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Heart Sound Classification using Shannon Energy

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Abstract: The graphical representation of acoustic of the cardiac activity is called as Phonocardiogram or PCG and the machine is so called phonocardiograph. It has a vital role in the diagnosis of the heart defects. It requires highly and experienced professionals to read the phonocardiogram, usually with the Electronic, Acoustic stethoscopes and stethoscopes for the Hearing impaired. The paper is about the implementation of a analytic system as a detector and classifier for heart diseases.
Keywords: Phonocardiogram · Long Short-Term Memory network · Neural Network · Arrhythmia

I. INTRODUCTION

Accurate localization of heart beats in phonocardiogram (PCG) signal is very crucial for correct segmentation and classification of heart sounds. There arises a challenge due to inclusion of noise in acquisition process due to the cause of several different factors.
In this paper we propose a system for heart sound analysis and classification

PCG is the representation of heart sounds in the form of graphs recorded by phonocardiograph and the process of recording during cardiac cycle is known as phonocardiography. It permits to record mild heart sounds which are difficult to record via regular stethoscope. The PCG is recorded using sensors, chest microphone or digital stethoscope. PCG signals provide very informative data about heart condition. It also permits to records murmur.

PCG signals have attracted attentions because it displays heart sounds, correlated with heart mechanical activity. PCG is comparatively new metric and correct localization, and classification of heart sounds has been a challenging task because of inconsistency of heart cycles.

The aim of this study is to find if direct classification can be made easily with instant signal energy data, without segmentation by using more complex methods or needing feature selection with hybrid methods. It is also to discuss the obtained results by comparing with other examples.

II. PROBLEM STATEMENT

Heart arrhythmias may feel like a fluttering or racing heart and may be harmless. However, some heart arrhythmias may cause bothersome, sometimes even life-threatening.

However, sometimes it's normal for a person to have a fast or slow heart rate. For example, the heart rate may increase with exercise or slow down during sleep.

Cardiological diagnosis is typically done by experienced cardiologists and surgeons. Though having multiple years of experience, Accuracy of such diagnosis is high using Phonocardiogram (PCG) signals (80%+) when compared to Electrocardiogram (ECG) signals (50-70%) in manual diagnosis.

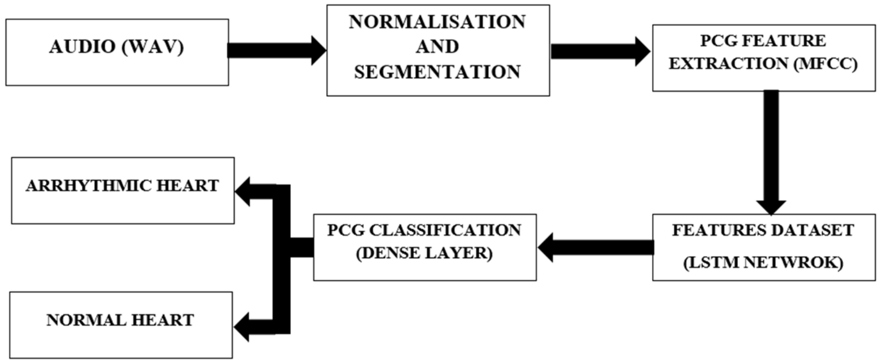
However due to the automation and deep learning technologies, the diagnosis is automated and hence accuracy is increased. The PCG signal is often used to compare with ECG in diagnosis. There is less options of exclusively using PCG signals for cardiac diagnosis.

III. PROPOSED METHOD

We help understand and try to classify the heart sounds in frequency domain using LSTM Recurring Neural Network (RNN) reducing the workload of the cardiologist diagnosing.

We hope to help building and providing a diagnostic application that can be used as a supportive cardiologist that produces a highly reliable and accurate diagnostic result which may help in other classification system.

The dataset consists of healthy and unhealthy PCG audio files, which is normalized, padded to make audio files have same length and regulated to have the same sample rate. The deep learning model used is the Long Short-Term Memory (LSTM) network also consisting of 9 layers including dropout layers, dense layers and flatten. The model is trained using around 64% of the dataset. The final layer of the model is used to classify if the signal is healthy or unhealthy (arrhythmia).



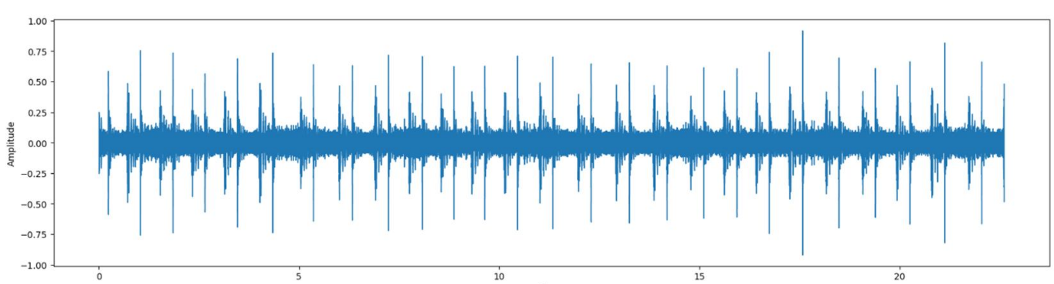
Block Diagram

IV. PROPOSED SYSTEM

The dataset is divided into Training set, Testing set and validation set that contains 64%, 20% and 16% of the dataset respectively. The model consists of bidirectional LSTM network layer, four Dense layers, 2 Dropout layers and a Flatten layer.

