EiPCA - A Portable Self-Screening Electrocardiographic System for Rapid Screening of Cardiovascular Diseases Using EiPCA Formula and Lead Augmentation Algorithm to Convert 1-Lead to 12-Lead ECGs

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Every 2 seconds, cardiovascular disease (CVD) steals a life. 12-lead electrocardiography (ECG) is the gold standard for CVD diagnosis, which is specialist-reliant and mainly available in urban areas, leading to inaccessibility. Additionally, results take up to 2 weeks on average, causing possible delays in reaching more patients. Current available portable ECGs typically come with only 1-2 leads which is incomprehensive, or 12-lead option requires expertise, making self-screening difficult for normal individuals. "EiPCA" aims to develop a rapid portable self-screening 12-lead ECG with 3 electrodes system using the EiPCA-Algorithm, a new method of converting 1-lead to 12-lead ECG. In Phase-1, we developed portable ECG device using the AD8232 ECG sensor. EiPCA collects single-lead ECG, then converts it to a 12-lead ECG using Einthoven's Triangle Theory, Goldberger's equation, and the EiPCA formula, referring to Inverse Dower's transformation. This utilized sensor exhibited 3.03% deviation and 97.80% accuracy in graph generation. In Phase-2, to enhance the analysis of ECG screening system, we customized Bi-LSTM AI model to classify cardiac conditions. The system was tested with SimMan3G patient simulator, by simulating 15 conditions it achieved 96.40% accuracy. EiPCA's web application and risk assessment form were developed, incorporating AI model from previous phases, to analyze, display and prioritize CVD risk patient effectively. It provides a comprehensive ECG graph for up to 33 cardiac conditions, comparable to hospital ECG devices, and is 25,900 times faster than conventional method. EiPCA will make ECGs accessible everywhere, reduce medical inequalities in low- and middle-income countries, offer faster cost-effective solutions, and decrease CVD mortality rates.