



K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

School of Engineering and Technology

AI-Powered ECG Analysis for Early Heart Disease Detection : A Research Study

Project ID: Y1-2024-25-G304

Supervisor:
Dr Yogita Raghav

Team Members:

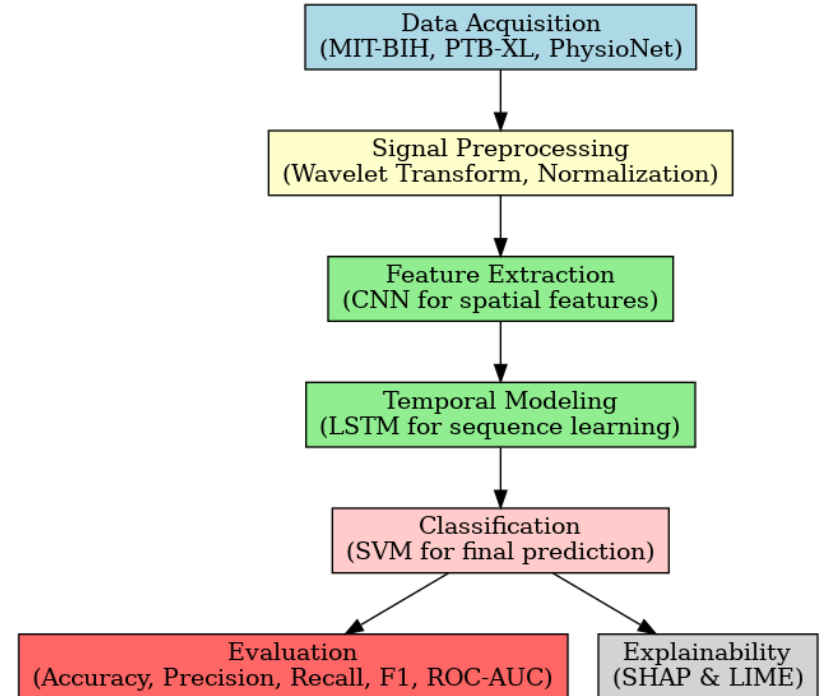
Anantika Paul (2401560042)
Jimni Gogoi (2401560041)

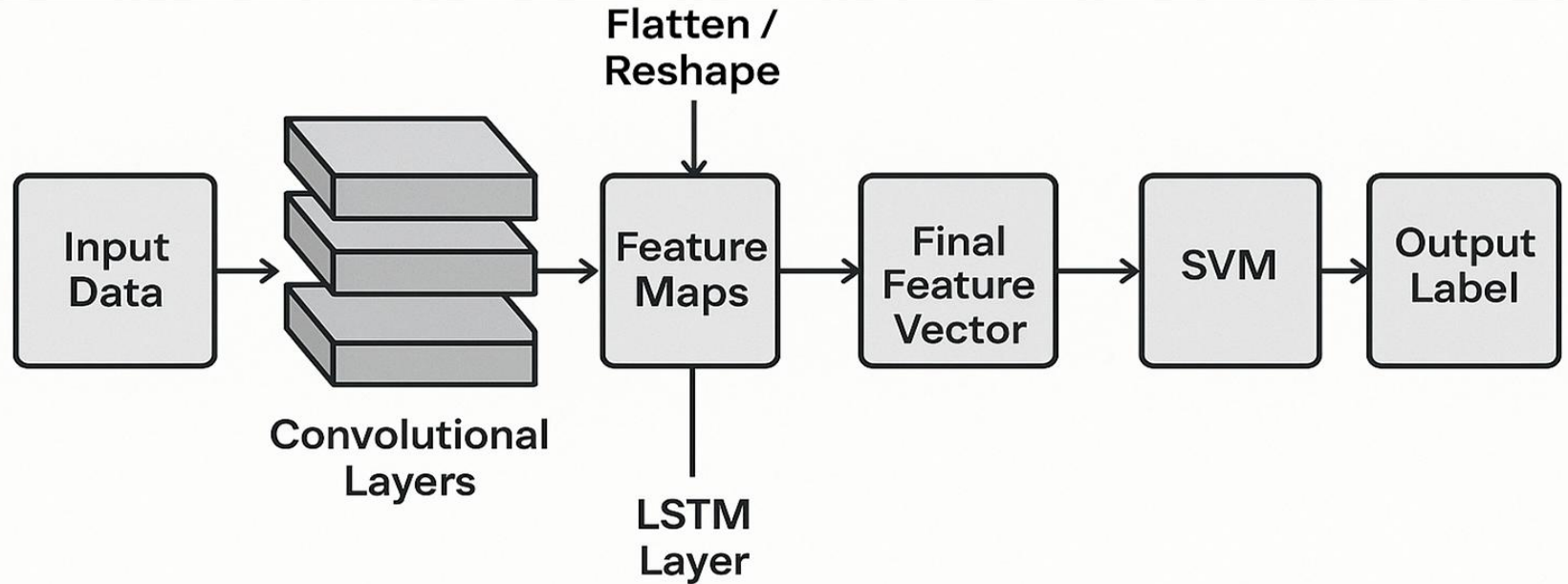
Introduction to the Problem

- **Cardiovascular diseases (CVDs)** are the **leading cause of death worldwide**.
- **Early detection** is critical for effective treatment and management.
- **Electrocardiograms (ECGs)** are the primary tool for diagnosing heart abnormalities.
- Manual ECG interpretation is **time-consuming, error-prone**, and requires **expertise**.
- There's a strong need for **automated, accurate, and interpretable** ECG classification systems.

Proposed Solution Overview

- Investigate a hybrid CNN-LSTM-SVM model for ECG classification.
- Integrate **SVM** for robust classification from learned deep features.
- Incorporate **explainable AI (SHAP & LIME)** for transparency and interpretability.
- Validate the proposed method using **benchmark ECG datasets** (e.g., MIT-BIH)
- Contribute to the field of interpretable AI in healthcare diagnostics.





Structure of Proposed Hybrid CNN-LSTM + SVM model

Key Innovations Over Existing Methods

| Feature | Our Approach | Typical Existing Methods |
|------------------------|--|---|
| Model Type | CNN + LSTM for features + SVM for classification | End-to-end deep models (e.g., CNN only) |
| Explainability | Uses SHAP and LIME | Usually lacks explainability |
| Preprocessing | Wavelet denoising | Often use raw or filtered signals |
| Hybrid Strategy | Combines deep learning + classical ML | Usually deep learning only |
| Scalability | Modular pipeline can be deployed in parts | Monolithic and less flexible |
| Trustworthiness | Explanations support clinical decisions | Black-box, difficult to validate clinically |

| Model | Accuracy (%) | Precision (0) | Precision (1) | Recall (0) | Recall (1) | F1-Score (0) | F1-Score (1) |
|-------------------------|--------------|---------------|---------------|------------|------------|--------------|--------------|
| CNN | 99.00 | 0.99 | 0.99 | 0.98 | 1.00 | 0.97 | 1.00 |
| LSTM | 82.77 | 0.79 | 0.88 | 0.90 | 0.75 | 0.84 | 0.81 |
| LSTM + CNN | 99.08 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| LSTM-CNN + RandomForest | 93.21 | 0.92 | 0.95 | 0.95 | 0.92 | 0.93 | 0.93 |
| LSTM-CNN + SVM | 83.60 | 0.84 | 0.75 | 0.93 | 1.00 | 0.88 | 0.87 |

Comparison Table of The Models

THANK YOU