4.6 RESULTS OBTAINED

VGG-16

(i) Number of Epochs = 20

```
Loss:  1.2541218996047974
Accuracy:  0.8207730650901794
4631/4631 [==============================] - 42s 9ms/step
                         precision    recall  f1-score   support

           Already fine       0.25      0.21      0.23      1171
    90 degree clockwise       0.25      0.26      0.25      1181
   180 degree clockwise       0.24      0.28      0.26      1126
90 degree anticlockwise       0.24      0.24      0.24      1153

               accuracy                           0.25      4631
              macro avg       0.25      0.25      0.25      4631
           weighted avg       0.25      0.25      0.25      4631
```

Fig 9: Accuracy of the model trained under VGG16 Baseline and 20 epochs is 82%. Also various other performance parameters are calculated for the four classes.

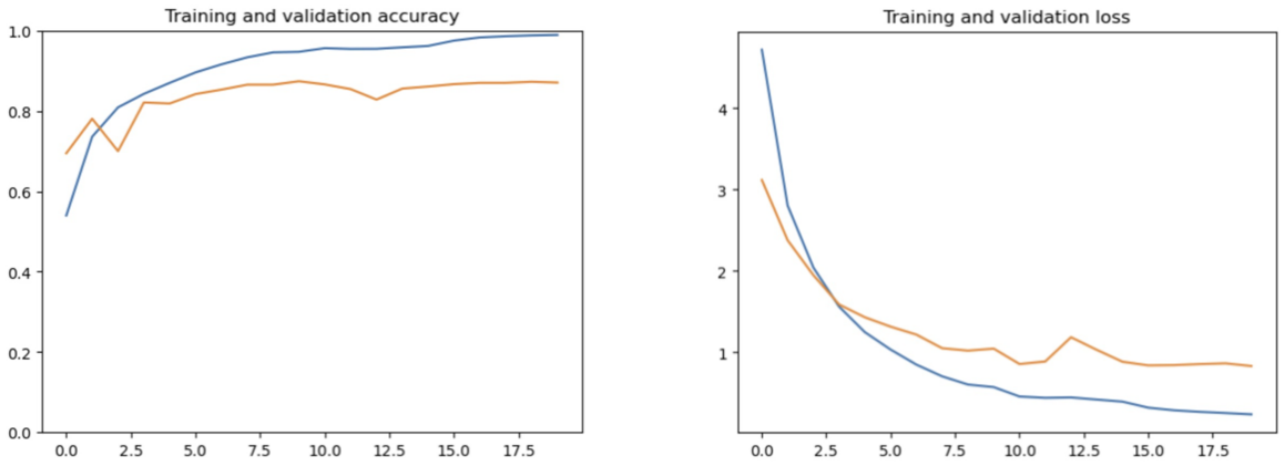

Fig 10: Training and Validation accuracy and loss graphs of the model trained under VGG16 Baseline and 20 epochs

(ii) Number of Epochs = 50

```
Loss:  1.3577481508255005
Accuracy:  0.8186137080192566
4631/4631 [==============================] - 42s 9ms/step
                         precision    recall  f1-score   support

           Already fine       0.26      0.23      0.24      1171
    90 degree clockwise       0.25      0.24      0.25      1181
   180 degree clockwise       0.25      0.29      0.26      1126
90 degree anticlockwise       0.24      0.25      0.24      1153

               accuracy                           0.25      4631
              macro avg       0.25      0.25      0.25      4631
           weighted avg       0.25      0.25      0.25      4631
```

Fig 11: Accuracy of the model trained under VGG16 Baseline and 50 epochs is 81.86%. Also various other performance parameters are calculated for the four classes.

