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Design and Development of Piezoelectric MAT

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Abstract: Electrical energy use is increasing quickly. Currently, the total electricity generated is not enough to equal the entire electricity needed. In this project, a technique for generating electricity by using human power is suggested. "Human power" is the use of human labour to produce energy that might be used to power electrical devices. In countries like India, where a sizable portion of the population walks everywhere, human power, such as walking, running, and jumping, can be exploited as a power source. This project exhibits a method for employing a piezoelectric sensor to capture energy from human motion as well as the use of saved energy to charge a mobile phone using RFID. a person's walking weight.

I. INTRODUCTION

The amount of electricity produced and imported cannot keep up with the demand that is increasing in every nation. The amount of power generated by wind, solar, tidal, or other sources is insufficient despite their regular use. We must therefore generate power in whatever way is necessary in order to address this situation. When a person walks, their weight is transferred to the ground, which uses energy. The production of electricity is the main contributor to global pollution. On the one hand, the exploration of alternative energy sources and their sustainable usage has come to light in response to growing concerns about the imbalance between the supply and demand of electricity for the general population. A different method of production electricity There are various ways to make electricity, but one of them, called "footstep energy generation," has the potential to be effective. Walking requires a lot of energy, which might be captured and converted into electrical energy. This research's objective is to gather this energy and change it into a usable form. Walking focuses the energy, which a piezoelectric sensor uses to convert it to electrical energy. This energy is used and stored by the battery. To use each step as a source of energy is the objective. This system makes a platform that can accommodate steps. The Top plate softly falls when people walk or stand on it, transforming their weight into electrical power. The amount of electricity used is increasing quickly. Right now, not enough electricity is being produced overall. In this project, a technique for generating electricity by using human power is suggested. "Human power" is the use of human labour to produce energy that might be used to power electrical devices. In countries like India, where a sizable portion of the population walks everywhere, human power, such as walking, running, and jumping, can be exploited as a power source. This project exhibits a method for employing a piezoelectric sensor to capture energy from human motion as well as the use of saved energy to charge a mobile phone using RFID. a person's walking weight.

II. APPLICATION

1) Actuators: For precise placement, control, and movement, piezoelectric mats can be included into actuators. Piezoelectric actuators, for instance, can be utilised in optical focusing and precise machining.
2) Piezoelectric mats can be used to track human movements in situations like sports or physical rehabilitation. To gather information on the movement and pressure patterns of the feet, the mat can be positioned on the floor or inserted inside shoes.
3) Structural health monitoring: Piezoelectric mats can be used for structural health monitoring of buildings and other infrastructure, such as bridges. The electrical response of the piezoelectric material can be measured to assess structural deformation and damage.
4) Sensors: Piezoelectric mats can be used in sensors to monitor force, vibration, acceleration, and pressure. Numerous devices, including medical equipment and automobile engines, can benefit from the use of these sensors.
5) Actuators: Piezoelectric mats are a good choice for actuators since they allow for precise positioning, control, and movement. Piezoelectric actuators, for instance, can be utilised in optical focusing and precise machining.
6) Human motion tracking: Piezoelectric mats can be used to track human motion, for example in sports or physical rehabilitation. To gather information on the movement and pressure patterns of the feet, the mat can be positioned on the floor or inserted inside shoes.

