



Engineering a Drum Frame Mount

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Engineering Problem & Goal

Engineering Problem

- Playing music is an essential part of many people's lives (Alfredo et al 2015).
- For individuals with limited hand mobility, finding resilient and robust accessible drums or drum mounts is difficult.

Engineering Goal

- The goal of this project is to engineer a drum frame mount to stabilize and position a drum for individuals with limited hand mobility.

Background

- Music therapy can be used to develop strength and range of motion in individuals with disabilities (Alfredo et al, 2015).
- Loose hand grip is often caused by osteoarthritis, rheumatoid arthritis, nerve damage, or tendinitis.
- Moreover, people with lower grip strength are seven more times likely to be facing mobility issues (Harvard Medical School).
- Loose hand grip and hand contractures can prevent people from doing everyday activities requiring hand mobility.

Competitors

Summary Table of Competitors				
#	Competitor	Price	Pros	Cons
1	Wheelchair Drum Straps	\$30.00	Allows clients to hold a drum	More suited to carry and store drums than support drum while the client is playing
2	Remo Wheelchair Clip	Unknown (Can't be bought)	Can attach to the front of the wheelchair, adjusted for drum size and various angles	Weak and flimsy build, disliked by the client
3	Wheelchair Tray	\$20-30	Washable and can be used with multiple instruments	Large, bulky, may limit the mobility of the client, make them feel uncomfortable, and cost-inefficient
4	Drum Frame Stand	\$49.50	Holds a paddle drum by the rim and can be adjusted for different drum sizes with rims	Stands on the ground and not accessible by the client

PDR Designs

Telescoping Adjustable Drum Holder

- Smaller concentric circles make a flat circle to support drum bottom
 - Adjustable for different drum sizes
- Drum holder connected to a clamp

Two Way G-Clamps

- Holds the drum from the side and clamps to table/wheelchair

Miniature Table

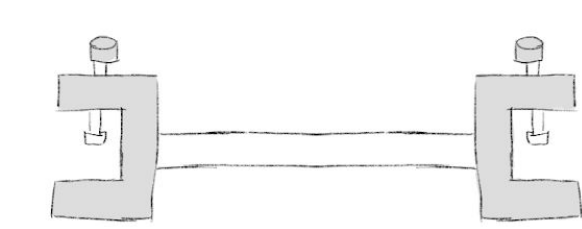
- Can be added to wheelchair trays or tables to provide a platform for a drum

Requirements

Table 1. List of Requirements For the Drum Frame Mount

#	Requirement Type	Requirement Statement	Level (1-3):	Prototype 1
1	Functional	The device shall be able to hold a drum without slipping.	1	YES
2	Functional	The device should be able to play the drum without slipping	1	NO
3	Functional	The device shall attach to wheelchairs.	1	MAYBE
4	Functional	The device shall be adjustable for different sized drums.	1	YES
5	Functional	Less Tension Under Force	1	MAYBE
6	Functional	Less Mobility During Use	1	YES
7	Functional	The device allows the instrument to swing or move.	2	NO
8	Physical	The device shall be cleanable.	1	YES
9	Physical	The device shall be made of a non-foam type material	1	YES
10	Physical	The device may attach to tables.	2	YES
11	Physical	The device should be easily reproducible.	2	YES
12	User	The user or caretaker should have the appropriate instructions or knowledge of how to attach it.	1	YES
13	User	The user or the caretaker has the ability to clamp the drum mount to a wheelchair or table.	1	YES
14	User (user-requested)	The device shall be made of durable materials.	2	NO
15	Cost	The device shall be made of less than \$30 of materials.	1	YES
16	Documentation	The device shall have a user's manual in the form of a booklet.	1	YES

