International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

FOOTSTEP POWER GENERATION

Aditya Landge[1] , Lalit Joshi[2] ,Anishka Kamble[3], Mrudula Khade[4], Prof. Pramod Jadhao[5]
Department of ENTC
Trinity Academy of Engineering Pune, India

ABSTRACT – The ever-increasing demand for sustainable energy sources has led to exploration of unconventional methods for power generation. Footstep power generation (FPG) is an emerging technology that harnesses the kinetic energy of human movement, specifically from footsteps, and converts it into electrical energy. This paper explores the concept of FPG, delving into the underlying principles, technological advancements, applications, and potential challenges. It discusses the utilization of piezoelectric materials, the design considerations for FPG systems, and their practical implementation in various settings. Finally, the paper analyzes the feasibility and limitations of FPG as a renewable energy source and explores future research directions in this promising field.

Key Words - Piezoelectricity, PZT, FPG, Inverter.

I. INTRODUCTION

Have you ever considered the energy you expend simply by walking? Footstep power generation (FPG) is an emerging technology that captures this wasted energy and converts it into usable electricity. This introduction dives into the basic concept of FPG, highlighting its potential and piquing your interest in this innovative approach to sustainable energy.Our world is brimming with untapped energy sources. FPG focuses on a particularly ubiquitous one: human movement. Imagine walking on a floor panel that transforms your steps into electricity! This is precisely what FPG aims to achieve. The magic behind FPG lies in a fascinating phenomenon called the piezoelectric effect. Certain materials, like specific crystals and ceramics, exhibit a unique property. When you apply pressure or force on them, they generate a small voltage. This voltage is the key to unlocking the power hidden within your footsteps.

FPG systems utilize these piezoelectric materials as transducers. Imagine these transducers strategically placed beneath floor panels or integrated into walkways. As you walk over them, the pressure from your steps compresses the material, generating electricity. The amount of electricity produced depends on the type of material used, the force exerted, and the design of the FPG system.

FPG technology is still young, but it holds immense promise. Imagine powering low-power devices in public spaces like bus stops or charging your wearable fitness tracker with your steps! FPG has the potential to revolutionize sustainable energy solutions in various applications.

II . LITERATURE REVIEW

Footstep power generation (FPG) is a rapidly developing field within renewable energy harvesting. This review explores the current state of research, focusing on the underlying principles, technological advancements, applications, and challenges associated with FPG technology.

Underlying Principles - The fundamental principle of FPG relies on the piezoelectric effect. Piezoelectric materials generate a voltage when subjected to mechanical stress. Numerous studies explore various piezoelectric materials for FPG applications. [1, 2] Research by [3] examines Lead Zirconate Titanate (PZT) ceramics, a common piezoelectric material, for its efficiency in converting mechanical energy from footsteps.

Technological Advancements - Beyond material science, advancements are being made in several key areas: Energy Harvesting Circuits: Extracting usable power from piezoelectric materials requires efficient electronic circuits. Studies by [4, 5] investigate the

design and optimization of circuits for FPG systems. These circuits typically rectify the AC output from the piezoelectric material and manage power efficiently for storage or direct use.

System Design Optimization: The layout and configuration of piezoelectric transducers within the FPG system significantly impact power generation. Research by [6, 7] explores optimizing transducer placement and maximizing the area covered to capture the most energy from footsteps..

III . METHODOLOGY

FPG harnesses the kinetic energy of human footsteps and converts it into electrical power through a three-step process:

1. Piezoelectric Sensor - At the heart of FPG systems lie piezoelectric transducers. These are specially designed components made from materials that exhibit the piezoelectric effect. When pressure is applied to these materials, they generate a small voltage Placement and Design - Piezoelectric Sensor are strategically positioned within the FPG system. This typically involves embedding them beneath floor panels in high-traffic areas like walkways, dance floors, or public transport platforms. The design of the system considers factors like the number and arrangement of transducers, the flooring material used, and the expected pressure exerted by footsteps.

2. Rectification: The AC (alternating current) generated by the footsteps is converted into DC (direct current) for storage and use.

3. Energy Storage and Utilization:

Depending on the application, the harvested electrical energy might need to be stored for later use. Rechargeable batteries are often employed in FPG systems to accumulate the generated power.

4. Durability and Maintenance: FPG systems installed in high-traffic areas need to be robust and withstand constant pressure and wear. Regular maintenance plans are essential to ensure optimal performance and longevity.

By effectively implementing these methodologies, FPG technology can pave the way for a more sustainable future, harnessing energy from our daily activities and powering the world around us.

IV. WORKING

Footstep power generation (FPG) is a fascinating technology that captures the kinetic energy from our steps and transforms it into electrical power. Let's delve into the mechanics behind this innovation and explore how it works its magic.

1. The Piezoelectric Powerhouse - At the heart of FPG lies the remarkable property known as the piezoelectric effect. Certain materials, like piezoelectric crystals and ceramics, possess the ability to convert mechanical stress (pressure or force) into electrical voltage. Imagine squeezing a tiny crystal, and voila! You get a small jolt of electricity.

