Chapter 4
Sudden Cardiac Arrest Detection by Feature Learning and Classification Using Deep Learning Architecture

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ABSTRACT

Ventricular tachycardia (VT) and ventricular fibrillation (VF) are known ventricular cardiac arrhythmias (VCA) that promote fast defibrillation treatment for the survival of patients and are defined as shock-oriented signals, perhaps the most common source of sudden cardiac arrest (SCA). The majority of existing VCA classifiers confront a difficult challenge of accuracy rate, which has generated the issue of continuous detection and classification approaches. In light of this, the authors present a feature learning strategy that uses the improved variational mode decomposition technique to detect VCA on ECG signals. The following SCA consists of a deep convolutional neural network (deep CNN) as a feature extractor and bat-rider optimization algorithm (BROA) as an optimized classifier. The MIT-BIH arrhythmia database is used to examine the approaches, and the analysis depends on performance indicators such as accuracy, specificity, sensitivity, recall, and F1-score.

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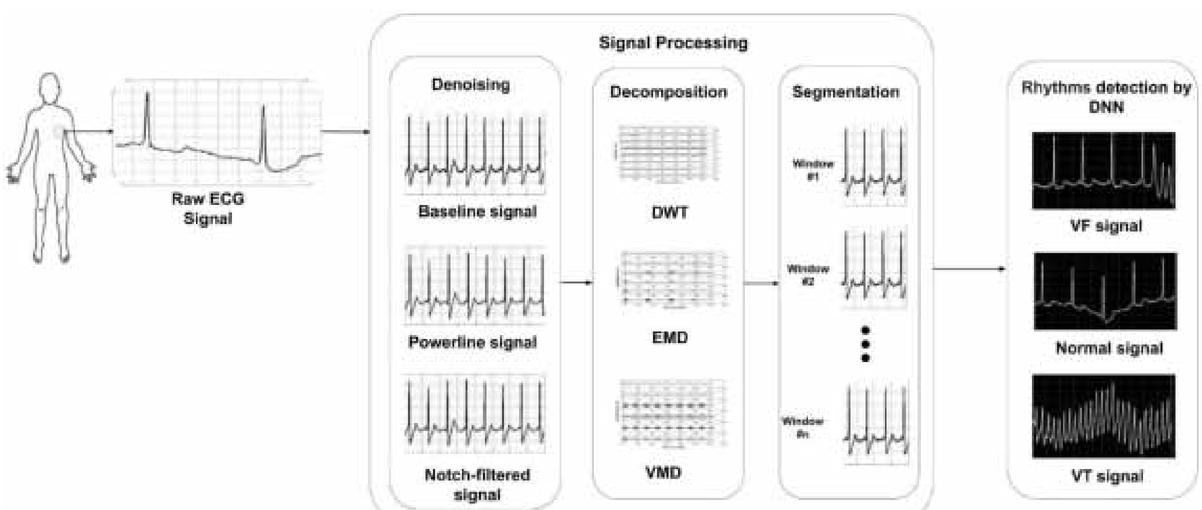
INTRODUCTION

Sudden cardiac death (SCD) is an important mortality factor that can be avoided. It is predicted to have a global annual prevalence of 5.2 million individuals (Rajendra Acharya et al., 2020). SCD is described as a heart failure that happens around 24 hours of the onset of symptoms perhaps within 24 hours after the last time the sufferer had been seen well (Sielski et al., 2021). The heart stops pumping or ceases to beat properly in heart failure, resulting in termination of the oxygen supply on the entire body leading to a shortage in flowage of blood. Ischemic brain damage occurs within seconds of cardiac arrest (Gentile et al., 2021) (Raziani et al., 2021), providing only a narrow time frame for treatment to prevent SCD. Ischemic heart disease causes the majority of SCD patients, however primary arrhythmic disorders are frequent in persons under the age of 30 (Nguyen et al., 2018). Early electrocardiographic (ECG) detection of abnormal electrical vs. normal electrical rhythm during circulatory collapse is critical, irrespective of the aetiology (Crea et al., 2021). By recovering the appropriate heart pumping rate, the shockable ECG signals such as VF and VT can return to standard sinus beat. Shock therapy, on the other hand, will not restore sinus rhythm or cardiovascular flow in non-shockable beats such as asystole or pulse-less electrical impulses (Tripathy et al., 2018), wherein electromechanical divergence prevents cardiac shrinkage despite an organized electrical heart rate. Artificial intelligence (AI) techniques have indeed been frequently integrated into the Computer-Aided Arrhythmia Classification (CAAC) scheme that improves overall accurateness by smart identification of shockable ECG rhythms, providing certain prognosis management that is premised on the appropriate ECG analysis throughout the cardiac arrest. The bulk of SCDs happens outside of the hospital, where ECG detection and treatment are unavailable, resulting in poor survival and cerebral outcomes disorders (Hagiwara et al., 2018). AED devices are commonly employed in the event of cardiac arrest to distribute electrical pulses to the heart to restore a stable heartbeat (Kranc et al., 2021). The establishment of innovative CAAC systems and associated AI-based methodologies is motivated by expanding development of accurate ECG rhythm diagnosis.

Figure 1. The architecture of ventricular arrhythmia detection



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