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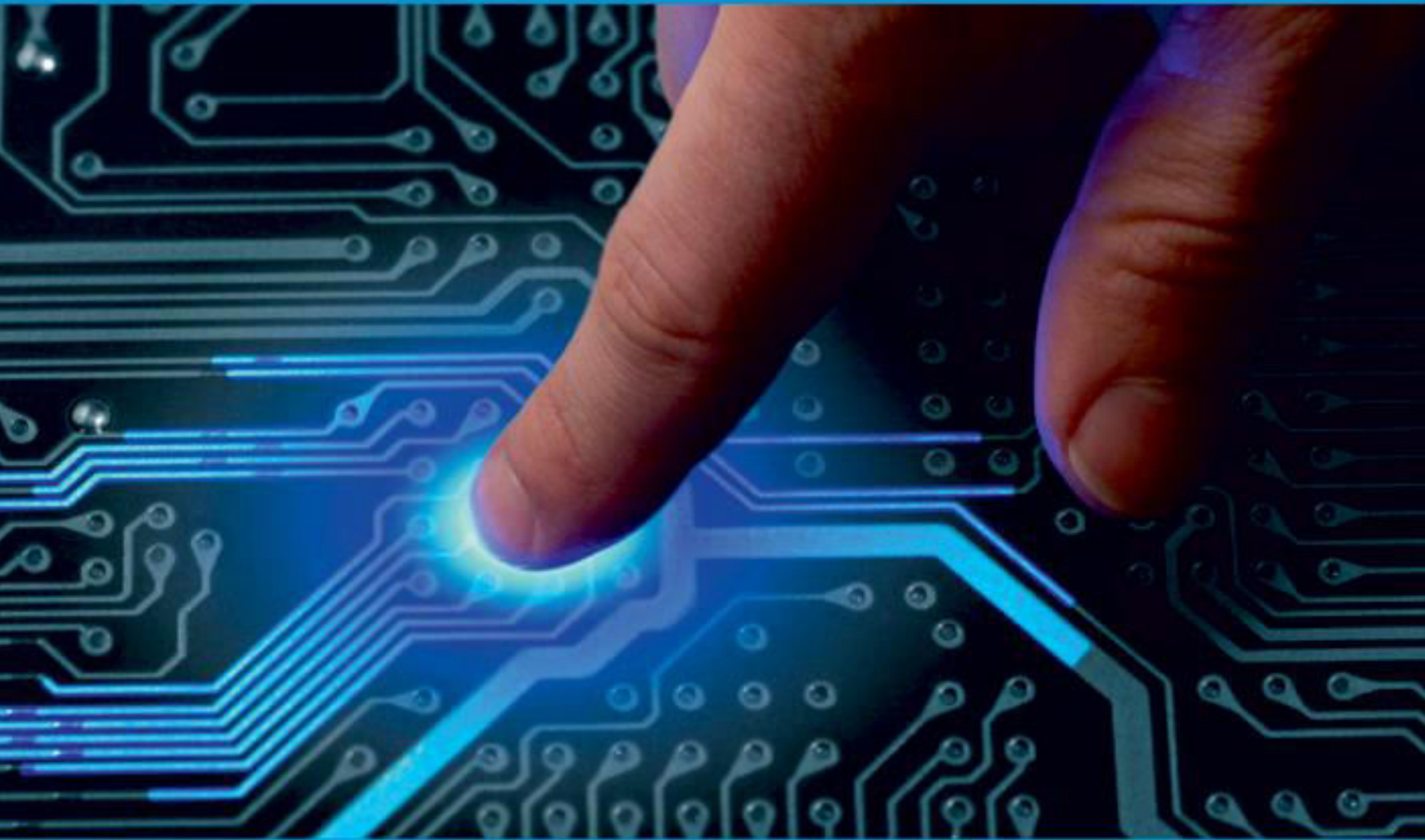

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Design and Development of Low Cost Modernised Mechanical Footstep Power Generation

