Tatum Robotics Glove Project

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EDFD-450-01 Degree Project I

Massachusetts College of Art and Design

Table of Contents

Introduction

Research

Ideation

Prototyping

Synthesis

Conclusion

Introduction: Tatum T1

Tatum Robotics' Tatum T1 is a robotic system that outputs natural tactile sign from mainstream communication media, providing freedom and privacy to DeafBlind people who have historically depended on braille and live interpreters for communication.

The unique geometry of the robot and various needs of DeafBlind users required that a new glove be designed specifically for the Tatum T1.

Tatum Robotics

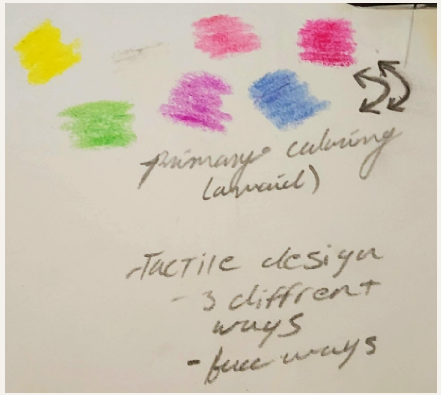
Research: Initial Notes

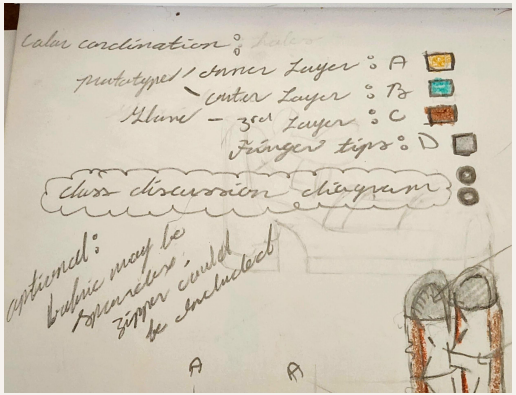
- Material: soft texture, similarity to human hand
- Functionality: should not limit ROM
- Durability: washable? Replaceable padding?
- Style: Color and texture coordination
- Embellishment: 3D simulation of hand creases?

What materials have we tried so far?

Material	Link	Pros	Cons
Dragon Skin Silicone	https://www.smooth-on.com/product-line/dragon-skin/	• Very flexible	• Very hard to manufacture with thin walls • Need molds (expensive) • Users thought it felt very sticky and warm • Users thought it felt like a monster
Arthritis Compression Gloves	https://www.amazon.com/gp/product/B07CTN28F7/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&th=1&psc=1	• Tight to the fingers (no gapping) • Familiar feel for DeafBlind users	• Tightness limits motion of the thumb • Users preferred something smoother • The color was limiting (tan). Solid color prevents shadowing on the glove – difficult for people with low vision.
Elastic Gel Arthritis	https://www.amazon.com/gp/product/B0919T6VN1/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1	• Tight to the hand • Allowed for full ROM of the thumb	• Easily dirty • Leaves residue on users hand • Again, users thought it felt sticky
Short Satin Opera Gloves	https://www.amazon.com/gp/product/B07KXQRBUV/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&th=1	• Tight to the hand • Users liked the smooth feel • Users thought it felt cold (preferred to feeling hot)	• Coloring prevents shadows (similar to above) • Limits ROM of the thumb • Limits ROM of lower joint of the fingers (too small)
Uniform Gloves (currently used)	https://www.amazon.com/gp/product/B07HGRQ2Y1/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&th=1	• Tight to the hand • More flexible than other cloth options • Users thought very smooth, preferred to the satin gloves • Users thought it felt cold (very nice!)	• Seams of the fingers do not line up so felt confusing where the ridges of the finger are – makes the glove hard to put on • More flexible but still limited ROM • Color prevents shadowing

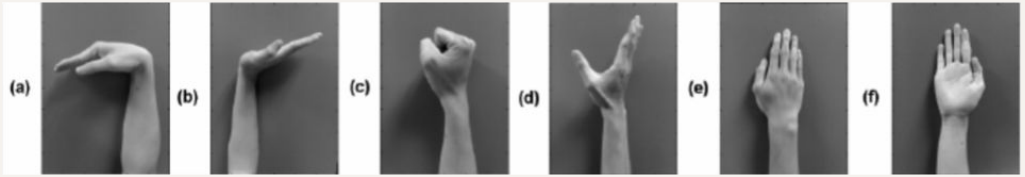
Tatum's previous ready-made glove testing





Initial team notes on color and user needs

Research: Internet



Types of tactile signing:

- Hand-over-hand (listener holds on to back of hand)
- Tracking (listener holds on to wrists or forearms)
- Rochester (listener feels front of hand)
- Haptics (provides additional environmental and social information)
- Pro-tactile/PT (new language, much more physical)

Types of hand movements

Image below:

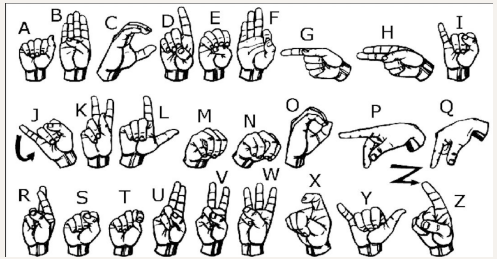
a) Wrist flexion
b) Wrist Extensions
c) Hand closure
d) Hand open
e) Forearm pronation
f) Forearm supination

Hand-over-hand

Haptics

Tracking

Pro-tactile



ASL Handshapes

John (Deaf-Low Vision)

- Color more important than texture
- Soft to the touch
- Prefers white and bright colors like neon
- Prefers contrast and shadows
- Pain point: differentiating middle and ring fingers

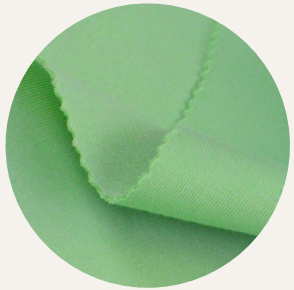
Jaimi (Deaf-Blind)

- Texture more important than color
- Soft to the touch
- Prefers stretch fabrics
- Prefers warm, friendly textures like cotton or leather
- Pain point: seam between fingers and palm plate

