BACK-END

- **TRAINING AND TESTING THE DATASET**

```
autism = 'DATASET/TRAIN/autism'
medulloblastoma = 'DATASET/TRAIN/medulloblastoma'
notumor = 'DATASET/TRAIN/notumor'
narcolepsy = 'DATASET/TRAIN/narcolepsy'
def plot_images(item_dir, n=6):
    all_item_dir = os.listdir(item_dir)
    item_files = [os.path.join(item_dir, file) for file in all_item_dir][:n]
    plt.figure(figsize=(80, 40))
    for idx, img_path in enumerate(item_files):
        plt.subplot(3, n, idx+1)
        img = plt.imread(img_path)
        plt.imshow(img, cmap='gray')
        plt.axis('off')
    plt.tight_layout()
def image_details_print(data,path):
    print('======== Images in: ', path)
    for key,values in data.items():
        print(key,':\t', values)
def images_details(path):
    files=[f for f in glob.glob(path + "**/*.*", recursive=True)]
    data={}
    data['Images_count']=len(files)
    data['Min_width']=10**100
    data['Max_width']=0
```

```
    data['Min_height']=10**100
    data['Max_height']=0
    for f in files:
        img=Image.open(f)
        width,height=img.size
        data['Min_width']=min(width,data['Min_width'])
        data['Max_width']=max(width, data['Max_width'])
        data['Min_height']=min(height, data['Min_height'])
        data['Max_height']=max(height, data['Max_height'])
    image_details_print(data,path)

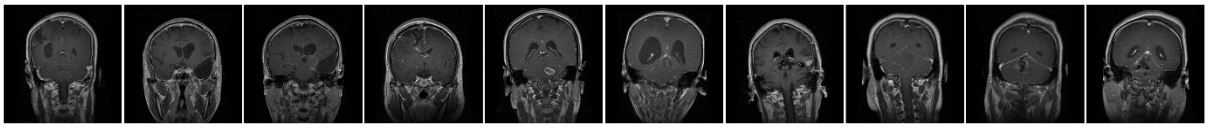
print("")
print("TRAINING DATA FOR AUTISM:")
print("")
images_details(autism)
print("")
plot_images(autism, 10)
print("")
print("TRAINING DATA FOR MEDULLOBLASTOMA:")
print("")
images_details(medulloblastoma)
print("")
plot_images(medulloblastoma, 10)
print("")
print("TRAINING DATA FOR NOTUMOR:")
print("")
images_details(notumor)
```

```
print("")
plot_images(notumor, 10)
print("")
print("TRAINING DATA FOR NARCOLEPSY:")
print("")
images_details(narcolepsy)
print("")
plot_images(narcolepsy, 10)
```

OUTPUT :

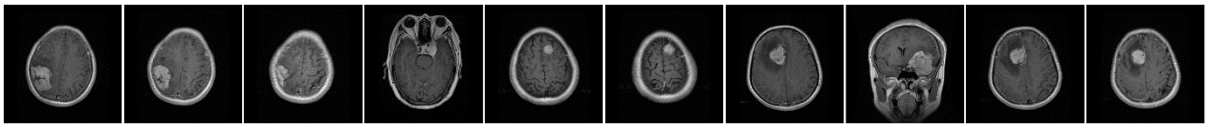
```
TRAINING DATA FOR AUTISM:

======== Images in:  DATASET/TRAIN/autism
Images_count :  500
Min_width :     512
Max_width :     512
Min_height :    512
Max_height :    512
```



