Heart And Lung Auscultation Using Matlab

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Abstract—Heart and lung conclusion is a major issue now a day. For heart finding we require MRI, X- beams, ECG and CT check and so on. We can get suspected outcomes from those tests but it are more costly. The heart and lung sound recording is a non- intrusive test that records the electrical action of the heart and lung. It is imperative in the examination of cardiovascular anomalies. Each segment of the heart and lung sounds flag waveform conveys different sorts of data of patient’s heart and lung condition. These heart and lung sounds signs of patients experiencing heart and lung related infections are recorded utilizing Sensors that are specifically taken from web in our venture. From these recorded signs we figure RMS values, LER for heart and recurrence, IDW, 2CD for lungs. Utilizing limit esteem said into Standard paper we break down the ordinariness and anomaly of the heart. For lung recurrence examination is utilized for checking ordinariness & abnormality condition. Our venture is identified with advanced flag Processing. The essential piece of programming will be finished by utilizing MATLAB. The graphical UI is intended to show given flag is typical or irregular.

Keywords- Auscultation, DSP, FIR, LER, Murmur, RMS

1. INTRODUCTION

In restorative frameworks, heart and lung sound determination is utilized as a crucial analytic system for diagnosing the condition of human inside organs by listening heart and lung sound utilizing stethoscope. To decide stream of blood through the courses of the heart, the specialist ought to have least involvement of around 3-5 years. Around then specialists advise patient to do different test for exact thinking. In this venture we will separate different hints of the heart and lungs for simple finding of the ailments. Subsequently there is a need to enhance the issues related with the heart and lung sound recognition.

1.1 Auscultation Motivation

Kong Biomedical field is evergreen and keen. In the present situation, quick development of restorative hardware is conceivable because of the appearance of microelectronics, imaging, microchips, transducers, information change methods, advanced flag preparing etc. The advance in therapeutic care is conceivable as humanity has obtained effective apparatuses to analyze and forestall ailments. Social insurance is an essential issue to be tended to in a nation like India. Presently by utilizing stethoscope gear we can perceive heart and lung sounds and identifies the distinctive variations from the norm in it. So the Matlab code will analyze the heart and lung variation from the norm in human body. Traditionally, to analyze malady, western solution glimpses within patient’s body utilizing numerous gadgets, for example, MRI, city filter etc. Hence there is a need to enhance the issues related with the customary heart and lung sound identifying contraption.

1.2 Objective of the Auscultation

• Malaga Diagnosis of different infections of heart & lung, for example, heart blockage, aspiratory scatters, pneumonia.
• Analysis of illnesses by listening sound originating from the lungs.
• An question of the Auscultation is to give a non-intrusive indicative Matlab code & GUI that decides irregularities of a heart & lung.
• Yet another protest of this is to give a Matlab code & GUI that empowers the minimization of heart & lung irregularities location time.
• Still another protest of Auscultation is to give a cheap Matlab code and GUI for identifying heart and lung related variations from the norm.
• Another goal of this Auscultation is to not require unique talented individual and separate research center.

1.3 Scope of the Auscultation

Abdul Specialists utilize a test called an ECG (electrocardiogram) to help analyze heart variation from the norm. This test recognizes and records the heart’s electrical action. To analyze sickness, western pharmaceutical looks within patient’s body utilizing numerous gadgets, for example, MRI, city filter and so forth. As of now there is no such demonstrative hardware accessible in the market which can perceive the sound of the human heart and lung, then anticipate the heart and lung variation from the norm in human body. Generally, the patient is required to take after...
pre-test systems which are troublesome to the patient. Promote, amid angiography, the patient needs to tolerate inconvenience and uneasiness in view of heart catheterization. In addition, angiography is tedious, costly and different reactions are related with it.

2. PROPOSED FRAMEWORK

2.1. Auscultation Features
- It requires less time to analyze the ailment.
- It gives the Precision result about heart Diseases.
- It is Portable; just we require tablet with matlab.
- Low cost gear.
- If specialist is having less experience then GUI will be helpful for investigation of infection.

2.2. Auscultation Specifications:
- Recorded Sound document in .wave arrange
- Signal Conditioning
- Computer with MATLAB (R2010a) Software.

