Department of Computer Science and Engineering
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COMPUTER VISION LAB

TWO CLASS CLASSIFICATION OF PASCAL HEART SOUND SIGNALS USING THE CONTINUOUS WAVELET TRANSFORM FEATURES.

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Submitted To:
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TABLE OF CONTENT

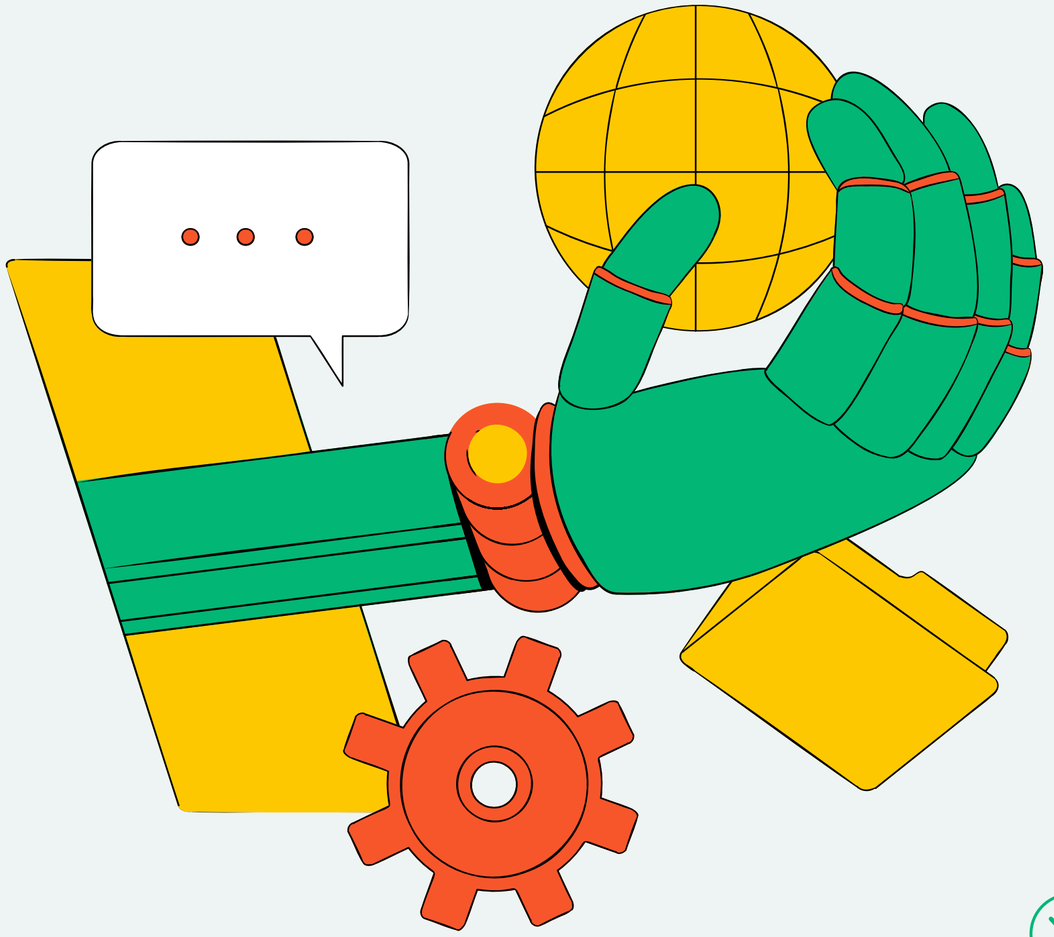
1.1 INTRODUCTION AND MOTIVATION

- The project aims to categorize pediatric heart sound signals into normal and abnormal categories using continuous wavelet transform and Convolutional Neural Network (CNN) models.

- The motivation behind this project lies in the critical importance of accurate cardiac assessment, especially in pediatric populations where early detection of heart abnormalities can significantly impact patient outcomes.

1.3 PROBLEM STATEMENT

- The project description states that continuous wavelet transform will be used to categorize pascal heart sound signals into normal and abnormal heart sounds .
- The main goal of this project is to create a Convolutional Neural Network (CNN) model 1D/2D that can distinguish between normal and abnormal cardiac sounds
- The dataset comprises pediatric heart sound recordings stored in .wav format, collected from 941 individuals.
- It includes 176 instances of normal heart sounds and 31 instances of abnormal heart sounds. The recordings are sampled at a rate of 4000Hz, ensuring high fidelity representation of heart sounds.