CDR Designs



G-Clamps with Straight Rod Connector

- 3D Printed G-Clamps with PVC Pipe



G-Clamps with Metal Hose Neck

- Similar Design
- Allows for attached drum to be adjusted



G-Clamps with Slotted Ball Hinge

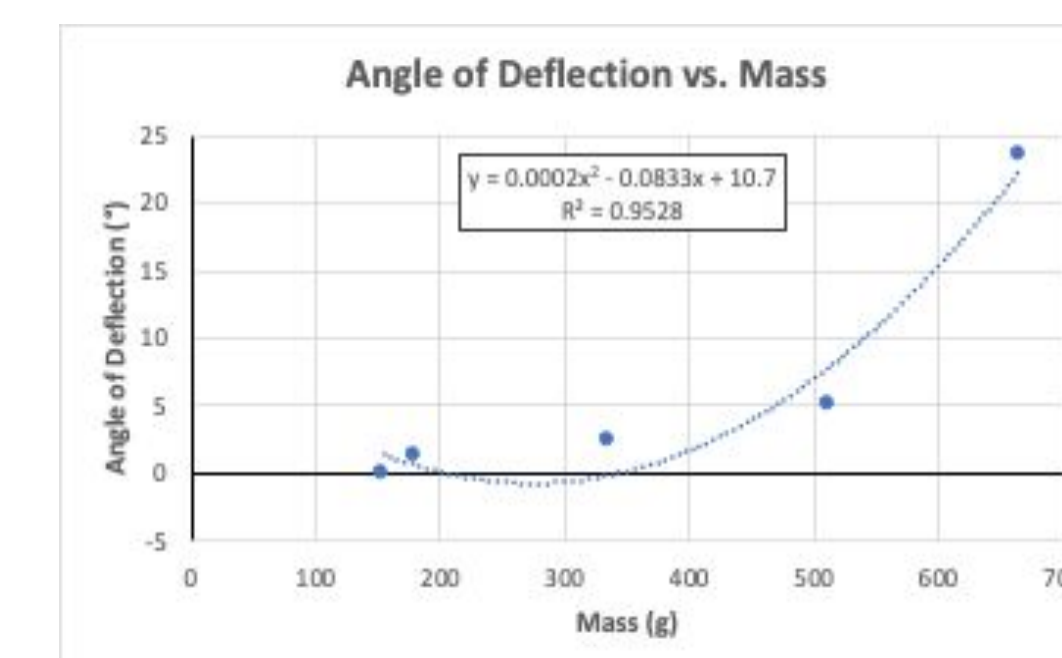
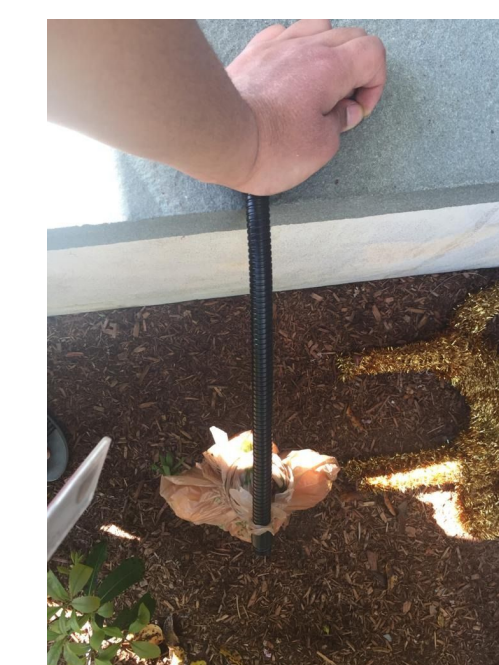
- Similar Design
- Allows for attached drum to be adjusted but more stable with locking mechanisms

Materials

- 1 ¼ #8-32 Truss Head screws
- #8-32 Hex Nuts
- PVC Pipe
- G-clamps (3D printed)
- Slotted Ball Hinge (3D printed)
- Metal hose neck (only tested in design studies)



Design Study 1



- Tested metal hose neck for its angle of deflection when masses of different weights were exerted on it.
- Metal hose neck did not deflect much until ~660g, this predicts a high angle of deflection with a paddle drum.

Design Study 2

G-Clamp Grip testing: Summary Table				
Trial #	Diameter	Weight	Score	Comments
1	N/A, it is a ruler	25 g	6.3	There was tension around the hole where the screw enters the g-clamp there was bending around this area as well. The ruler was able to be pried off the g-clamp.
2	5.75"	475 g	9.3	Holds on to uneven circular surfaces well Could use a rubber attachment on the protector to better grab
3	6.75"	735 g	4.6	Failed 2nd and 3rd test because it fell off when attached to lifted clamp, Pried off on last test



- Conducted qualitative testing on grip strength of g-clamp.
- G-clamp does not easily move, however does bend against clamp.

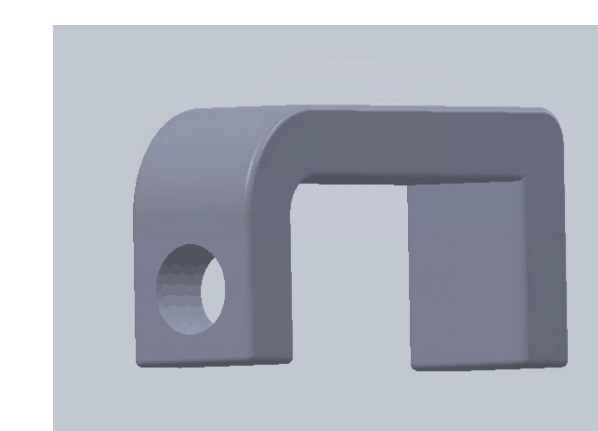
Design Study 3



G-Clamp Strength Testing: Summary Table				
Trial #	Diameter	Weight	Score	Comments
1	N/A it is a ruler	25 g	6	
2	5.75"	475 g	4	showed signs of deformation and tension. It was around the hole.
3	6.75"	735 g	0	Clamp screw on the verge of breaking.

