SteadiGrip: An Accessible, Low-Cost, Multi-Modal AI-Driven Wearable Platform for Parkinson's Diagnosis and Personalized Closed-Loop Rehabilitation

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Background: Parkinson's Disease significantly impairs quality of life through motor deficits like tremors. Current pharmacological treatments often carry side effects, while physical therapy lacks personalization and existing pneumatic devices remain functionally limited by a lack of intelligent analysis and high costs. To democratize care, we developed SteadiGrip: a portable, low-cost platform enabling "anytime, anywhere" accessibility. By fostering consistent habit formation through highly personalized, AI-driven experiences, it restores user autonomy, empowers patients psychologically, and accelerates recovery, effectively outperforming rigid pneumatic devices. Methods: We engineered a cost-effective mechanical system replacing expensive flex sensors with a novel strina-driven potentiometer array to auantify flexion kinematics. This hardware integrates multi-modal data streams-including EMG and IMU-processed on-edge via a hybrid Pre-traineoBio-encoder, CNN, and TCN-Lite architecture. This framework governs a servo-actuated system providing dynamic resistive feedback, requiring users to overcome AI-regulated loads for targeted conditioning. Additionally, a voice diagnostic model was integrated to analyze acoustic features for holistic monitoring. Results: With 98.2% accuracy, the system dynamically modulated torque to ensure achievable intensities. This personalized control reduced tremors, proving robust therapy is attainable via accessible hardware.

Awards Won: