Hybrid AI Driven Energy Harvesting System

Title:"Artificial Intelligence powered Hybrid Energy Harvesting from Traffic Flow"

• Absract:-

- The rapid increase in vehicular traffic has led to significant energy dissipation in the form of mechanical vibrations, heat, and friction. Harnessing this wasted energy can contribute to sustainable power generation. This project proposes a **hybrid AI-driven traffic energy harvesting system** that integrates multiple technologies—piezoelectric, electromagnetic, triboelectric, thermoelectric, and solar energy harvesting. Artificial Intelligence (AI) is employed to optimize energy prediction, manage hybrid sources, and improve efficiency based on traffic density and environmental conditions. The system aims to provide a scalable, eco-friendly solution for powering roadside infrastructure such as streetlights, traffic signals,and IoT devices

Keywords:-

- Hybrid Energy Harvesting
- Artificial Intelligence
- Piezoelectric
- Electromagnetic
- Triboelectric
- Thermoelectric
- Solar Energy
- Smart Traffic System
- Sustainable Power

Introduction

- Urbanization and the rise in vehicle usage have created challenges in energy demand and environmental sustainability. Roads and highways experience constant mechanical stress, vibrations, and heat dissipation due to traffic flow. These wasted energies can be harvested using advanced technologies. Traditional single-source energy harvesting systems often suffer from low efficiency and limited scalability.
- A **hybrid approach**, combining multiple energy harvesting technologies, ensures higher energy output and reliability. By integrating AI algorithms, the system can predict traffic flow, optimize energy conversion, and intelligently distribute harvested energy. This makes the solution suitable for smart cities and sustainable infrastructure development.

Existing Process:

- Current traffic energy harvesting systems typically rely on **single-source technologies**:
- **Piezoelectric systems**: Convert mechanical stress from vehicle movement into electrical energy.
- **Electromagnetic systems**: Use coils and magnets to generate electricity from vibrations.
- **Triboelectric systems**: Harvest energy from friction between surfaces.
- **Thermoelectric systems**: Capture heat from vehicle engines and road surfaces.
- **Solar panels**: Installed near roads to harness sunlight.
- Limitations of existing systems:
- Low efficiency when traffic density is inconsistent.
- Energy output varies with environmental conditions.
- Lack of intelligent control and prediction.
- Systems often operate in isolation without hybrid integration.

Proposed Process:

1.Hybrid Energy Sources

- •Install piezoelectric sensors, electromagnetic coils, triboelectric layers, thermoelectric modules, and solar panels along traffic routes.

2.AI Optimization

- •Use AI algorithms to predict traffic flow and sunlight intensity.
- •Dynamically adjust harvesting parameters for maximum efficiency.

2.Energy Collection & Storage

- •Collect energy from all sources.
- •Store in batteries or supercapacitors.

3.Utilization

•Power streetlights, traffic signals, and IoT devices.

•Feed excess energy into the local grid.

Link: mini-project/code at main · bhoyarpreethi2005-cmd/mini-project