Case Study - Arrythmia Classification

Heartbeat Classification and Arrhythmia Detection Using a Multi-Model Deep-Learning Technique – Irfan et al.

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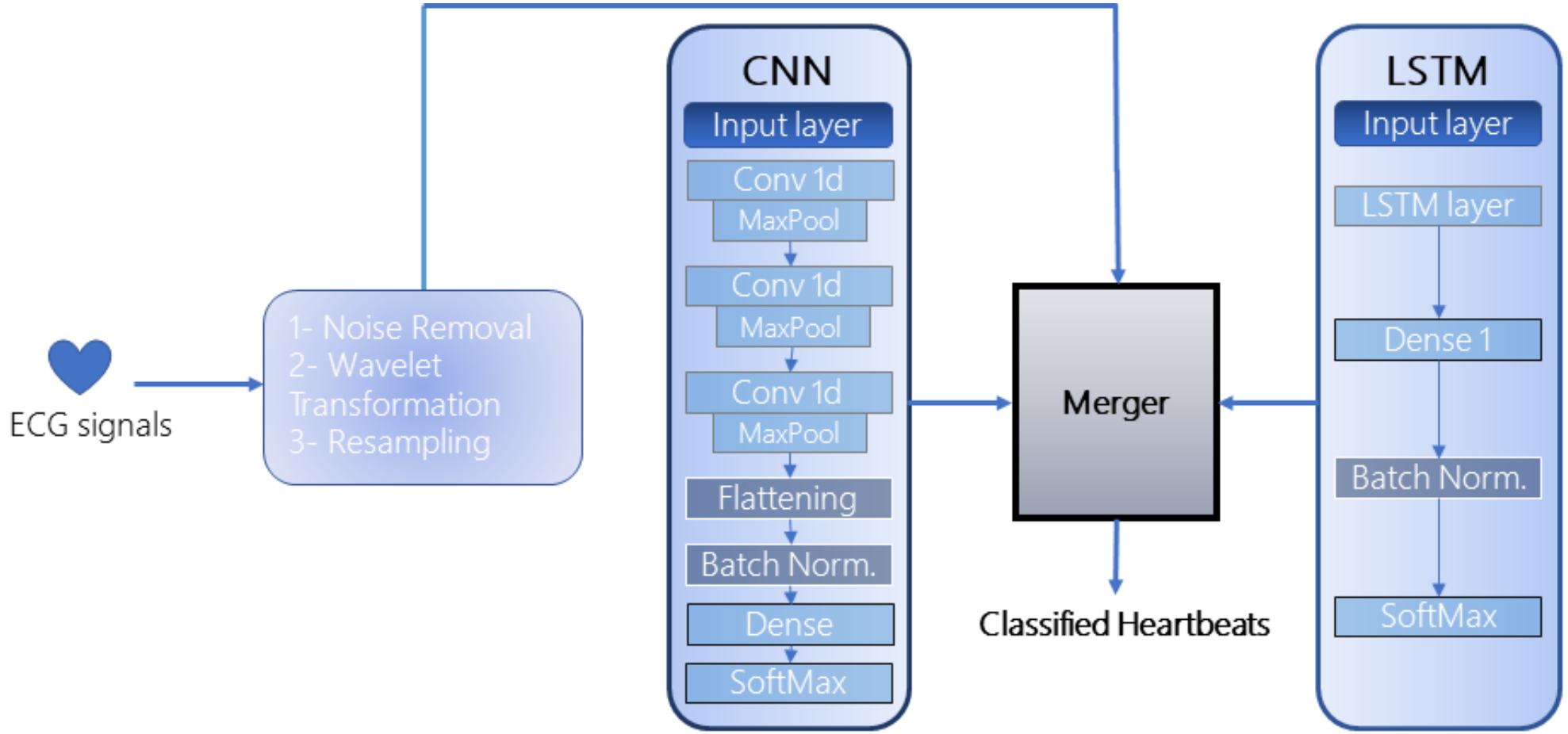
Mandla Gwetu (mvgcollab@gmail.com)

