ECG (Normal & LBBB)

Team Number: 21

Team Members

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1. Introduction

- **Objective**: This project aims to diagnose the Left Bundle Branch Block (LBBB) in ECG signals using a K-nearest neighbours (KNN) model.
- **Dataset**: The dataset includes normal and LBBB ECG signals, sourced from the MIT-BIH database with a sampling rate of 360 Hz.

2. Data Preprocessing

- **Steps**:
    - **Mean Removal**: The mean of the signal is removed to center it around zero.
    - **Bandpass Filter**: To remove noise, a Butterworth filter is applied with a range of 0.5 to 40 Hz.
    - **Normalization**: The signal is normalized to a standard range [-1, 1] for consistent feature extraction.

3. Feature Extraction

- **Wavelet Transform**: Daubechies wavelets are used to decompose the ECG signals into approximation coefficients.
    - **Used Parameters (After Several Trials)**:
        - **Type:** db2
        - **Level:** 3
- **Statistical Features**:
    - **Mean**: The average value of the wavelet coefficients.
    - **Standard Deviation**: The dispersion or variability of the coefficients.
    - **Skewness**: The asymmetry of the coefficient distribution.
    - **Kurtosis**: The peakedness of the coefficient distribution.

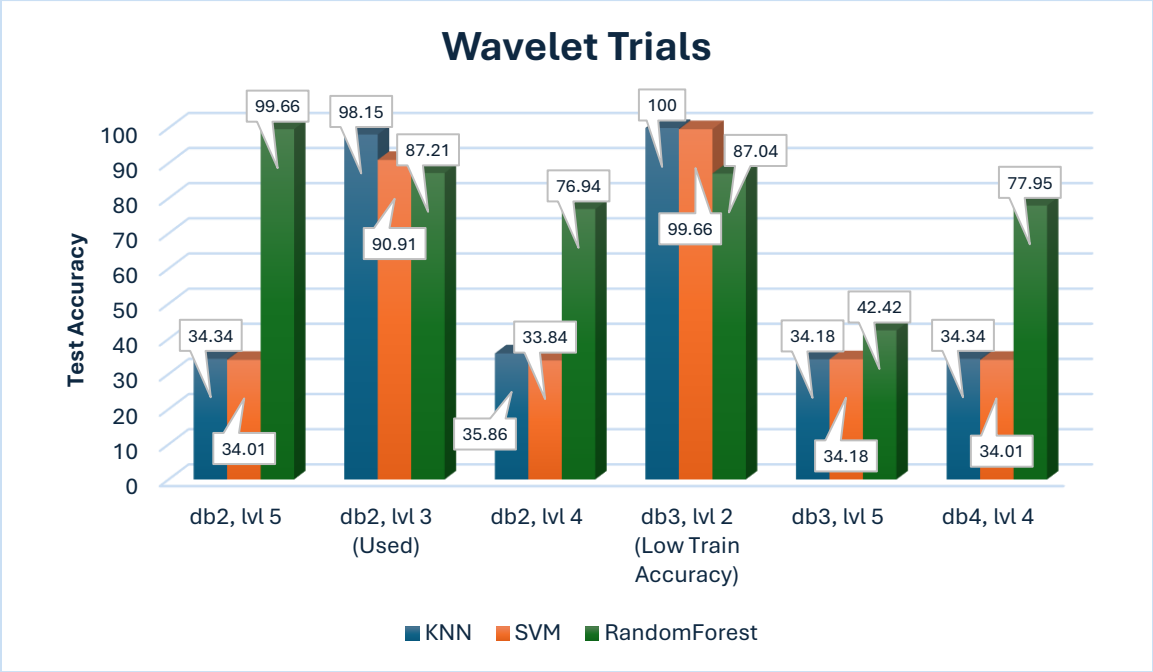
4. Model Training

- **Algorithms**:
    - **K-Nearest Neighbors (KNN) classifier:**
        - **n_neighbors**: 11 (Number of neighbours to use)
    - **Support Vector Machine:**
        - **C**: 0.4 (Regularization parameter)
        - **kernel**: 'rbf' (Specifies the kernel type to be used in the algorithm)
    - **Random Forest:**
        - **n_estimators**: 1 (Number of trees in the forest)
        - **random_state**: 42 (Controls the randomness of the estimator)
        - **max_depth**: 1 (The maximum depth of the tree)
- **Parameter Tuning**:
    - **GridSearchCV**: Used to find the best parameters (e.g., number of neighbours, weights) through cross-validation.
    - **Elbow Method**: Plotted error rate vs. Parameters to identify the optimal ones.