2. LITRETURE

HEART SOUND/PCG SIGNAL:
Heart sounds are divided into two primary categories:

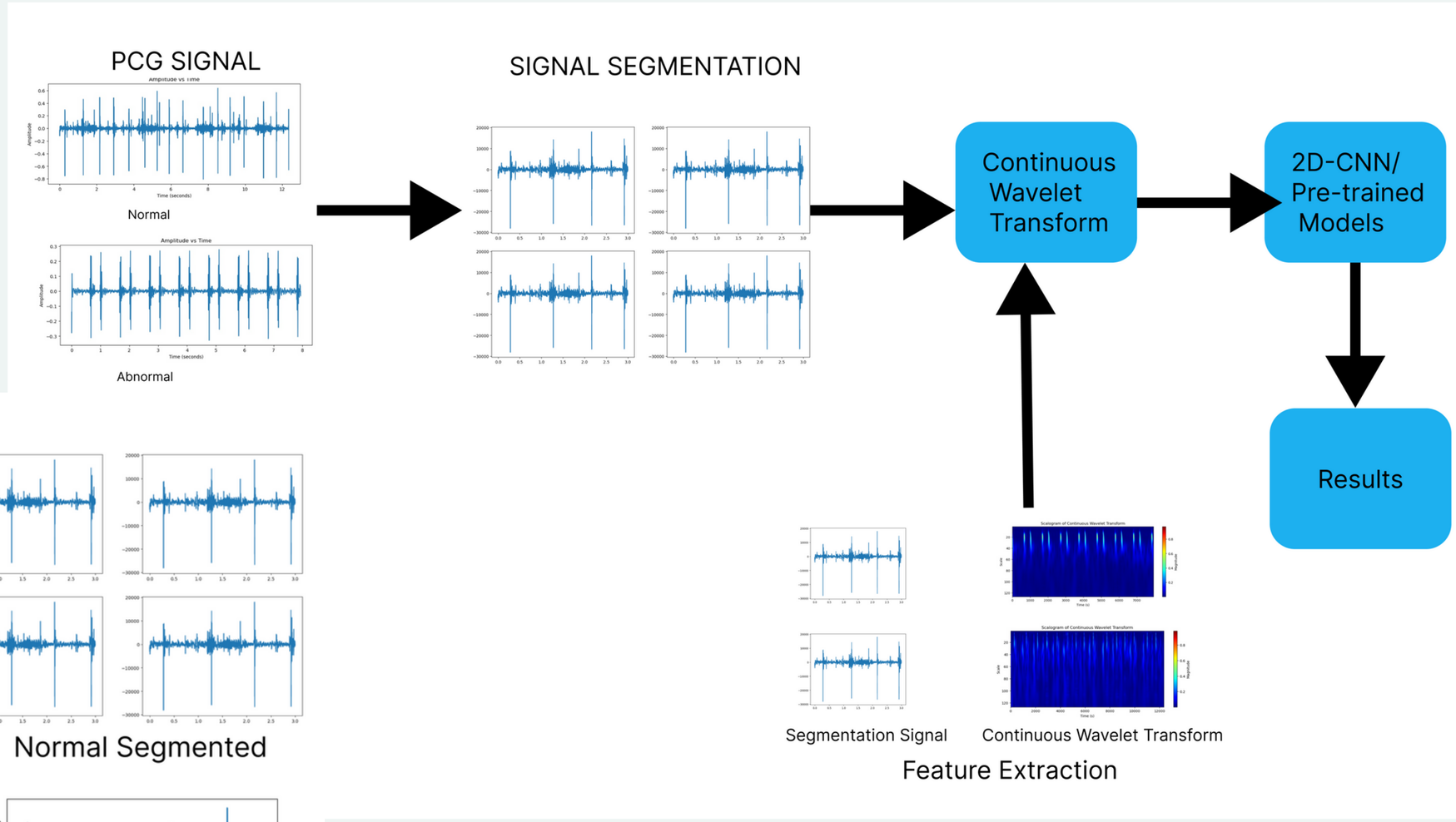
- **Normal Heart Sounds**: Sounds produced by the functioning of blood flow.

