HARNESSING CLEAN ENERGY FROM FALLING RAINWATER DROPLETS

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DripVolts | 2025.05.14 | ME325Mechanical Engineering Group Projects

Aim of the Project

To design and develop a compact hybrid system that harvests electrical energy from falling raindrops using **piezoelectric** and **electromagnetic methods** which will generate enough electricity to power low-voltage devices and will be evaluated based on energy output under controlled rainfall simulation making it feasible within the project's timeline and resource constraints.
This project addresses the need for renewable micro-energy solutions in regions with frequent rainfall, especially where solar power is less effective.
With a 10-week period, aligning with the academic project schedule.

Project Objectives

- Design a panel-based system capable of capturing the kinetic energy of raindrops through flexible surfaces.
- Integrate piezoelectric discs and electromagnetic coils to generate electricity from mechanical impact and motion.
- Develop an energy storage system using rechargeable batteries to store the harvested energy.
- Power low-voltage devices such as LED bulbs continuously using the stored energy.
- Ensure system portability and cost-effectiveness for application in both rural households and educational demonstrations.
- Contribute to sustainability goals by offering an alternative clean energy source suited to tropical, rain-heavy environments like Sri Lanka.

Intended Learning Outcomes

- Understand the principles of piezoelectric and electromagnetic energy harvesting and assess their use in micro-scale renewable systems.
- Design and build a compact hybrid prototype that converts raindrop kinetic energy into electrical energy.
- Demonstrate technical skills in selecting and integrating components like piezoelectric discs, coils, magnets, and energy storage circuits.
- Simulate and analyze system performance with tools like MATLAB or Proteus under various rainfall conditions.
- Optimize energy conversion efficiency based on experimental results and real-world constraints.
- Communicate project outcomes clearly through a report and demonstration, addressing technical challenges and societal impact.
- Apply sustainable engineering practices to create an environmentally friendly, low-cost solution for off-grid energy.
- Collaborate in a multidisciplinary team, showing project management and problem-solving abilities throughout the design and development stages.

