AUTOMATIC ATRIAL ARRHYTHMIA DETECTION FROM A REMOTELY ACQUIRED ECG

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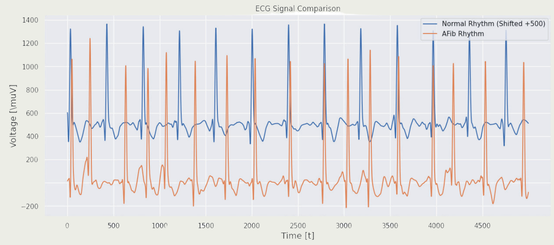
EDISS MASTER'S PROGRAMME

Mälardalen University

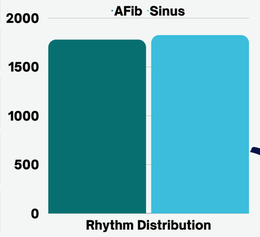
PROBLEM STATEMENT

This project aims to develop a Machine Learning tool that enables early detection of ***Atrial Fibrillation*** using ECG data on portable devices, thereby making heart health monitoring accessible everywhere, particularly in regions with limited healthcare.

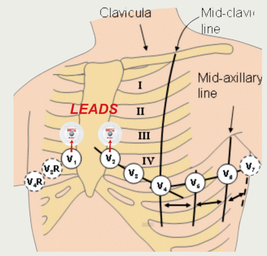


DATASET

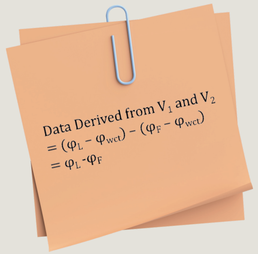
PATIENTS	10,646
LEADS	12 (V1-V2 similar to single lead)
RESOLUTION	500 Hz of Frequency, 5000 rows (10 seconds of recordings)
LABELS	16 types of rhythm including Atrial Fibrillation
FORMAT	CSV - 1 file per patient



APPROACH

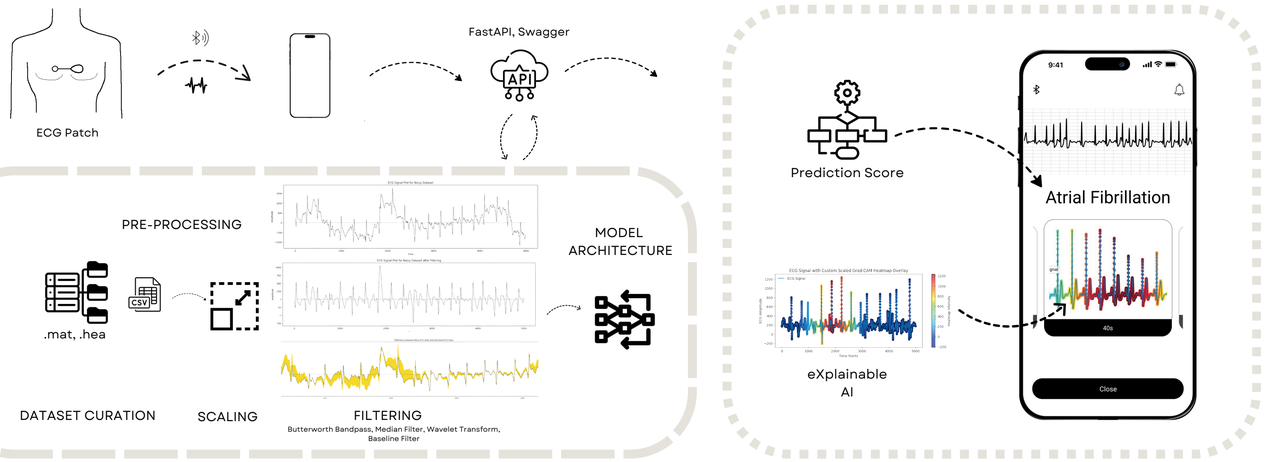


Contrary to the widespread use of traditional 12-lead ECG devices, which analyze data from leads V1 to V2, our approach focuses on data from just ***V1*** and ***V2***,taking the difference of the leads V1 and V2 thus simulating a single-lead ECG system. As illustrated in the image, V1 and V2 are two leads attached to the heart.



PIPELINE

- The ECG Signal comes from a handheld device.
- Noise filters are used to remove the noise.
- Scaling is used to upscale the signal.
- The model is used for inference and then generation of Explainability.



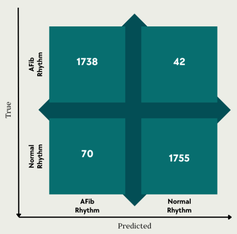
MODEL ARCHITECTURE

- Our base architecture draws inspiration from ***EfficientNet (CNN)*** and integrates a MultiHeadAttention layer to enhance feature interpretability.
- The final layer of the CNN is utilized for model explainability.

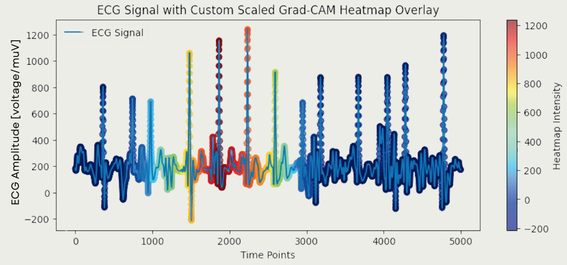
- **Epochs:** 1600
- **Learning Rate:** 0.00006
- **Optimizer:** Adam
- **Loss function:** Binary Cross Entropy

RESULTS

CONFUSION MATRIX



METRICS	SCORE
ACCURACY	97%
PRECISION	97%
RECALL	97%
F1-SCORE	97%



- The model produces a classification result with **97%** accuracy, precision, and recall.
- GRAD-CAM is used to generate the heatmap for gradient-weighted class activation and overlayed over the dataset.
- This method explains the section of the signal that has more importance in the classification.

CONCLUSION

Our approach to use the leads V1-V2 is a novel approach that not only yields more precise results but also simplifies the process for users by minimizing the complexity and potential errors associated with multiple leads.
Moreover, the eXplainable AI feature that we introduced is another innovation that allows users to validate the results with their doctor and seek timely treatment.