An Active Role for Machine Learning in the Diagnosis of Cardiac Arrhythmias, Year Two

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Cardiac arrhythmias occur when the electrical impulses that coordinate heart beats don't work properly. In the U.S., they cause over a million hospitalizations and over 200,000 sudden cardiac deaths per year, while also increasing the risk of stroke and heart failure.3,3a Accurate and early diagnosis is key, however, the disease is significantly under-diagnosed. Monitoring devices can acquire large amounts of real-time ECG images but evaluating this big data remains a challenge. Diagnostic accuracy with current technologies is high but false positive rates are between 27-90%. There is a growing need for automated image analysis. This study aims to create a supervised machine learning algorithm to identify five deadly arrhythmias – Afib, Atrial Flutter, VF, VT and AVNRT – while reducing the false positive rate. 8,786 pre-classified ECG images were collected, augmented and classified. An algorithm was created using a multilabel classifier CNN that was specifically trained to diagnose multiple discrete, structured diagnostic ECG images that includes adjustments to the learning rate and a gradient optimization algorithm. It was hypothesized that a machine learning algorithm could be built to diagnose these arrhythmias, maintaining sensitivity while significantly reducing the false positive rate. The optimal model included six CNNs, the RMSprop optimizer, 7 dense layers and a dropout rate of 4 (Sensitivity 94.4%, false positive rate 5.6%). With a consecutive-image trigger, the false positive rates are dramatically reduced (< one per 10 years). Using this algorithm to diagnose arrhythmias can potentially achieve similar accuracy and a significantly lower false positive rate than algorithms used today.

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