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Design And Development Of Energy-Generating Shoes Using Electromagnetic Induction

Chayan Saha

Bongaigaon, Assam, India

Abstract—

In the pursuit of renewable and wearable energy solutions, this paper proposes a novel design of energy-generating shoes that utilize the principle of electromagnetic induction to convert mechanical foot motion into electrical energy. The system incorporates a copper coil wound around a slanted tube (angled at 120°), within which a magnet moves freely. As the user walks, the motion of the magnet induces a voltage in the coil, which is rectified and used to charge a rechargeable battery placed beneath the tube. This movement induces a voltage, which is used to charge a battery installed beneath the tube. The design offers a sustainable, user-friendly source of low-power energy suitable for portable electronics.

Keywords—Energy harvesting, wearable technology, electromagnetic induction, renewable energy, generator shoes.

1. Introduction

With the increasing demand for portable energy sources, wearable energy harvesting has gained attention as a feasible method to power small electronic devices. This paper presents a simple yet effective mechanism integrated into a normal shoe that converts kinetic energy from foot movement into electrical energy using electromagnetic induction.

2. Principle of Operation

The design operates on Faraday's Law of Electromagnetic Induction, which states that a change in magnetic flux through a coil induces an electromotive force (EMF).

3. Design and Materials

- Shoe Base: A standard sports shoe is modified to house the components.

- Tube: A cylindrical non-metallic tube is fixed inside the sole at a 120-degree angle to the horizontal.

- Magnet: A permanent magnet is placed inside the tube.

- Coil: A copper wire forms a solenoid.

- Battery: A small rechargeable Li-ion battery stores the generated energy.

- Rectifier : A diode bridge the converts AC to DC current.

4. Working Mechanism

When a person walks, the vertical and horizontal forces cause the magnet to move inside the angled tube. This motion continuously alters the magnetic flux through the surrounding coil, inducing an alternating voltage. The current passes through rectifier and charges the battery. The system can be used to power small devices such as LEDs, fitness trackers, or recharge mobile phones during prolonged walking.

5. Advantages

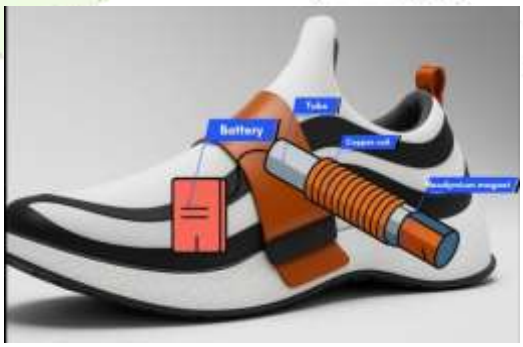
- Environmentally friendly and renewable
- No external energy required
- Lightweight and wearable
- Suitable for outdoor applications
- Integrates with existing footwear

6. Limitations and Challenges

- Limited power output
- Durability concerns
- Possible discomfort if not ergonomic
- Efficiency depends on walking patterns

7. Future Improvements

- Integration with piezoelectric elements for hybrid generation
- Use of multiple magnets and multi-coil arrays for higher output
- Wireless charging capability
- Improved ergonomic design



8. Conclusion

The proposed energy shoe design offers a simple, low-cost method to harvest biomechanical energy from walking. Through efficient use of electromagnetic induction, the system provides a practical solution for on-the-go charging of small devices, promoting sustainable and wearable energy innovations.

References

[1] M. Faraday, "Experimental Researches in Electricity," 1831.