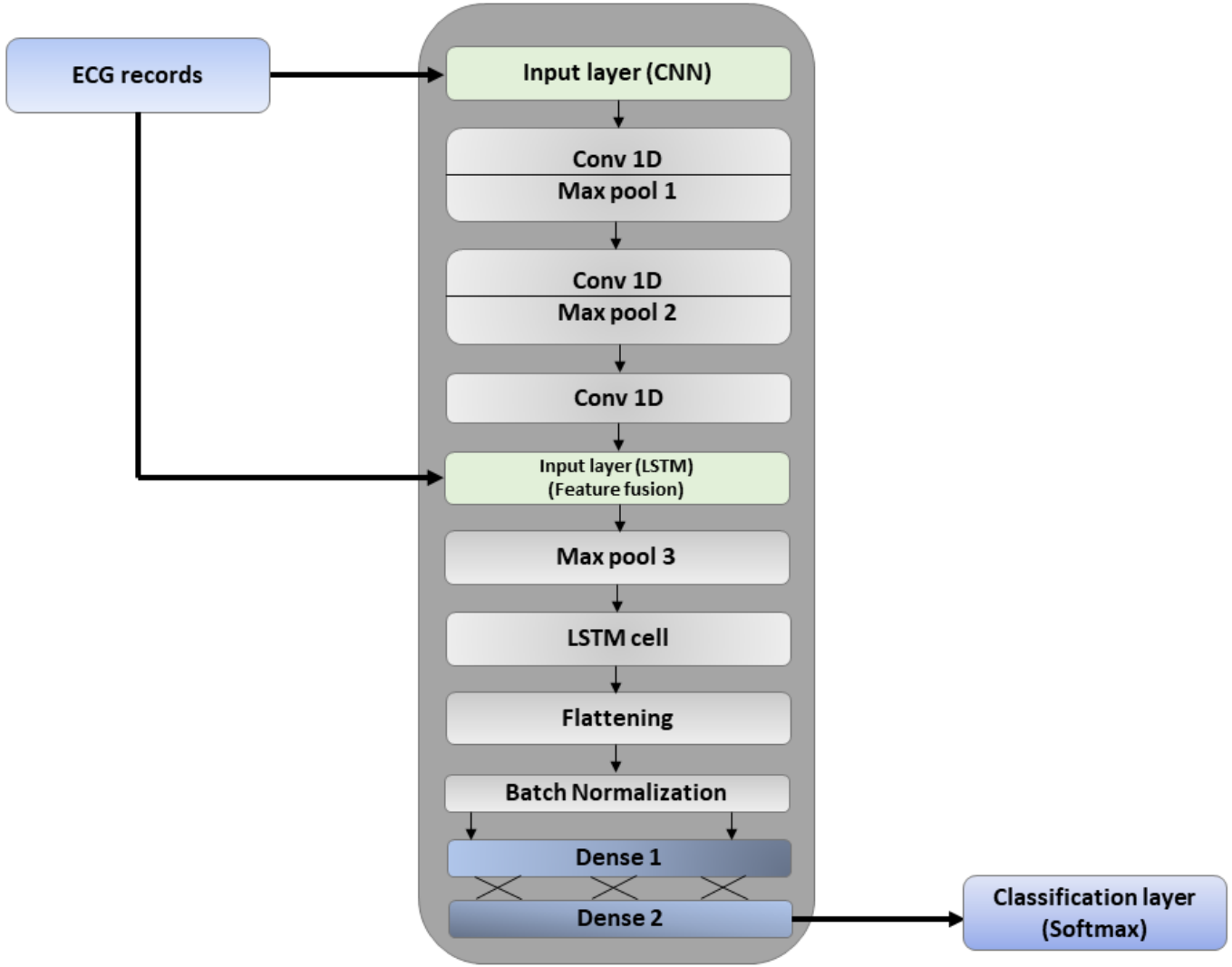
Arrhythmia

- Cardiac condition that is represented by abnormal heart beats.
- Efficient and prompt diagnosis is essential for survival.
- Detection of Arrhythmia done mainly through Electrocardiogram (ECG) analysis.
- Manual analysis of ECGs by medical experts is often inefficient.
- Automated analysis requires extensive training time and effective feature selection.
- Deep-learning framework applied to two datasets: preprocessing + 1D-CNN + RNN.