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ABSTRACT: An inventive and environmentally friendly energy harvesting system called a mechanical footstep power generator (pressure sensitive device) was created to capture the kinetic energy produced by human footfalls and transform it into useful electrical power. By using a straightforward driving mechanism like a rack and pinion assembly, this technology takes advantage of the regular and continuous foot traffic in a variety of contexts, such as public spaces, sidewalks, stadiums, and commercial places. The rack and pinion are carried by the control/spring mechanism, and a D.C. generator is attached to the pinion, which is coupled to an LED to display output. As a result, mechanical energy is converted into electric energy that may either be stored or used right away to power various applications. A promising method for obtaining clean, renewable energy from human activity is the mechanical footstep power generator. Its capacity to access a plentiful and reliable energy source has the potential to significantly improve energy sustainability and lessen dependency on conventional fossil fuel-based power generation techniques.

KEYWORDS: Mechanical Footstep, Rack, Pinion, Clean Energy, pressure sensitive device, power generator

I. INTRODUCTION

In order to turn human footfalls into a useful source of clean, renewable electricity, the mechanical footstep power generator (pressure sensitive device) project aims to unlock their potential. This effort stands out as a crucial step towards addressing both the need for alternative power sources and the requirement to reduce environmental effect in an era characterised by a growing worldwide demand for sustainable energy solutions. The constant rhythm of foot traffic in busy sections of cities offers a rich but underutilised source of kinetic energy. This dynamic energy source is captured by the mechanical footstep power generator, which seeks to transform it into useful electrical power. Thus, it supports the larger goal of advancing green technologies and ushering in a new era of environmentally responsible urban development. Innovative endeavours like the mechanical footstep power generator serve as rays of light as the world struggles with the problems brought on by the depletion of fossil fuel reserves and growing concerns about climate change. This project not only exemplifies the inventive spirit, but it also has the ability to completely alter how we see and use energy in contemporary cities. This concept represents a potent fusion of human activity and sustainable technology, opening the way for a more durable and ecologically sound future by collecting the latent energy inside our footprints.

Paper is organized as follows. Section II describes the Historical context and past studies on this topic. Section III. Section IV presents materials used, sketches, experimental results. Finally, Section V presents Potential Application, Future Implications and conclusion.

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II. RELATED WORK

Early Ideas: - The idea of producing power from footsteps first surfaced in the 1980s, with the initial emphasis on using piezoelectric materials to transform mechanical stress—such as footsteps—into electrical energy. In order to harness the energy from human movement, this design proposed to embed these materials within floors and pavements.
Initial Experiments: - In the 1990s, scientists ran test experiments to determine whether or not footstep electricity generating was feasible. Small-scale tests looked at the performance of piezoelectric materials and their potential for use in real-world applications.
Real-World Implementations: Pilot initiatives to install footstep power generating in public settings were started in the early 2010s. Examples include the use of piezoelectric floor tiles at Japanese and British train stations to generate electricity from the footsteps of passengers, which is then used to power nearby lighting and displays. **Technologies for Multiple Energy Harvesting:** Researchers investigated other energy harvesting systems while piezoelectric materials remained the focus. Promising techniques for harnessing the energy of footsteps have been studied, including electromagnetic mechanisms and pressure-sensitive devices.

