

# **Project Documentation 2**

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# **1 Conceptualizations**

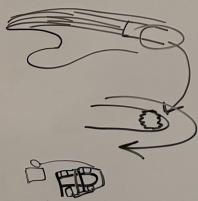
## **1.1 Brainstorming**

USB-Connection  
Esp Board



### Materials

- carbon fiber
  - diamond
  - titanium
  - cloth
  - rubber
  - aluminum
  - plastic
  - nylon
  - PLA
- to get?  
cost?



### FRAME

Plastic - PLA / 3D printed material  
glove - et cloth

TPU - flexible, high elasticity, soft

### design superficial

- comfortable - should dig into skin
  - lightweight
  - pastel
- tech
- air propulsion
  - actuators
  - hydraulics
  - pulleys - fishing line
  - Rotor Pulley

Soft for User Comfort  
or Rigid for Structural Support?

↓  
SOCKET 15 total?  
3 per finger

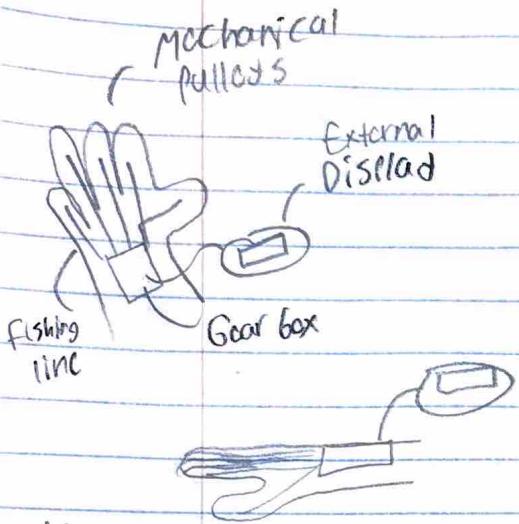
- rubber
- neoprene

- hydraulics  
- Flex Sensors  
- bowen cable

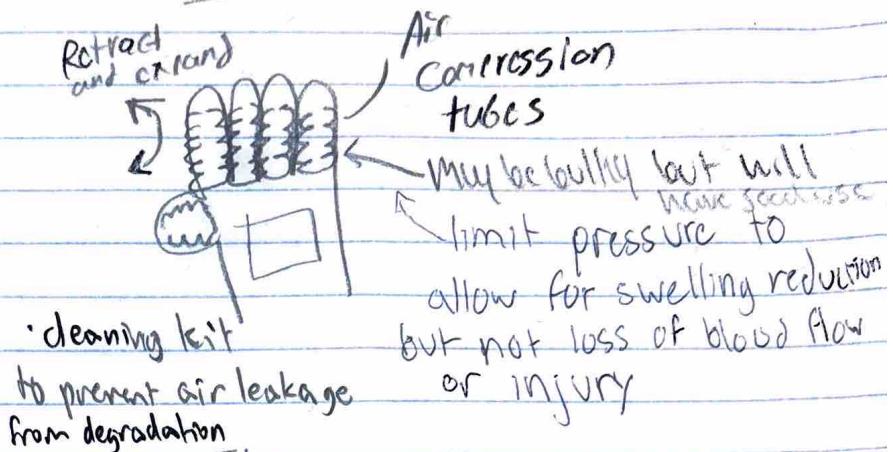
## 1.2 6-3-5 Method

Jhavany Uribe

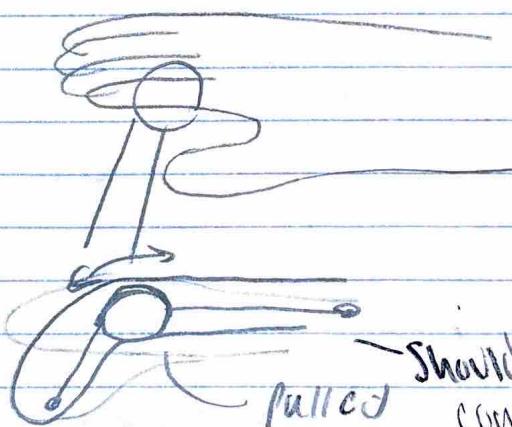
### Idea #1



### Idea #2

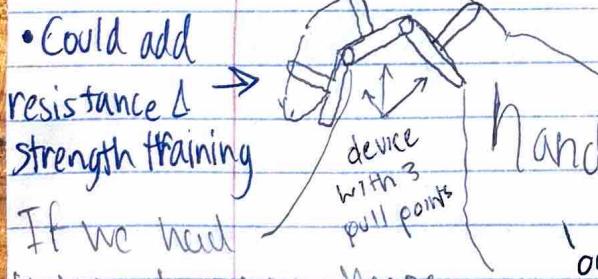


### Idea #3



- Add sensors to track pulley line movement

Single finger device should be compound pull from the bottom:



• Could add resistance & strength training  
If we had a way to rotate these from a distance, could be a good way to move them

Program device from app to allow quick changes, contain all parts to the finger itself

Hand-Cranked hand rehab device

one pulley for each finger  
~~base toe and the toe joints not help separate joints help the finger move with natural pulley~~

Should have electrical connection to driving device, so wires included.

