Overview

The goal of this project was to redesign a functional prototype of a collaborative tool that could be used by humans and robots for various mounting and dismounting of rotational design elements in Volvo's truck manufacturing process. This project was a continuation of a capstone project from 2017, where Penn State and Chalmers University students collaborated again to improve the previous tool created for Volvo. The tool produced the same result as a traditional torque wrench but with increased adaptability, speed, and efficiency. Instead of the user controlling the speed and duration while performing the operation, the user, either human or robot, would position the tool on the bolt and then let the tool complete the mounting procedure.

Objectives

This project aimed to improve the previous tool by reducing the overall product weight, redesigning the shape to allow for the use of sensors, minimizing the force applied for counter torque, reducing the overall cost, and making the tool more ergonomically efficient for human use.

Approach: The project was divided into an Alpha, Beta, and Gamma phase.

- The Alpha phase outlined the project objectives, team and project management schedule, concept generation and selection, customer needs assessment, relevant patents and existing products research, and target engineering specifications.
- An Alpha prototype of the tool was created in CAD, and presented to the sponsor to ensure the project direction and vision aligned with the customer's original specifications and goals.
- The Beta phase went into further detail about the final concept selection and prototype, as well as analyzed performance predictions and tests for our selected design. The team refined the final design by updating the target engineering specifications based on Volvo's feedback.
- A gearbox and motor solution was used from an existing Milwaukee 3/8 ratchet tool and integrated into the prototype.
- Handles of the tool were tested by students and designed to ensure operator comfort and support.
- The Gamma phase concluded in a physical, 3D printed prototype of our design in ABS plastic with all electrical components integrated into the tool.

Outcomes

- The team produced a functioning prototype that would allow for the mounting and dismounting of screws and bolts on Volvo’s assembly line.
- The tool consisted of a front and back handle, a middle compartment, a Milwaukee 3/8 ratchet tool, three 18650 batteries, and two mock robot connections.
- The main result of this redesign was a collaborative tool with increased operator comfort, reduced size and weight of the tool(<5 lbs), and increased robot compatibility.