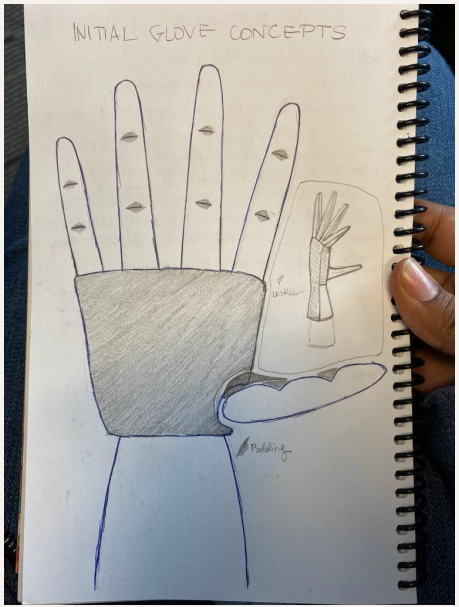
Research: User Needs

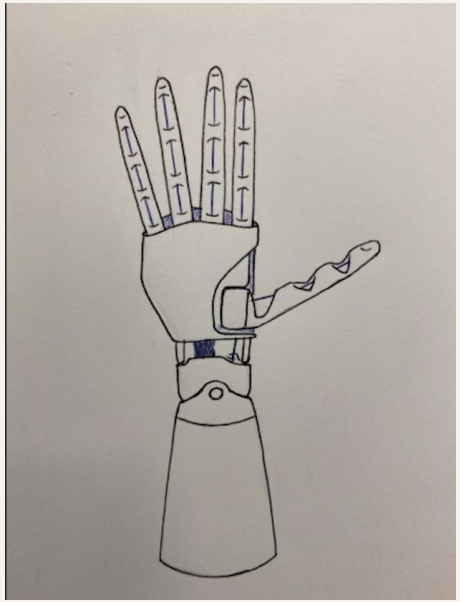
Ideation: Initial Materials List

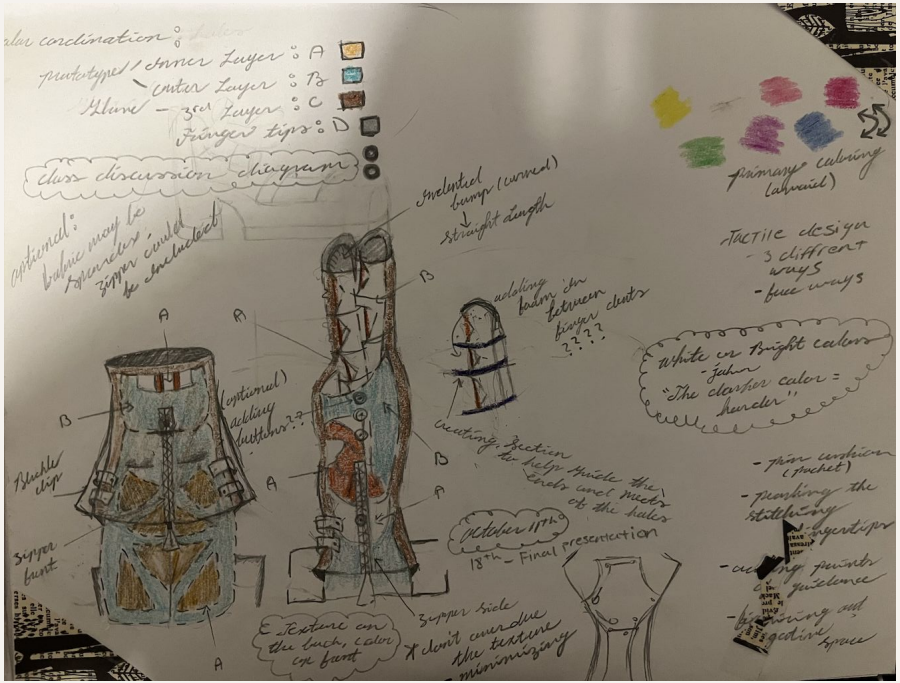
Material	Notes
TPU (Thermoplastic Polyurethane) (all3dp.com, backpackinglight.com, aatcc.org)	Flexible, can be used either as main fabric or as panels welded to main fabric Can be printed in shape of pattern pieces and welded/sewn together
Nylon mesh (jasonmills.com)	Wear, temperature, acid, alkali, corrosion, and dust resistant Lightweight, soft feel, high tensile strength and flexibility, knit fabric
80%/20% Cotton/Spandex (batikindonesia.com)	Soft, durable, knit fabric
50%/50% Cotton/Polyester (batikindonesia.com)	Knit fabric, durable, versatile, easy to care for (prone to pilling over time)



