International Research Journal Of Engineering And Technology (IRJET) E-ISSN: 2395-0056
Volume: 09 Issue: 12 | Dec 2022 Www.Irjet.Net P-ISSN: 2395-0072

ENERGY GENERATION VIA FOOTSTEPS USING PIEZOELECTRIC SENSOR

Priyanka Bhatele,Shubham Mali, Atharv Mali, Mahi Chrungoo, Adwait Mali, Rishikesh Makode

Department of Engineering, Sciences and Humanities (DESH)
Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India

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Abstract —

. Electricity is becoming a vital part of our life and that's why power generation has also become important. As we know generation of electricity can be done in numerous ways.

One of the ways is to convert mechanical energy from vibration in human motion into electrical energy, which is a non-fossil fuel driven sustainable form of energy. A system has been devised in which numerous piezoelectric sensors convert mechanical energy from pressure applied on them into energy which is stored in a battery inside the soul of the shoe. outside of the shoe consists of an USB port through which we can connect our mobile phones after returning home ,our shoe thus acts as a power bank. This is thus a renewable form of energy and a sustainable future use solution.

Keywords *— Green Energy, piezoelectric energy generation, renewable energy, mechanical to electrical conversion*

I. INTRODUCTION

Considering the expected endangerment of non renewable resources in near future , it is important to sustain to renewable forms , a lot of human energy is wasted in human locomotion in form of vibration , or heat and other forms .When human walk some force exerts on surface of shoe which can be used to generation of electricity. This can be done by using piezoelectric sensors.

A)PIEZOELECTRIC EFFECT

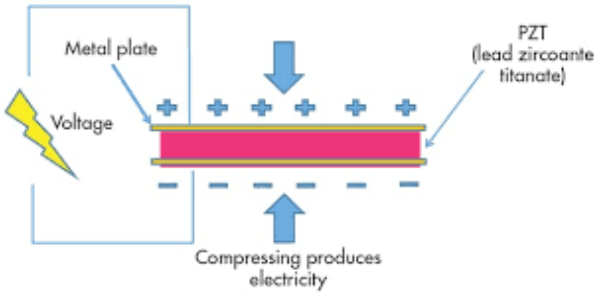
When pressure or stress is applied on the piezoelectric materials a small amount of voltage or electric potential is generated this is nothing but piezoelectric effect So we can generate the electricity by this piezoelectric effect..Common piezoelectric materials include **lead zirconate titanate (PZT), barium titanate, and lead titanate**

In other materials like metals , we can see the symmetrical structure of a unit cell but in this case it is not true. Normally, we can see electrically neutral behavior of the piezoelectric crystals l:no symmetry in the arrangement of the atoms can be seen but this is not the case about the electrical charges. Cancelation of positive charge to the negative can be seen inside these crystals.

But by applying the pressure on the crystal structure of the respective get disturbed ,so net movement of positive and negative charge will be happened due to deformation and net electric charge will be produced. This effect when happens across the whole structure ,causes net positive and negative charges to appear.

Electrical polarization corresponds to the change in positive and negative charges creating a peripheral electric field. The applied force in the material creates the development of potential differences in the materials. This concept is even termed as the **direct piezoelectric effect**.

The other scenario that has to be noted is that this effect is reversible which means that the result will be electrical deformations in the material by applying the electric field is called a **reverse piezoelectric effect**.



B)LITERATURE REVIEW

There have been previous methods of generation of electricity via piezo sensors.In the research done by Fernandes M. et al[1] ,involved transfer of voltage generated by the piezo sensors to a bridge rectifier circuit to a Protection circuit which comprised of Reed Relay as the main component, along with 2 LEDs (Red and Green) for

indication, and current limiting resistors and then to a 5V voltage regulator along with a capacitor and current limiting resistor that helps in providing a 5v constant DC Supply by which we can charge our mobiles.

In the research done by Anis Maisarah Mohd Asry et al[2] ,there were Two sets of three piezoelectric sensors which were series-parallel connection. The piezoelectric tile was used to place the 6 cells of piezoelectric sensors . The design of the tile was square shaped and was of wooden nature This tile can be fit on the floor by the screws and as the persons steps on it the upper tile will apply the pressure on the piezoelectric material . As piezoelectric sensor was placed between the two tiles and spring was fitted between upper and lower tile .It was observed that when sensors are in series there was a high output but low current. But in case of parallel combination it was opposite . So the solution of this was a combination of two sets of three piezoelectric materials in series combination and are attached together in parallel so that series and parallel connection and combination can be achieved .

In the research done by M. Nitashree et al[3] , have used piezoelectric-sensor, voltage regulator, PIC ,microcontroller, battery, voltage booster, LCD display, LDR ,and mobile charging socket . They had used two voltage boosters to amplify the voltage. Battery was used to store the generated power or voltage and the percent charged was shown on the LCD screen .

In the research done by D. Marshiana, et al[4] , have worked on the idea of using piezoelectric sensors under street tiles , so when people walk on them power is generated. Here they used a PZT piezoelectric transducer to harvest the kinetic energy from footsteps. Here they have fitted this setup under a tile with 2 capacitors ; one of them works as a filter and the other for storing the generated energy. After the capacitor is charged it is ready to transfer the power to the desired low power device.

