Engineering a Drum Frame Mount

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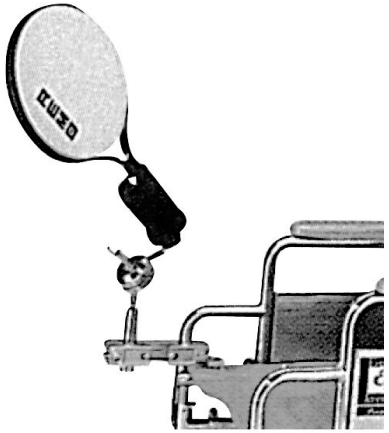
Problem Statement & Goal

- Playing music is an integral part of many people's' life (Alfred 2015).
- Many times playing the drums is hampered by limited mobility in individuals' hands.

Therefore, the goal of this project is to **engineer a drum frame mount to stabilize and position a drum** for individuals with limited hand mobility.

Competitors



Remo paddle drum clip (currently used by client) (West Music)

- Versatile & Flimsy

Drum Straps (The Rhythm Village)

- Requires strapping around user

Grover drum stand (Pro Percussions)

- Can only position from floor

Requirements

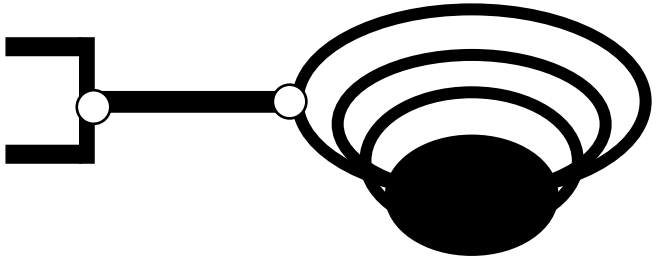
#	Requirement Type	Requirement Statement	Level (1-3):
1	Functional	The device shall be able to hold a drum without slipping.	1
2	Functional	The device should be able to play the drum without slipping	1
3	Functional	The device shall attach to wheelchairs.	1
4	Functional	The device shall be adjustable for different sized drums.	1
5	Functional	Less Tension Under Force	1
6	Functional	Less Mobility During Use	1
7	Functional	The device allows the instrument to swing or move.	2
8	Physical	The device shall be cleanable.	1
9	Physical	The device shall be made of a non-foam type material	1

Requirements

#	Requirement Type	Requirement Statement	Level (1-3):
10	Physical	The device may attach to tables.	2
11	Physical	The device should be easily reproducible.	2
12	User	The user or caretaker should have the appropriate instructions or knowledge of how to attach it.	1
13	User	The user or the caretaker has the ability to clamp the drum mount to a wheelchair or table.	1
14	User (user-requested)	The device shall be made of durable materials.	2
15	Cost	The device shall be made of less than $30 of materials.	1
16	Documentation	The device shall have a user's manual in the form of a booklet.	1

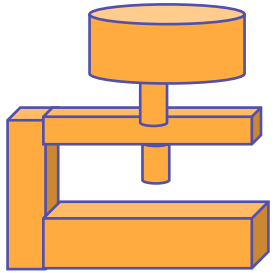
PDR Overview

Telescoping Adjustable Drum Holder



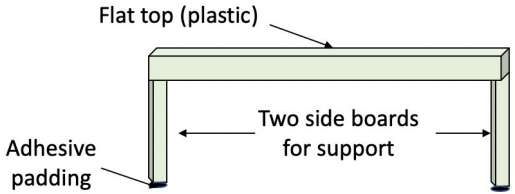
- Multiple concentric circles
  - Smaller concentric circles make a flat circle to support drum bottom
  - Adjustable for different drum sizes
- Drum holder connected to a clamp

Two way G-Clamps



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

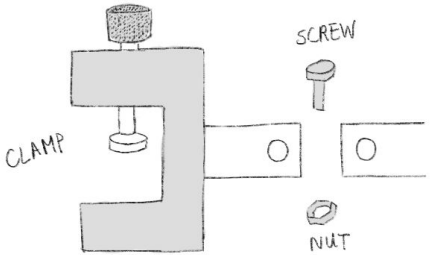
Miniature Table

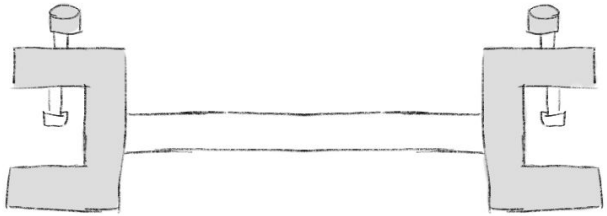


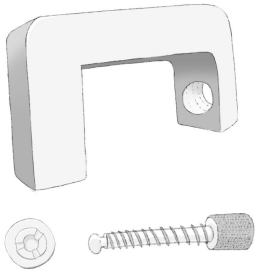
- Small table that can be added to wheelchair trays or tables to provide a platform for a drum

Design: Prototype 1

Two-Way Clamp With Straight Rod



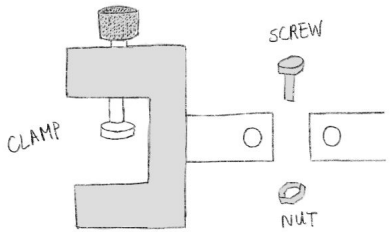


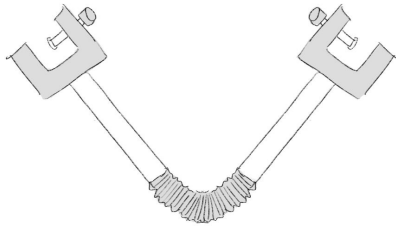


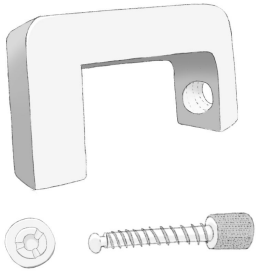
- Two 3D Printed G Clamps that consist of the frame, clamp protector, and the knurled knob
- Single PVC pipe connected to clamp with a screw that passes through both poles
- Most basic functioning prototype

Design: Prototype 2

Two-Way Clamp With Metal Hose Neck



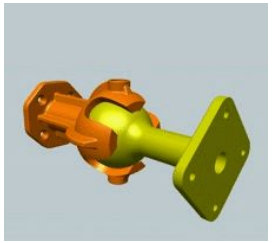


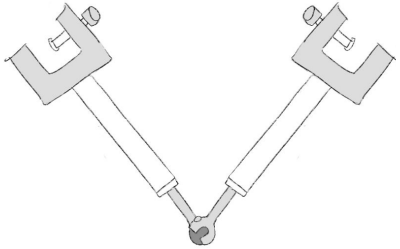


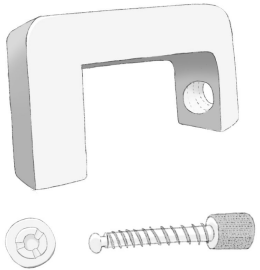
- Two 3D Printed G Clamps that consist of the frame, clamp protector, and the knurled knob
- PVC pipes connected to clamp in same way
- Metal hose neck allows for mobility of the drum to suit the client's needs

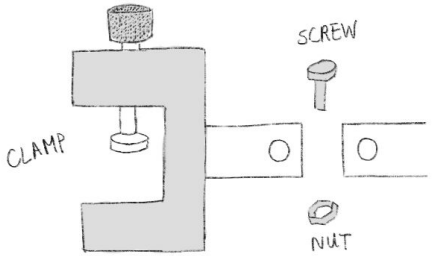
Design: Prototype 3

Two-Way Clamp With Slotted Ball Hinge









- Two 3D Printed G Clamps that consist of the frame, clamp protector, and the knurled knob
- PVC pipes connected to clamp in same way
- Slotted Ball Hinge also allows for mobility but is more stable with locking mechanisms

Build Process - Clamp

Original Version

- Used for proof of concept in CDR
- 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

Build Process - Slotted Ball Hinge

First Version

- Used for proof of concept in CDR
- Wasn't compatible with pvc pipe due to plates
- Leg couldn't go into slots

Second Version

- Removed plates from the ends of the hinge
- Realized that cylinders on the ends would need to be smaller to fit in PVC pipe

