

Software Requirements Specification

For

Detection of freezing of gait in Parkinson's disease using machine learning

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1. Introduction

1.1 Purpose

The purpose of this document is to outline the software requirements for a system that detects freezing of gait in individuals with Parkinson's disease using machine learning techniques.

1.2 Scope

The model will analyse gait data collected from Parkinson's disease patients and healthy individuals, utilizing machine learning algorithms to identify patterns associated with freezing of gait. The system aims to provide early detection and monitoring of Parkinson's disease progression.

1.3 Definitions, Acronyms, and Abbreviations

- **PD**: Parkinson's Disease
- **ML**: Machine Learning
- **FOG**: freezing of gait
- **V**: vertical
- **M**: mediolateral
- **AP**: anteroposterior

2. Functional Requirements

2.1 Data Collection and Preprocessing

2.1.1 Data Acquisition

The system shall be capable of collecting gait data from wearable devices (accelerometers, 3D lower back sensor)

Acceleration from a lower-back sensor on three axes: V - vertical, ML - mediolateral, AP - anteroposterior.

Series from the dataset are recorded at 128Hz (128 timesteps per second), while series from the defog and daily series are recorded at 100Hz (100 timesteps per second).

2.1.2 Data Preprocessing

The system shall preprocess raw gait data to remove noise and irrelevant information, including filtering, resampling, and synchronization.

2.2 Feature Extraction

2.2.1 Feature Calculation

The system shall calculate the identified gait features from the pre-processed data for each individual in the dataset.

2.3 Machine Learning Model

2.3.1 Model Selection

We used machine learning algorithms, Decision Trees(home dataset), XG Boost (Extreme Gradient Boosting)(lab data set), for freezing of gait detection

2.3.2 Model Training

The system shall train the selected machine learning model using labelled gait data from individuals with Parkinson's disease and healthy controls.

2.3.3 Model Evaluation

The system shall evaluate the trained model's performance using metrics such as accuracy, precision, recall, and F1-score on a separate validation dataset.

2.4 Parkinson's Disease Detection

2.4.1 Batch Processing

The system shall support batch processing of gait data for retrospective analysis and research purposes.

2.5 User Interface

2.5.1 Data Visualization

The system shall offer visualizations of gait features and detection results, such as heatmap, line plots, and confusion matrices.

3. Non-Functional Requirements

3.1 Performance

Specificity, sensitivity and f1 score are the performance measures.

3.2 Accuracy

The system's detection accuracy shall exceed 90% on both validation and real-time data.

3.3 Usability

The user interface shall be intuitive, requiring minimal training for healthcare professionals to operate effectively.

4. Constraints

- The system's accuracy heavily depends on the quality and quantity of available gait data.
- Hardware constraints of the deployed devices might affect real-time processing capabilities.

5. Future Enhancements

- Integration with electronic health record systems for seamless patient data retrieval.
- Continuous model updating to adapt to variations in gait patterns over time.

6. Conclusion

This Software Requirements Specification outlines the functional and non-functional requirements for the development of a system that detects freezing of gait in individuals with Parkinson's disease using machine learning techniques. The system aims to contribute to the early detection and monitoring of Parkinson's disease progression for improved patient care.