Smart Heart: A Portable Early Diagnostics System for Myocardial Infarction Events Utilizing Generative Machine Learning Algorithms

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Myocardial Infraction Events (Heart Attacks) are cardiac emergencies that restrict blood flow through coronary arteries to major cardiac muscle tissue. Prolonged blood demand deficiency to this muscle tissue induces tissue necrosis and leads to inefficient heart function, arrhythmia or heart failure. Tissue necrosis during an MI can be avoided if the area of blood restriction is promptly treated. The goal of this engineering project was to address this demand for the immediate detection and prediction of MI. To meet the engineering goal, first, a portable ECG system was developed to provide cardiac information on a patient in real time. Feature extraction techniques are applied to the dynamically filtered segmented ECG heartbeat data collected by the system to represent the waveform in a 2D image format and allow for analysis by a trained Convolutional Neural Network (CNN). The CNN utilizes convolution layers and the machine-learning back propagation algorithm to build a ECG heartbeat pattern-based classification algorithm that detects MI in real time. The final stage of the algorithm pipeline uses a Generative Adversarial Network (GAN) to produce the ideal ECG data of a certain patient based upon patterns and deviations present in their unique ECG signal and healthy control signals. The generated ECG data from the GAN algorithm is used to deduce cardiac risk by analyzing differences between the generated ideal ECG and the measured real ECG of a patient. ECG data of patients having MI Events in clinical settings and ECG data of high cardiac risk patients was collected online from publicly available databases to train the networks and validate the accuracy of the system.

Awards Won:
Fourth Award of $500
Samvid Education Foundation: Honorable Mention