Preprocessing Techniques

- **Image Resizing:**

  The preprocess_imgs function is used to resize the images to a fixed size (224, 224) using OpenCV's cv2.resize function.

  Resizing ensures that all images have the same dimensions, which is a requirement for feeding images into deep learning models like VGG19 and ResNet50.

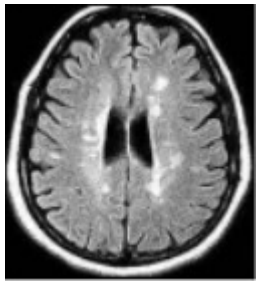

Fig 1. MRI image of brain before Resizing (226*226)

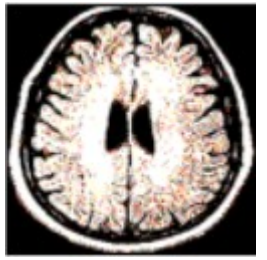

Fig 2. MRI image of brain after Resizing (224*224)

- **Normalization:**

  Preprocessing includes normalization using the preprocess_input function provided by the VGG19 model.

  Normalization helps in scaling pixel values to a range that the model expects, which often enhances training stability and convergence.

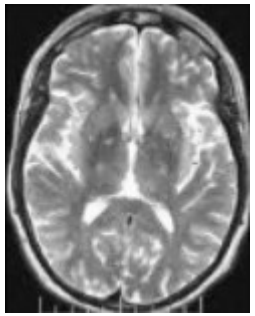

Fig 3. MRI image of brain before normalization

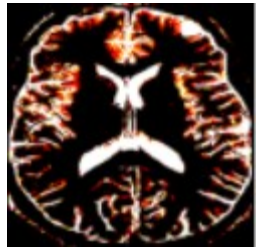

Fig 4. MRI image of brain after normalization

Augmentation Techniques

- **ImageDataGenerator:**

  The ImageDataGenerator from TensorFlow's Keras API is used to perform data augmentation on the training images.

  Augmentation parameters include rotation range, width shift range, height shift range, rescaling, shear range, brightness range, horizontal flip, and vertical flip.

- **Manual Cropping:**

  The crop_imgs function is used to crop images based on contours and extreme points detected in the images.

  This technique helps in focusing on the regions of interest within the images, potentially removing unnecessary background noise.

