THE ETUG PROJECT

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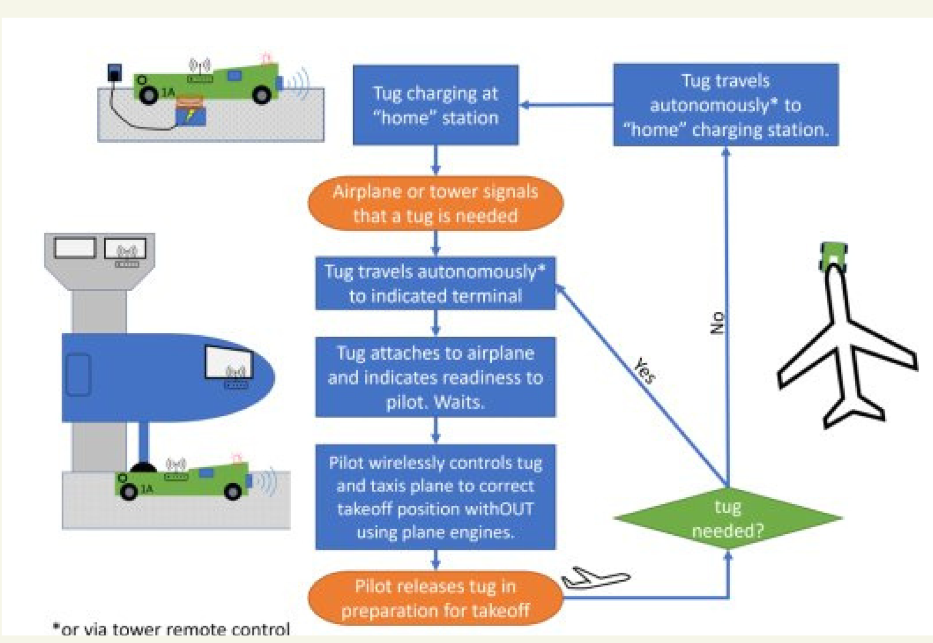
Special Thanks to: Dr. Matthew Jensen, Andrew Peatross, Provo Airport Staff, Salt Lake Airport Staff

MOTIVATION

Air and noise pollution at and around airports is a serious problem with no current solutions.

OBJECTIVE

Create a better environment for airport staff and the surrounding population by reducing carbon emissions and noise pollution through the design of a proof of concept for an autonomous electric tug.



DESIGN REQUIREMENTS

- Multiple Control Options
  - (Remote, Partial Autonomy)
- Automatic Plane Attachment
- Fully Electric Vehicle
- Enough power and range to pull a small aircraft to the runway and then return multiple times
- Ability to monitor the tug remotely

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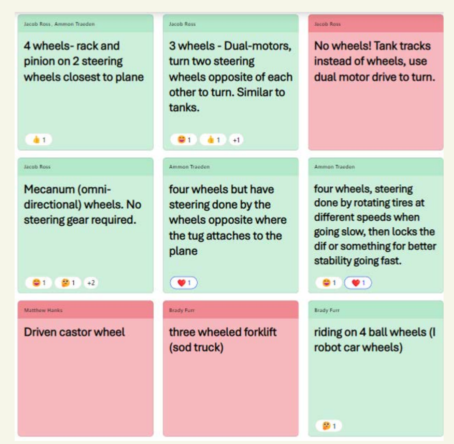
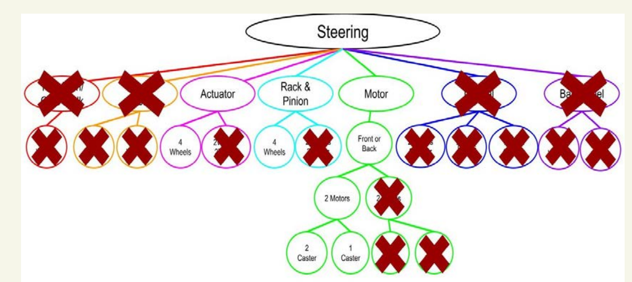
IDEA GENERATION

Brainstorming methods:

- Sticky notes with voting system
- Tree diagram



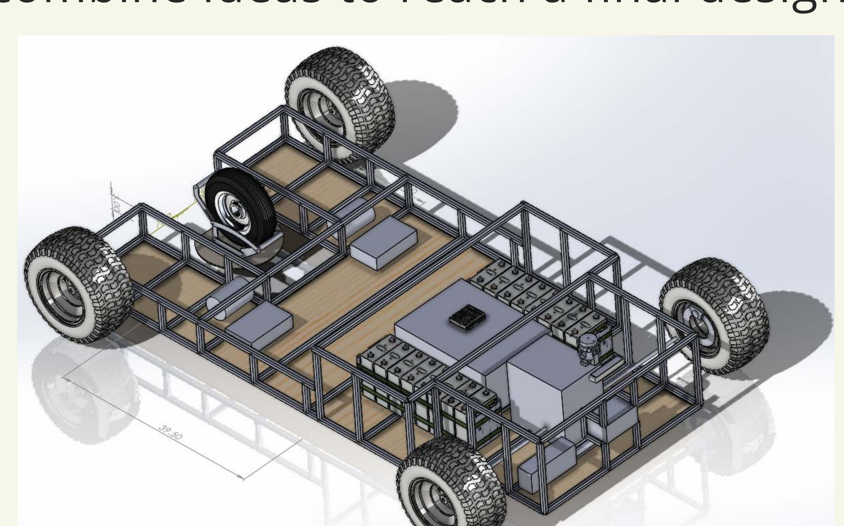


The top ideas moved on to the next step

DESIGN SELECTION

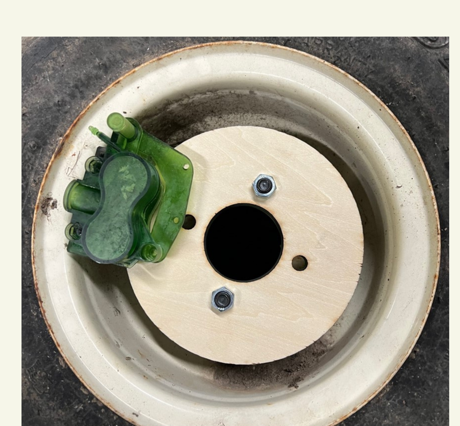
Decision matrices were used to initially rank ideas for each system

After combining, the teams collaborated to combine ideas to reach a final design.



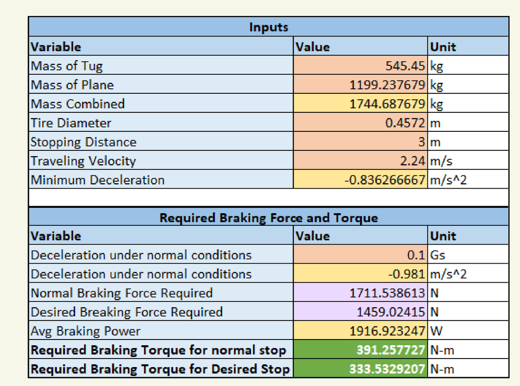
PROTOTYPING

Prototypes were used to test complicated designs and check tight tolerances

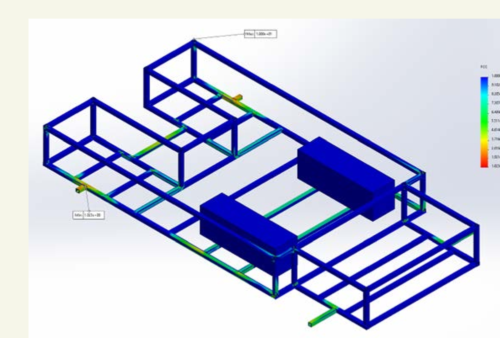


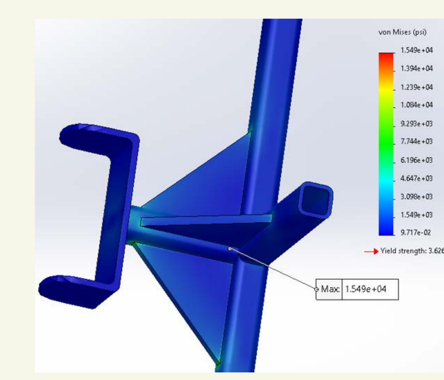
ANALYSIS

Excel calculators were built to ensure the parts ordered would be able to power and stop the tug



Simple FEA was used to show weak points in structural designs and areas for improvement