Literature Survey : Chun Kit Ang et al. [1], a mechanical footstep power generator placed on the back foot region has been proposed as a simple, low-cost mechanism to improve the effectiveness and efficiency of energy conversion from kinetic energy to electricity energy. The experiments involved 45 people in all, and the experimental findings were then contrasted with those predicted by theory.**Mohammed Asad and others [2]** The simple drive mechanisms discussed in this project, like the rack and pinion assembly and chain drive mechanism, are used to generate power by using the force that is acquired when walking up and down stairs and converting it into electrical energy with the use of mechanical systems. The generated electricity is used to turn on the associated loads after being stored in a battery. This is one of the simple to build electricity-generating systems that is also small and effective.**P.A. Bhosale and colleagues [3]:** Authors of this study employed a regulated 500mA, 5V power source. The secondary output of the 230/12V step down transformer's ac output is rectified using a bridge type full wave rectifier.**R. Sarnaik et al [4]** This paper focuses on creating electricity when people walk on floor 7. If we can design a power-generating floor that can generate 100W in just 12 steps, we can generate 1000W in 120 steps, and if we install this system in 100 floors, it can generate 1MegaWatt. **Sarat Kumar Sahoo et al [5].** In this project, the rack and pinion drive system, alternator, and chain drive mechanism are all used to generate electricity. Currently, there is a huge need for unconventional energy systems. Steps can produce energy without utilising any fuel, producing electricity. In this project, the rack and pinion system, alternator, and chain drive mechanism are all used to generate electricity.

III. METHODOLOGY

Working Principle:

The complete fabricated model picture of Foot Step is shown below. The upper plate is mounted on six springs, the weight impact is converted into electrical power. The spring and rack & pinion arrangement is fixed below the foot step which is mounted on base. Spring system is used for return mechanism of upper plate after release of load. The shaft along with pinion is supported by end bearings. the generator is used here is 3-9Volt permanent magnet DC generator. The terminal of DC generator is connected to lightning LEDs.

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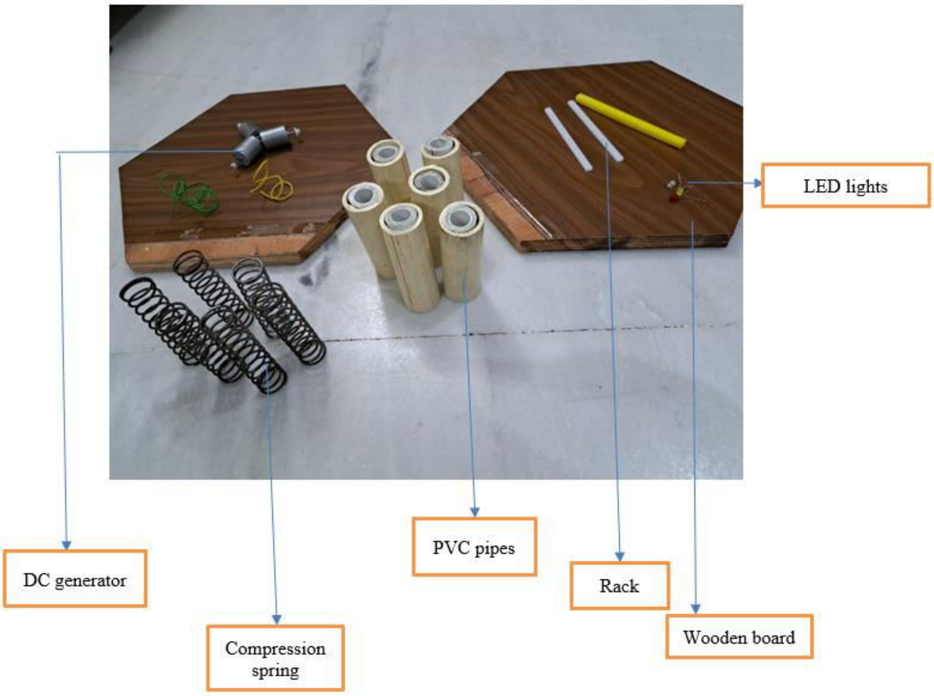
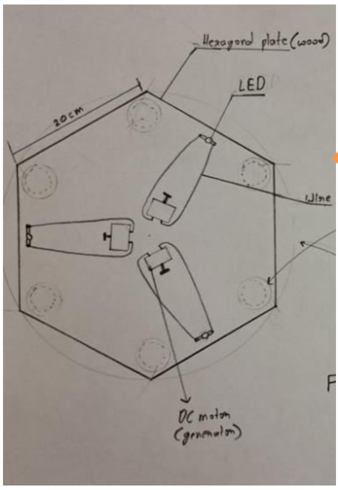
Materials & Dimensions

1. Springs. (9cm)
2. Pipes to support spring movement(10cm)
3. Rack and pinion. (rack:10cm, pinion:0.5cm)
4. DC generators (3 pieces).
5. Wooden frame. (Hexagon of side 19cm)
6. LED lights.