Ideation: Sketches



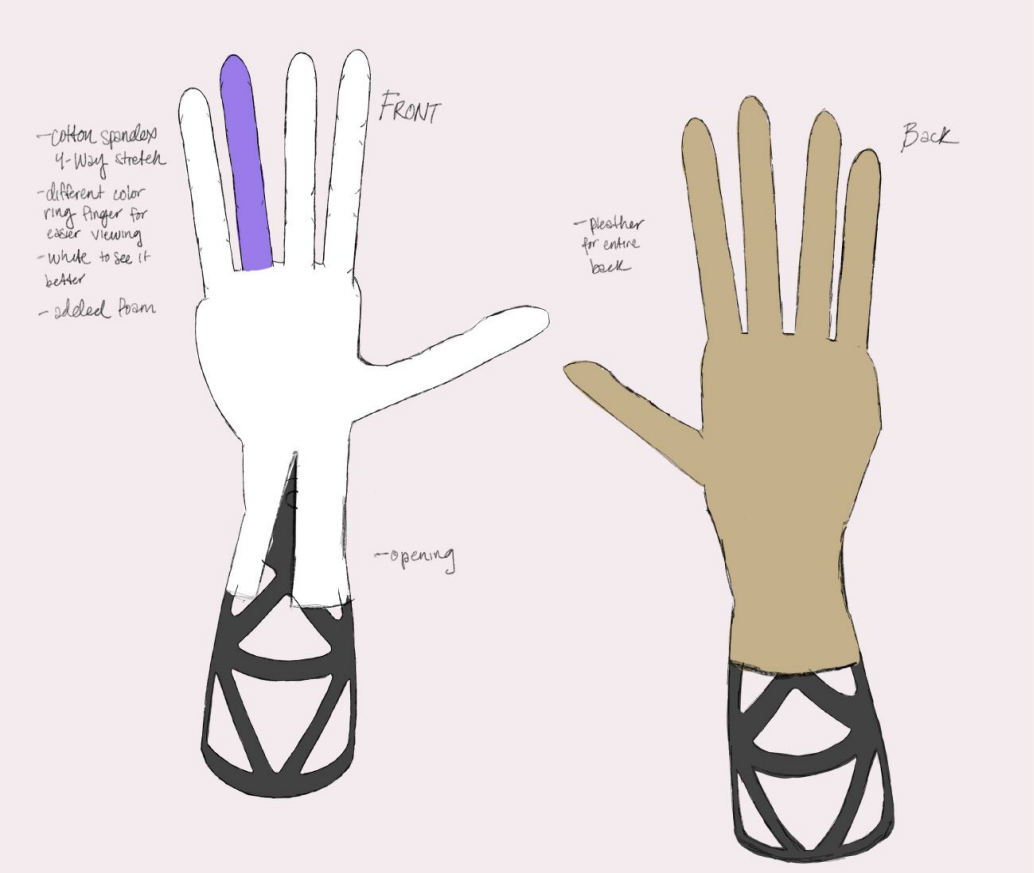




From left to right: concept sketch for potential foam padding; robotic hand rendering; inner, outer, front, and side views of glove concept with details and notes

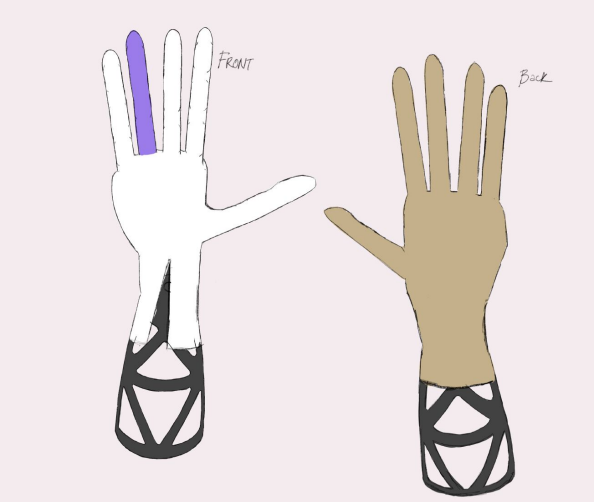
Ideation: Synthesis

- Top Fabric option: 4-way stretch jersey, cotton/spandex blend
- Slight stretch pleather for back of glove
- Detailing with fabric paint or embroidery?

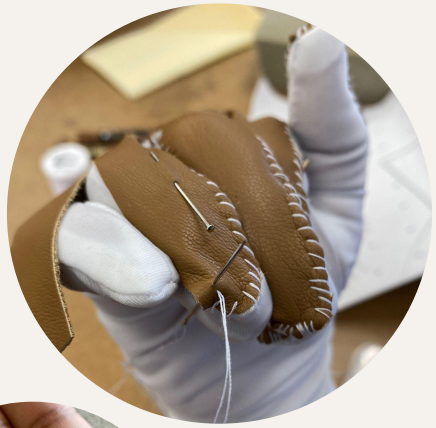


Initial Illustration

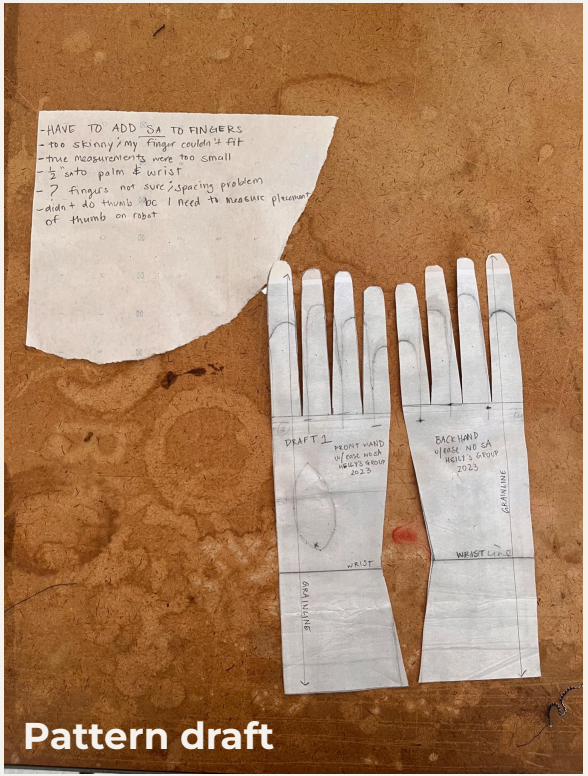
- Front: white cotton/spandex 4-way stretch, slit along center front
- Back: tan pleather
- Ring finger: purple cotton jersey,