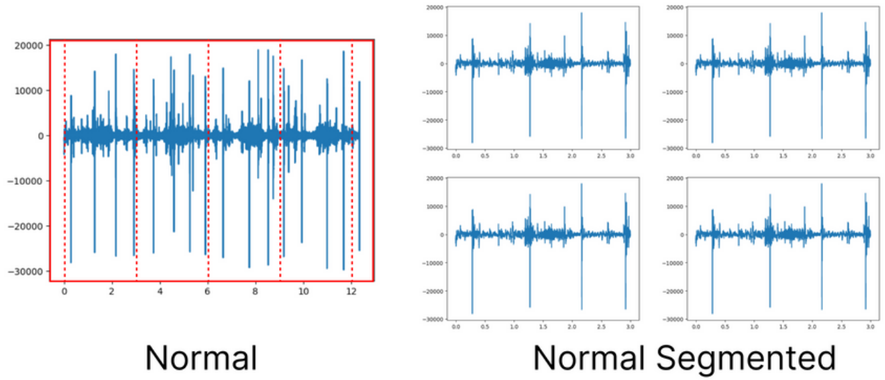
  Example: lub.....dub..... lub.....dub..... lub.....dub..... lub.....dub...

- **Abnormal Heart Sounds**: Murmurs that can indicate underlying cardiac conditions, such as abnormal blood flow.

  Example: 1. ...lub..****...dub..... lub..****..dub
  2. ...lub.lub.....dub..... lub. lub.....dub...