Sketches :



Top View of Base Plate showing the DC Generators, and the LEDs connected

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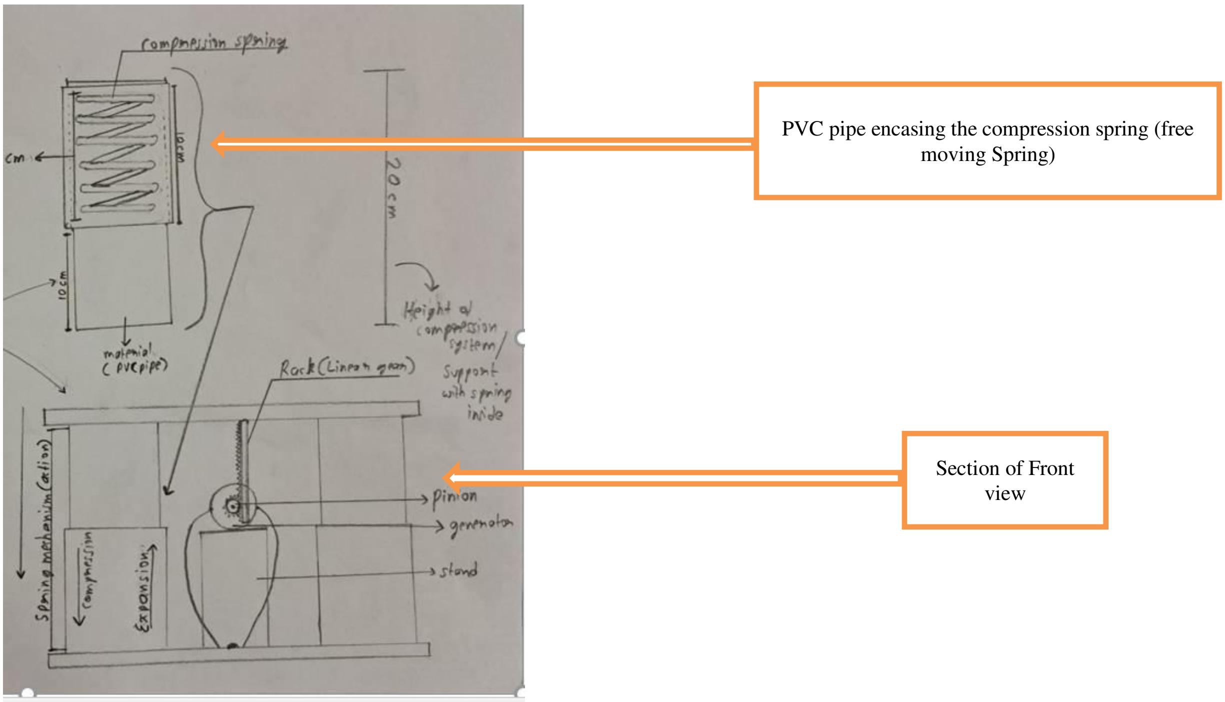
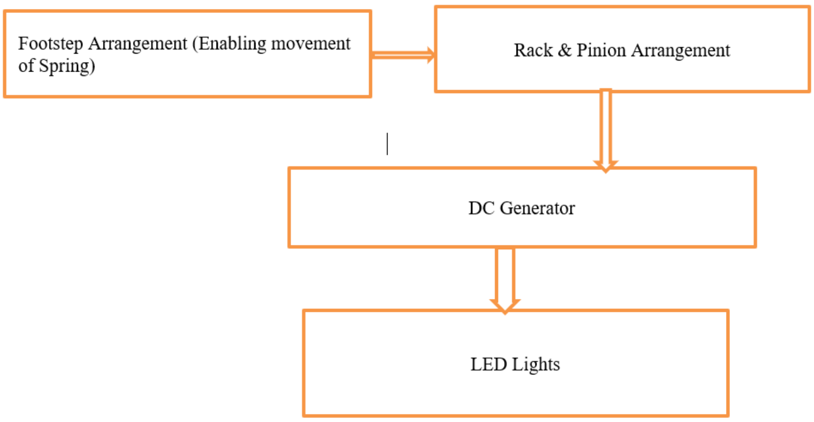


