THESIS PORTFOLIO

The Improvement of Object Detection and Localization for Autonomous Camera Movement

(Technical Paper)

An Investigation of the Social Implications of Medical Robots

(STS Paper)

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Socio-Technical Synthesis

Artificial intelligence and deep learning are continually improving processes in almost every field there is. One such field is the field of medicine. Before I even started my undergraduate studies at UVA I had always been fascinated by the intersection of medicine and technology. This led to me pursuing a research opportunity available in the UVA Dependable Systems and Analytics Lab in my second year. After working in this lab for two consecutive semesters, I continued my research there as my capstone research. My capstone research focuses on the improvements that can be made to the perception component of the RAVEN-II surgical robot, in order to localize and detect objects of interest in its drylab workspace. These improvements would eventually lead to a higher precision in the automated movement of the ZED mini camera. This research directly corresponds with my STS research. As surgical robots, like the RAVEN-II, continue to make advancements in the medical field, one should bear in mind the consequences that these technologies have on our healthcare system. These are things that can steer the development of such tools in one way or another.

The technical portion of my thesis produced higher accuracies for the computer vision task of the RAVEN-II robot. This was done through image augmentation, which is the artificial expansion of a dataset, and more generalized labeling. The specific augmentation techniques used include flipping left/right 50% of the time and canny edges. The generalized labeling eliminated the need for distinguishing between the left and right graspers and the colors of the blocks. As a result, the model performed better and we actually saw a 99.15% accuracy with the validation set.

The STS part of my research explored the impacts that medical robots would have on our society. While they have been proven to be a valuable tool, accidents with devastating repercussions have occurred. This can be reason for concern and it raises many important

questions like who should be held accountable when the technology malfunctions? How would this affect hospitals, insurance companies, surgeons, and patients and how comfortable are patients with surgical robots? The answers to these questions are sought with the help of SCOT theory, users vs. nonusers, and case studies.

Completion of the two components was both necessary and enriching, because no technology is a stand-alone product. It resolidified my understanding of the socio-technical system and how one can not exist without the other. Both must be considered to accurately assess a technology. As with any technology, surgical robots influence society and society influences its development and future phases. Due to the spike in minimally invasive surgeries, surgical robotics is becoming a focal point. It will be interesting to see where this technology is headed, but we should also remain somewhat cautious as it progresses into its more advanced stages.

As I conducted my research and wrote this thesis, I was fortunate to receive the support and guidance that I did. I'd like to first thank my technical advisor, Professor Alemzadeh, for welcoming me into her lab when I had no prior background knowledge or experience in machine learning and for continually challenging me. Thank you to my mentors, Mohammad Samin Yasar and Kay Hutchinson, for pushing me to do better and setting me up for success. Lastly, I'd like to thank my STS professors, Professor Odumosu and Professor Jacques, whose valuable feedback made this final thesis possible.