


# Piezoelectric Walking

Team Members  
Justin King and Xavier Ramos

## Motivation



- Make a new sustainable source of energy available for retail use
- Make energy accessible to consumers through new means
- Harvest in a manner that Doesn't Inconvenience the user
- Piezoelectrics are also seen as possible Low power supply devices. Capable of powering sensors in the absence of batteries and other high-cost components.

## Piezoelectric Calculations


Example 1: A force of pressure is applied to 110µm piezo-disk. Determine the voltage output.

$P = 1 \text{ kg/cm}^2$  Applied pressure  
 $t = 0.11 \text{ mm}$  Thickness of the disk

$V_{OC} = \frac{P \cdot d_{31} \cdot A}{t}$   
 $V_{OC} = \frac{1 \cdot 0.00011 \cdot 0.00011}{0.11} = 0.11 \text{ V}$  open circuit  
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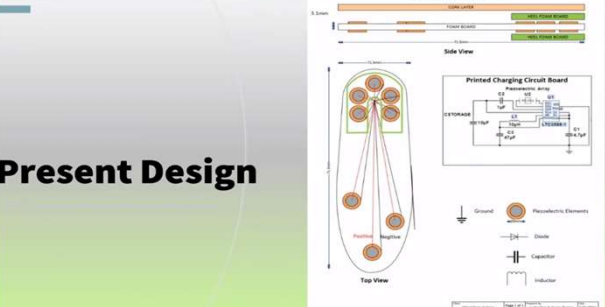
Resonant Frequency (MHz)	Resonant Thickness (µm)	Capacitance (pF)	Plate Size (mm)	Element Size (mm)	Electrode Size (mm)	Thickness (mm)	Plate Thickness (mm)	Plate Material
3.6 x 10 <sup>-6</sup> (3.6kHz)	500 max	20.0 ± 10% (184nF)	200	14.0	12.8	0.22	0.30	Brass
6.3 x 10 <sup>-6</sup> (6.3kHz)	350 max	30.0 ± 10% (276nF)	200	14.0	12.8	0.42	0.20	Brass
6.3 x 10 <sup>-6</sup> (6.3kHz)	1000 max	10.0 ± 10% (91nF)	200	14.0	12.8	0.42	0.20	Brass

## Technical Objectives



Generate	Engineer a shoe sole that generates usable electricity
Comfort	Make it a comfortable insole that is non-intrusive, and convenient.
Use	Rectify and regulate Generated Voltage for Specialized or General Use.

## Present Design



Top View, Side View, Printed Charging Circuit Board

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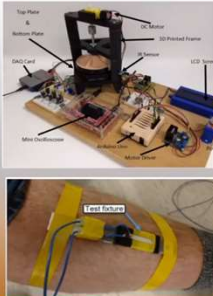
## Background/Literature Review

Bianconi J., Hallett J., Pealo J., & Rashidi, R. (2020). A Hybrid Piezoelectric and Inductive Rotational Energy Harvester (Master's thesis, State University of New York, Alfred State College, Alfred, NY 14802, USA)

Bower K., Colon R., Kamyski C., Minkel J., & Rashidi R. (2019). Piezoelectric-Based Monitoring of Restless Legs Syndrome (RLS) (Master's thesis, State University of New York, Alfred State College, 2019).

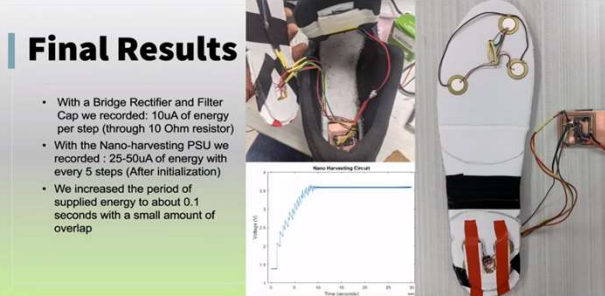
Digi-Key European Editors, (2014). Piezoelectric Energy Harvesting at the Heart of the Matter <https://www.digikey.com/en/articles/piezoelectric-energy-harvesting-at-the-heart-of-the-matter>


Ramadasa A., Saravankumar B., Lee S., Kim Y., Kim S., Wang Z., Piezoelectric-Driven Self-Charging Supercapacitor Power Cell, <https://doi.org/10.1021/acsnano.5b00759>



## Final Results

- With a Bridge Rectifier and Filter Cap we recorded: 10µA of energy per step (through 10 Ohm resistor)
- With the Nano-harvesting PSU we recorded : 25-50µA of energy with every 5 steps (After initialization)
- We increased the period of supplied energy to about 0.1 seconds with a small amount of overlap






The State University of New York

### Piezoelectric Generator

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ALFRED STATE COLLEGE  
STATE UNIVERSITY OF NEW YORK

#### Motivation

- Make a new sustainable source of energy available.
- Make energy accessible to consumers through new means

#### What is Our Project?

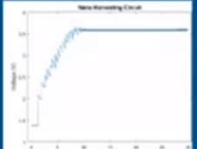
- We created an array of Piezoelectric elements with complementary electronics that allow us to either power devices, or safely trickle charge a battery.
- The Idea for this project came from inspiration from other renewable energy sources that we otherwise would take for granted, like solar and wind power.

#### Project Goals

- Engineer a shoe sole that generates usable electricity.
- Make it a comfortable insole that is non-intrusive, and convenient.
- Rectify and regulate Generated Voltage for Specialized or General Use.

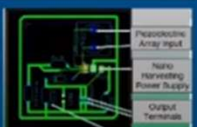
#### Electronics

- 26 Piezoelectric Disks
- Full Bridge Rectifier with 0.1µF Filter Capacitor
- Nano-harvesting energy supply circuit

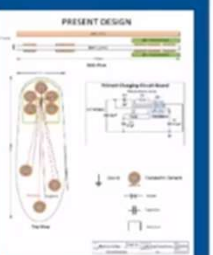


#### What Skills Were Used?

- Analog and digital circuit design/analysis
- PCB Milling Machine
- MATLAB
- Soldering
- Ultiboard
- NI Multisim
- Testing/Troubleshooting
- Schematics/Wiring Diagrams



#### PRESENT DESIGN



#### Results

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