VIBE-ENERGY

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Duke UNIVERSITY | BASS CONNECTIONS

Bass Connections in Energy & Environment

Introduction & Background

- Reliance on carbon producing energy is causing global temperature rise
- Demand for energy is increasing every year
- Need for clean energy sources is greater now than ever before
- Piezoelectricity is the use of sound waves and vibrations to generate electricity
- Noise pollution is everywhere and easily accessible, which makes it a sustainable energy source
- Our piezoelectric energy prototype creates a closed energy system that decreases battery use

Objectives & Hypothesis

- Create a feasible and scalable new type of sustainable energy
- If used properly, piezoelectricity could increase the energy efficiency of many industries and decrease the reliance on fossil fuels
- Produce an amount of energy that can be used to power a lightbulb, or small LED to show a proof of concept of piezoelectricity technology

Design Approach

- Utilized steel and aluminum sheet metal, 80/20 and OnShape for modelling of mechanical components and frame
- Performed frequency testing utilizing oscilloscopes and sound meters
- Performed testing on Multisim and TinkerCad for Circuit Schematic as well as integrated testing

Testing & Results

- Sound waves of high decibel levels at resonant frequency of aluminum sheet metal transmit continuous vibrations to structure
  - Input signal to piezo crystals
- Piezo crystals act as AC voltage source
  - Converted to DC to charge capacitor which discharges through LED for proof of electricity
- High capacitance incorporated to store sufficient energy over long time interval compensates low rate of charging
- Ideal frequency of 140 Hz

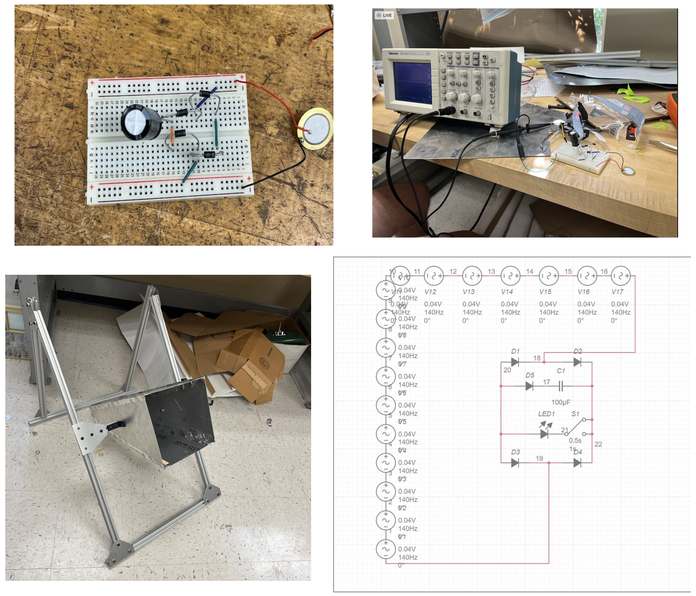

Figure 1: Mechanical Component, Electrical Component, Circuit Schematic via MultiSim, and Oscilloscope Testing

Business Plan & Target Markets

- Target markets must have consistent, high decibel sound waves.
- Chiller plant at Duke University was the best fit
  - Average 94 decibels and consistent sound production
- Prototypes are scalable, as you can use many in a single location to generate energy

Social & Environmental Benefit Analyses

- Reduces carbon emissions by harnessing wasted sound energy
- The average light bulb (50W) can emit ~2,000 lbs of CO_2 and ~ 15 lbs of sulfur dioxide per year
- Using our prototype: 1hr of piezoelectric energy collection can power ~30 min of the avg light bulb
- Improves social awareness of the different renewable energies that exist and the importance of clean energy to become a carbon-neutral society
- Positively impacts public health by offsetting carbon emissions elsewhere in the value chain

Conclusions

- Prototype represents original model for proof-of-concept prototype geared towards sustainability, reliability and feasibility
- Device capable of producing up to 1V of charge
- Assuming average cost of electricity is 13c/kWh, each prototype saves between $10.7 - $42.7 / year
- Future prototypes should explore the use of additional piezoelectric sensors and substitution of plastic for metals.

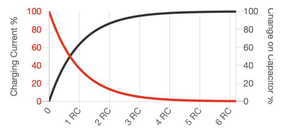

Figure 2: Ideal Charging Graph for Circuit Capacitor

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