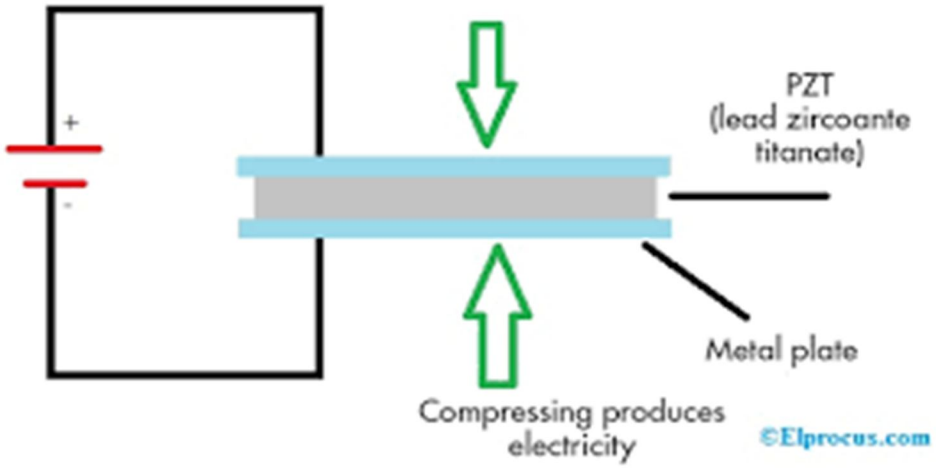
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Due to its special ability to produce electricity when subjected to mechanical stress or vibration, piezoelectric mats can be used in a wide variety of applications. Their usefulness in a variety of applications, from energy harvesting and acoustic ones to structural health monitoring and human motion tracking, stems from their capacity to transform mechanical energy into electrical energy.

III. ABOUT THE PIEZOELECTRIC EFFECT

The phenomenon of certain materials producing an electric charge when under mechanical stress is known as the piezoelectric effect. The material's crystal lattice structure is deformed as a result of the stress being applied, which results in this effect. Positive and negative charges inside the material are separated as a result of this deformation, creating an electric field and an electric charge. It is possible to use the piezoelectric effect for a variety of purposes, including energy harvesting, sensors, and actuators. The arrows in the diagram below reflect the movement of charges as a result of the applied stress, and it illustrates the fundamental idea of the piezoelectric effect.



IV. LITERATURE REVIEW

A. "Design and Development of Piezoelectric Energy Harvesting Mats for Smart Floor Applications" by C. V. N. R. K. Prasad, et al. (2019)

This study focuses on the design and development of piezoelectric energy harvesting mats for smart floor applications. The authors present a design methodology for developing a piezoelectric mat that can harvest energy from human footsteps. They evaluate the performance of the mat using different materials and thicknesses and suggest a design that maximizes energy output.

B. "Design and Analysis of Piezoelectric Energy Harvester Embedded in Vehicle Tires" by M. Shahinpoor and M. Kim (2018)

This study presents the design and analysis of a piezoelectric energy harvester embedded in vehicle tires. The authors propose a design that can harvest energy from the deformation of the tire as it rolls over the road surface. They evaluate the performance of the harvester using simulations and experiments and discuss the potential applications of the technology.

C. "Piezoelectric Mats: Materials, Devices, and Applications" by R. Sharma, et al. (2019)

This review article provides an overview of the materials, devices, and applications of piezoelectric mats. The authors discuss the different types of piezoelectric materials and their properties, as well as the various designs and configurations of piezoelectric mats. They also review the applications of piezoelectric mats in energy harvesting, sensors, actuators, and acoustic applications.

D. "Piezoelectric Polymer Composite Mats for Structural Health Monitoring" by C. R. Bowen, et al. (2017)

This study focuses on the development of piezoelectric polymer composite mats for structural health monitoring. The authors present a design methodology for developing a piezoelectric mat that can detect damage and deformation in structures such as bridges and buildings. They evaluate the performance of the mat using simulations and experiments and suggest potential applications for the technology.