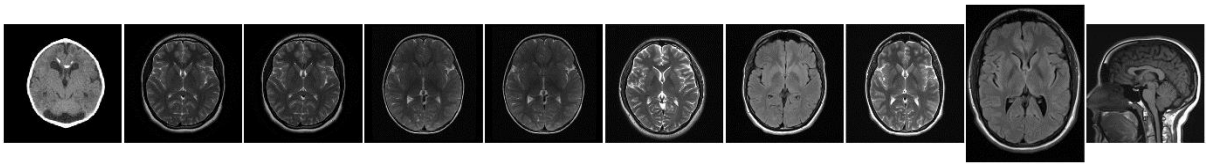
```
TRAINING DATA FOR MEDULLOBLASTOMA:

======== Images in:  DATASET/TRAIN/medulloblastoma
Images_count :  500
Min_width :     200
Max_width :     1149
Min_height :    207
Max_height :    1019
```



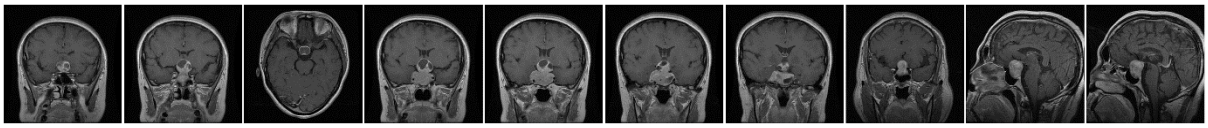
```
TRAINING DATA FOR NOTUMOR:

======== Images in:  DATASET/TRAIN/notumor
Images_count :  500
Min_width :     150
Max_width :     1375
Min_height :    168
Max_height :    1446
```



```
TRAINING DATA FOR NARCOLEPSY:

======== Images in:  DATASET/TRAIN/narcolepsy
Images_count :  500
Min_width :     201
Max_width :     1365
Min_height :    202
Max_height :    1365
```



- **MOBILENET ARCHITECTURE**

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

train=ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,
horizontal_flip=True,validation_split = 0.2)

train_data=train.flow_from_directory(directory='DATASET/TRAIN',target_size
=(224,224),  batch_size=32,class_mode='categorical')

test=ImageDataGenerator(rescale=1./255)

test_data=test.flow_from_directory(directory='DATASET/TEST',target_size=(2
24,224), batch_size=32,class_mode='categorical')

def mobilenet(input_shape, n_classes):
```

```
  def mobilenet_block(x, f, s=1):
    x = DepthwiseConv2D(3, strides=s, padding='same')(x)
    x = BatchNormalization()(x)
    x = ReLU()(x)
    x = Conv2D(f, 1, strides=1, padding='same')(x)
    x = BatchNormalization()(x)
    x = ReLU()(x)
    return x
  input = Input(input_shape)
  x = Conv2D(32, 3, strides=2, padding='same')(input)
  x = BatchNormalization()(x)
  x = ReLU()(x)
  x = mobilenet_block(x, 64)
  x = mobilenet_block(x, 128, 2)
  x = mobilenet_block(x, 128)
  x = mobilenet_block(x, 256, 2)
  x = mobilenet_block(x, 256)
  x = mobilenet_block(x, 512, 2)
  for _ in range(5):
    x = mobilenet_block(x, 512)
  x = mobilenet_block(x, 1024, 2)
  x = mobilenet_block(x, 1024)
  x = GlobalAvgPool2D()(x)
  output = Dense(n_classes, activation='softmax')(x)
  model = Model(input, output)

model.compile(optimizer='Adam',loss='categorical_crossentropy',metrics=['acc
uracy',tensorflow.keras.metrics.Precision()])
```

```
  return model
input_shape = 224, 224, 3
n_classes = 4
K.clear_session()
model = mobilenet(input_shape, n_classes)
model.summary()
model_path = "MOBILENET.h5"
from keras.callbacks import ModelCheckpoint
M = ModelCheckpoint(model_path, monitor='accuracy', verbose=1, save_best_only=True)
epochs = 100
batch_size = 128
history = model.fit(
        train_data,steps_per_epoch=train_data.samples//batch_size, epochs=epochs, validation_data=test_data,validation_steps=test_data.samples // batch_size, callbacks=[M])
history.history.keys()
import matplotlib.pyplot as plt
import numpy as np
plt.figure(figsize=(20, 8))
plt.plot(history.history['accuracy'])
for i in range(epochs):
    if i%5 == 0:
plt.annotate(np.round(history.history['accuracy'][i]*100,2),xy=(i,history.history['accuracy'][i]))
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.show()
```

OUTPUT :

- Fitting model

