Thesis Project Portfolio

Toward Robotic Triage: a Distributed Task and Motion Planning Framework for Efficient Human-Robot Emergency Response

(Technical Report)

The Hidden Prejudice of AI: Examining Gender Bias in Algorithmic Decision-Making

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The integration of technology into processes traditionally performed by humans has often been portrayed as beneficial and efficient. Artificial intelligence (AI), in particular, has assumed many tasks once completed by people, such as resume screening and facial recognition. While this shift can save time and human effort, AI decisions have also demonstrated biases that affect large groups of users. This reveals the hidden negative aspects of technological advancement that must be addressed. For example, while robots operating in triage situations can support medics, engineers must ensure that robotic assistance does not delay or obstruct patient treatment. Careful consideration is essential to ensure that the technologies engineers develop are genuinely beneficial.

The technical portion of my project explores how to effectively incorporate robotic assistance in disaster triage environments. In such high-stress situations, medics are often overwhelmed by the demands of finding, prioritizing, and treating victims. Robotic support could enable medics to triage more patients at a faster pace. Our approach utilizes Unmanned Ground Vehicles (UGVs), an Unmanned Aerial Vehicle (UAV), and a medic, with each component playing a distinct role in the triage process. UGVs are responsible for environmental exploration and task identification; the UAV handles the delivery of task information to the medic, who then executes the tasks. Once UGVs locate victims, they deliver the task information to the UAV at a rendezvous point. The UAV then transports the compiled task list to the medic, who prioritizes patient visits based on injury severity and proximity. This behavior was modeled in a Python simulation. Three additional triage approaches were also developed and evaluated using various performance metrics.

Throughout this project, we grappled with important ethical questions, recognizing that our findings could directly impact how quickly victims receive life-saving care. These considerations highlight the profound influence that technology can have on human lives. While technical interventions can offer tremendous benefits, they also carry risks if not implemented thoughtfully.

For my STS (Science, Technology, and Society) research, I chose to investigate the issue of gender bias in AI and strategies for mitigating its effects. Gender bias in AI manifests in various domains, including hiring algorithms, facial recognition software, and language models. Some argue that these tasks should remain the responsibility of humans rather than AI. To better understand the roots of this bias, I examined the historical development of AI and analyzed the actor-network surrounding its implementation. This research underscored how deeply entrenched gender bias is in AI systems and emphasized the extensive effort required to address it. Based on expert opinions and research studies, I found that solutions to gender bias in AI must be multifaceted, involving a combination of more diverse development teams, increased support for women in STEM fields, and the use of more representative datasets.

Exploring both my technical and research projects has revealed the powerful impact that technological involvement in human-centered processes can have. Developing the behavior of UGVs and UAVs for triage assistance required multiple iterations and careful consideration of robot decision-making. I learned how crucial precision is in development work—small oversights can easily lead to unexpected outcomes. Similarly, engineers working on AI tools may unintentionally contribute to bias by failing to address bias directly. As engineers, we must remain conscious of the broader impacts of the technologies we create, particularly on

marginalized groups. The decisions we make shape the experiences of every user, whether or not those users are aware of how those decisions were made.