

## ABSTRACT

Trine University was contacted by the coach of the United States National Women's Goalball team, Jake Czechowski, to research and develop a goalball throwing device for use during training activities. Goalball is a team sport for the blind and visually impaired and is played competitively worldwide and in the Paralympics.

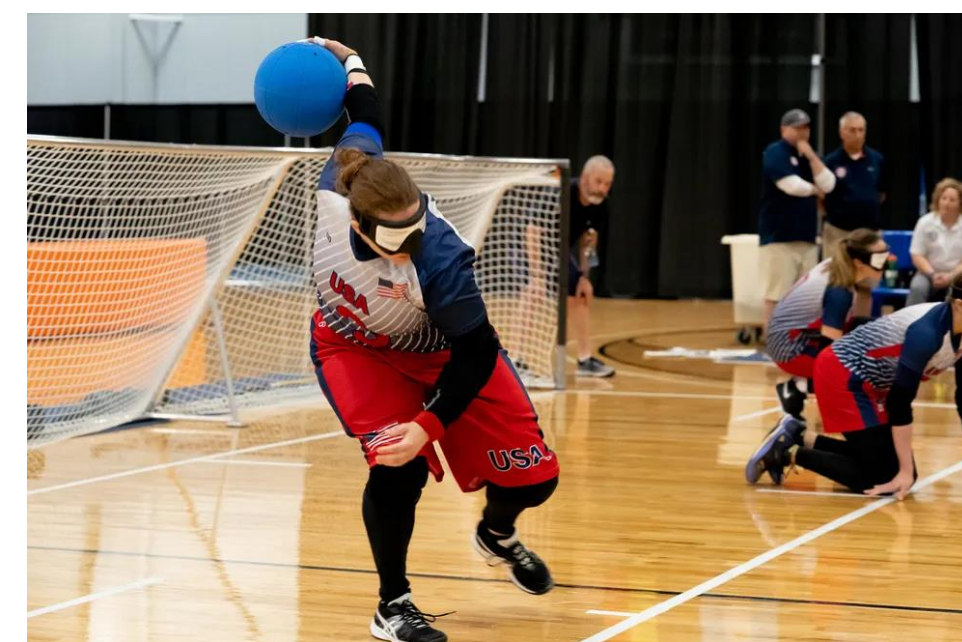


Figure 1: Official Goalball    Figure 2: USA Goalball Player

The goalball is 9.4 inches in diameter and weighs 2.8 pounds. This ball is thrown at speeds of approximately 40 mph and released very close to the floor. This throwing device is crucial to maximize training while preventing injuries to the athletes.

The team was tasked with producing a device which will simulate a goalball "pitch" as closely as possible.

## CUSTOMER NEEDS/SPECS

After meeting with the sponsor there was a lot of good information gathered on what the requirements and specifications are for this device. These are shown below:

**Table 1:**  
Customer Needs

NEEDS
Machine Mobility
Device on wheels
Ball feeder system
Height adjustable
Tolerable noise level

**Table 2:**  
Design Specifications

SPECIFICATIONS
Shoot at least 56ft
Velocity @ 45mph
Weight 70lb or less
Max height 3 ft

## DESIGN CONCEPTS

There were many concept designs considered for this project, including both completely new designs and modifications to existing equipment. Ultimately the team decided to purchase a machine, the "Nevon Projects soccer ball throwing machine, and redesign the device to fit the specifications of goalball.

