Dual Glove Stroke Therapy System

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Abstract

Hand impairment is a common consequence of stroke affecting over half of survivors [1], and while proprioceptive training has shown promise for sensorimotor recovery [2], few rehabilitation tools target hand proprioception. REX0 is a dual-glove system designed for proprioceptive retraining through real-time motion replication, in which a sensor-based Control Glove captures finger movement and a Response Glove mechanically reproduces it via micro-servo actuation and low-latency ESP-NOW communication.

Methods

1. Control Glove: Flex sensors capture finger motion (ESP-NOW, low-latency IEEE 802.11) →
2. Response Glove: Receives data and actuates servos to replicate motion (USB CDC / UART-over-USB) →
3. Laptop / Web App: Visualizes finger positions, logs data, and monitors system state

(REFER TO FIG. 1 FOR VISUAL)

Materials

Software Used: Arduino IDE 2.2.1, Solidworks 2025

Materials (Fig. 4):

1. ESP32 WROOM Dev Board (x2)
2. Custom PCB
3. Long Flex Sensor (x10)
4. Continuous Rotation Micro Servo - FS90R (x5) → with 3D Printed Spool attachment
5. Fishing wire
6. Metal Crimps
7. 3D Printed Glove Attachment (w/ Velcro)
8. 3D Printed Bridge
9. 3D Printed Bridge w/ Crimp
10. Extension springs
11. 3.7V LiPo Battery
12. Hot Glue
13. Fabric Gloves