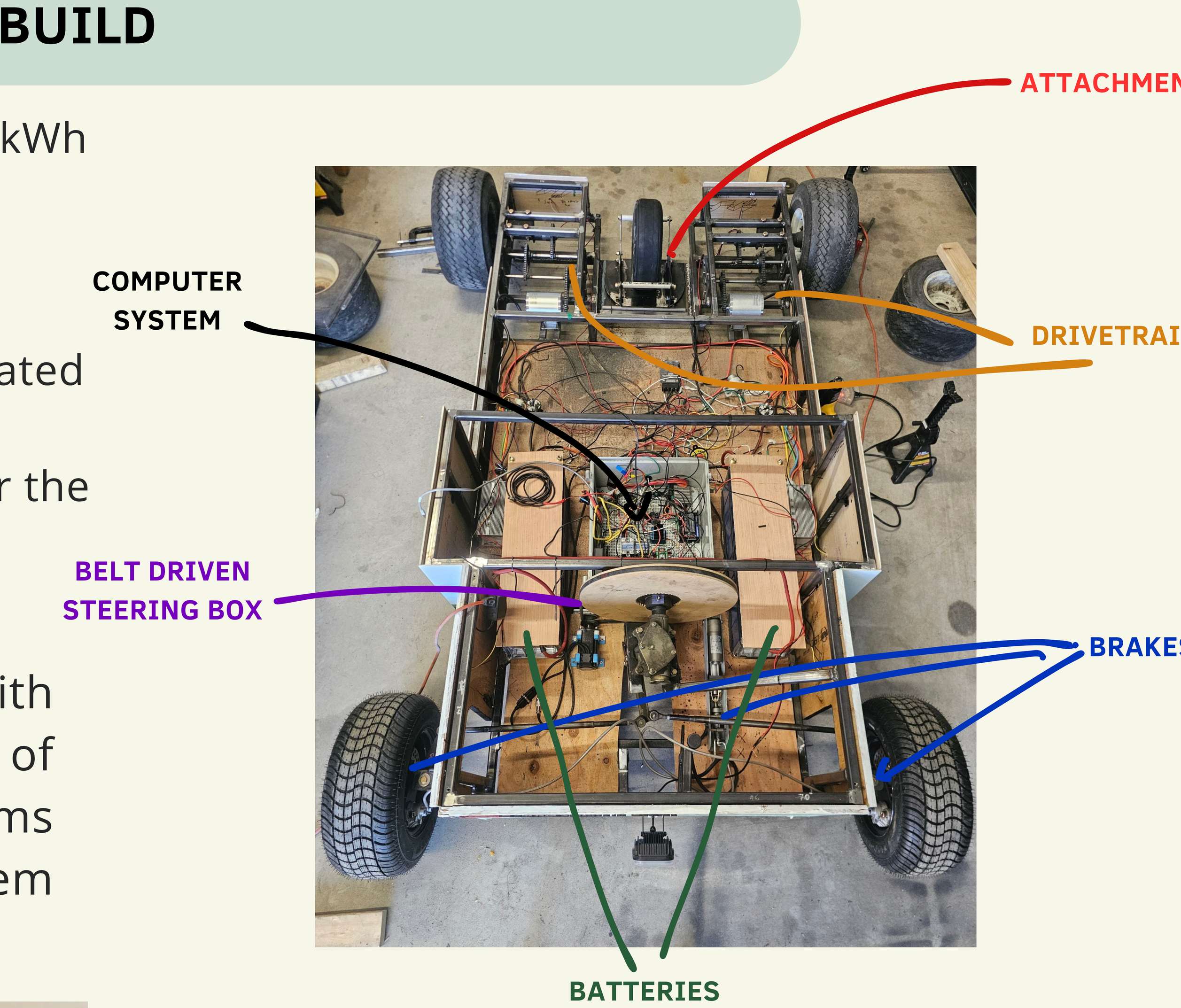
TESTING & REFINEMENT

Functional tests were performed at the Provo airport using a Diamond DA-40.

These tests highlighted weak points to redesign for the final build

FINAL BUILD

- Batteries are lithium-ion from Lion Energy with 14.3 kWh
- The computer controls the entire system
- A hydraulic disk brake system was used
- A stepper motor controls the steering
- The attachment was completely designed and fabricated by the team
- A gearing system was designed and implemented for the dual motor drivetrain



Project Goals Review:

At end of semester, tug is partially autonomous, with features in place to implement a further level of autonomy in the future. The tug's physical systems establish a solid proof of concept of a scalable system that would improve emissions and noise pollution.

Next Steps:

This project succeeded in its goal of being a proof of concept, the next steps for this project are to:

- Refine the autonomous system
- Improve tolerances and functionality of the attachment feature
- Implement lazy susan attachment feature
- Incorporate steering system that is capable of 90 degree steering angles