Prototyping



Draft #1



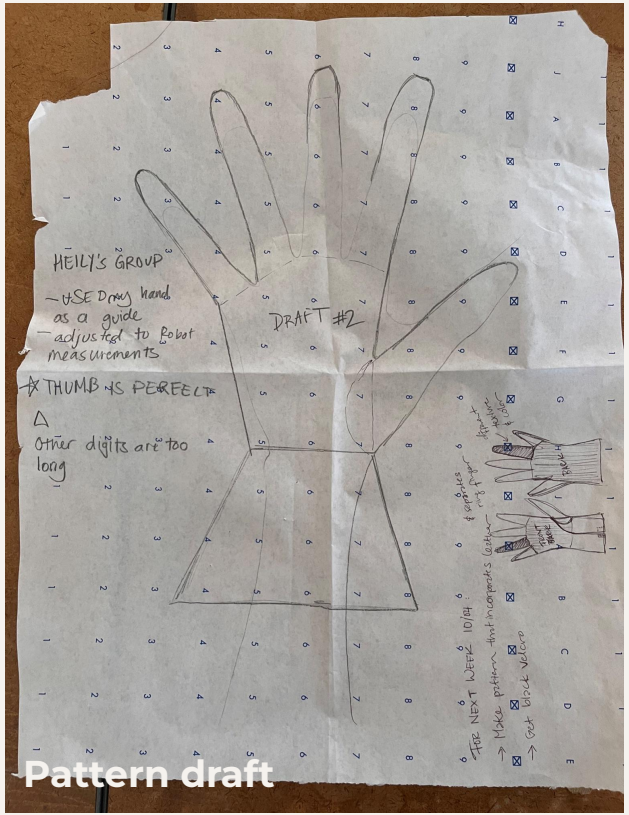
Pattern draft


Pearl stitch

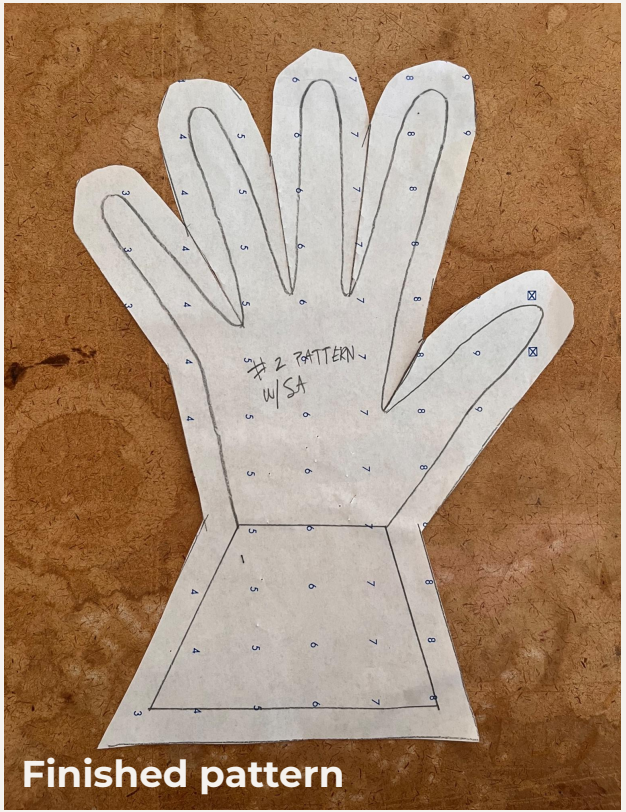

Overlock stitch

Fit Testing

Draft #2



Pattern draft

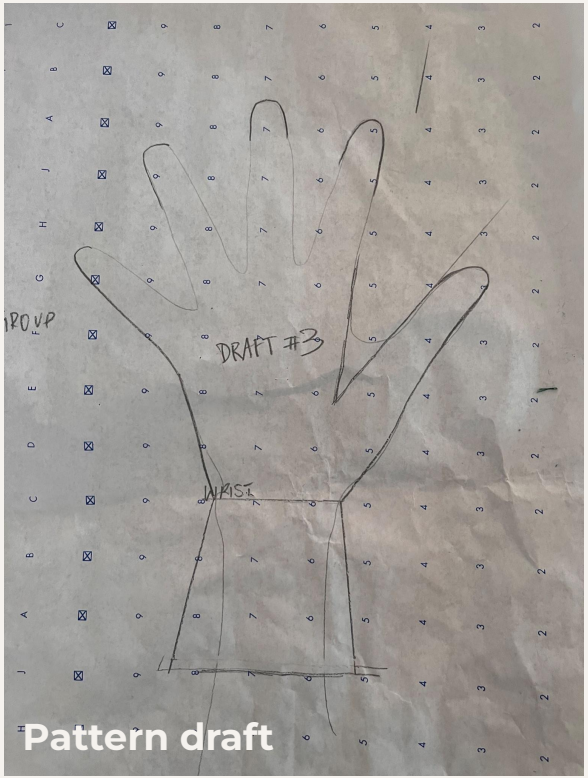


Finished pattern

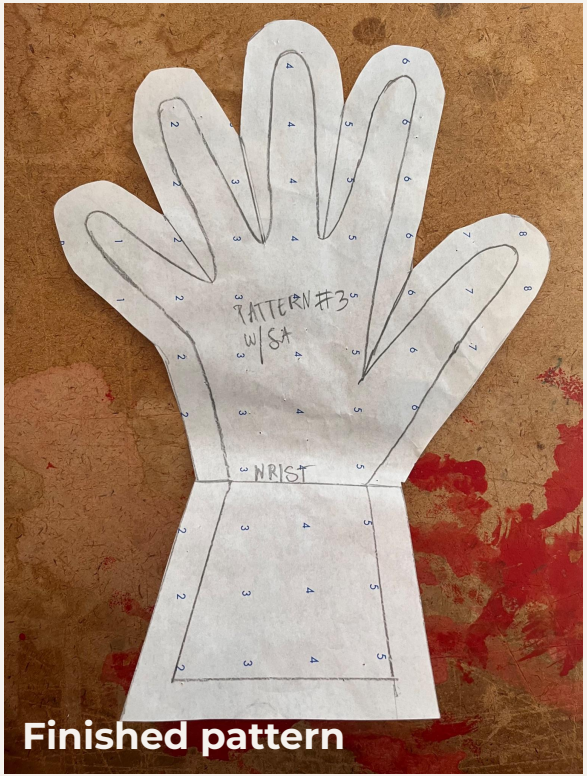

Pearl stitch

Fit Testing

Draft #3



Pattern draft



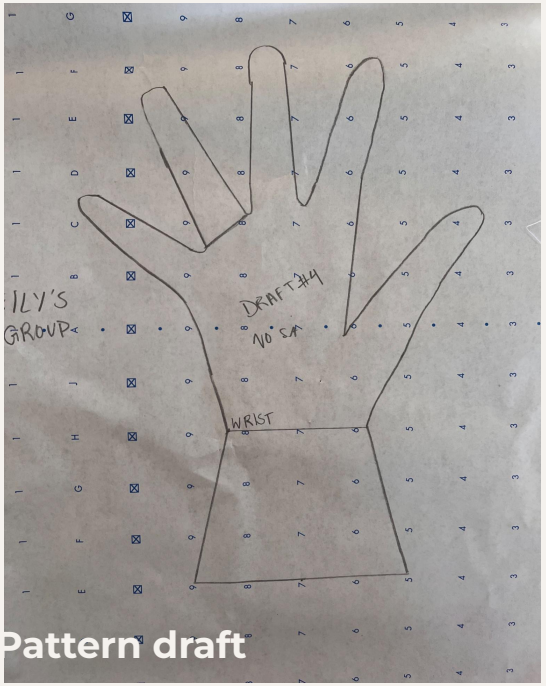
Finished pattern


Stretch stitch

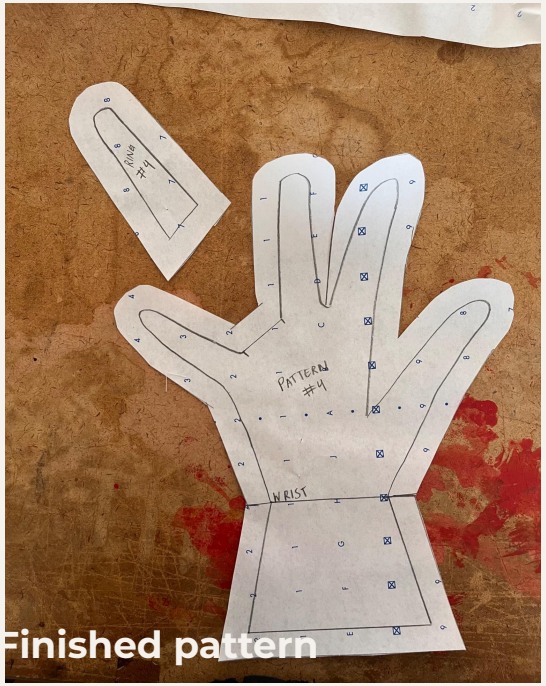
Fit Testing

Testing Draft #3 on a newer model of the robotic hand.