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 bidirectional (Bidirectiona  (None, 25, 256)          133120
 l)

 dense (Dense)               (None, 25, 128)           32896

 dense_1 (Dense)             (None, 25, 64)            8256

 dropout (Dropout)           (None, 25, 64)            0

 dense_2 (Dense)             (None, 25, 32)            2080

 dense_3 (Dense)             (None, 25, 32)            1056

 dropout_1 (Dropout)         (None, 25, 32)            0

 dense_4 (Dense)             (None, 25, 32)            1056

 flatten (Flatten)           (None, 800)               0

 dense_5 (Dense)             (None, 2)                 1602

=================================================================
Total params: 180,066
Trainable params: 180,066
Non-trainable params: 0
_________________________________________________________________
```

MODEL DIAGRAM



HEALTHY PCG SIGNAL

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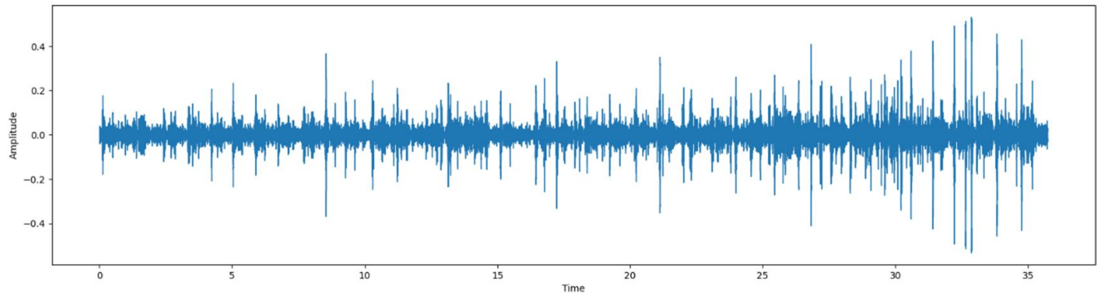
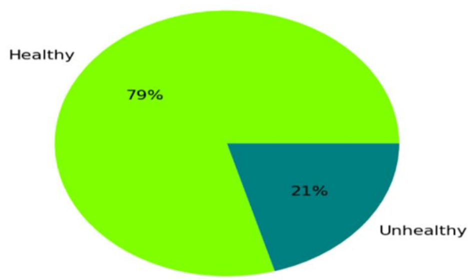


UNHEALTHY PCG SIGNAL

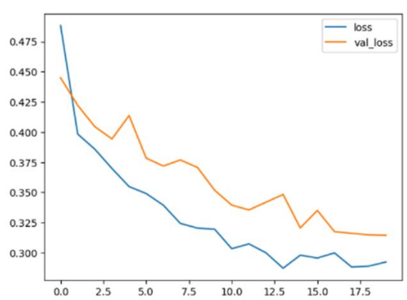
The audio file is regulated to have fixed length then features are extracted by using Mel-Frequency Cepstral Co-efficient (MFCC). The extracted feature is added to the feature dataset. The model classifies the audio file into healthy and arrhythmic types.

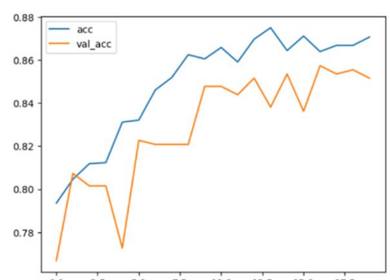
V. DISCUSSION

The model trained with training set is made to have 85% accuracy by training to 20 epochs and recording the losses when classifying testing and validating datasets. The testing and validation accuracy of the model is shown below.



DATASET RATIO





LOSSES ACCURACY

VI. CONCLUSION

The PCG signal confirms, and mostly, refines the auscultation data and provides further information about the acoustic activity concerning the chronology of the pathological signs in the cardiac cycle, by locating them with respect to the normal heart sounds.

