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MULTICLASS CLASSIFICATION OF HEART SOUND USING DEEP LEARNING TECHNIQUES

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Abstract: Heart sounds play an important role in the diagnosis of cardiac conditions, it is problematic and time-consuming for experts to discriminate different kinds of heart sounds. Thus, objective classification of heart sounds is often essential. In this work, datasets of normal subjects and pathological subjects suffering from different kinds of cardiovascular diseases are considered and CNN models are trained by using training sets. The best accuracy obtained for classification is 90.9%.

Index Terms- **Classification, CNN, Deep Learning, Heart Sounds**

I. INTRODUCTION

Cardiovascular diseases (CVDs) are a major global cause of death, with prevention possible by addressing behavioural risk factors. Heart sounds play a crucial role in diagnosing CVDs, including normal sounds (S1 and S2) and abnormal sounds (S3, S4, and murmurs) that indicate disturbances. To improve heart sound diagnosis, this work focuses on using artificial intelligence, specifically a convolutional neural network (CNN), to classify heart sounds and diagnose heart failure. The CNN analysis aims to distinguish between normal and abnormal heart sounds, offering a valuable tool for early detection and accurate cardiac condition assessment.

II. METHODOLOGY AND IMPLEMENTATION

The main goal of the present work is to distinguish between healthy individuals and those with heart-related disease based on their heart sounds. Data from both healthy and diseased patients are collected for analysis. A deep learning model is chosen for the classification task. The model is trained using a training dataset, and its performance is validated. The trained model is tested using a separate testing dataset to assess its accuracy and efficiency. Once the model is trained and validated, it is ready to classify the data into healthy and diseased categories. This process is indicated in figure 1.

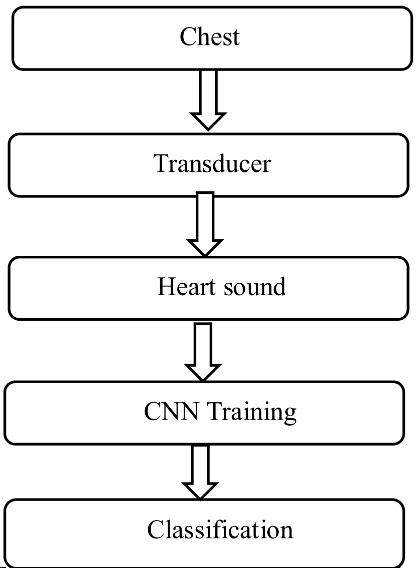

Figure 1: Classification of heart sounds

III. RESULT

Here four categories of audio sound samples are considered. In artifact category, 40 samples, extrahls category19 samples, murmur category 35 samples and in normal category 200 samples are considered. This data set is fed into the CNN training algorithm in order to classify the audio. The accuracy obtained is 95.8%

3.1. Two Class Classification

Training and classification is performed using CNN by choosing number of epochs as 5, filter size as 10, Number of filters as 64 and Max pooling layer.

a) Artifact and Normal: The training and classification results are indicated in figures 2 and 3.

Figure 2: Training CNN for Artifact vs normal

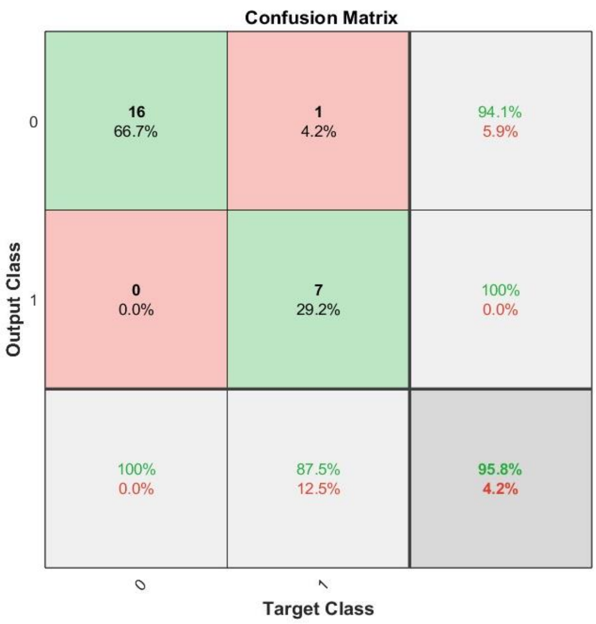

Figure 3: Confusion Matrix of artifact vs normal

b) Extrahls and Normal: The result is indicated in figures 4.

