Application of Multi-sensor Technology on the Diagnosis of Parkinson's Disease

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Summary

This study aims to combine two methods—upper limb tremor severity evaluation and lower limb motion analysis—to propose a simple procedure for diagnosing ET and PD.

Introduction

Currently, the diagnosis of Parkinson's disease (PD) is often based on the subjective judgment of medical professionals, which may lead to misdiagnosis [1]. This study aims to determine whether participants have PD by integrating upper limb and lower limb assessment and establishing a corresponding machine learning model (ML model). The procedure is designed to provide physicians with an objective tool to differentiate between essential tremor (ET) and PD.

Methods

The diagnostic process is shown in Figure 1. The subjects first underwent upper limb assessment, as shown in Figure 2, mainly through the spiral drawing test to extract tremor-related characteristic parameters. The upper limb ML model was used to diagnose whether the participants had ET. If the participants were diagnosed with non-ET, they underwent a lower limb assessment, as shown in Figure 3, which involved extracting gait-related feature parameters through a walking test. The lower limb ML model was used to diagnose whether the participants had PD. If a participant was diagnosed as "other," it indicated that the participant did not have ET or PD.

The core algorithm used in the ML model is XGBoost (Extreme Gradient Boosting). The data and training parameters of the upper limb model were based on the dataset collected by Tsai et al. [2] For the lower limb model, data from PhysioNet was used. The training parameters were based on those selected by Abdulhay et al. [3] and Lin et al. [4].

Results and Discussion

The upper limb model achieved an accuracy of 84% and a ROC AUC score of 0.83. The lower limb model achieved an accuracy of 72% and a ROC AUC score of 0.8. These results demonstrate the effectiveness of the model.

Conclusions

This study proposes a simplified diagnostic algorithm that integrates upper limb tremor severity assessment and lower limb movement analysis. The two conditions can be accurately distinguished through their respective ML model.

Acknowledgments

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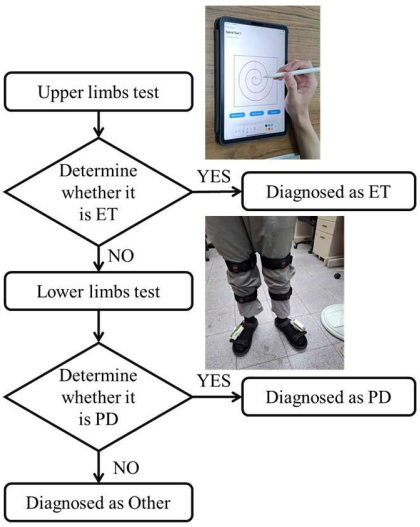

Figure 1: Testing process.

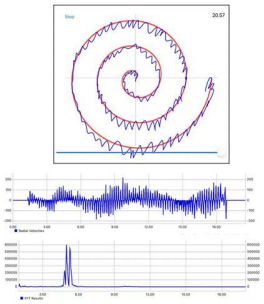

Figure 2: Schematic diagram of the spiral drawing test.

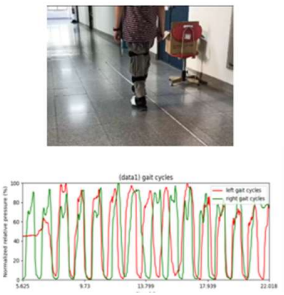

Figure 3: Schematic diagram of the lower limb test.

References

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