



A Step towards Free Electricity Generation

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Abstract: There has always been an exponential increase in both the amount of energy consumed and the amount of energy needed, in one form or another. Therefore, it is necessary to look into the availability of energy from alternative sources. For densely populated nations like India, where the train stations, temples, and other public spaces are constantly filled, the use of foot power waste energy with human locomotion is pertinent and significant. When pressure is created on floor the sensors capture the motion and electrical energy get generated and transformed the electrical energy by piezo transducer and gets stored and used as a power source. This paper focuses an alternative source of energy generation by piezo electric material. This invention shows the effective use if piezo electric material for producing electric energy by walking people on piezoelectric energy generation method. Then we will compare the total electrical generation cost by using this method with solar energy generation.

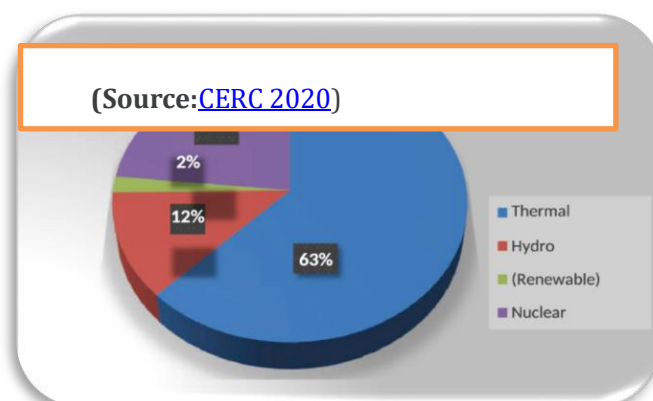
IndexTerms – piezoelectric, piezoelectric material, piezo transducer

I. INTRODUCTION

In India, 52% of the respondents from business and industry work in the energy sector. It is past time to consider producing cleaner sources of power given the nation's increasing need for electricity on a regular basis. The Indian power industry has already taken a number of steps to encourage the use of renewable energy sources, such as solar, wind, and hydro, through laws and programmes that ultimately benefit all stakeholders. However, there is still a great need for additional ways to produce power. There are many ways and different methods by which we can generate electricity out of which we can generate electricity out of many methods there is footstep energy generation method to generate electricity. Considering the demand required day by day of power, the global climatic changes gets massive requirement of cleaner source of power while there is still time. India has chosen to achieve 175 GW of power by 2022 by renewable source of energy.

Total power production in India:-

Fuel	MW	% of total
Total thermal	2,30,189.57	63.2%
Coal	1,97,964.5	54.2%
Lignite	6,760	1.7%
Gas	24,955.36	6.9%
Diesel	509.71	0.1%
Hydro (renewable)	45,399.22	12.6%
Nuclear	6,780	1.9%
Renewables	86,321.03	22.7%
Total	368,689.82	



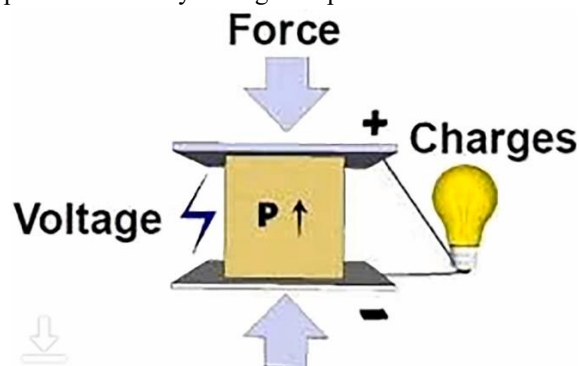
(Source: CERC 2020)

Electricity Generation from Piezoelectric element

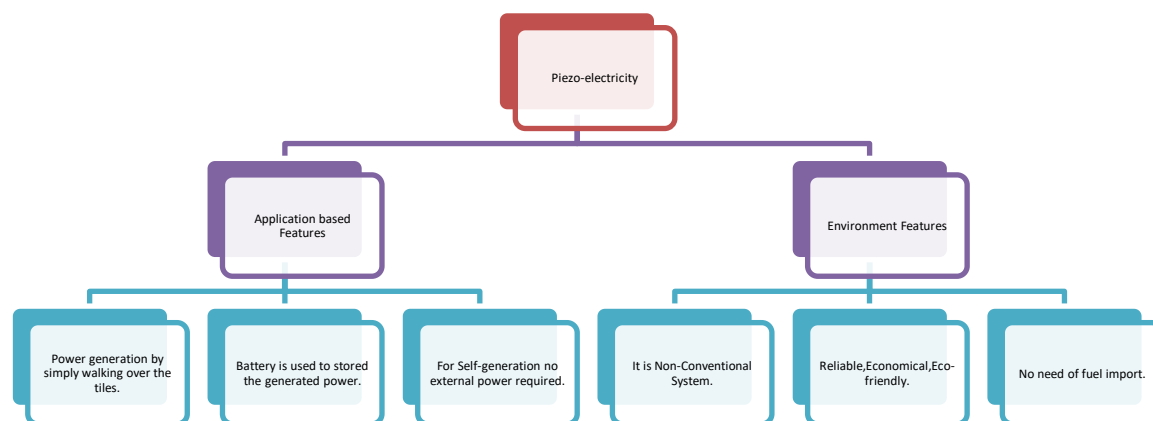
In this method we will generate electricity from piezoelectric element by using Piezoelectric Effect.