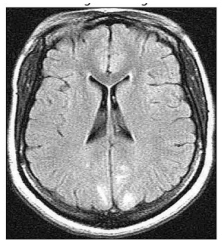

Fig 5. Input Image

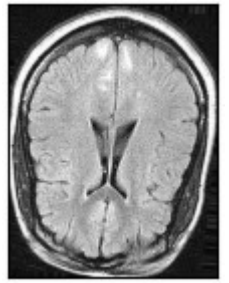

Fig 6. Vertically Flipped Image

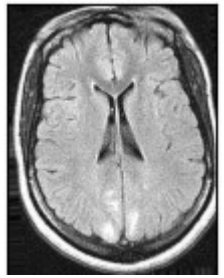

Fig 7. Horizontally Flipped image

Fig 8. Brightened Image

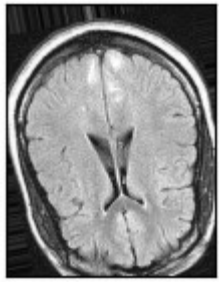

Fig 9. Rotated Image

Proposed Workflow

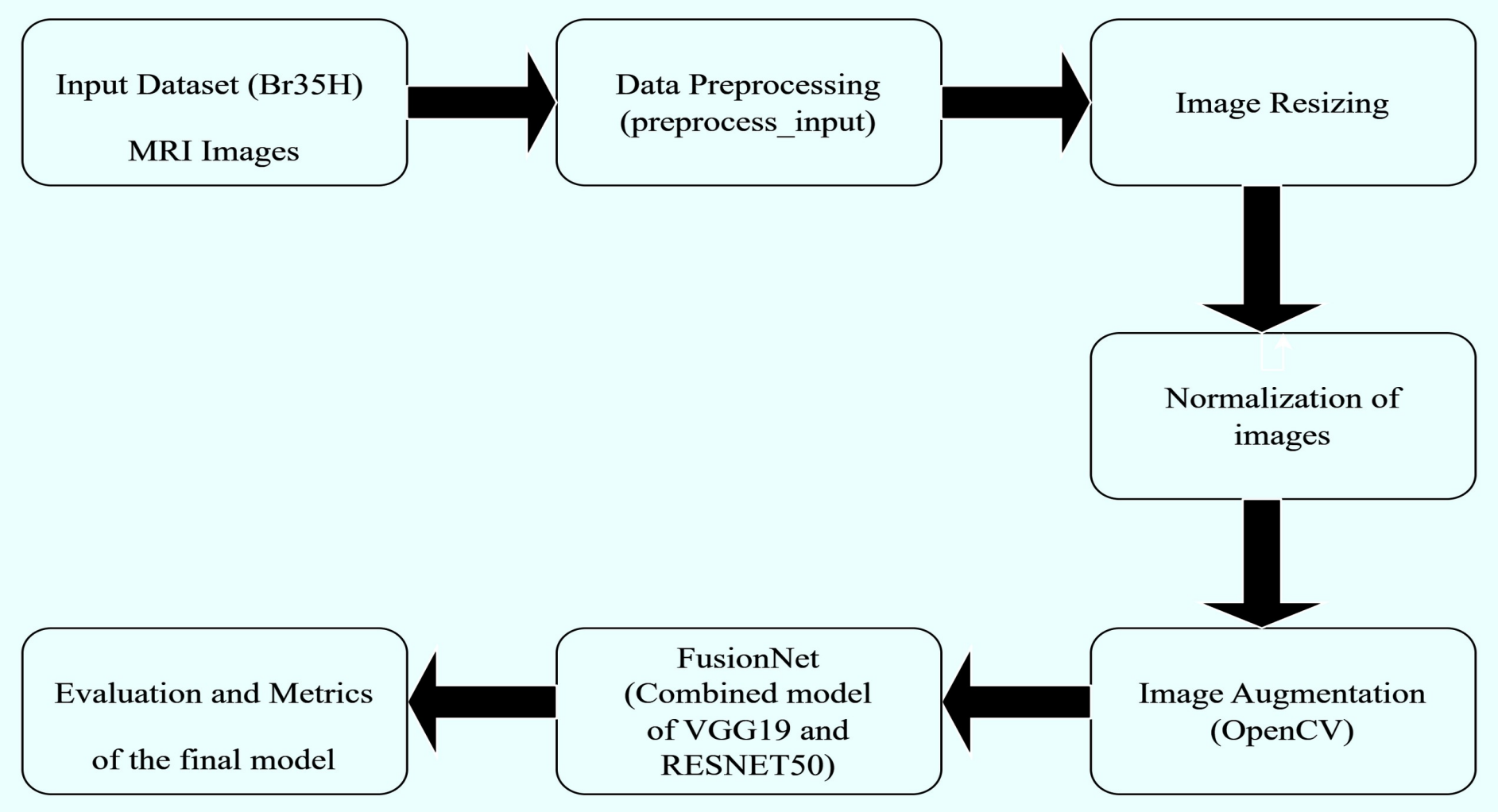

Fig 10. Block diagram representing the workflow of the project

Model Architecture of VGG19 & RESNET 50

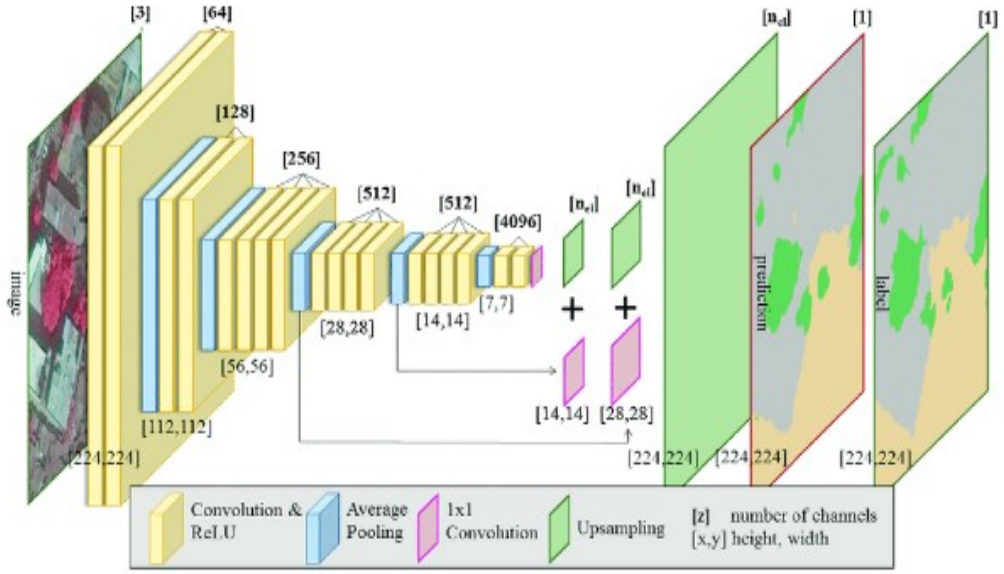

Fig 11. VGG19 Architecture

