Harnessing Piezoelectricity to Create Kinetic Walkways

Pavani Agarwal
City Montessori School, Cambridge Section, Lucknow
pavani.agarwal1911@gmail.com
Innosphere Conference 2024

Introduction

1. Problem Statement

a. Pressing environmental concerns have led to a deterioration of energy resources.
b. Using piezoelectric cells, the possibility of designing and introducing kinetic walkways in public spaces to harness energy will be discussed.
c. The specific circuit diagrams required, that would constitute such a walkway with an efficient arrangement to capture maximum energy.

2. Objective

a. To find an alternative energy source while benefiting public health.
b. To optimize the collection of energy and find an ideal arrangement of cells.

3. Why It Matters

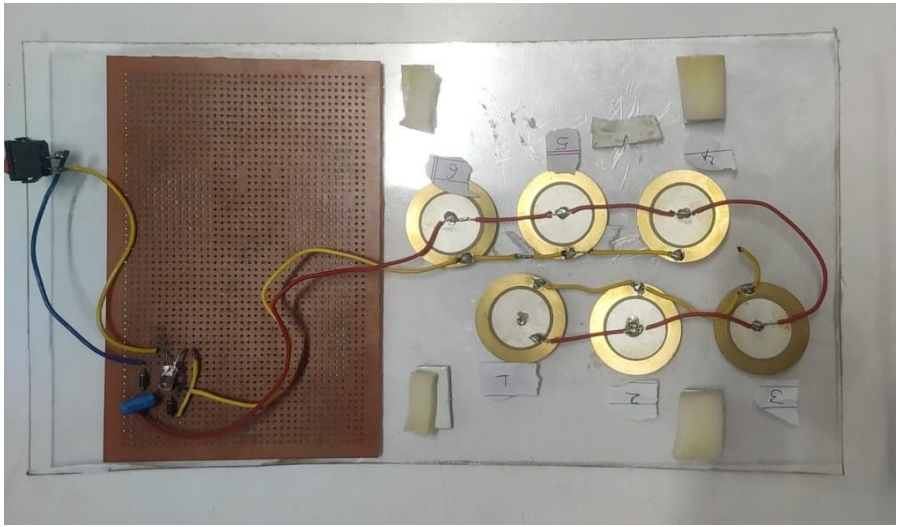
a. An environmentally friendly source of energy, using piezoelectric cells to allow renewable energy generation.
b. A walkway with the purpose of bettering the environment would create an incentive for walking and may also improve the general health of society.

Literature Review

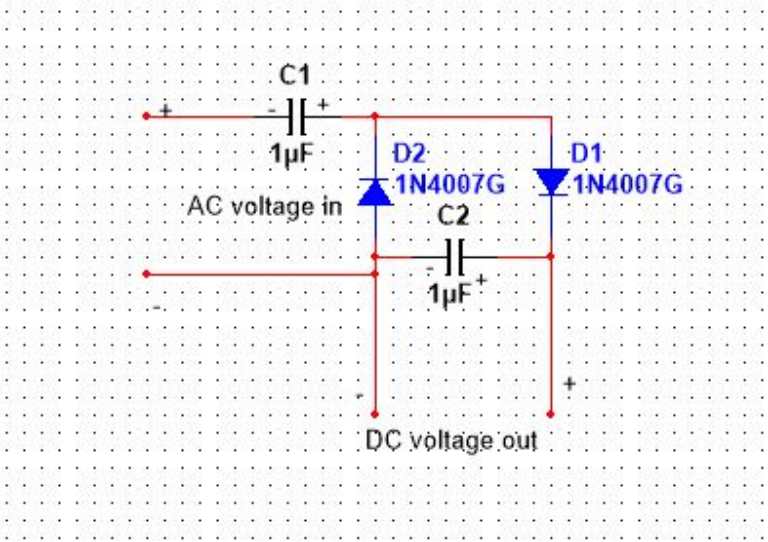
1. Piezoelectric walkways in public areas
2. Study on the types and workings of piezoelectric cells
3. The depletion of energy resources available in the foreseeable future

