Thesis Project Portfolio

Design of a Device for Sorting Ball Bearings by Size and Material

(Technical Report)

Analyzing the Effect of Automation on Workers in the U.S. Automotive Manufacturing Industry

(STS Research Paper)

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Executive Summary

The technical project is an entry into the 2025 ASME Student Design Competition, which is inspired by industrial assembly lines. It is common for items on an assembly line to be sorted and transported, and automated systems can be used to drastically improve the efficiency of these tasks. However, when a task is automated, it is important to consider how the workers who were previously doing the task are affected. They could lose their jobs, or they could face new hazards. In the case of this technical project, the task is to sort ball bearings by size and material, but all sorts of tasks can be automated, including much more complex assembly tasks such as those done on an automotive assembly line. Impacts on workers in the U.S. automotive industry are the focus of my STS research paper. In a similar way that ball bearings being sorted autonomously could potentially displace workers, more advanced robotics and AI are increasingly being applied to automotive assembly, and this has the potential to affect a large population considering how many people work in the American auto industry.

The technical project was to design, create, and test a device that autonomously sorts ball bearings. This device is aimed at automating the repetitive and cumbersome task of sorting ball bearings based on their size and their material. The device is designed to sort three various types of material: steel, nylon, and brass, as well as two different sizes of ball bearings: ¼" and ½". Initially the bearings are poured into the device's hopper by the user. Then when the device is powered on, the hopper opens at the bottom which releases the bearings and allows them to roll into a wheel that is used to raise the bearings to the top of a spiral like track. The wheel also increases the separation between individual bearings for the separation mechanisms. The bearings are first sorted by size using a hole that allows the smaller bearings to drop down onto their own track, where each track has identical sorting mechanisms. Next, the nylon bearings are

sorted out using conductivity, as both steel and brass bearings are conductive, and nylon is not. An actuator then diverts the nylon bearings but allows the steel and brass bearings to continue down the track. Lastly, magnets are used to pull the steel bearings onto a separate track and allow the brass bearings to continue to the final packaging station. This type of device could be used in a range of different industries such as warehousing, auto manufacturing, and other various types of assembly lines that use automated technology to increase efficiency.

As advanced robotics and AI rapidly develop, auto manufacturers are increasingly turning to automation to enhance the efficiency of their production lines and cut costs by replacing human labor. This research thesis seeks to answer the question of how the introduction of advanced automated manufacturing affects the job market, safety, and general quality of life for workers in the U.S. automotive manufacturing industry. The application of AI and robotics in manufacturing is in a stage of growth and is predicted to increase in coming years, so the question will be analyzed through the framework of technological momentum. Analysis of the research finds that automation has the potential to impact auto workers in various ways depending on their ability to learn new skills and how the technology develops as it gains momentum. If auto manufacturers and developers of automation technologies prioritize worker safety and well-being, it is likely that workplace injuries will decrease and many workers will have higher-paying, less strenuous jobs, though there will also be many who lose their jobs. This analysis is relevant because U.S. auto workers are a group that is expected to be affected soon by the current wave of automation, but as AI and robotics develop, more and more workers in all sectors will need to learn to work with this technology.

Designing and manufacturing a ball bearing sorting device while studying the impacts of automation on U.S. auto workers has provided some insight that would not have been as

apparent if the two projects were done separately. Going through the entire process of creating and testing an automated sorting device has shown that there is definitely a lot of labor involved in creating these devices, and also a fair amount of labor required to maintain automated devices and make sure that they are operating properly. It is already known that while automation replaces some jobs, it creates others, but doing both projects has emphasized this idea. Additionally, doing research and writing about how automated systems affect workers has served to put a focus on making the sorting device safe and user friendly, because someone would have to work with it if it were to be used on an assembly line.