```
Epoch 1/100
15/15 [==============================] - ETA: 0s - loss: 1.1648 - accuracy:
0.5271 - precision: 0.6332
Epoch 1: accuracy improved from -inf to 0.52708, saving model to MOBILENET.
h5
15/15 [==============================] - 63s 4s/step - loss: 1.1648 - accur
acy: 0.5271 - precision: 0.6332 - val_loss: 1.4369 - val_accuracy: 0.2396 -
val_precision: 0.0000e+00
Epoch 2/100
15/15 [==============================] - ETA: 0s - loss: 0.9319 - accuracy:
0.5875 - precision: 0.6590
Epoch 2: accuracy improved from 0.52708 to 0.58750, saving model to MOBILEN
ET.h5
15/15 [==============================] - 50s 3s/step - loss: 0.9319 - accur
acy: 0.5875 - precision: 0.6590 - val_loss: 1.5892 - val_accuracy: 0.2708 -
val_precision: 0.0000e+00
Epoch 3/100
15/15 [==============================] - ETA: 0s - loss: 0.8783 - accuracy:
0.6667 - precision: 0.7354
Epoch 3: accuracy improved from 0.58750 to 0.66667, saving model to MOBILEN
ET.h5
15/15 [==============================] - 50s 3s/step - loss: 0.8783 - accur
acy: 0.6667 - precision: 0.7354 - val_loss: 1.9160 - val_accuracy: 0.2354 -
val_precision: 0.2354
Epoch 4/100
15/15 [==============================] - ETA: 0s - loss: 0.9206 - accuracy:
0.6583 - precision: 0.7089
Epoch 4: accuracy did not improve from 0.66667
15/15 [==============================] - 48s 3s/step - loss: 0.9206 - accur
acy: 0.6583 - precision: 0.7089 - val_loss: 2.1760 - val_accuracy: 0.2583 -
val_precision: 0.2583
Epoch 5/100
15/15 [==============================] - ETA: 0s - loss: 0.7351 - accuracy:
0.7220 - precision: 0.7506
Epoch 5: accuracy improved from 0.66667 to 0.72198, saving model to MOBILEN
ET.h5
15/15 [==============================] - 47s 3s/step - loss: 0.7351 - accur
acy: 0.7220 - precision: 0.7506 - val_loss: 2.6492 - val_accuracy: 0.2438 -
val_precision: 0.2438
Epoch 6/100
15/15 [==============================] - ETA: 0s - loss: 0.8109 - accuracy:
0.6938 - precision: 0.7354
Epoch 6: accuracy did not improve from 0.72198
```

