Thesis Project Portfolio

Using Deep Learning to Classify LV Scarring in Diverse Patient Populations

(Technical Report)

Effective and Systematic Adoption of Medical AI Devices

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

With the artificial intelligence (AI) revolution taking place within the 21^{st} century, society has been introduced to a novel way to solve problems plighting the medical field. Within the medical field diagnostics are crucial for identifying and treating patients with a specific disease state. However, the process of diagnostics, finding crucial biomarkers that indicate a disease state, can be arduous, time consuming, and error prone due to the nature of it being manually examined by a physician. Thus, an essential question can be asked: how can we implement AI technologies that decrease the physician's work load as well as maintain a high accuracy and precision for diagnostic of diseases? The following theses explores the aforementioned question through the lens of a technical and socio-technical aspect.

The technical thesis sought out to improve an AI segmentation model created by Carina Medical. The segmentation model is used to extract the size and location of 4 main regions of interest (ROIs) from cardiac MRI scans: left ventricle (LV) blood cavity, normal LV myocardium wall, myocardial infarction area or scar, and no-reflow scar area. These biomarkers are crucial for identifying cardiac diseases. In addition, while the segmentation model is able to effectively segment key ROIs including infarction scar, exploratory analysis of the model suggests that the model produces several false positives (FPs) and false negatives (FNs) for scar identification. These high FP and FN rates deem the model ineffective for implementation within the hospital system. Thus, we propose a novel pipeline that involves coupling a scar classification model with the Carina Medical LV scar segmentation model to improve the robustness of scar identification accuracy, while still minimizing physician workload.

My STS research dealt with finding ways to systematically and efficiently adopt medical AI technologies within hospitals. While conversations of medical AI have been around dating back to 70 years ago, adoption of medical AI technologies have been slower than experts anticipated. Even when the AI technology showcased high accuracy, precision, and reliability the adoption of said AI technology was low. The million-dollar question can be simply stated as “why?”. Within my STS research I dive deep into what is causing gridlock with the adoption of medical AI technologies, as well as propose methods that stakeholders of medical AI technologies can use to help resolve said gridlock.

The technical project was a success. Our novel pipeline that combines the segmentation model with the classification model improved the scar identification accuracy from an original value of 76% to 88.1%. In addition, with this novel pipeline we have also maintained a significant reduction in physician workload, specifically the pipeline reduced physician workload by 68.4%. My STS research also introduces important findings that are crucial for the adoption of medical AI technologies. At this current point in time medical AI’s intent in the hospital-physician system is unknown and can be boiled down to either the augmentation of physicians or the replacement of physicians. It is this uncertainty, that prevents physicians from adopting medical AI, through their influence as key personal that help decide what technologies hospitals decide to purchase. Through the use of a Technology Acceptance Model (TAM) and Multi-level Perspective Theory (MLP) I introduce two novel methods that can help medical AI’s adoption.

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