WALK-POWERED WIRELESS CHARGING

TEAM MEMBERS:

24BEC1312 - HARSHINI GURUPRASATH
24BEC1317 - SRUTHI CS
24BEC1319 - KIRUTHIKA
24BEC1382 - VARSHA R P
24BEC1417 - NAGULAPALLI MOUNICA SRINIDHI
24BEC1419 - V G MANASA
24BEC1441 - JAYAVARDHINI V
24BEC1458 - SHRUTHI NARAYANAN
24BEC1487 - P. SWETHASRI
24BEC1503 - A HARSHITAA

SEMESTER: FALL 2024-2025
SLOT: A1+TA1
FACULTY NAME: VINITHA G
COURSE CODE: BPHY101L
COURSE NAME: ENGINEERING PHYSICS

ABSTRACT

This project explores the development of a walk-powered wireless charging system, utilizing piezoelectric sensors to harness kinetic energy from human footsteps. The harvested energy is converted into electricity and transmitted wirelessly to charge small devices, promoting an eco-friendly and sustainable solution to meet the demand for portable power. By integrating this technology into wearable devices like insoles or shoes, the system offers a green energy alternative, reducing dependency on traditional power sources and contributing to renewable energy innovation.

INTRODUCTION

As global energy demands rise and environmental sustainability becomes a pressing issue, innovative solutions for renewable energy are critical. Walk-powered wireless charging combines two emerging technologies: energy harvesting from human motion and wireless power transfer. By leveraging piezoelectric materials that convert mechanical energy into electricity, this project aims to provide a practical way to generate power from everyday activities like walking.

The system offers significant potential for wearable technology, allowing users to charge devices such as smartphones and fitness trackers on the go. It also aligns with the growing emphasis on reducing electronic waste and reliance on conventional charging methods. Beyond personal use, this technology could be scaled for public infrastructure, such as parks and sidewalks, harnessing energy from pedestrian traffic. By integrating sustainability with convenience, this project paves the way for greener, self-sufficient energy solutions.

METHODOLOGY

Objective:

The goal is to convert the mechanical energy generated by walking into electrical energy. This can be achieved by embedding piezoelectric materials in the shoe's insole. Flexible piezoelectric material such as films or ceramics are used.

Materials Required:

1.Flexible piezoelectric material such as films or ceramics
2. Bridge rectifier (to convert AC to DC)
3. Rechargeable battery (such as Li-ion or NiMH)
4. Voltage regulator (to provide stable output voltage)
5. Wires and connectors
6. Shoe insoles or any other wearable object wherein this technology can be integrated
7. Soldering iron and solder
8. Multimeter for test purposes
9. Adhesive or mounting materials to fix the piezo elements

Prototype:

It involves the development and the integration of these components into a wearable device which can be compact, and at the same time, ergonomic and durable as well.

Testing should be done to measure-

- Energy Harvesting Efficiency: the amount of energy generated per step
- Performance of wireless charging: Power transfer rates and compatibility with various phones,
- Testing for User Comfort and Practicality: carrying out the wearability and use in real life conditions.

Piezoelectric Material Selection-

Select materials that will be able to bear stress and strain repeatedly for several times, and are made of lightweight yet tenacious materials to allow comfort during walking. They should be flexible piezoelectric materials.

Designing the Insole-
Design customized insoles or customize any insoles given to be used with the piezoelectric elements; add constraints to it in such a way to ensure the maximum flexing and compression occurs upon walking.

Placement of Piezoelectric Materials-
Arrange several piezoelectric materials in the insole at predefined distances, preferably in a grid pattern to harvest the maximum energy. Secure them tightly so that they won't shift during walking.

Bridge Rectifier Connection-
Connect the bridge rectifier on the output of the piezo elements. This device shall convert the AC flow generated by the piezo materials into DC current that can be readily used for charging.