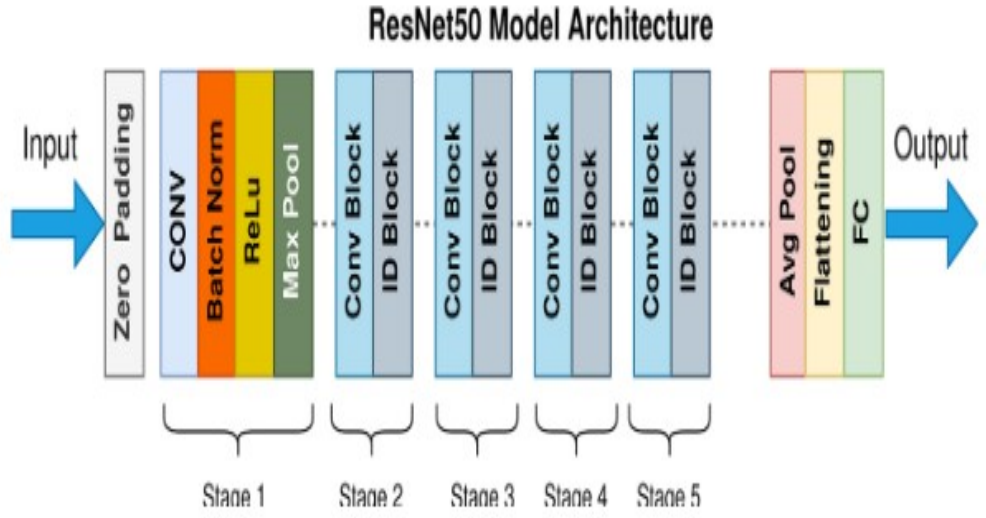

Fig 12. RESNET50 Architecture

Model Results of VGG19 & RESNET50

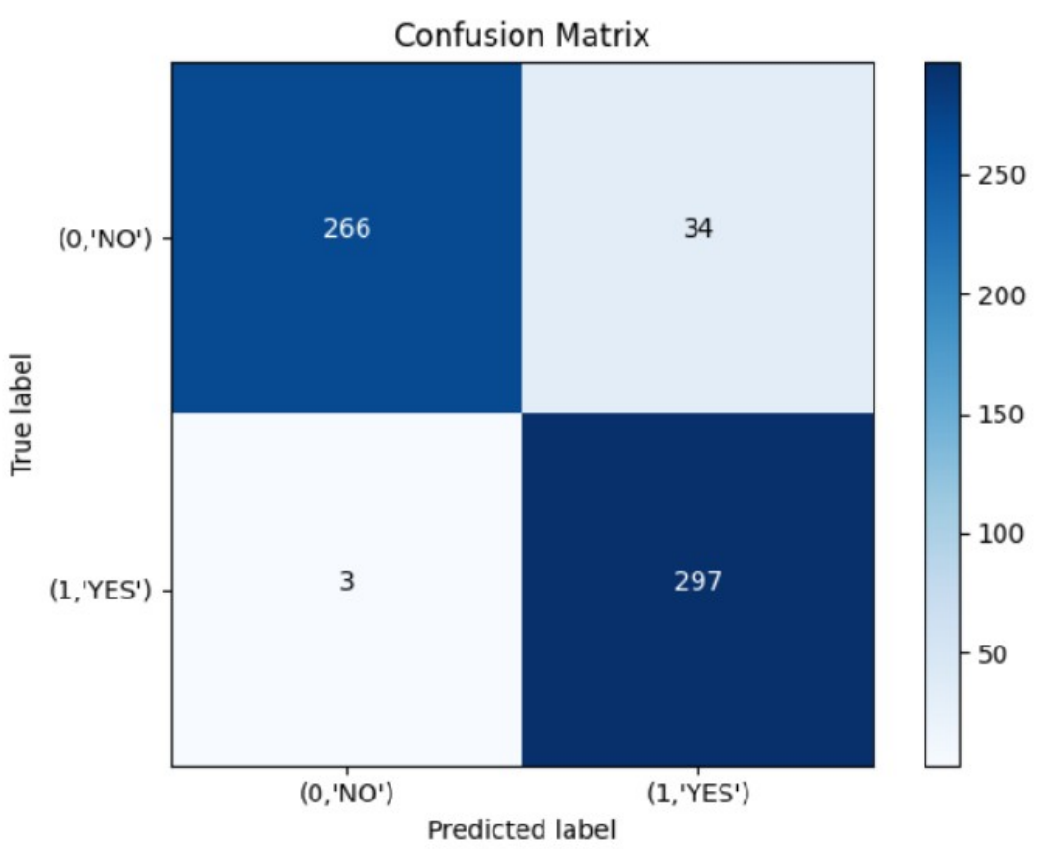

Fig. 13 VGG19 Model Confusion Matrix of test dataset

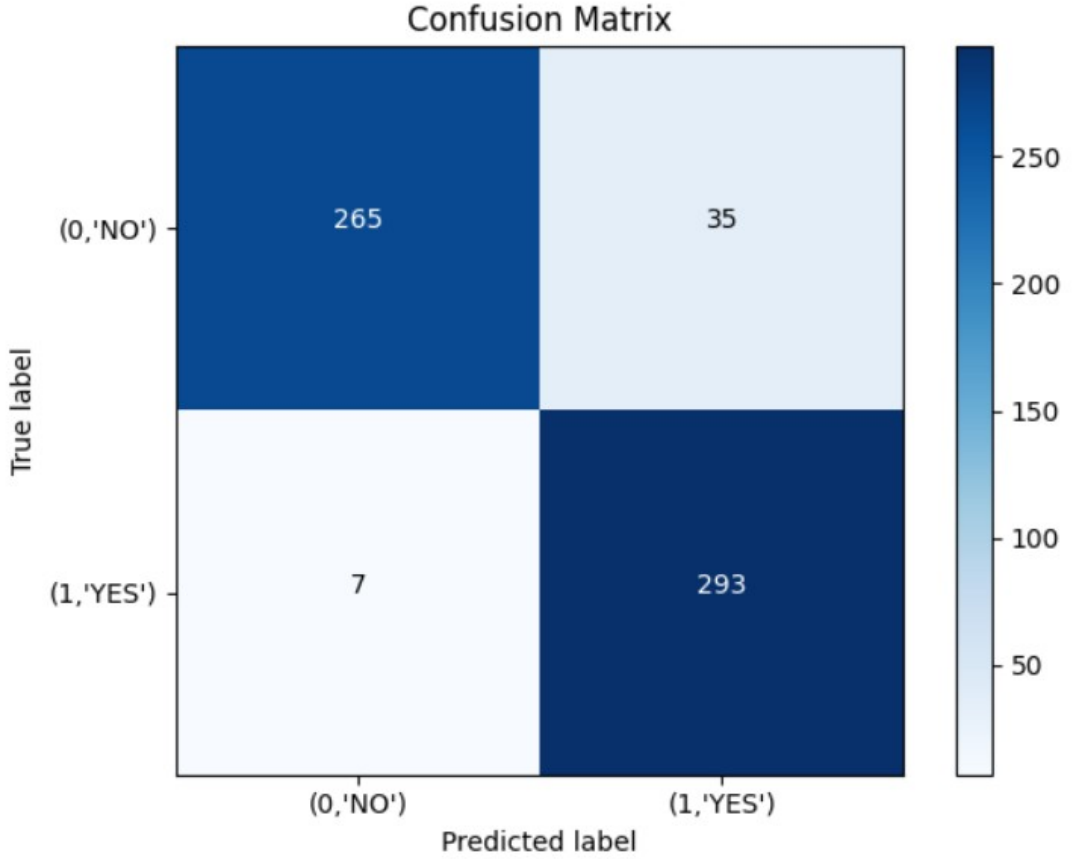

