

Thesis Project Portfolio

Design and Construction of Modern University of Virginia Themed Pinball Machine

(Technical Report)

Historical Development of Environmental Racism in Louisiana's Cancer Alley

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Executive Summary

Engineers should not become complacent; they must keep striving to update and optimize previously working systems with new technological advancements. My technical capstone was a large group endeavor to continue the work of an unfinished UVA-themed pinball machine started by a 2016 capstone group. This project was taken on as a challenge to construct a working pinball machine with modern mechatronic components to increase the quality of gameplay and the longevity of its mechanical parts; also, it would be a fun way to bring to the UVA community together with a custom game that captures the ups and downs of student life at the University. The STS thesis is largely a historical analysis of the history of the Cancer Alley region in Louisiana. This topic was chosen because of my personal interest in understanding a complicated and overlooked case of widespread environmental racism. While very different, both topics involve older technologies that could use an upgrade. Since their creation, pinball machines have been made with mainly solenoids. However, recent mechatronic innovations can provide similar functions. Cancer Alley includes hundreds of polluting industrial facilities; while solutions to address this environmental problem largely include policy, which doesn't mean that engineers should stop looking for modern technical solutions to decrease pollutants or optimize alternative energies to move away from oils and petrochemicals.

The UVA Pinball 2.0 project strived to create a working pinball game with updated components. Modern pinball machines still rely mainly on solenoids. Solenoids can supply large amounts of force almost instantaneously. However, large amounts of current through the wires can overheat the solenoid causing it to become unusable and large voltage spikes can be dangerous to other system components. To update the technology within the custom pinball machine, solenoids were replaced with linear actuators and motors. For some of the game's

features solenoids still work best, so the plan was to have custom solenoids built with heat and current sensors to prevent burnout.

In the end, the main elements of the pinball machine, the structure of the gameplay, and field design were prototyped but not fully polished. Although a fully functioning game was not completed, many parts of it were redesigned and rethought to create modern mechatronic components that can serve to update the modern pinball machine. The redesign of basic pinball parts, outline of gameplay, and gameboard prototype can serve as a basis if another capstone team wants to build upon the 2016 and 2023 groups' project.

The STS thesis seeks to understand how environmental racism shaped the Cancer Alley region of Louisiana. For decades, the residents of Cancer Alley, many of whom are Black, have been reporting high cancer rates and other negative health effects as a result of the pollution from the neighboring petrochemical industries. Although there are conflicting reports as to whether cancer rates are higher than the state average for the region, there is a complex history of environmental racism that resulted in Black communities adjacent to polluting facilities. Resources from secondary and tertiary sources were used to conduct a historical analysis of the region to understand how environmental racism and the growth of the petrochemical facility shaped the region. Through the historical analysis, it was found that the history of slavery, redlining, and government support of the petrochemical and oil industry contributed to predominately black fence line communities. Moreover, the state and federal governments did not protect communities from polluting facilities by failing to enforce emission regulations.