Draft #4



Pattern draft

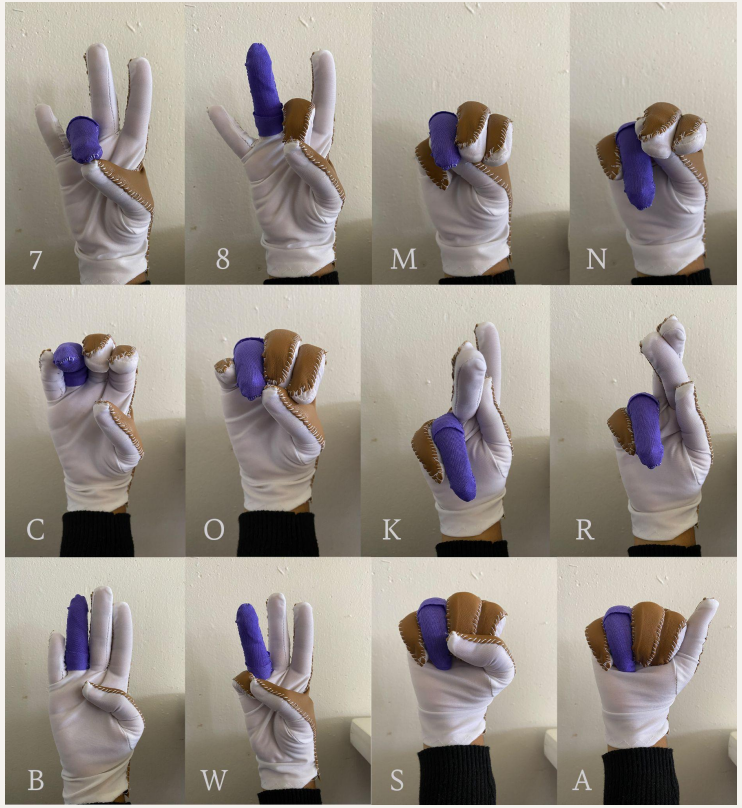


Finished pattern

Color mock-up

Experimenting With Leather

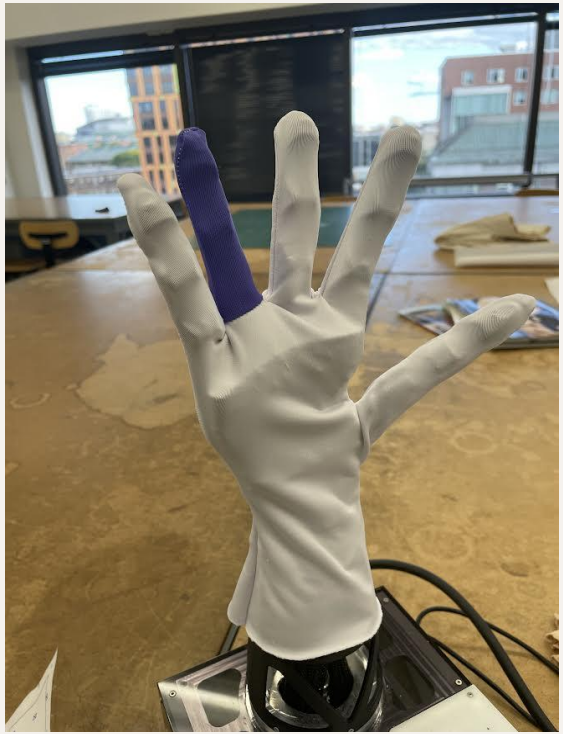
Initial Leather Mock-up



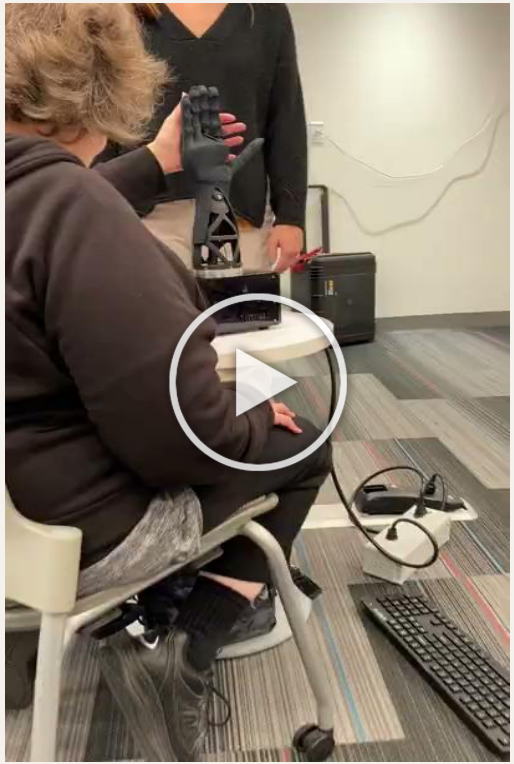
We made this rough mockup to test the effectiveness of the differentiation in color and texture. One of the team members wore the glove and photographed different ASL handshapes to illustrate how the colors would perform on the robotic hand.

Draft #5

Design variation with white spandex for both front and back of glove.



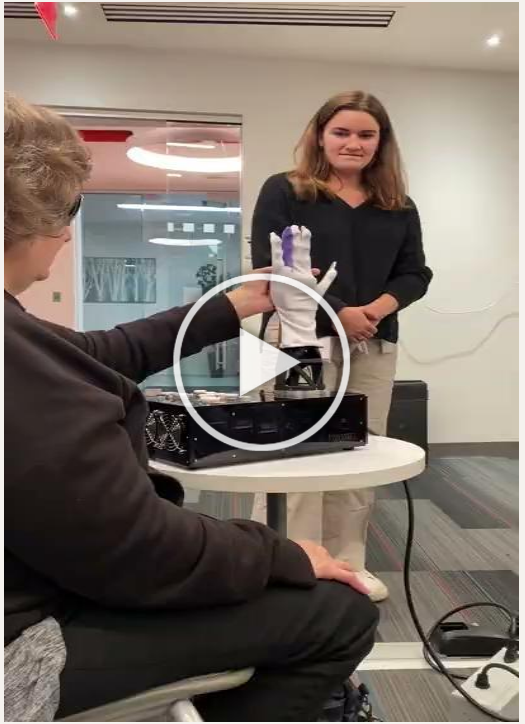
Tatum Robotics Visit



Testing Prototype #1 on newer version of Tatum T1

Tatum Robotics Visit