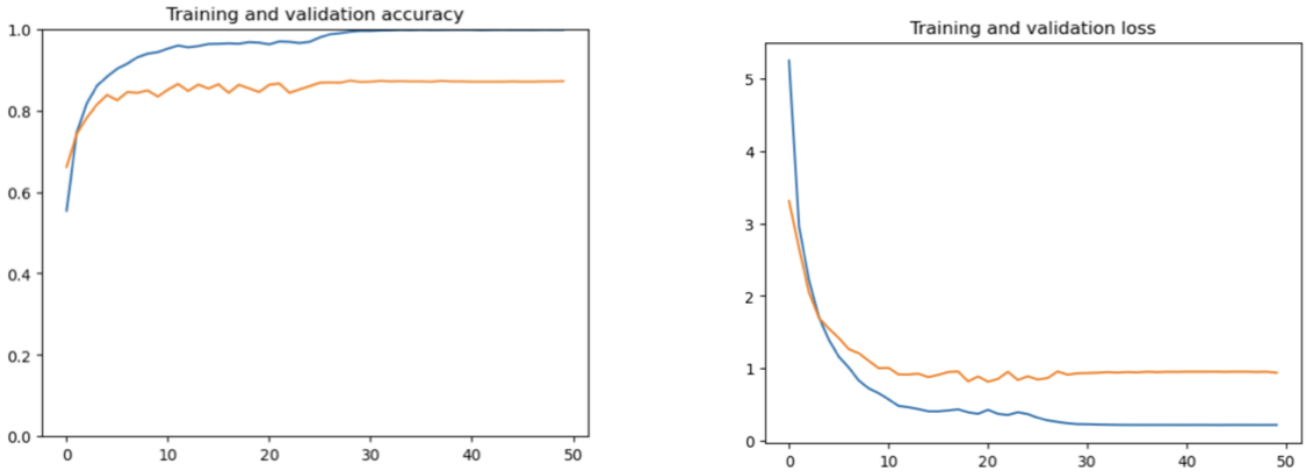

Fig 12: Training and Validation accuracy and loss graphs of the model trained under VGG16 Baseline and 50 epochs

(iii) Number of Epochs = 150

```
Loss:  1.3589458465576172
Accuracy:  0.8181818127632141
4631/4631 [==============================] - 42s 9ms/step
                         precision    recall  f1-score   support

           Already fine       0.26      0.22      0.24      1171
    90 degree clockwise       0.24      0.22      0.23      1181
   180 degree clockwise       0.24      0.29      0.26      1126
90 degree anticlockwise       0.24      0.25      0.25      1153

               accuracy                           0.25      4631
              macro avg       0.25      0.25      0.24      4631
           weighted avg       0.25      0.25      0.24      4631
```

Fig 13: Accuracy of the model trained under VGG16 Baseline and 150 epochs is 81.81%. Also various other performance parameters are calculated for the four classes.

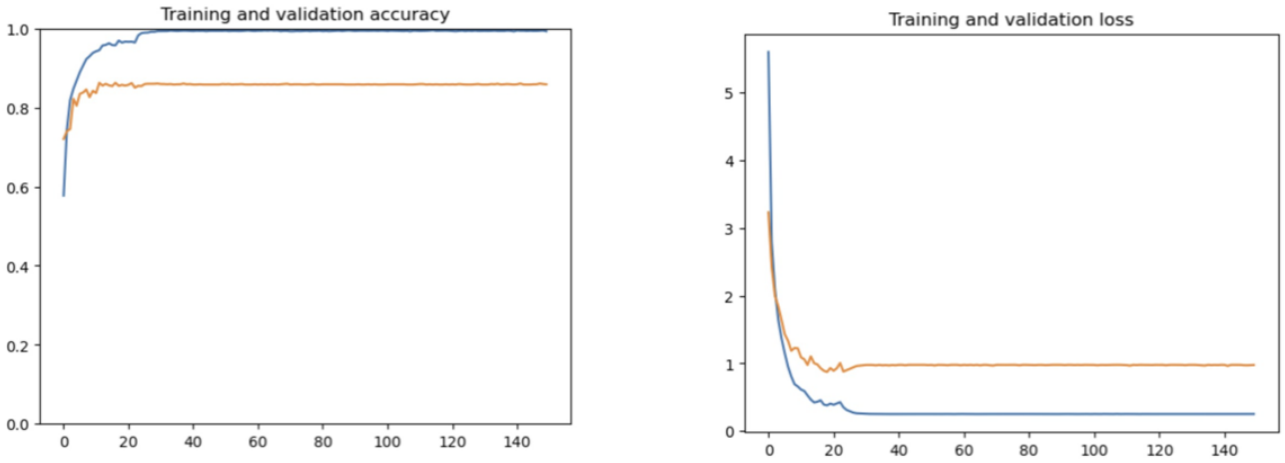

Fig 14: Training and Validation accuracy and loss graphs of the model trained under VGG16 Baseline and 150 epochs

