Automated Diagnosis of Cardiac Abnormalities using Heart Sounds

Ishanka S. Perera, Fathima A. Muthalif, Mathuranthagaa Selvarathnam,
Madhushanka R. Liyanaarachchi, and Nuwan D. Nanayakkara, *Member, IEEE*

Abstract— Listening to the heart sounds is a common practice in identifying cardiac malfunctions. Since this method has many limitations, tools that aid physicians in their diagnosis of heart diseases are very useful. This paper presents a software tool to predict cardiac abnormalities which can be identified using heart sounds. Both heart sound information and symptoms are used in disease prediction. First audio inputs at four clinically important locations on the chest are acquired using an electronic stethoscope and entered to a database with symptoms for each patient. After de-noising, prominent features and statistical parameters needed for disease detection are extracted from the heart sound samples using several algorithms. Then the disease classification is performed to find out possible disease and murmur types. The software tool reported in this paper is capable of identifying normal heart sounds and abnormal heart sounds with possible kind of disease and murmurs presented there. Hence, it helps doctors to detect diseases early and can be integrated as a standard module of electronic stethoscope software.

I. INTRODUCTION

DISEASES caused by abnormal heart valves and functions require early detection to prevent serious health problems. Listening to the sounds produced by the cardiac-auscultation, is a common practice in the screening of heart malfunctions. Diagnosis based on sounds heard through a stethoscope is a skill that takes years to perfect and mostly cardiologists are the experts in performing a satisfactory diagnosis. Heart sounds fall in lower end of audible frequency, and are difficult to decipher them. Thus diagnostic tools that aid physicians in their diagnosis of heart sounds can be very useful. The software tool presented in this paper analyzes the heart sounds, symptoms of patients and predicts possible diseases to assist doctors in diagnose.

Most literature presents techniques for the identification of main components of heart sounds, known as "lub" and "dub"(first heart sound (S1) and second heart sound (S2))[1] and boundary calculation of S1, S2, Systole and Diastole [2]. Some electronic stethoscopes come with software programs but they indicate only whether murmurs are present in heart sound or not. So the system presented in this paper is a novel one which indicates possible diseases a person could have. The system indicates abnormalities of heart sounds and

Nuwan D. Nanayakkara is with the Department of Electronic and Telecommunication Engineering, University of Moratuwa, Moratuwa, Srilanka. (Tel: +94-11-2650634 x3308, e-mail: nuwan@uom.lk, nuwan@alumni.uwo.ca).
Ishanka S. Perera, Fathima A. Muthalif, Mathuranthagaa Selvarathnam, Madhushanka R. Liyanaarachchi were with the Department of Electronic and Telecommunication Engineering, University of Moratuwa, Moratuwa, Srilanka. (e-mail: sewwandi_7@yahoo.com; afi.1987@gmail.com; m.selvarathnam@gmail.com; rukshani88@yahoo.com)

identifies the possibilities of common heart diseases such as Mitral Regurgitation (MR), Mitral Stenosis (MS), Pulmonary Stenosis (PS) and some Ventricular Septal Defects (VSD) [3]. A correct diagnosis is highly dependent on the site of auscultation and age, gender of the patient. For a correct diagnosis heart sounds taken from four places- Apex area, Aortic area, Pulmonary area and Tricuspid area [4] should be considered. In addition to heart sound, the site of auscultation, age and gender are taken as the input to the system. Furthermore, symptoms of patients are also used for the prediction algorithm.
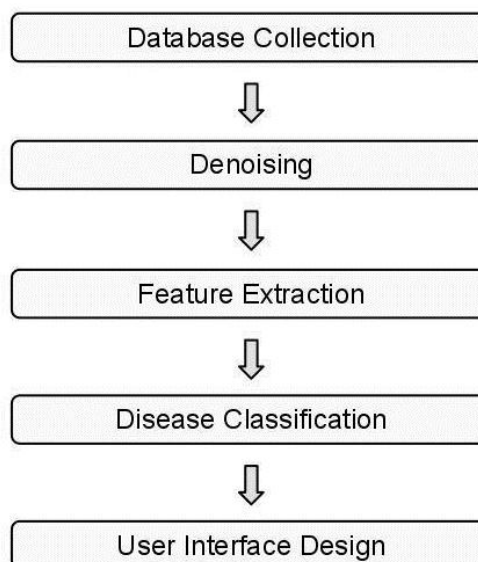

Fig. 1.   Block diagram of the procedure

There are five main stages in this proposed approach as shown in Figure 1. In the first stage heart sound files are collected from patients from different age groups with different diseases using an electronic stethoscope and they were added to a database.

The next stage is preprocessing with de-noising of heart sounds. Wavelet decomposition was used for noise removal. The third stage is extracting features from heart sounds using algorithms. As the fourth stage, disease classification is done using statistical results got from heart sounds database. Finally the software program with a graphical user interface is delivered so that doctors as well as patients could use it easily.