Model Architecture



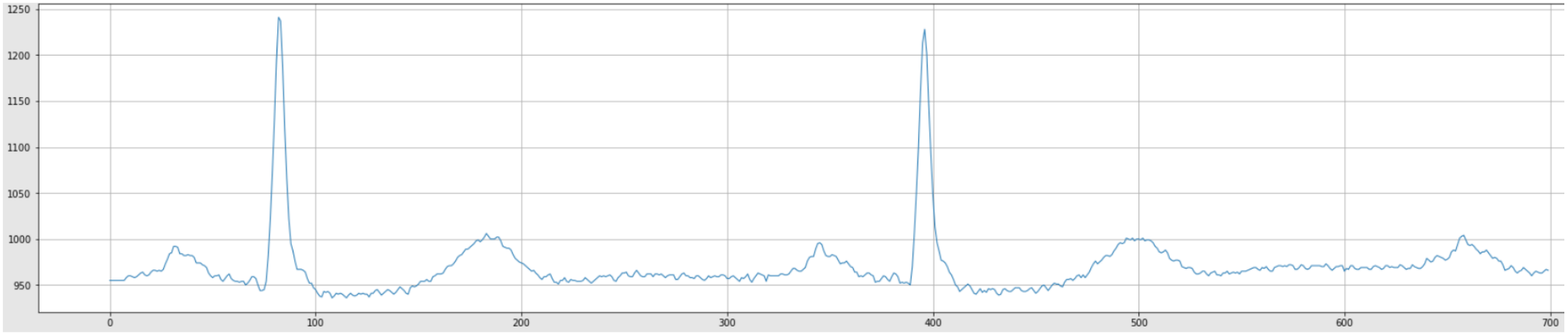
Model Merger

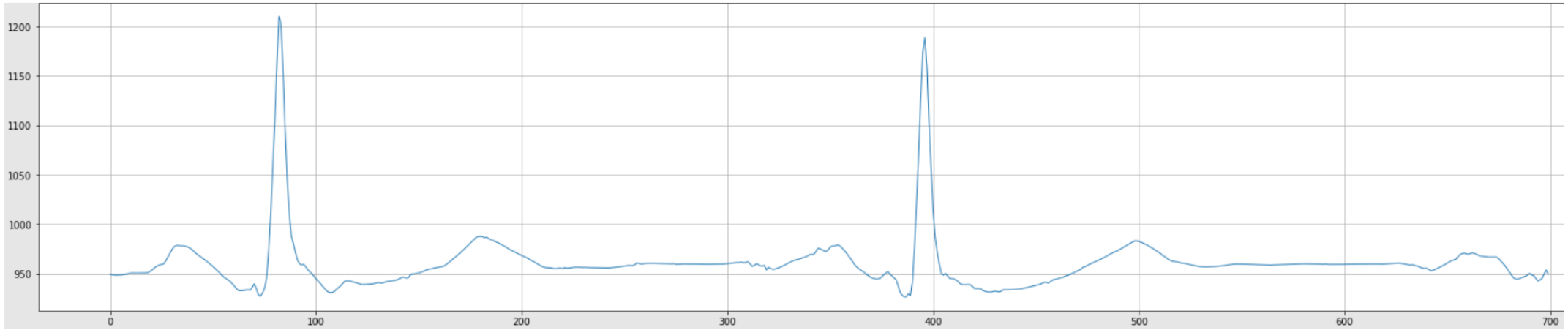


MIT-BIH Arrhythmia Dataset—D2

- Publicly available – Kaggle [https://www.kaggle.com/datasets/taejoongyoon/mitbit-arrhythmia-database]
- 30-min raw ECG recordings of 48 patients
- 5 arrhythmia sub-classes – Normal (N), Left bundle branch block beat (L), Right bundle branch block beat (R), Atrial premature beat (A), and Premature ventricular contraction (V).
- Preprocessed through denoising and resampling.