To test our model, we took a few input images that the model has never seen and tried to predict the orientation of that input image. The following are the results obtained:

```
Predicted labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree anticlockwi
se', '180 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree anticlockwise']
Actual labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree clockwise', '1
80 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree anticlockwise']

Predicted labels:  [0 0 0 0 3 2 2 3 3]
Actual labels:  [0 0 0 0 1 2 2 3 3]
```

Fig 15: Output for applying trained model (VGG16 , 20 epochs) on random 9 images

RESNET-50

(i) Number of Epochs = 20

```
Loss:  0.8672741651535034
Accuracy:  0.8376160860061646
4631/4631 [==============================] - 70s 15ms/step
                          precision    recall  f1-score   support

              Already fine       0.26      0.23      0.24      1171
     90 degree clockwise         0.24      0.23      0.23      1181
    180 degree clockwise         0.25      0.28      0.27      1126
90 degree anticlockwise          0.24      0.25      0.24      1153

                  accuracy                           0.25      4631
                 macro avg       0.25      0.25      0.25      4631
              weighted avg       0.25      0.25      0.25      4631
```

Fig 16: Accuracy of the model trained under Resnet-50 Baseline and 20 epochs is 83.80%. Also various other performance parameters are calculated for the four classes.

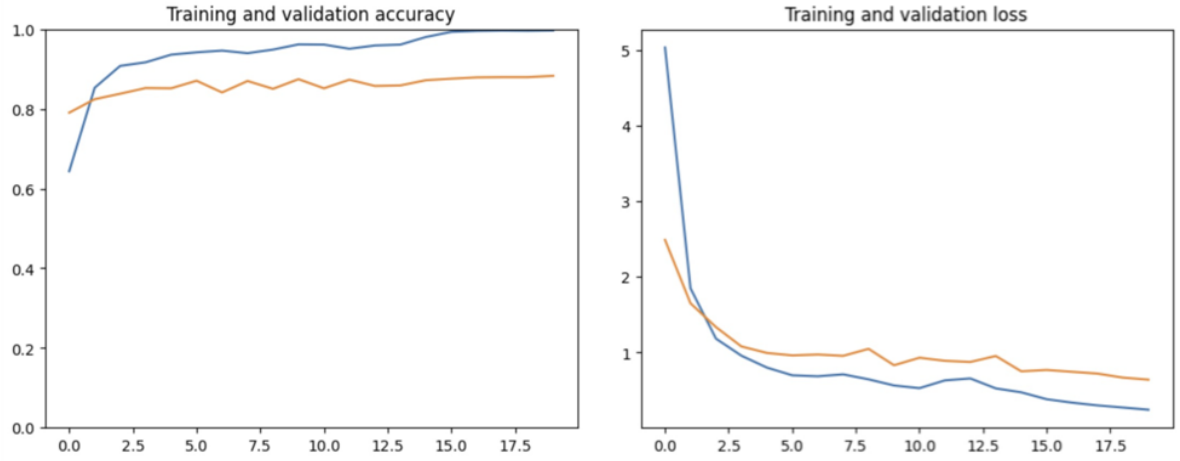

Fig 17: Training and Validation accuracy and loss graphs of the model trained under Renset-50 Baseline and 20 epochs

(ii) Number of Epochs = 50

```
Loss:  0.6243727207183838
Accuracy:  0.8399913907051086
4631/4631 [==============================] - 121s 26ms/step
                         precision    recall  f1-score   support

           Already fine       0.26      0.22      0.24      1171
    90 degree clockwise       0.24      0.22      0.23      1181
   180 degree clockwise       0.25      0.26      0.25      1126
90 degree anticlockwise       0.24      0.27      0.25      1153

               accuracy                           0.24      4631
              macro avg       0.24      0.24      0.24      4631
           weighted avg       0.24      0.24      0.24      4631
```

Fig 18: Accuracy of the model trained under Resnet-50 Baseline and 50 epochs is 83.99%. Also various other performance parameters are calculated for the four classes.

