

Thesis Project Portfolio

DESIGN OF A DEVICE FOR SORTING BALL BEARINGS BY SIZE AND MATERIAL
(Technical Report)

**THE BALANCE BETWEEN HUMAN INTERACTION AND AUTOMATION
TECHNOLOGY ON ASSEMBLY LINES IN AMAZON WAREHOUSE DURING THE
COVID19 PANDEMIC.**
(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

The modern world is defined by automation. While automation has been a great help to improve the flow and efficiency of the human condition by limiting unnecessary human interactions in manufacturing settings like assembly lines and packaging warehouses, it has not always been adopted perfectly. According to the U.S. Bureau of Labor Statistics, rates of injury among employees due to automated systems in warehouses were “more than double the rate of 2.7 incidences per 100 for workers across all industries” in 2021. This highlights, despite the benefits of automation, there are also some important risks to consider. Knowing this, the goal of major companies like Amazon is, “making it one system of humans and robots working together to accomplish the goal of shipping the product.” Trying to find ways to effectively achieve this balance of technology with humanity has been a difficult challenge, but one that has continually evolved as technology has evolved.

While exploring automation, the goal of my technical project was to construct a ball bearing sorter that would accurately sort 6 varieties of 40 ball bearings completely autonomously in a minute. This would include three materials: nylon, brass, and steel. As well as quarter inch diameter and half inch diameter size for each ball bearing. To start the separation process ball bearings would be loaded into a hopper that would open a gate upon activating a switch allowing the ball bearings to roll down a ramp and be loaded onto a wheel fitted with appropriately sized holes. At the top of the wheel ball bearings would roll down onto a track. Shortly after the ball bearings go through the start of the track, they would pass over a small hole in the track that would allow half inch diameter ball bearings to pass over while quarter inch diameter ball bearings would fall through onto a spirit track to begin their own sorting process. To sort the nylon from the metal ball bearings two copper contacts were placed upon the track so when the

metal ball bearings cross this part of the track a flap attached to a servo motor would allow the metal ball bearings to move forward while diverting the nylon ball bearings to a separate track. To separate the brass from the steel ball bearings a magnet was placed on the side near the track where the magnet would attract the steel ball bearing to one side while allowing the nylon to continue past the magnet along to the track to be sorted. Both the quarter inch and half inch tracks operated essentially the same, but the copper contacts were changed to aluminum sheet metal contacts in the quarter inch track to achieve stronger results for those ball bearings. While our device didn't always work perfectly, especially the conductivity separation for the quarter inch ball bearings, the results were mostly accurate. In the future exploring ways to simultaneously sort all bearings at once as well as ways to improve conductivity and shorten track length would be something our group would have liked to improve during the sorting process.

While I found methods to achieve automation to be fascinating, I also explored the negative consequences of this technology. In fact, the goal of my STS project was to answer the question: how and why Amazon's automated systems outpaced human labor during the pandemic, which led to increased worker fatigue and rates of injury. To analyze this question quantitative methods such labor statistics from the U.S. Department of Labor and rates of injury. Additionally, qualitative methods like employee testimonies and various ethical frameworks such as "Technological Politics" were utilized. The results from these methods pointed to a culture of neglect and as well as prioritization of profit at Amazon not just within this setting but in many other settings around the world that contributed to the negative situation Amazon Employees were caught up in. While it would be difficult to break Amazon's control over its employees, certain measures can still be taken to limit their effects. If nothing is done, Amazon

employees will continue to work in an environment of fear and uncertainty about how to make their living and how to maintain their health.

This year was very stressful but completing so much work I couldn't be more proud of myself. There is still room for improvement, particularly in increasing the efficiency of the technical project and in strengthening sources to flesh out some of the STS theories I used to analyze my ethics paper. Despite these shortcomings, I still was able to construct a ball bearings sorter that functions as it was designed to do and completes detailed analysis of my STS topic. For anyone who would be interested in continuing my work, I recommend continuing to design more efficient sorting methods that would be capable of simultaneously arranging every ball bearing. Additionally, I would also recommend exploring a greater variety of ethical frameworks that could lead to a more varied understanding of my STS topic. I believe expanding on these foundations would improve on my technical topic as well as the depth of my STS project.