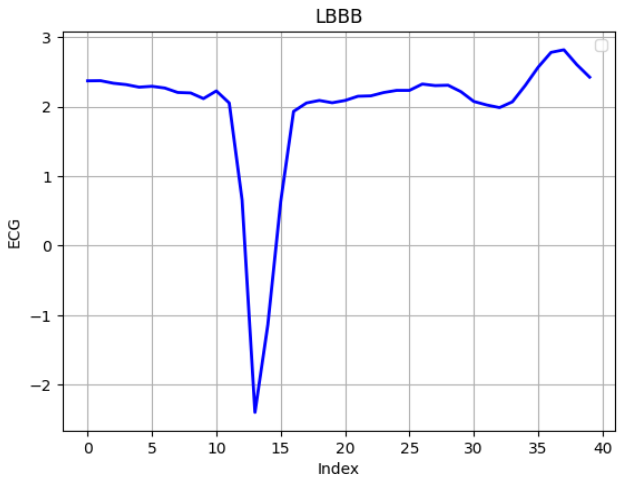
5. Model Evaluation

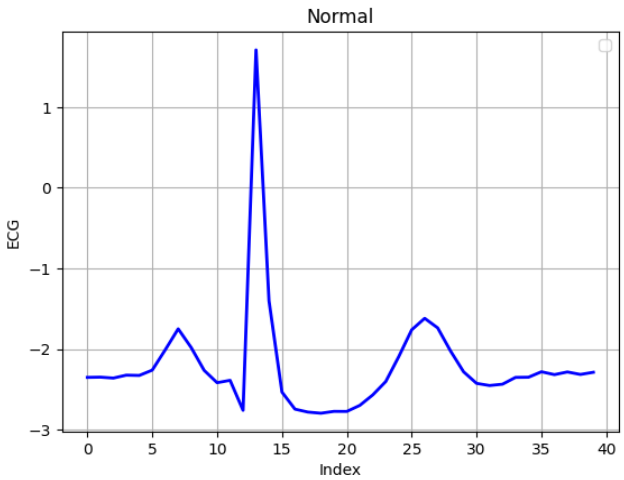
- **Metrics**:
    - **Accuracy**: The percentage of correctly classified instances.
    - **Confusion Matrix**: A table showing the true positives, false positives, true negatives, and false negatives.
    - **Permutation Importance**: Evaluated the importance of each feature.

6. Trials



Used Wavelet (db2, level 3):

