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Mechatronics Engineering Student

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Machining Vibration Measurement System

Project
- Designed and built a vibration measurement system for real-time chatter detection in CNC machines.

Implementation
- Created signal conditioning circuity to take input from miniature piezoelectric accelerometers.
- Designed interior layout of control box and magnetic mounting brackets in SolidWorks.
- Programmed 3-axis and 5-axis cuts and operated Hurco CNC machines to test control box.
- Wrote custom signal processing software in Python using NumPy, SciPy, and Matplotlib.
- Developed BOM for box components in Word and engineering drawings in SolidWorks.

Results
- Machine tool lifespan increased by up to 50%.
- Measurements from the system were incorporated as ground truths in the research paper *Transfer Learning for Three-Axis CNC Anomaly Detection in an Industrial Machine Shop*, under peer review.

Laser Cut Truss Bridge
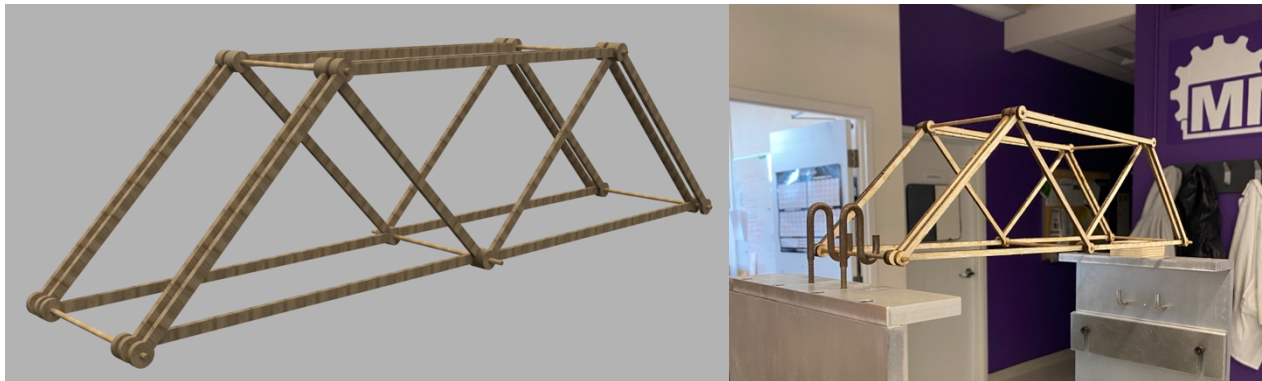
Project
- Designed a truss bridge made of balsa wood and dowels to withstand as much weight as possible.
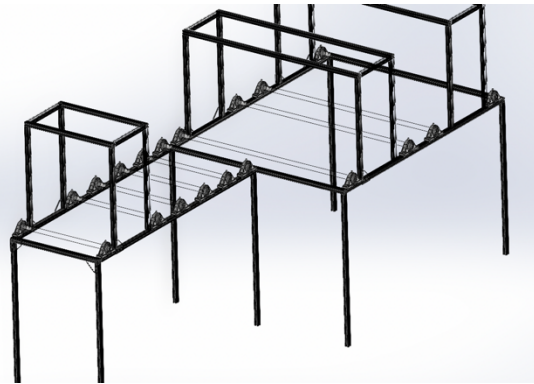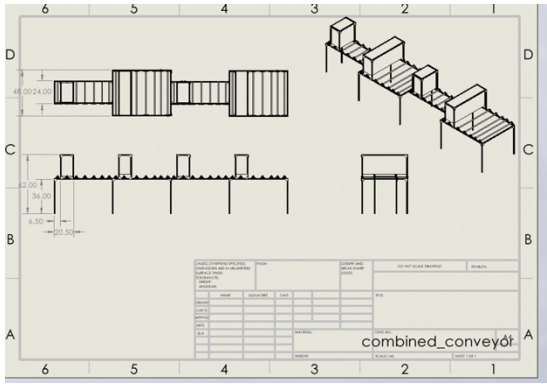
Implementation
- Modeled bridge components in Fusion 360 to produce renders.
- Performed static stress analysis in MATLAB to validate design and predict ultimate strength of bridge.
- Used AutoCAD to create technical drawings conforming to GD&T of bridge components.
- Redesigned components to improve tolerances and allow for a glue-free assembly with interference fits.

Results
- Bridge held up more than 400 times its own weight before fracturing and placed 4th out of 30 teams.
- Predicted ultimate strength of bridge was within 20% of actual value, with the predicted value being greater.

Conveyor Belt Design Project

Project
- Designed a self-sorting conveyor system for moving 10 kg packages and sorting using custom sensor.
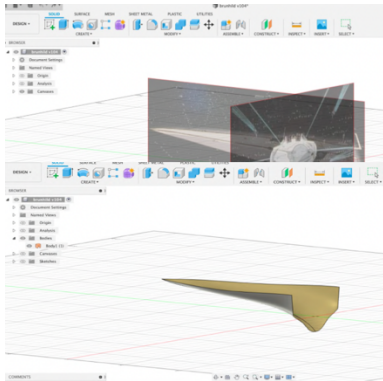
Implementation
- Created assemblies, CAD drawings, and 3D simulations in SolidWorks.
- Design and wired custom IR LED and photodiode sensor for detecting box type.
- Implemented custom Canny edge detector in MATLAB to locate box position and angle from camera images.
- Documented and justified design with technical report and BOM before sourcing parts from McMaster-Carr.

Results
- Successfully sorted all boxes during test day and achieved accuracy to within 1 cm.

Brunhild Model Spaceship

Project
- Created a CAD model of a spaceship in Fusion 360 and optimized design for 3D printing.

Implementation
- Collected reference images from a variety of angles to aid in modelling process.
- Combined surface, mesh, and conventional modelling to create complex, aesthetically pleasing shapes.
- Redesigned components to feature interference fits for glue-free assembly.

Results
- Printed the final model using a Creality Ender 3, fine-tuning print parameters like layer height and nozzle temperature, to produce 8 separate pieces which were then assembled together to form the completed model.