

Energy Harvesting from Dance Floor Model

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Abstract: The rapid depletion of conventional resources necessitates novel, sustainable energy solutions. This paper introduces a dance floor energy harvesting system that converts human kinetic movement into usable electrical energy. Utilizing an embedded rack and pinion mechanism beneath the floor tiles, the system efficiently captures the mechanical vibrations and pressure exerted by dancers. This captured mechanical energy is then converted into electricity via an electromagnetic generator. The harvested power can support auxiliary loads such as LED lighting and device charging, reducing reliance on the conventional grid. This technology not only offers a sustainable and eco-friendly energy solution for public spaces (clubs, gyms, events) but also significantly enhances user engagement by allowing active participation in energy generation, promoting awareness of energy conservation, and contributing to smart infrastructure development. The design, working principle, energy conversion mechanisms, and practical applications of this innovative system are explored.

Keywords: *Non conventional energy, Dance floor energy generation, Electromagnetic generator, Rack and pinion mechanism.*

I. INTRODUCTION

The growing imperative for sustainable energy solutions has driven research into exploiting unconventional and readily available energy sources. Traditional power generation methods contribute significantly to carbon emissions, necessitating a shift toward localized, renewable alternatives. Among these emerging technologies, kinetic energy harvesting (KEH) from human movement offers a promising, clean, and interactive approach to power generation

The body is an abundant source of mechanical energy, with activities like walking, running, and dancing generating substantial power—an average person can system store energy equivalent to a large battery. While most KEH research focuses on wearable or pedestrian-based systems, a particularly novel application involves the use of high-traffic communal spaces to capture this “wasted” energy.

II LITERATURE REVIEW

In this paper [1] Power Generation from Dance Floor (A Mechanism Design using Rack and Pinion), the

authors propose a method to generate electricity using human movement, specifically from dancing or jumping on a floor. Traditional power generation methods waste the kinetic energy produced by human activities, while this system captures and converts it into electricity without harming the environment. The idea is to create a clean and low-cost source of power that can help reduce global warming and energy shortages. Their design mainly uses a rack-and-pinion arrangement with a dynamo to transform pressure energy from footsteps into mechanical rotation and then into electrical power. This paper [2] study focuses on the real-world performance of a triboelectric floor tile used for energy harvesting. The authors investigated how three factors—triboelectric material thickness, gap width between the cover plate, and pressing frequency—affect electrical output. The tile was constructed using commonly available PTFE film and aluminum foil, making it simple and inexpensive to manufacture. By simulating human footsteps with square-wave pressing, the researchers found that increasing the gap width and reducing the material thickness significantly improved voltage and current

output. This paper [3] At the International Conference on Sustainable Energy and Green Technology, these authors presented the “Genpath” energy-harvesting floor system. The concept converts human footsteps into electricity using a rack-and-pinion mechanism that drives a DC generator. The prototype demonstrated promising performance, generating around 199 mJ per step (about 331 mW of power) and reaching a peak voltage of 19 V under a 140- Ω load. This amount of energy is sufficient to power small electronic devices, proving the feasibility of using large crowds to generate useful electricity. This paper [4] article explores the potential of generating electricity from dance movements. The authors report that a human body contains stored energy comparable to a large 1,000 kg battery, though only about 25% can be converted through muscle motion. During dancing, a person can produce a maximum of 80–100 W of power, with an average output of 20–30 W over 10 seconds. Their energy-harvesting floor system demonstrates how entertainment spaces like dance clubs can capture this otherwise wasted energy. Although power from a single person is limited, combining energy from a large crowd can contribute meaningfully to sustainable power generation. This research paper[5] presents a way of generating power using a speed breaker mechanism. When a vehicle passes over the speed breaker, the downward mechanical force turns a generator to produce electricity. The generated power can be used for low-power applications such as traffic signals and street lighting. The study also analyzes how factors such as vehicle weight, speed, and mechanical efficiency influence the total amount of power generated. The method is described as a cheap and environment-friendly urban energy solution. This paper [6] the authors highlight the increasing demand for renewable and sustainable sources of power, especially for electronic systems. Their research shows that human body vibrations can generate around 5 V of usable energy during daily activities. Similar vibrations from traffic, railways, tall buildings, bridges, and ocean waves can be harvested and stored to run low-power devices. With large-scale harvesting systems, the output can even reach between 1 W and 100 kW, demonstrating the immense potential of vibration-

based energy systems. This paper [7] presents the development of a next-generation floor system called Genpath, designed to harvest power from footsteps in public areas. The researchers compared two conversion mechanisms—rack-and-pinion and lead-screw—using MATLAB/Simulink modeling and a physical prototype. The lead-screw mechanism, combined with a 12-V DC generator, was found to deliver superior performance, producing an average energy output of 702 mJ per step (about 520 mW), which is a 184% improvement over the earlier rack-and-pinion prototype. The electromagnetic generator achieved an efficiency of about 26%, while the power-management circuit reached nearly 75%, confirming the practicality of the overall system.

