

Thesis Project Portfolio

AI-based image auto-segmentation with AI-based accuracy assessment with respect to a clinical task: Application in Radiation Therapy

(Technical Report)

Analyzing social media's influence on vaccination misinformation through Haidt's perspective on human groupishness

(STS Research Paper)

An Undergraduate Thesis

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

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

**Improving Auto Delineation in Radiation Therapy and Analyzing Social media's effect of
Vaccine Hesitancy**

Technical Report Title

**AI-based image auto-segmentation with AI-based accuracy assessment with respect to a
clinical task: Application in Radiation Therapy**

STS Research Paper Title

**Analyzing social media's influence on vaccination misinformation through Haidt's
perspective on human groupishness**

Prospectus

**Quality Control in the Determination of Delineation Errors in Radiation Therapy and
Distrust of Vaccination in the United States**

Sociotechnical Synthesis

Improving Auto Delineation in Radiation Therapy and Analyzing Social media's effect of Vaccine Hesitancy

Head and neck cancer begins in several places in the head and throat, not including brain and eye cancers. It accounts for 4% of cancer patients in the United States, and it is estimated to kill approximately 14,620 Americans in the year 2021 (NCI, 2017). Head and neck cancer can be treated with radiation therapy (RT) which uses beams of radiation to kill the tumor. To perform RT physicians must segment CT scans to identify where organs near the tumor are, otherwise known as organs at risk (OAR). This manual segmentation is irreproducible at the millimeter level which means it is prone to error. Manual segmentation also can take up to 7 hours, so with pockets of idle time, it can take up to 10 days. To solve this problem my technical project was to develop a pipeline that could automatically segment CT scans and reduce the error in segmentation. My research project was not directly connected to my technical project. I researched the effect social media has had on the expansion of vaccine hesitancy.

The technical portion of my thesis produced a pipeline that intakes CT scans and produces auto segmented images as well as provide the physician a predicted 3D dose estimation of radiation on the OARs. It also gives graphs and figures that can help the physician. The pipeline was designed to be user friendly so there is no need for coding knowledge to use it. The pipeline also produces a relevancy table that informs the physician which OARs do not need review because the radiation levels are low enough. Through testing with 33 patient CT scans it was found that the relevant OARs, OARs that require physicians attention, was on average 5.67.

This means that on average our pipeline could reduce the OARs that need manual review by 1. This could save physicians time in treatment planning process.

For my sociotechnical project, I investigated the effect that social media has on the anti-vaccination movement. Specifically, it was important to look at the echo chamber that some social media sites such as Facebook and twitter can have. People are shown what they are most likely to view which tends to be what they agree with. In a book called *The Righteous Mind* the author Jonathan Haidt presents the idea that humans are “groupish”. I apply this to anti-vaccination advocacy groups in social media and observe that one of social media’s contributing factors is the fact that it is an echo chamber that does not allow for new opposing information. This can cause people to have a false perception of vaccinations due to a lack of information.

My technical and STS projects show that both technical as well as non-technical aspects of innovation are important. Specifically, considering non obvious outcomes of a design can allow engineers to produce products that are ethically diverse. When companies such as Facebook overlook ethical responsibilities, harmful outcomes can ensue. My STS project made me become more aware of how important ethical considerations are. If I follow what has been taught to me in STS, I feel my accomplishments as an engineer will improve society even more.