# Generating Precordial-lead Electrocardiogram from smartwatch

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ABSTRACT

**Background and Objective**: The market for smartwatches is growing as wearable devices are proving to be effective for monitoring fitness and health. The acquisition of electrocardiogram (ECG) data with a smartwatch is limited because only a single lead can be obtained using two electrodes, which restricts the detection of heart disease. To address this limitation, this study aims to compare the chest lead ECG data generated by generative adversarial networks (GAN) with the chest lead data obtained using a standard 12-lead ECG device.

**Methods**: This study collected ECG data from both Galaxy watch4 classic and a standard 12-Lead ECG device. Single lead ECG data was obtained from the smartwatches. A total of 10 healthy volunteers participated in the experiment, and 100 datasets were collected. The performance of the smartwatch-generated data was evaluated using Fréchet distance (FD) score and mean squared error (MSE) as evaluation methods.

**Results**: The study found that the mean FD score was 15.4591 and the mean MSE score was 0.0937. These scores indicate that the generated ECG signal from the smartwatch had a high level of similarity to the standard 12-Lead ECG signal.

**Conclusion**: The study demonstrated that the need to change the placement of the smartwatch to obtain different leads can be eliminated by generating chest lead ECG signals using a single smartwatch. This approach provides a way to overcome data restrictions associated with obtaining only a single lead ECG signal from smartwatches. Therefore, the generated ECG signals can offer a practical and convenient alternative for monitoring heart health using smartwatches.

**Keywords**— Smart watch, Generative adversarial networks, deep learning, electrocardiogram

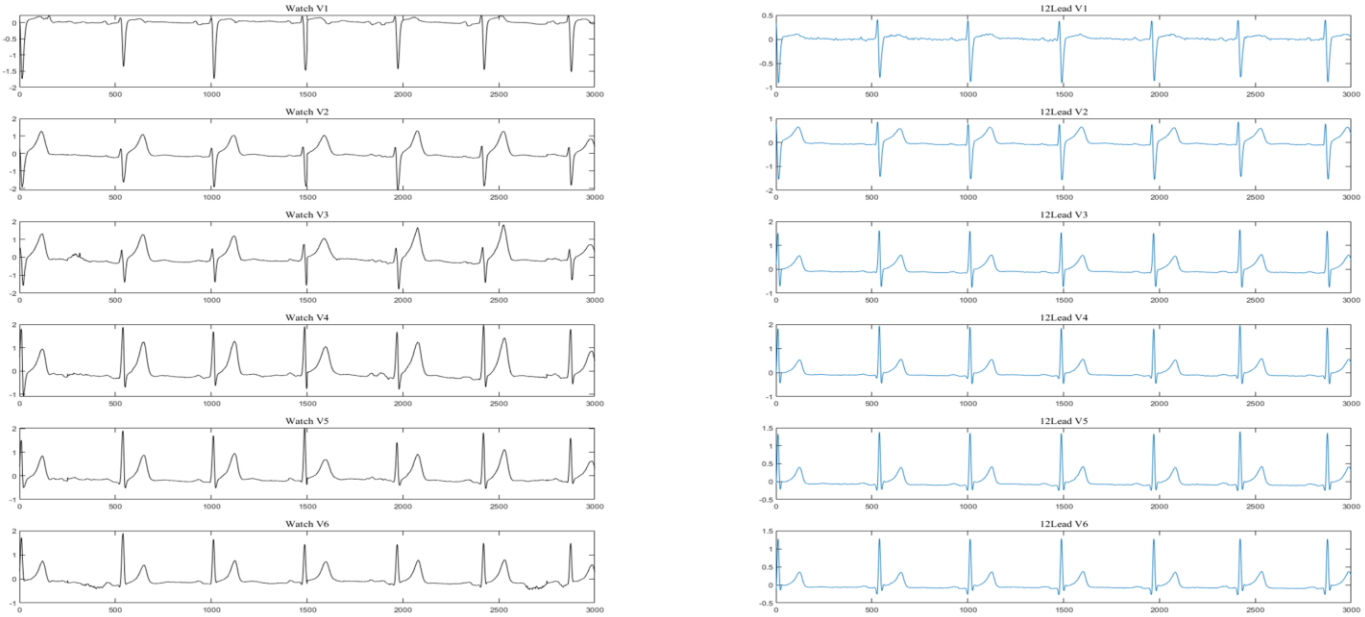


Figure 1. Chest lead signal generated and measured with a standard 12-lead ECG device. The black lines represent the generated signal, and the blue lines represent the standard 12-lead signal.