III BLOCK DIAGRAM

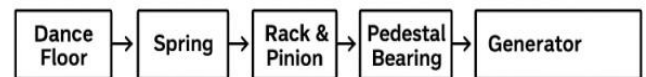


Fig 1: Block diagram of energy harvesting system

This block diagram shows how energy is generated from people dancing or stepping on a special floor. When someone steps on the Dance Floor, it moves slightly downward due to their weight. This movement is passed on to a Spring, which gets compressed and stores the energy from the step. As the spring moves up and down, it pushes a Rack and Pinion mechanism. The rack moves in a straight line, and the pinion (a gear) converts that up-and-down motion into rotation. This rotating motion is supported by a Pedestal Bearing, which helps the shaft spin smoothly without friction. Finally, the rotating shaft drives a Generator, which converts the motion into electrical energy. This electricity can then be stored or used for powering small devices. In simple terms, the system turns the energy from footsteps into useful electrical power.

IV METHODOLOGY

The methodology for the proposed energy harvesting using dance floor model involves the design, fabrication, and testing of a floor-based mechanical–electrical conversion system. The system consists of a spring-supported platform integrated with a rack-and-

pinion mechanism that converts the vertical displacement produced by human footsteps or dance movements into rotational motion. This rotational motion drives a DC generator to produce electrical energy. The platform is constructed using durable materials to withstand repetitive dynamic loads, while linear guides are used to ensure smooth vertical motion. Sensors are incorporated to measure displacement, force, and output voltage for performance evaluation. The generated electrical power is conditioned using a rectifier and voltage regulator before being stored in a battery or supercapacitor. Experimental trials are conducted by varying footstep frequency, load weight, and platform stiffness to analyze system efficiency. Data collected from these tests are used to validate the feasibility of the dance-floor-based energy harvesting model and to optimize the mechanical design for improved power output.

V PROBLEM STATEMENT

Conventional energy sources are increasingly unable to meet the growing global demand for electricity, leading to a need for alternative energy-harvesting solutions that are sustainable, cost-effective, and environmentally friendly. In high-footfall areas such as malls, auditoriums, public events, and dance floors, a significant amount of mechanical energy produced by human motion is wasted. However, existing human-powered energy harvesting systems often suffer from low efficiency, limited durability, and complex mechanisms that restrict their practical implementation. Therefore, there is a need for a reliable dance-floor-based energy harvesting model that can effectively convert vertical footstep impacts and dance movements into electrical energy. The problem addressed in this study is the development and evaluation of an optimized mechanism that captures this unused mechanical energy, converts it into usable electrical power, and demonstrates its feasibility as a supplementary renewable energy source for small-scale applications.

VI OBJECTIVES

The primary objectives of this paper are to design, model, and experimentally validate a novel dance floor

energy harvesting system. Specifically, this work aims to structurally design and optimize the integration of a rack and pinion mechanism within a modular floor tile to maximize the capture of vertical kinetic energy from human movement. Furthermore, the research focuses on developing and analyzing the efficiency of the electromagnetic conversion mechanism in transforming this variable mechanical input into stable electrical power.

VII COMPONENTS

A. Floor Tile

The floor tile is the top mechanical component of the system that comes into direct contact with the user's footsteps. It serves as the surface that captures mechanical pressure and transfers it to the spring and generator mechanism beneath. In this paper, the tile is made from acrylic sheet, both chosen for their high strength, durability, and resistance to wear. Acrylic provides a smooth, glossy, and visually appealing surface, offers good loadbearing capacity, flexibility, and low cost, making it suitable for continuous stepping or dancing.

B. Frame Dimensions

A typical size for a single-footstep tile is roughly a square that is large enough to comfortably place one foot:

Platform Size: 30 cm×30 cm (12 inches×12 inches) up to 40 cm×40 cm (16 inches×16 inches).

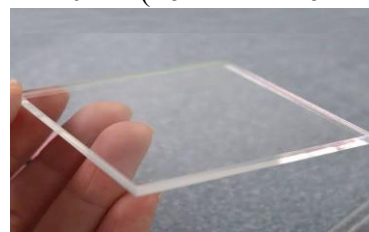


Fig.2:Floor tile

C. Spring

The spring is one of the key mechanical components of the system, responsible for converting the vertical force from footsteps into mechanical motion. When a person steps on the floor tile, the spring compresses and stores potential energy, which is later released as mechanical motion to drive the generator through the gear mechanism.

