

Piezoelectric Energy Harvesting Tiles

Problem

The world is in constant need of energy and with the growing climate crisis, using renewable energy sources is extremely important.

Goals

The objective is to develop an energy harvesting tile that can store energy from mechanical forces such as human footsteps. The goal is to use the stored energy to charge mobile devices.



Concept [1]

Key Design Objectives

- Harvesting circuit to provide minimum 10V/3mA peak per footstep.
- Output of DC 5V/1A to charge mobile devices.

References

[1] "What is Kinetic Pavement?", OVO Energy Ltd, [online] Available: <https://www.ovenergy.com/blog/technology-and-innovation/kinetic-pavements-are-giving-a-whole-new-meaning-to-power-walking>

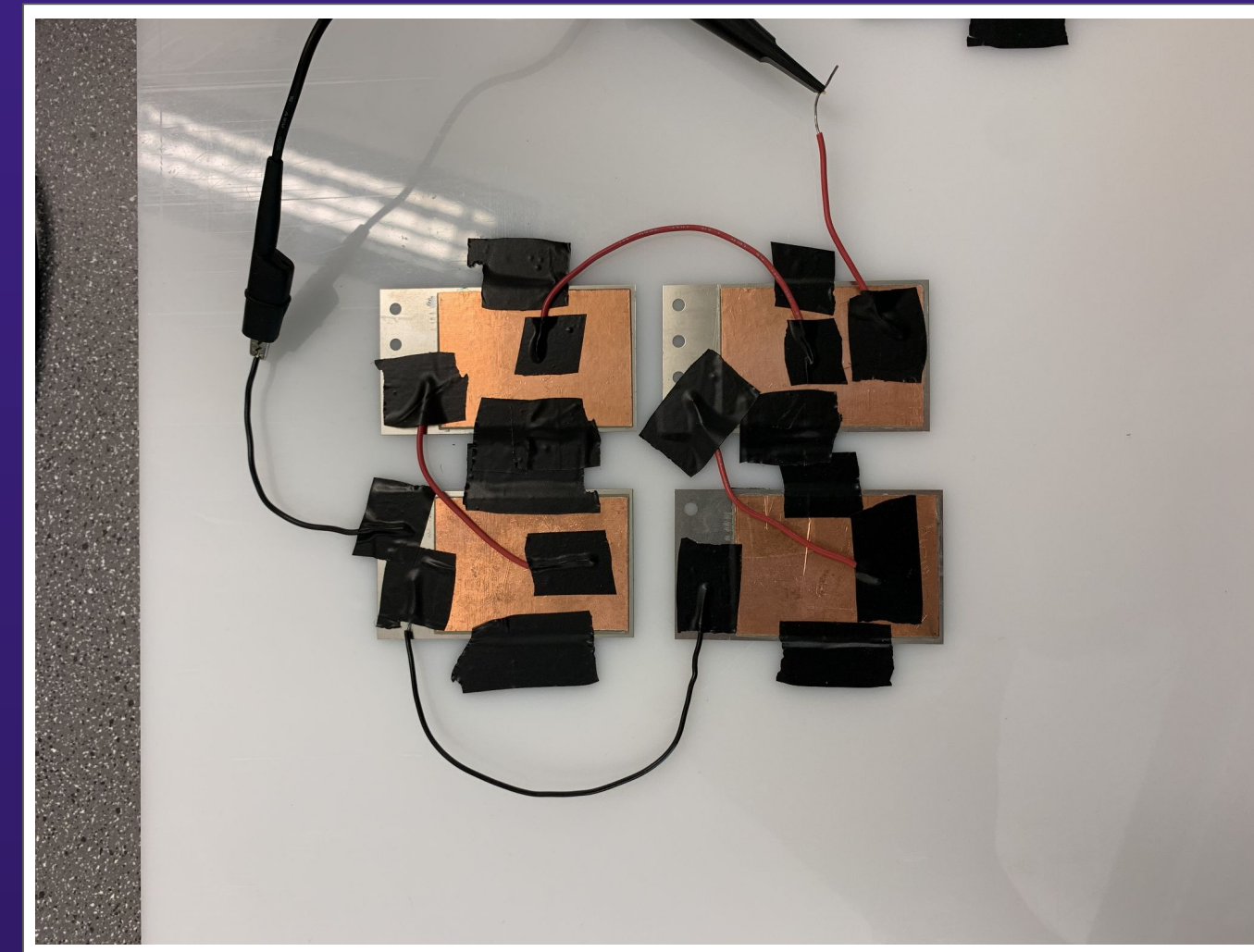
Design

Energy Harvesting

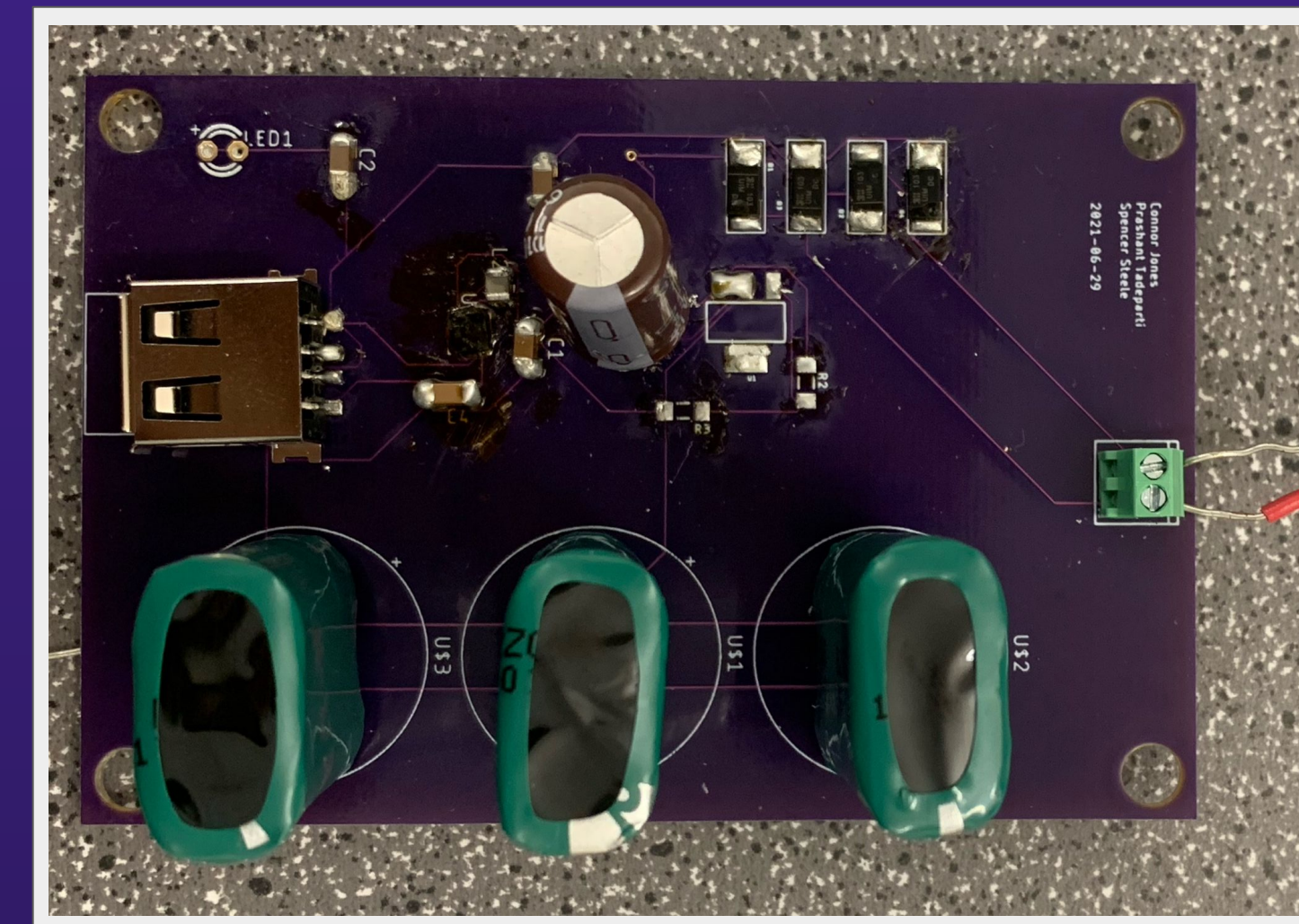
- Piezoelectric transducer array to collect and convert mechanical energy into electrical energy.
- Rectification using silicon diodes and smoothing capacitor for AC to DC conversion.