Build Process - Slotted Ball Hinge

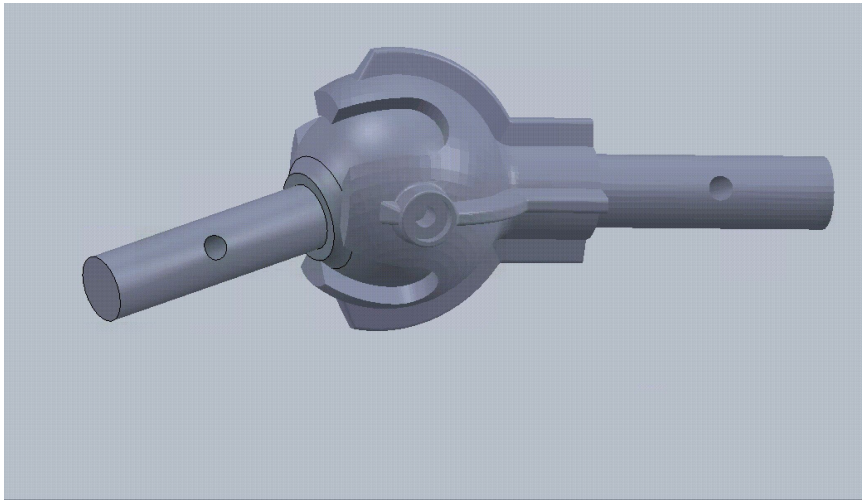
Third Version

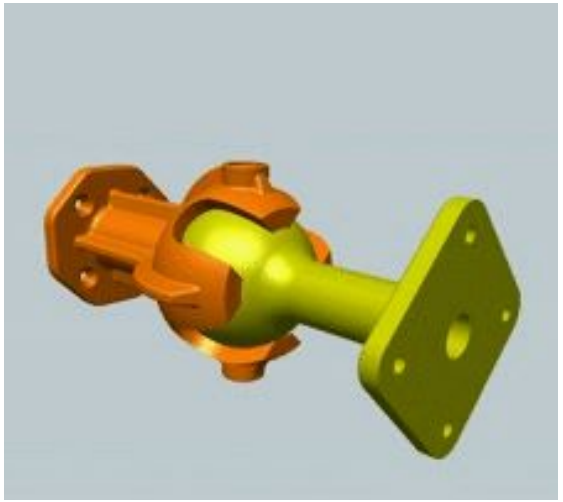
- Split assembly into parts
- Added cylinders with holes for screws to attach to PVC
- Had to be printed assembled because ball couldn't be pushed into socket

Fourth Version

- Created assembly and printed
- Ball and socket fused together and part would not move

Build Process - Slotted Ball Hinge

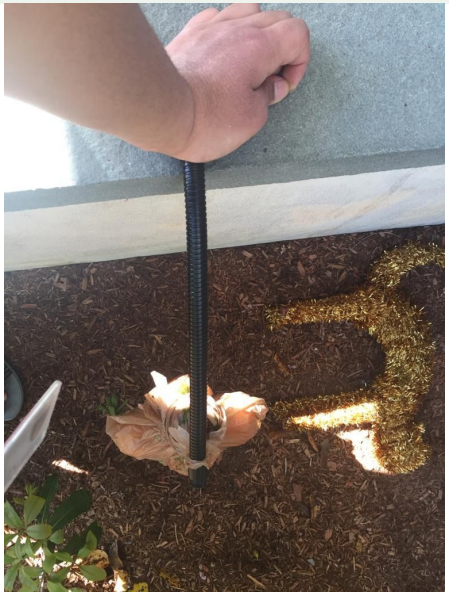


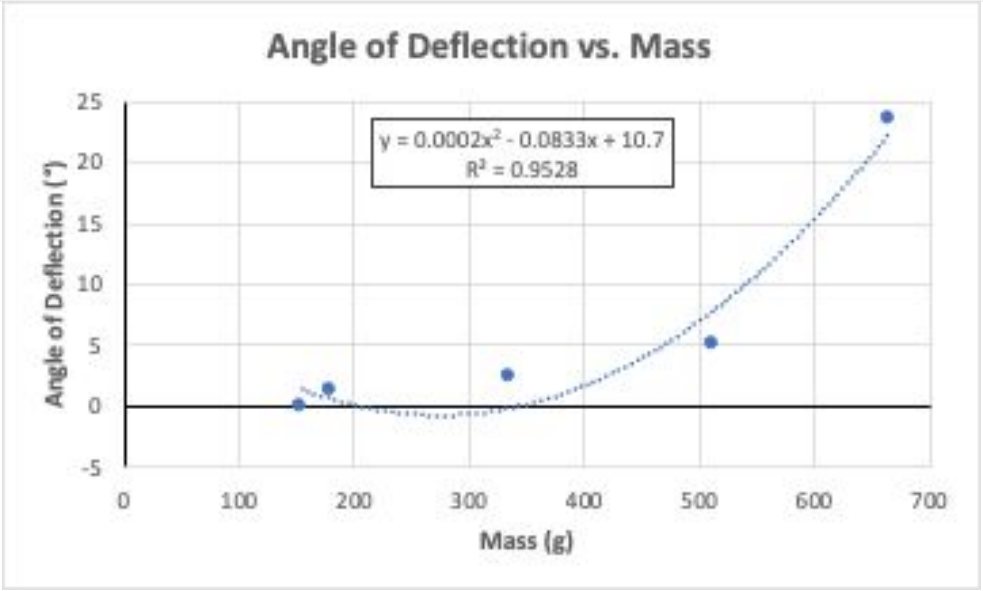


Final Version

- Changed assembly to prevent fusing between ball and socket
- Couldn't be implemented into prototype in time

