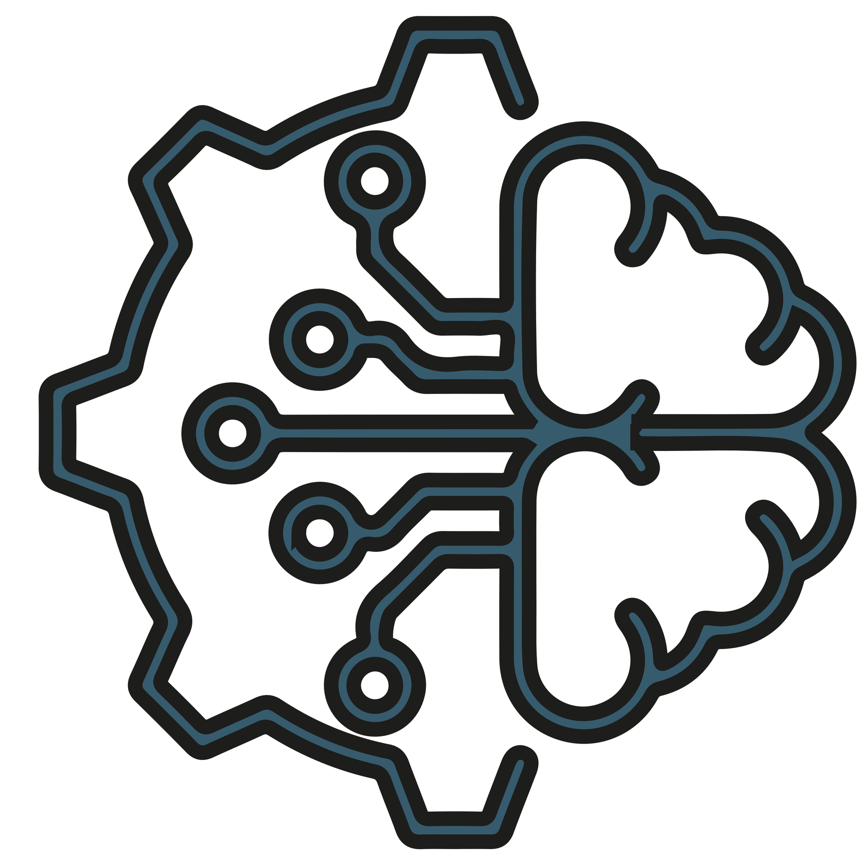
VENTRICULAR ARYTHMIA DETECTION

Ventricular arrhythmias are abnormalities in the heart's rhythm that can result in the death of the patient. So far detection methods of ventricular arrhythmias have been using traditional programming techniques based on the test results of patients. We have built a deep learning algorithm that can automatically detect the abnormalities in heart's rhythm.



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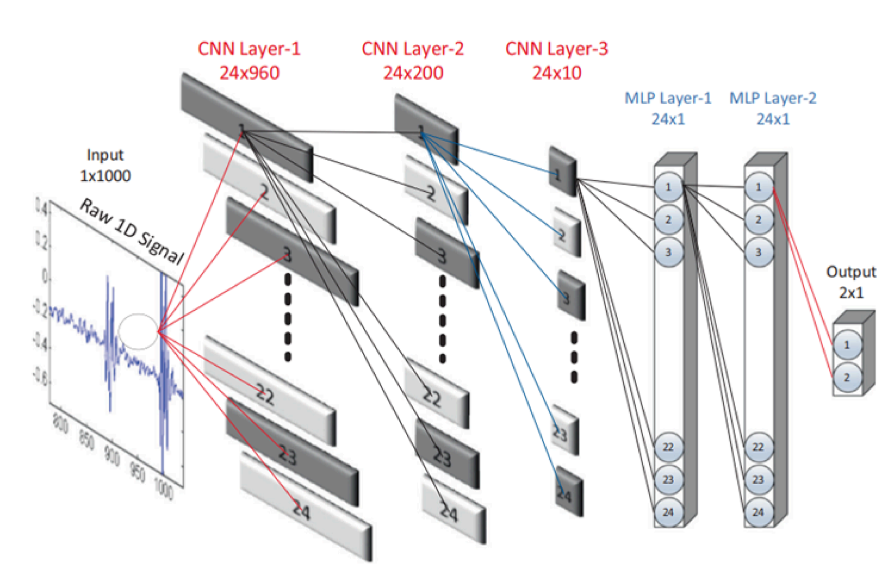
OBJECTIVE

