Adaptive Cycle for a Limbless Individual

Overview
The IM ABLE Foundation tasked us with creating a modified recumbent cycle for Craig Dietz, who was born without fully developed limbs. This project is the second iteration of the cycle. Major modifications were completed on the pedaling, steering, mounting, and shifting mechanisms.

Objectives
The team’s objectives were to create an easy to use, safe, and durable cycle. The team needed to modify the pedaling, steering, shifting, braking, and mounting mechanisms to be usable for Craig.

Approach
- The team began the project by visiting the IM ABLE Foundation and Craig to determine the customer needs of both the sponsor and the client.
- The team reviewed existing patents in order to develop concepts that could be used for Craig.
- These concepts were weighted with the customer needs to determine the recommended design.
- The team began prototyping with cardboard before creating an aluminium prototype.
- Finite Element Analysis was conducted to determine the appropriate spring constants to be used in the ratcheting pedaling mechanism.
- SolidWorks models were created of the pedaling, steering, and mounting mechanisms in addition to the overall cycle excluding the seat and headrest.
- The team created one final prototype to be used by Craig.
- Craig visited Penn State to test the cycle and recommend design modifications. The team measured speed, stopping distance, and turning radius of the cycle.
- These results were then compared to the target specifications outlined earlier in the semester.
- The team modified the cycle based on his recommendations during the remainder of the semester.

Outcomes
- The team was able to create a fully functional cycle for Craig.
- Craig highly rated the shifting mechanism, which was a new addition to the cycle.
- Minor adjustments were made to the braking mechanism in terms of position and sensitivity of the brakes.
- Although the pedaling mechanism was functional, it was deemed impractical for use in a race due to the short distance covered with each push of the pedal. The pedaling mechanism requires major refinement.
- The steering mechanism requires only minor refinements, such as the addition of a fin and adjusting the angle of the steering cup.