NEUROSENSE: AI-DRIVEN PARKINSON'S DISEASE PREDICTION USING ONLINE HANDWRITING

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Introduction:
This project presents an AI-based system for early detection of Parkinson's Disease using online handwriting analysis, especially spiral drawing. The system captures handwriting data, processes it, and extracts important features related to movement, speed, and shape. It uses advanced techniques like Beta stroke segmentation and a BLSTM model to accurately classify whether a person has Parkinson's or not. The approach is non-invasive, fast, and cost-effective, making it suitable for both clinical use and remote monitoring. By using datasets like the PaHaW dataset and a newly created Arabic dataset, the system achieves high accuracy and helps in early diagnosis of the disease.

Objectives:

1. Detect early signs of Parkinson's Disease Using Handwriting analysis.
2. Provide tracking of disease progression and offer actionable insights throughout an AI-powered Chabot.
3. Transform Parkinson's care by integrating advanced technology info the diagnosis and support process.
4. Helps users to seek early consultation and maintain regular checkups through engaging Chabot reminders.

Methodology:

1. Processes handwritten data (e.g., spiral drawings, signatures, text samples) to extract relevant geometric and kinematic features.
2. Training machine learning model on labeled handwriting data to classify Parkinson's and Non-Parkinson's pattern.
3. Combine handwriting-derived features with patient-reported symptoms and history to generate personalized health insights.
4. Deploy a user-friendly interface for easy patient and clinical use.

Result and Conclusion:

1. Dataset from healthy and Parkinson subjects was analysed using handwriting features, and among multiple models, Random Forest gave the highest accuracy for classification.
2. A CNN model trained on spiral-drawing images compared several architectures, where EfficientNet-B0 performed the best in distinguishing healthy vs PD samples.
3. Overall, both approaches (feature-based ML and CNN) successfully detect Parkinson's disease**,** enabling accurate prediction using handwriting data.
4. AI-based handwriting analysis is a non-invasive, cost-effective, and accurate method for early detection of Parkinson's disease by identifying symptoms like tremors, bradykinesia, and micrographia using key handwriting features.
5. The use of machine learning and neural network**s** enables real-time analysis, making handwriting a reliable biomarker and providing a scalable decision-support system for medical professionals.

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Future Scope:

The future scope of this project includes:

1. **Custom Writing Tasks**
   While the current scope focuses on spirals and seven alphabetical tasks, you could incorporate Free-Form Writing (e.g., describing a picture) to capture higher cognitive-motor demands, which often highlight Parkinson's symptoms more clearly.
2. **Voice and Speech Integration**
   Since Parkinson's often affects vocal cords (causing a soft or raspy voice), adding a speech analysis module to our multi-modal learning architecture could further increase overall diagnostic accuracy beyond handwriting alone.
3. **Physician Consultation Portal**
   Develop a secure interface specifically for doctors to remotely review the Grad-CAM visualizations (which highlight tremors or stroke distortions) and download standardized clinical reports in real-time.