Testing Prototype #2 – Successful fit, not enough texture differentiation.

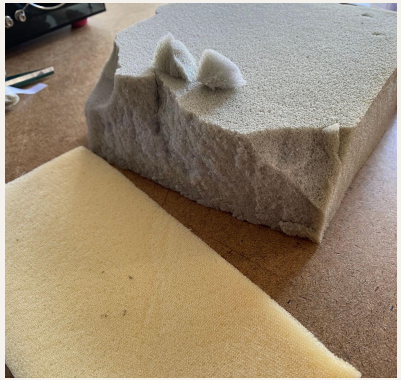


Testing Prototype #3 – Pleather back significantly limited thumb ROM.

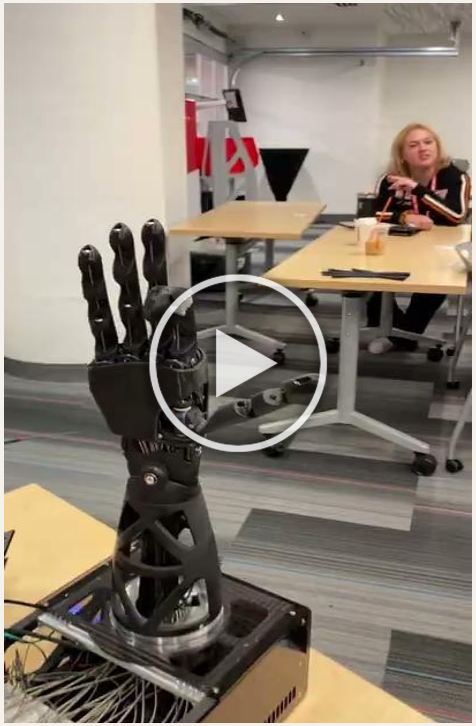
Experimenting With Foam

We started by taping foam in between the joints of the robot's pinkie finger. This filled out the robot's silhouette, made it plush, and didn't seem to hinder its ability to move.

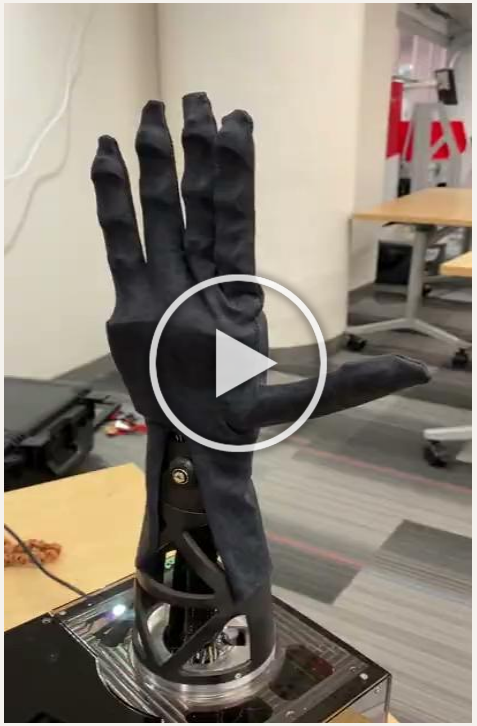
Should the foam be a part of the hand? Should it be stitched to the glove? Should we make a whole new glove?



Experimenting With Foam @ Tatum Robotics



Testing mattress topper foam strung through robot tendons – easy to insert, poor shape recovery.

