iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: VI Month of publication: June 2022

DOI: https://doi.org/10.22214/ijraset.2022.44204

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Footstep Power Generation System

Gaurav Kumar Khandelwal[1], Garima Choudhary[2], Kashish Sharma[3], Himanshu Sharma[4], Mohd. Imran[5]
[1, 2, 3, 4]UG Student, Department of EE, SKIT College, Jaipur, India
[5]Assistant Prof., SKIT College, Jaipur, India

***Abstract:** We require energy for our day-to-day activities. There are numerous traditional energy-producing methods, but they are rapidly decreasing, thus a non-conventional energy system is critical to our nation at this time. The purpose of this study is to demonstrate how individuals may generate electricity by walking on the floor. Piezoelectricity is recommended as an alternative energy source in this research. The goal is to discover a pollution-free energy source as well as to use and maximize the energy that is now being squandered. A piezoelectric transducer is the type of transducer used to detect vibrations. The mechanical energy is converted into electrical energy by this transducer. When the pressure from a footstep is delivered to a piezoelectric transducer, the pressure or force is converted into electrical energy. A series-parallel connection is used to connect the piezoelectric transducer. It is then put on a wooden tile as a model for a footstep tile to apply pressure to the piezoelectric transducers. This tile may be used in a congested location, on a walking path, or workout equipment. Low-power appliances can be powered by the electric energy generated by this piezoelectric tile.*
***Keywords:** Piezoelectric sensors, Renewable Energy, Electricity, Generator.*

I. INTRODUCTION

There are a variety of ways to create electricity as an alternative, and one of these techniques, footstep energy generation, can be an efficient way to generate power. Walking is the most widespread kind of human activity. When a person walks, he loses energy to the road surface in the form of impact, vibration, and sound, among other things, as a result of his weight being transferred to the road surface through foot falls on the ground. This energy may be harnessed and turned into a form that can be used, such as electricity. If installed in the pathway, this gadget can transform foot impact energy into electrical energy.

Walking, running, and swimming have all been forms of human-powered transportation since the dawn of time. Modern technology, on the other hand, has enabled machines to make better use of human power. Pedal power is a fantastic source of energy in this context, and it has been used since the nineteenth century, utilizing the body's most strong muscles. Ninety-five percent of the pedal force exertion is turned into energy. Pedal power is a simple, inexpensive, and convenient source of energy that may be used for a variety of tasks. However, Human kinetic energy can be beneficial in a variety of situations; however it may also be used to create power using a variety of sources. Many companies are already using these methods.

The capacity of a piezoelectric transducer to transfer mechanical energy to electrical energy is known as the direct piezoelectric effect. When a piezoelectric transducer is subjected to vibration or mechanical stress, it deforms and generates an electric charge. The generator or transducer effect is another name for it. The reverse piezoelectric effect describes the capacity of a piezoelectric transducer to transfer electrical energy into mechanical energy. When the piezoelectric transducer is exposed to an electric field or an electric field is applied to an electric field, the piezoelectric transducer deforms. This is often referred to as the actuator or motor effect. The vibration energy harvesting process begins with the extraction of mechanical vibration energy from the environment, followed by the rectifying and conversion of the alternating current (AC) voltage into a direct current (DC) voltage. The piezoelectric effect may be exploited to create power from lost energy. When pressure and tension are applied to the piezoelectric material, it converts mechanical energy from the footstep into electrical energy. Piezoelectric materials can be used to convert mechanical energy, such as ambient vibration, into electrical energy, which can then be stored and utilized to power other devices. Depending on the load and the produced AC source, the electrical energy from a piezoelectric transducer connected to a vibration system is generally quite low. As a result, an interface circuit that performs the DC conversion is required. The full-wave bridge rectifier is used to convert AC to DC, after which the waveform is filtered and stored in the capacitor that serves as a storage. This piezoelectric transducer is linked to other piezoelectric transducers and put on pathways, stairwells, platforms, or in frequented locations. The voltage created by this piezoelectric transducer may be utilized to power low-power equipment such as street lights, street lights, and street sign boards. Because the voltage created by the piezoelectric is low, it may be stored in the battery and also in the capacitor before being utilized.

The piezoelectric material can be used to create electrical energy in Bangladesh due to its population density. The minimal voltage each step is 1V in this investigation, which uses 12 piezoelectric sensors in 1 square foot and 50kg weight pressure from a single individual. It takes 800 steps to increase 1V charge in a battery, hence 9600 steps are required to increase 12V charge in a battery. If the typical footstep takes 2 steps per second, it will take 80 minutes to complete 9600 steps.

II. WORKING OF THE SYSTEM

The basic working principle of our project is based on the piezoelectric sensor. The cardinal block diagram of the working is demonstrated below in the block diagram figure 1.

