

Generating Clean Energy Through Piezoelectric Tiles In Urban Spaces

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Abstract

Piezoelectric Energy Harvesting Tiles present an innovative approach to harnessing and converting mechanical energy into electrical energy. These tiles, embedded with piezoelectric materials, are designed for integration into various surfaces, such as floors, pavements, and roadways, where significant foot traffic or mechanical vibrations occur. The piezoelectric materials generate direct current in response to mechanical pressure or vibrations, enabling them to capture the energy from human footsteps or vehicular movement. The energy conversion mechanism within the tiles transforms the generated mechanical pressure into alternating voltage, which is then rectified to direct current (DC) voltage. To ensure a continuous power supply, an onboard energy storage system, such as a rechargeable battery or supercapacitor, stores the harvested electrical energy. Monitoring capabilities and sensors track energy generation, usage patterns, and system performance. These energy-harvesting tiles offer versatile scalability and easy integration into new or existing infrastructures. They contribute to a sustainable and eco-friendly approach by converting mechanical vibrations into clean and renewable electrical power, reducing reliance on fossil fuels and greenhouse gas emissions. The potential applications of Piezoelectric Energy Harvesting Tiles span various industries, from urban environments to remote areas. By revolutionizing the way we harness energy from our surroundings, these tiles pave the way towards a greener and more sustainable future. (Cottone et al., 2011)

Introduction

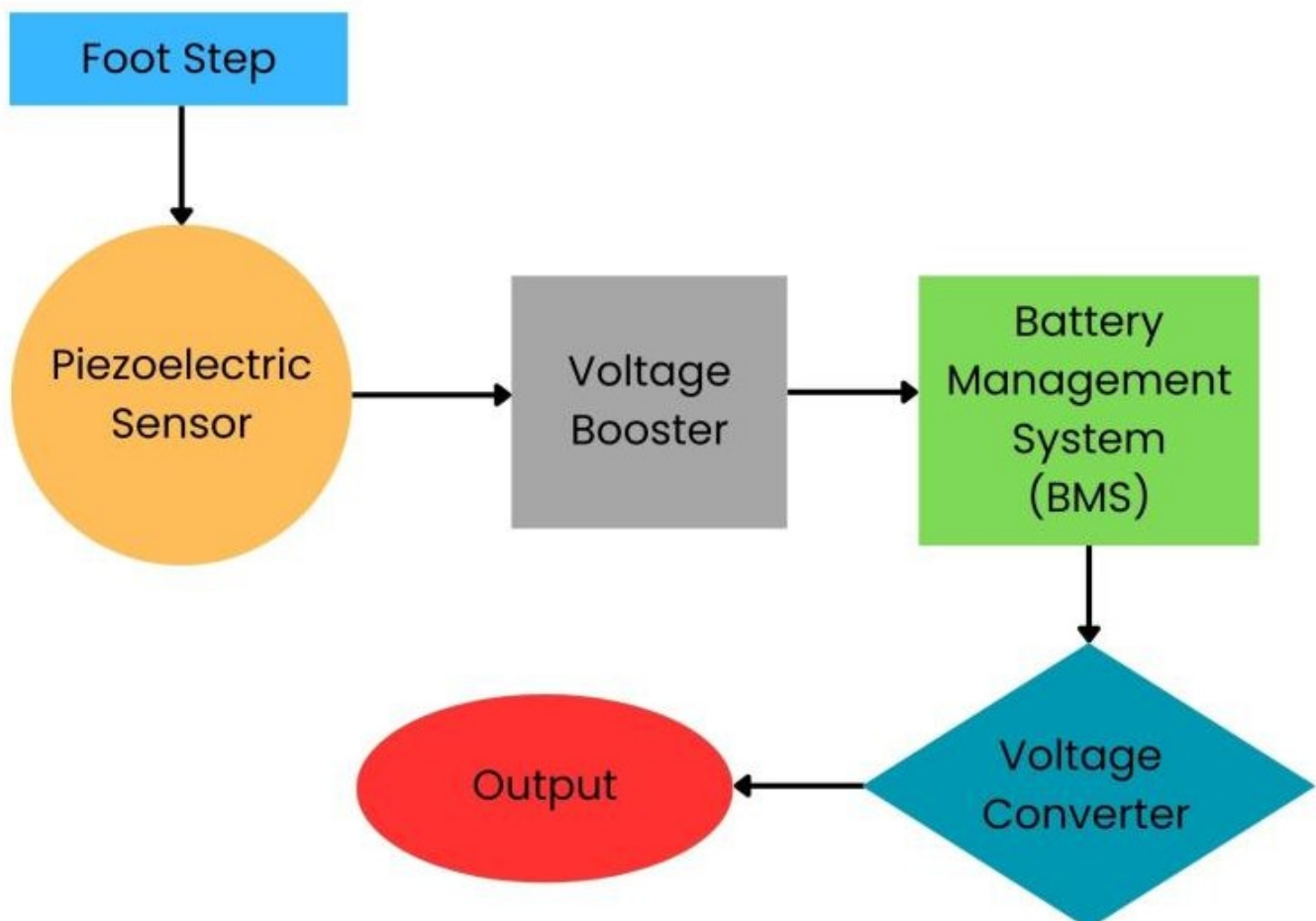
This study aims to utilize piezoelectric sensors to recover lost energy from footfalls. When mechanical energy is delivered to a transducer known as a piezoelectric sensor, electrical energy is produced. In order to build a foot mat that generates a DC voltage when people step on it, piezoelectric sensors are covered with rubber mats or wooden boards that are connected in series and parallel. Because it cannot go on, the output is rectified and stored in a battery. The technique has been heavily utilized on roads, parks, and other public spaces where the energy from foot circulation may be gathered and turned into electrical power.