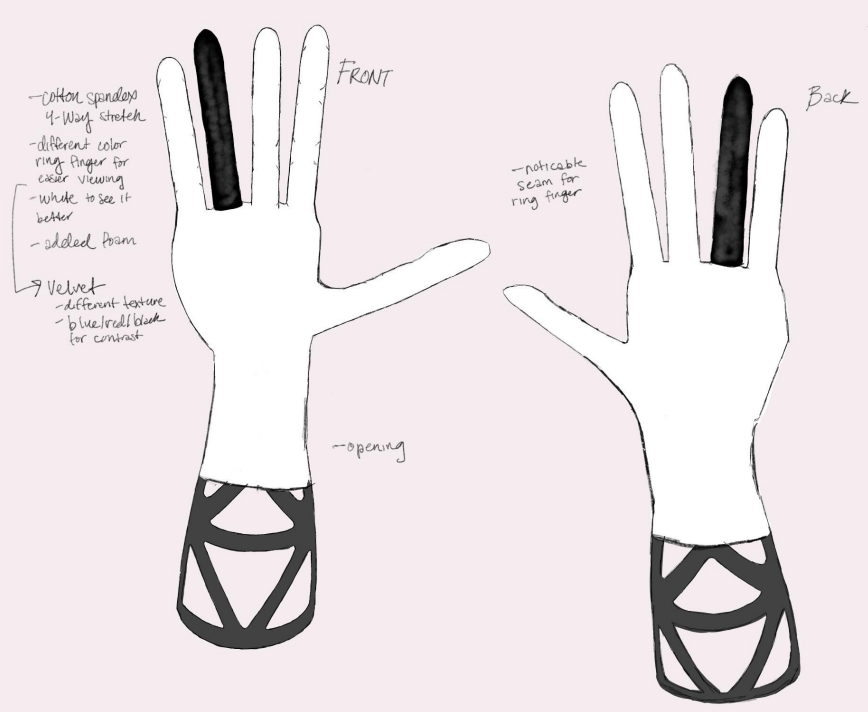


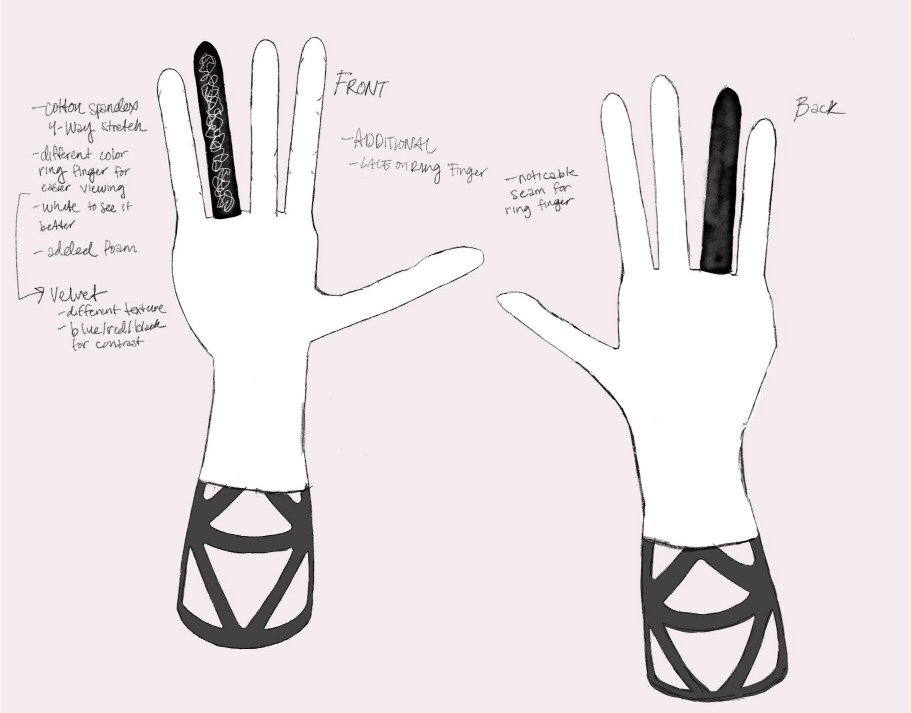
Testing glove over foam insert and comparing with finger without foam insert (middle finger).

Synthesis: Final Prototype

- Adjusted pattern for improved fit around fingers
- All-white spandex fabric sewn with stretch stitch
- Eliminated pleather
- Switched the ring finger to red velvet for added texture and color contrast

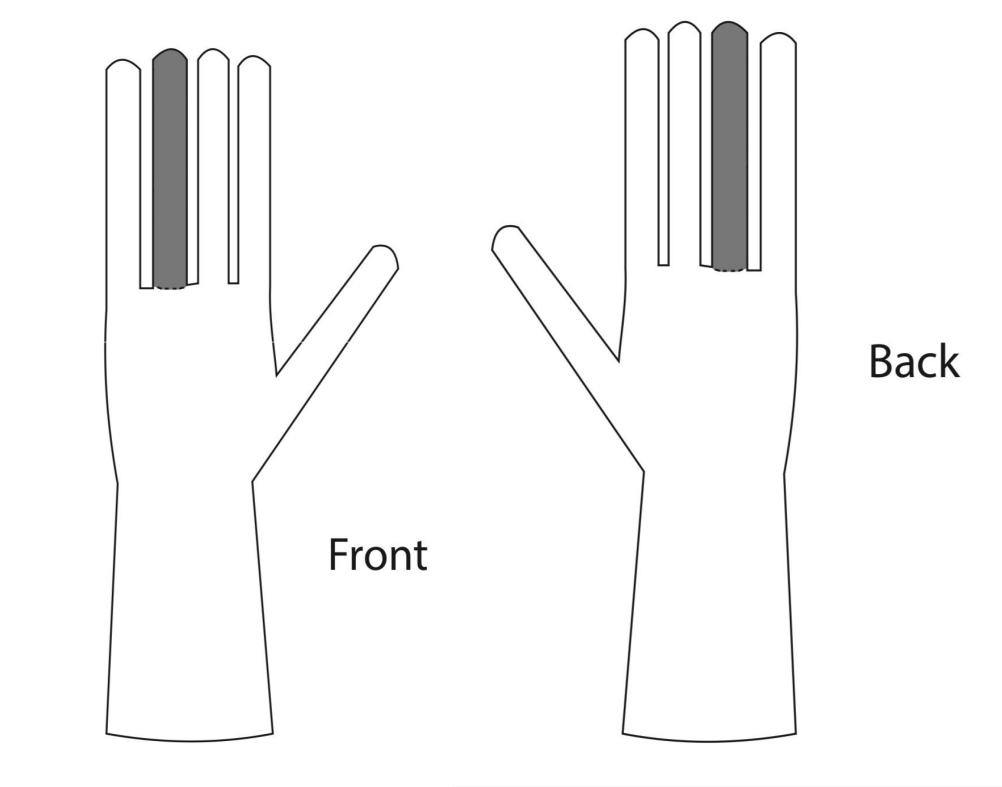
Final Illustration





Cotton spandex on front and back; ring finger customization options based on consumer need (black color, lace overlay for texture, etc.)

