

Generated ECG signal feasibility evaluation for classification

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ABSTRACT

Background and Objective: Conventional ECG measurement methods are resting ECG, Holter monitoring, and treadmill method. Unlike conventional ECG measurement methods, now days ECG signals can be measured by wearable devices such as smart watches. Most wearable devices provide fewer details, however, has advantage of recording data in real life. To overcome the limitation of having fewer details 12-lead ECG were generated from lead I and the feasibility were tested in this study.

Methods: 12-lead ECG were generated by U-net based GAN. U-net based GAN were trained by ECG data obtained from Asan Medical Center. Unseen data from PTB-XL PhysioNet data were used to generate 12-lead ECG and for classification. Generated 12-lead ECG and real 12-lead ECG were compared by ResNet classification model. Normal, Afib, CLBBB, CRBBB, LVH and RVH were classified. Afib were chosen to compare limb lead performance and others were chosen to compare the precordial lead performance. AUC, precision, recall and f1-score were calculated to compare classification performance between generated and real ECG data.

Results: Mean AUC, precision, recall and f1-score for real 12-lead ECG were 0.70, 0.72 and 0.70, respectively. Mean AUC, precision, recall and f1-score for generated 12-lead ECG were 0.82, 0.80 and 0.81, respectively. Generated 12-lead ECG score resulted higher performance than real 12-lead ECG.

Conclusion: In this study we have evaluated our 12-lead generative model by classifying 6 diagnostic classes. The results show that generated 12-lead ECG could be used to diagnose cardiac diseases.

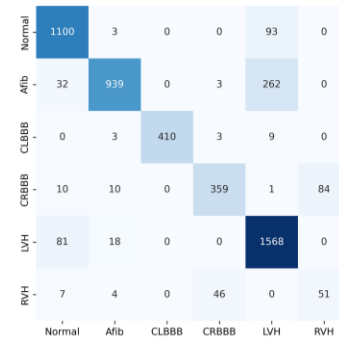
Keywords— Generative adversarial networks, deep learning, electrocardiogram, classification

Table I
Generated 12-lead Classification results.

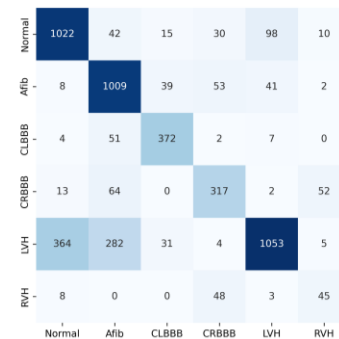
	Precision	Recall	F1-score
Normal	0.89	0.92	0.91
Afib	0.96	0.76	0.84
CLBBB	1	0.96	0.98
CRBBB	0.87	0.77	0.82
LVH	0.81	0.94	0.87
RVH	0.38	0.47	0.42

Table II
Real 12-lead Classification results.

	Precision	Recall	F1-score
Normal	0.72	0.84	0.78
Afib	0.70	0.88	0.78
CLBBB	0.81	0.85	0.83
CRBBB	0.70	0.71	0.70
LVH	0.87	0.61	0.72
RVH	0.40	0.43	0.41



(a)



(b)

Figure 1. (a) confusion matrix of generated 12-lead ECG (b) confusion matrix of real 12-lead ECG