Soft Computing Applications and Techniques in Healthcare

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7 Application of Soft Computing Techniques to Heart Sound Classification

A Review of the Decade

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7.1 INTRODUCTION

Heart sound classification plays an important role in the diagnosis and prevention of cardiovascular disease and is used for automatic heart sound auscultation and cardiac monitoring [1]. As indicated by the World Health Organization, nearly 17.5 million individuals around the world have died because of cardiovascular illness, which is 31–32% of all deaths and its rate is expanding quickly [2]. The heart is one of the most significant organs of the human body and conveys blood to all parts. The heart works like a siphon and pulsates 72 times each moment for a normal individual under ordinary conditions [3]. The heart pumps blood through a network of arteries and veins called the cardiovascular system. The human heart has four chambers: the right atrium, the right ventricle, the left atrium and the left ventricle. The human heart performs the duties in two cycles: systole and diastole. The contraction of heart is known as systole and the relaxation of heart is known as diastole. The heart sound can be produced using two sounds, 'lub' and 'dub', in sequence that occur due to the closing of the valves of the heart [4]. The abnormal sound is produced due to damaged valves. Because of the disorder of the heart valve, the common disease of the heart occurs. Some of the diseases that occur are myocardial infarction (heart attack), congestive heart failure, heart murmur, coronary artery disease, heart valve disease, stable angina pectoris, unstable angina, pectoris and arrhythmia. The primary method is the auscultation used by the physicians to differentiate between normal and abnormal heart sounds. Any disorders can be detected by the physicians after listening these sounds using the stethoscope, digital applications and so on [4].

Traditionally, cardiologists use stethoscopes for examination of heart sounds. The accuracy of heart sound classification is based on the experience and skill of the physicians. But this manual clinical process is time-consuming and costly. To alleviate these limitations, recently a computer-based automatic computer assist tool is recommended for detection of abnormal heart sound. Hence this is becoming an emerging research for the biological signal processing and machine learning groups as it is computer based. Soft computing is one of the problem-solving approaches used to solve real life complex problems in the field of science and technology. Applications of various soft computing techniques such as

artificial neural network, fuzzy logic and evolutionary computing have been extensively used in the medical diagnosis. Various soft computing techniques are also applied by the researchers in the field of classification of heart sound.

The main objective of this chapter is to provide a systematic review of different existing approaches for the classification of heart sounds of the last 10 years from 2008 to 2018. Also, this chapter will provide the details about the databases, techniques applied in designing models, classifiers used, extract features, domain analysis and performance comparison between review papers. Lots of research has already been done on heart sound classification. However, there is still work to be done in this area through the development of different algorithms and techniques. In particular, the development of some smart mobile applications will be helpful in the improvement of cardiovascular disease diagnosis.

The rest of this chapter is organised in the following sections. Section 7.2 provides the systematic related literature review. Section 7.3 describes the three steps of heart sound classification: preprocessing, feature extraction and classification. The research gap (proposed work and future work) is discussed in Section 7.4. Finally, Section 7.5 is a conclusion of this chapter.

7.2 RELATED LITERATURE REVIEW

Reviewing literature is a key part of research, as it works as a guidepost, not only because it shows the quantum of work done in the field but also because it enables us to perceive the gap and lacuna in the related field of research. It helps in understanding the potentiality of the problem at hand and ensures the evidence of unnecessary duplication. The purposes of the survey of related literature are to locate comparative data useful in the interpretation of results and to provide ideas, theories and explanations in solving the problem.

A systematic review of papers from 2008 to 2018 describing various works done in the field of heart sound (HS) classification are shown in Table 7.1.