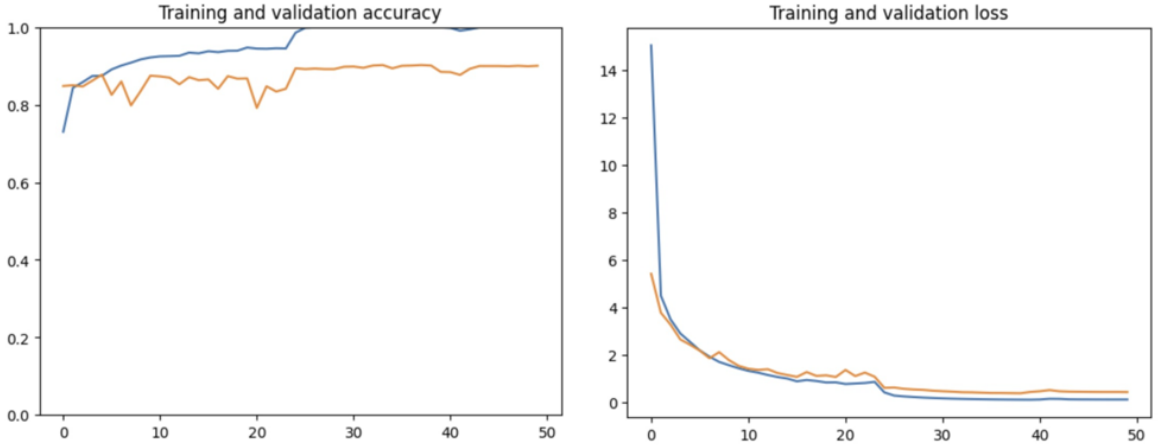

Fig 19: Training and Validation accuracy and loss graphs of the model trained under Renset-50 Baseline and 50 epochs

(iii) Number of Epochs = 100

```
Loss:  0.6636569499969482
Accuracy:  0.8505722284317017
4631/4631 [==============================] - 50s 11ms/step
                          precision    recall  f1-score   support

            Already fine       0.26      0.24      0.25      1171
    90 degree clockwise        0.24      0.22      0.23      1181
   180 degree clockwise        0.25      0.26      0.26      1126
90 degree anticlockwise        0.24      0.27      0.25      1153

                accuracy                           0.25      4631
               macro avg       0.25      0.25      0.25      4631
            weighted avg       0.25      0.25      0.25      4631
```

Fig 20: Accuracy of the model trained under Resnet-50 Baseline and 100 epochs is 85.01%. Also various other performance parameters are calculated for the four classes.

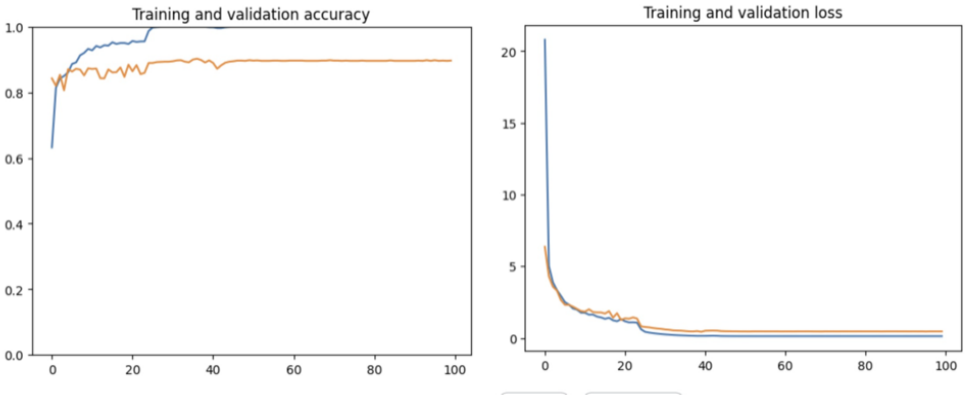

Fig 21: Training and Validation accuracy and loss graphs of the model trained under Renset-50 Baseline and 100 epochs

