HRLMAC-AST Stroke Rehabilitation System

Overview

This repository contains the implementation of the Hierarchical Reinforcement Learning Meta-Actor-Critic with Adaptive Skill Transfer (HRLMAC-AST) framework for stroke rehabilitation, combining mixed reality, haptic feedback, and AI-driven adaptive therapy.

Key Features

* **Mixed Reality Interface**: Immersive VR environment for rehabilitation exercises
* **Haptic Feedback System**: Realistic force and vibration feedback
* **AI-Driven Therapy**:
  + CNN for spatial data processing (motion tracking)
  + RNN (LSTM) for temporal sequence analysis
  + Combined hierarchical model for movement classification
* **Real-Time Motion Tracking**: 120Hz tracking with 0.3° precision
* **BCI Integration**: EEG signal processing for severe motor impairments

System Architecture

Installation

Prerequisites

* Python 3.8+
* TensorFlow 2.6+
* NumPy
* Matplotlib
* scikit-learn
* Seaborn

Code Structure:

hrlmac-ast-rehab/

├── rehabilitation\_system.py # Main system implementation

├── models/ # Neural network architectures

│ ├── cnn\_model.py

│ ├── rnn\_model.py

│ └── hrlmac\_ast.py

├── components/ # System components

│ ├── mixed\_reality.py

│ ├── haptic\_feedback.py

│ ├── motion\_tracker.py

│ └── bci\_module.py

├── data/ # Sample data

├── docs/ # Documentation

└── tests/ # Unit tests