Use Apple M1 chip

for the device, maybe an RTX 5090?

use esp/Arduino for device

hold in multiple fingers with latex glove that houses any additional hardware flat beneath the fingers

- fit in flex sensors beneath fingers
  - add a compartment on the glove to house pulley system
  - Will be easy to transport when electronics are held inside, wires can easily be inside or outside glove depending on comfort.
  - maybe not latex... but cloth! or a breathable cloth that doesn't feel too warm / make the user overly heated... a thin glove? But the material should be strong enough to hold off the device ...
- we could have an exposed part of the glove so that sanitization could happen easier during a visit to the therapist

Create an app to monitor usage, progress, and allow patients to communicate with therapists

- We can implement our potential app software into existing healthcare apps like MyUCDavis or EPIC
- Make it like a game

This is a great idea.  
There could be a license  
doctor view and a patient  
view of the all. Making it a good idea unless it's not

- Can be remotely viewable by physical therapists so they can view progress remotely.
  - being able to communicate with the therapist via the device is a great idea. that way they don't need to make a visit if they have any questions/progress check
- Very high weight to strength ratio to make it a safe and effective rehab option
- Use hypoallergenic & biodegradable materials to provide comfort, hardware will add weight
- Create program to set comfortable ranges for fingers
- Maybe a calibration system upon first use that can variably change overtime.
- waterproof glove.

Comfortability and wearability should be crucial

# C: Akash Srinivasan

maybe a charging station so it charges during routines or overnight?

- Use supercapacitors & batteries in conjunction  
So batteries work for longer
- Could keep the device constantly powered and make it a stationary device
- Prolonged battery life could allow for the user to not need to charge the device, only recharge during therapy sessions.
  - I agree it would be best if it isn't something that needs to be recharged often, hopefully though the basic mechanics of the glove doesn't need too much battery to function
  - solar powered? batteries?

Solar powered was  
an idea I had at one point  
but it wasn't practical after  
some testing

- AR/VR interactivity
- track improvements from device using an app
- helps USC visually track change in performance. Or help visualize work that needs to happen
  - yes. helps with consistency as well.

Need  
more  
explanation?

could use animations  
and app-trackable  
progress

## Charge with USB-C for convenience

Use a durable, soft leather like  
Nubuck for each part in contact  
with the hand

- Step Motor or Servo
- Pneumatic air valves
- Multiple electronic servos may be needed for full finger movements.
  - yes. - one for each finger?

## Might get power intensive?

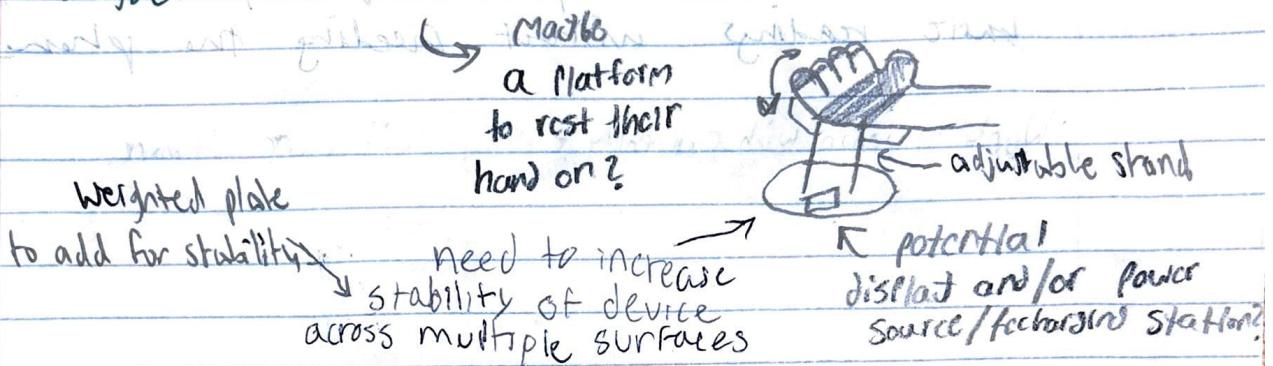
Would servos make too much sound? Maybe we need to suppress the sound to not inconvenience user

might be  
a lot of  
noise?  
optical?

## 1) Object that keeps the hand off of the table (elevated).

↳ this is a good point because they might want something to rest their hand on while they do the exercises and not want to hold it up (fatigue, can get in the way of things), or if they can't?

maybe ... wait this is for putting it on ... now.



## 2) Give that homes electronics like flex sensors and wires, which attaches to mechanics.



could increase stability with watch-like band of components

New idea:

Different material wires for fingers depending on condition?

difference in progress, human variability, etc. we need separability finger function



↳ There is more variety and accessibility

Different colors for each will to track progress at all?

How to deal

w/ people who have irregular joints

Make it waterproof

Sweat proof / Breathability

Should introduce a calibration exercise for new users to determine

which REMOTE exercises between contain within glove for simplicity and

these "Natural States"

1. Flex sensor to measure the bend of the fingers.
2. External connection to battery and microcontroller for lighter weight.
3. Perform simple therapeutic exercises for fingers.

These should be located under the finger to properly detect angle and range.

yes I agree

It could be attached using hot glue

This should have a hub so it can be easily transferable.

yes

something like this?

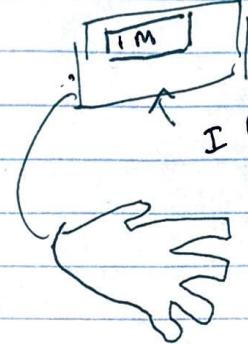
Maybe these should be pre-adjustable routines with set patterns of movement.

Yes I agree

diff basic pulses may

can choose but you can also customize your own (i.e. the physical therapist can make some themselves for the patient)

Flex sensors could determine "Neutral State" or position at which the hand starts at



I feel like it should not only be the hub but also have

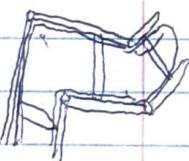
a display screen for basic readings like from the activators + setting the range

Finger may need to bend in two directions

Jarvis

Maybe it could be voice controlled to accommodate more users?

1 simultaneously, use pairs of pulleys top and bottom



Confirm Routine

2 waterproof to allow hot-cold therapy

Use real-life hand rehab exercises & simulate those thru glove

Incremental adjustments to finger movements during practice routines?

3 material that needs to be sanitized and not washed



6 Maybe various different exercises like a massage chair

Mitten design

Eliminate glove, instead of separate fingers its all joined (except the thumb) scope

Grill would be a challenge

this could be for more getting the general movement back instead of bigger fundamental issues like paralysis.

As in someone who just wants to regain strength after taking off a cast

Mitten design allows for it to be lighter weight but may lower effectiveness or splinted with another for support, perhaps the strength of other fingers alone is enough to trigger more mobility.

↳ is there another way without pulleys?

diffs how would one big pulley work? (individual hinges so force across certain joints can be controlled)

could recruit something instead of a pulley... idk.)

easier gripping motion

webbed fingers?

One pulley seems unpredictable though convenient. I think we need to think about the hand being able to open AND close, and that one pulley will provide less control

(G) Chalances and pull finger tips

Skeleton glove.

Think of a reverse fingerless glove. Hand will be exposed but also hardware?

Use Andy for human experimentation??