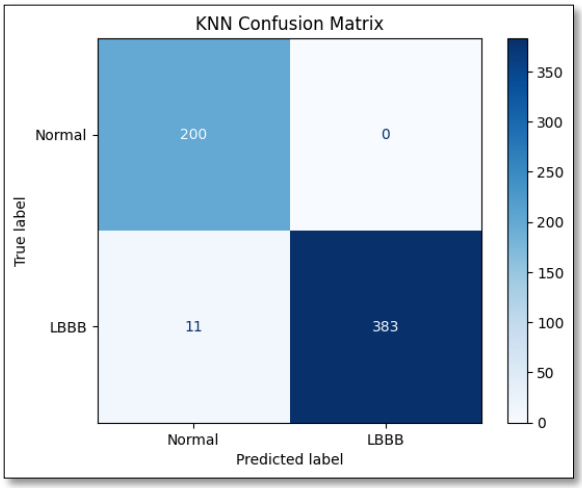


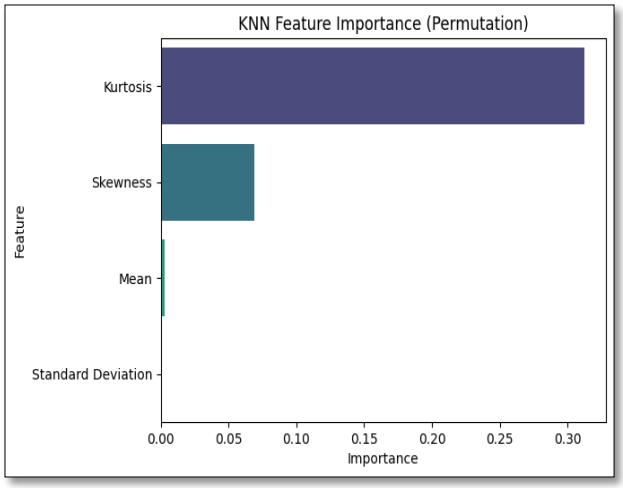


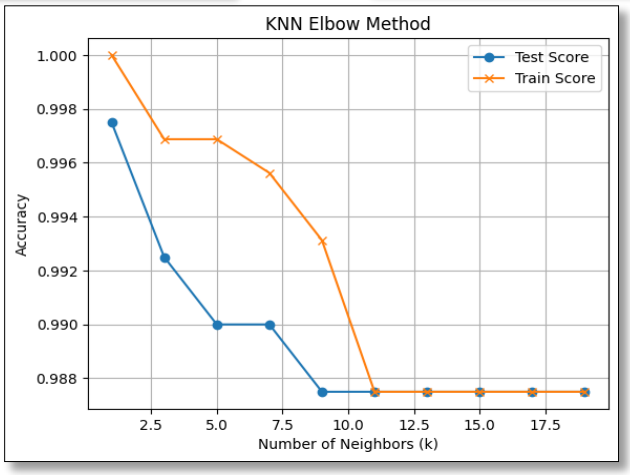
7. Results

Model	Train Accuracy	Test Accuracy
KNN	98.75%	98.15%
SVM	99.25%	90.91%
Random Forest	99.50%	87.21%