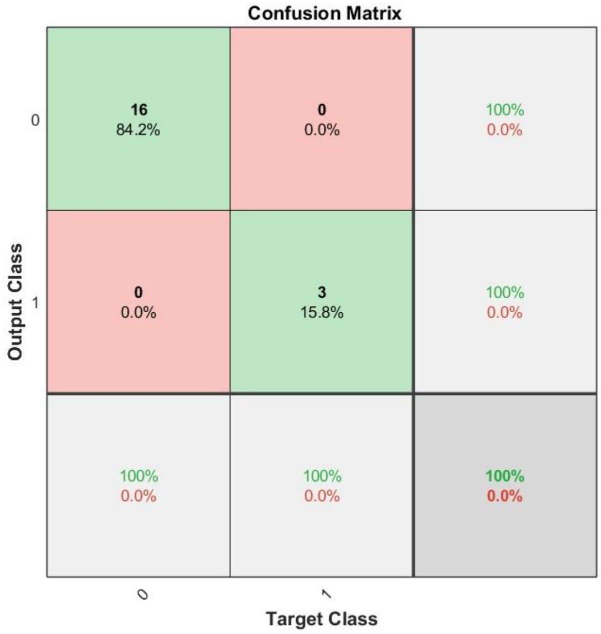

Figure 4: Confusion Matrix of extrahls vs normal

The accuracy obtained is 100% for Extrahls vs Normal.

c) Murmur and Normal: The result is indicated in figures 5.

Figure 5: Confusion Matrix of murmur vs normal

The accuracy obtained is 95.5% for murmur vs Normal

3.2. Three Class Classification

a) Artifact, Murmur and Normal: The training and classification results are indicated in figures 6 and 7.

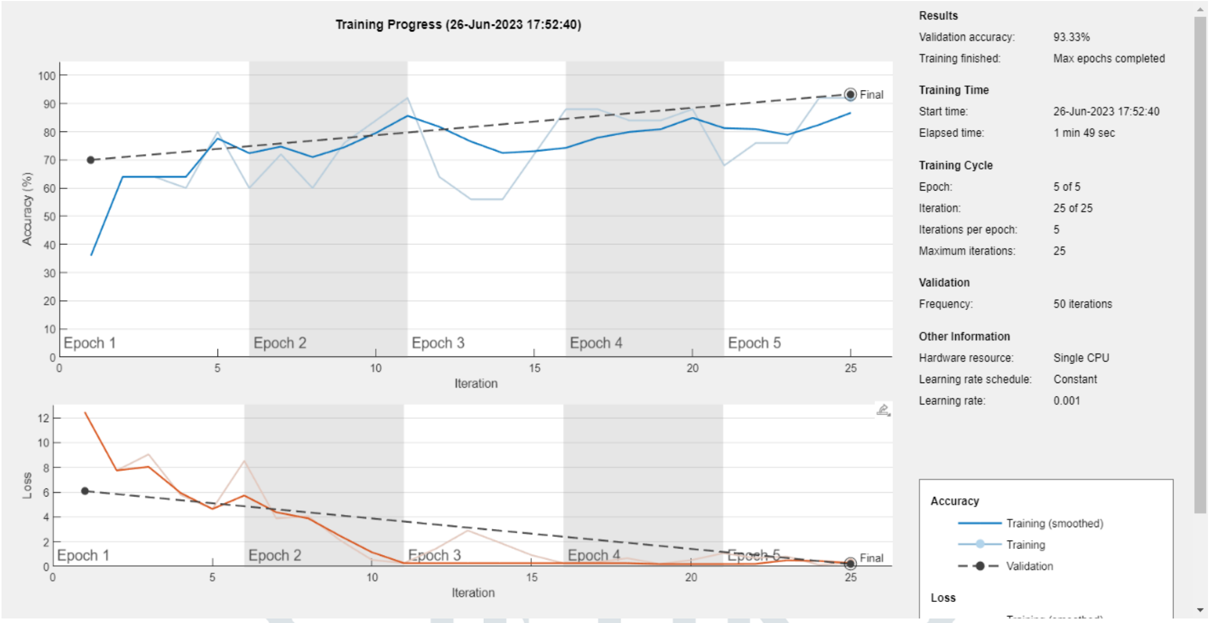

Figure 6: Training data for artifact vs murmur vs normal

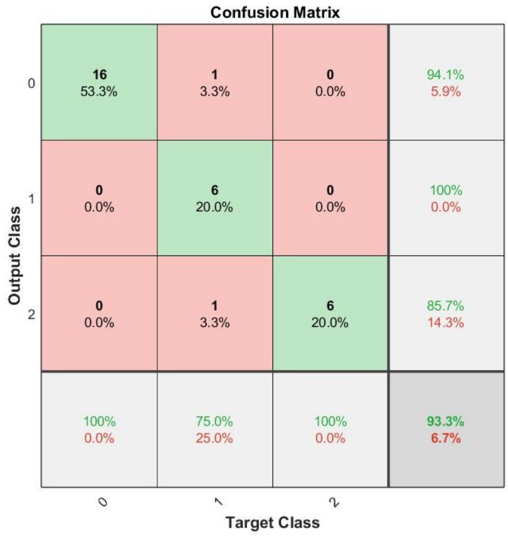

Figure 7: Confusion Matrix of artifact vs murmur vs normal

The overall accuracy obtained after training is 93.3%

b) Artifact, Extrahls and Normal: The result is indicated in figures 8.

