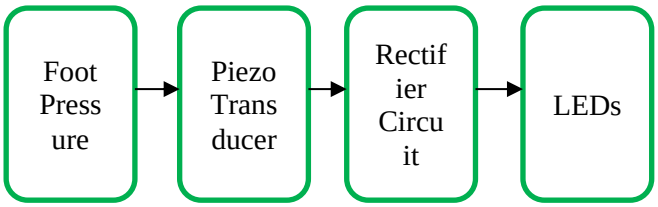

FIGURE 1: BLOCK DIAGRAM OF THE IMPLEMENTED WORK

A. Piezoelectric Sensors

The piezoelectric sensor used in the work is shown in Figure 2

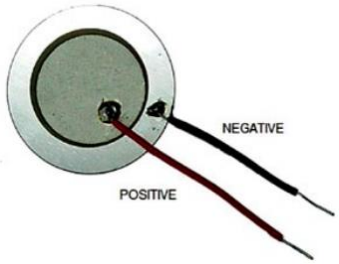

FIGURE 2: PIEZOELECTRIC SENSOR

B. Rectifiers and Filters

A center-tapped full wave bridge rectifier circuit is used followed by a C filter. Figure 3 shows the bridge rectifier used and Figure 4 shows the C filter.

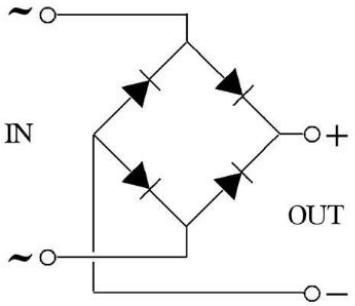

FIGURE 3: FULL WAVE BRIDGE RECTIFIER

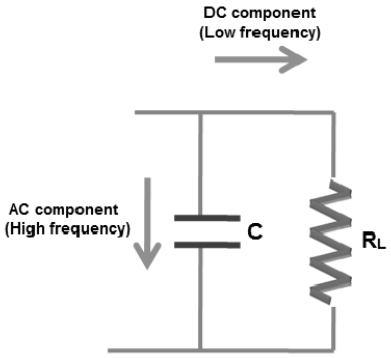

FIGURE 4: C FILTER

C. LEDs

LEDs used in the work are 590 nm LEDs, which emit yellow color for a votage of 2.1 volts applied at 20mA. 9 such LEDs are used.

III.RESULTS

To begin with, a simple analysis was done on the piezos connected in series and then connected in parallel. It was found that series connections result in higher voltage, but the parallel connections result in higher power.

The next analysis involves the analysis done on the entire piezoelectric tile system. People with varying weights were asked to put foot pressure on the system and the equivalent power generated and glowing time of the LEDs was noted down. It is to be noted that the pressure is to be applied with the foot and the person is not to stand on the set-up, else the set-up may get

damaged. These results are summarized in Table 1 and Figure 5.

The third analysis is related to the pressure applied in terms of footsteps to the duration of the LEDs lighting is seconds. The results are summarized in Table 1.

After all these analyses, the final setup is shown in Figure 6. Figure 7 shows the glowing of the LEDs when a person sets a foot on the setup. Also, the voltage reading measured through the multimeter is also shown in the picture.

TABLE 1

WEIGHT AND THE DURATION OF LED LIGHTING IN SECONDS

Weight	Duration of Lighting
40	2
50	3
60	5
70	6

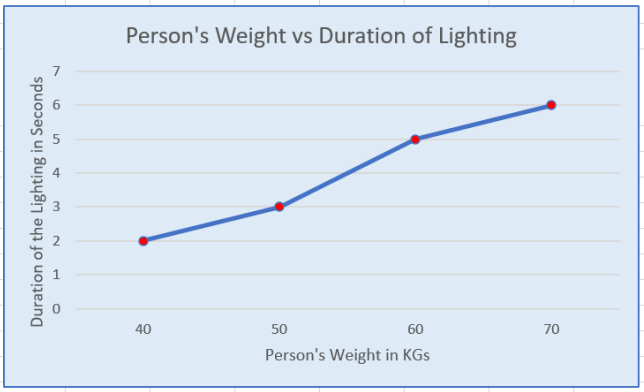

FIGURE 5: BODY WEIGHT VS GLOWING TIME OF THE LEDS

TABLE 2

NUMBER OF FOOTSTEPS AND THE DURATION OF LED LIGHTING IN SECONDS

No. of footsteps.	Duration of Lighting
10	6
20	12
30	18
50	25

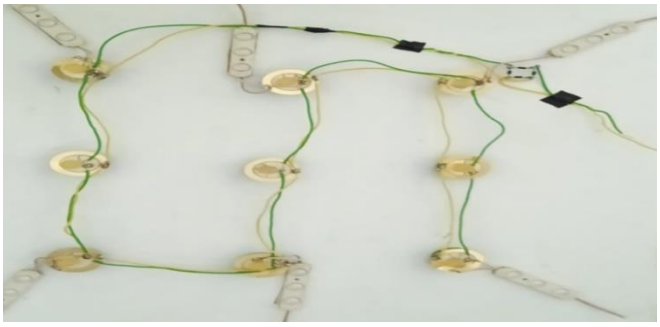

FIGURE 6: INITIAL SET-UP OF THE WORK

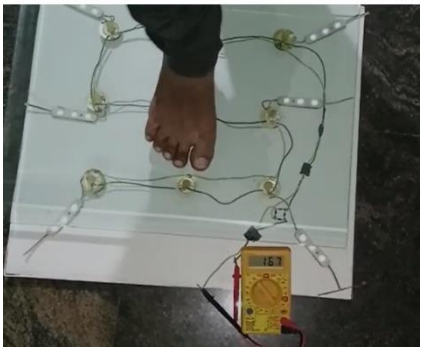

FIGURE 7: LEDS GLOWING WHEN PRESSURE IS APPLIED

IV.CONCLUSION

The main aim of this work is to harness the mechanical energy generated by a person's footsteps in such a way that it can be converted into an electrical voltage and can drive the LEDs. The prototype is developed and tested for various pressures and loads successfully. This can be extended to form a series of LEDs on the pedestrian walkway, which can be powered by the pedestrians themselves.

V. REFERENCES

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