The phonocardiogram (PCG) detects and records heart sounds, the sounds made by the various cardiac structures pulsing and moving blood. The sound is caused by the acceleration and deceleration of blood and turbulence developed during rapid blood flow.

We tried and built a heart sound classification system that helps in diagnosing heart sounds through recordings producing 87% accurate model. However, the result we obtained may not be sufficient. The accuracy and the efficiency of the system is to be further developed. The system is hoped to be implemented or be helpful to implement a classifier system. The more the system finds features from the recordings (or a better detailed form of audio file), the better the diagnosis and classification by the system.

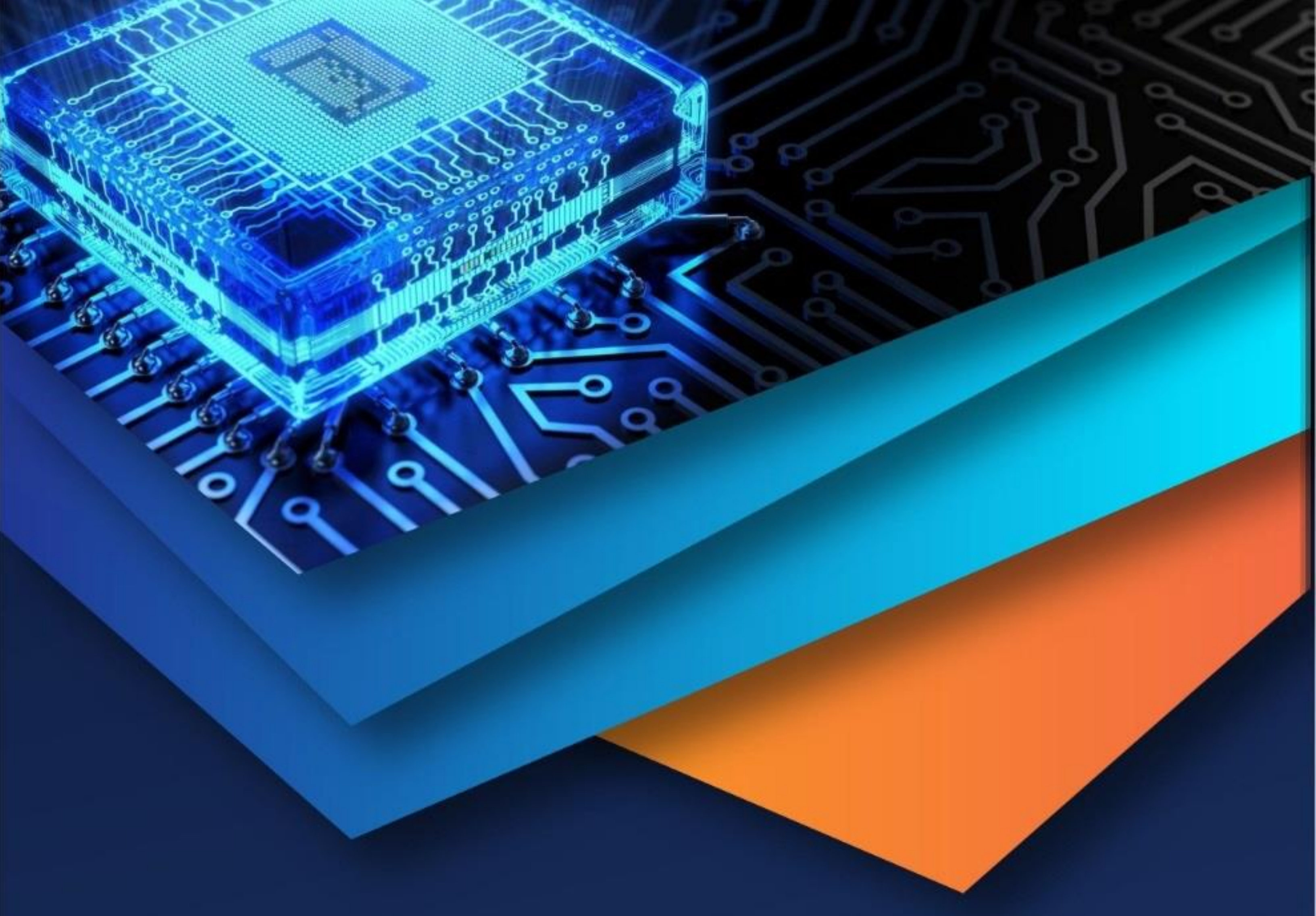
REFERENCES

[1] Davoud Shariat Panah, Andrew Hines, Joseph A. McKeever, Susan McKeever, “An audio processing pipeline for acquiring diagnostic quality heart sounds via mobile phone”, Computers in Biology and Medicine, Volume 145, 2022, 105415, ISSN 0010-4825, https://doi.org/10.1016/j.compbiomed.2022.105415.

[2] Omer Deperlioglu, “Heart sound classification with signal instant energy and stacked autoencoder network”, Biomedical Signal Processing and Control, Volume 64, 2021, 102211, ISSN 1746-8094, https://doi.org/10.1016/j.bspc.2020.102211.

[3] Qurat-ul-Ain Mubarak, Muhammad Usman Akram, Arslan Shaukat, Farhan Hussain, Sajid Gul Khawaja, Wasi Haider Butt, “Analysis of PCG signals using quality assessment and homomorphic filters for localization and classification of heart sounds” , Computer Methods and Programs in Biomedicine, Volume 164, 2018, Pages 143-157, ISSN 0169-2607, https://doi.org/10.1016/j.cmpb.2018.07.006.

[4] Omer Deperlioglu, Utku Kose, Deepak Gupta, Ashish Khanna, Arun Kumar Sangaiah, “Diagnosis of heart diseases by a secure Internet of Health Things system based on Autoencoder Deep Neural Network”, Computer Communications, Volume 162, 2020, Pages 31-50, ISSN 0140-3664, https://doi.org/10.1016/j.comcom.2020.08.011.



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