```
15/15 [==============================] - 49s 3s/step - loss: 0.8109 - accur
acy: 0.6938 - precision: 0.7354 - val_loss: 2.9946 - val_accuracy: 0.2313 -
val_precision: 0.2313
Epoch 7/100
15/15 [==============================] - ETA: 0s - loss: 0.7651 - accuracy:
0.6897 - precision: 0.7365
Epoch 7: accuracy did not improve from 0.72198
15/15 [==============================] - 47s 3s/step - loss: 0.7651 - accur
acy: 0.6897 - precision: 0.7365 - val_loss: 3.6865 - val_accuracy: 0.2271 -
val_precision: 0.2271
Epoch 8/100
15/15 [==============================] - ETA: 0s - loss: 0.7311 - accuracy:
0.7306 - precision: 0.7459
Epoch 8: accuracy improved from 0.72198 to 0.73060, saving model to MOBILEN
ET.h5
15/15 [==============================] - 51s 3s/step - loss: 0.7311 - accur
acy: 0.7306 - precision: 0.7459 - val_loss: 3.4450 - val_accuracy: 0.2562 -
val_precision: 0.2562
Epoch 9/100
15/15 [==============================] - ETA: 0s - loss: 0.7885 - accuracy:
0.7104 - precision: 0.7365
Epoch 9: accuracy did not improve from 0.73060
15/15 [==============================] - 51s 3s/step - loss: 0.7885 - accur
acy: 0.7104 - precision: 0.7365 - val_loss: 3.9195 - val_accuracy: 0.2479 -
val_precision: 0.2479
Epoch 10/100
15/15 [==============================] - ETA: 0s - loss: 0.7422 - accuracy:
0.7271 - precision: 0.7737
Epoch 10: accuracy did not improve from 0.73060
15/15 [==============================] - 51s 3s/step - loss: 0.7422 - accur
acy: 0.7271 - precision: 0.7737 - val_loss: 3.7273 - val_accuracy: 0.2229 -
val_precision: 0.2229
Epoch 11/100
15/15 [==============================] - ETA: 0s - loss: 0.6276 - accuracy:
0.7812 - precision: 0.8005
Epoch 11: accuracy improved from 0.73060 to 0.78125, saving model to MOBILE
NET.h5
15/15 [==============================] - 53s 4s/step - loss: 0.6276 - accur
acy: 0.7812 - precision: 0.8005 - val_loss: 4.1427 - val_accuracy: 0.2646 -
val_precision: 0.2646
Epoch 12/100
15/15 [==============================] - ETA: 0s - loss: 0.6485 - accuracy:
0.7479 - precision: 0.7903
Epoch 12: accuracy did not improve from 0.78125
15/15 [==============================] - 52s 3s/step - loss: 0.6485 - accur
acy: 0.7479 - precision: 0.7903 - val_loss: 4.0213 - val_accuracy: 0.2375 -
val_precision: 0.2375
```