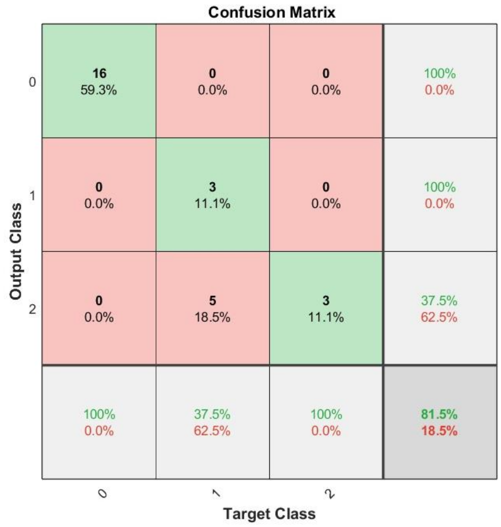

Figure 8: Confusion Matrix of artifact vs extrahls vs normal

The overall accuracy obtained after training is 81.5%

c) Murmur, Extrahls and Normal: The result is indicated in figures 9.

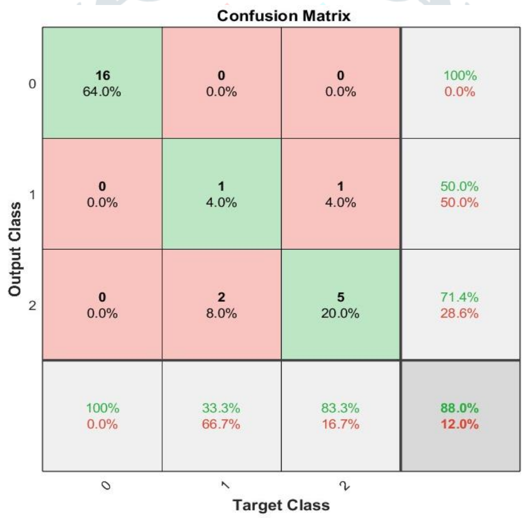

Figure 9: Confusion Matrix of murmur vs extrahls vs normal

The overall accuracy obtained after the training is 88.0%

3.3. Four Class Classification

All the four category of signals is considered for classification. Here number of epochs is considered as 5. The training and classification results are indicated in figure 10 and 11.

