ISEF Sample Abstract & Certification

Employing Adversarial Machine Learning and Computer Audition for Smartphone-Based Real-Time Arrhythmia Classification in Heart Sounds

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We propose a novel approach to detect arrhythmias in Phonocardiograms (PCGs). Typically, many arrhythmia conditions are unknown until a patient is suggested an ECG/EKG test. PCGs provide ease of access to everyone who has a device capable of recording audio, allowing medical professionals to treat arrhythmias in the developmental stages. The new design is comprised of two subsystems; one is based on the relationship between Electrocardiograms (ECGs) and PCGs, and the other between PCGs and arrhythmias. The first subsystem uses a Generative Adversarial Networks (GAN), in which both generated and real PCG signals are fed into the discriminator for classification. In subsystem two, ECG spectrograms are dimensionally reduced, then constructed into PCG spectrograms using a transGAN. These constructed PCG spectrograms, when converted back into time series, should be identical to the ground truth. This would allow the transGAN to convert ECG datasets into PCG datasets, providing subsystem one to train on both ECG and PCG datasets. After testing, the GAN model (subsystem one) should achieve an accuracy of 86.02%, a specificity of 77.81%, and a sensitivity of 94.24% on the testing set. Furthermore, the transGAN should show promising results, in that the transGAN discriminator should be able to construct the PCG spectrogram accurately. With this data, we should be able to use subsystem one to create a smartphone-based app to detect arrhythmias in heart sound recordings. Our proposed method should accomplish exemplary statistics in abnormalities detection and show promising results in increased arrhythmia construction.

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