A. Block Diagram

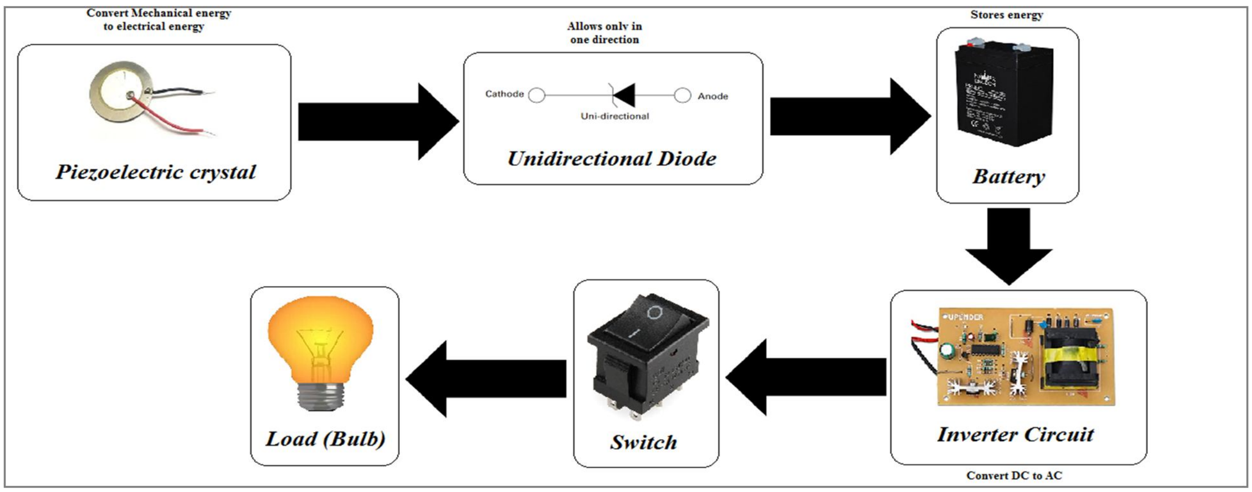

Figure 1: Block diagram of piezoelectric system

B. Approach Towards the Working Model

As indicated in figure 2, we modify the wooden plates above and below the sensors and adjustable springs to achieve this. Using your feet to generate non-conventional energy is as simple as transferring mechanical energy into electrical energy. The Footstep Board is made up of 16 piezoelectric sensors that are wired in series. When pressure is applied to the sensors, mechanical energy is converted into electrical energy. The 12v rechargeable battery linked to the inverter will store this electrical energy. The battery charging system employed here is a standard battery charging device that is widely used in other applications. This inverter converts 12 volts D.C to 230 volts A.C to provide power to the circuits. This 230 Volt A.C voltage is utilized to activate the loads, and we may run AC loads with this voltage.

Figure 2: Arrangement of wooden plates over the sensors and movable springs

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C. *Energy Storing Table*

An energy storage device can be used to store the electricity generated by the foot step generator. Through an ACDC converter bridge, the generator's output is supplied to a 12 V lead acid battery. The FSEC was powered by a foot weight, and the energy was stored in a battery that was originally entirely depleted. An inverter was used to link a 100 W, 230V bulb to the batteries. The duration of lighting, the bulb for number of footsteps and corresponding energy stored, are given in table 3.

The pressure applied to the piezoelectric material is converted into electrical energy. The source of pressure might either be the weight of moving automobiles or the weight of individuals walking across it. The piezoelectric material's output is not constant. To transform this variable voltage to a linear one, a bridge circuit is employed. An AC ripple filter is utilized once again to filter out any further output variations. A rechargeable battery is used to store the output DC voltage. Due to the poor power output of a single piezo-film, a combination of many Piezo-films was examined.

No. of footsteps	Duration of lighting a 100 watt 230 volt bulb (Second)	Total Energy (J)	Energy / Step (J)
250	6	600	2.4
500	12	1200	2.4
750	18	1800	2.4
1000	25	2500	2.4

Figure 3: Energy Storing Table

There were two types of connections tested: parallel and series. The voltage output from the parallel connection did not rise much. Additional piezo-film leads in an increase in voltage output when connected in series, but not in a linear proportion. So, in order to provide a 40V voltage output with a high current density, a mix of parallel and series connections are used. Provisions for connecting a dc load are made available from the battery. A battery is linked to an inverter, which allows an AC load to be connected. In an LCD, the voltage produced across the tile may be observed.

III. CALCULATION OF MAXIMUM THEORETICAL VOLTAGE GENERATED

A charge is created across a piezo material when a force is applied to it. As a result, it's safe to believe it's a perfect capacitor. As a result, any capacitor equations may be applied to it.

In this project, we link three piezos in series on one tile, and ten of these series connections are connected in parallel. Thus when 3 piezoelectric discs are connected in series, its equivalent capacitance becomes:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

We know that $Q = C \times V$

So

$$\therefore \frac{V_{eq}}{Q} = \frac{V_1}{Q} + \frac{V_2}{Q} + \frac{V_3}{Q}$$

Thus $V_{eq} = V_1 + V_2 + V_3$

The net voltage created in a series connection is now equal to the total of the individual voltages generated across each piezoelectric disc.

