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Step Energy Harvesting

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Abstract: *As a sustainable and renewable energy source, step power generation has attracted a lot of attention. Utilising Stepper Dynamo Motors, which capture the energy generated by human locomotion and transform it into useful power, is one novel method in this subject. The principles, uses, and prospects for footstep power generation are highlighted in this abstract's description of the stepper dynamo motor technology. Specialised generators known as stepper dynamo motors interface with the surfaces of footsteps and use electromagnetic induction to transform the kinetic energy of footsteps into electrical energy. Stepper Dynamo Motors may effectively convert the mechanical force exerted by foot pressure into electrical power in sidewalks, stairways, and other high-traffic locations. The electricity produced can be used to support conventional energy sources, run low-energy appliances, or even add to the grid.*

Keywords: Energy Harvestting, Stepper Dynamo Motor, Renewable Energy, Kinetic Energy

I. INTRODUCTION

Researchers and engineers have been investigating cutting-edge technology to capture and utilise energy from routine human activities in the search for sustainable and renewable energy sources. Footstep power production, sometimes referred to as step energy harvesting, has become a potential method for capturing the mechanical energy generated by human mobility and transforming it into useful electrical power. Step energy harvesting provides a sustainable and eco-friendly alternative to conventional energy sources by collecting the energy produced while moving or running.

Systems called "step energy harvesting" are made to collect the kinetic energy produced by walking and transform it into electrical power. To transform the mechanical force exerted by foot pressure into useful electricity, these devices often use piezoelectric materials or electromagnetic induction principles. Energy harvesters may effectively capture and use the combined energy from several footsteps by being placed in high-traffic places like walkways, stairwells, or public spaces.

Step energy harvesting has a wide range of possible uses. When energy harvesters are integrated into public areas like malls, airports, or train stations, the constant foot traffic can provide a sizable quantity of electricity. Reduce the dependency on traditional power sources and cut carbon emissions by using this gathered energy to power low-energy gadgets like lighting systems, signage, or charging stations.

II. LITERATURE SURVEY

Title: "Energy Harvesting from Human and Machine Motion for Wireless Electronic Devices"

Authors: Stephen Beeby, Neil M. White Published: 2009

This in-depth overview covers a wide range of methods and tools for obtaining energy from mechanical and human motion, including step energy harvesting. It provides information on the ideas, components, and tools utilised in energy harvesting systems as well as insights into the difficulties and potential uses of step energy harvesting.

Title: "Footstep Energy Harvesting for Wearable Sensors"

Authors: Andrea Vocca, Alessandro Monti, Maurizio Valle, Antonio Rizzi Published: 2015

This study focuses on the application of footstep energy harvesting for wearable sensors. It discusses the design considerations, materials, and techniques used in footstep energy harvesters. The authors evaluate the performance and efficiency of different harvesting systems and provide recommendations for practical

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III. METHODOLOGY

Literature Review → Material Selection → CAD Model → Purchase Components → Assembly / Fabrication → Testing

IV. MODELLING AND ANALYSIS

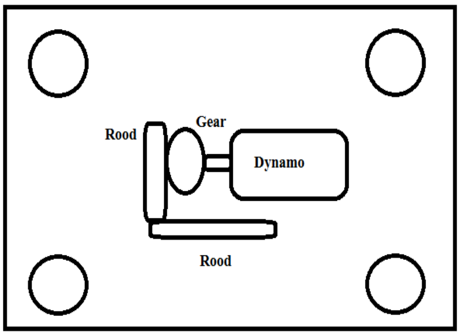

Fig 1: Block Diageam

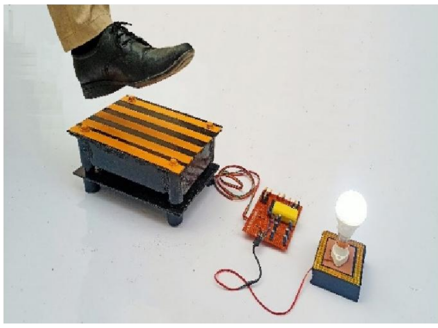

Fig 2: Actual Model

V. MATERIAL USED

Sr.No	Part	Specifications
1	Stepper Dynamo Motor	DC 5V
2	BATTERY	300mAh
3	Spring	Length 6mm x 4
4	FlatPlate	150mm*300 mm
5	Resistor	5 Watt
6	LED Bulb	3V DC

VI. WORKING

- Stepping on the surface where the stepper motor is placed causes a mechanical force to be applied that causes the motor to turn on. This mechanical input will cause the motor to react.
- Electromagnetic Induction: The footstep activates the stepper motor, starting the electromagnetic induction process. An electromagnetic field is created by the interaction of coils and magnets inside the motor.
- Conversion of Mechanical Energy: The stepper motor's coils move in the magnetic field as a result of the mechanical force generated by the step. The footstep's mechanical energy is transformed into electrical energy by this action, which creates a current within the coils.
- Electricity Generation: After the stepper motor produces electricity, it is collected and stored for later use. Low-energy devices can be immediately powered by it, or it can be directly stored in batteries or capacitors for later use.
- Continuous Footstep Power Generation is possible thanks to the embedded stepper motor's ability to repeat the operation when more footfall are made on the surface, which results in continuous footstep power generation

VII. RESULTS AND DISCUSSION

How well a stepper motor converts mechanical energy into electrical energy depends on its efficiency. Usually, the efficiency is shown as a percentage. The motor can transform 80% of the mechanical energy from footsteps into electrical energy, for instance, if its efficiency is 80%.

Let's make the following assumptions so that we may produce a simple estimation:

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Weight of the person (m): 70 kg
Height from which the person steps (h): 0.1 meters (approximately)
Efficiency of the Stepper Motor (η): 80% (0.8)
We can calculate the potential mechanical energy harvested per footstep using the gravitational potential energy formula:

Potential Energy (PE) = mgh

Where:
m = mass of the person (70 kg)
g = acceleration due to gravity (9.8 m/s^2)
h = height from which the person steps (0.1 meters)
PE = 70 kg * 9.8 m/s^2 * 0.1 meters
PE $\approx$ 68.6 Joules (J)
To calculate the electrical energy generated by the Stepper Motor, we multiply the mechanical energy by the efficiency:

Electrical Energy (EE) = PE * η

EE $\approx$ 68.6 J * 0.8
EE $\approx$ 54.88 Joules (J)

VIII. CONCLUSION

Utilising a stepper motor to gather step energy has the potential to provide sustainable and renewable energy from human movement. It can encourage environmentally friendly behavior's and help us rely less on conventional power sources. To increase the efficiency and efficacy of step energy harvesting systems and investigate their useful uses in diverse contexts, more research and development in this area is required.
The exact outcome and power output of step energy harvesting using a stepper motor depend on a number of variables, including the motor's performance, the weight and force of the person stepping, and the design of the entire system. These elements might change depending on the circumstances and surroundings.

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