Thesis Portfolio

Human-Powered Illuminated Runner's Vest
(Technical Report)

Energy Accessibility in Urban and Rural Communities
(STS Research Paper)

An Undergraduate Thesis
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By Katarina Catallo

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Technical Team Members:
Trevor Cook
Jacob Fishman
Garrett Hanrahan
Kyle Peter
Clayton Tondreau

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Modern American society revolves around the rapid development of technology. It is in a state of rapidly increasing demand for electricity, a variety of power sources, and an aging electrical infrastructure. The fragile American electric system has been failing to supply reliable power to its consumers and having a profound effect. Effects of an unreliable electric system include reduced lighting and heating, but can also negatively impact the economic, health, and educational components of a community. For example, the 2003 New York City blackout event resulted in an economic loss of $6 billion and a significant increase in mortality rates. The reliability of the electricity system also varies across the United States, and perhaps the most profound difference is between urban and rural areas. There have been attempts to reduce the gaps in electricity distribution through the creation of novel technologies, such as portable generators and solar panels. This paper focuses on the following general problem: *how has the increased need for electricity in American societies created a responsive desire for reliable access to electricity in developing communities?*

The increasing volatile electricity demand has created a need for alternative sources of electricity that add to the reliability of the electric grid. Our product satisfies this need by generating power for a light source that is completely independent of the electric grid. Over the course of nine months, we designed and constructed a human-powered illuminated running vest. In December 2019, we completed the initial design phase with a collection of technical drawings that were then constructed between January and March 2020. The initial prototype went through multiple testing phases, leading to changes in the design, and resulting in the final product. The design of the vest consists of two linear generators placed on the upper back (shoulder) area of a reflective safety vest. These generators are attached to supercapacitors to store the energy produced, which, in turn, are connected to LED strips that are attached to the front and back of

the vest. While the consumer is running, the magnets inside of the linear generators will move up and down with the user's stride, bouncing off of springs at the top and bottom of the generators. The coils connect to superconductors that will store the energy and slowly dissipate it out the LEDs on the vest. Due to the COVID-19 pandemic, we were not able to finish assembling our product. However, we did complete the proof of concept prototype, showing that the technology did work independently of an separate power source.

The relationship that is developed between a community and its access to electricity forms a unique sociotechnical system that impacts many other components of the community. In my STS research, I focus on the similarities and differences in the sociotechnical systems that exist between urban and rural areas and their respective electrical grids. A case study compared the electricity reliability of an urban node and a rural node by researching the consequences of a major power outage event on each node. The urban and rural node chosen are Monroe County and Orleans County, respectively, in New York State. Both locational nodes generally had electricity reliability ratings below the national average. To continue to evaluate the unique sociotechnical system that is formed between a community and its electrical grid, the inferred impacts of poor electricity reliability are measured using economic, health, and educational metrics. Based on previous qualitative research and the demographic analysis performed, it can be inferred that there is a link between poor electricity reliability and negative impacts on the economic, health, and educational components of a sociotechnical system.

My research highlighted the connections and interdependencies between different components of a community. For my technical project, my team was on track to build a product that was marketable within many consumer groups. We had received a lot of encouraging feedback from runners prior to spring break, and were excited to test its performance once it was

completely done. In order to create a successful product, we worked with many different people to identify a need we could address, and then to gain the skills and materials to bring our design to life. For my STS research project, I had originally thought that I would be able to identify the specific differences in electricity reliability between two locations. However, that did not work out as intended because most of the data collected is self-reported by utilities, and is then lumped into yearly summaries. In addition, the data that I was able to retrieve for each node was not different enough to be of significance. For further analysis, identifying and evaluating two nodes with above average electricity reliability would serve as a control for comparison.