Flow Chart :



IV. EXPERIMENTAL RESULTS

1. When our foot applies pressure to the device
2. The compression spring is compressed, the upper plate descends vertically.
3. As a result of this downward motion, the pinion on the rack turns clockwise.
4. The generator's shaft rotates as a result of the pinion's clockwise rotation.

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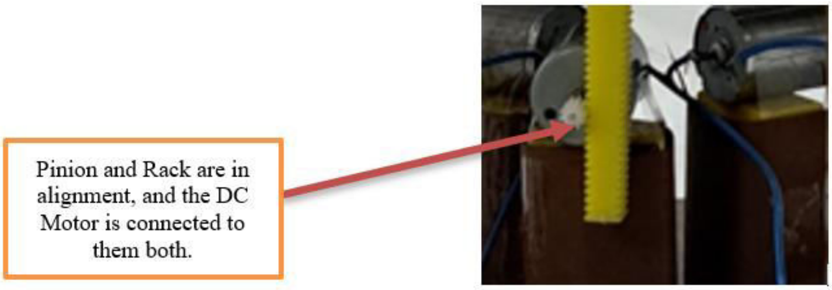

5. The rotation alters the wiring's flux with regard to time.
6. The windings generate an Emf as a result of this shift in flux.
7. As a result, electricity is produced and electrons are in motion.
8. This current may run through an external load connected to lightning LEDs, such as an LED lamp or a storage device (for power storage).

The several forces at work in this experiment include

1. Static—without motion (though with force).
2. Dynamic - forces in motion.
3. Compression: forces that squish.
4. Pulling force under tension.
5. Compression and tension when bending.
6. Torsion is the act of rotating or twisting.
7. Equilibrium: the equilibrium of all forces

Amount of power generated in a single press(per generator):

Due to the rotation of the shaft of the generator we get the following output	
Current generated	0.02A
Voltage generated	2V
Therefore, the power generated is	P = V x I = 0.02 x 2 = 0.04W of power is generated

V. APPLICATION POSSIBILITIES:

1. A number of uses for the electrical energy produced by the mechanical footstep power generator include: - Increasing public safety, powering energy-efficient lamps, and lowering dependency on traditional power sources.
2. Providing pedestrians with practical conveniences by charging electronics and small appliances in public areas.
3. Providing additional electricity to surrounding structures and infrastructure, relieving pressure on the current power grid.
4. Getting dance floors going

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VI. CONCLUSION

- In this work, a foot step is used to meet the energy needs of the power producing system.
- There is less pollution from this form of energy and no requirement for power from the mains.
- It is especially helpful in areas where non-conventional energy, such as electricity, is produced, such as all highways and staircases of every kind.
- The power generated is 0.04W,current generated is 2A,voltage produced is 0.02V(per generator).

VII. FUTURE IMPLICATIONS

- The project's results have the potential to influence the future of smart cities and energy harvesting technology, with the following implications:
- Promoting the development of effective and adaptable energy harvesting devices by spurring more advancements in energy capture and conversion techniques.
- Making it possible for footstep power generators to be widely incorporated into infrastructure and urban design, which will help cities become smarter and greener.
- Promoting a paradigm shift towards sustainable energy options by highlighting the potential of human-centric energy generation to create a future that is friendlier to the environment.

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