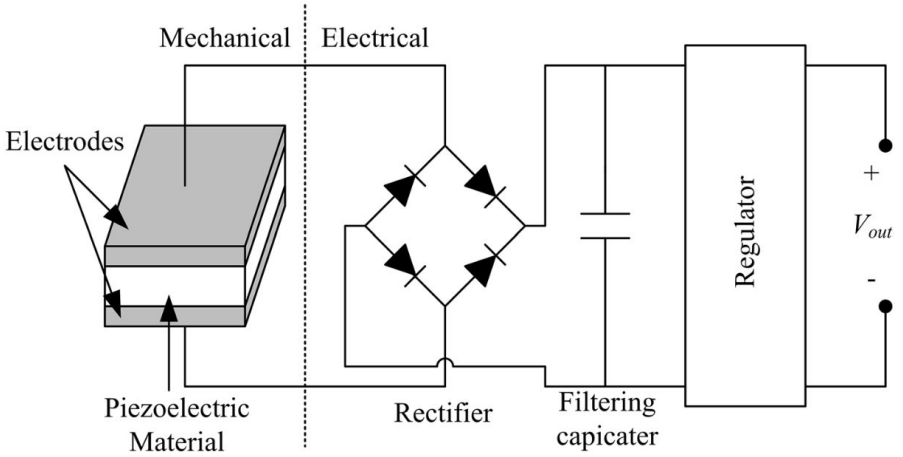
Materials

1. Piezoelectric cells
2. Multimeter
3. Acrylic, Styrofoam, Hookup wire, Capacitors, Diodes, PVC Sheet, Glue.
4. 2kg Weight, 15cm Ruler