When output voltage from 1 piezo disc is 13V then,

$$V_{eq} = 13 + 13 + 13$$

$$V_{eq} = 39\ Volt$$

Thus the maximum voltage that can be generated across the piezo tile is around 39V.

IV. CONCLUSION

When the time needed to generate voltage is increased, a piezoelectric tile may generate higher voltage. The longer the time is consumed, the greater force is given to the tile. The voltage generated and the time taken has a linear relationship. This device is ideal for use in congested areas such as sidewalks, railroad ticket counters, stairwells, and dance floors. In fact, renewable energy accounts for only 11% of our primary energy. If this idea is implemented, we will be able to address the energy crisis to some extent. Furthermore, this leads to a positive worldwide environmental shift.

Overall, we believe that this technology will prove to be an effective method for producing electricity from human footprints. This approach would show to be a panacea in densely populated nations like India and China. This technology may also be used to meet one's own energy demands because energy can be converted into electrical energy by just walking or jogging over piezo placed tiles in a highly cost-effective and efficient manner.

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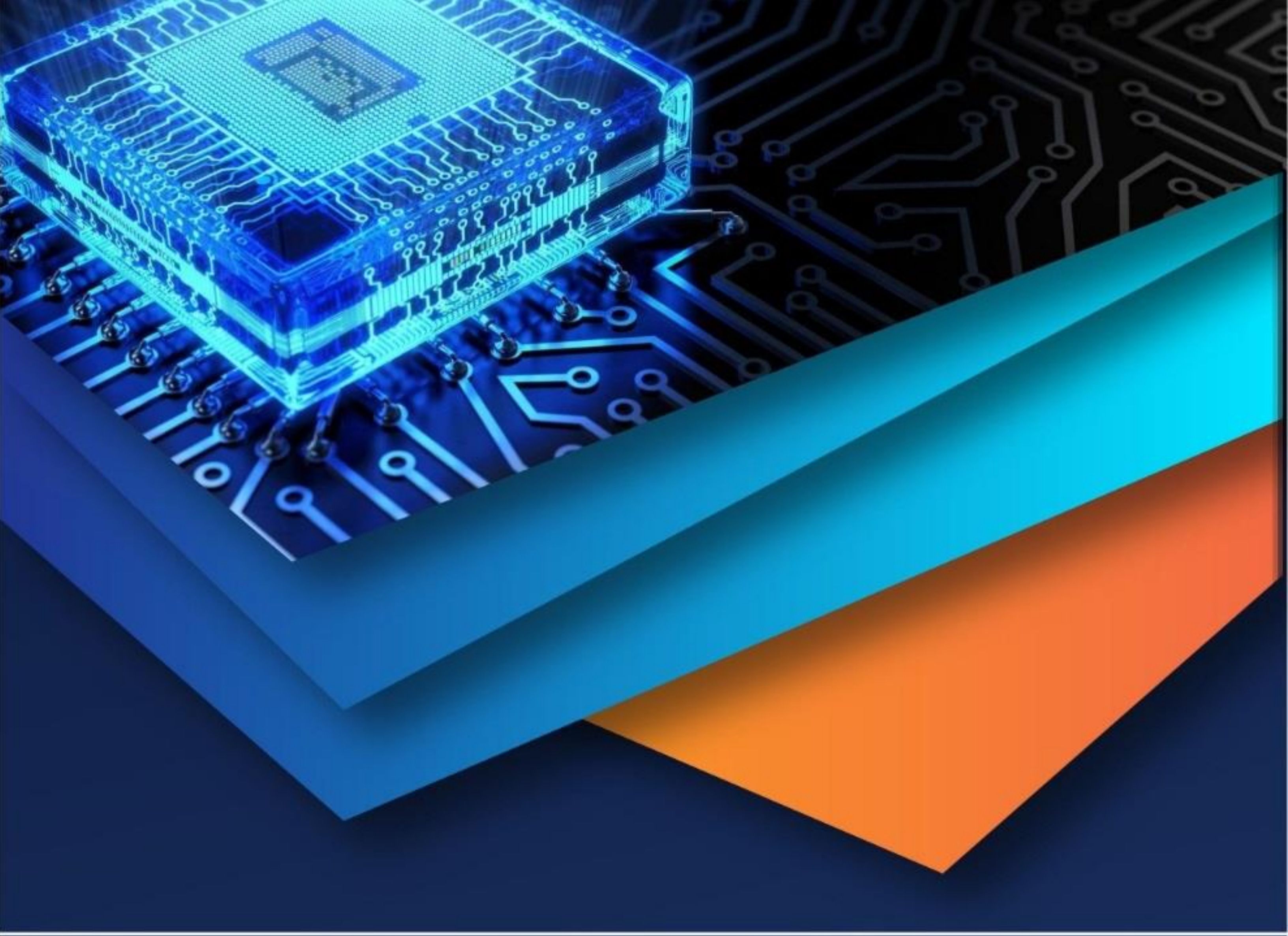

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