UW Adapted Fitness: Grip Strength Improvement Mechanism

Product Design Specification

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Client

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Function

The device must assist the user with impaired hand function by enhancing their ability to open and close the hand with greater strength and control. It should provide assistance to initiate movement when needed and resistance to build muscle strength during rehabilitation. The device should promote dexterity, independence in daily activities, and measurable progress in grip strength over time.

Client requirements

- The device must be easy to put on and remove.
- Adjustable to fit different hand sizes and grip requirements.
- Must allow safe and quick release of objects in case of emergency.
- Must be easy to sanitize for frequent use

Design requirements

1. **Physical and Operational Characteristics**
    a. **Performance requirements**
        i. The most important performance requirement of the device is to improve the client's grip strength, the goal being to achieve full strength, after having suffered a traumatic brain injury.
        ii. The device must also be easy to take on and off without assistance.
        iii. Must transmit and store grip strength information to track progress of the client over time.
    b. **Safety**
        i. The device must be made with materials that do not irritate the skin, and fits comfortably on the hand
        ii. Must allow for quick release of objects in case of emergency
    c. **Accuracy and Reliability**
        i. Device must be versatile and allow the user to perform multiple tasks with objects of different sizes and shapes
        ii. Device must report feedback accurately and consistently, allowing the client to understand progress or setbacks in their grip strength training
    d. **Life in Service**
        i. The device should be reliable for at least one year with regular use. Components should be replaceable for ease of repair.
    e. **Shelf Life**
        i. The lifespans of any sensors or electronics used should be considered
        ii. If a battery is required it should be replaceable and removable for storage
    f. **Operating Environmen**t

i. Product will be used in a gym during workouts/physical therapy sessions
ii. Durability should reflect this: sweat proof, breathable, flexible

g. **Ergonomics**
   i. Glove should be comfortable for client to wear when working out
   ii. The glove needs to be put on by a person with limited hand mobility

h. **Size**
   i. The device should be around the size of the client's hand. The device will need to cover up to the fingertips of the hand and around the palm of the hand.
   ii. The average size of a male hand is length of about 7.6 inches and a width of 3.5 inches so our design will be in similar dimensions.

i. **Weight**
   i. The weight of our object should be light and should not put an immense amount of pressure on the clients hand. The client has mobility issues with extending open his hand, so the object can't be too heavy because that would make it extremely difficult for the client to learn how to use the tool.

j. **Materials**
   i. The materials that we choose to use will have to be comfortable and durable. The client will have to wear this product while working out and potentially for everyday use, so it is necessary that it is comfortable material. The materials will also have to withstand and last during strenuous activities.
   ii. There will also need to be a power source so materials like batteries and wires will be necessary so the object can move and pull the hand open.

k. **Aesthetics, Appearance, and Finish**
   i. The product will be worn frequently, so it should be clean and have good aesthetics. Additionally, it should not have anything sharp or unsafe protruding for the device because the client could get injured. Objects like wires and batteries should not be shown on the device and should be concealed appropriately.

2. **Production Characteristics**
   a. **Quantity**
      i. Only one final device will be needed to be fabricated with the option of being scalable for mass production.
   b. **Target Product Cost**
      i. Current competing devices range from $90 to $400. Low cost materials and modular design should be implemented to reduce replacement costs.
3. **Miscellaneous**
   a. **Standards and Specifications**

i. The device must adhere to basic safety and usability standards for assistive and fitness devices, prioritizing user comfort, ergonomics, and injury prevention. Where applicable, guidelines from the Americans with Disabilities Act (ADA) and ASTM standards for fitness equipment will be referenced. The mechanism should also follow university safety protocols for electronics and mechanical design.[1]

b. **Customer**
   i. The primary customer is Dr. Kecia Doyle, representing UW Adapted Fitness. The client is a longtime Adapted Fitness participant with a specific need for grip strength improvement in one hand. The device should be tailored to his abilities, preferences, and fitness goals, while also providing value for broader adapted fitness applications.[update when we meet John(patient)]

c. **Patient-related concerns**
   i. The client's comfort, safety, and motivation are central to the design. The mechanism must not cause pain, strain, or unintended injury during use. Ease of use, adjustability, and the ability to operate independently (when possible) should be taken into consideration. The design should accommodate variability in grip strength and hand dexterity.[update when we meet John(patient)]

d. **Competition**
   i. Commercial grip-strength trainers exist (spring-loaded hand grippers, therapy putty, squeeze balls), but they are not customized for adapted fitness clients with asymmetric grip ability or integration into workout routines[2]

References

[1] ASTM International, ASTM F3021-17(2023): Standard Specification for Universal Design of Fitness Equipment for Inclusive Use by Persons with Functional Limitations and Impairments. West Conshohocken, PA, USA: ASTM International, 2023. [Online]. Available: https://www.astm.org/f3021-17.html

[2] Flint Rehab, "9 Best Physical Therapy Tools for Hands: Improve Strength, Mobility, and Function With Rehab Tools at Home," *Flint Rehab*, July 21, 2025. [Online]. Available: https://www.flintrehab.com/physical-therapy-tools-for-hands/. [Accessed: Sept. 18, 2025].