To test our model, we took a few input images that the model has never seen and tried to predict the orientation of that input image. The following are the results obtained:

```
Found 9 images belonging to 4 classes.
9/9 [==============================] - 0s 20ms/step - loss: 0.2818 - acc: 1.0000
9/9 [==============================] - 0s 15ms/step
Predicted labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree clockwise',
'180 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree anticlockwise']
Actual labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree clockwise', '1
80 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree anticlockwise']

Predicted labels:  [0 0 0 0 1 2 2 3 3]
Actual labels:  [0 0 0 0 1 2 2 3 3]
```

Fig 22: Output for applying trained model (Resnet-50 , 20 epochs) on 9 random images

ConvNeXt-Base

(i) Number of Epochs = 20

```
Loss:  0.8464184403419495
Accuracy:  0.8402072787284851
4631/4631 [==============================] - 211s 45ms/step
                          precision    recall  f1-score   support

            Already fine       0.26      0.30      0.28      1171
     90 degree clockwise       0.25      0.26      0.25      1181
    180 degree clockwise       0.25      0.22      0.24      1126
90 degree anticlockwise       0.23      0.21      0.22      1153

                accuracy                           0.25      4631
               macro avg       0.25      0.25      0.25      4631
            weighted avg       0.25      0.25      0.25      4631
```

Fig 23: Accuracy of the model trained under ConvNeXtBase Baseline and 20 epochs is 84%. Also various other performance parameters are calculated for the four classes.

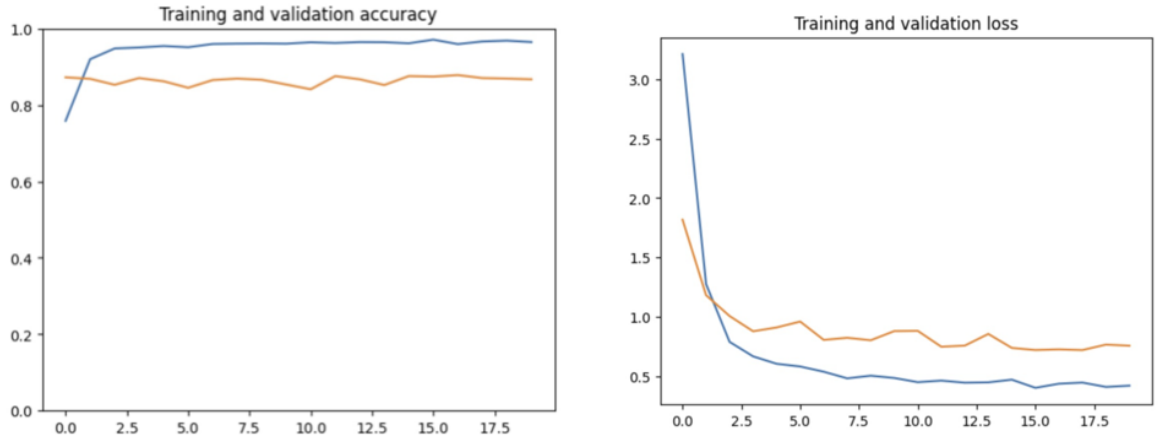

Fig 24: Training and Validation accuracy and loss graphs of the model trained under ConvNeXtBase Baseline and 20 epochs

(ii) Number of Epochs = 50

```
Loss:  0.465302973985672
Accuracy:  0.8611531257629395
4631/4631 [==============================] - 209s 44ms/step
                          precision    recall  f1-score   support

            Already fine       0.26      0.32      0.29      1171
    90 degree clockwise        0.25      0.22      0.24      1181
   180 degree clockwise        0.25      0.23      0.24      1126
90 degree anticlockwise        0.23      0.21      0.22      1153

                accuracy                           0.25      4631
               macro avg       0.25      0.25      0.25      4631
            weighted avg       0.25      0.25      0.25      4631
```

Fig 25: Accuracy of the model trained under ConvNeXtBase Baseline and 50 epochs is 86.11 %. Also various other performance parameters are calculated for the four classes.

