Computers, Materials & Continua CMC, vol.60, no.2, pp.497-509, 2019

Automatic Arrhythmia Detection Based on Convolutional Neural Networks

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Abstract: ECG signal is of great importance in the clinical diagnosis of various heart diseases. The abnormal origin or conduction of excitation is the electrophysiological mechanism leading to arrhythmia, but the type and frequency of arrhythmia is an important indicator reflecting the stability of cardiac electrical activity. In clinical practice, arrhythmic signals can be classified according to the origin of excitation, the frequency of excitation, or the transmission of excitation. Traditional heart disease diagnosis depends on doctors, and it is influenced by doctors' professional skills and the department's specialty. ECG signal has the characteristics of weak signal, low frequency, large variation, and easy to be interfered. In this investigation, an ECG anomaly automatic classification system based on the convolutional neural network is proposed. The training sets of the convolutional neural network are ECG beats extracted from the MIT-BIH database as training sets. A 36-layer convolutional neural network (CNN) is trained based on Caffe framework to classify ECG signals automatically. The experimental results show that it can reach or even exceed the level of a senior cardiologist in judging three diseases: FIB, AFL and IVR.

Keywords: Convolutional neural network, ECG, arrhythmia detection, human, QRS.

1 Introduction

Arrhythmia is a common clinical cardiac abnormality, not only relates to cardiovascular disease, but also relates to many other diseases and occur in a few healthy people. The type and frequency of arrhythmia are essential indicators of cardiac stability [Schwartz and Menotti (2000)]. Arrhythmia affects the normal synchronous systolic timing of the heart, reduces the efficiency of cardiac pumping, and threatens the safety of human life. Therefore, timely and correct diagnosis of arrhythmia is of great significance [Li, Zheng and Tai (1995)]. ECG is a macroscopic record of depolarization and repolarization of cardiac cells, which objectively reflects the physiological status of various parts of the heart to a certain extent, therefore it is of great significance in clinical medicine. In clinical practice, arrhythmic signals can be classified according to the origin of excitation, the frequency of excitation, or the transmission of excitation. ECG arrhythmia detection

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