1. Device Design Consideration

• Which type of soft robotic system is most suitable for hand rehabilitation?

Soft Robotic System: A novel soft exoskeleton glove designed for hand rehabilitation uses pneumatic actuators to provide assistance with finger movements. This glove focuses on increasing range of motion while ensuring gentle force application, making it suitable for stroke patients or individuals with muscle weakness. It leverages soft actuators capable of bending and stretching to mimic natural hand movements.

• What approach will be taken to control the actuators and ensure accurate movement?

Actuator Control: A control system based on electromyography (EMG) signals is integrated into the glove. The system detects muscle activity in the user’s arm and translates these signals into precise control commands for the soft actuators. This method enables the glove to respond to the user’s intention, making rehabilitation more intuitive and user-driven.

• Are there specific mechanical design limitations we need to address (e.g., size, weight)?

Mechanical Design Constraints: The device is lightweight and portable, focusing on long-term wearability and comfort. It incorporates flexible silicone-based actuators that are both durable and gentle on the skin, preventing discomfort during prolonged use. Its compact design allows the glove to be worn without restricting hand movement.

2. Ensuring Comfort and Safety

• What strategies will be implemented to enhance comfort during extended use? Are there specific ergonomic materials to consider?

Comfort: The glove is built with soft, flexible materials like silicone and elastomers, which ensure a comfortable fit. Additionally, it includes breathable fabrics that prevent sweating during extended wear, improving the user’s overall comfort.

• What methods will be employed to detect or mitigate excessive forces applied to the hand?

Preventing Excessive Forces: Embedded force sensors continuously monitor the pressure applied by the actuators. The glove’s control system adjusts the force in real-time to avoid overexertion, ensuring that the user receives only the assistance needed for rehabilitation.

3. Sensor Integration and Feedback Mechanisms

• What types of sensors will be utilized to monitor hand movements (e.g., force sensors, position sensors, EMG sensors)?

Types of Sensors: The glove employs a combination of EMG sensors to detect muscle activity and force sensors to monitor the pressure applied to the hand. These sensors enable precise control of the glove’s movements, aligning with the user’s muscle activity.

• In what ways will feedback be communicated regarding rehabilitation progress (e.g., tracking data, performance metrics)?

Providing Feedback: Feedback will be given through LED indicators and audio cues. When the EMG sensors detect muscle activity, the system will activate the LED lights and produce audio signals, providing immediate feedback on the user’s progress and encouraging them during rehabilitation exercises.

4. Material and Technology Selection

• Which materials are optimal for soft actuation and facilitating repeated hand movements?

Material Suitability: The glove uses soft pneumatic actuators made from medical-grade silicone, chosen for its flexibility, durability, and skin-safe properties. These actuators allow for natural, fluid hand movements during rehabilitation.

5. Assessing Rehabilitation Outcomes

• What criteria will be used to evaluate the effectiveness of our device in enhancing hand rehabilitation results (e.g., hand strength, range of motion)?

Measuring Success: Success is measured through improvements in grip strength, hand dexterity, and range of motion. Regular assessments are conducted to track how well the user is progressing in regaining fine motor skills.