Website (Fig. 3): Javascript, HTML, CSS, C++

Diagrams/Figures

Figure 1: Workflow

Figure 2: Project Documentation

Figure 3: Web Application

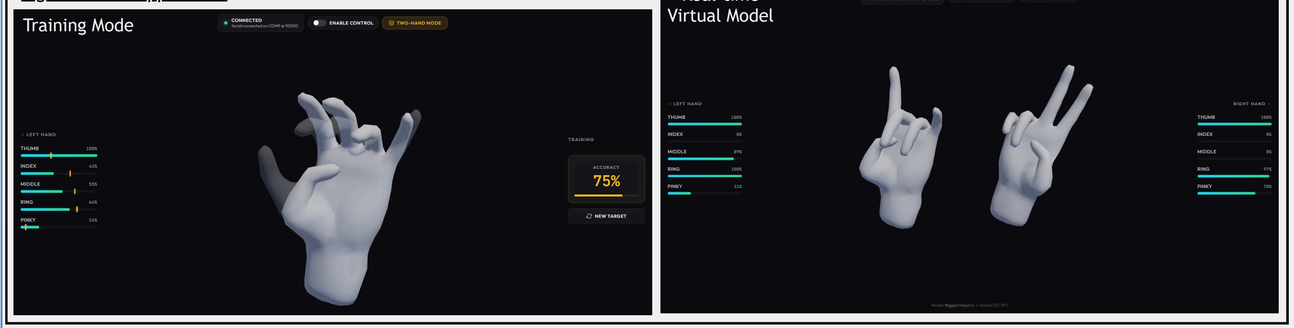
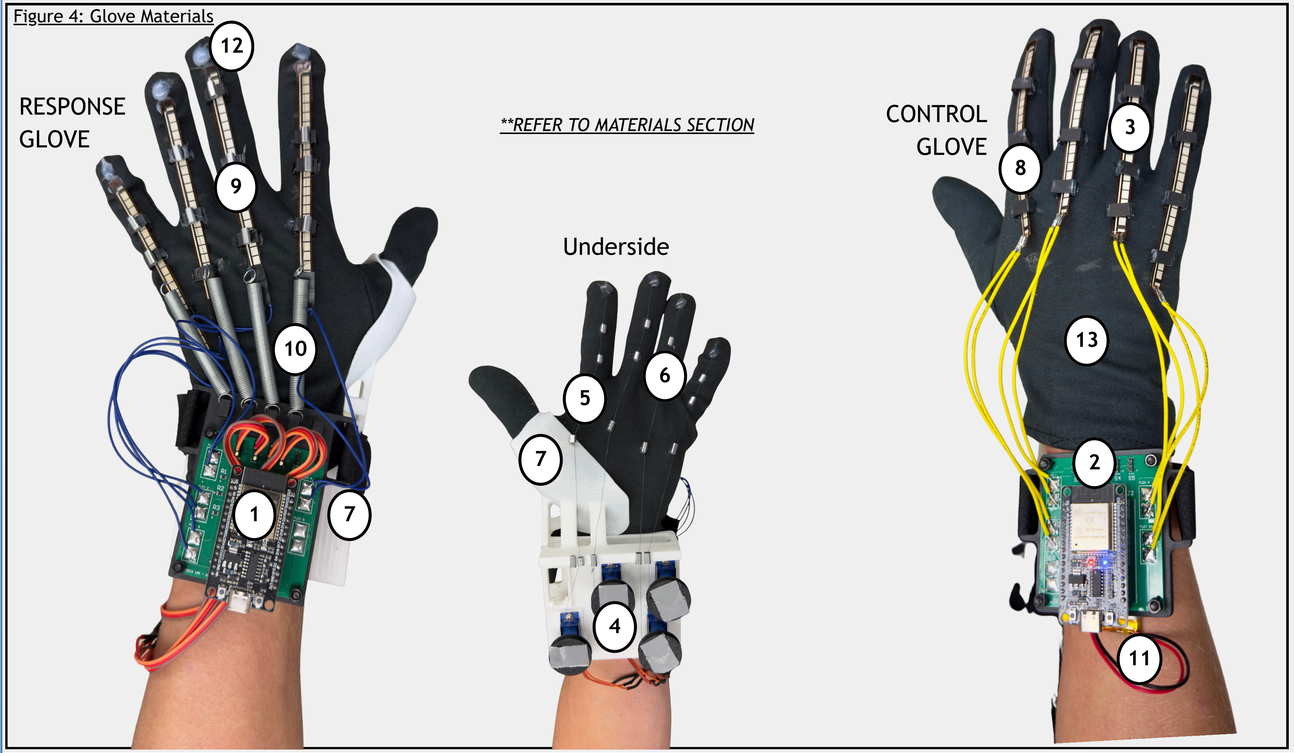


Figure 4: Glove Materials



Objectives

- Develop a Control Glove capable of accurately and consistently measuring finger-joint motion using flex sensors.
- Implement wireless transmission of sensor data from the Control Glove to the Response Glove.
- Design a Response Glove that mechanically replicates the Control Glove's finger movements through servo-driven wire-and-anchor actuation and spring-based retraction.
- Support proprioceptive training, enabling users to perform and mimic hand movements to reinforce sensorimotor awareness.
- Create a simple, user-friendly UI/web/mobile interface for usability and progress tracking.

Results + Future

We successfully created a working glove for 4 fingers for the Control and Response Gloves with the accompanied web application along with more detailed project documentation. (Fig. 2)

Future Work + Limitations

1. Integrate thumb complexity
2. Incorporate progress tracking and suggestions
3. Improve Flex Sensor noise adjustment
4. Improve modularity, flexibility, and visuals of the gloves

References

[1] C. O. Wodu, G. Sweeney, M. Slachetka, and A. Kerr, "Stroke survivors' interaction with hand rehabilitation devices: Observational study," JMIR Biomedical Engineering, https://biomedeng.jmir.org/2024/1/e54159 (accessed Dec. 5, 2025).

[2] J. He et al., "Proprioceptive training with visual feedback improves upper limb function in stroke patients: A pilot study," Neural plasticity, https://pmc.ncbi.nlm.nih.gov/articles/PMC8783730/ (accessed Dec. 5, 2025).