

Generation of Electricity using Shoes(Building a smart shoe)

Mrs. S K Pawar¹, Mrs. A S Nigade², Shivam Harjai³, Paarth Goel⁴, Neeraj Narwal⁵

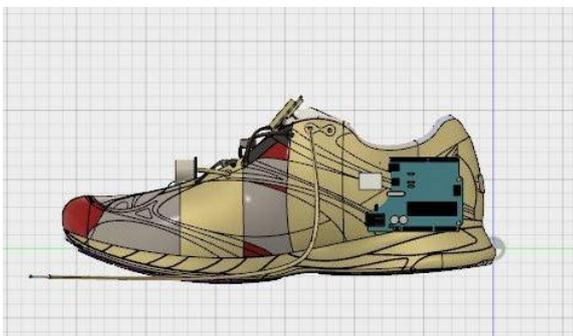
¹⁻⁵Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, Maharashtra, India, Department of Electronics Engineering

Abstract -Since the invention of dynamo; Scientists have been trying to rotate it through different means to generate electricity. Let it be through stream of water- i.e. hydroelectricity, by steam of burning fuels i.e. thermal electricity or by using temperature of the core of the Earth i.e. geothermal energy. But other than just rotating the dynamo, scientists shifted their focus on the sources of energies which were the future at that point of time to build the present which we live in. This was done with the objective to focus more on renewable sources of energy for a sustainable development in the field of science and technology. This gave birth to renewable sources of energy like solar energy, wind energy, nuclear energy and many more. Our project is a small step in the direction to use the vast potential of the 'human energy' on this planet.

Every day we all walk around from one place to the other. While walking, we are applying force in the backward direction on the ground to move forward. Our project aims at using this energy to produce electricity. This would provide us the opportunity of utilization of energy, which was being wasted earlier. It is therefore a step towards smarter future wearing a 'smart shoe'.

1. INTRODUCTION

The smart shoe would work through a group of piezoelectric transducers connected in series and parallel on the sole of the smart shoe, which are further used to charge a lithium ion battery. This battery forms the power Centre of the smart shoe and gives power supply to various circuits.



1.1 Scope

This smart shoe will be able to help visually impaired individuals in the most amazing way.

It includes the following features:

- Generate electricity while we walk
- Charge the Phone on the go
- Obstacle detection for Blind
- Emergency Lighting
- Health Tracker

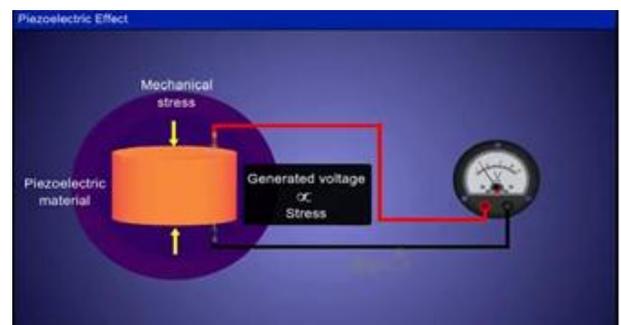
2. PIEZOELECTRIC

2.1 Principle

Piezoelectric effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. Piezoelectric materials produce electricity when a force is applied that changes their shape in some way. When an amount of pressure is applied to the quartz crystal, voltage is produced by changing charge created by the moving electrons.

2.2 Effect

Piezoelectricity is defined as the change in electric polarization with the change in applied stress. In the absence of external strain, the charge distribution is symmetric and the net dipole moment is zero. When an external stress is applied the charges will be displaced and the charge distribution will be no longer symmetric and the net polarization is created. This can cause the change of electric charge due to the uniform change in the temperature and produce electric field which in turn produce electricity.