Charging

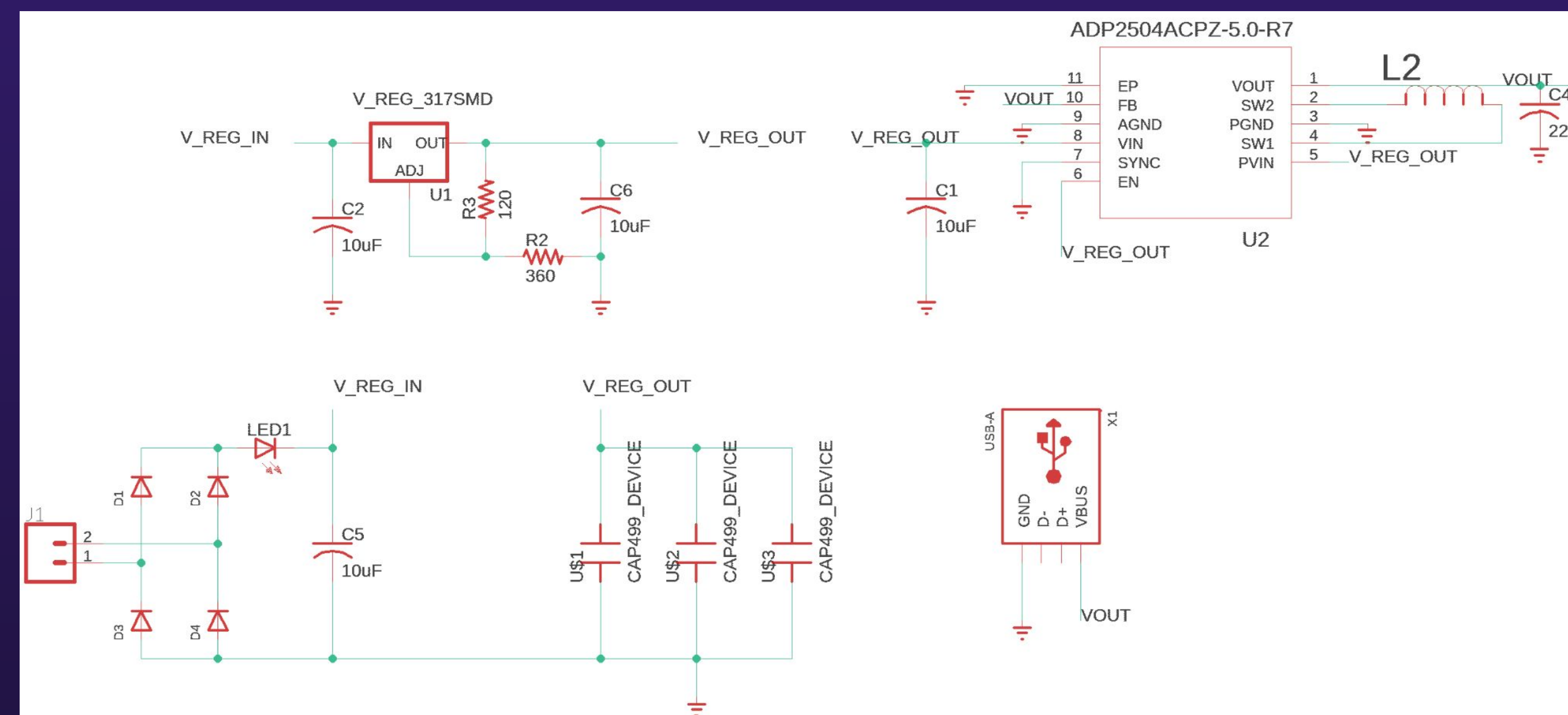
- Three 5F supercapacitors to provide 220 J per cycle.
- DC-DC converter to stabilize output signal to 5V/1A.



