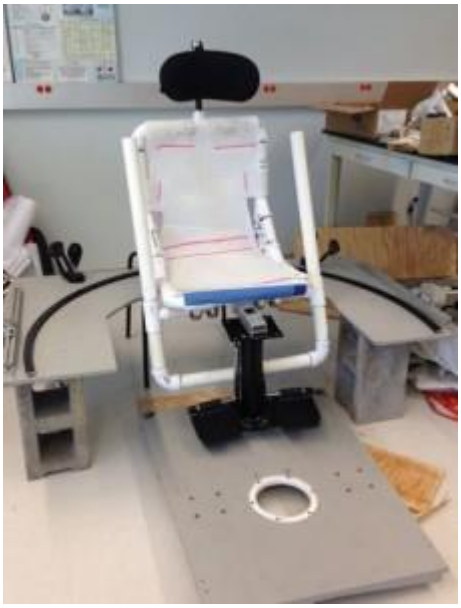
Skipper's Chair - P14032



Jeffery Flowerday, Richard Dzionara-Norsen, Jonathan Nguyen, Kassandra Schlott

ABSTRACT

To those who are able bodied, sailing is often seen as a sport that the disabled cannot participate in. However, all over the world people are sailing not only for fun, but also for competition. This task continues to be difficult, especially with people who have severe spinal cord injuries. We have worked to improve a previous device that allows people who suffer from quadriplegia to be the skipper (the person in charge of steering) of a Sonar sailboat.

We have modified the previous device to allow the user to feel the forces acting on the tiller. This allows the captain to communicate the sailing conditions with the rest of the crew. The device also allows the user to move across the from port to starboard without risk of boom contact.

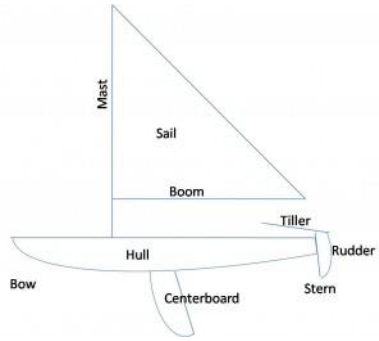


Figure 1: Sailboat with major components labeled

BACKGROUND

The first iteration of this device was designed for a specific user, using a hand crank as the steering mechanism (similar to a pedal mechanism found on a bike). The second iteration focused on allowing the system to be used for people of different size and shape. The design was ergonomically adjusted for use by ninety percent of the population. The second iteration had issues with the crank mechanism and device positioning when in a sailboat. These two issues were considered our top priorities in this third iteration.

We worked directly with the Piers Park Sailing Center team in Boston, Massachusetts. They required that we not only make this device more like original sailing (feeling the forces on the tiller and working better with the rest of the team), but also easier for the volunteers at their center to assemble and install.

APPROACH

As this had been the third generation of this project, we studied the work of the previous teams. We then brainstormed possible changes to benefit the skipper and volunteers that would be installing the device.

Very early on we realized that we would need more than models to understand the previous device; we would need experience. As a result, we took a trip to Boston to meet with Piers Park Sailing Center. We were able to see the first generation of the project in use, and understand the potential upgrades to the device. They also taught us how to sail, in order to understand the difficulties that we might encounter during our design. From this trip we learned what the skipper needed from the device and how Piers Park volunteers needed to have an easy device to install.

From our own designs and our work at Piers Park we determined that we would focus on changing two major sections of the device: the steering and the chair. Because we wanted the device to be as intuitive as possible, we decided to make these redesigned sections with PVC pipe. This would allow the system to be easily fixed and adjustable as well as being much lighter and cheaper than the previous iteration.

We then focused on the biggest change: the steering. Piers Park asked that we design a system that would allow the skipper to feel the forces on the tiller. This would give the sailor a more nature feel, similar to what an able bodied sailor would experience without he use of our device. Although, the skipper cannot see the tiller, he must be able to track the tiller movement. The previous design used a crank mechanism that did not allow for this to happen. We decided to combine the concept of the previous design with a tractor seat device that Piers Park had used regularly.