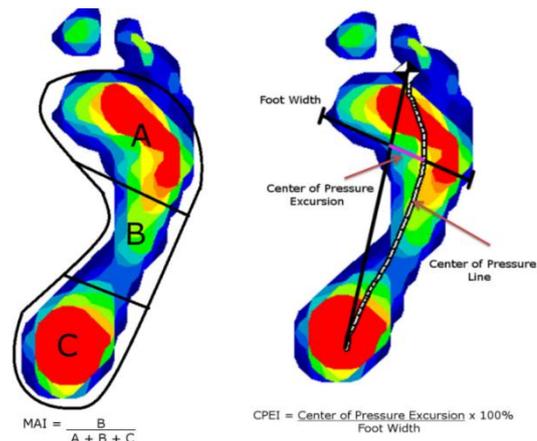
2.3 Working Principle

It works on the principle, that when we step on the floor or pavement our kinetic energy squeeze the piezoelectric material fixed under the floor, the positive and negative charges separated and dipoles orderly arranged due to mechanical stress from our footsteps. Piezo materials such as quartz, lead zirconate titanate, topaz, ceramics, polymers, Rochelle salt etc are used. The pressure or

vibrations caused from our footsteps is fed as an input to the transducer. The working of transducer is to convert one form of energy into other form of energy. Transducer produce the input as an alternating current. After that by using bridge rectifier we can convert alternating current into direct current which can save in battery for later use or for immediate usage, current capacitor is used. To reduce current flow, adjust signals, and to divide voltages for the required purpose, resistor is used. For better efficiency of this technology in highway, the rectifier bridge is sealed with electronic glue to prevent the short circuit caused by water leakage. Stainless steel gasket is used to prevent stress concentration and also it gives better performance in fatigue resistance, waterproof performance, and good compression performance. If Greater stress is applied, greater power will be produced. This technology is efficient only in the place of overcrowded areas. If the energy harvesting is very low, Nano wires or micro watts can be used as a trigger for self-powered sensors that tracking the users and control all equipment depend on their movement. Piezo sensors also can be used instead of piezoelectric transducers for producing electricity. Voltage generated by a single tile can be displayed on display devices like LCD located at the different location using zigbee technology for smart analysis.

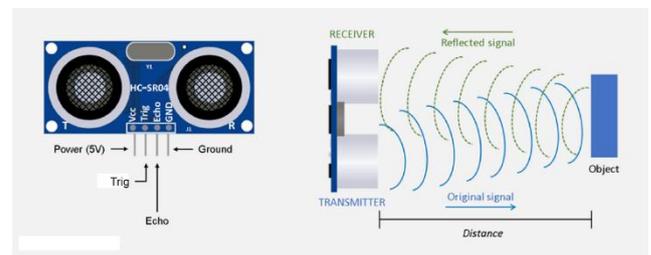
3. SMART SOLE

The idea of preparing a smart shoe instead of a whole smart shoe itself is to increase the versatility of the final product. We designed the sole which is supposed to carry the layer of piezoelectric crystals in such a way that the crystals are placed at the points of maximum pressure under the foot while walking. These hyper pressure points are scientifically proven and are the reason for maximum stress and therefore maximum output voltage. After the generation of electricity, it could be used to charge the lithium ion battery. This battery would then be used to perform various functions like providing mobile charging facility, powering up the Arduino board to drive the circuit for visually impaired people and emergency lighting console etc.

