**RBBB vs Normal**

TEAM: **SC\_16**

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**Abstract**

This is an AI model that predicts whether a person has Right Bundle Branch Block (RBBB) or is normal. We used a dataset from the MIT-BIH database with a sampling rate of 360 Hz.

We tested different AI models, including k-NN, SVM, Random Forest, and Logistic Regression, and observed that SVM achieved the best accuracy among them.

**Methodology**

* **Data Collection**

In the **pre-processing stage**, we applied several techniques to prepare the signal for analysis:

1. **DC Component Removal:**

We removed the DC component to eliminate any shifts in the signal and ensure it remains centred around zero.

1. **Noise Filtering:**

A bandpass filter was applied with cutoff frequencies in the range of 0.5–40 Hz to remove outlier noise and retain relevant signal components.

1. **Signal Normalization:**

We normalized the signal using **Z-score normalization** to ensure uniformity and enhance the stability of subsequent processing and analysis.

Although we experimented with **Min-Max normalization**, it produced suboptimal results compared to Z-score normalization.

1. **Feature Extraction:**

To extract meaningful features, we utilized the **wavelet transform** with the Daubechies wavelet (db4) and performed a **4-level decomposition**. This approach enabled us to capture significant signal characteristics across different frequency bands effectively.

* **Data Collection**

We experimented with several models, including k-Nearest Neighbours (k-NN), Support Vector Machines (SVM), Random Forest, and Logistic Regression. Among these, **SVM** and **Random Forest** delivered the best performance.

**K-Nearest Neighbours (k-NN) Model Analysis**

We implemented a k-NN classifier with k=15k = 15, cosine distance as the similarity metric, and distance-based weighting. The model achieved the following performance:

* **Training Accuracy:** 100.00%
* **Testing Accuracy:** 99.75%
* **Precision, Recall, F1-Score:** 1.00 (each)

**Support Vector Machine (SVM) Model Analysis**

We implemented an SVM classifier using an **RBF kernel**, with a regularization parameter C = 5 and automatic gamma. The model achieved the following performance:

* **Accuracy:** 100.00%
* **Precision:** 1.00
* **Recall:** 1.00
* **F1-Score:** 1.00

**Random Forest Model Analysis**

We implemented a **Random Forest** classifier with 50 estimators (trees), no maximum depth, and a minimum of 3 samples required to split an internal node. The model achieved the following performance:

* **Accuracy:** 99.75%
* **Precision:** 1.00
* **Recall:** 1.00
* **F1-Score:** 1.00

**Logistic Regression Model Analysis**

We implemented a **Logistic Regression** classifier with L1 regularization, a regularization strength C=0.5C = 0.5, and the **liblinear** solver. The model was trained with a maximum of 1000 iterations and balanced class weights to handle potential class imbalances. The model achieved the following performance:

* **Accuracy:** 87.75%
* **Precision:** 0.80
* **Recall:** 1.00
* **F1-Score:** 0.89
* **Conclusion**

This project aimed to classify **Right Bundle Branch Block (RBBB)** and **normal** ECG signals using the MIT-BIH dataset. After comprehensive pre-processing and feature extraction through wavelet transformation, we evaluated multiple machine learning models. **Support Vector Machine (SVM)** and **Random Forest** performed the best, with SVM achieving perfect **100% accuracy** and Random Forest reaching **99.75% accuracy**. In contrast, **Logistic Regression** showed lower performance with **87.75% accuracy**. The results indicate that **SVM** is the most effective model for this task, demonstrating superior precision, recall, and overall performance for RBBB classification. This work demonstrates the potential of AI-driven methods in ECG-based diagnostic applications.