Fig. 14 RESNET50 Confusion Matrix of test dataset

Results Of Concatenated and Pruned Model

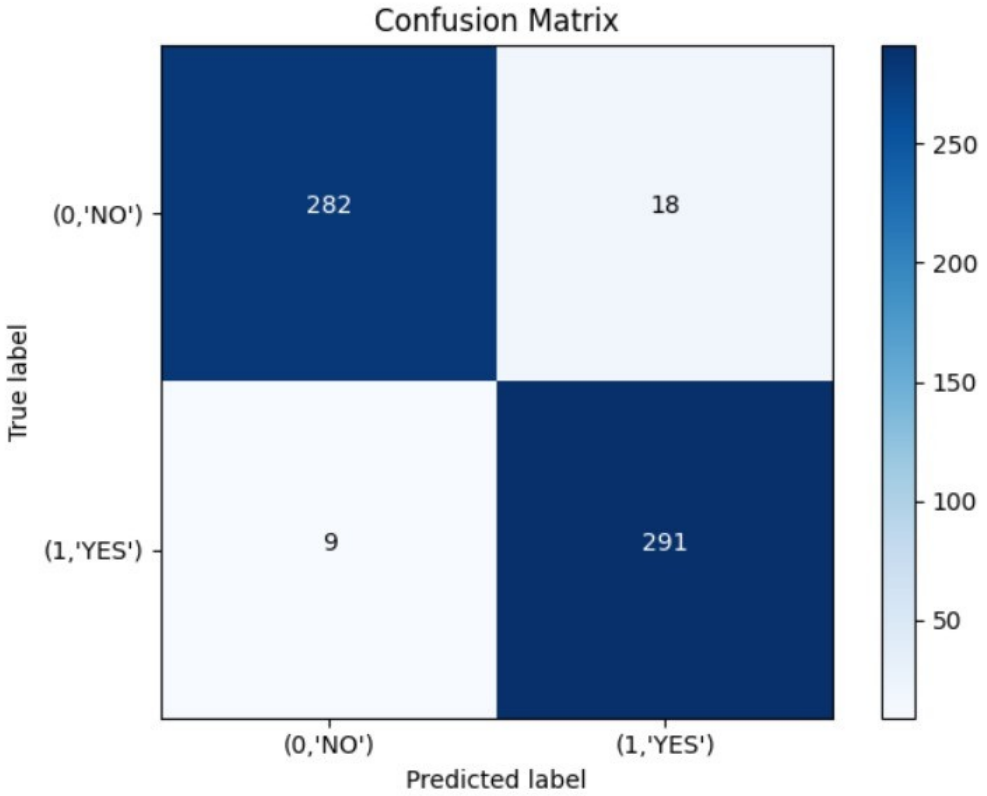

Fig. 15 Concatenated Model Confusion Matrix of test dataset

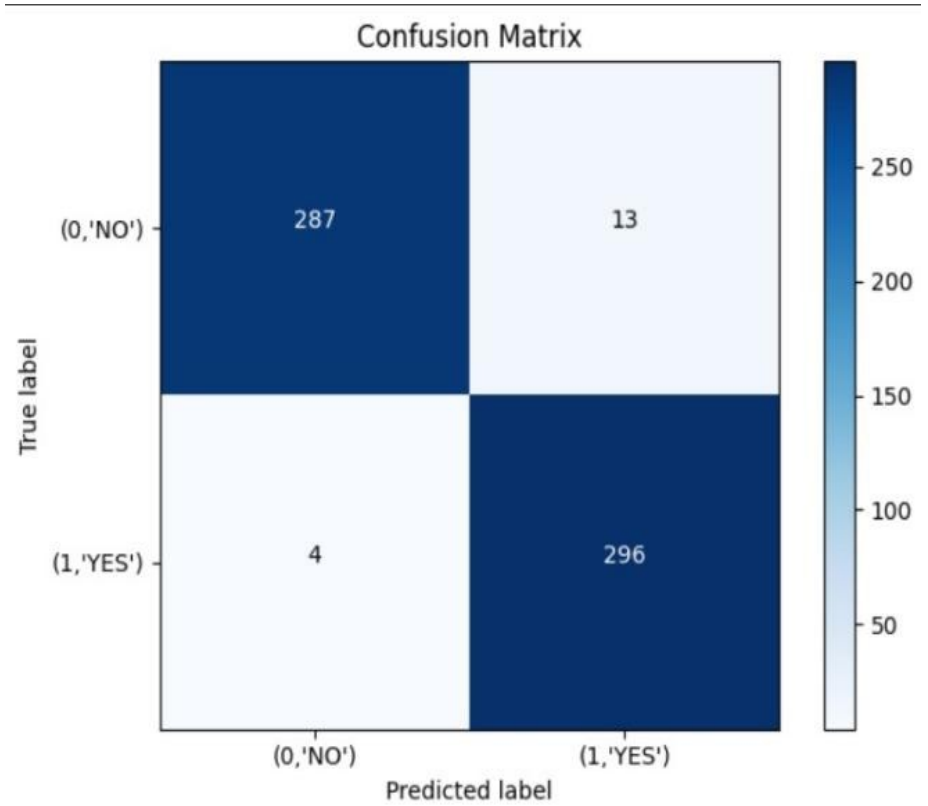

Fig. 16 Pruned Model Confusion Matrix of test dataset