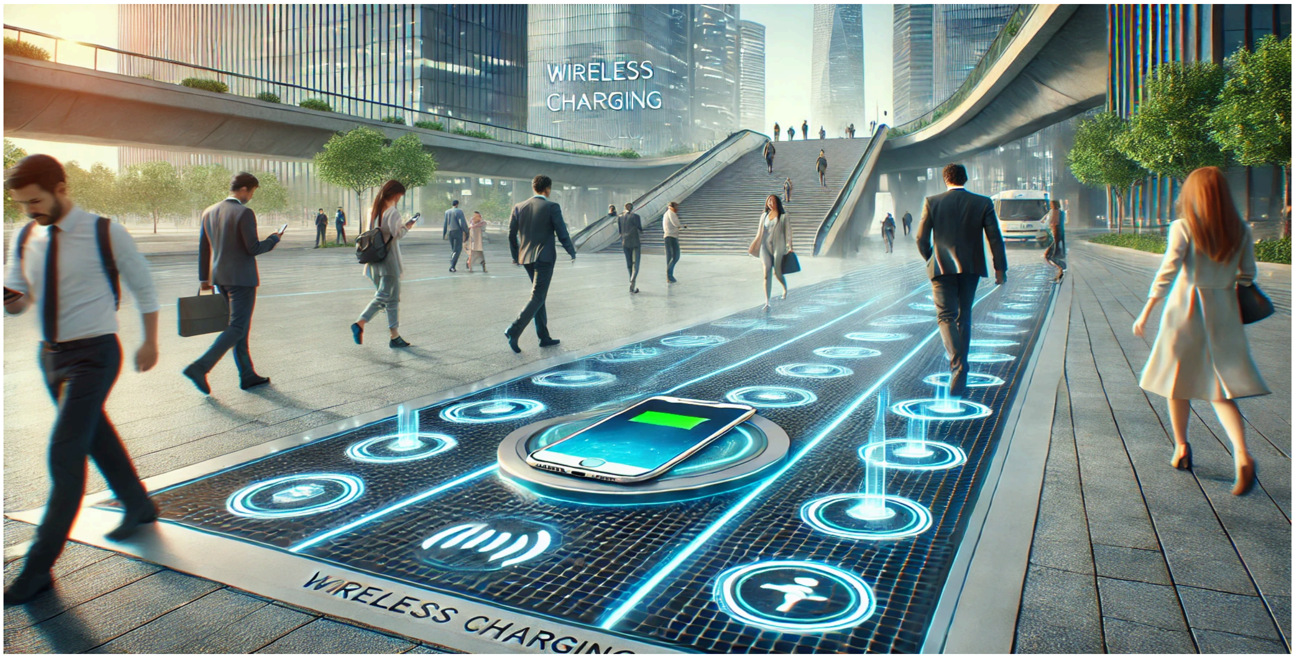
Integration of the Battery-
The output of the bridge rectifier will be connected to a rechargeable battery. The specifications of the battery should match that of the rectifier with respect to output voltage and current.

Adding a Voltage Regulator-
Adding a voltage regulator will keep the output voltage stable at roughly 5V, which is generally needed to charge almost all mobile devices.

Testing the Circuit-
Use a multimeter to measure the system's output voltage and current. Verify that these match your charging needs for your phone to charge correctly.

Final Assembly-
Secure all the component parts inside the shoe, thereby protecting the piezoelectric elements from wear and tear. You may do this using adhesive or a custom enclosure to hold everything in place.

Final Testing-
Test the shoe charger by walking and observing the charging cycle. Observe whether the energy harvested is enough to charge your phone.Hence, the ultimate system integrates a wearable device based on practical user-friendliness with high efficiency energy harvesting and wireless charging capability.


WIRELESS
CHARGING
WIRELESS CHARGING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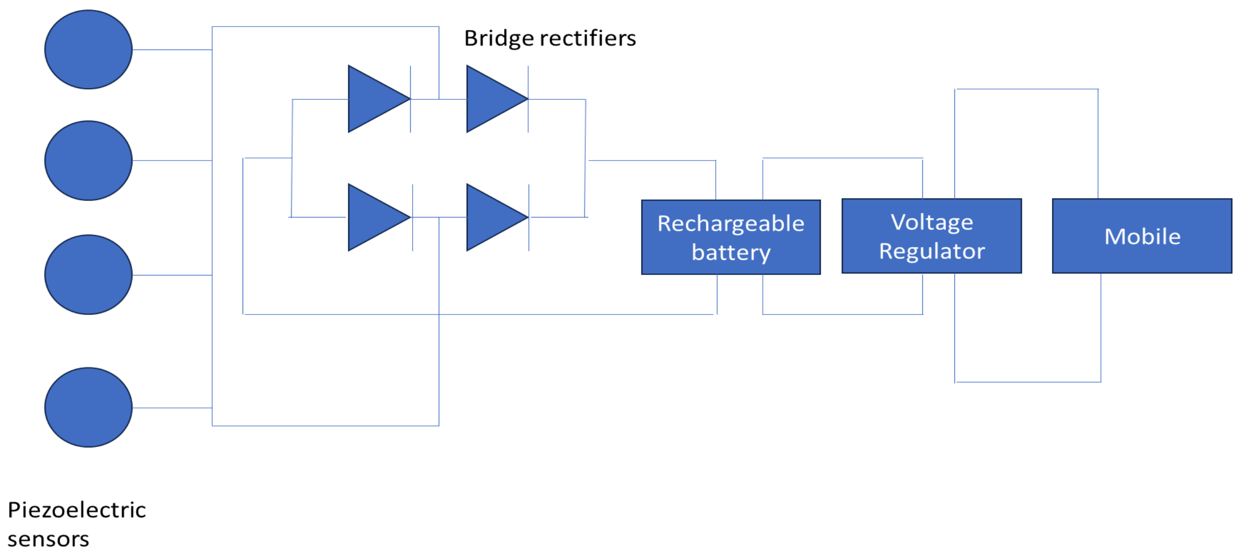
BLOCK DIAGRAM