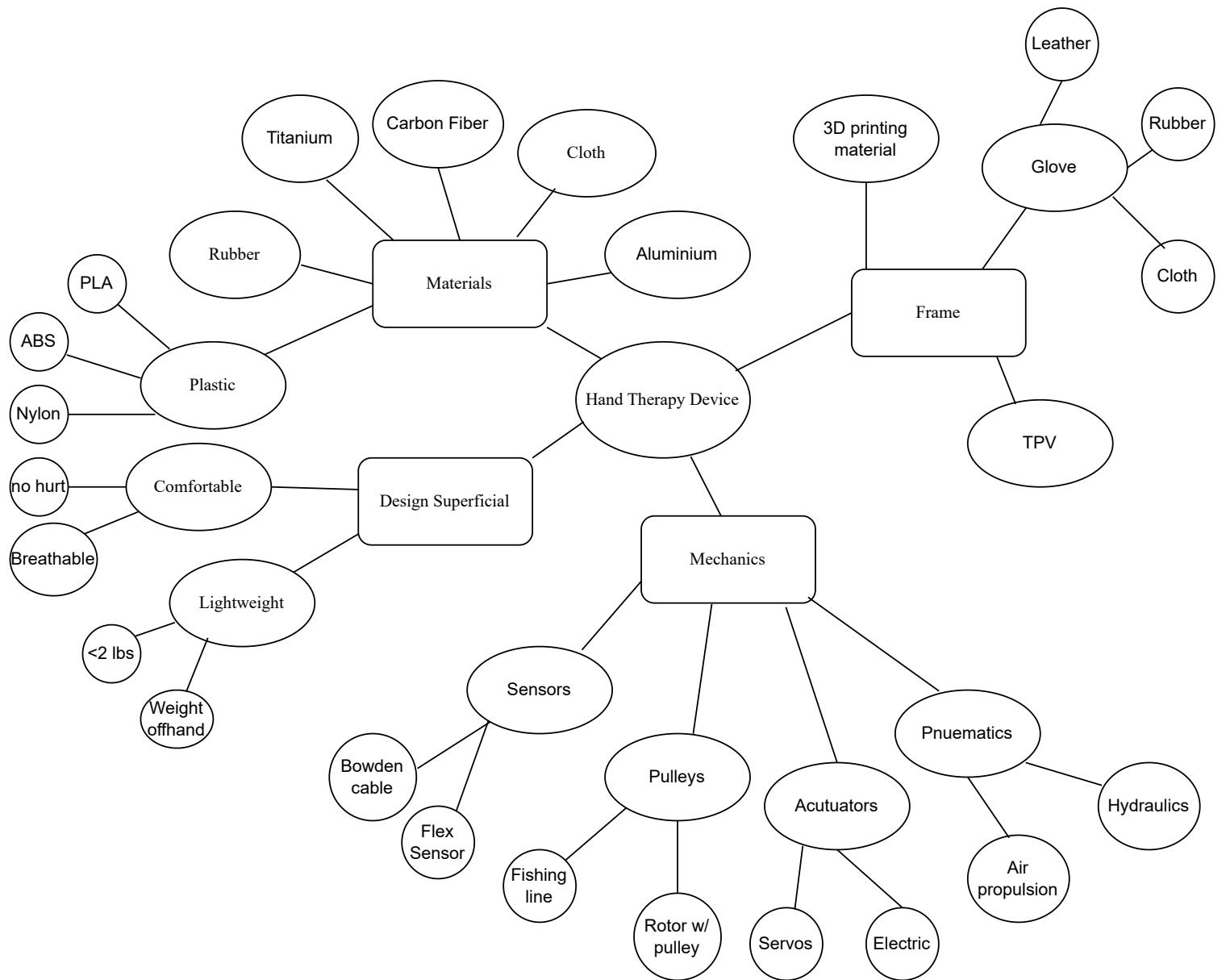
Good for prototype, want to have aesthetic glove for final product

↑ Mini Servos instead of 1 giant servo handling one pulley

### 1.3 Morphological Chart

Velcro Straps 	WSL/Ubuntu 	Wooden Hand 	Fishing Line 	Rotor Pulley 
Gloves 	Raspberry Pi 	Silicone Hand  FLEXIBLE FINGERS Finger joints are flexible like real hand	Bowden Cable 	Air Tubes 
Hot Glue Gun 	ESP32-C3 			Plastic (PLA) 
	Arduino 			Actuators 
				Neoprene (Rubber) 

### 1.4 Mind Map



## 1.5 Decision Tables

Criteria	Weight (%)	Design 1 (Attached Fingers)		Design 2 (Prosthetic Hand)		Design 3 (Pneumatic)	
		Raw	Weighted	Raw	Weighted	Raw	Weighted
Wearability (person)	20	8	160	7	140	7	140
Cost	30	9	270	6	180	3	90
Damage Likelihood (device)	10	8	80	6	60	5	50
Power Consumption	5	10	50	8	40	6	30
Weight	15	9	135	5	75	4	60
Functionality	20	6	120	9	180	10	200
<b>Total</b>			815		675		570

Criteria	Weight (%)
Wearability	20
Cost	30
Damage Likelihood	10
Power Consumption	5
Maintenance	15
Weight	20

## 1.6 Gantt Chart

WBS Number	Task Title	Start Date	Due Date	Completion (%)
1	Planning	01/23/25	02/07/25	100%
1.1	Work on Assignment 1	01/23/25	02/03/25	100%
1.1.1	Establish problem/need statements	01/23/25	01/23/25	100%
1.1.2	Develop personas, LaTeX document	01/27/25	01/27/25	100%
1.3	Brainstorm design ideas	01/29/25	01/29/25	100%
1.3.1	Submission 2, Acquired materials	02/03/25	02/03/25	100%
1.3.2	6-3-5 Method, Decision Table	02/05/25	02/05/25	100%
1.3.3	Morphological Chart, Gantt Chart, Mindmaps	02/10/25	02/10/25	100%
2	Prototyping	02/12/25	XX	5%
2.1	CAD designs, 3D printed objects, flex sensors	02/12/25	02/12/25	100%
2.2	TBD	-	-	0%
3	Testing	-	-	0%
4	Refinement	-	-	0%

Table 1: Gantt Chart Table