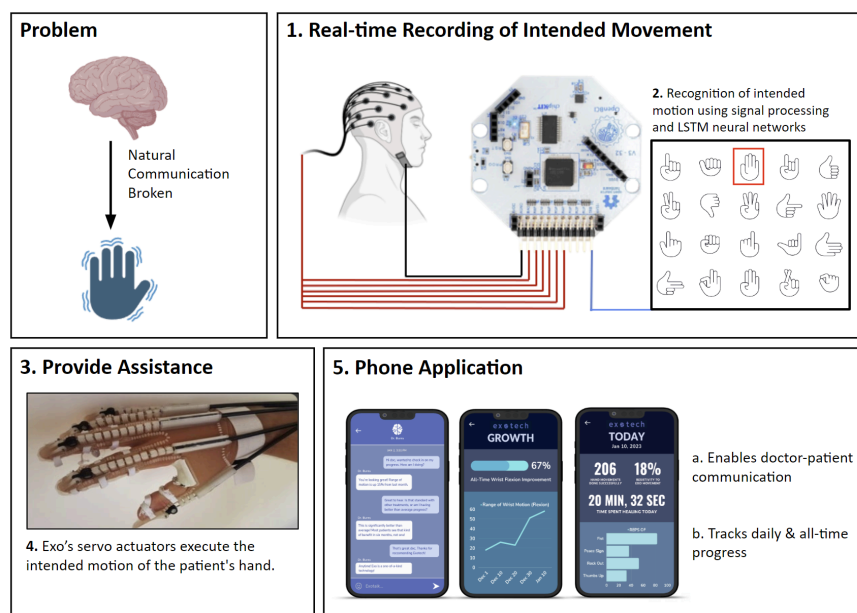


Concept ID: 57669780**—Problem Statement—**

Annually, more than 655,000 people survive a stroke in the United States. More than two thirds of these survivors spend time in rehabilitation, meaning that rehabilitation centers serve around 437,000 people each year. Current rehabilitation techniques include physical therapy, acupuncture, and speech exercises, all of which leave room for further technological innovation.

From a financial standpoint, surviving a stroke is dismally expensive. Hospitalization alone can be upwards of \$30k. Rehabilitation costs an average of \$17k for the first year and medication adds on another \$5k per year. Most medical insurance fails to cover stroke costs and grants often do not work as expected, leading many survivors to resort to crowdfunding or loans for what adds up to more than fifty-two thousand dollars in stroke costs. Keeping in mind that the median American income is around \$40k, current systems simply do not serve the people.

What patients need is a rehabilitation technique that is both highly effective and affordable; Exotech has that solution.

—Our Solution: Exotech—

[#] refers to numbered steps in the diagram

Exotech revolutionizes stroke rehabilitation through a brain-computer interface and exoskeleton tailored for each patient's recovery journey. This device utilizes neuroplasticity to help patients regain hand movement. It interprets the patient's intended movements from brain signals in real-time and assists them in executing these movements.

Our development began with an electroencephalography headcap **(1)**, featuring carefully placed spike electrodes to capture brain activity linked to hand movements. These signals pass through a biosensing board, equipped with bandpass and notch filters to isolate essential brain wave frequencies. We trained our system on a wide array of hand movements, laying a robust foundation for our neural network.

The neural network's core is a Long Short-Term Memory (LSTM) model **(2)**, chosen for its ability in modeling time-related dependencies. This model ensures the swift yet accurate classification of intended movements, vital for real-time application.

At the heart of Exotech lies its exoskeleton, constructed from 3D printed parts and servo motors, closely mirroring the human hand's anatomy **(3)**. Capable of executing 20 fundamental hand movements using cost-effective actuators and bowden cables **(4)**, this exoskeleton is a versatile tool for rehabilitation, responding dynamically to the neural network's signals to provide user-specific assistance.

Prioritizing user safety, we integrated a sophisticated fail-safe mechanism in the exoskeleton. Force sensors constantly assess resistance during movements. Should this resistance exceed a set limit, indicating a possible error, the system activates safety protocols. This precaution ensures the exoskeleton never forces the hand into potentially harmful positions, safeguarding our users from any adverse effects.

The user interface **(5)**, provided through a phone application utilizes data from force sensors, as well as motion sensors, to provide daily and all-time statistics on rehabilitative progress. Furthermore, a two-way communication feature is installed to facilitate doctor-patient communication. Exotech is able to factor in all these features in a mere \$227, less than half the price of leading competition.