Model Results

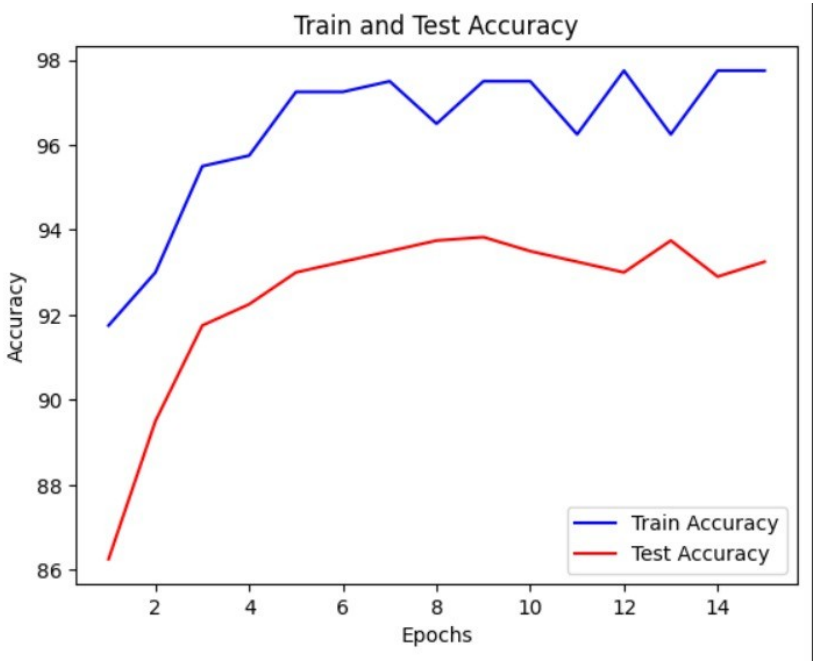

Fig. 17 VGG19 Model Confusion Matrix of test dataset

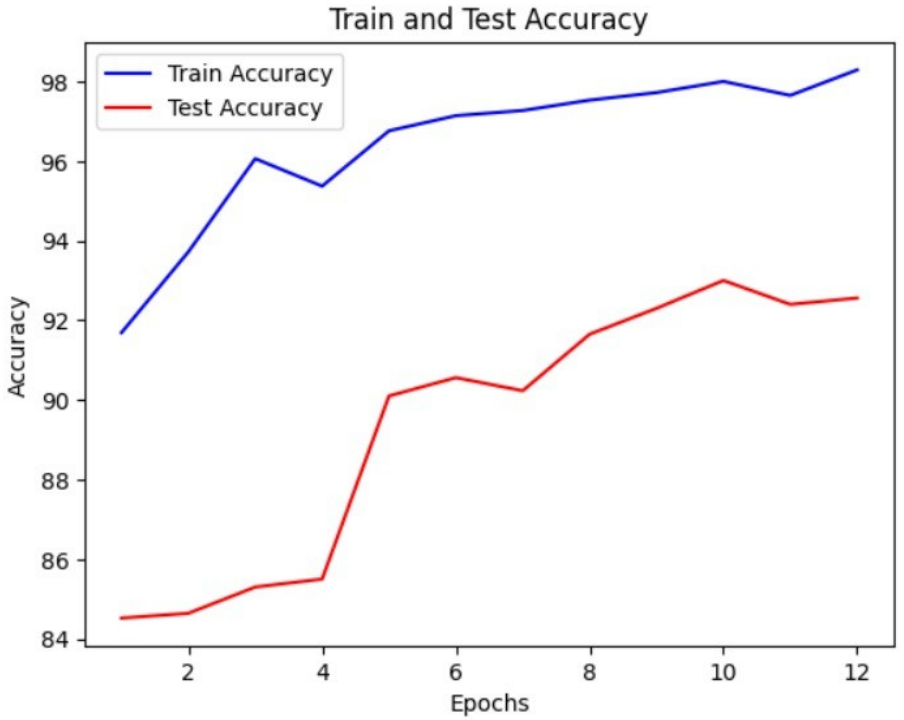

Fig. 18 RESNET50 Confusion Matrix of test dataset

Model Results

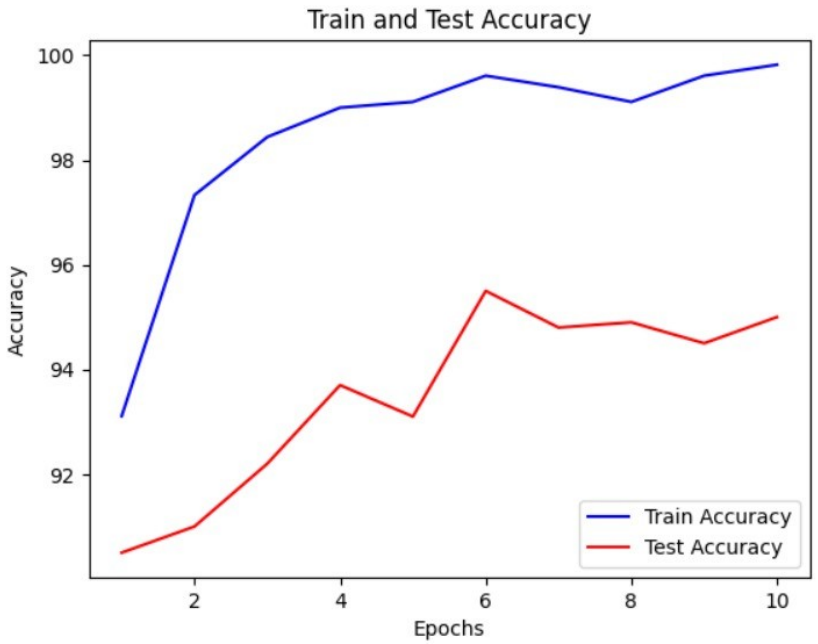