II. PIEZOELECTRIC EFFECT

The capacity of some materials to produce an electric charge in response to applied mechanical stress is known as the piezoelectric effect. The piezoelectric effect can be seen in the piezoelectric crystals. There are two characteristics to this piezoelectric phenomenon. The first is the direct piezoelectric effect, in which a element has the capacity to transform mechanical strain into electrical charge. The second effect is the opposite one, where the mechanical strain energy was created from the supplied electrical potential. In this project, electricity is produced directly through the piezoelectric action.



Characteristics of piezo electricity



Concept:

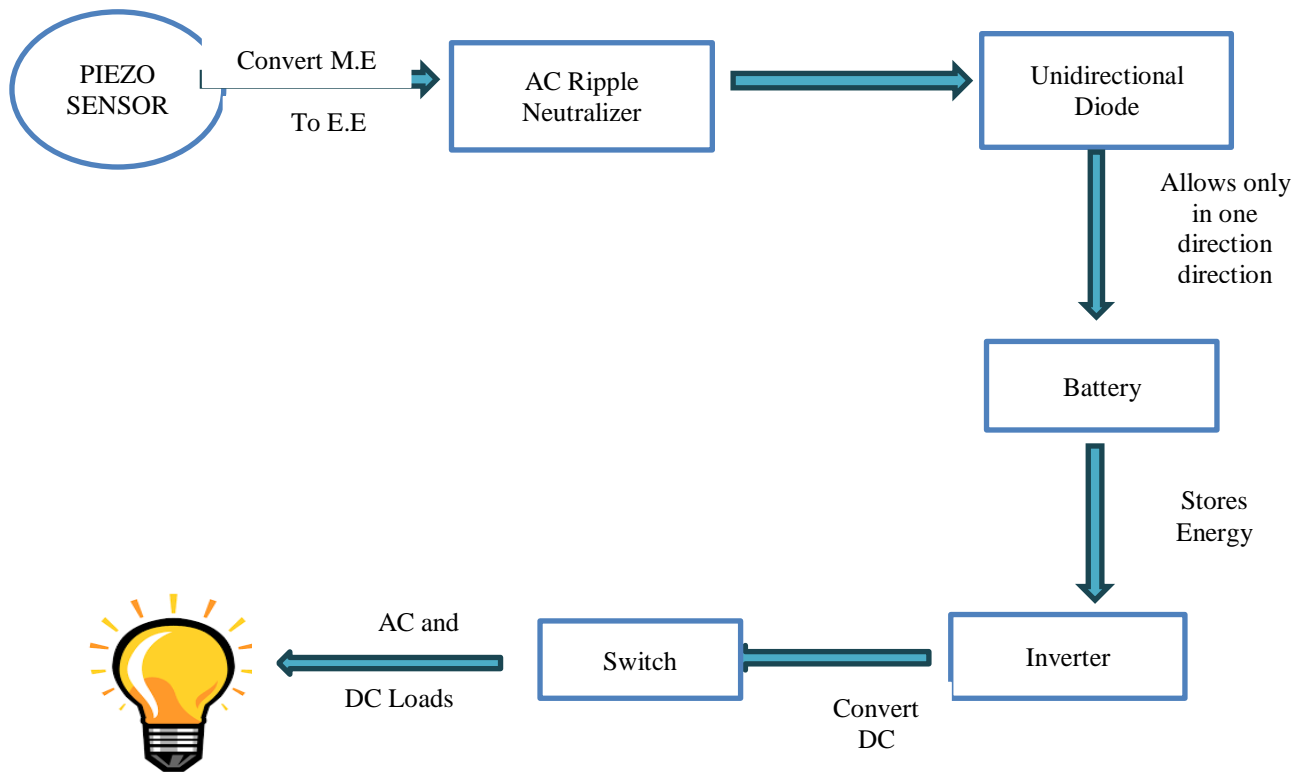
A voltage multiplier is electrical device which converts AC power(low) to DC power(high), typically using network of capacitor and diodes. Voltage multipliers can A piezoelectric plate is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical charge. Piezoelectricity effect is generated from material which is electricity and it has ability of many material to generate AC voltage when added to mechanical stress or vibration. The most common piezoelectric material is quartz. The piezoelectric effect is the ability of certain elements such as crystals, ceramics, and polymers to generate an electric field or charge in response to applied mechanical stress or deformation. Conversely, if an AC signal is applied to the plates, it causes the crystal to vibrate in sync with the signal voltage .This form acoustic disturbance.

