

## **Thesis Project Portfolio**

### **Development of a Pressure-Sensing, Battery-Powered Air Purifier Respirator System**

(Technical Report)

### **Examination of Intellectual Property and University-Industry Relations amid a Global 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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Spring 2021

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## **Table of Contents**

Sociotechnical Synthesis

Development of a Pressure-Sensing, Battery-Powered Air Purifier Respirator System

Examination of Intellectual Property and University-Industry Relations amid a Global Crisis

Prospectus

## **Sociotechnical Synthesis**

The outbreak of the Coronavirus Disease (COVID-19) and the declaration of a global pandemic led to the emergence of disruptive conditions that threatened public health and redefined social interactions. The following technical and STS theses seek to understand how technology can mitigate these disruptive conditions and how the development of the aforementioned technology is accelerated in a global crisis.

My technical capstone project involves the invention of a powered air purifying respirator (PAPR) system to combat the spread of COVID-19 and therefore improve public health. The medical device was developed with the intention of preventing the transmission of virus particles when users exercise, as it was observed in the community that individuals generally did not wear face coverings—a preventative measure supported by the Centers for Disease Control and Prevention (CDC)—while partaking in high-impact activities. My motivation for developing a comfortable, durable, and cost-effective PAPR system suitable for COVID-19 applications can be explained by the capacity of the system to prevent asymptomatic exercisers from spreading the virus and potentially infecting individuals who could have severe or fatal complications. This concept was brought to my capstone group by Professor Gavin Garner of the Department of Mechanical and Aerospace Engineering at the University of Virginia.

My STS research involves the analysis of intellectual property and technical transfer offices and how these avenues of information transmission inhibit or accelerate technological development, especially in a global crisis like the COVID-19 pandemic. My motivation for selecting this topic is due to the accelerated rate of innovation I witnessed during the pandemic—with advancements in vaccinations, personal protective equipment, sterilization systems, and more—in combination with my personal experience developing the PAPR system. Global crises

like the COVID-19 pandemic serve as a call to action to entrepreneurs, academia, and corporations alike to develop technologies to solve the emerging disruptive conditions. The examination of two institutions—intellectual property and technical transfer offices—and how they connect or obstruct the transmission of innovations is of importance given the capacity of the technology to save lives.

As I built a device that met a challenge identified in my community, I was also able to understand how the invention process, from concept to distribution, of this device would be altered given the global pandemic. The thorough examination of the exchange of information, ideas, and ownership between academia, industry, government, and society while participating in the innovation process myself was an enriching experience. Following the completion of a final-stage prototype after a vigorous iterative design process, I was able to understand the challenges that entrepreneurs face when developing, patenting, and commercializing their inventions.

To conclude, I wish to acknowledge my technical capstone partners—Hannah Lothrop, Kimberly Louie, Kallia Smith, and Pascale Starosta—and advisor Professor Garner for their efforts throughout the iterative design process. In addition, I would like to thank Professor Ferguson for his assistance in developing my STS research. Finally, I would like to acknowledge my family members for their continued support throughout my undergraduate career.