Fig. 19 Concatenated Model Confusion Matrix of test dataset

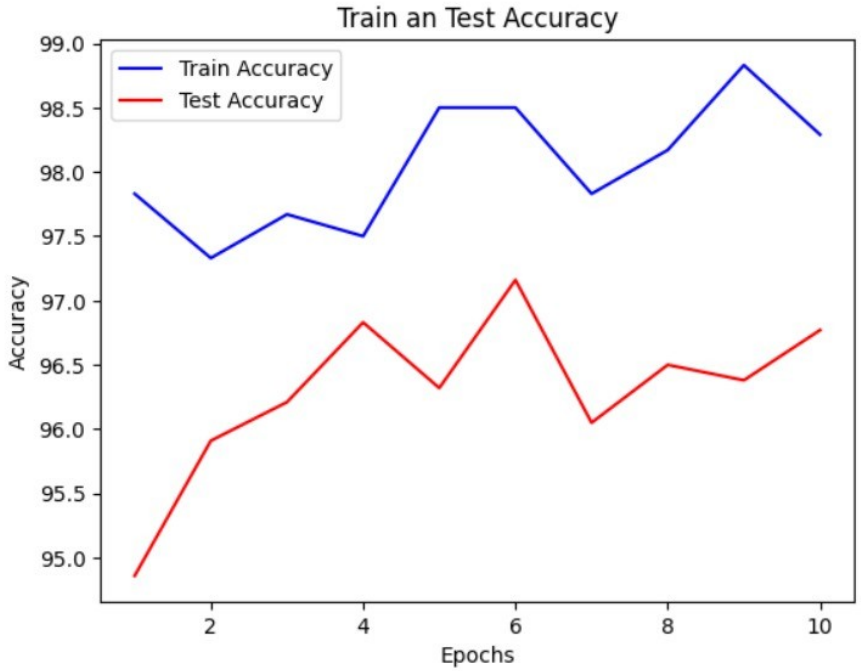

Fig. 20 Pruned Model Confusion Matrix of test dataset

Performance Parameters of the final model

Accuracy =

Recall =

Precision =

F1-score =

Table 2. Performance parameters of final model

Model	TP	FP	TN	FN	Accuracy	Precision	Recall	F1-score
VGG19	297	3	266	34	93.83	94.30	93.83	93.81
RESNET50	293	7	265	35	93	93.37	93	92.99
Concatenated Model	291	9	282	18	95.50	95.54	95.50	95.55
Pruned Model	296	4	287	13	97.16	97.20	97.16	97.16