Figure 2: Crank mechanism used in the previous two iterations

Figure 3: Tractor seat from Piers Park

Figure 4: Lever arms used to move the tiller in the Skipper's Chair. Design based off combination of crank mechanism and tractor seat.

After these changes had been made, we focused on the ease of assembly and installation. We simplified sections like the handholds and the chair. For the chair we purchased a headrest and leg rests to eliminate manufacturing problems and facilitate ease of replacement. We condensed the amount of tools needed and created easily understandable installation instructions for volunteers.

SYSTEM

Many components of the Skipper's Chair were used from the second iteration of the project. These sections played an integral part of the overall design.

Figure 5: Rounded track used to move the skipper from port to starboard

Figure 6: Floor base and pedestal that aids in skipper mobility

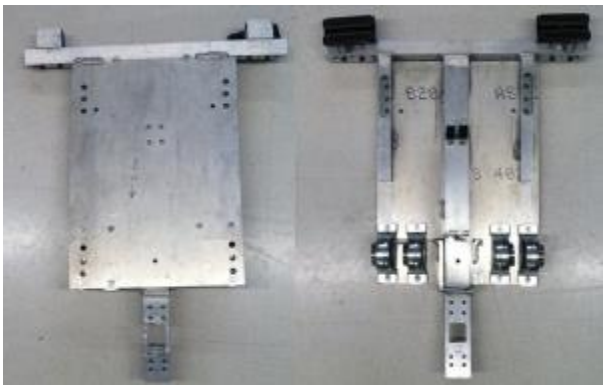


Figure 7: Seat plate Top view (left), Bottom view (Right)

Figure 8: Tiller strut that leads lines from the levers to the tiller

Figure 4: Lever Arms

EVALUATION

We have continuously evaluated the device based on the requirements set at the beginning of the project. We have successfully created a device that allows individuals with limited upper body strength to steer a sailboat and move from port to starboard. However, we are currently unsure of the systems extent of use. Our projected steps are to evaluate the devices usefulness when mounted in a sailboat. This includes the full range of tiller motion, the force that is required by the skipper, and the stability of the system.

CONCLUSION

Many aspects were addressed during the designing, building, and testing portions of this project. Of primary concern, was the ability of the device to steer the sailboat. Other goals were the decreased weight in comparison to the previous iteration and eliminating the risk of boom contact. Because the system was designed for recreational and competitive use, it must not be too complicated or intimidating to the user. Finally, the sailor must be able to feel the force of the water against the rudder in order to increase handling capabilities and fully experience the joys of sailing.

Acknowledgements

- Steers boat
- Lightweight
- User cannot make contact with boom
- Ease of adjustment

- Sailor empowerment

Areas of Future Improvement

- Ease of assembly
- Volunteer/companion assistance
- Force needed to move rudder

The major concern we had during our building process was the steering system. Initially, it was not able to steer a boat efficiently, based on tests we conducted outside of the boat. Another issue was the binding of lines against sharp edges with certain line configurations. At higher tiller forces, the lines became snagged unpredictably due to unlevel pulley configurations. Both of these line issues produced higher frictional forces, which resulted in difficult to move steering arms. Some of these issues were resolved, but we believe that more analysis before building would have allowed this process to go smoother.

If this project does go on to a fourth generation, we feel the team would benefit from not starting over entirely. The focus should be on improving either the lever system or the previous crank system. Both have their advantages, but neither have been 100% successful at this point. If the team chooses the lever style, the ergonomics of the overall system are very easily customizable. Some of these traits can be brought into the crank style if that is chosen.

Overall, we believe the Skipper's Chair will be a valuable tool for sailors at the Piers Park Center and will be a more encouraging device for them to use.

ACKNOWLEDGMENTS

RIT MSD Organization for funding

Dr. Kate Leipold, RIT Mechanical Engineering Professor acting as Faculty Guide

Dr. Tim Landschoot, RIT Mechanical Engineering Professor

Keith Burhams, Member of the Rochester Yacht Club

Caitlyn Ridgely, Piers Park Sailing Center Adaptive Recreation Director

Piers Park Sailing Center Staff

P13032, 2nd iteration of Skipper's Chair