In our project we used Villard Cascade to convert AC supply to DC and amplify the voltage .We chose Villard cascade because it rectify and amplify the input from the source simultaneously by using diodes and capacitor.

III. VILLARD CASCADE:

A voltage multiplier is an electrical circuit that converts AC electrical power from a lower voltage to higher DC voltage, typically using network of capacitors and diodes. Voltage multiplier can be used to cause a few volts for electronic appliances, to millions of volts for purposes such as high-energy physics experiments and lightning safety testing. The most typical type of voltage multiplier is know as Villard cascade or Half series multiplier.

BLOCK DIAGRAM:



WORK CARRIED OUT

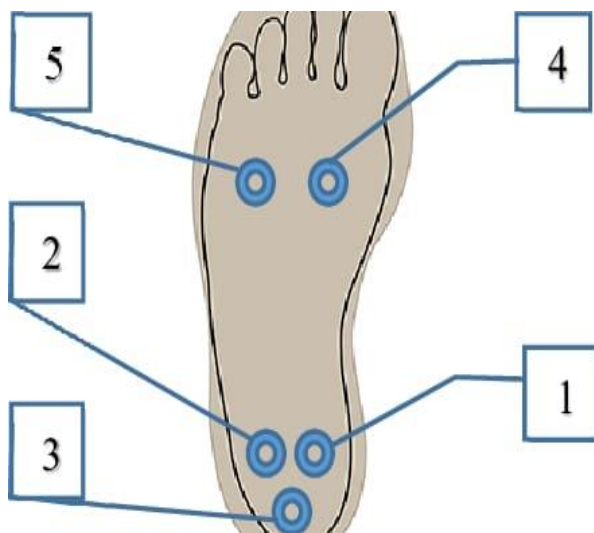
Step 1: Elements (Components) Required

- ELEMENTS:
- Piezoelectric elements
- Hookup wire
- Capacitors
- Diodes
- PVC sheet
- Foam Push ups
- Glue
- TOOLS:
- Soldering Iron
- Drem Tools

Step 2: Construction

1. on PVC sheet Mark the feet size and cut it accordingly
2. Place piezo materials on the PVC sheet and mark it to make holes
3. according to the marking make holes into the PVC sheet.
4. Stick the piezo element in the sandwiching manner with hot glue

Precaution:



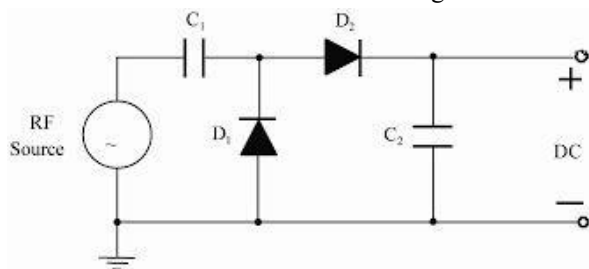
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Step 3:

In the project we used piezoelectric transducer of ceramic type. Piezo transducer generate AC voltage when we apply pressure on piezoelectric transducer.

We must convert AC voltage to DC voltage since AC voltage cannot be added to itself. Because AC voltage cannot be added together in series with DC voltage, we are converting AC to DC. But we can lose some energy during the AC to DC conversion process. If we convert AC to DC using a full wave reflection bridge. We receive about 80% of the energy produced by the transducer. Here, we are experiencing an energy loss of almost 20%. Each piezoelectric transducer may lose more energy when connected in series with each full wave rectifier bridge, which could result in output that is not much higher.

