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Water Purification Using Solar Energy

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A B S T R A C T :

Electricity is a basic need in today's world, but still, many people in rural or underdeveloped areas don't have regular access to it. Setting up traditional power systems in such areas can be very expensive and may harm the environment too.

This project looks at a new way of producing electricity using piezoelectric materials. These materials create electric energy when they are pressed or moved. So, whenever a person walks or a car moves over them, they can produce small amounts of electricity.

We used piezoelectric tiles connected to a circuit that stores the energy. The system includes a rectifier to convert the electricity, a battery for storing it, and a microcontroller to manage the whole setup. This energy can then be used for small needs like lighting LEDs or charging phones.

This idea can help in places where electricity is not easily available. It is eco-friendly, low cost, and easy to install. With more improvements, it could be a smart solution for powering small devices in villages, bus stops, or even in crowded city areas.

Keywords: Piezoelectric Effect, Energy Harvesting, Smart Roads, Vibration Energy, Human Kinetic Energy, Sustainable Energy, Power Management, Renewable Electricity, Urban Infrastructure

INTRODUCTION

Electricity plays a major role in our day-to-day lives. We use it for lighting, cooking, communication, and almost everything around us. However, even today, there are many villages and remote places where people don't have proper access to electricity. This creates a big challenge, especially for students, farmers, and families living in such areas.

As cities grow and the population increases, we need smarter and cleaner ways to produce energy. Traditional methods like coal and fuel are harmful to the environment and cost a lot. Renewable sources like solar and wind are good options, but they also depend on weather and location. So, we need an energy source that is available anytime and anywhere.

Piezoelectric materials can help in this situation. These materials can generate electricity when they are pressed or shaken. That means we can collect power from footsteps on roads or vibrations from vehicles. This is a smart way to use energy that usually gets wasted.

In this project, we are trying to make a simple system using piezoelectric tiles that can be placed on roads, footpaths, or public places. When someone walks or a vehicle moves over it, electricity is generated. This power can then be stored and used for small things like lighting LEDs or charging small devices. This system is eco-friendly, cost-effective, and can help in places where there is no regular electricity supply.

LITERATURE SURVEY

Many researchers and scientists have studied the idea of using piezoelectric materials to create electricity. In the beginning, most of the work was done in labs, but now people are trying to use it in real life.

In 2005, a study by Sodano and his team showed how vibration-based piezoelectric systems could produce electricity. Their work helped build the basic idea for future projects.

Later, in 2019, Maheshwari and Kumar tried putting piezoelectric tiles in university walkways. They found that each step on the tile could produce up to 6 volts, which was enough to light small LEDs or charge little devices.

In 2022, Fang and his team used soft, flexible piezoelectric sheets in places like metro station floors. These were more durable and worked better than older models.

Some new studies also talk about mixing piezoelectric with other methods like electromagnetic energy to make even more power. Researchers are working on improving the materials, making better circuits, and lowering the cost of the system.

Thanks to these efforts, piezoelectric energy harvesting is no longer just an idea—it's becoming something we can use in smart cities and villages without electricity.
Recent research has focused on enhancing material efficiency, optimizing circuit designs for better energy storage, and reducing overall system cost. As a result, the idea of piezoelectric energy harvesting has evolved from experimental setups to field-ready systems suitable for smart cities and rural electrification.

PROBLEM STATEMENT

Even today, many parts of the world still don't have proper access to electricity. Building big power stations or connecting these places to the main power grid is costly and takes a lot of time and resources. Also, using fuel-based power plants is not good for the environment.
Some renewable energy sources like solar and wind are helpful, but they also have limitations. They don't always work well if the weather is bad or if the location is not suitable.
That's why we need a new method that is simple, doesn't cost much, and works anywhere. Piezoelectric energy harvesting is one such method. It uses the pressure from footsteps or traffic to generate electricity. This kind of energy is everywhere but usually gets wasted.
The main challenge is to design a piezoelectric system that can create enough power and also last long, even with regular pressure and use. In this project, we are trying to make such a system—one that is strong, works well, and can be used in places like roads, footpaths, or crowded areas.

METHODOLOGY

To build our piezoelectric energy harvesting system, we used different parts that all work together to turn pressure into electricity.

Step 1: Choosing the Components

- **Piezoelectric Sensors (PZT):** These are the main parts that produce electricity when pressed or stepped on.
- **Bridge Rectifier & Capacitor:** The electricity from the sensors is AC (alternating current), so we use a rectifier to convert it into DC (direct current), and a capacitor to smooth the current.
- **Boost Converter:** This part increases the voltage to a level we can actually use.
- **Microcontroller (MCU):** This controls how power is stored and used, and checks if everything is working properly.
- **Rechargeable Battery:** Stores the electricity so it can be used later when no one is stepping on the tiles.

Step 2: System Setup

We placed the piezoelectric tiles under a platform or floor where people or vehicles move. Every time someone steps on it or a car moves over it, the pressure produces electricity.
That electricity goes through the rectifier, then through the boost converter to raise the voltage, and finally gets stored in the battery.

Step 3: Testing & Improvements

We tested the system by making people walk or jump on it, and checked how much electricity it made. We also checked how well it stored energy and how strong the system was after being stepped on many times.After testing, we made small changes to improve how much energy it produced and to make sure the system was durable and efficient.

Fig Water Purification using Solar Energy

Advantages

1. Eco-friendly
2. Cost-effective
3. Suitable for rural areas
4. Low maintenance
5. Safe drinking water
6. Reduces health risks
7. Sustainable solution
8. Portable and scalable
9. Promotes renewable energy use
10. Independence from fuel

Applications

1. Rural and remote villages
2. Disaster relief camps
3. Military camps and field operations
4. Schools and community centers in off-grid areas
5. Agricultural farms
6. Temporary construction sites
7. Tourist camps and eco-resorts
8. Urban slums with poor water access
9. Emergency water supply during power outages
10. Small-scale industries requiring clean water

Conclusion

The project "Water Purification Using Solar Energy" demonstrates a practical and sustainable approach to addressing the critical need for clean drinking water, especially in remote and rural areas where access to electricity and purified water is limited. By utilizing solar energy—a clean, renewable, and abundantly available resource—this system ensures a continuous water purification process without relying on non-renewable energy sources.

In this project, we worked on using piezoelectric materials to create electricity from simple movements like walking or vehicle pressure. This method gives us a smart and eco-friendly way to produce energy, especially in areas where normal electricity is not available.

By installing piezoelectric tiles in public places like roads or footpaths, we can collect energy that is usually wasted. This small amount of energy can be used for useful things like lighting LEDs or charging small devices.

The system we designed is low-cost, easy to install, and does not harm the environment. It's also helpful for both cities and villages. In the future, with better materials and design, this system can be used on a larger scale.

This idea also helps reduce our need for fossil fuels and supports the use of clean, renewable energy. Projects like this are important for building a more sustainable and smart future.

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