SmartRate: A Machine Learning Approach to Predicting Cardiac Arrest

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Preventing death from Sudden Cardiac Arrest (SCA) holds great importance for the medical and public community worldwide. 326,000 people each year in the U.S. alone are afflicted and 90% do not reach appropriate medical care on time. Current studies focus only on non-wearable electrocardiogram derived signals, and few highly accurate classifiers have been developed for the prediction of an oncoming SCA. This research involved the design, construction, and testing of a wrist-worn device containing a photoplethysmographic (PPG) based Heart Rate (HR) sensor that communicated via Bluetooth to an iOS application. HR samples were then sent from the iPhone to a Python server hosting a machine learning binary classifier and a growing database. The database contained both PPG samples under various physical activities and MIT Arrhythmia dataset samples. The server then parsed each sample for statistical heart rate variability (HRV) features that act as standard indicators for the classifier to generate a prediction of SCA or Normal. Upon each prediction, the server returned the classification value to the iOS application and the user was then notified. Without a user response following an SCA classification, a previously developed early-warning algorithm to notify Emergency Medical Services was independently triggered through the iOS application. Testing of the classifier demonstrated greater than 90% accuracy to correctly predict SCA two-minutes prior to the event. Results suggest that this wrist-worn prototype therefore has potential to decrease fatality from SCA and may provide a useful model for low-cost, effective wearables for the prediction of other cardiovascular abnormalities.

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