Proposed Work with Methodology

The piezoelectric material responds to pressure by producing electrical energy. The weight

People walking across it or the weight of moving cars can both put pressure on the surface.

Alternating voltage is produced by the piezoelectric energy harvesting (PEH) device. A rectifier is used to convert the AC voltage to DC voltage. The output of the piezoelectric material is discontinuous. The output DC voltage is stored in a rechargeable battery. As the frequency of footsteps increases, piezoelectric sensors' ability to generate power decreases. Voltages and currents were all measured using a multimeter. As varied forces were applied to the piezoelectric material, variations in voltage readings matching the force were displayed. For each voltage reading across the force sensor, different voltage and current measurements of the piezoelectric material are made.



Literature Survey

Fig.1-Work Flow Diagram

According to a newly released survey, 13% of the population either uses non-grid sources for energy

and lighting or doesn't use any at all, leaving the remaining 87% of the population with access to grid-based electricity. According to a survey, 13% of Indian households still lack access to grid-connected electricity. The scarcity of electricity will rise to 20% due to the growing population and limited energy sources. Due to the growing population and limited energy sources, there will be a 20% or more increase in the electricity shortfall. Everywhere in India, there will be more power outages, which will result in more vital patients dying during medical procedures and less work being done by inspectors dependent on electrical machinery.

Summary of the Invention

The invention of piezoelectric energy harvesting tiles introduces a novel technology that harnesses energy from footfalls and vibrations in various environments. These specially designed tiles incorporate piezoelectric materials, which generate electrical energy when subjected to mechanical stress. As people walk or move on the tiles, the mechanical pressure applied to the piezoelectric elements converts into usable electricity. This innovative solution offers an eco-friendly and sustainable way to generate power, making it proper for an example range of applications, from public spaces to high-traffic areas. By effectively converting mechanical energy into electrical energy, these

Piezoelectric energy harvesting tiles hold the potential to significantly contribute to [renewable energy sources](#) and reduce environmental impact. (Cottone et al., 2011)

Field of the Invention

Piezoelectric Energy Harvesting Tiles represent an innovative technology at the intersection of materials science, engineering, and renewable energy. These smart tiles are designed to capture mechanical energy, often from sources like foot traffic or vibrations, and convert it into DC Power using piezoelectric materials. The process involves the generation of an electric charge in response to mechanical stress, which can then be stored and used to power various devices or contribute to the energy needs of buildings, infrastructure, or even smart cities. The tiles find applications in various fields, from powering wireless sensor networks and IoT devices to providing sustainable energy solutions in public spaces and commercial buildings. Their integration into architectural designs and construction materials aims to enhance energy efficiency and promote eco-friendly practices. As a fresh and non-renewable energy source, piezoelectric energy harvesting tiles play a crucial role in reducing reliance on traditional power grids and moving towards a more sustainable future.

