Thesis Project Portfolio

Co-Navigational Aquaculture Vehicle System Design

(Technical Report)

Automation and the Potential for Marginalization

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

The rise in use of autonomous technologies in different fields of work has been consistently growing in the past decade due to recent advancements in artificial intelligence and machine learning, as well as a general desire for greater productivity within the workplace. However, in order to responsibly develop such a technology, an understanding of its potential impacts on the workplace environments and population as a whole are important. With this understanding, engineers like myself can better weigh the risks and benefits of these technologies, and figure out a way to implement them such that they benefit groups more than harm them. Thus, my technical project focuses on the design and build of a co-navigational autonomous two-robot system used to improve the cleaning processes associated with aquacultural farming. This inspired the topic of my STS research paper, which analyzes how autonomous technologies impact higher-skill and lower-skill workers differently. The conclusions drawn from this analysis help to guide some of the decision-making that goes into the development of our technical project.

Technical Project

The goal of the technical project by my team in the mechanical engineering design course is to design and develop a co-navigational two-robot system that autonomously runs and can clean aquacultural fish pens on its own. The inspiration of this project was a need from the Department of Agriculture to improve the safety hazards surrounding current approaches to fish pen cleaning – as it involved workers diving down and manually removing any debris. The technical project was broken down into a few parts to help divide and conquer the work, with a group member (or pair) focused on each of the following: surface vehicle development, underwater vehicle navigation, and the cleaning mechanism to be implemented with the underwater vehicle. The ideal system would operate autonomously, and would be able to run for long periods of time while effectively removing debris from the fish pens.

As this is a project that will likely be passed down to future ME design groups, a focus of our group was on foundational groundwork. The surface vehicle is currently fully designed and built, and can operate via remote control. Due to time constraints, we recognized that autonomous development may not be feasible for our team, and instead we aimed to make the entire system remote operable, as this is a crucial step in progress towards full automation. The underwater vehicle is also remote operated, and now has a cleaning mechanism attached that utilizes the underwater environment to its advantage, as it pumps water and sprays it with high force into its surroundings. The goal of groups to follow should ideally be to a) automate both vehicles, and b) utilize wave energy from the environment to power the system, as this reduces sustainability concerns.

STS Research Paper

As the rise of autonomous technologies becomes increasingly prominent due to advancements in its peer technologies – machine learning and artificial intelligence, the concern for its impact on different groups becomes more relevant. To address the question of how automation impacts different classes of workers in different manners, a literature review was done to evaluate different journals and articles on what the measured impact was found to be, but also to see what gaps there were in this field of research and study. The aforementioned gap was then found to be a lack of education and policy on wealth distribution management that was driving a vastly different impact for each group, and simultaneously further marginalizing the lower classes of workers.

The two groups of workers I chose to focus on were finance workers, as I interned in a sales and trading position and saw firsthand the way algorithmic trading and other autonomous technologies were being implemented recently, as well as farmers, which are not only one of the first groups impacted by automation, but it also related well to the aquacultural farming aspect of my technical project. Through my analysis and use of Latour's actor network theory, I was able to determine that while automation is undeniably making its way into virtually all jobs, it can benefit all classes of workers, so long as the

government and businesses leaders give it the proper place to do so; with educational aid and policy measures to minimize wealth polarization.

Conclusion

In working on these two projects simultaneously, I was able to gather the knowledge necessary to develop a system with autonomous potential that would not completely displace workers. Instead, the system was made to be simple and straightforward – this allows even those without high levels of education or understanding to successfully operate and repair the vehicles over time. Additionally, the technical portion of my work enabled me to understand the perspective of engineers of other autonomous technologies, and utilize that lens to better curate my analysis done in the research paper. Rather than solely focusing on the negative ways the technology has been impacting the lower class, I also was probed into looking into why and how these technologies were designed, and if some of these impacts were not necessarily intended. Ultimately, doing the work for both projects has helped me grow into a more well-rounded thinker, as I now value and consider the impact and implications of the pieces I design, but also now know how to evaluate other technologies with the perspective of an engineer while still holding important values such as equality at the forefront of my evaluation.