

ABSTRACT

The design team partnered with Innovation One and Turnstone's USA Goalball team to improve a goalball launching device first constructed in 2023. Goalball is a Paralympic sport designed for athletes with visual impairments, emphasizing auditory and tactile skills. The device is intended for team practice to reduce the stress on players and coaches by mimicking human throwing motions in terms of speed, velocity, angle, bounce, and curvature of a 2LB goalball. The specific goals for redesign to improve the electrical systems, reduce vibration and noise, and improve control of the ball.



Figure 1: Goalball Players

GOALBALL HISTORY

Goalball was created in in the 1940s after WWII to rehabilitate soldiers who suffered from eye injuries. The game is played on a 9-meter by 18-meter wood or rubber court. For reference this is the same size court that indoor volleyball is played on. There are two nets located at each end of the court that stretch the full width of the court. It is a 3 vs. 3 game where players take turns throwing or rolling a 2lb goalball across 3 different sections (landing area, neutral area, landing area) with points scored if the ball makes it into the opposing teams net without being blocked.

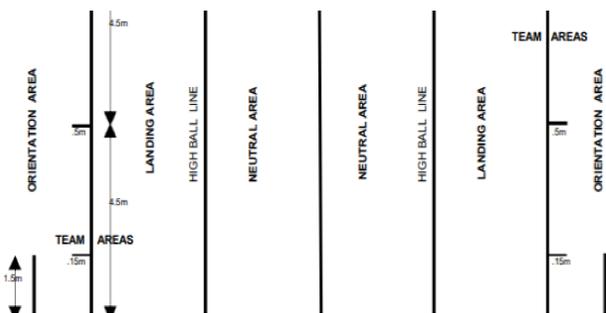


Figure 2: Goalball court layout

CUSTOMER SPECS

The U.S. Paralympic Team needs a machine that will accurately launch a goalball with enough power to replicate a human throw. The list of customer needs is shown below.

Table 1: Needs and Specs

Customer Needs	Target Specs
Various Shooting Speeds	20, 30, 40 mph intervals
Different shot angles	180-to-90-degree angle variance
Low Noise level	60 decibels or less
Height	3 feet or less
Number of Bounces	3 or more bounces

CHALLENGES/LESSONS LEARNED

Base/Wheels/Mounts:

The initial way the wheels had been mounted caused them to rotate improperly due to collision with the mounting screws. The vibration and noise of the motors has been a major challenge that was drastically improved by correcting the misaligned axles, adding spacers and tightening bolts/nuts.

Electrical/programming:

The previous electrical design was insufficient and failed to work properly so an entirely new circuit was designed and had to be built. All new parts were purchased, and a new PCB was programmed.

Lessons Learned:

- Electrical components can malfunction and break unexpectedly, so back-up plans and options need to always be considered.
- Thorough analysis of every component can prevent future problems from arising such as stability and case issues.
- TPU takes longer than most polymer materials to 3D print and needs an adequate amount of time to finish and trouble shoot.

FINAL DESIGN

This section shows the finalized version of the current goalball machine and its various components

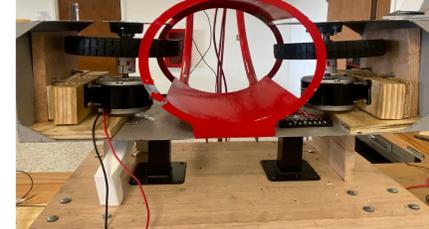


Figure 3: Final Machine



Figure 4: Motor Speed Control Dials



Figure 6: Wheel, Shaft, Coupling and Bearing

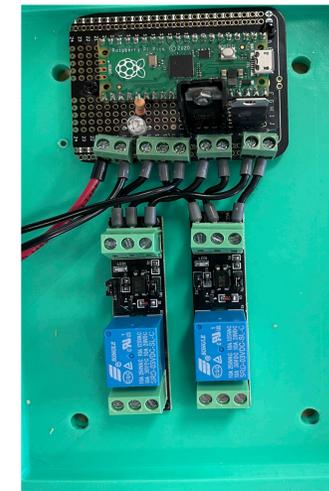


Figure 5: Electrical Panel

CONCLUSION

The team has created a functional machine that still needs some key improvements. The team accomplished the goal of creating a mobile machine with variable firing speeds. However, the vibration of the machine at high speeds causes too much noise for it to be usable in goalball. Additionally, the ball has an issue of hitting the top lip of the machine when released from high on the handle.

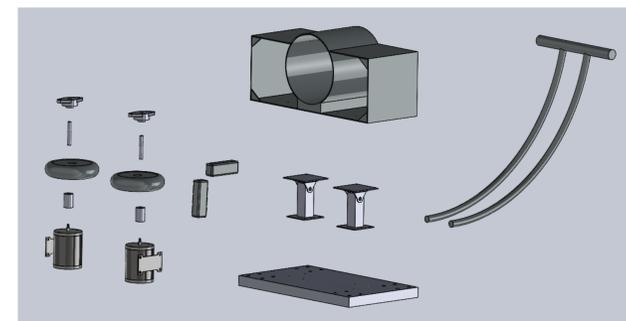


Figure 7: CAD of Final Machine

DESIGN ALTERATIONS



Figure 8: Old Control Panel



Figure 9: New Control Panel



Figure 10: Old Mounting System



Figure 11: New Mounting System



Figure 12: Old Wheel & Shaft System



Figure 13: New Wheel & Shaft System

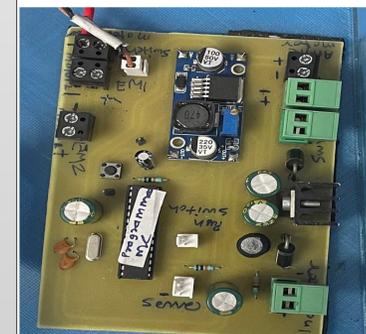


Figure 13: Old Electrical Panel

The team made many design improvements to the Goalball Machine including an updated control panel, wheels, electrical circuits, wiring and batteries, couplings, shafts, bearings, and motors mounts.

ACKNOWLEDGMENTS

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