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Green Energy Generation From Human Kinetics Using Piezoelectric Transducers

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Abstract. *Advancements in science and technology have significantly improved the way energy is harnessed in our daily lives. Recognizing the critical importance of electricity and the need for sustainable alternatives, this project explores the generation of green energy through human kinetic activity. The system utilizes piezoelectric transducers that convert foot pressure into electrical energy. When subjected to mechanical stress from footsteps, these sensors produce alternating current (AC), which is then converted into usable direct current (DC) through a bridge rectifier circuit. To enhance reliability, a backup mechanism is incorporated to ensure continuous power supply during periods of inactivity. This approach demonstrates a practical and eco-friendly solution for energy generation in high-footfall areas, offering potential for scalable deployment in public infrastructure and smart city applications..*

Keywords: *Effortless human energy, piezoelectric sensors, bridge rectifier,power generation, Green Energy.*

1 INTRODUCTION

The concept of generating electricity from pedestrian movement, known aspiezoelectricity, has gained attention in recent years. Piezoelectric materials can convert mechanical stress, such as footsteps, into electrical energy. In today's worldas the population increase especially in crowded places, this project can be initiated in huge amounts so that enormous amounts of power can be generated and stored in a battery and used in electrical appliances. This is an innovative and cost-effective idea that uses effortless energy when compared to other sources of energy. It is also reliable as a proper failsafe is provided (switching to an external power supply in case of low voltage).

1.1Drawbacks of the current pavements in crowded places

In the crowded pavements and sidewalks of a busy city, the pavements are often overlooked as source of renewable energy, the large amount of kinetic energy obtained from the foot presses of the thousands of pedestrians is not utilized and no such useful modifications are made to make the floor generate energy for us.

2 PROPOSED PLAN

This project utilizes piezoelectric sensors in tiles to convert human foot pressure into electricity. The generated power can be used immediately or stored in a battery for later use. A microcontroller manages the power supply, and various parameters are displayed on a screen. The detailed methodology of this idea is as follows.

2.1 Methodology

This project is something to do with the production of power or generally electricityby using piezoelectric sensors with absolutely a free and effortless human foot pressor any force. we are using tiles to demonstrate this concept as just useless human foot press is used as energy that vibrates the piezoelectric sensors. Firstly, the sensor vibrates due to any force applied onto the rectangular diaphragm that generates ac voltage that's graphically represented as a sinusoidal wave. Firstly, by using a bridge rectifier this voltage is converted to positive pulsating dc voltage. A capacitor is used as a filtering circuit to get the pure dc voltage from pulsating dc voltage. The DC voltage is dropped according to the voltage prescribed on the load by using a high resistance whose value depends on the current of the load. This project can be implemented especially in crowded places where humans passing through these tiles generate a decent amount of electricity. If the battery is placed instead of LEDs, generated power can be stored and used for other useful purposes. And when there isa lack of foot presses, the voltage

produced by the battery lowers and when it does,the power supply is switched to an external power source with the help of a microcontroller (Arduino).
Various parameters like voltage supplied, number of steps and power stored, are displayed on the screen.

2.2Flowchart

The flowchart shown in Fig. 1 will clearly explain the complete working of ourproject.

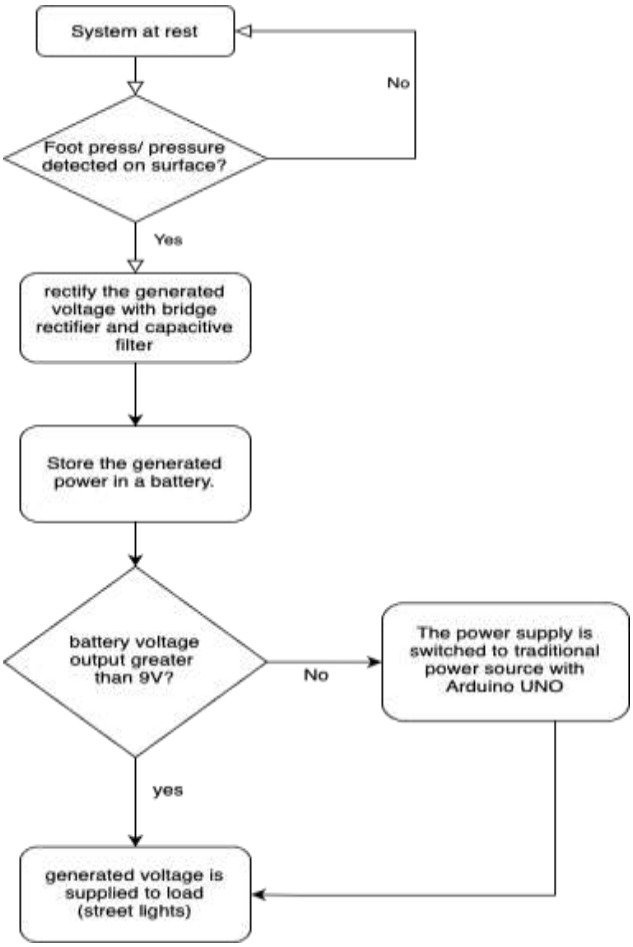

Fig. 1. Working flow of the system

3 HARDWARE

The prominent hardware products of our project are, Piezoelectric sensors, Bridge rectifier, Uninterruptible power supply, Arduino UNO, potentiometer, and relay.