**Fig.3:Spring****Specification**

Type: Compression springs

Number: At least 4, one for each corner.

Load Capacity: Each spring should be rated for approximately 20 kg to support the weight of the tile and a user.

Travel: Springs should allow for a vertical travel of at least 5 cm.

D. Rack and pinion

The rack and pinion mechanism is an essential part of the system used to convert linear motion into rotational motion. In this paper, when a person steps on the floor tile, the downward movement compresses the spring and pushes the rack, which is a straight, toothed bar. The pinion, a circular gear, is connected to the shaft of the DC generator. As the rack moves linearly, its teeth engage with the pinion's teeth, causing the pinion to rotate.

**Fig.4: Rack and Pinion****Specification**

Rack Material: Hardened plastic.

Rack Length: A minimum of 15 cm to accommodate the 5–10 cm of travel.

Pinion Material: Hardened plastic.

Pinion Diameter: Approximately 2 cm to 3 cm.

E. Dynamo

The generator is the main electrical component of the system, responsible for converting Mechanical energy into electrical energy. In this paper, a DC generator (dynamo) is used, which operates on the principle of electromagnetic induction when a conductor (coil) rotates within a Magnetic field, an electric current is induced. The rotational motion required for this is provided by the rack and pinion mechanism, which transfers the vertical movement of the floor tile into rotary motion. The generator produces a small amount of alternating voltage, which is later rectified to direct current (DC) for storage and use.

**Fig. 5: Dynamo****Specifications**

Voltage	12 V
No load current	60mA
Load current	300mA
Torque	4kgcm
RPM	200 rpm

F. Diode

The diode rectifier is an important electronic component in the system that converts the alternating current (AC) produced by the generator into direct current (DC). In this paper, a bridge rectifier made of four diodes (such as 1N4007) is used.

**Fig. 6: Diode**

G. Capacitor

The capacitor is an essential component in this paper used for storing electrical energy and Smoothing voltage fluctuations. to smooth voltage in power supplies to filter noise in circuit



Fig.7: Capacitor

H. LED (Light emitting diode)

The LED (Light Emitting Diode) is a semiconductor device that emits light when an electric Current passes through



Fig.8: LED (Light emitting diode)

VIII. EXPERIMENTAL SETUP

The experimental setup consists of a small-scale dance floor model designed to convert human footsteps into electrical energy. A rack-and-pinion mechanism is placed beneath a movable floor tile, where the downward force from each step pushes the rack, causing the pinion gear to rotate a mini dynamo. The generated electrical output is measured using a multimeter, while the displacement of the tile and the applied pressure are recorded to study their effect on power generation. This setup helps simulate real-world footstep energy harvesting and evaluate its efficiency.

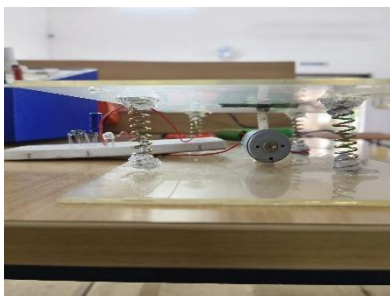


Fig. 9: Experimental setup of Energy Harvesting System

IX RESULT

Table 1: Time vs Power

Time Pressure applied(sec)	Voltage (V)	Current (mA)	Power Output(W)
1	3 - 5	20 - 40	0.06 - 0.20
2	4 - 7	30 - 50	0.12 - 0.30
5	6 - 9	40 - 70	0.24 - 0.63
10	8 - 12	50 - 80	0.40 - 0.96
15	9 - 12	60 - 80	0.54 - 0.96

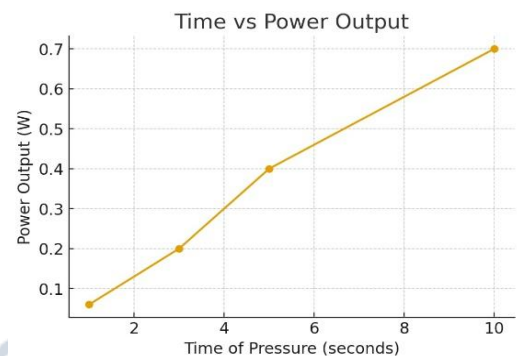


Fig 10: Time vs Power Output

X CONCLUSION

The energy-harvesting floor system effectively demonstrates how human motion can be converted into useful electrical energy through a rack-and-pinion mechanism coupled with a dynamo. Even though the power output from a single tile is modest, the setup proves the feasibility of generating electricity from everyday activities like walking or dancing. With improvements in mechanical design, material selection, and generator efficiency, this technology can be scaled for practical applications such as lighting, low-power charging, and smart-floor systems. Overall, the paper highlights a sustainable and innovative approach to utilizing wasted kinetic energy.

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