Classification Normal and Abnormal Heart Sounds Using Short Time Fourier Transform and Convolutional Neural Network

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*Abstract*—A medical device that diagnoses the patient's condition by observing the patient's heartbeat with a stethoscope. Every sound produced by a stethoscope has a unique pattern and it depends on the condition of person’s heart. This technique is also known as auscultation. Because auscultation is based on a doctor's experience and knowledge, researchers have automatically developed different methods to analyze heart sounds. In this research, we do classify of normal and abnormal heart sounds using XXXX.

Keywords—component, formatting, style, styling, insert (key words)

# Introduction (*Heading 1*)

Stethoscopes are used by medical personnel to listen to acoustic signals emanating from inside human organs [1]. Diagnosis includes examination of body parts: the lungs, heart, and intestines. The type and strength of the generated acoustic signal helps medical staff diagnose the patient's condition [2]. A stethoscope is an essential tool as it plays an essential role in diagnosing a patient's disease. The current observational process refers to the technique of listening to sounds from within the patient's body as auscultation [3]. This process uses a stethoscope to hear more precise sounds. However, this direct approach has many obstacles. These problems are low frequency, low amplitude, ambient noise, hyperacusis, and sounds with much the same pattern.

One of the signals that can be heard with auscultation techniques is the heartbeat. Doctors diagnose heart problems by hearing this sound. With these subjective factors in mind, many methods have been developed to automatically classify heart sounds using digital signal processing methods [4].

In general, heart sound signal processing can be divided based on signal regions such as time domain, frequency domain and time-frequency domain [5]. Signal processing in the time domain. B. Statistical features of heart sounds, empirical modal decomposition (EMD), and computation of fractal dimension [6]. On the other hand, the processing of heart sound signals in the frequency domain includes filter banks, frequency band average power, MFCC, quartile frequencies, and zero-crossing analysis [7]. Frequency-domain signal processing primarily uses the Fourier transform to convert a signal from the time domain to the frequency domain. Short-time Fourier transform (STFT), Wigner-Ville distribution (WVD), Stockwell transform (S-transform), Hilbert-Huang transform (HHT) or wavelet transform [ 5]. The use of the time-frequency domain is fairly common. This technique provides information about the frequency content of the signal at any point in time.

Since the time-frequency domain method described above only changes the signal from the time domain to the time-frequency domain, we need to use feature extraction methods to preserve the properties of the signal. One way to do that is signal complexity. kings. We used wavelet temporal entropy to separate normal and abnormal heart sound signals [8]. Other researchers have used the fractal dimension to distinguish between normal heart sounds and heart murmurs [9]. Short-time Fourier transform (STFT) as a method of transforming 1D signals into the time-frequency domain has also been used in previous work. STFT and tensor decomposition were used by Zhang et al. Proposed. as a feature of normal and abnormal heart sounds [10]. On the other hand, wavelet entropy is used as a feature of his STFT from unsegmented signals of heart sounds [11]. The properties in all previous studies were calculated directly with STFT. No analysis of dissemination of information on STFT was performed

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