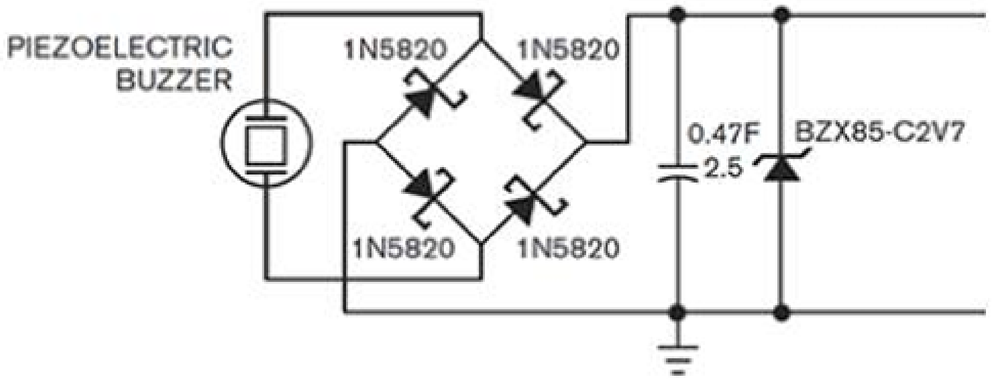
Project Introduction

DripVolts

Methodology

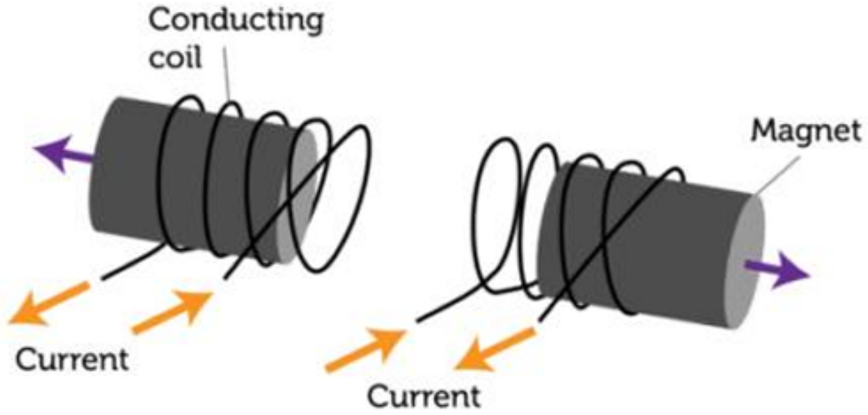
Piezoelectric disc

Rain hits piezo film → Mechanical stress → Voltage

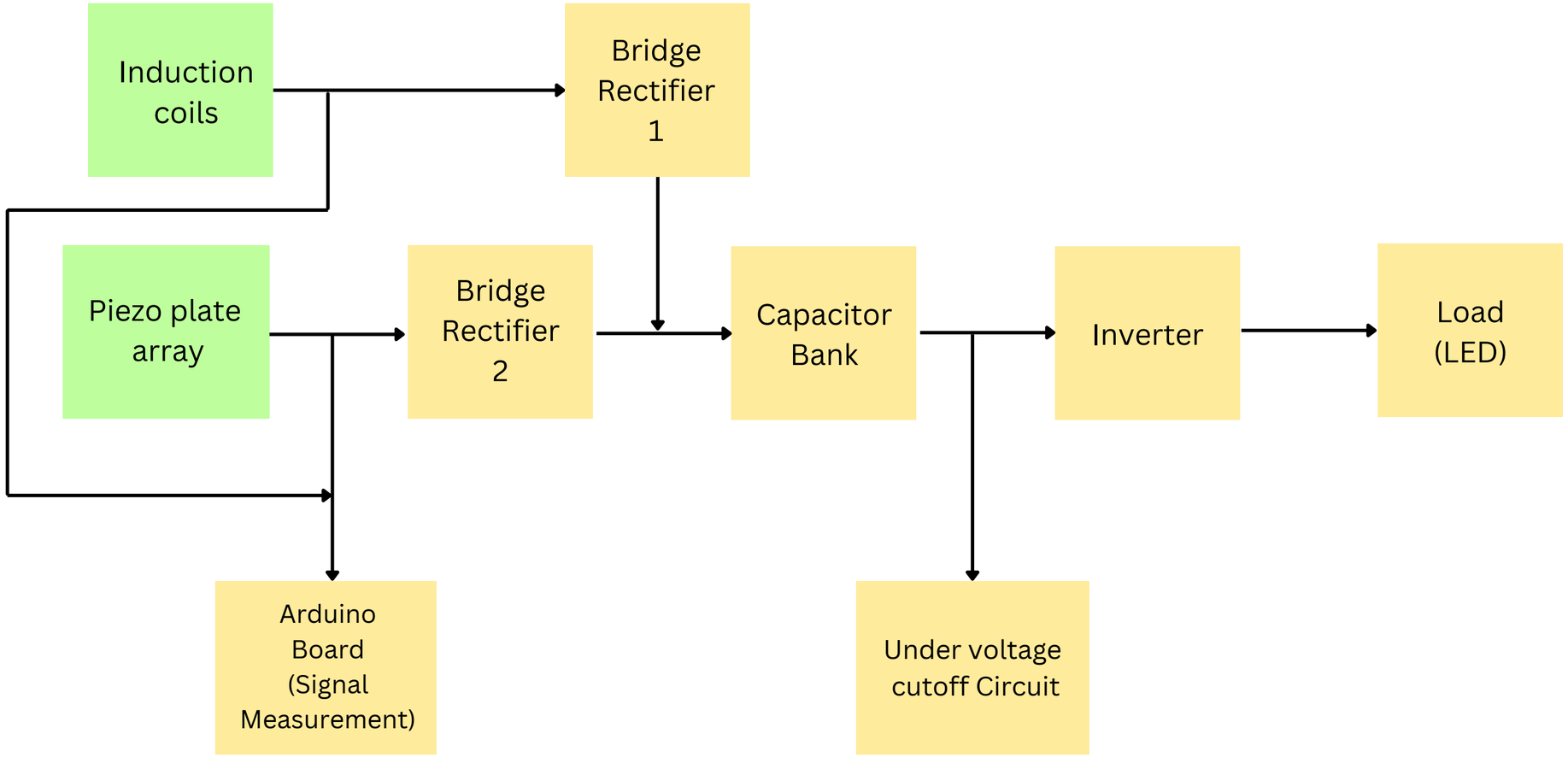


Magnetic induction mechanism

Rain hits film → Vibration → Electricity



Methodology continued...



Software and Simulation Tools

SOFTWARE	USAGE
SolidWorks / AutoCAD	Mechanical design
Arduino	Graphing generated signal
MATLAB / Simulink	Simulate energy output
Proteus / Multisim	Circuit simulation.

Project Timeline

Project Title & Literature Review								
Proposal Submission & Presentation								
System Design & Component Selection								
System Development & Testing								
Mid-semester Progress Presentation								
Final Development & Optimization								
Final Report & Presentation								
Final Demonstration								
	April 21 - May 2	May 5 - May 14	May 14 - May 20	May 21 - June 10	June 11	June 12 - June 15	July 16 - July 25	To be announced

References

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2. R. R. Sahoo, B. C. Tripathy, and D. S. Roy, “Piezoelectric energy harvesting from raindrops: An experimental investigation,” Journal of Renewable and Sustainable Energy, vol. 9, no. 3, 2017, pp. 033701–033708.

3. M. Yoon, H. Lee, and J. Lee, “Design of hybrid piezoelectric and electromagnetic energy harvester,” Sensors and Actuators A: Physical, vol. 221, 2015, pp. 65–72

4. C. B. Williams and R. B. Yates, “Analysis of a micro-electric generator for microsystems,” Sensors and Actuators A: Physical, vol. 52, no. 1–3, 1996, pp. 8–11

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Thank You!