Characteristics of Voltage (V) Vs Weight (Kg)



Fig.2-Output Voltage Depends on Weight (Kg) at 1*1 Feet tile

Expected Outcome / Results

The core of a piezoelectric sensor is made of piezoelectric materials. When mechanical stress is applied to these materials, electricity can be generated. Piezoelectric refers to electricity produced by pressure. A piezoelectric sensor is a device that uses the piezoelectric effect. The piezoelectric tile has a 30 cm × 30 cm size. 16 piezoelectric sensors have been put on this tile. Series and parallel connections are used to link the sensors. When the tile is under

Compressive or tensile stress produces electricity, creating a voltage gradient and subsequent current flow.

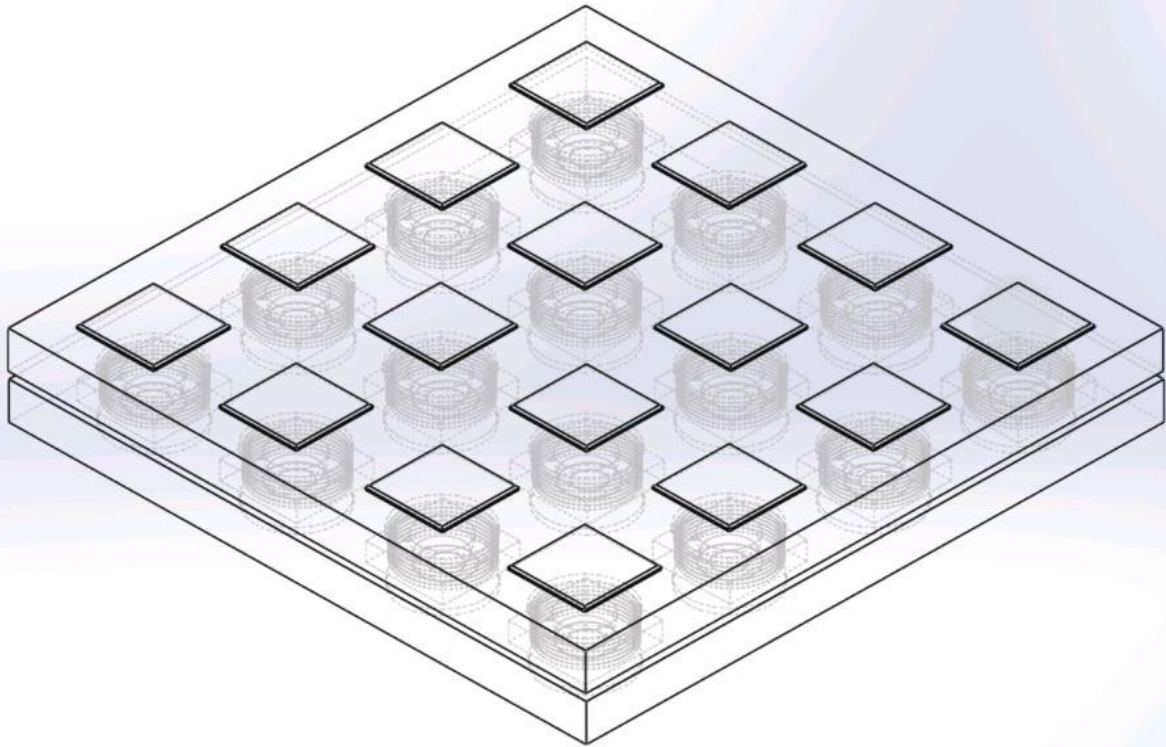


Fig.3-Transparent Design View of Intouch Tiles

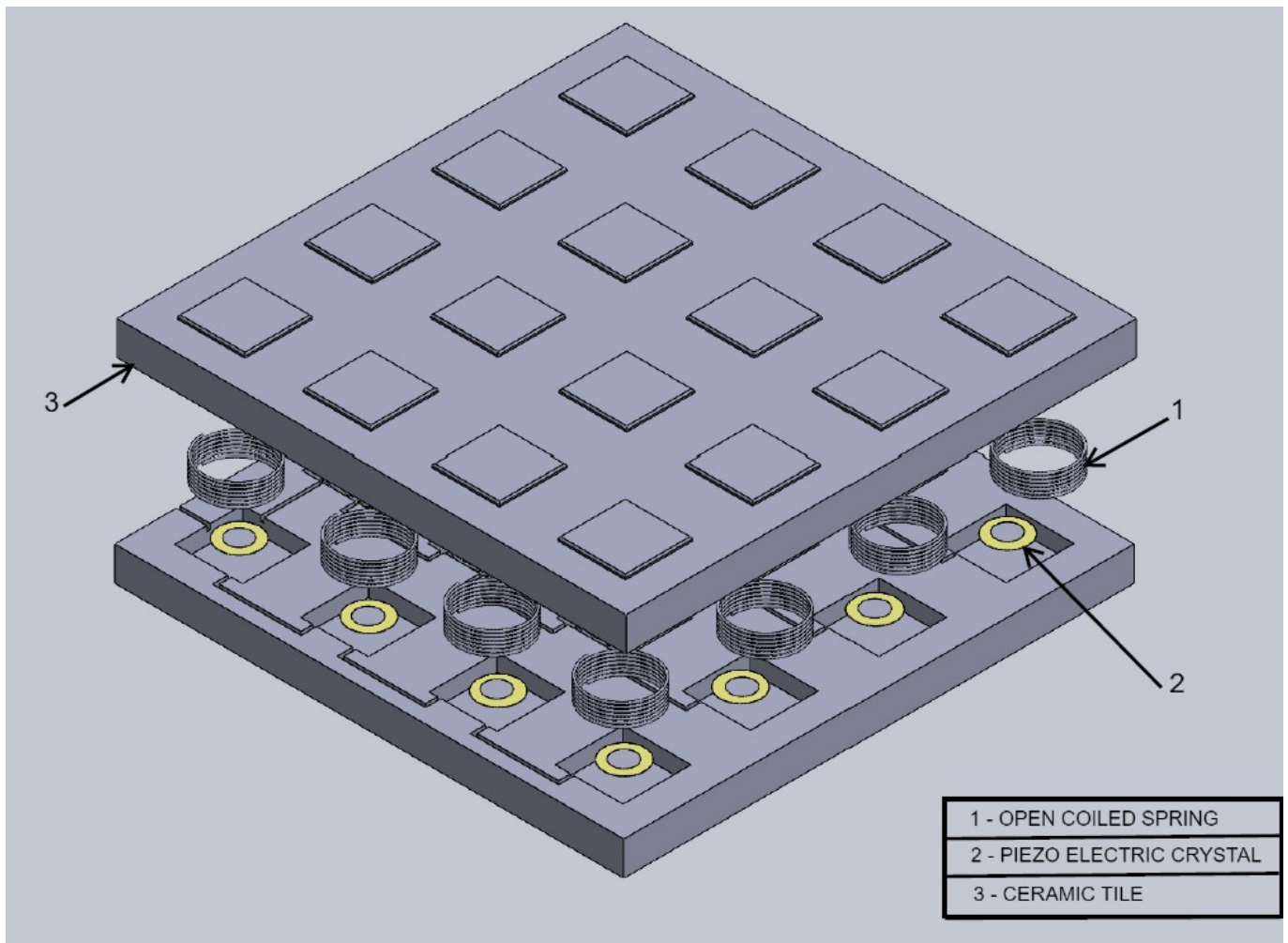


Fig.4-Open View of Intouch Tiles

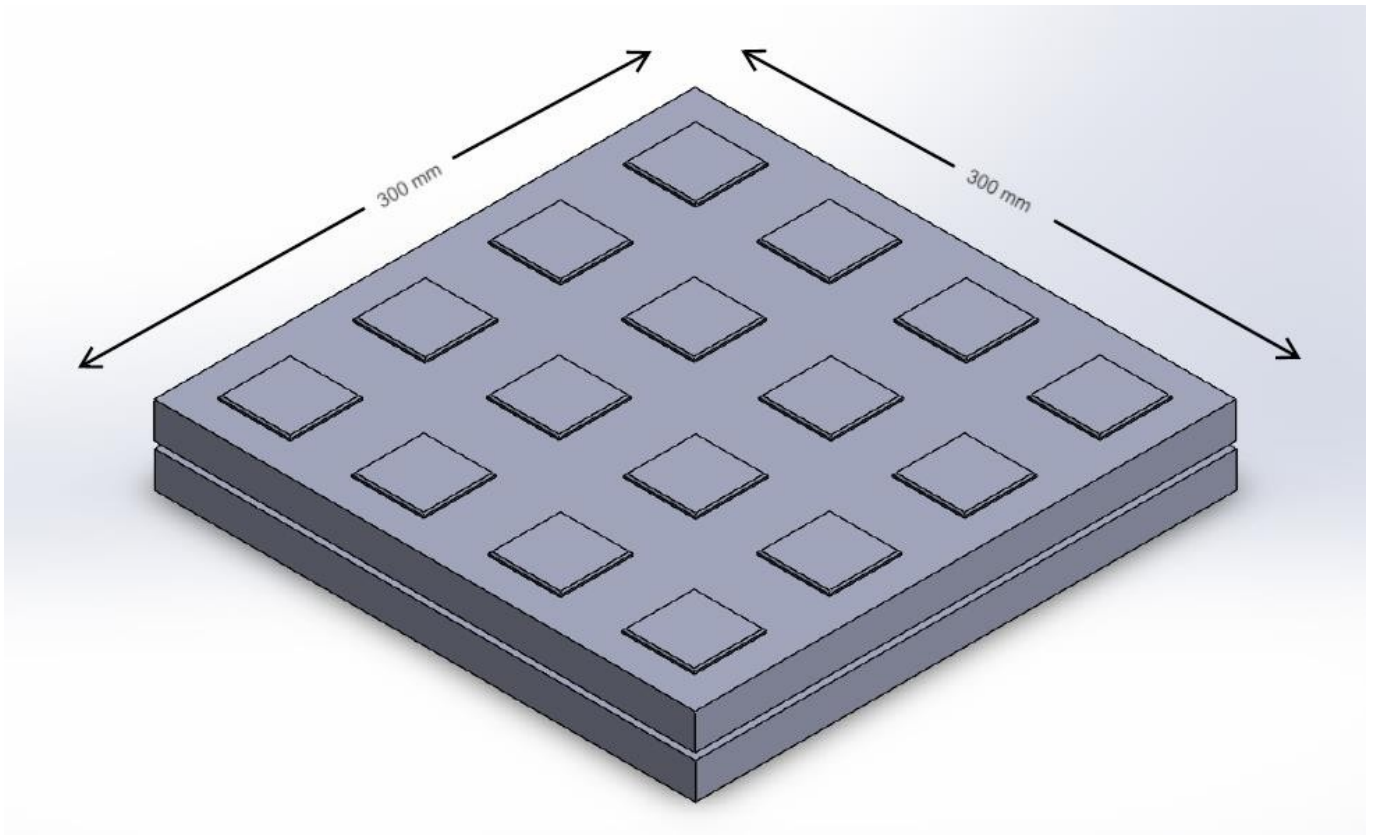


Fig.5-Complete design view of Intouch Tiles

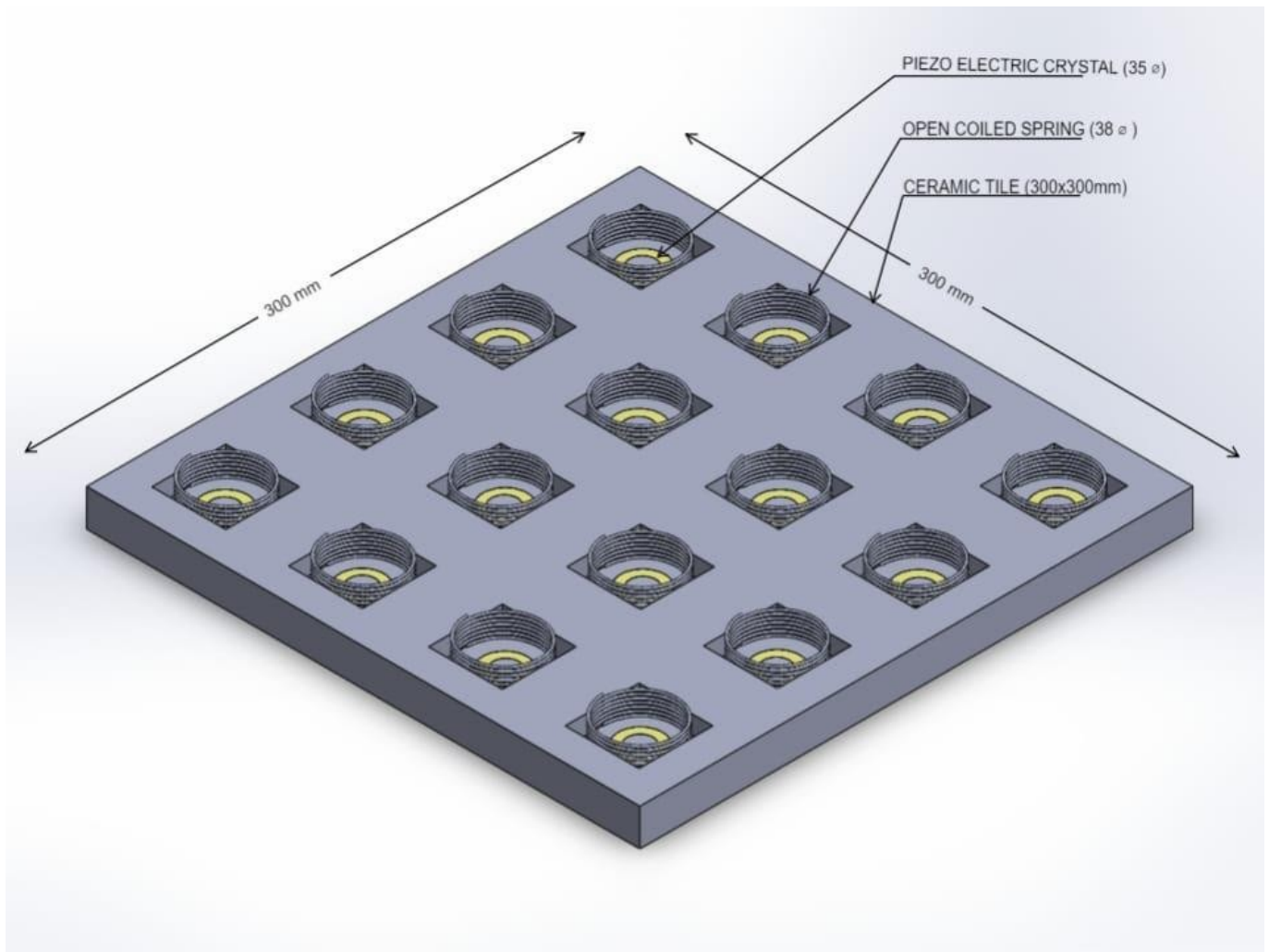


Fig.6-Assembly Diagram of Intouch Tiles

Conclusion

Energy-harvesting piezoelectric tiles offer a promising and innovative solution for generating electricity from ambient mechanical energy. These tiles, made from piezoelectric materials, can convert vibrations and mechanical stress into electrical energy, providing a sustainable and renewable power source. The application of energy-harvesting piezoelectric tiles is diverse and holds significant potential. They can be deployed in various settings, including transportation hubs, public spaces, and even residential environments, to capture energy from human activities and foot traffic. By utilizing piezoelectric tiles, we can reduce dependence on traditional power sources and contribute to a more sustainable energy ecosystem. These tiles provide a way to generate electricity from everyday activities, making it possible to offset power consumption and reduce environmental impact. Overall, energy-harvesting piezoelectric tiles represent a compelling pathway towards a greener future, where we can harness the energy of our surroundings to power devices and contribute to a more sustainable and environmentally friendly world. As technology continues to

advance, the adoption of piezoelectric energy harvesting solutions will likely play an essential role in our transition to a more sustainable energy paradigm. (Stephen et al., 2010)

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