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V. DESIGN AND CALCULATION

Block Diagram

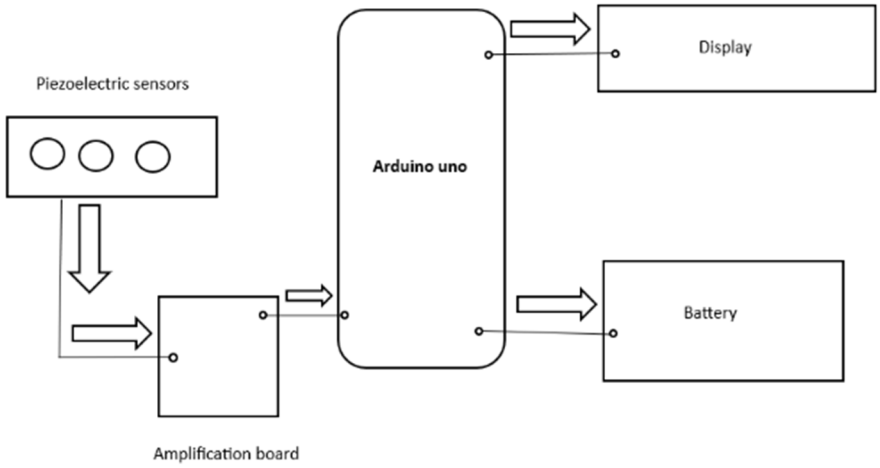


Fig. Block Diagram

So Now, According to Newton's third law of motion, it mentioned that every action will have the equal and opposite reaction. There will a force that produce to the ground when step on it which is the vector force that generally moving downward and backward. On the other hand, the ground will react and produce a force that is upward and forward. This force called as ground reaction force (GRF). The amplitudes were normalised with respect to the body weight of the humans. Increased speed was accompanied by shorter force periods and larger peak forces. The peak amplitude of the vertical reaction force in walking increased with speed is from approximately 1.0 to 1.5 of the human body weight. Using the assumption that on average, the body mass of a people is 62 kilograms:

$$1.25 \times 62\ kg \times 9.81\ m/s2$$
$$= 760.28\ N$$

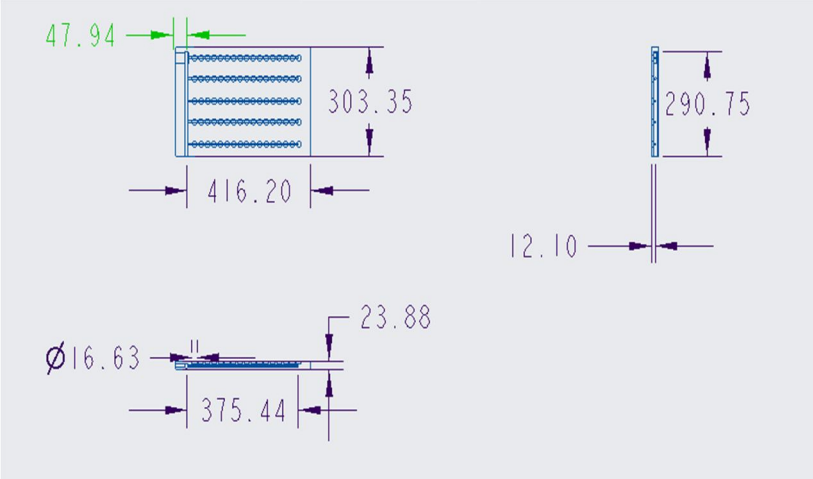
Force applied over the 0.01m depression of the tile:

$$760.28\ N \times 0.01\ m = 7.60\ J/step$$

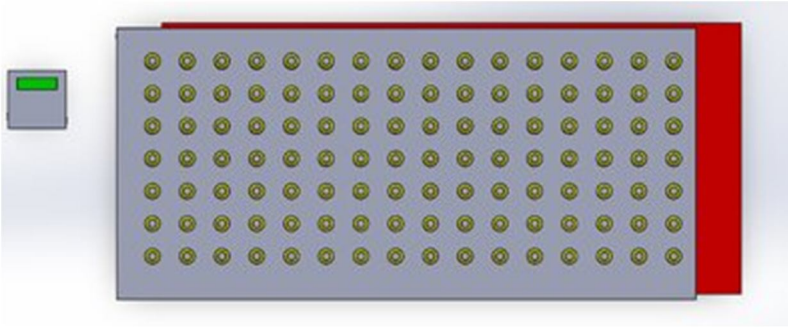
Energy efficiency of each tiles: 50 % of the energy