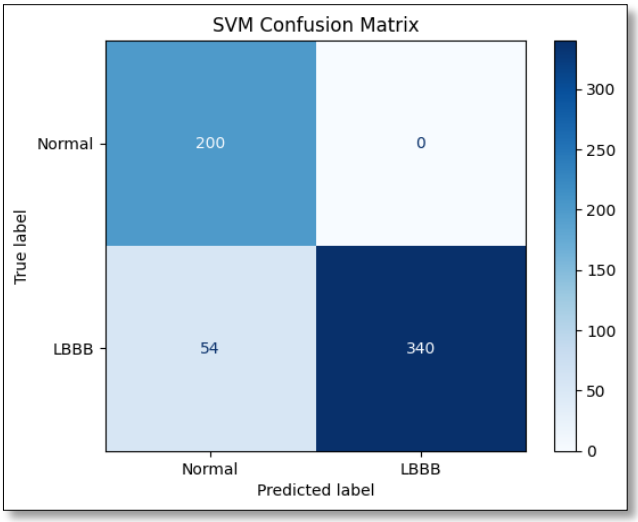
KNN Model

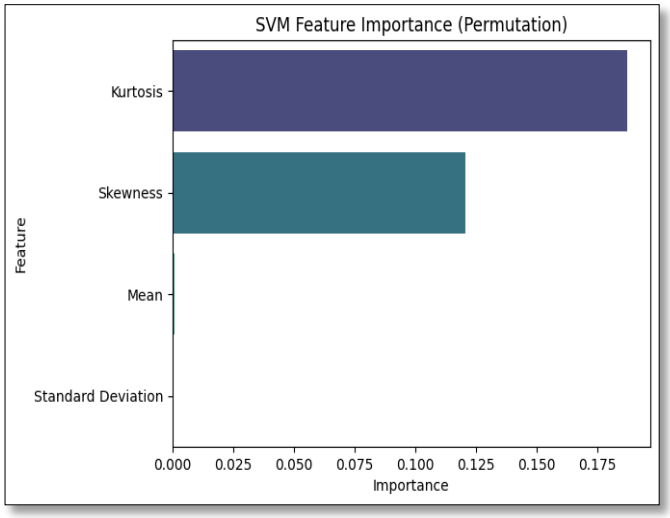


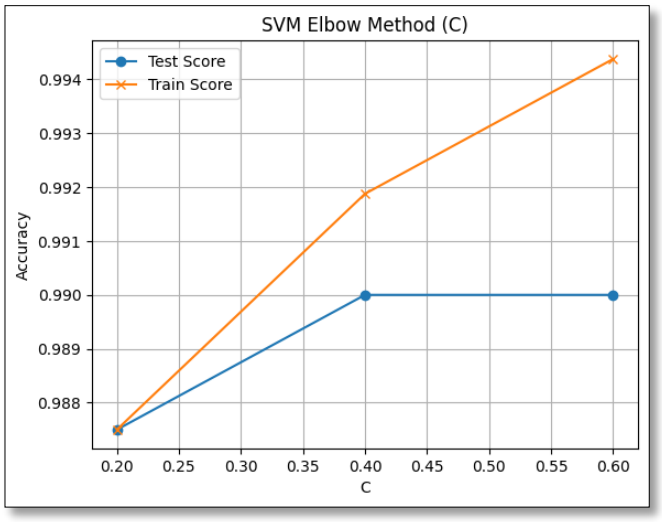




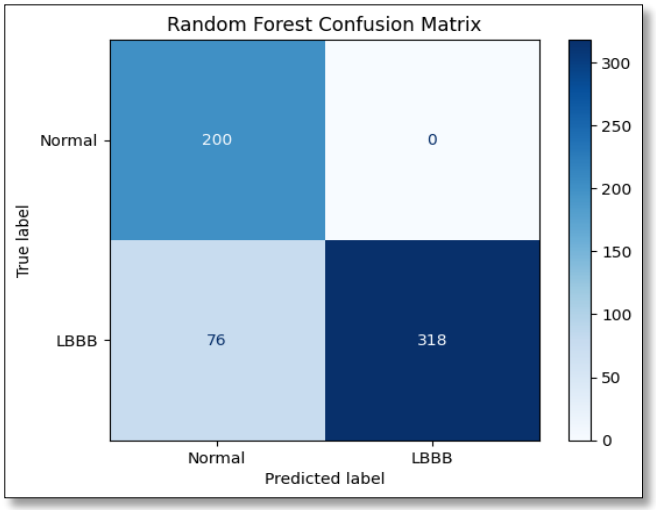
SVM Model

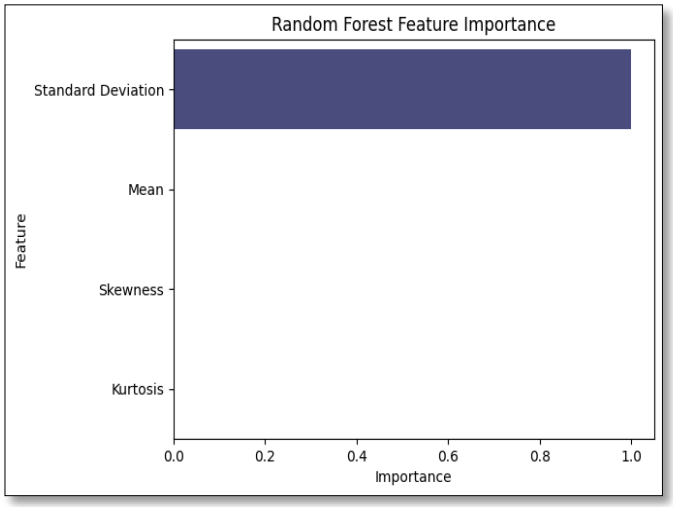






Random Forest Model





7. Model Deployment

- **Saving the Model**: Using joblib to save and load the trained model for deployment.
- **Creating GUI**: Using Tkinter to develop a simple graphical user interface (GUI) for users to input ECG signals and get predictions.