Flats & Cutter's Must



CUTTER'S MUST SHEET - pattern record card

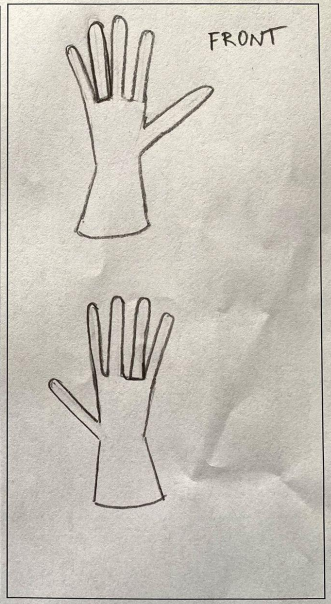
DESIGNER HEILY'S GROUP DATE 10/18/23

DESIGN Tatum Robotics ASL GLOVE STYLE # 1 SIZE OS

List each name and quantity cut for each pattern piece.
Include Cutter's Must sheet and Patterns in envelope.

FRONT & BACK SKETCH

PAT #	PATTERN NAME	# OF CUTS
1	HAND	2
2	RING FINGER	2



Bill Of Materials

	Item/Description	Placement	Content	Supplier	Quantity
1	Opaque White Poly Spandex	Front of Hand	86% Polyester & 14% Spandex	Imagine (Joann)	1 yard
2	Stretch Velvet	Ring Finger	100% Polyester	Joann	1 yard
3	Stretch Lace	Over Velvet Ring Finger	90% Nylon & 10 % Spandex	Joann	⅛ yard
4	White All Purpose Thread	Seams	100% Polyester	Coats and Clark	1 Spool (250 yards)

JOANN

96 PROVIDENCE HWY
EAST WALPOLE, MA 02032
508-850-9580

Ticket: 61545 Cashier: 851277
Date: 10/3/23 Time: 11:03 AM
Store: 2403
Register: 11

Item	Qty	Price	Amount
BRND IMAGINE OPAQUE WHITE POLY SPNDX			
12955423	1.000	24.99	17.49
Sale 30% off			(7.50)

Subtotal 17.49
State 0.00
Total 17.49

Visa 17.49
**********823
Auth #: 626225
Transaction Type: Sale
Auth Time: 11:03 AM
********** PURCHASE **********
APPROVED

Total: $17.49

Card Type: VISA
Card Entry: SWIPED
Acct #: **********0823
Approval Code: 626225
Account Balance: $74.58
Change 0.00

You have saved 7.50

Sold Item Count = 1

Did our service measure up? Tell us!
joann.com/storesurvey

Customer Copy

Sewing Instructions

1. Cut glove (2) with knit fabric
2. Cut ring finger (2) with stretch fabric (contrasting texture)
3. Stitch individual ring finger piece to the main glove with ½” seam allowance, leaving ½” free on each side
4. Trim the unsewn corners
5. Pin the glove wrong together, stitch with ½” seam allowance and a stretch stitch
6. Trim seam allowance to ⅛”
7. Hem at ½” with a stretch stitch or coverstitch

Conclusion: Final Thoughts

Moving forward, there is great potential for Tatum Robotics to continue exploring foam padding underneath the glove to fill in the joint gaps and smooth the ridge between the fingers and the back palm plate.

Moreover, the final prototype design allows for the ring finger to be customized according to the needs of the person using the robot. For example, the texture of velvet might not be comfortable for all users. It could be switched for a ribbed knit or, in cases where texture is not essential, a knit jersey in a contrasting color.

Conclusion: Takeaways

Tatum's mission – "advancing accessibility" – is essential, and it is a mission we can all contribute to. Our team learned a great deal about the DeafBlind community through this project, and we would like to share some videos for all to watch to learn more about tactile signing and DeafBlind life.

- Introduction to Protactile Language
- New touch-based language by DeafBlind people – Protactile
  (Jaimi appears in this video!)
- Tactile signing at Holyland Institute for the Deaf and Deafblind
- Reflections on Deafblindess: Hands & Touch
- She Can't See or Hear. How Does She Learn? (India)
- Living DeafBlind: Rodenna Frank (Iowa)

Catch Jaimi in the second video to the left!

Continued Partnership

Hi Heily,

I hope you are doing well! Exciting update I just shared with your professor - You did such a great job creating such tailored gloves that it led our team to a clue - the hand must be the wrong size! Now that we could see how long the fingers were compared to a human hand, we realized our fingers were sitting too high on the palm. Since then, we have shorted the palm and have been receiving so much positive feedback!

I was wondering if you would be willing to adapt your glove for this updated geometry? We would be happy to give you a Visa gift card for your efforts (and we have all the materials here as well!).

Let me know if you are interested! No worries if this is out of scope for you.

Talk soon,
Samantha

Tatum Robotics

Samantha Johnson *(she/her)*
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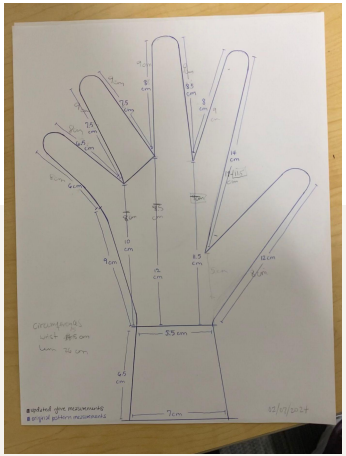
C: *(978)618-8598*
Calendar: *calendly.com/sjohnson-143*



Signing with Jaimi!