Human-Robot Triage Systems
AI Enhancing the Economic Divide and Effects on the Job Market

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Systems Engineering

By
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November 4, 2024

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction:

The Human-Robot Triage technical capstone project aims to better understand how robots can be involved in Mass Casuality Incident triaging. The use of robots in MCI situations can better protect medics and optimize the time that patients are waiting for treatment in the field. There are many decisions involved in the triaging process that developers and programmers must consider when deploying robots.

In our project, robots are tasked with finding victims and communicating the locations of said victims to medics in the field. Exploratory robots are used to scan the environment of the incident, and robots communicate with eachother to ensure that the entire environment is surveyed. Victims are flagged and sorted into specific injury priority levels. Based on the priority level of each victim, the robot will make decisions on whether to keep looking for other victims and add each one to a queue or to return to the medic and communicate the victim queue. The project aims to determine the best decision algorithm to implement on the robot in order to reduce the time waiting for medical attention for critically injured victims.

Similar to the algorithm implemented above, AI decision making is present in many situations that have large impacts on human life. Manufactoring, healthcare, and transportation are large industries where the use of AI has somewhat “simplified” processes that once required large amounts of human effort and thinking. Many consumers tend to rejoice in the new implementations of technology and AI, as technological changes are often seen as a generally positive thing. Technological innovation is often idealized, causing an allure and trust in these AI systems (Smith, 1994).

The algorithms behind these AI decisions have the power to negatively impact people, as biases held by developers and programmers can covertly influence conclusions often taken as fact by majority of users. These negative impacts span different aspects of life, including the economic state of consumers.

AI biases have contributed to discrimination in the housing market and prevented certain groups of people from obtaining housing loans and being accepted in rental applications (Akselrod, 2023). Algorithms used in job application screenings have been proven to discriminate against applicants based on characteristics like gender or race (McCormack, S., & Schwarz, D. 2024). AI has also played a significant role in replacing jobs, especially those within manufacturing, data entry, and customer service fields (Agrawal, A., Gans, J. & Goldfarb, A. 2019).

The presence of artificial intelligence in the job market and the finance industry has led to the question of whether the pros of artificial intelligence really outweigh the cons. As AI becomes more powerful, law makers must take action in order to protect marginalized groups from targeted discrimination that would affect one's economic status. In the context of the Human-Robot Triage capstone project, we must ensure that the algorithm implemented does not cause certain victims to wait for medical attention when their injuries call for treatment. We must also analyze whether robot intervention truly saves victims time. The ethical implementation of AI will be studied as part of this prospectus in both my technical and STS topics.

Technical Topic:

The Human-Robot Triage project aims to find an optimized algorithm that will provide a decision model for robots in triage situations. The components of the project include: exploratory ground robots, drone robots acting as a hub, human agents representing medics, victims/tasks, obstacles within the environment, and the environment itself. To analyze the situation, a simulation is being developed using Python.

The simulation currently contains an environment that randomly places tasks, or victims, throughout the grid. Each victim is indicated on the map with an ashterisk. The ashterisks are color coded by the severity of the victim's injuries. Red astericks indicate a priority level of 3, which means that victims need attention quickly. Magenta asterisks indicate a priority level of 2, which mean that victims can wait to be treated, but they should still receive treatment. Green asterisks indicate a priority level of 1, which means that the victim's injuries do not require the attention of a medic.

The robots will traverse the environment, using frontier point calculations, in order to ensure that the whole environment is explored and all victim locations are found. Each robot updates an Occupancy Map that tracks which cells within the environment have been explored, and the cells turn from gray to white once a robot has explored them. We intend to add obstacles to the environment that robots would not be able to traverse through. This will make the environment more realistic and similar to an actual Mass Casuality Incident scene.

When the ground robots want to communicate to the medic the location of an injured victim, they navigate to the hub, or drone robot, and transfer information about the location(s) of any victims to the drone robot. This drone robot then navigates to the medic, and informs them of the victim locations. The medic will them navigate to these locations in an order based on the priority level of the injuries.

Our team is looking to test different methodologies for alerting medics about victims the robots have found while minimizing the time that victims spend waiting for treatment. The default method for alerting medics of victims is exploring the map and adding priority 2 victims to a queue and returning to the hub once a priority 3 victim is found. When the robot returns to the hub, the whole queue will be communicated to the medic. Another method we will consider is returning to the hub after any priority 2 or 3 victim is found. We will test different methods while measuring the amount of time it takes for each victim of high priority to receive treatment.

STS Topic:

The STS topic I wish to explore is how AI and technical innovation have negatively contributed to the economic state of consumers and widened the economic divide. I wish to address several factors that would contribute to this phenomenom.

I want to explore how algorithms used within the housing industry have discriminated against certain groups of people and unjustly denied people an opportunity to obtain housing and home loans. Currently, borrowers of color have been overcharged more than 700 million for home loans and over one million creditworthy applicants of color have been rejected. Big tech companies have also been found to target certain audiences when advertising housing, often times ignoring people of color and those living in areas of lower economic status (Sissons 2019).

Hiring algorithms used in the application process can also be discriminatory, especially against women. Instances similar to the controversy that Amazon faced when their algorithms were found to be biased against women applicants happen often, and many of these algorithms are not monitored (Langenkamp, M., Costa, A., & Cheung, C. 2020). Current policies are in

place that are supposed to protect applicants from this type of discrimination, but there are still calls for employers to do more. The Office of Federal Contract Compliance Programs is currently responsible for protecting applicants and employees. Some argue however, that their audits are not satisfactory and that there should be more robust documentation and checks in place to avoid discrimination (Rieke, A. 2021).

Lastly, I would like to research how AI has affected the job market, specifically, how AI has removed certain jobs from the market. Many jobs that involve repetition or routine tasks are being turned over to be completed by AI. These jobs often displace those who do not have college degress or do not pocess certain technical skills. (Agrawal, A., Gans, J. & Goldfarb, A. 2019). The difference in jobs being replaced by AI contributes to the economic divide by negatively targeting jobs considered low-skill.

I will complete some historical analysis to get a better understanding of how the involvement of artificial intelligence in the economy has developed and evolved over time. I will research the history of policy behind AI's impact on economic standings and what the government has done to mitigate it. I will also take part in some discourse analysis, as many circumstances that negatively affect the economic standings of certain groups of people are not necessarily obvious. I will try to find related literature and testimonies that will help me learn about the topics I have stated.

Conclusion:

The Human-Robot Triage project seeks to develop an optimized decision algorithm that enables robots to efficiently prioritize victims during Mass Casualty Incidents, ultimately

reducing the time critically injured individuals wait for medical assistance. By testing various methodologies for victim prioritization and communication within the triage process, this technical deliverable aims to enhance the efficiency of emergency response systems.

My STS research addresses the socio-economic impacts of AI, particularly how algorithmic biases contribute to discrimination in housing access, employment opportunities, and the displacement of certain job sectors. These issues highlight AI's potential to exacerbate existing inequalities, often affecting marginalized groups disproportionately. The expected outcome of this research is an analysis that sheds light on AI's role in economic disparities and offers insight into policy to ensure ethical AI deployment. Together, these deliverables aim to foster a more responsible and equitable approach to AI in society.

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