Intelligent Stethoscope

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ABSTRACT

Heart valve disorders are primarily detected by auscultation, technique of listening to heart sounds. A more modern form of this technique is phonocardiography, concerned with the automated acoustic recording and processing of heart sounds. This paper presents a method that aims at development of an algorithm to detect common heart valve disorders by processing heart sounds and provision of easy access to patient data via the Internet. The proposed method uses thresholding techniques to determine certain criteria which can detect whether a heart sound recording belongs to a person suffering from valvular heart disease or not, by giving 'diseased' or 'not diseased' decisions (S. Ari, K. Sensharma, G. Saha, 2008). The recording in case of a 'diseased' condition is transmitted to the hospital information system via the Internet, wherein it can be further analyzed by a doctor to diagnose the disease.

Keywords: Disease, Heart Valve Disorders, Internet, Phonocardiography, Thresholding Techniques

INTRODUCTION

Cardiovascular diseases (CVDs) are the number one cause of death globally (World Health Organization, 2011). Heart auscultation is a fundamental tool in the diagnosis of cardiac diseases during the interpretation of acoustic waves which are produced by the mechanical action of the heart. It is commonly used for screening and diagnosis in the primary healthcare as it is a non-invasive and low cost screening method. However, auscultation is a difficult skill to master which can take up to years to acquire and refine. It also depends on the experience of the listeners, in this case, the physicians. The human ear is poorly suitable for cardiac auscultation and does not enable the physicians to obtain both qualitative and quantitative information about the heart sounds. Hence, any means to aid the physicians in making a better diagnosis will be extremely beneficial. A computer assisted system can help the general physicians to come out with a more accurate and reliable diagnosis at the early stages of the disease and also to reduce the unnecessary referrals of patients to expert cardiologists.

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The usage of electronic stethoscopes and the ability to visually display the heart sounds will aid the physicians in diagnosing their patients. The system can also be used for educational purposes where the acquired heart signals can be stored, played back at a later stage and help in auscultation training. The objective of this paper is to implement a computer assisted system using a signal processing program for analysis of heart sounds to reveal important information in the phonocardiographic signals. As the analysis of heart sounds by auscultation depends highly on the skills and experiences of the physicians, the implementation of this program can benefit those inexperienced physicians by coming up with a more accurate and reliable diagnosis for the patients, thereby preventing them from wrongly diagnosing them.

**METHODS AND METHODOLOGY**

In the present approach, the computer assisted analysis system has stages for Signal acquisition, Signal Processing and Signal Transmission (See Figure 1).

### Signal Acquisition

A Digital Electronic Stethoscope used to record in the Bell mode and an open source software, Thinklabs Phonocardiography ease the recording of heart sounds devoid of interferences. Acquisition adds on external noises such as ambient noise, as well as internal body noises, breathing noises and speech to the heart sounds. This necessitates the conditioning of recorded signals by a low pass IIR filter with a cut off frequency of 1 kHz, a built in function in the recording software to remove the recording hiss (Thinklabs Digital Stethoscopes). Heart sounds being periodic, information contained in it is repetitive. Typical heart cycle duration varies in the range of 0.46-1.2 seconds. Hence, a signal of 3 seconds which accommodates at least one heart cycle is sufficient for this analysis (S. Ari, K. Sensharma, & G. Saha, 2008).

### Signal Processing

Signal Processing requires the corresponding MATLAB toolboxes for the implementation of the algorithm and Graphical User Interface (GUI).
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