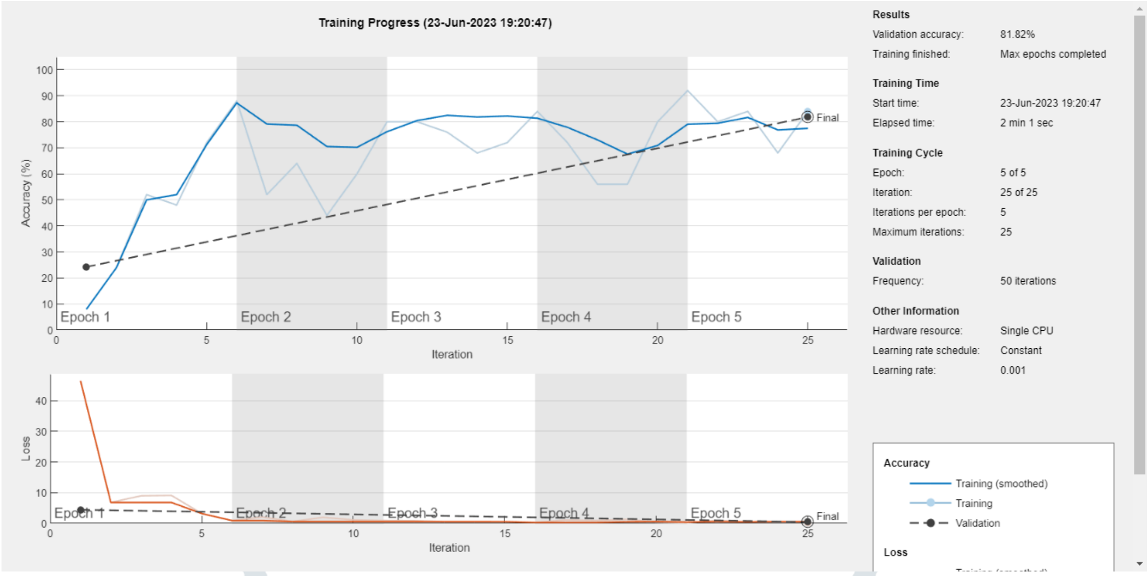

Figure 10: Training data for 5 epochs

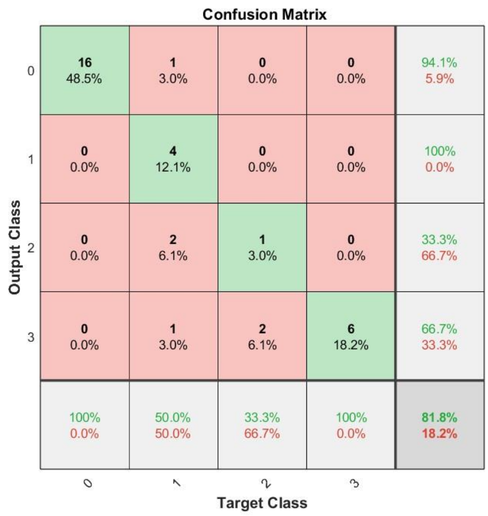

Figure 11: Confusion Matrix of 5 epochs

The overall accuracy after training is 81.8%.

b) All the four category of signals is considered for classification. Here number of epochs is considered as 10. The training and classification results are indicated in figure 12 and 13.

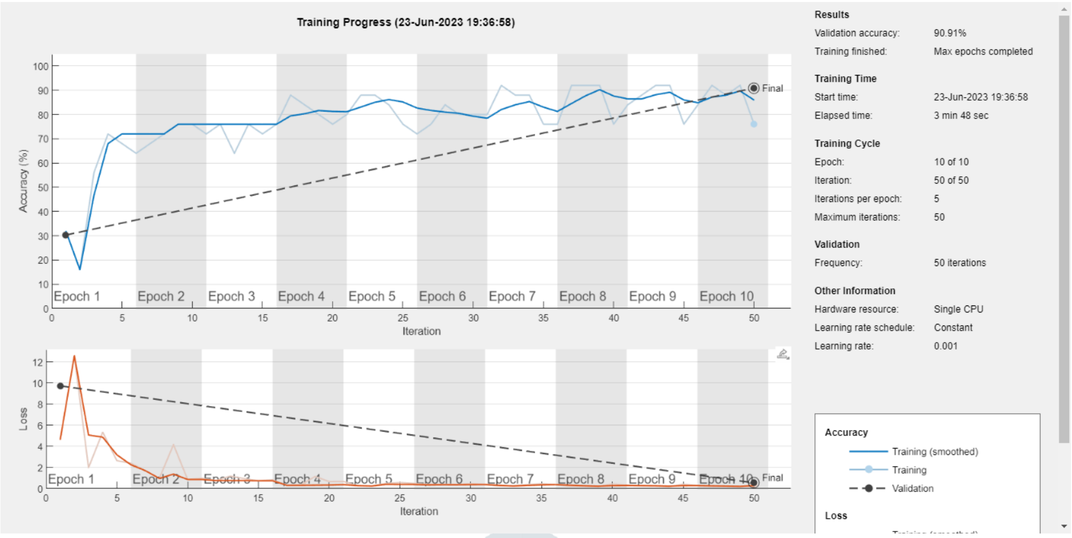

Figure 12: Training data for 10 epochs

Figure 13: Confusion Matrix of 10 epochs

The overall accuracy after training is 90.9%.

3.4. All the results of classification are summarized in Table 1.

TABLE 1: Results of classification

Methodology	Filter Size	Pooling Layer	Accuracy in %
CNN	5	Max	81.8
CNN	10	Max	90.9

IV. CONCLUSION

The multiclass classification of heart sounds is aimed to develop a model that accurately identifies different heart sound segments. By applying machine learning techniques, we successfully trained a model using a dataset of heart sound recordings. The deep learning technique CNN was used in the classification of heart sound of normal person and person suffering from CVD, by varying the parameter such as number of filters, filter size, kfold, epochs to get the better accuracy of classification. Accuracy is high in case of using CNN with the filter size set to 10 and epoch of 10. The best obtained accuracy of classification is 90.9%. Hence, we conclude that CNN is the better way to classify heart sound samples of healthy person and a person having CVD diseases. Overall, the multiclass classification of heart sound project provides a valuable contribution to the field of medical diagnostics, demonstrating the potential of machine learning algorithms in accurately categorizing heart sound segments.

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