3. AUSCULTATION DESIGN FLOW

3.1 Overview
The framework contains recorded heart and lung sound& MATLAB Software. So we quickly portray our framework and utilize different element recognizing techniques to show issue in heart and lungs. By perusing the recorded heart and lung sound in Matlab that are send to FIR separating reason. The example flag is traded in the .wave records and this flag is further utilized for flag handling in MATLAB and highlight are extraction. These components are contrasted and consequence of patients and limits are figured for each element and these edges are at long last put in the program and last code is created.

3.2 Auscultation Flow chart

Consequently it's obligated to feature to Associate in an IOT framework which provides secure health awareness checking. Therefore outlining a savvy healthful services framework wherever consumer data is gotten by the device and sent to the cloud through Wi-Fi and allowing simply approve the user to get information data.

3.3 Heart Flowchart
In heart ordinariness and variation from the norm is kept an eye on premise of RMS Value, LER parameter. On the off chance that sound is irregular then further examination of sound is happens on premise on wavelet investigation. The sound pattern obtained by wavelet decomposition and scalogram are used for classifying various diseases

3.4 Lung Flowchart
In lung typicality and variation from the norm is kept an eye on premise of frequencyvalue. In the event that lung sound flag is strange then it contains crackle and wheeze. If crackling sound is present then the various parameters are calculated such as IDW and 2CD for determining pneumonia and COPD disease. The wheezing sound analysis is done by calculating frequency of the audio sound and the presence of asthma can be detected.
4. AUSCULTATION IMPLEMENTATION

4.1 Auscultation block diagram

Figure: Auscultation Block Diagram

4.2 Design Methodology

4.2.1 Signal Preprocessing:
Wave identification and disease diagnosis. Analysis and recognition tasks were done using MATLAB R2010b. Initially, the signal is filtered from high-frequency component using the FIR filter.

4.3 Heart Feature Extraction

4.3.1 RMS Value

The root of mean of square of all the values of a signal is termed as root mean square value of the signal.

\[
RMS = \sqrt{\frac{1}{n}(x_1^2 + x_2^2 + x_3^2 + \cdots + x_n^2)}
\]

Where the sample of signal x and n is the total no of samples in the signal.

4.3.2 Low Energy Rate

If P is the no of signals below RMS and Q is the total no of signals then the fraction of these two is called the low energy rate.

\[
LER = \frac{P}{Q}
\]

4.4 Lung Feature Extraction

4.4.1 Using Frequency Analysis

Usually normality and abnormality of lung sound is detected on basis of frequency analysis. Generally normal lung sounds are having frequency range less than 100 Hz. Crackles and Wheezes are having frequency range greater than 100 Hz. Based on that normality and abnormality of lung sound is detected.

Using wavelet and peak detection:

For de-noising the input lung sound the previously used wavelet transform is used. For crackling, db8 wavelet is mother wavelet used, as crackling sound is having sudden discontinuities in the waveform. For the lung sound analysis of crackling sound the initial depletion(IDW) width and 2CD value of crackling sound is calculated. The figure for extraction of this information is shown below. The maximum peak from the input sound is calculated by using peak finding algorithm. The previous peak of the maximum peak is detected and then the width of that pulse is calculated. This gives us information about initial depletion width. Again by detecting peak next to maximum peak the 2CD width is calculated.
5. RESULT AND DISCUSSION

5.1 Features Word Sheet:
Table 1: Heart Normal Signal Result

<table>
<thead>
<tr>
<th>Disease Names</th>
<th>File Name</th>
<th>LER</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>NL</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Normal Split B1</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Normal Split B2</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Normal Split S12</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>Opening Snap</td>
<td>0.8551</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>S3</td>
<td>0.8475</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>S4</td>
<td>0.8475</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>3421399141210_normal</td>
<td>0.8475</td>
<td>True</td>
</tr>
</tbody>
</table>

The normality of heart sound is checked by LER value calculated. The input sound files (.wav)

Table 2: Heart Abnormal Signal Result

The various abnormal input sound files are listed above. The LER values of each sound is calculated. For abnormal heart sounds LER value is below 0.8.

5.2 Performance Metric

Three measurements can be utilized to assess the execution of the project. These measures are characterized as follows:

\[ \text{Sensitivity} = \frac{TP}{TP + FN} \]
\[ \text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \]
\[ \text{Specificity} = \frac{TN}{TN + FP} \]

\( T' \) alludes to genuine and \( F' \) alludes to false characterized flag. A positive ID demonstrates a mumble and a negative recognizable proof shows a typical flag.