Exo is not just a product; it's a paradigm shift in stroke rehabilitation, combining cutting-edge technology with user-centric design to offer a safe, effective, cost-conscious and personalized stroke recovery experience.

—Unique Value—

Exotech distinguishes itself in the hand rehabilitation market with its groundbreaking Brain-Computer Interface (BCI) technology. No other known hand exoskeleton on the market utilizes BCI. This enables Exo to use direct brain signal interpretation to replicate intended hand movements. When compared to the industry standard, SaeboFlex, Exotech surpasses in numerous aspects. Notably, Exotech's exoskeleton is capable of 20 hand motions; SaeboFlex is capable of 1. Exotech's design also incorporates safety features such as resistivity and range of motion sensing. Furthermore, Exotech's value has been validated through user trials. Remarkably, Exotech achieves this at a price point of \$227, less than half of SaeboFlex's \$600 price tag. Exotech's unmatched performance sets it ahead as the best hand exoskeleton.

—Market Plan/Economics—

As a manufacturer of class-1 medical devices, Exotech will sell to hospitals and physical therapy (PT) centers to maximize social good. We would achieve this through a few steps:

1) Crowdfunding: Crowdfunding platforms will provide early stage capital for our startup.

Through online fundraising platforms, we have already secured approximately \$1,000 validating

interest in our product. We are also discussing seed investment with venture capitalists and medical device executives. Their expertise and connections will prove invaluable in guiding us. Our goal is to raise around \$25,000 by Q4 2024. This will enable us to kickstart our next chapter.

2) Trial Phase: We plan on initiating 6-month trial periods of our product at select hospitals and PT centers. This phase will provide valuable real-world testing and feedback to inform our development while also garnering exposure and credibility in this competitive industry.

Successful trials will attract further investment as we demonstrate the merits of our product to key healthcare players. Overall, this trial approach will help boost product refinement, clinical validation, awareness, and funding in one unified push.

3) Take Off: With momentum from previous phases, we will sell to hospitals and PT centers that we conducted the trial phase at. In this phase, we break even and establish long term contracts with these hospitals. Other care centers' interest will ensure our viability.

4) Maturity: After take off, we will prioritize sales to participating hospitals and PT centers. Our goal is to convert at least 90% of our trial partners into long-term commercial customers via multi-year contracts. With consistent revenue streams from established buyers, we aim to reach profitability within 12 months after trials' completion. Positive outcomes and feedback from our trials are also expected to generate interest among prospective customers such as orthopedic clinics, sports medicine facilities, and rehabilitation networks. Landing these customers will prove that Exotech has established itself in this competitive landscape.

—Our Team—

Exotech was founded by Arush Goswami, Jazveer Kaler, Akash Pai, and Eleanor Song. Pai leads signal processing, having spent three summers and hundreds of hours researching the field. Goswami wields extensive expertise in mechanical engineering, taking several college

classes and applying his knowledge to build Exo's physical part. Kaler has been coding since age 5, allowing him to make a robust and aesthetic app. Song utilizes her skills in marketing, graphic design, photography, and publishing to transform Exotech's technology into consumer-friendly solutions. Beyond our core skills, we share a personal dedication to healthcare advocacy. We have collectively volunteered over 900 hours building mobility aids for children with disabilities. These experiences revealed gaps in current rehabilitative solutions, inspiring our commitment to Exotech. As a team of empathetic problem-solvers, we are driven by a shared mission: empowering people and transforming lives with technology.

—Evidence—

The Exotech team has been fortunate enough to conduct initial trials on family members and nursing home members with strokes. We conducted a one month study of 10 stroke patients split into two groups of 5: one group utilized Exo two hours a day, and the other used the industry standard, SaeboFlex for the same amount of time. We measure our product's efficacy through the hand range of motion (ROM) and grip strength readings after rehabilitation.

Hand Function Metrics After One Month of Rehabilitation

Participants were randomly chosen for each product. Participants had no prior rehabilitation.

	Exo		SaeboFlex	
Range of Hand Flexion (degrees)	Patient 1: 73 Patient 3: 60 Patient 5: 64	Patient 2: 68 Patient 4: 55 Average: 64	Patient 1: 48 Patient 3: 51 Patient 5: 44	Patient 2: 51 Patient 4: 58 Average: 50.4
Grip Strength (lbs)	Patient 1: 60 Patient 3: 46 Patient 5: 48	Patient 2: 41 Patient 4: 51 Average: 49.2	Patient 1: 26 Patient 3: 40 Patient 5: 31	Patient 2: 37 Patient 4: 30 Average: 32.8