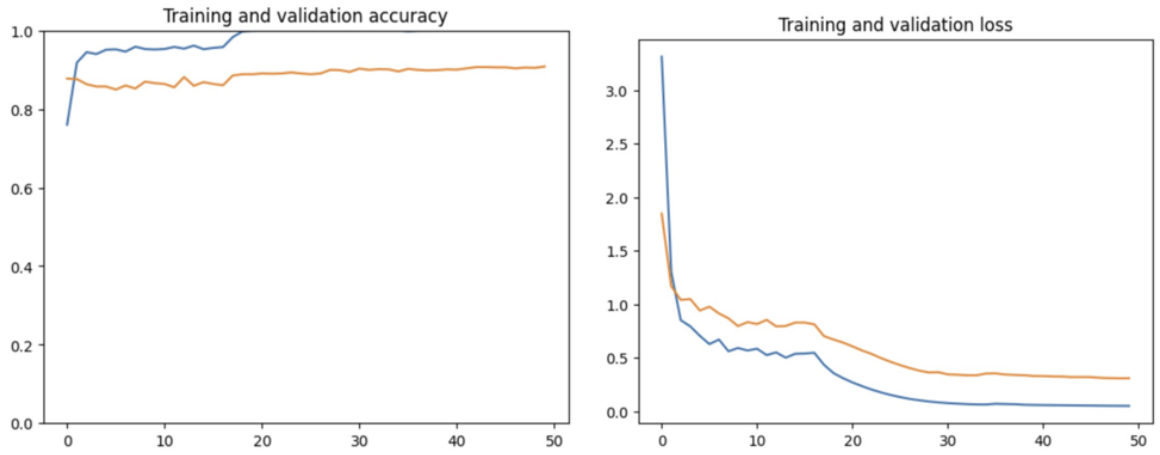

Fig 26: Training and Validation accuracy and loss graphs of the model trained under ConvNeXtBase Baseline and 50 epochs

(iii) Number of Epochs = 100

```
Loss:  0.4543675184249878
Accuracy:  0.8715180158615112
4631/4631 [==============================] - 287s 61ms/step
                        precision    recall  f1-score   support

           Already fine       0.25      0.30      0.27      1171
    90 degree clockwise       0.25      0.23      0.24      1181
   180 degree clockwise       0.25      0.23      0.24      1126
90 degree anticlockwise       0.23      0.21      0.22      1153

               accuracy                           0.24      4631
              macro avg       0.24      0.24      0.24      4631
           weighted avg       0.24      0.24      0.24      4631
```

Fig 27: Accuracy of the model trained under ConvNeXtBase Baseline and 150 epochs is 87.2%. Also various other performance parameters are calculated for the four classes.

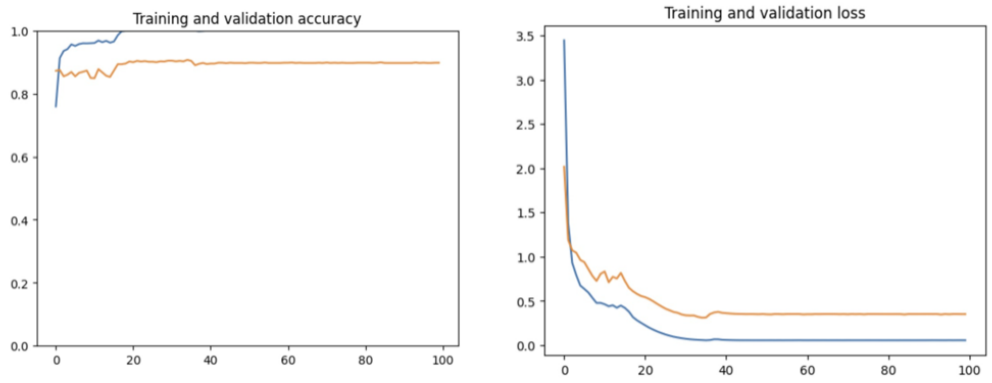

Fig 28: Training and Validation accuracy and loss graphs of the model trained under ConvNeXtBase Baseline and 100 epochs

