

ECG Waveform data Extraction from Paper ECG Recordings by K-means Method

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Huge amount of ECG paper recordings were produced every day since electrocardiograph was invented. Though modern ECG machine with digital-out has been applied for years, paper recordings are still chosen by medical organizations because of inexpensive price, especially in China from 1990s till now. Unfortunately, the recording paper is heat-sensitive paper, it is easily be broken and the line of ECG waveform is fading with time. Cause of clinical diagnosis characteristic and the fast development of HIS (Health Information System), history ECG paper recordings are becoming more precious. These ECG data were necessarily to be extracted and keep the valuable ECG information as digital type for clinical information sharing, online diagnosing and ECG database establishing. A method based on K-means was proposed to extract ECG data from paper recordings with the help of optical scanner. The required pre-processing procedure contains image binarization, edge detection, and color-image rotation. After that, color regions of paper ECG were clustered by K-means, the ECG waveform and the background grid were separated well, the digital ECG data were acquired from ECG paper recordings correctly. 105 patients ECG paper recordings were adopted in the experiment. The data were obtained from different level of medical services organization. The date of these recordings is ranging from 1990s to present. And the recordings are in different damage level, the paper are in different background color and made by different manufacturers. The result shows that ECG waveform can be extracted precisely and smoothly. The precision rate of RR interval, QRS interval, QT interval, ST slope, and R amplitude from ECG data which are digitalized by the approach in the paper could reach 99%. This was done by the comparison with the corresponding result of original ECG paper recordings. And the digitalized ECG data meet the requirement of clinical diagnosis.