Automated ECG Image Classification with InceptionV3

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Aims: Although digital electrocardiogram (ECG) are increasingly prevalent, traditional paper-based ECGs remain common, particularly in underrepresented and underserved populations. This study, conducted by the DSAIL team as part of the George B. Moody PhysioNet Challenge 2024, aims to develop an open-source algorithm capable of classifying ECG images.

Methods: We fine-tuned a pre-trained InceptionV3 model using the PTB-XL dataset, which includes 21,799 12-lead ECG recordings. For training, we used 80% of the recordings along with synthetic ECG images generated using the ECG-Image-Kit, while 20% of the data was reserved for validation. The InceptionV3 architecture was chosen due to its ability to efficiently capture both local and global features, making it suitable for the variability inherent in ECG image patterns. Additionally, InceptionV3 is optimized for use in environments with limited computational resources. Data processing involved resizing the images to (425, 550) pixels, converting non-RGB images to RGB, and normalizing pixel intensity distributions around 0 to facilitate more effective learning by the model. Fine-tuning involved adapting the model's weights in PyTorch by adding a linear layer for 11 classification classes. Training was conducted for 20 epochs with a learning rate of 0.001 and batch size of 32, using stratified 10-fold cross-validation, where 8 folds were used for training and 2 for validation. We utilized binary cross-entropy as the loss function and Adam optimization. The experiment was run on a Kaggle notebook with an accelerator enabled for 12 hours.

Results: On a hidden validation set, the challenge organizers evaluated our fine-tuned InceptionV3 model and reported a macro-F-measure score of 0.332.

Conclusion: While the current results indicate a need for further iteration and training, the neural network-based algorithm shows potential for improving access to ECG-based diagnosis and cardiac care.