Through lengthy research on this concept, we discovered a solution called the Villard cascade, also known as a voltage multiplier. Here, an AC output is generated by applying pressure to the piezoelectric transducer. This AC output is connected to a Villard cascade (voltage multiplier). If you connect a voltage multiplier, the output will be DC with some boost in voltage. We have reduced the number of rectifier bridges and voltage boosters by using voltage



$$\Delta U = \frac{I}{fC} \left(\frac{2}{3}n^3 + \frac{1}{2}n^2 - \frac{1}{6}n \right)$$

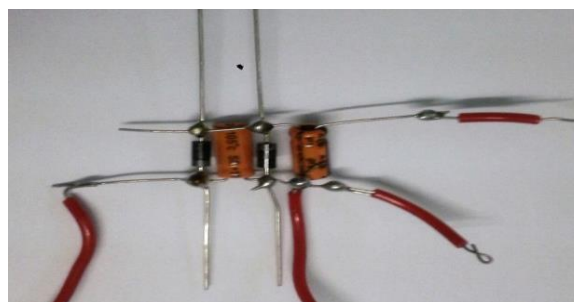
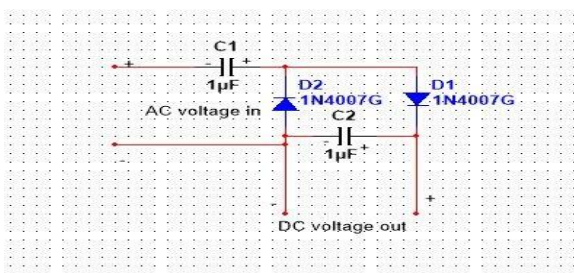
where ΔU : voltage drop
 I : output current
 f : input frequency
 C : capacity of caps
 n : # of stages

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multipliers.

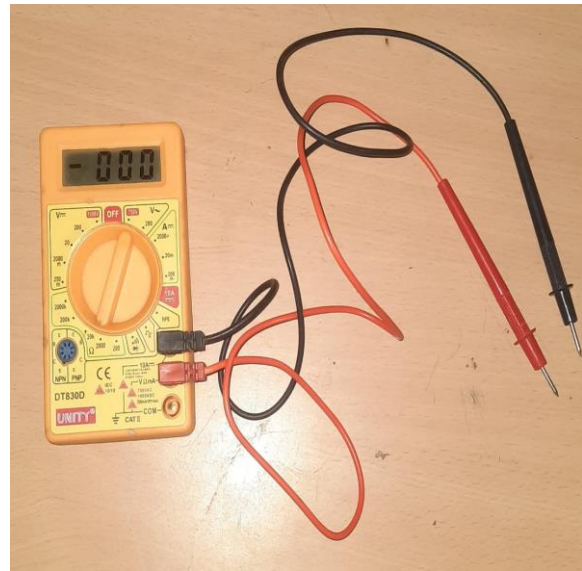
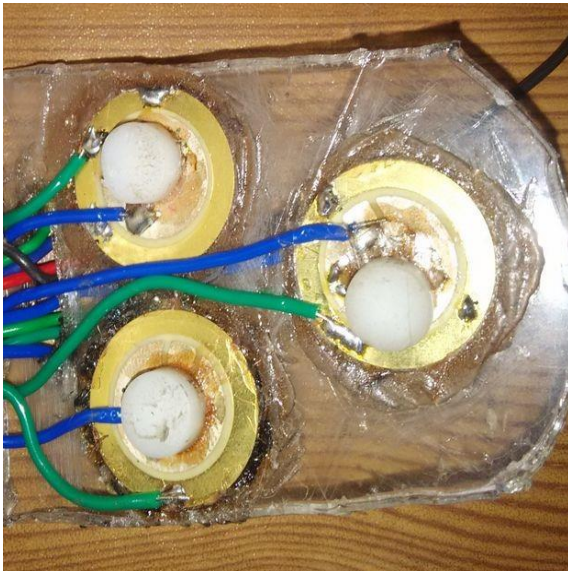
Step 4:

I linked each piezoelectric transducer to a voltage multiplier in the project. I utilised 6 piezoelectric transducers for this project. As a result, we have 6 DC outputs. I linked the DC outputs in series to boost the output. I total the 6 DC outputs of the voltage multiplier as shown in the photographs by connecting them in series.



Step 5:

I sandwiched six piezoelectric transducers to a flexible plastic material, allowing the piezoelectric parts to bend readily. Soldered each piezoelectric element separately to the voltage multiplier .I used foam material to focus force at the centre of the piezo transducer and avoid damaging the piezoelectric element. It can be place in shoes.



Step 6: Testing

Advantages and disadvantages of piezoelectric transducer

When an external force is applied to this transducer, the produced voltage that can be measured easily. This change is measured by its corresponding value of sound or some of the vibration. There are many different types of transducer available but piezoelectric transducer are some of the advantages compare to other transducers. So this page is given below some advantages and disadvantages of the piezoelectric transducer are given below:

There are some advantages of the piezoelectric transducer which are given below:

piezoelectric transducer has a nice frequency response.