Piezoelectric Transducer Arrangement



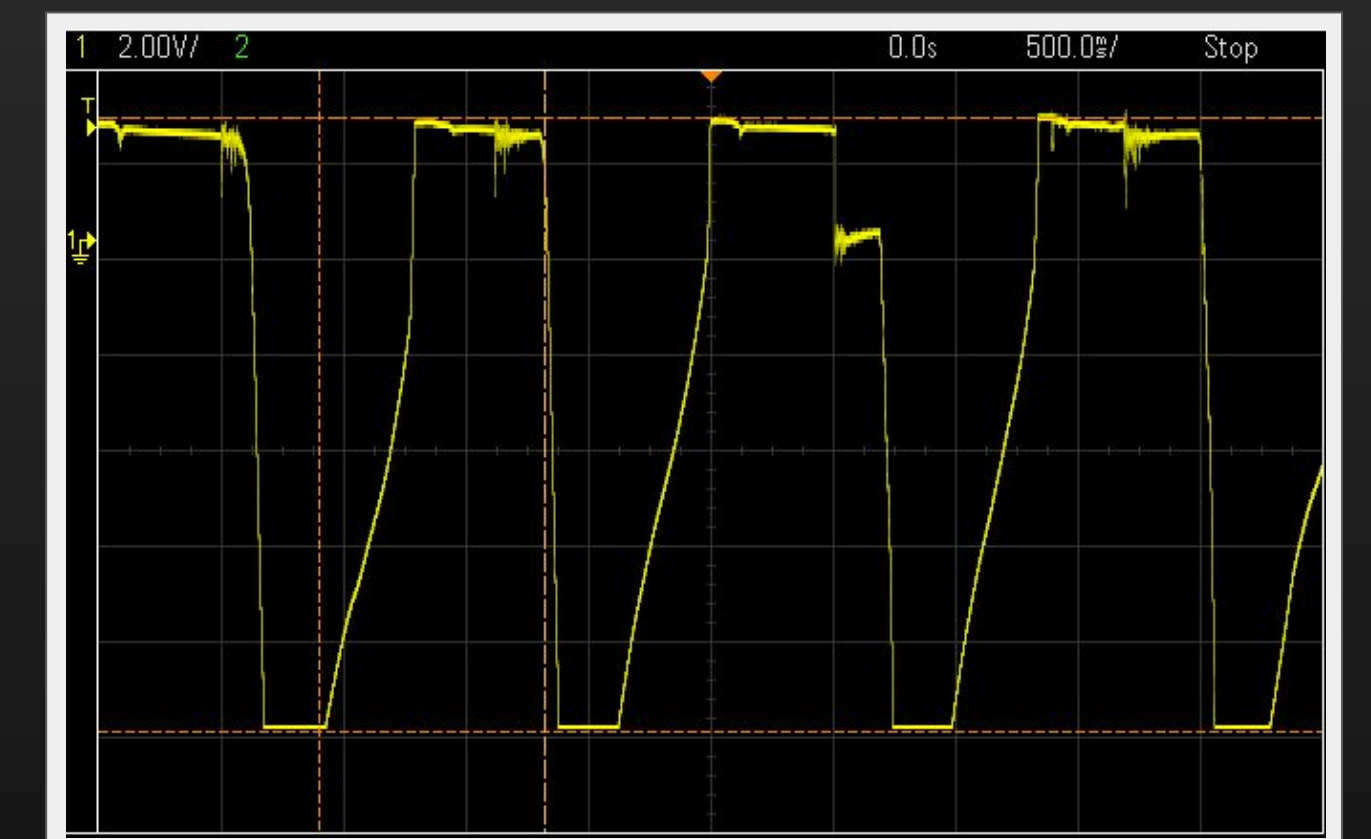
Assembled Prototype



Designed Schematic

Results

- The piezoelectric transducer arrangement successfully provided 10V peak voltage per footstep.
- The AC signals from the transducer arrangement were successfully rectified into a constant DC signal.
- The prototype was able to charge a 470 uF capacitor, but fell short of charging a 5F supercapacitor.



Transducer Output Waveform

Conclusion

- Large fleet of transducers (>15) should be placed on a single tile in order to charge three 5 F supercapacitors.
- The prototype works on a small scale, but several cascaded tiles are needed to harvest meaningful power.

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