3. PROPOSED METHOD





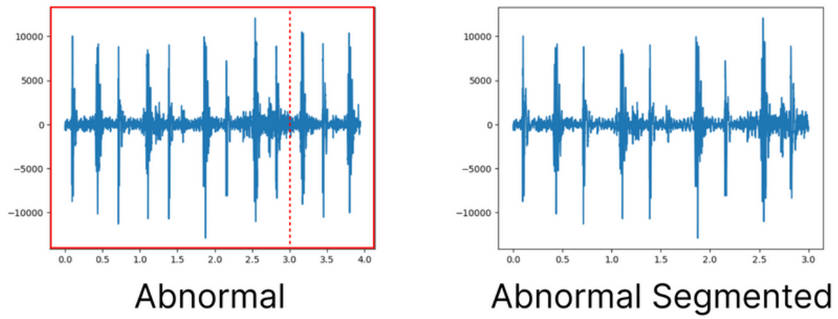
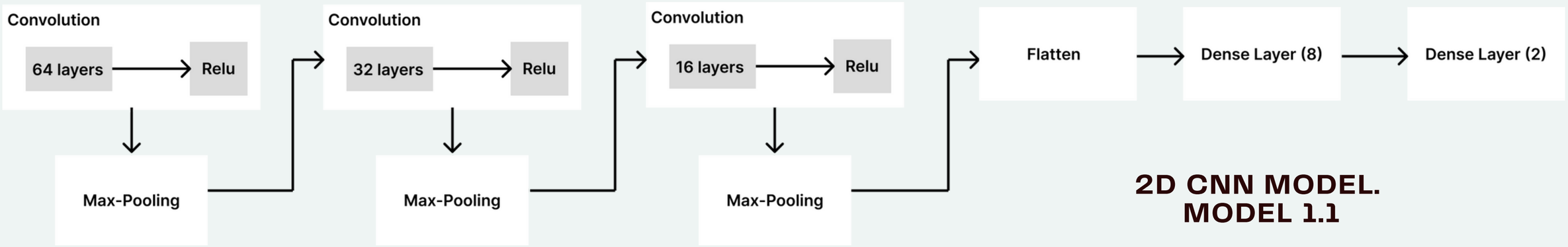
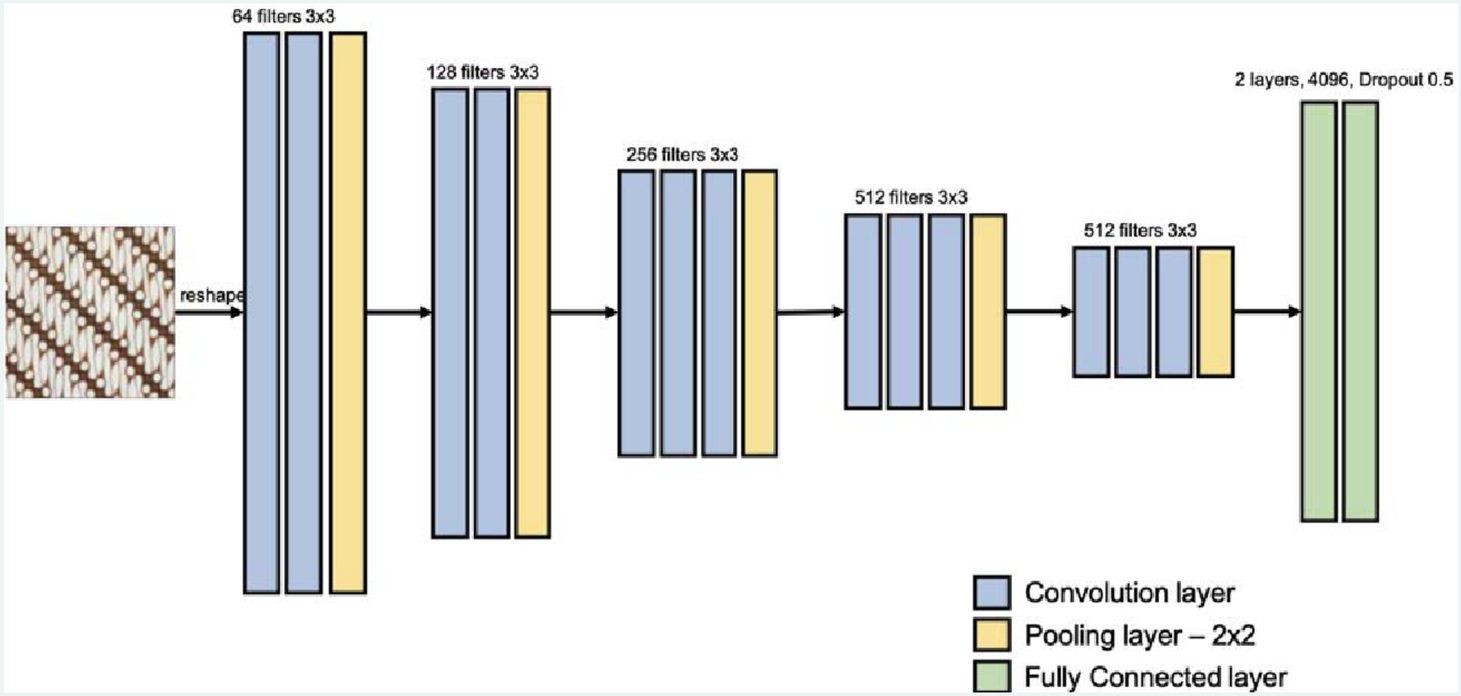


FIGURE 1. HEART SOUND CLASSIFICATION ARCHITECTURE USING WAVELET ANALYSIS TECHNOLOGY AND AN ENSEMBLE OF DEEP LEARNING MODELS

