STEPVOLT: SUSTAINABLE FOOTSTEP ENERGY GENERATION AND UTILIZATION SYSTEM

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Renewable Energy, Arduino-Based System, Piezoelectric Sensor, Energy Harvesting, Footstep Power Generation.

Introduction:

1. With the increasing demand for energy and the depletion of conventional resources, there is a strong need to adopt renewable and sustainable energy solutions. Traditional power generation methods contribute to environmental pollution and are not sufficient to meet future energy needs. Therefore, alternative methods that utilize clean and eco-friendly sources are becoming increasingly important.
2. One such innovative approach is generating electricity from human footsteps using piezoelectric sensors. In crowded areas like railway stations, malls, and footpaths, a large amount of mechanical energy is wasted daily. Piezoelectric materials have the ability to convert this mechanical pressure into electrical energy, making it possible to harness this otherwise unused resource effectively.
3. This project focuses on capturing, storing, and utilizing energy generated from footsteps. It also integrates monitoring and automation using microcontrollers, allowing real-time voltage display and intelligent control of devices like fans and lights. Overall, the system demonstrates a practical, eco-friendly solution for energy harvesting and efficient energy usage.

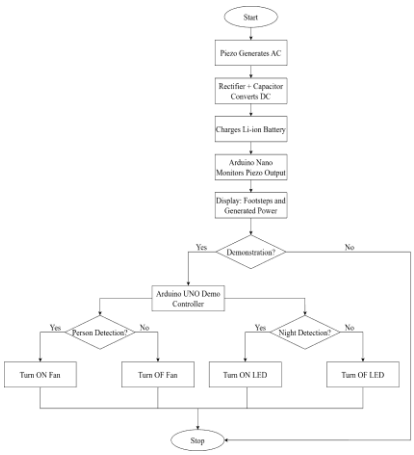

Figure 1: System Flow of the StepVolt

Objectives:

1. To generate electrical energy from human footsteps using piezoelectric sensors.
2. To store the generated energy in a rechargeable battery for later use.
3. To monitor and display voltage and Foot Steps using Arduino Nano.
4. To demonstrate the utilization of stored energy through a sample load (LED/Fan).
5. To promote sustainable energy harvesting in high-footfall areas.

Methodology:

The system generates electricity using piezoelectric sensors that produce alternating voltage when a person steps on the platform, serving as the primary energy source. This AC output is converted into stable DC power using a bridge rectifier and filtered by a capacitor to ensure safe battery charging. The harvested energy is then stored in a Li-ion battery for later use. An Arduino Nano monitors the piezoelectric activity in real time and displays the generated energy on an OLED screen for easy observation. Once sufficient energy is accumulated, an Arduino UNO controls the operation of connected loads. A PIR sensor enables automatic fan control by turning it ON when motion is detected and OFF when no movement is present, while an LDR sensor automates lighting by switching the LED bulb ON in darkness and OFF in bright conditions, thereby optimizing energy usage.

Result and Conclusion:

1. The project successfully demonstrates the conversion of mechanical energy from human footsteps into electrical energy using piezoelectric sensors. The generated energy is effectively stored in a rechargeable battery, ensuring it can be utilized when needed. The integration of an OLED display enables real-time monitoring of voltage levels, making the system user-friendly and informative.
2. The results show that while the amount of energy generated per step is relatively small, it is sufficient to power low-energy devices such as LEDs and small fans. This proves the feasibility of using human movement as a supplementary energy source, especially in high-footfall areas like railway stations, malls, and public walkways.
3. In conclusion, this project highlights an innovative and eco-friendly approach to energy harvesting. It encourages the utilization of wasted mechanical energy and contributes to sustainable energy solutions. Although not a replacement for conventional power sources, it serves as a valuable step toward renewable energy integration in smart infrastructure and public spaces.

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Future Scope:

1. **Efficiency Enhancement:**
   Improve energy generation by optimizing piezoelectric sensor arrangement and using advanced power conditioning circuits.
2. **Smart Monitoring & Data Analysis:**
   Integrate wireless communication (Bluetooth/Wi-Fi) and data logging systems for remote monitoring and performance analysis.
3. **Scalable Real-Time Applications:**
   Expand the system for large-scale use in public areas like railway stations and malls, with intelligent load management for powering bigger devices.