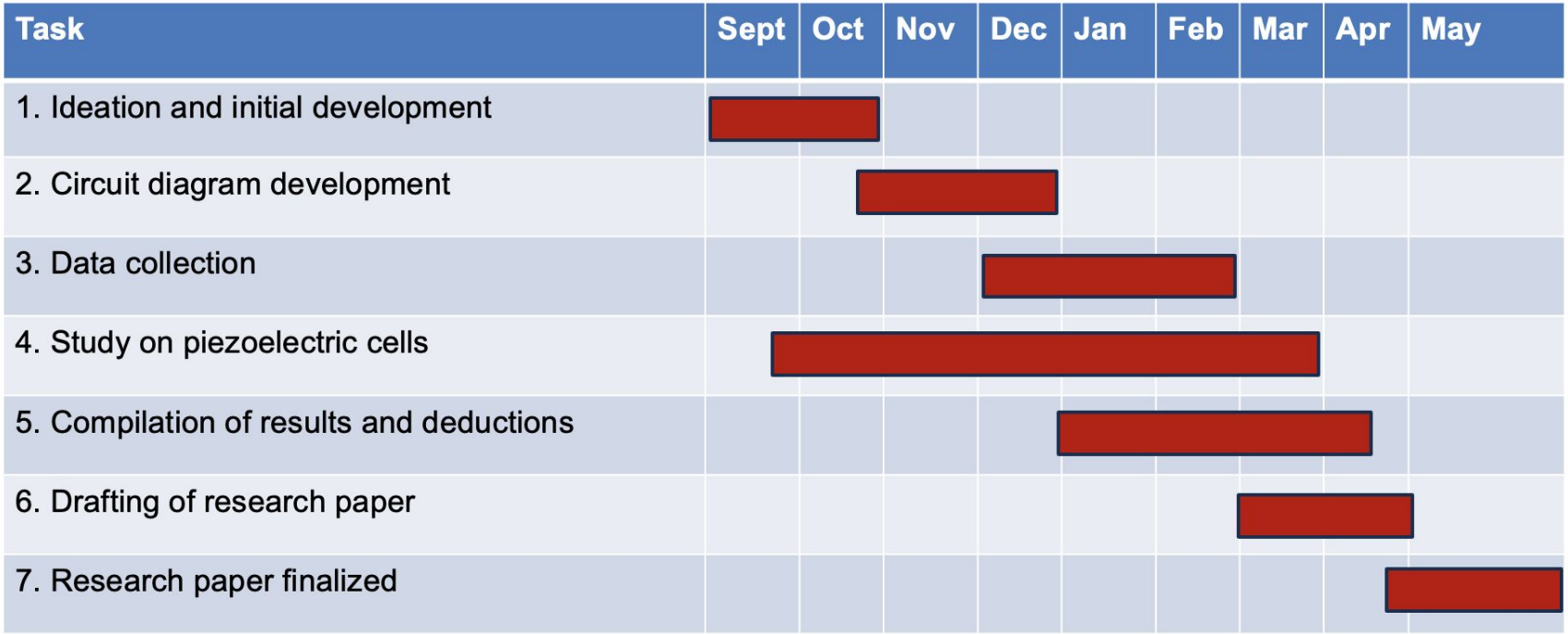
Circuit Diagrams





Timeline

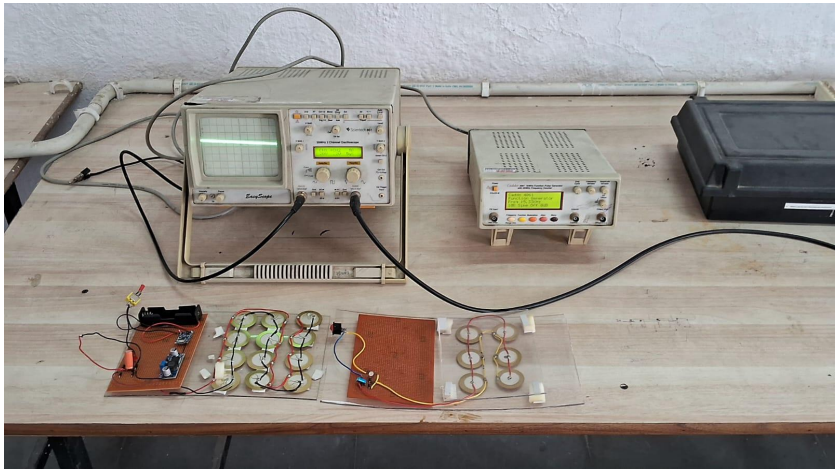
Gantt Chart



Methods

A 2 kilogram weight was taken as a constant to measure the amount of energy generated due to pressure. 5 readings were recorded, and an average was taken.*

*A height of 15 centimeters was ensured by using a ruler at every drop and ensuring a constant room temperature to create consistent testing conditions. After each drop, the voltage was dropped to zero before taking another reading to ensure no changes. We measured the distance accurately to 0.1 decimal place.



Recordings

The generated voltages were low due to the smaller amount of weight and piezoelectric sensors. However, even in this smaller sample size, we can clearly see that the matrix configuration was 11.6% higher than the alternating configuration.

Readings : Alternative Configuration	**Readings : Matrix Configuration**
0.30V	0.50V
0.60V	0.90V
0.50V	0.30V
0.70V	0.50V
0.23V	0.40V
Average reading taken: 0.47V	**Average reading taken: 0.52V**

Evaluation

Through the readings, it can be deduced that the matrix configuration is an optimal arrangement of piezoelectric cells in a circuit to maximize energy collection in a kinetic walkway. We studied the different readings from different configurations of piezoelectric sensors as an efficacy and design problem.

The design of these walkways would be created with the optimization of energy using piezoelectric sensors. We studied how the design and the arrangement of the piezoelectric cells would impact the final design of the kinetic walkway. We considered a symmetric and a non-symmetric design and finally decided to use matrix and alternate arrangements.

Scope For Future

1. The project could later be conducted at a larger scale with larger weights and more cells, with more readings to add to accuracy.

2. The design of a fully functional circuit for the walkway was the main idea for this paper, which could be further developed into a tangible kinetic walkway.

Conclusion

Summary:

1. The matrix arrangement of cells was 11.6% more efficient compared to the alternate arrangement.

2. This implies that in the final and larger-scale production of kinetic walkways, we must consider matrix arrangements for energy optimization.

3. The movement on those areas and walkways would help generate enough electricity to power the local area, thus cutting down on electricity costs and, moreover, addressing larger health related and environmental issues.

References

The environmental impact of non-renewable energies: climate change and more. (n.d.)
David, L. (2023, December 28).

How Much Power Does A Solar Panel Produce? (2023).

Learn, I. (2022, July 4). What is the total percent of workable mineral deposits? Infinity Learn; Infinity Learn.

Kim, H. S., Kim, J.-H., & Kim, J. (2011). A review of piezoelectric energy harvesting based on vibration. International Journal of Precision Engineering and Manufacturing, 12(6), 1129–1141.

Votel, K. (2022, June 3). Health risks of a sedentary lifestyle and how to make changes. HealthPartners Blog.

Kumar, C. N. (2015). Energy collection via piezoelectricity. Journal of Physics: Conference Series, 662, 012031.

Wang, H., & Jasim, A. (2020, January 1). 14: Piezoelectric energy harvesting from pavement (F. Pacheco-Torgal, S. Amirkhanian, H. Wang, & E. Schlangen, Eds.). ScienceDirect; Woodhead Publishing.

Acknowledgements

Dr. Nishchal Dwivedi

Athena Education