4.1 MODEL USED

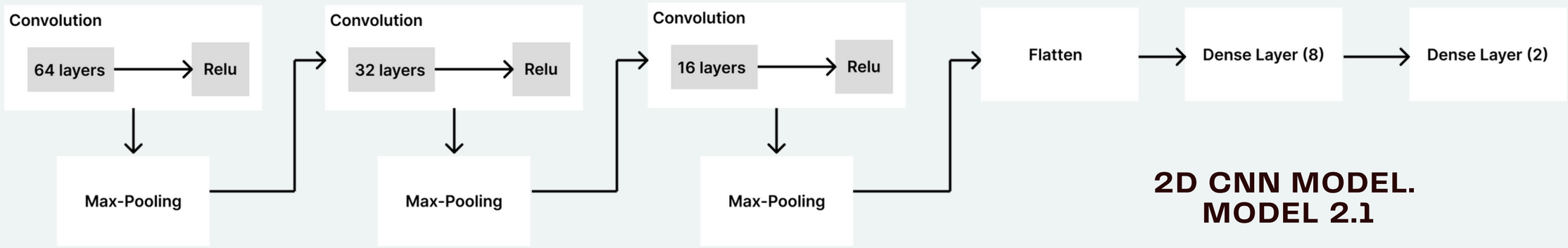


2D CNN MODEL.
MODEL 1.1

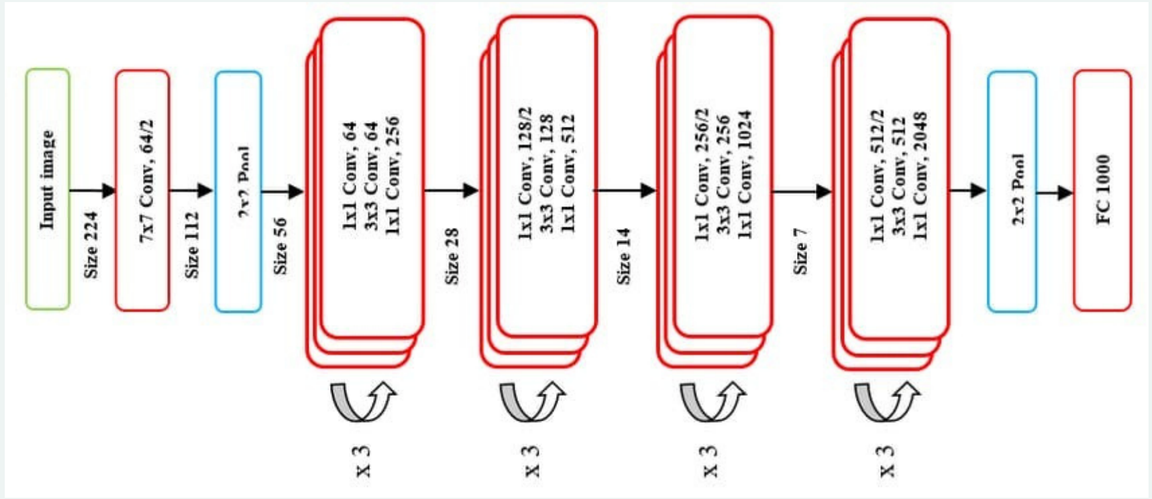


VGG-16 WITH RANDOM FOREST CLASSIFIER.
MODEL 1.2

4.2 MODEL USED



2D CNN MODEL.
MODEL 2.1



RESNET50
MODEL 2.3

RANDOM FOREST CLASSIFIER
MODEL 2.2

2D CNN MODE WITH RANDOM FOREST CLASSIFIER.
MODEL 2.4

4.3 PERFOMANCES METRICES

- **Accuracy:** Calculated as (TP +TN) / (TP + TN +FN + FP), where TP is true positives and FN is false negatives, TN is true negatives and FP is false positives

- **Sensitivity:** Calculated as TP / (TP + FN), where TP is true positives and FN is false negatives.

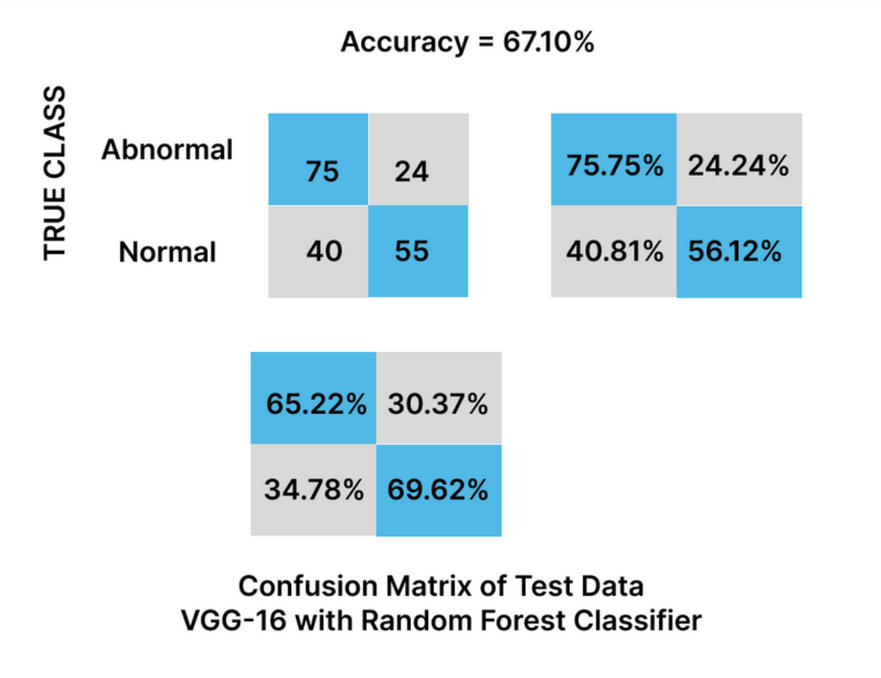
- **Specificity:** Calculated as TN / (TN + FP), where TN is true negatives and FP is false positives