2.Transforming Footsteps into Electricity:

FPG systems utilize these piezoelectric materials as transducers, strategically positioned beneath floor panels or embedded within walkways. These transducers act like tiny energy conversion factories. As you walk on these surfaces, the pressure exerted by your footsteps compresses the piezoelectric material. This compression, in turn, triggers the piezoelectric effect, generating a small voltage.

3. Capturing the Flow

The generated voltage, however, is quite low. To make it usable, FPG systems employ sophisticated electronic circuits. These circuits perform two crucial tasks:

I. Rectification- The voltage produced by footsteps is alternating current (AC). However, most applications require direct current (DC). These circuits rectify the AC output, converting it into usable DC power.

bioenergy Harvesting- The voltage generated from a single footstep might be minimal. The circuits are designed to capture and accumulate this small amount of energy from each step, gradually building up a usable amount of power.

Optimizing the System- The design and configuration of the FPG system play a vital role in maximizing power generation.

FPG technology leverages the power of everyday movement, utilizing the piezoelectric effect to convert foot pressure into electricity. While challenges like power output and system cost remain, FPG holds immense potential for powering low-power devices, contributing to a more sustainable future.

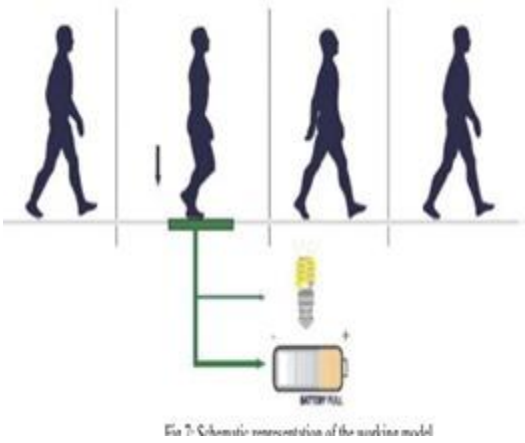

Fig1. Schematic Representation of working model

BLOCK DIAGRAM -

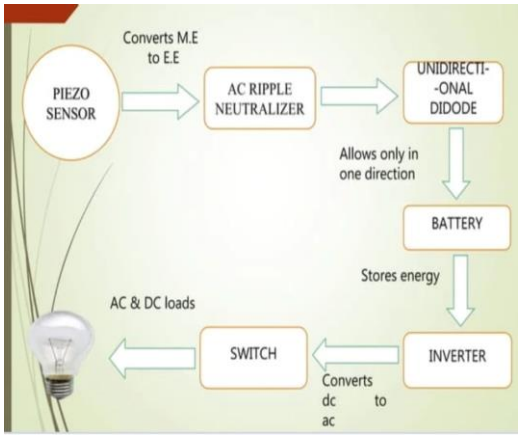

Fig.2: Block diagram of foot step power

V. COMPONENTS USED

The footstep arrangement is used to generate the electric power. Now a day's power demand is increased, so the footstep arrangement is used to generate the electrical power in order to compensate the electric power demand. In this arrangement the mechanical energy is converted into electrical energy. This section is constructed by of rubber or other material which is placed within the surface areas. This section is mainly placed in the crowed areas. This footstep arrangement is attached with spring section. Footstep section consists of

1. Springs
2. Foot – step
3. Gearwheel arrangement
4. Rack and Pinion section
5. DC Generator
6. LEDs
7. Shaft
8. Battery

The rack & pinion, spring arrangement is fixed at the inclined step. The spring issued to return the inclined step in same position by releasing the load. The pinion shaft is connected to the supporter by end bearing. The gearwheel arrangement is connected to the shaft which in turn is connected to the DC generator. The DC generator is connected to the battery and the LEDs

VI .CONCLUSION

A piezo tile capable of generating 40V has been devised. Comparison between various piezo electric material shows that PZT is superior in characteristics. Also, by comparison it was found that series- parallel combination connection is more suitable. The weight applied on the tile and corresponding voltage generated is studied and they are found to have linear relation. It is especially suited for implementation in crowded areas. This can be used in street lighting without use of long power lines. It can also be used as charging ports, lighting of pavement side buildings.

VII. REFERENCES

[1] Vibration Based Energy Harvesting Using Piezoelectric Material,M.N. Fakhzan, Asan G.A.Muthalif, Department of Mechatronics Engineering, International Islamic University Malaysia, IIUM,Kuala Lumpur, Malaysia.

[2] Piezoelectric Crystals: Future Source Of Electricity, International Journal of Scientific Engineering and Technology, Volume 2 Issue 4, April 2013Third Year ISSN: 2277-3754 ISO 9001:2008 Certified International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue 10, April 2014 267 Electronics Engineering, Atharva College of Engineering, Mumbai, India.

[3] Electricity from Footsteps, S.S.Taliyan, B.B. Biswas, R.K. Patil and G. P. Srivastava, Reactor Control Division, Electronics & Instrumentation Group And T.K. Basu IPR, Gandhinagar.

[4] Estimation of Electric Charge Output for Piezoelectric Energy Harvesting,LA-UR-04-2449, Strain Journal, 40(2), 49-58, 2004;Henry A. Sodano, Daniel J. Inman, Gyuhae Park.