Thesis Project Portfolio

Design and Construction of a Ferrofluid Kinetic Art Clock

(Technical Report)

Exploration of Micro Nuclear Reactors as a Solution to The California Energy Crisis

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

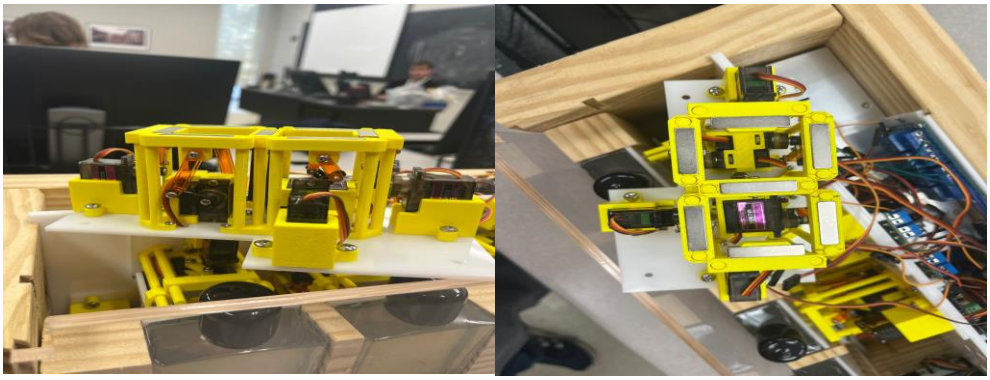
(Executive Summary)

Reinventing Systems For the Future

My technical project and STS research topics are not closely related, yet they still enrich each other. My technical project has me redesigning a clock mechanism from a previous year's project. It is not a typical clock as this displays time through the use of ferrofluid controlled by magnets as opposed to an array of lights like a digital clock. My STS research paper focuses on the viability of nuclear power in solving the California energy crisis. This topic was inspired from my summer internship where I was introduced to some of the most advanced developments in nuclear technology. California is consistently in a power deficit and power demand is only growing. Because of this, I propose the introduction of portable micro reactors to help with this deficit. This could then spur greater future use of nuclear energy upon the public seeing its benefits. At first glance, it is very difficult to see any clear connection between both my technical project and STS research. However, both can be seen as replacing existing systems with a new, more advanced, and efficient system. Both the clock and California have systems in place that are not reliable enough to keep up with demand.

The technical portion of my thesis was inspired by suggestions made by my capstone professor. My group and I were shown previous year’s projects and were given suggestions on how to improve them. We elected to redesign the mechanism controlling a ferrofluid clock produced a few years ago. Their design consisted of 4 sets of 7 motors connected to 3D printed

magnet holders, supported and guided by 3D printed support rods. Pictures have been included to aid in understanding the design.



The magnets would extend to pull the fluid from the bottom of the vile and then retract to display the appropriate digits. The primary issue with the old design is that it would occasionally get stuck when trying to transition to a new number. This was due to the mechanism being made entirely from 3D printed ABS plastic. This resulted in a lot of friction between the moving magnet holder and the support rods. The solution my group and I reached was to change this mechanism to a laser-cut acrylic rack and pinion. With acrylic being very smooth, there is very little friction which allows the mechanism to move with ease. It also takes up a similar amount of space as the old design. Which allows us to maintain the same motor layout, programming and wiring; thus greatly reducing the overall cost and workload. The overall goal of this project was to eventually be able to place the clock in an engineering building for all students to see in the future; while also learning more about the engineering design process.

In my STS research I looked into the feasibility of implementing micro nuclear reactors to aid in California's energy crisis, and how this could lead to greater expansion of nuclear energy in the future. I focus on the statewide lack of energy production as well as the shortcomings and dangers associated with the existing fossil fuel and natural gas based power

generation methods. The main area of concern with implementation of nuclear energy is mitigating the perceived risk involved with it, and educating the public of its safety and possibilities. To help the public embrace the idea of nuclear energy, less risky micro reactors can be utilized first before building large, permanent nuclear power plants. The end goal being that the public will see the benefits of nuclear energy, leading to it being more widely adopted nationwide; while also exploring the various possible uses of the exciting new micro reactors.

Both my technical project and STS research have enriched my learning experience as an engineer. Initially, the two seemed vastly different with no common ground. In reality, they are more alike than one would think. They both have the same underlying idea of taking an older design or system and turning it into something new. In the case of my technical project, we took an old mechanism that did not work consistently, and built something new with better reliability in mind. Similar things can be said about the California power grid. In this instance, the fossil fuel and natural gas based power grid is constantly putting people at risk of being without power. To combat this, more efficient and cleaner nuclear fuel can be utilized to advance the capabilities of the existing power grid.