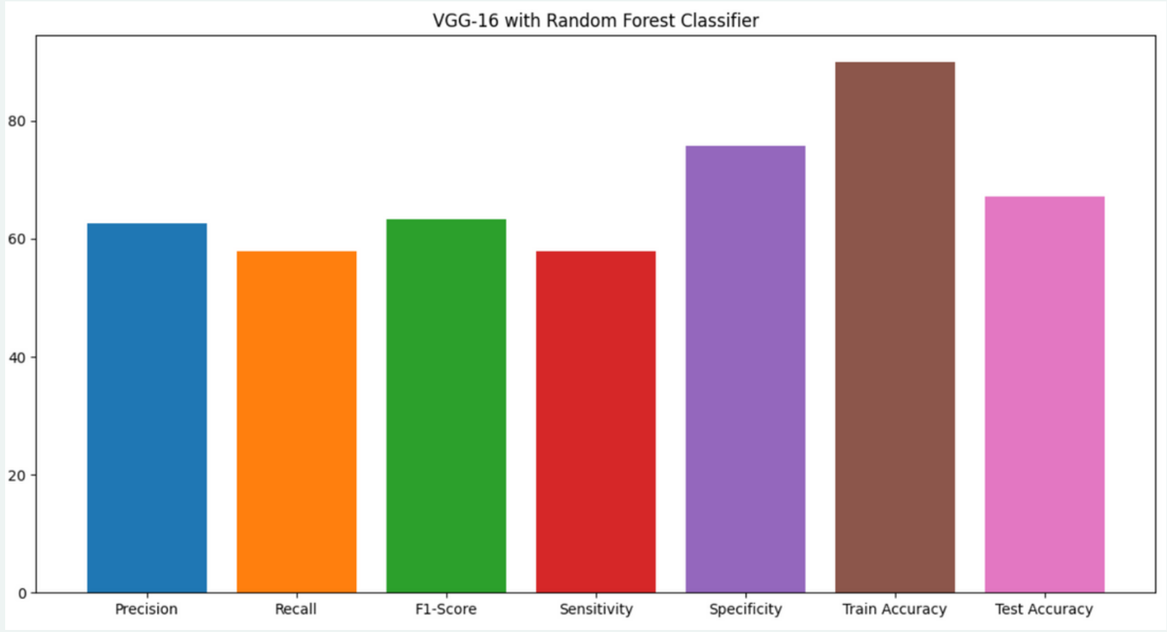
- **Confusion Matrix :** Shows the distribution of true positive, true negative, false positive, and false negative predictions.

4.4 RESULTS

Model	Accuracy
Model 1.1	55.67
Model 1.2	67.1
Model 2.1	65.3
Model 2.2	57.3
Model 2.3	60.2
Model 2.4	57.9

4.4 RESULTS





Dataset Averages

Precision	Recall	F1-Score	Sensitivity	Specificity	Train Accuracy	Test Accuracy
69.62	57.85	63.21	57.90	75.75	89.93	67.10

Table: Performance Results for VGG-16 with random forest classifier

5. CONCLUSION

- The model shows a moderate level of success in correctly classifying the test data, with an experiment accuracy of **67.10%.**
- It shows some degree of effectiveness in identifying patterns within the image data, even though it is not quite perfect.
- To improve performance and close the discrepancy between the model's predictions and ground truth labels, more optimization and fine-tuning might be required.
- The achieved accuracy of **67.10%** suggests that the Continuous Wavelet Transform **(CWT)** might **not be the most optimal** choice for feature extraction in this context.


THANK YOU