To test our model, we took a few input images that the model has never seen and tried to predict the orientation of that input image. The following are the results obtained:

```
Predicted labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree anticlock
wise', '180 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree clockwise']
Actual labels:  ['Already fine', 'Already fine', 'Already fine', 'Already fine', '90 degree clockwise',
'180 degree clockwise', '180 degree clockwise', '90 degree anticlockwise', '90 degree anticlockwise']

Predicted labels:  [0 0 0 0 3 2 2 3 1]
Actual labels:  [0 0 0 0 1 2 2 3 3]
```

Fig 29: Output for applying trained model (ConvNeXtBase , 20 epochs) on 9 random images

4.5.2 SAMPLE RESULTS

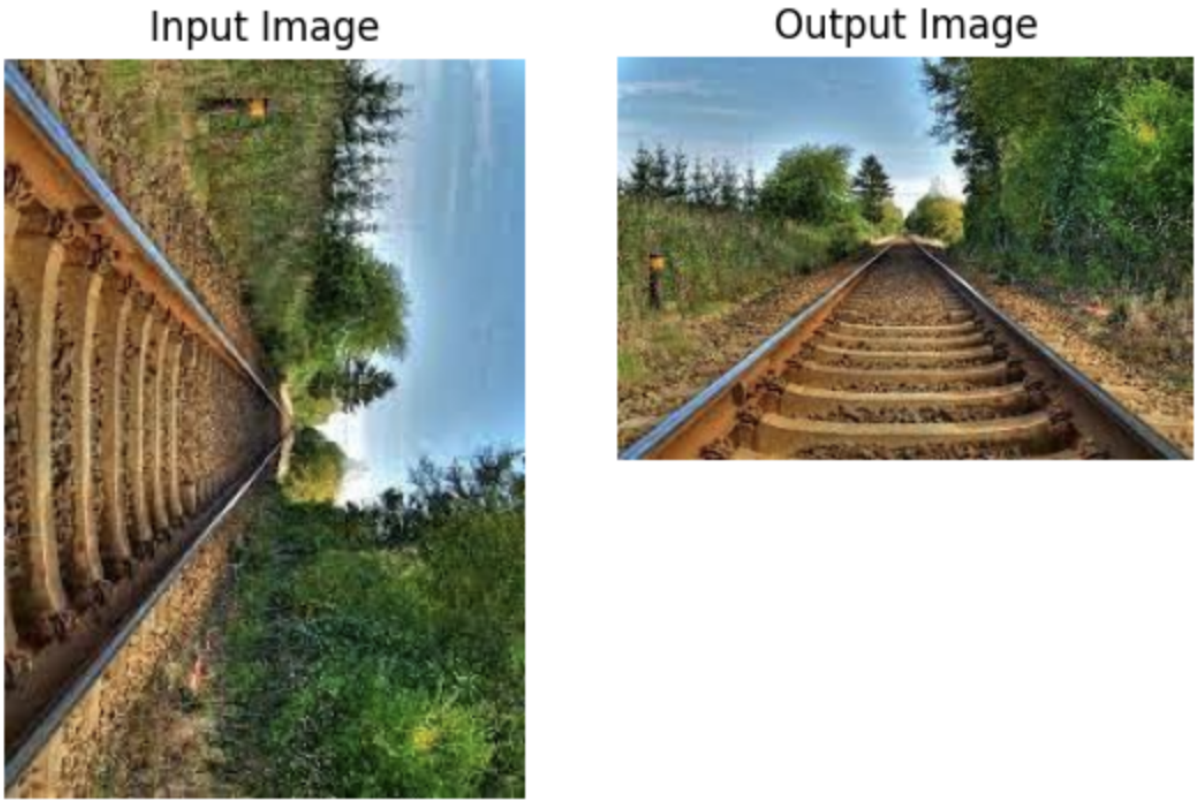

Fig 30: Sample input provided to the trained model and output received after correcting it

Fig 31: Sample input provided to the trained model and output received after correcting it