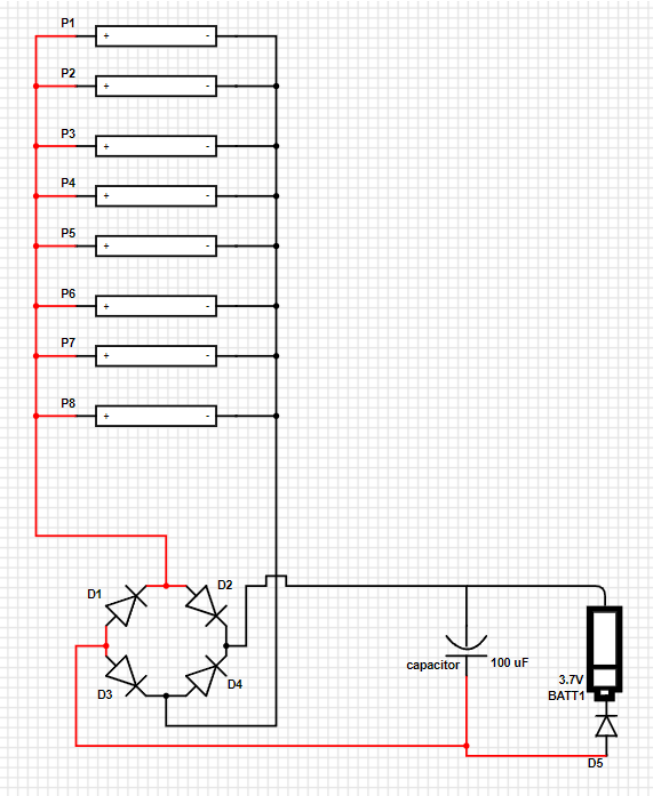
II. METHODOLOGY/EXPERIMENTAL

Materials and Components :

Piezoelectric sensors (27 mm diameter) , Capacitor(35 volts , 100 microfarad) , 1N4007 Diode ,Light Emitting Diode (LED) , Full wave bridge rectifier , jumper wires , glue gun , solder gun, shoes, sponge, Rechargeable battery .

Note: The energy used in charging appliances like mobile phones make use of AC voltages that are supplied to our homes, but the mobile charges act as AC-DC Converters

Circuit diagram:



B.METHODOLOGY

1)This circuit involves the use of 8 piezoelectric sensors(P1-P8) that are connected in a parallel manner which are installed on the sole of the shoes .This sensors are also connected to two ends out of the 4 ends of the bridge wave rectifier .

2)Capacitor is connected to the DC Output of the bridge rectifier in parallel .

3)The anode of a diode is connected to the positive end of the capacitor and its cathode is connected to the positive end of a load(for eg a battery)so that the capacitor is in forward bias and the battery is in reverse biased with the diode ,thus capacitor shall always conduct while battery should not get discharged.

4) Due to walking pressure piezoelectric sensors convert it into the AC Voltage .

5) With the help of a full wave bridge rectifier AC Voltage will convert into DC voltage .

6) Then DC Voltage will be stored into the capacitor and this capacitor will get charged.

7)The capacitor thus can then be used to charge a load like a battery.

8)As the piezo sensor has property to generate the small electric potential across its terminals by applying the stress, calculated voltage by one step is approximately 0.3 to

0.5 volts on average this voltage is in the 'AC' form so for converting this into dc from the bridge rectifier will be connected ,this used rectifier already has four pins two are dc pins and two are ac pins .

9)The more is the force on the piezo sensor ,the more is the voltage generated across its terminals .Thus more the weight of the person more will be the force .

10)The usage of sponge foams helps in the application of more pressure on the piezo sensor as force is more evenly distributed in comparison when piezo sensors are pressed without them,this leads to generation of more voltage across their terminals.

III. RESULTS AND DISCUSSIONS

Observations

Voltage across capacitor at t=0: 0V

Voltage across capacitor after being subjected to 65kg weight continuous pressing for 2 minutes=0.50V

The voltage generated by piezoelectric sensor will be stored in the capacitor this voltage will be in the form of 'DC' as voltage generated by piezo is passed through the bridge rectifier ,AC voltage will be converted into DC form this voltage will be passed to the battery and through the battery voltage is passed to the USB port so through port mobile can be charged .Voltage generated by the one step is 0.3 to 0.5 volt so according to that voltage energy will be get stored in the capacitor and simultaneously in the battery.

IV. FUTURE SCOPE

While working on this project the authors observed that it was not that comfortable to wear,so,the shoes can be made more comfortable and handy so it is easy to use. In this project , some new features like wireless charging for charging phones while walking can also be added. light weight batteries so the overall weight becomes less and it's more convenient to use . In the future it could add some new features like LED lights for visibility in dark places .

V. LIMITATIONS

The energy produced by the piezoelectric sensors is less in amount compared to other means of conversion of energies, it makes the shoes non-washable due to the presence of electrical components, excessive weight on the piezo sensor may break the sensor.

VI. CONCLUSION

After the completion of the project , the power generated is getting stored in the capacitor , which could be used further to charge devices . This is a step towards a sustainable form of energy , it would be very helpful in the near future for power generation with the help of footsteps for while walking charging as well as establishment of piezoelectric tiles on streets for charging of streetlights.

VII. ACKNOWLEDGMENT

We would like to thank prof. priyanka bhatele for continuous support and proper guidance throughout the project . We would also like to thank our friends Gitesh mane and aditya suryawanshi for providing us with required material at the right time and helping us when we experienced complications.

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