Table 3: Heart parameter check.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Systolic</th>
<th>Diastolic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>0.523</td>
<td>0.76</td>
<td>0.688</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.712</td>
<td>0.833</td>
<td>0.903</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.3212</td>
<td>0.674</td>
<td>0.355</td>
</tr>
</tbody>
</table>

The total accuracy for heart abnormality is 69.56%, for systolic it is 52.38% and for diastolic it is 75%. Sensitivity for systolic it is 71.96% and for diastolic 84.21%, total sensitivity is 90.38%. Total specificity of project is 35.73%.
5.3 Heart Signals Normal Sound

The 1st column plot in this only two heart sounds are present. Same we can see in the 2nd and 3rd heart sound sample. No other extra heart sounds are observed in both plot. We have taken 6 normal sound files and 3-6 abnormal heart sound files for each disease. Abnormal Sounds

Table 5: Heart abnormal scalogram result

<table>
<thead>
<tr>
<th>Mitral Prolapse (MP)</th>
<th>Aortic Stenosis (AS)</th>
<th>Mitral Regurgitation</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Mitral Prolapse Scalogram" /></td>
<td><img src="image2.png" alt="Aortic Stenosis Scalogram" /></td>
<td><img src="image3.png" alt="Mitral Regurgitation Scalogram" /></td>
</tr>
</tbody>
</table>
The diseases that can be diagnosed in systolic period are shown in above plots. 1<sup>st</sup> is mitral prolapsed in which at the centre of the systolic interval occurrence of third heart sound is observed. 2<sup>nd</sup> is Aortic stenosis in which diamond shaped waveform can be observed in the systolic interval. 3<sup>rd</sup> is mitral regurgitation in which continuous low intensity sound occurs in systolic interval. Diastolic gallop is a disease indication in which possibility of heart blockage is there in patient. In diastolic gallop third and forth sound occurs in diastolic period. Split S2 is physiological split in S2 sound as observed in the plots. In mitral same diamond shape sound observed nut in the diastolic period.

5.4 Lung Sounds

<table>
<thead>
<tr>
<th>Sound Type</th>
<th>FileName</th>
<th>Frequency(Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>normal1</td>
<td>20.7</td>
</tr>
<tr>
<td></td>
<td>normal2</td>
<td>60.72</td>
</tr>
<tr>
<td></td>
<td>normal3</td>
<td>19.10</td>
</tr>
<tr>
<td>Crackle</td>
<td>crackle1</td>
<td>193</td>
</tr>
<tr>
<td></td>
<td>crackle2</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>crackle3</td>
<td>254.85</td>
</tr>
<tr>
<td>Wheeze</td>
<td>wheeze1</td>
<td>323.74</td>
</tr>
<tr>
<td></td>
<td>wheeze2</td>
<td>1193</td>
</tr>
<tr>
<td></td>
<td>wheeze3</td>
<td>1310</td>
</tr>
<tr>
<td></td>
<td>wheeze4</td>
<td>423.96</td>
</tr>
</tbody>
</table>

The abnormality of lung sound is detected with the help of frequency of sound. For normal lung sound the frequency range lies below 100Hz. The crackling sounds from lungs are having frequency range in between 150-260 Hz. The wheezing sound is having frequency range greater than 300Hz. The observed frequency ranges are shown in above table.

In that crackles, IDW (Initial Deflection Width) and 2CD(Two cycle duration) these parameters are consider for identifying various lung related diseases. If 2CD<8ms then it may be ‘PULMONARY FIBROSIS’. If 2CD>9ms and 2CD<10ms then it may be COPD(chronical Obstructive pulmonary disease) Or ‘BRONCHIECTASIS’. As well as if 10ms<2CD then it may be ‘PNEUMONIA’.

5.5 Output GUI Window:

HEART GUI BEFORE EXECUTION:

HEART GUI AFTER EXECUTION OF PROGRAM:

Figure 15: Heart signal Before Processing
6. CONCLUSION

6.1 Conclusion

Our sole target of this venture is to build up a strategy to contribute in the auscultation field for helping specialists in conclusion of different ailments at essential stage.

- In this a bit of work we proposed the utilization of wavelet change for proficient commotion evacuation.
- The abnormality of heart and lung sound is done with precise accuracy with the help of MATLAB CODE.
- The various disease diagnoses such as stenosis, regurgitation, gallop of heart and pneumonia, asthma, COPD is done efficiently with the help of various parameters calculated.

6.2 Future enhancement

- For increase in accuracy of result further large database can be used.
- The development of android application can be useful for doctors so that they can handle it easily.
- Hardware development can be done.

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