Design Studies (Metal Hose Neck)





- 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 Studies (G-Clamp I)

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

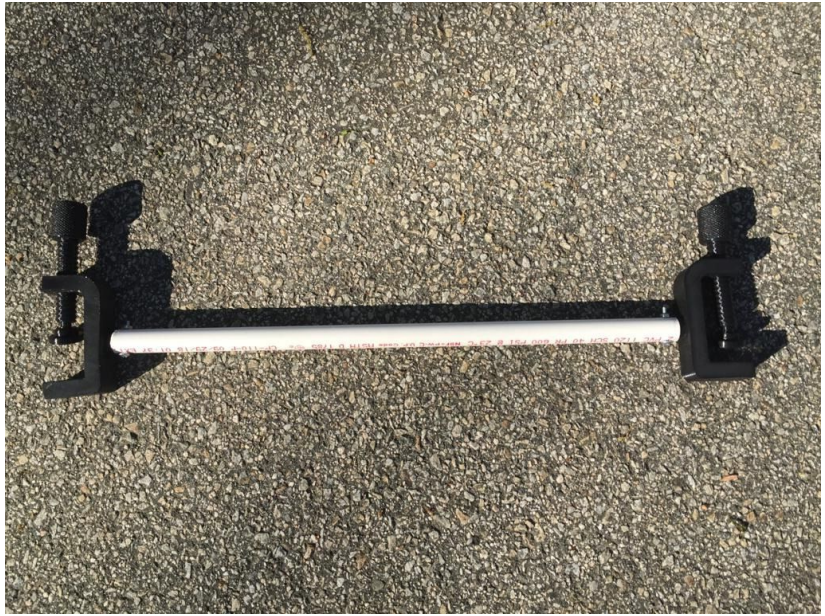
- Conducted qualitative testing on grip strength of g-clamp.
- G-clamp does not easily move, however does bend against clamp.

Design Studies (G-Clamp II)

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.

Final Prototype



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

Final Prototype

Orientation 1

Video

Evaluation of Final Prototype

- 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

Orientation 2

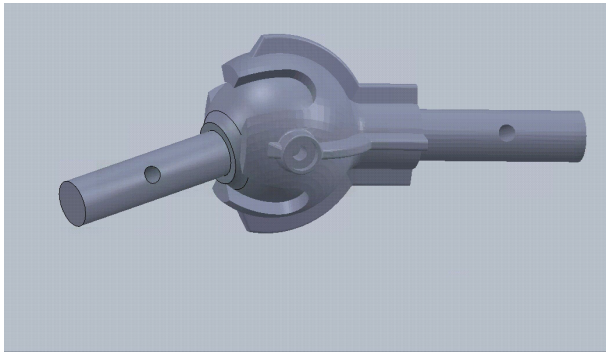
Requirements (Pass/Fail)

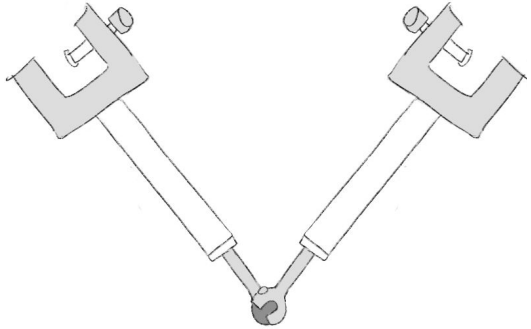
#	Requirement Type	Requirement Statement	Level (1-3):	Prototype 1
1	Functional	The device shall be able to hold a drum without slipping.	1	YES
2	Functional	The device should be able to play the drum without slipping	1	NO
3	Functional	The device shall attach to wheelchairs.	1	MAYBE
4	Functional	The device 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

Requirements (Pass/Fail)

#	Requirement Type	Requirement Statement	Level (1-3):	Prototype 1
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

Future Studies





- 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.

Questions?