$$7.60\ J/step \times 50\% = 3.80\ J/step$$

VI. CAD MODEL



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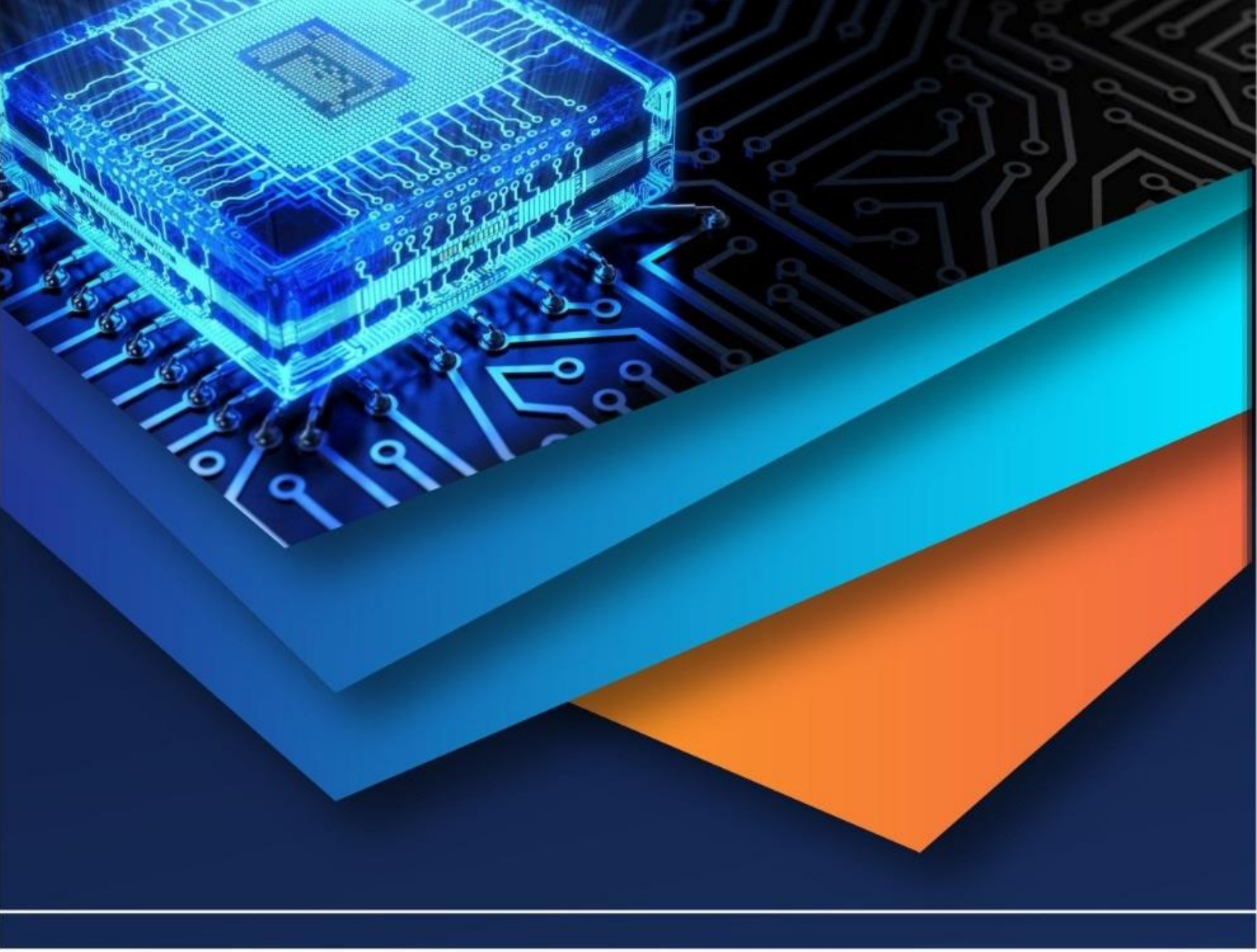
VII. CONCLUSION

Using piezoelectric plates, we efficiently produce power. The primary goal of this project is to produce energy from routine movements like those of people and vehicles. Technology for generating power is advancing daily. Our project introduces a fresh, creative way to produce electricity that may be applied to several additional uses. Positive outcomes were reached after the introduction of the use of piezoelectric crystals. The selection and use of better synthesised piezoelectric crystals, along with further advancements in electronics, have the potential to produce more electricity and represent the next possible source of power. The general economic criteria can be maintained by reducing unconventional, non-polluting energy. Electricity is becoming more and more necessary every day. Nowadays, electricity is a necessity for everything. This is the primary cause of designing of this project.

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