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AN EXPLORATION OF INTELLIGENT ECG INTERPRETATION USING MORPHOLOGICAL FEATURE CHARACTERIZATION AND SUPPORT VECTOR MACHINE CLASSIFICATION

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Abstract

Cardiovascular disease is a fatal disease and the most common cause of death nowadays. Most people think that cardiovascular disease merely related to the elders. However, the age of cardiac patients is decreasing gradually, especially for those who are obese or lack of exercise. Even though the teenagers are also have probability to be cardiac patients. For the most cases, if the medical help is given timely, the patient's life may be saved. As a matter of fact, cure is not better than prevention for all kinds of chronic disease. Early and continuous monitoring permits a complete observation of cardiac variations and increases the understanding of patients' circumstances.

Most of the human body's checking is required to be done at the hospital, which includes blood pressure measuring, electrocardiogram recording, etc. Owing to the rapid growth in computing and measuring technology recently, it is promising to extend to self-checking for the home user. The benefit of home healthcare monitoring is that it provides a cost-effective and timesaving prognostic approach for those cardiac disease victims.

For these reasons, the demand of researching and developing an Intelligent Home Healthcare System (IHHCS) is increasing. As regards to the input source of IHHCS, there are various types of cardiac testing, which provide a large amount of information. Among them, the electrocardiogram (ECG) is one of the most prevalent tests used by cardiologists. Numerous cardiovascular diseases can be

detected by means of analyzing ECG. Not only it is one of the simplest and non-invasive cardiac testing, but also it does not take any risk to the patient and yields valuable information about a wide variety of heart conditions.

Owing to the significance of ECG analysis in cardiac disease detection, a reliable, robust and accurate ECG interpreter is essential to the IHHCS, which is constructed on the basis of the extraction and analysis characteristic features upon the ECG source. However, the ECG signal is usually corrupted by various kinds of noise, such as power line interference and physiological activities. Furthermore, the morphology of ECG is highly variation, especially for those abnormal rhythms. So, it is a challenge in either feature extraction or intelligent interpretation.

In this thesis research, a novel morphological based feature extraction technique is applied, which provides an alternative characterization of ECG. Basically, it emphasizes the changing in waveform instead of conventional analyzing the characteristic points, and provides an entire description of the ECG segment. In addition, the ECG segment is represented by few of morphological parameters merely, and the segment can be totally re-constructed later on. This glamorous property is significant to the IHHCS since the information capacity could be greatly reduced.

As regards to the intelligent interpretation, the support vector machine (SVM) is known to be a fast and efficient machine learning technique for classification problems, especially for those high-dimensional classification problems. Not like others "black box" system, the SVM is practically analogous to a linear machine operation, this makes it to be easily verified by physicians when something goes wrong. For these reasons, the SVM is adopted to differentiate the types of heart diseases in this research.

Automatic classification of cardiac arrhythmias via Support Vector Machine and morphological characterization is proved to effectively enhance the system performance. The overall sensitivity and specificity of the proposed approach in this thesis is 95.76% and 99.70% respectively. ECG data is taken from standard MIT-BIH arrhythmia database and the major types are taking into account. The

results of the analysis are found to be more accurate than the other existing methods. Classification of cardiac signal is important for diagnosis of cardiac abnormalities and hence any processing that assists this process would be of assistance and is the focus of this paper.

Keywords: ECG interpreter, morphological feature extraction, support vector machine