A Wearable Patch for Cardiologist Level Real-Time Detection of Atrial Fibrillation

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Purpose: Atrial fibrillation (AF), the most common cardiac arrhythmia, is currently under-diagnosed as it can be asymptomatic. Early detection of AF could be highly beneficial for the prevention of stroke, a major risk associated with AF with a five-fold increase. The advent of portable devices has made remote health monitoring more practical, offering better understanding of cardiac arrhythmia such as AF, and help uncovering the underlying human dynamics more efficiently. This work presents SmartWearable (SmartCardia S.A., Lausanne, Switzerland), a wearable patch for continuous and long-term monitoring of patients, with real-time detection of AF.

Methods: The data used in this study comprise of ECG recordings from publicly available databases, and those recorded from SmartWearable in clinical trials. The public databases of Physionet MIT-BIH arrhythmia database (MITDB), atrial fibrillation database (AFDB), and long-term atrial fibrillation database (LTAFD) were processed to assemble 30-sec non-overlapping segments of ECGs categorized into AF/non-AF classes. The SmartCardia wearable database (SC_AFDB) comprises ECG recordings from cardio-respiratory patients undergoing clinical trials. A set of 500 30-sec ECG recordings was assembled, and annotated by three cardiologists into AF, Normal, and other abnormal rhythm categories, in a blind fashion.

ECG recordings were scrutinized and hundreds of features were extracted, which represented the complexity, irregularity of heartbeats. The most prominent attributes were selected to create an AF detection model and implemented on a cloud system for real-time detection.

Results: Preliminary results suggest that the created model can efficiently detect AF episodes. Trained on LTAFDB, an accuracy of 95.76% (Sen= 96.58, PPV= 96.56) was obtained against the aggregate test set of AFDB+MITDB. Moreover, the model achieved a F1-score of 95.01 against SC_AFDB, for which the cardiologist agreement had a unanimous F1-score of 95.33. More importantly, the features are computationally uncostly and extracted in real-time, making the model suitable for wearable monitoring scenarios.