Its size is small.

Because of small dimension it is easy to handle.

It has rocky construction.

It has desired shape.

It have a negligible phase shift.

Natural quartz and barium titanate can be made any desired form and shape.

It offers high output that is measured in the electronics circuit.

There are some disadvantages to the piezoelectric transducer which are given below:

It has high-temperature sensitivity.

Some crystals are water soluble and dissolve in a high humid environment

This transducer is used for dynamic measurement only, not suitable for static conditions.

It required high piezoelectric cable for electrical interface because the device operates with the small electric charge.

The result obtained from the piezoelectric transducer is low, so the external electronic circuit has to be connected.

Applications of piezoelectric transducer:

used for recording player.

It is used in accelerometer.

It can be used in electronic watches.

It is used in spark ignition engines.

This are advantages of piezoelectric pressure transducer which are given below:

Advantages of piezoelectric pressure transducer:

Rugged construction.

Small size.

Excellent frequency response.

High output with negligible phase shift.

Disadvantages of piezoelectric pressure transducer:

Temperature sensitive.

It can be used for dynamic measurement only.

Piezoelectric crystals are water soluble hence it has a high humidity environment gets dissolved.

There is some application of piezoelectric pressure transducer given below:

It is used in spark ignition engines.

It is used for measurement of nonelectrical quantities such as acceleration, vibration dynamic pressure, and sound intensity.

It is used in ultrasonic, non-destructive test equipment, ultrasonic flow meters, micromotion actuators.

IV. MANY MORE EXAMPLES WHERE WE CAN USE IT IN DAY TO DAY LIFE:

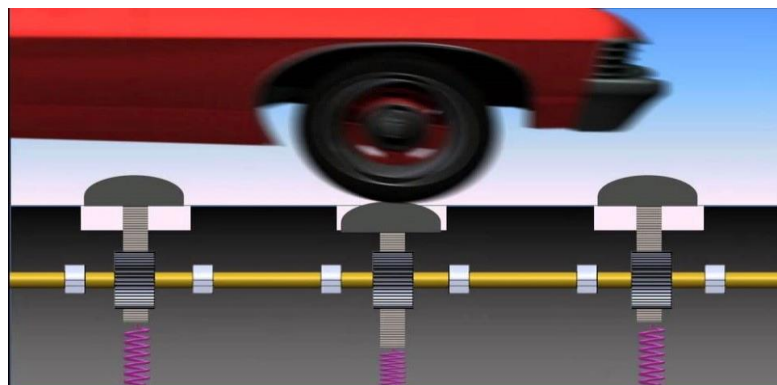
Stairs:

as a human efforts that we can put on our side for generating free electricity is by walking on stairs. for example we students use college stairs. by using piezoelectric material or cell which are planted along the stairs mechanical energy generated by walking is taken in the form of mechanical vibration which is converted by the help of piezoelectric transducer or a device in the energy harvesting circuit. further this energy stored is used for other equipment's. for energy conversion from mechanical to electrical Villard cascade case is used which converts low AC voltage to high DC voltage.



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The concept of piezoelectricity, which is being lost daily, underlies the usage of speed breakers in generating energy. The piezoelectric material in the speed breaker is mechanically deformed by the kinetic energy supplied into the vehicle, producing electricity.



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Railway platform or Railway track's

On the platform floor at certain area we can plant the Pizeo devices by which when traveller passes through it the pressure created on floor will generate mechanical vibration and this vibration got converted into electrical by help of piezoelectric device.



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<https://c0.wallpaperflare.com/preview/575/295/820/york-station-united-kingdom-york-railway-platform.jpg>

V. CONCLUSION:

The initiative has shown to be the most cost-effective, accessible energy alternative for regular people. Bangladesh is a developing nation with a sizable population, making energy management a difficult task. There are certainly some practical limitations to the systems given, even while the theory developed in this study validates the employment of switching mechanisms in effectively transforming that energy to a useful form. The goal of producing energy from a piezoelectric disc is achieved by the final prototype design. There are certainly some practical limitations to the systems given, even while the theory developed in this study validates the employment of switching mechanisms in effectively transforming that energy to a useful form. There is relatively little actual current gain between the input and output ports of the switch in the forward converter hybrid, according to measurements of source current into the primary and load current transferred from the secondary. Examining the energy transferred through the series switch and inductor in the buck converter also produced results that were similar. Additionally, the final prototype design does achieve the goal of producing power from a piezoelectric disc, according to the data acquired throughout this inquiry. The piezoelectric system is a useful device that might extend the functioning life of most popular products due to its cheap cost design.

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