The primary goal of this study is to develop a deep learning algorithm capable of accurately detecting life-threatening ventricular arrhythmias, specifically ventricular fibrillation (VF) and ventricular tachycardia (VT), by analyzing single-channel intracardiac electrograms (IEGMs) obtained from single-chamber Implantable Cardioverter Defibrillators (ICDs). The approach aims to deliver speedy and reliable arrhythmia identification by maintaining compatibility with resource-constrained microcontroller (MCU) systems, eventually improving patient outcomes in critical cardiac circumstances.

METHODOLOGY

Developing a 1D convolutional neural network model with necessary configurations such as quantization and pruning was our main approach.

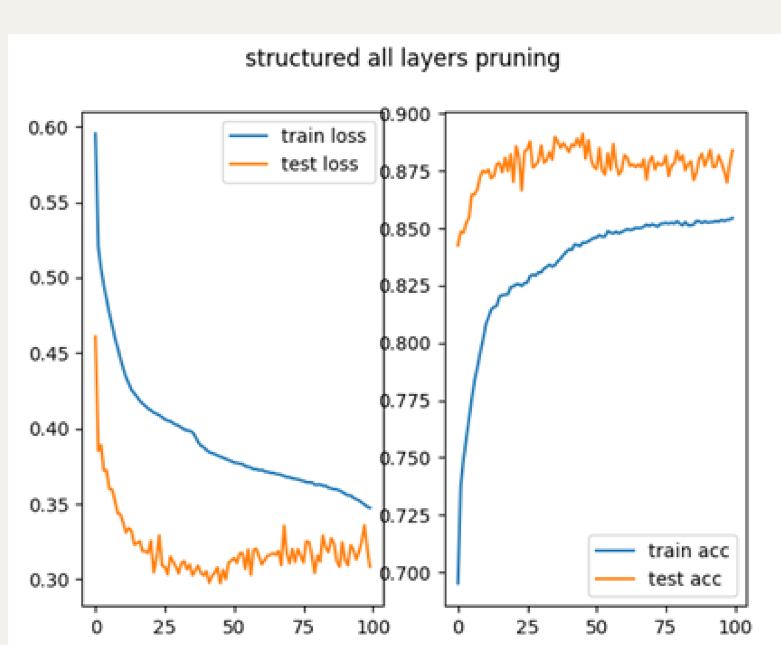


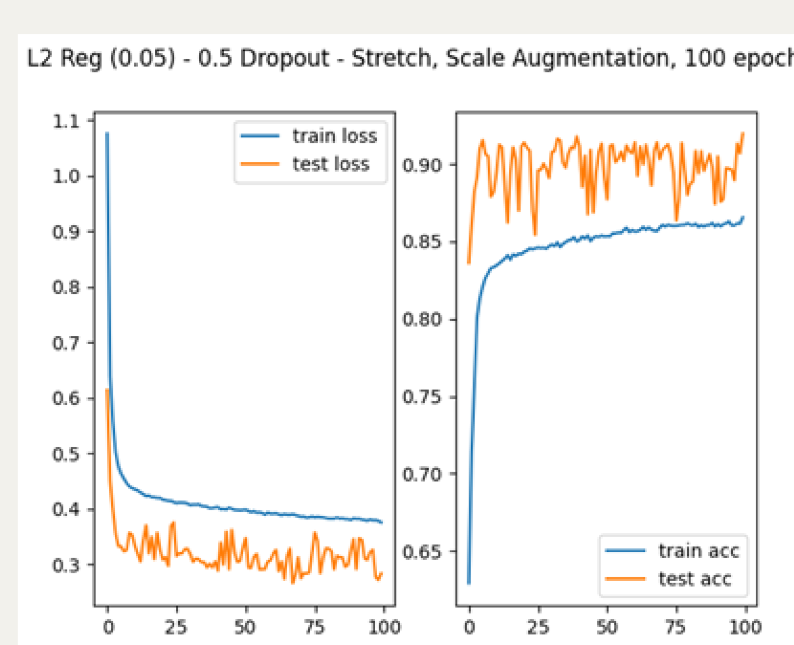
RESULTS

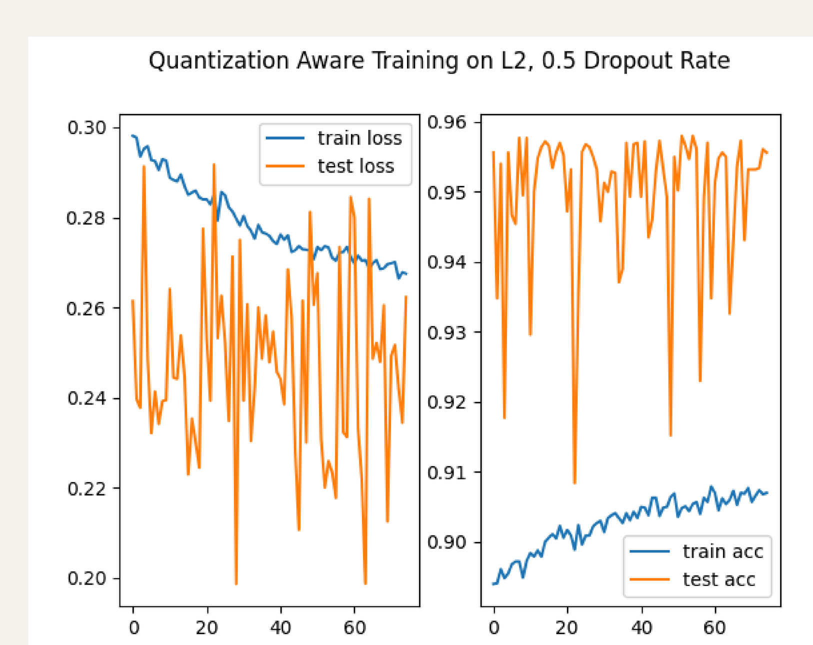
With applying many methods between our initial model and the last model, we have achieved a great improvement.

	best	best_qat
Partial Score	84.6115	84.5286
F-Beta	0.8873	0.8861
G-Score	0.75	0.75
Acc	0.9435	0.9435
Precision	0.9108	0.9113
Sensitivity	0.9489	0.9474
FP-Rate	0.0412	0.0408
PPV	0.8864	0.8849
NPV	0.9588	0.9592
F1	0.8923	0.8916

ANALYSIS







In our efforts to optimize the deep learning model for detecting life-threatening ventricular arrhythmias, we used quantization and pruning approaches to reduce model size while maintaining performance. Quantization enabled us to convert the model weights to lower precision, lowering the memory usage, whilst pruning included deleting less relevant neurons and connections, resulting in a more efficient model. Furthermore, during the experimental phase, we implemented numerous regularization algorithms to reduce overfitting and improve the model's generalization capabilities.

CONCLUSION

To summarize, our research efforts aimed at improving the identification of life-threatening ventricular arrhythmias have shown promising findings using a combination of novel approaches. We effectively optimized the model architecture using quantization and pruning approaches, resulting in a considerable reduction in size while maintaining performance integrity.