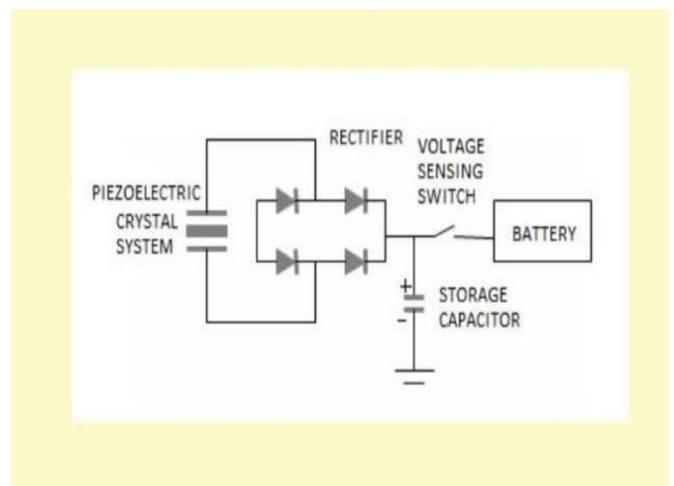


4. ULTRASONIC SENSOR PAIR

To detect any object near the shoe, a pair of ultrasonic sensors has been employed. One of the sensors has been placed in the x-axis and the other in the y-axis. There is buzzer which is activated by the presence of any object. To differentiate between the beeps of the buzzer in the different directions, each direction has its own defined frequency of beep. In case the beeps overlap, it means that the object is somewhere in the between of the two axis respectively



5. CIRCUIT DIAGRAM



6. COMPONENTS

Components used in this piezoelectric transducer are as follows:

- Piezoelectric transducer

- Bridge rectifier
- Capacitor
- Lithium ion battery

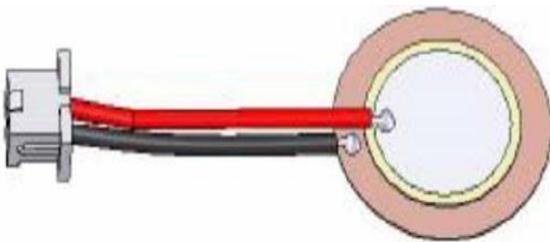
6.1 Piezoelectric Transducer

Piezoelectric materials are materials that produce an electric current when they are placed under mechanical stress. There are several materials that possess piezoelectric properties are crystals (E.g. Quartz) and ceramics (E.g. Lead zirconate titanate).

A transducer is an electrical device which is used to convert one form of energy to another form. In general, these devices deals with different types of energies such as mechanical energy, electrical energy, light energy, chemical energy, thermal energy, acoustic energy, electromagnetic energy.

6.1.2 Working Principle

In piezoelectric transducer, piezoelectric material is inbuilt with the piezoelectric metal plate. The piezoelectric transducer work on the principle of piezoelectric effect. When mechanical stress or forces are applied to some materials along certain planes, they produce electric voltage. The voltage output obtained from these materials due to piezoelectric effect is proportional to the applied stress or force.



6.2 Bridge Rectifier

A bridge rectifier is a converter that converts alternating current to direct current that rectifies main AC input to DC input.

6.3 Capacitor

The capacitor is a component which has the ability or capacity to store energy in the form of an electrical charge producing a potential difference across its plates, much like a small rechargeable battery.

6.4 Lithium ion Battery

A Lithium-ion battery or Li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

7. CONCLUSIONS

From this project, we conclude that by using natural renewable resources, power can be generated. There is no need of fuel. This electrical energy is supplied for various purposes such as charging of laptops and mobile phones. It can be laid in pavements, roads, football ground and also infrastructure projects. The efficiency of this technology depends on the number of people passing over that pavement and axle load from the vehicles moving on them whereas in football ground the pressure given by the players while running on them or hitting the ball on the ground. For developing countries with more population, energy management is a big challenge. It can also be used in rural areas where power availability is less or totally absent. More research is underway to increase efficiency, optimality and durability of the device under varying conditions and for the suitability of the technology for the mass development and commercialization of the equipment.

REFERENCES

1. Alexander " What if you footsteps could power your city sustainably" 2014
2. Birnbaum " force on a runners foot" 2014
3. Breech.J. "cowboys stadium uses more electricity than Liberia"2015
4. Scenario, N.P.,M. East & P.Cedex. "world energy outlook 2014 factsheet." Paris: International Energy Agency(2015).
5. Energy Harvesting through piezoelectric effect at sport venues by Julius Evans faculty of Humboldt state university (2015)
6. Wang,Zhao.et.al "Piezoelectric nanowires in Energy Harvesting applications." Advance in material science and engineering(2015)
7. Feasibility study for using piezoelectric energy harvesting floors in buildings' interior spaces(2017)
8. Footstep renewed tiles-Fatima Zahra Bousidy(2017)