Wheeze Extraction Using Analog Filter For Asthma Patients

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Abstract – Asthma is a disease from which most of the human beings are suffering. Its earlier detection is required. This paper proposes a modified conventional method which extracts wheezing signature from lung sound signals using low cost, low power, higher order band pass filter. From this signature the doctor can easily predict the status of asthma.

Index Terms – Asthma, Wheeze, Band Pass Filter, Op-Amp.

1. INTRODUCTION

Asthma is the chronic lung disease. A large percentage of the population of developing countries is affected by asthma. It is essential to detect asthma in its primary stage. Lung sounds are the primarily used for the detection of asthma. The conventional method to hear lung sound uses a simple stethoscope. Using the stethoscope has disadvantages: it depends on the expertise and sense of hearing [2-3]. Another downside of stethoscope is the lack of recording, low sensitivity and offers no statistical description. Also, the stethoscope reduces the strength of the frequency of sound above 120 Hz. Moreover the human hearing capability has low sensitivity to the lower frequency components. So a new methodology is required to separate only lung sound signals and to extract the wheeze signature, which makes quite easy for the physician to detect asthma in its earlier stage. This paper proposes a modified method which will do the above said things.

2. PORPOSED METHODOLOGY

Conventional stethoscope gives mixed sound signals like heartbeats, blood flow, muscle and lung sound signals. For detection of asthma, only lung sound signals in the range 300Hz – 1.2 KHz (Wheeze Signal) are important. Therefore, if we can separate these wheezing signals, then it is easy for the physicians to take decision whether the patient is asthmatic or not. So in this work, we first take sound signals using a microphone and an instrumentation amplifier gives necessary amplification to all types of sound signals. Then the only wheeze signature sound is separated from others using the seventh order low power, low cost band pass filter. The output sound signals are clearly wheeze signals by hearing which the doctor can easily predict the status of asthma with high accuracy.

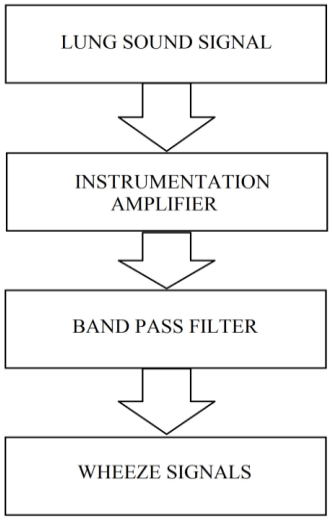

Figure 1 Flowchart of Proposed System

3. METHODOLOGY REALIZATION

In this experiment, normal, asthma, tuberculosis, rheumatoid and pneumonia patient's lung sound signals are captured by surface mount microphone. Low cost, low power instrumentation amplifier is used to increase strength of lung sound signal. A seventh order band pass filter is used to separate out asthma wheezing sound from lung sound signals as shown in Fig. 1.

A. Acquisition of Lung Sounds and Preprocessing

In this paper, lung sound signals are acquired by microphone. This microphone is mounted near the headset of the stethoscope. Lung Sound signals are captured by the microphone from patients who had problem of asthma, tuberculosis, rheumatoid and pneumonia. The Lung sound

signal is in audio form and to amplify and drive, microphone required instrumentation amplifier.Here we used Taxas Instrument IC OPA344PA low cost, low power Operational Amplifier which consumes a very less current and operate on a 3V battery.

B. Higher Order Band Pass Filter.

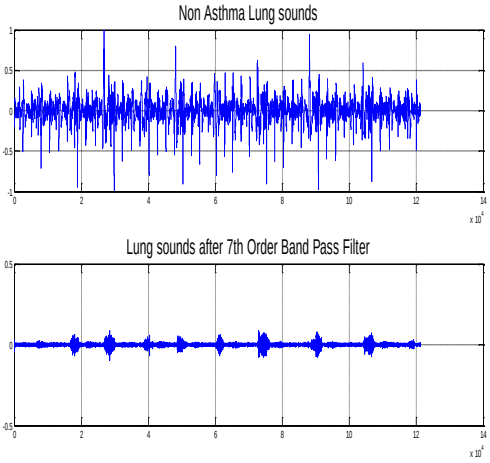

Figure 2 Simulation of Non-Asthma Signal

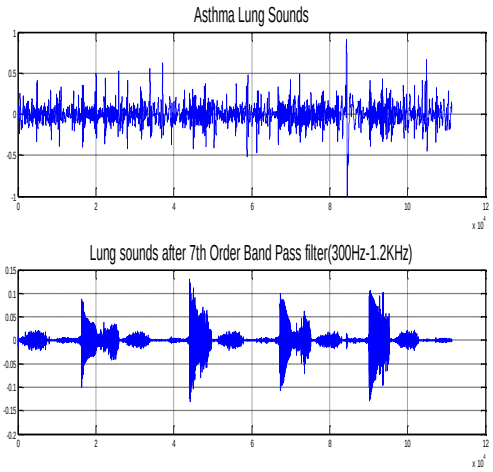

Figure 3 Simulation of Asthma signal

Because of the mix of other sound like heart, muscle, and other which not belonging to respiratory disease. Hence we have used a band pass filter to remove these unwanted sound signals from lung sound. In filtering stage we filter out the lung sound signals above 300 Hz and below 1200 Hz by using seventh order band pass filter. From the different 60 patients and 10 healthy lung sounds are analyzed. The above system includes seventh order band pass filter using Op-Amp IC OPA 344PA consume only 1.481mA from 3V rechargeable battery and cost is around Rs. 500/-

Sr. No.	Name Circuit	Current Consumption from 3V Rechargeable battery
1	Instrumentation amplifier	355µA
2	Higher Order Band Pass Filter.	1419µA
	Total	1774µA

Table 1 Current Consumption of the system

4. RESULTS AND DISCUSSIONS

It is seen that Higher order band pass filter and instrumentation amplifier using Op Amp IC OPA744PA give a high success ratio. So, we used this circuit to inspect respiratory sounds. We access this analysis technique in terms of classification accuracies. The results are very positive to detect asthma disease. Future work is required, particularly with a standalone, low power, low cost portable embedded system to take sample of respiratory sound and provide a useful result for common people in urban and rural areas.

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