3.1Piezoelectric sensors:

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changesin pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.

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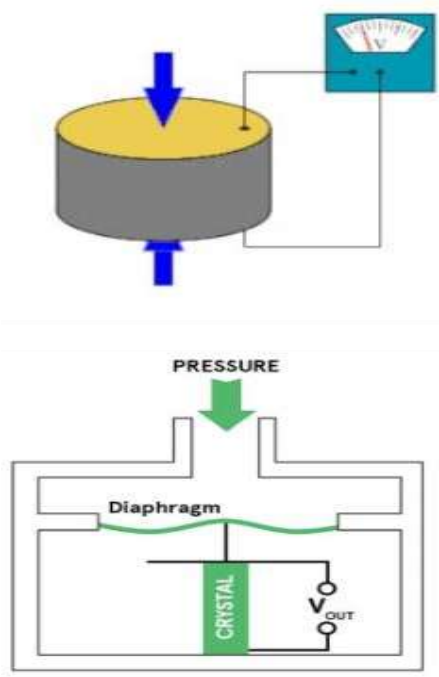

Fig. 2. Piezoelectric Sensor

In this project, the sensors are used to detect human force in this case foot press and convert it into AC voltage. The mechanical stress is converted to electrical energy

3.2Bridge Rectifier

A bridge rectifier circuit consists of four diodes that is used in the process of converting alternating current (AC) from the input terminals to direct current (DC, i.e. fixed polarity) on the output terminals. Its function is to convert the negative voltage portions of the AC waveform to positive voltage, after which a low-pass filter can be used to smooth the result into DC.

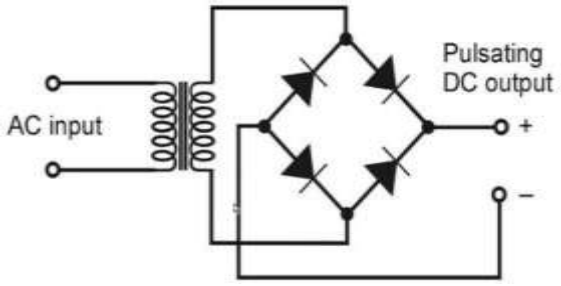

Fig. 3. Bridge Rectifier

3.3Uninterruptible Power supply(UPS)

UPS or uninterruptible power supply that's initially connected to the external power supply via the transformer and the bridge rectifier is disassembled and then the battery and inverter is connected to the piezoelectric generator setup.

Firstly, the Battery is used to store voltage and power generated by the piezoelectric sensors. The Piezoelectric sensors are connected in such a way that its total voltage should be comparable to the Battery's voltage, so that maximum efficiency is produced.

Fig. 4. Uninterruptible Power Supply (UPS)

Then, the inverter is used to convert the stored DC battery voltage to 230V AC voltage and supply it to the respective load, in this case, 230V LEDs .

3.4. Arduino UNO

Arduino UNO is one of the most popular microcontrollers. In this project this is used to calculate the voltage value, current value and the power generated in the battery present by using a voltage and current sensor that's connected in between the battery and the inverter and then displayed by using 0.96-inch OLED display.
Along with that the supply is switched to external power supply as soon as the battery is drained to 9V or below and this is done by using relay that's programmed by using this microcontroller.

Fig. 5. Arduino UNO

3.5 Hardware Specifications

The specifications of the hardware items used in the system is listed in Table 1.

Table 1. Specifications of the hardware items

COMPONENT	SPECIFICATION
Arduino UNO	ATmega328 SMD.
Piezoelectric sensors	12 units with 20mm diameter

4 OUTPUT:

4.1Applying force on the piezoelectric sensors:

When force or pressure is applied to the surface of the diaphragm containing the piezoelectric sensors, the sensors generate an electrical voltage due. to the piezoelectric effect. This voltage is then detected by the LED circuit, causing the RedLED to flash and visually indicate the presence of the applied force or pressure.

Fig. 6. Application of force on the diaphragm

4.2Storage of charge in the 12V battery and powering the load:

The generated voltage from the piezoelectric sensors is stored in a 12V battery forlater use. This stored voltage is then used to power a load, which could be any electrical or electronic device.

Fig. 7. The final setup

4.3 A Display to check the step count and voltage:

A display interface is provided to show the real-time count of steps taken by the user.This display continuously updates as steps are detected by the piezoelectric sensors. Also, the same display is employed to indicate the output of the battery, providing useful information about its voltage level.

Fig. 7. The Display

5 CONCLUSION

This project aims to harness the otherwise wasted kinetic energy generated by human footsteps in high-footfall areas and convert it into usable electrical energy through piezoelectric transducers. By capturing this passive form of energy, the system contributes to the broader objective of transitioning away from non-renewable energy sources such as fossil fuels. When implemented at scale in densely populated urban environments, this technology offers a sustainable and eco-friendly solution that supports the global movement toward clean and renewable energy. Although modest in its initial application, the proposed system has vast potential for scalability in locations such as railway stations, airports, shopping malls, and pedestrian crossings. Its low-maintenance design and ability to generate electricity without any active human effort make it ideal for integration into smart

city infrastructure. Furthermore, the system can be combined with energy storage solutions to power lighting, sensors, or small electronic devices, thereby promoting decentralized micro-energy generation. Overall, this project represents a meaningful step toward energy self-sufficiency, environmental sustainability, and smarter urban living..

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