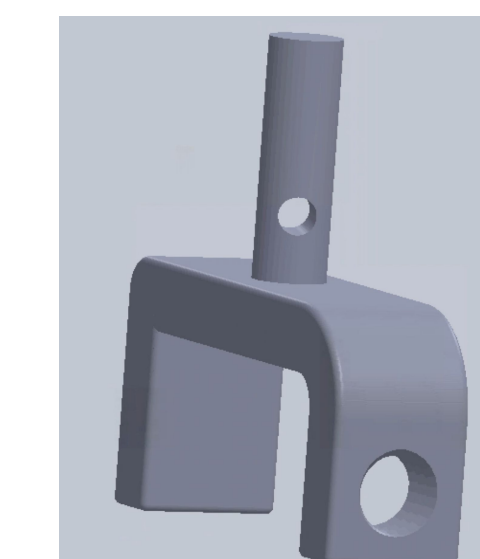
- Conducted qualitative testing on strength/tension resilience of g-clamp.
- G-clamp is weak on the screw, breaks easily under stress from heavy objects.

Clamp Iterations



Original Version

- Could not connect to PVC pipe
- Protector and screw were unaltered and functioned correctly



Modified Version

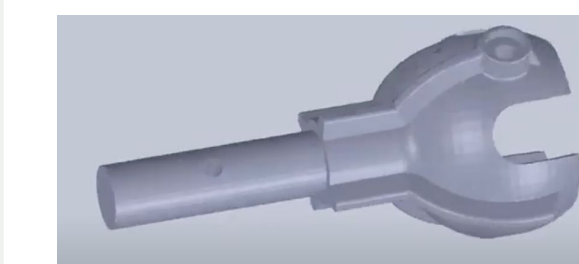
- Cylinder smaller than PVC pipe diameter added to frame
- Hole in cylinder to put screw connecting it to pipe

Slotted Ball Hinge Iterations



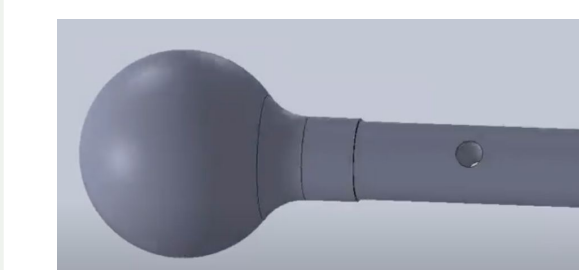
First Version

- Wasn't compatible with PVC pipe due to plates
- Leg couldn't go into slots



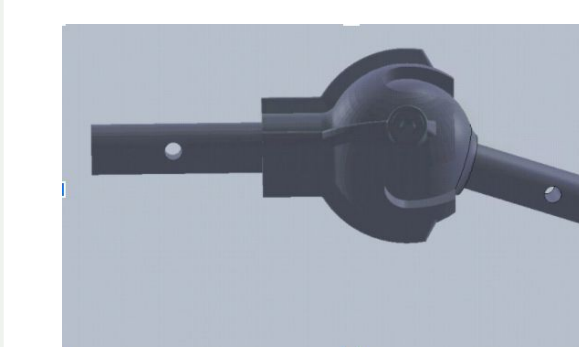
Second Version

- Removed plates & split assembly into parts
- Added cylinders with holes for screws to attach to PVC
- Had to be printed assembled because ball couldn't be pushed into socket



Final Version

- Changed assembly to prevent fusing between ball and socket
- Joined assembly into one part



Final Design



- Implemented straight-rod connection with two G-clamps and a PVC pipe connection.
- PVC/G-clamp connection is reinforced with screws.

Conclusions

- Outperformed other prototypes in projected/qualitative tests
- Versatile for various positions/variations in carrying drum
- Screw breaks easily in G-clamp
- May reduce sound quality when clamped inside the drum

Future Work

- Fortify the G-clamp screw by inserting a metal base rod inside the screw to ensure that it can withstand the force of repeated hits on a heavy drum.
- Add rubber stoppers at the end of the G-clamps to ensure no slipping at the end of the g-clamps.
- Build the slotted ball hinge into the PVC pipe as outlined in the preliminary designs section.