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Theme: Tech For Health And Humanity

Evaluation of AI- Integrated IOT- Enabled Triboelectric Nanogenerator for Sustainable Hygroelectric energy harvesting

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Abstract

This paper presents the design and development of a Hygroelectric Nanogenerator based on the principles of Triboelectric Nano generation (TENG) for harvesting energy from water interaction. The system employs Teflon (PTFE) and aluminum or copper as the triboelectric layers, chosen for their ability to effectively transfer charge through contact and separation. To enhance output, saw-shaped electrodes are patterned on the surface, with copper wires connected to a multimeter to record voltage generation. When water droplets or streams fall on the layered structure, a voltage is induced due to the triboelectric effect, confirming the generation of usable electrical energy. Also, we have integrated AI and IOT system to predict the total energy that can be generated and also calculate the total energy generated. This prototype serves as a demonstration of clean, moisture-based energy harvesting, utilizing low-cost materials and a simple setup. The project holds potential for development into scalable, off-grid power sources in humid or rainy environments.

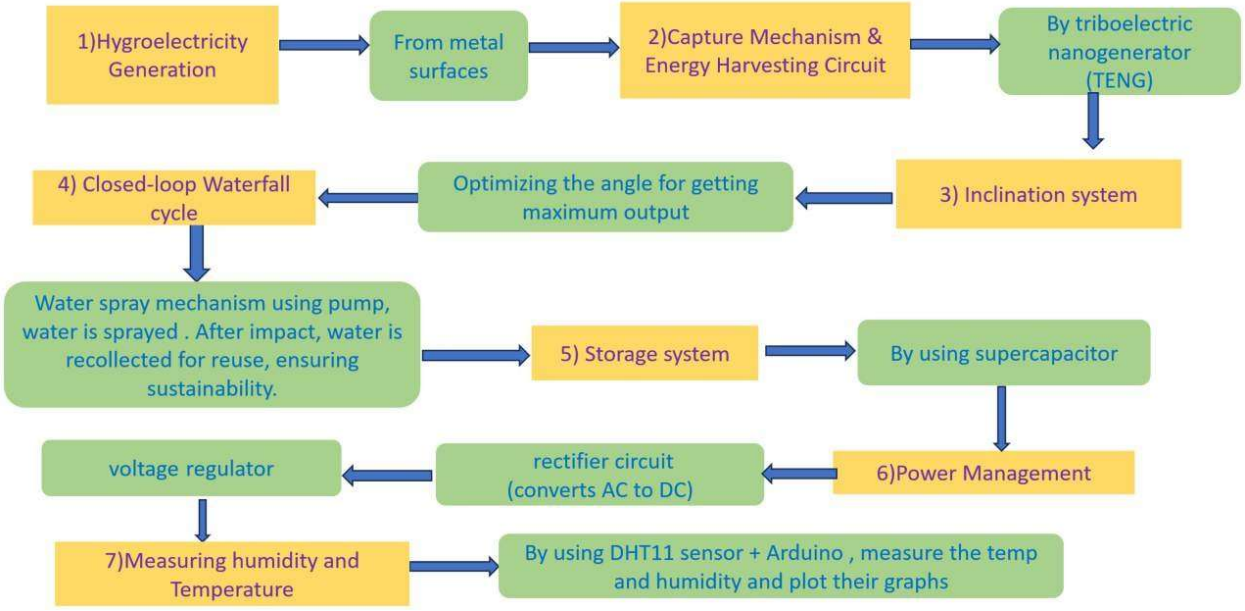
Objective

- To generate hygroelectricity using the combination of Contact electrification from water- metal friction, Conversion of mechanical energy to electrical energy via our prototype.

- To develop a model capable of withstanding water droplet impact and successfully convert raindrop energy into voltage.
- To visualize output voltage using a op-amp (gain = 10*2=100) and interface the result with an Arduino.

- To predict the optimal angle of inclination that would maximize triboelectric output by testing it at various angles.

Flow / Architecture Diagram



Results

- The Copper- PTFE Prototype generated voltage that ranged of 0.25V. Which was mostly based on frictional interaction of water droplets sliding on copper surface.
- The Aluminum- PTFE Prototype showed better output that ranged from 0.1V to 0.7V. This depended on factors like angle of inclination, head of water and droplet flow conditions.
- Combined System that is by connecting both copper and aluminum prototypes in series we got output voltages that reached more than several hundred millivolts.
- Hygroelectric TENGs are clean, scalable, and locally adaptable energy solution, with practical performance strongly influenced by device geometry, water delivery, and environmental conditions. They are sustainable also.
- AI module can also predict the energy generation plus calculate the total energy generated.