Noise Removal

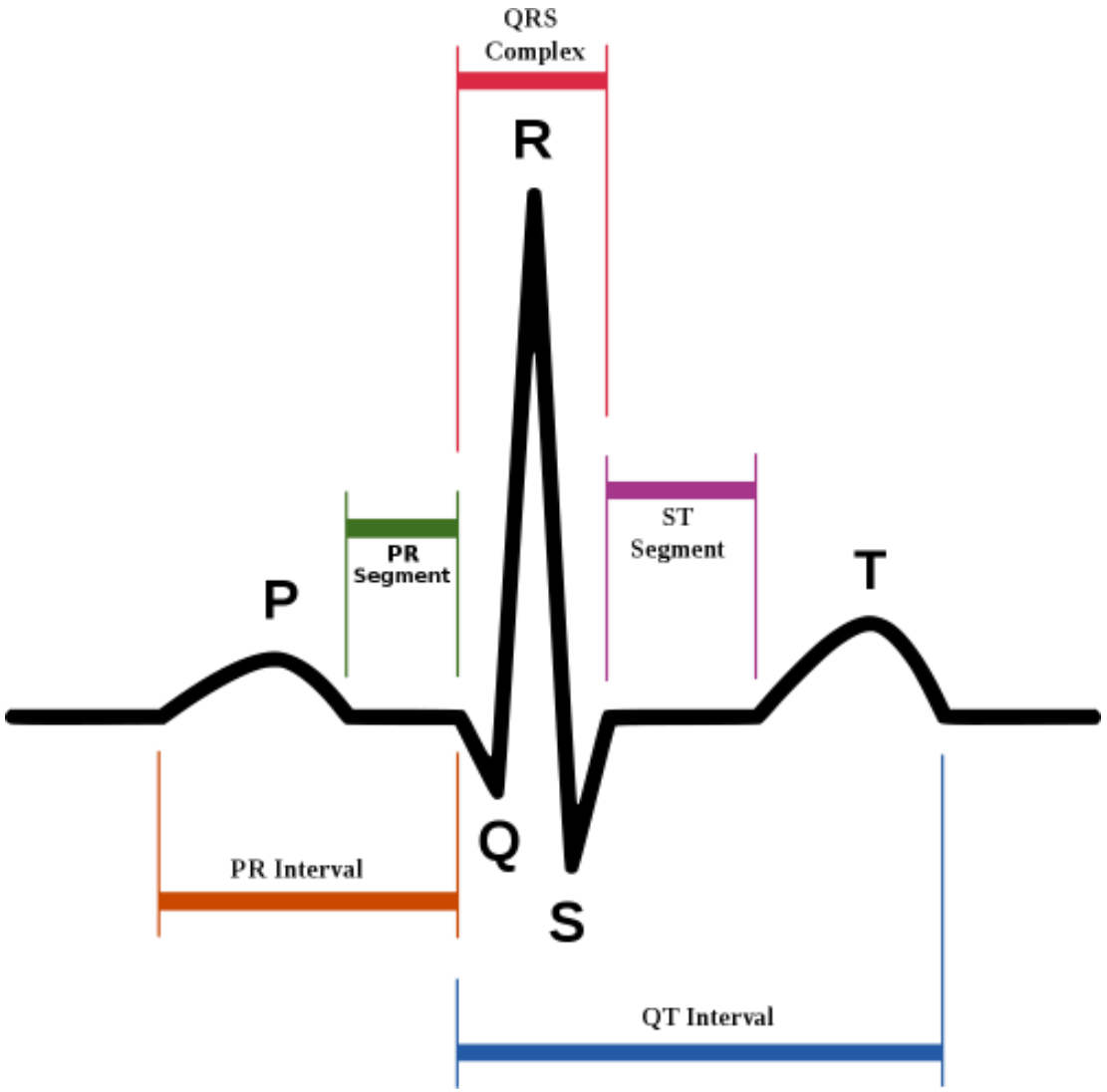




Pre-processed Dataset

Class	No. of Instances
N	75,011
L	8071
R	7255
A	2546
V	7129

Typical Features



Evaluation Metrics

$$sensitivity = \frac{tn}{tp + fn}$$

$$specificity = \frac{tn}{tn + fp}$$

$$Ppv = \frac{tp}{tp + fp}$$

$$accuracy = \frac{tp + tn}{tp + tn + fp + fn}$$

Results

		Predicted				
		N	**L**	**R**	**A**	**V**
Actual	N	2019	3	4	14	9
	L	3	2015	0	1	5
	R	10	0	1945	7	0
	A	60	0	17	1889	1
	V	21	4	1	2	1970

Extension Projects

- Pre-processing – what and how much can we throw away?
- Signal profile interpretation – what about the signal is informative?

sensors

MDPI

Article

Heartbeat Classification and Arrhythmia Detection Using a Multi-Model Deep-Learning Technique

Saad Irfan [1], Nadeem Anjum [1,*], Turke Althobaiti [2], Abdullah Alhumaidi Alotaibi [3], Abdul Basit Siddiqui [1] and Naeem Ramzan [4]