Design Project Proposal: Machine Learning on Pattern Electroretinograms (PERG-IOBA Dataset)

Domain

This project falls under **Ophthalmic Signal Processing**. We focus on **Pattern Electroretinograms (PERG)** — a non-invasive electrophysiology test that measures how the retina responds to alternating visual patterns (e.g., checkerboards). The PERG waveform reflects the activity of retinal ganglion cells and the macula. Clinicians use it to diagnose and monitor retinal and optic nerve disorders.

Dataset (PERG-IOBA, PhysioNet, 2024)

- Size: 1354 signals, 304 subjects, collected from 2003–2022 at IOBA (University of Valladolid, Spain).
- Structure:
  • Signals: Right Eye (RE), Left Eye (LE) recordings (time-series, 1700 Hz sampling).
  • Demographics: Age, sex.
  • Clinical Info: Diagnosis (Normal / Pathological), visual acuity (logMAR).
- Open Access: PhysioNet repository.
Dataset DOI: https://doi.org/10.13026/d24m-w054

Problem Statement

Can machine learning models detect **abnormal vision** or predict **visual acuity** directly from PERG signals? If successful, this would automate retinal signal interpretation and aid early detection of vision loss.

Project Goals

1. Classification Task
 Input: PERG signals.
 Output: Normal vs Abnormal eye health.

2. Regression Task
 Input: PERG signals.
 Output: Predicted logMAR visual acuity (continuous score).

Technical Approach

- Signal Preprocessing: Filtering, normalization, segmentation.
- Feature Extraction: Wave components (N35, P50, N95), statistical features, FFT.
- Models:
  • Classical ML (Logistic Regression, Random Forest, SVM).
  • Deep Learning (1D CNNs, LSTMs, Transformers for time-series).
- Evaluation:
  • Classification: Accuracy, F1, ROC-AUC.
  • Regression: MSE, RMSE, R² score.

Expected Outcomes

- An ML pipeline that can classify or predict visual outcomes from retinal electrophysiology signals.
- Visualizations of PERG waveforms with identified biomarkers (N35, P50, N95).

- Potential research contribution: linking **objective signals (PERG)** with **subjective vision measures (visual acuity)**.

Why Suitable for B.Tech Design Project

- Dataset is **small, structured, and open-access**.
- Tasks (classification/regression) are **clear and achievable**.
- Provides interdisciplinary exposure (ML + biomedical).
- Recent dataset (Jan 2024) $\Rightarrow$ high novelty and paper publication potential.