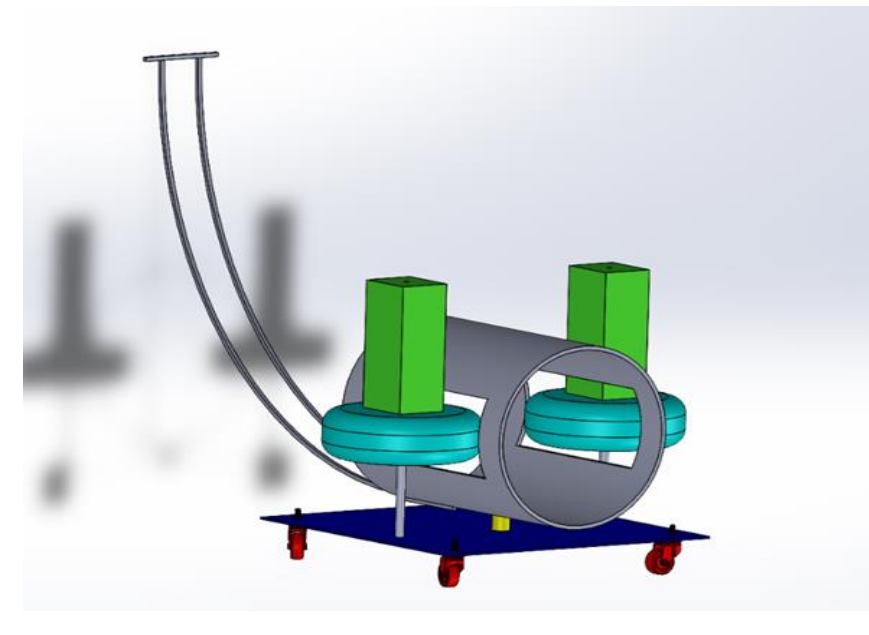


Figure 3: Team Design Concept



Figure 4: JUGG Soccer Ball Throwing Machine



Figure 5: Nevon Projects Soccer Ball Throwing Machine

## TEST RESULTS

The battery pictured below in Figure 9, is the recommended battery to use and 2 were required. This battery is a 11.1V, 2200mAh, 50C LI-PO battery. There are two motors, one being used on each wheel, as pictured in Figure 10. These motors are 24VDC Permanent magnet DC motors. However, the circuit was only wired to deliver 11 V to these motors. A harness was created to wire 2 batteries in series to deliver appropriate voltage to the motors (Figure 9). However, the it was determined that the other components in the circuit are cannot take that much power.



Figure 9: 11.1V(2) LI-PO wired in series



Figure 10: Two 24VDC Permanent Magnet Motors

## FINAL DESIGN

After communicating with our sponsor and gathering data from the goalball teams practice, we decided to go with a design that was a ready to assemble machine from an online company that would need a few different changes to fit the needs of goalball. This machine was initially built for soccer, which is helpful because a soccer ball and goal ball are very close in size. This machine also has a mechanical height adjuster, and ball release lever that fits the needs of our customer.



Figure 6: Rear View of Final Device



Figure 7: Front View of Final Device



Figure 8: Operation Buttons

## FUNCTION TESTS

The device has several functional problems:

- Main ball throwing motors are not matched in voltage to the rest of the electrical system.
- The ball release motor and linear actuator to control angle of release do not function.
- Significant time was spent re-soldering components to the pcb and creating good connections to the pcb.

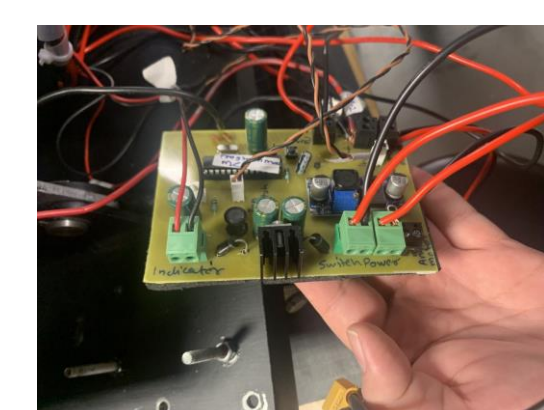


Figure 11: PCB Motherboard

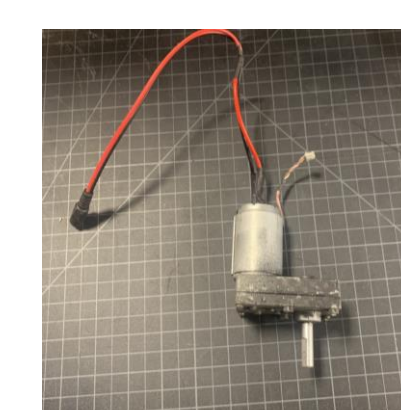


Figure 12: Linear Actuator



Figure 13: Ball Release

## CONCLUSION

In conclusion, the team successfully built and reverse engineered a device that will launch a goalball but does not yet meet the full needs of the sponsor. The purchased machine had many design and construction flaws. The team was able to identify these flaws and attempted to make improvements but did not have sufficient time to complete the necessary changes. It is recommended that this project be continued with a future senior design team to allow more time for electrical and mechanical improvements. This device presented many challenges, and while the final design may not yet be ready for use, it is believed that the device is capable of meeting the needs of the USA National Goalball Team.

## LESSONS LEARNED

There were many lessons learned throughout the multiple phases of this project. Some of the key lessons learned are:

- Time management skills
- When purchasing products from overseas companies, delivery and communication are more challenging
- What is advertised is not always what is received.
- Working as a team is crucial and is a great way to succeed. Without teamwork, the completion of this project wouldn't have been possible.

## ACKNOWLEDGEMENTS

The Goalball throwing device team would like to thank our sponsor, Jake Czechowski for allowing the group to create a device that will be used by the USA National Goalball Team.

The team would also like to thank Innovation One for funding the project to its completion.