

Undergraduate Thesis Prospectus

Cloud Chamber Clock

(technical research project in Mechanical Engineering)

Motorcycles and Electrification

(sociotechnical research project)

by

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October 27, 2023

technical project collaborators:

Julian Lee  
Blake Wiese

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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*STS advisor:* Peter Norton, Department of Engineering and Society

## General research problem

*How may old technologies be used in new systems?*

The creation of new technologies is a constant process, and appears to be happening faster than ever. When describing new technology, two words often come to mind: invention and innovation. According to Merriam-Webster (n.d.), an invention is “a device, contrivance, or process originated after study and experiment”, whereas to innovate is “to make changes” or to “do something in a new way”. Additionally, Merriam-Webster describes one of the major differences between the two as follows: an invention is creating “something which has not previously been in existence”. Put simply, something entirely new is an invention, and something built from an existing object or idea is an innovation. With this distinction, the possibilities for new technologies through innovation become vast. The wheel can never be reinvented, but it can be used in new ways.

## Cloud Chamber Clock

*How may a cloud chamber and an analog clock be combined?*

This project is within the Mechanical Engineering department and will be advised by Professor Garner. Current team members are Julian Lee and Blake Wiese. The technical problem is to design and build a cloud chamber that contains an analog clock. A cloud chamber reveals the motion of subatomic particles by using fog as a medium for the particles to travel through and leave visible trails. The clock must be capable of working correctly in both the corrosive environment of the alcohol vapor and the extreme temperature gradient necessary for a cloud chamber to work. Hobbyist cloud chambers are common, but a chamber with a working clock inside is unprecedented.

Principles of thermodynamics, mechatronics, and machine design will be used to experiment and to create computer-aided design (CAD) models, acrylic prototypes, and the final product made from aluminum and glass. The cloud chamber will use supersaturated isopropyl alcohol vapor as the fog medium. Acrylic is easily damaged by alcohol, so only the prototypes will use acrylic. The alcohol recirculation, heating elements, and clock will all be run by mechatronic systems with built-in feedback and control. The clock will use some form of power transmission using gears and actuators. There are many ways to implement each of these subsystems. The end goal of the project is the first-ever cloud chamber to contain a functioning analog clock.

## Motorcycles and Electrification

*How have proponents of sustainable mobility distinguished between and promoted competing versions of electrified two-wheeled vehicles?*

The goal of this problem is to dig deeper into the differences between e-bikes and motorcycles (specifically electric) and examine the role of motorcycles in sustainable mobility. By definition, a motorcycle is a bike with a motor. However, today electric motorcycles and electric bicycles are treated as different machines. The history of motorcycles, electric motorcycles, and electric bicycles is unclear and sometimes contested. Prototypes for all three appeared in the 19th century, but only the internal combustion motorcycle entered regular use (NMAH, n.d.). Understanding the different histories of these machines is one of the primary goals for this problem.

Some research has already been conducted on the electrification of motorcycles. A research team from the University of Michigan found the electrification of motorcycle taxis in

Uganda to have a net positive impact on vehicle emissions (Vanatta, et al., 2022). Electric motorcycles also cause much less noise pollution than conventional motorcycles (Hernandez et al., 2019). However, a study reviewing the uses of two-wheeled transportation in China found that e-bikes and motorcycles had independent growth trends, indicating a societal or political difference between the two (Gu, Kim, & Currie, 2021).

The United States Environmental Protection Agency (EPA) is a federal agency responsible for creating and enforcing policies regarding vehicle emissions. The Motorcycle Industry Council (MIC, n.d.) works to “keep motorcycling fun, accessible and safe for motorcyclists, and to promote motorcycling’s positive image of serious fun and a responsible, environmentally friendly mode of transportation”. The news organization CleanTechnica has reported on the issue of electric motorcycles with the purpose of bringing attention to an often overlooked issue. Peopleforbikes (PFB) is an advocacy that works to create “a prominent place for bikes in transportation, mobility and recreation decisions at all levels of government” (PFB, n.d.). Earthjustice is a nonprofit environmental law organization that was “created to fight - and win - for our planet in court” (Earthjustice, n.d.). They are partnered with the online e-bike retailer Urban E-Rider Co., which donates a portion of their revenue to Earthjustice (Urban E-Rider Co., n.d.a). Urban E-Rider Co.’s goal is to “enrich peoples' lives by increasing the awareness, access, and usage of electric transportation” (Urban E-Rider Co., n.d.b). More participants will be identified to deepen understanding of the issue.

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