EXPECTED OUTCOMES

1) Sustainable Energy Generation

The device converts kinetic energy from walking into electrical energy and thus reduces reliance on traditional power sources, promoting green energy solutions.

2) Increased Convenience

Allows us to charge devices on-the-go without the need for physical chargers or outlets. The device integrates everyday activities like walking.

3) Converting it into Wearable Technology

- Like smartwatches it can be worn.
- It minimizes battery replacements and electronic waste.
- It maintains longer device lifespans by maintaining battery health through consistent charging.
- Can be implemented in public spaces, such as parks or sidewalks, where energy can be harvested from pedestrians.

4) Innovative Charging Solutions

This device will lead to development of new wireless charging technologies, such as inductive or capacitive charging, specifically designed for movement.

ADVANTAGES

- **Sustainability and Renewable Energy**

Utilizes human activity (walking) as a renewable energy source, reducing dependency on non-renewable energy.Promotes the idea of green energy, contributing to environmental conservation.

- **Scalability**

Can be scaled for various applications, from small gadgets to larger systems powering streetlights or sensors.Easy to integrate into existing infrastructure like pavements or flooring.

- **Educational Value**

Provides hands-on experience in piezoelectric materials, power management systems, and circuit design.Enhances understanding of energy conversion principles and smart systems.

- **Potential for Research**

Opens up avenues for further research, such as optimizing piezoelectric materials or improving energy storage systems. Can lead to innovative upgrades like combining with other renewable sources (e.g., solar power).

DISADVANTAGES

- **Low Energy Output**

Piezoelectric devices typically generate very small amounts of electricity, often insufficient for high-power applications. Requires multiple piezoelectric elements and high foot traffic to generate usable energy.

- **High Initial Cost**

Piezoelectric materials and installation can be expensive, especially when scaled for large areas.The cost-to-energy ratio may not be economically viable for certain applications.

- **Durability and Maintenance**

Piezoelectric elements can degrade over time due to repeated mechanical stress.
Maintenance in high-traffic areas can be challenging and costly.

- **Bulky Design**

Such devices often require additional components, like kinetic energy harvesters or piezoelectric materials, which may add weight and bulk, reducing portability and comfort.

RESULTS

- **Sustainable Energy:**

Converts walking energy into electricity, reducing reliance on traditional power sources and environmental waste.

- **Convenience:**

Offers on-the-go charging with no visible cords or outlets.

- **Wearable Integration:**

Durable, eco-friendly wearables like insoles or fitness trackers minimize battery replacements and extend device lifespans.

- **Public Application:**

It harvests energy from foot traffic in public places, enabling communal charging solutions.

- **Innovative Charging:**

Integrates High Efficiency Wireless Charging Technologies Tailored for Movement-Based Energy.

- **Environmental Impact:**

It reduces electronic waste and promotes renewable energy and living eco-friendly lifestyles.

PROBABLE DIFFICULTIES

1. Energy harvesting efficiency - The kinetic energy produced by humans may not be enough for charging high energy devices and even storing the captured energy from each step in a way that is useful for wireless charging is difficult.

2. High cost for practical implementation - High-quality piezoelectric materials and wireless transmission modules are expensive, making this model is costly and it might scale up, especially for applications requiring a significant amount of energy.

3. Safety - wireless power transfer near the human body may raise significant safety concerns related to electromagnetic fields.

Despite these challenges, walk-powered charging remains a promising step toward sustainable and renewable energy solutions for small devices, especially in wearable technology and low-power applications. With further innovation, it has the potential to contribute to greener and more portable energy solutions.