Thesis Project Portfolio

Hybrid Humanoid Robot

(Technical Report)

Humanoid Robots: A Socio-Technical Study of Their Effect on the Automotive Manufacturing Workplace

(STS Research Paper)

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Executive Summary

Humanoid robots have made large changes already within the automotive industry by improving efficiency and safety for human workers, though they do have drawbacks in terms of workplace environment and job reduction. The Navy is exploring the use of humanoid robots in more dangerous maritime environments, which can be expected to improve quality of life for human workers. For my capstone project, I worked with a team of seven other undergraduate mechanical engineering students to design and build a hybrid humanoid robot with both walking and climbing capabilities. This project is contracted by the United States Navy. My STS Research paper will focus on the relationship between humanoid robots and human workers in automotive manufacturing to determine how humanoid robots change the work environment and the quality of life of humans. My reason for undertaking this research comes from personal work experience in automotive manufacturing, working on incorporating collaborative robots. I was interested in seeing if the benefits for the company in terms of efficiency and saving money reflect benefits for the human workers. My research on the automotive industry will help predict the effects of humanoid robots in the military industry. This will serve as a case study to see how humanoid robots could be implemented in the Navy.

Our humanoid robot is designed to move both on all fours for stability and also just two feet in order to climb ladders, giving it more versatility in difficult terrains. It will work in environments that are difficult for humans due to high temperatures and lack of light. The development process included a four-month design process, including ideation, stress testing, electrical design, and then three months of manufacturing, assembly, and testing. During this time, our programming team worked on the motor structure.

Our robot was designed to be lightweight and easily manufactured by 3D printing all of our parts and using only 2 screw sizes to assemble the robot. The legs are capable of sustaining load, and the arms are able to lift up with some assistance. However, we faced difficulties in making the robot walk due to the weight of the hands and feet. Improvements to make our original design better would be to use stronger motors or to use only pneumatics throughout the whole robot in order to reduce weight. We would also improve on the wire setup to make troubleshooting electrical issues easier.

The research paper explores how humanoid robots affect the work environment and the workforce in automotive manufacturing. The focus is on if increased efficiency and benefits to the manufacturer reflects better quality of life for human workers despite job security concerns and uncanny valley effect. This paper uses Actor-Network Theory to examine interactions between human workers, humanoid robots, and non-human actors, such as money and efficiency.

Reviews of existing literature, coupled with a case study of humanoid robots at BMW, showed that while robots improve efficiency and reduce risk posed to humans through repetitive or hazardous tasks, they also cause anxieties over job security. They may also cause human workers discomfort due to their uncanny appearance. Humanoid robots tend to shift human jobs rather than eliminate them, which require new skills and training. This research concluded that humanoid robots will be used due to their economic benefits for manufacturers. In order to facilitate the human-robot workforce, companies should implement training programs and upskilling opportunities to help workers adapt, which will ease tensions and more smoothly integrate humanoid robots.