```
Epoch 13/100
15/15 [==============================] - ETA: 0s - loss: 0.5612 - accuracy:
0.7854 - precision: 0.8190
Epoch 13: accuracy improved from 0.78125 to 0.78542, saving model to MOBILE
NET.h5
15/15 [==============================] - 51s 3s/step - loss: 0.5612 - accur
acy: 0.7854 - precision: 0.8190 - val_loss: 4.0682 - val_accuracy: 0.2271 -
val_precision: 0.2271
Epoch 14/100
15/15 [==============================] - ETA: 0s - loss: 0.5700 - accuracy:
0.7875 - precision: 0.8115
Epoch 14: accuracy improved from 0.78542 to 0.78750, saving model to MOBILE
NET.h5
15/15 [==============================] - 49s 3s/step - loss: 0.5700 - accur
acy: 0.7875 - precision: 0.8115 - val_loss: 4.2777 - val_accuracy: 0.2208 -
val_precision: 0.2208
Epoch 15/100
15/15 [==============================] - ETA: 0s - loss: 0.4677 - accuracy:
0.8375 - precision: 0.8539
Epoch 15: accuracy improved from 0.78750 to 0.83750, saving model to MOBILE
NET.h5
15/15 [==============================] - 49s 3s/step - loss: 0.4677 - accur
acy: 0.8375 - precision: 0.8539 - val_loss: 4.6406 - val_accuracy: 0.2333 -
val_precision: 0.2333
Epoch 16/100
15/15 [==============================] - ETA: 0s - loss: 0.5283 - accuracy:
0.7979 - precision: 0.8303
Epoch 16: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.5283 - accur
acy: 0.7979 - precision: 0.8303 - val_loss: 4.3832 - val_accuracy: 0.2333 -
val_precision: 0.2333
Epoch 17/100
15/15 [==============================] - ETA: 0s - loss: 0.6634 - accuracy:
0.7354 - precision: 0.7544
Epoch 17: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.6634 - accur
acy: 0.7354 - precision: 0.7544 - val_loss: 4.1760 - val_accuracy: 0.2708 -
val_precision: 0.2708
Epoch 18/100
15/15 [==============================] - ETA: 0s - loss: 0.5691 - accuracy:
0.8000 - precision: 0.8326
Epoch 18: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.5691 - accur
acy: 0.8000 - precision: 0.8326 - val_loss: 3.9466 - val_accuracy: 0.2542 -
val_precision: 0.2542
Epoch 19/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.5729 - accuracy:
0.7833 - precision: 0.8026
Epoch 19: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.5729 - accur
acy: 0.7833 - precision: 0.8026 - val_loss: 3.7308 - val_accuracy: 0.2896 -
val_precision: 0.2896
Epoch 20/100
15/15 [==============================] - ETA: 0s - loss: 0.5023 - accuracy:
0.8188 - precision: 0.8341
Epoch 20: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.5023 - accur
acy: 0.8188 - precision: 0.8341 - val_loss: 3.8050 - val_accuracy: 0.2333 -
val_precision: 0.2333
Epoch 21/100
15/15 [==============================] - ETA: 0s - loss: 0.5086 - accuracy:
0.8188 - precision: 0.8341
Epoch 21: accuracy did not improve from 0.83750
15/15 [==============================] - 49s 3s/step - loss: 0.5086 - accur
acy: 0.8188 - precision: 0.8341 - val_loss: 3.6820 - val_accuracy: 0.2438 -
val_precision: 0.2438
Epoch 22/100
15/15 [==============================] - ETA: 0s - loss: 0.5986 - accuracy:
0.7812 - precision: 0.7996
Epoch 22: accuracy did not improve from 0.83750
15/15 [==============================] - 50s 3s/step - loss: 0.5986 - accur
acy: 0.7812 - precision: 0.7996 - val_loss: 3.7234 - val_accuracy: 0.2333 -
val_precision: 0.2333
Epoch 23/100
15/15 [==============================] - ETA: 0s - loss: 0.5491 - accuracy:
0.8062 - precision: 0.8207
Epoch 23: accuracy did not improve from 0.83750
15/15 [==============================] - 50s 3s/step - loss: 0.5491 - accur
acy: 0.8062 - precision: 0.8207 - val_loss: 3.3417 - val_accuracy: 0.2354 -
val_precision: 0.2354
Epoch 24/100
15/15 [==============================] - ETA: 0s - loss: 0.4830 - accuracy:
0.8229 - precision: 0.8504
Epoch 24: accuracy did not improve from 0.83750
15/15 [==============================] - 51s 3s/step - loss: 0.4830 - accur
acy: 0.8229 - precision: 0.8504 - val_loss: 3.6090 - val_accuracy: 0.2562 -
val_precision: 0.2562
Epoch 25/100
15/15 [==============================] - ETA: 0s - loss: 0.4205 - accuracy:
0.8470 - precision: 0.8613
Epoch 25: accuracy improved from 0.83750 to 0.84698, saving model to MOBILE
NET.h5
```

```
15/15 [==============================] - 52s 3s/step - loss: 0.4205 - accur
acy: 0.8470 - precision: 0.8613 - val_loss: 3.5858 - val_accuracy: 0.2562 -
val_precision: 0.2562
Epoch 26/100
15/15 [==============================] - ETA: 0s - loss: 0.5627 - accuracy:
0.8021 - precision: 0.8226
Epoch 26: accuracy did not improve from 0.84698
15/15 [==============================] - 49s 3s/step - loss: 0.5627 - accur
acy: 0.8021 - precision: 0.8226 - val_loss: 4.1176 - val_accuracy: 0.2167 -
val_precision: 0.2167
Epoch 27/100
15/15 [==============================] - ETA: 0s - loss: 0.4631 - accuracy:
0.8229 - precision: 0.8425
Epoch 27: accuracy did not improve from 0.84698
15/15 [==============================] - 49s 3s/step - loss: 0.4631 - accur
acy: 0.8229 - precision: 0.8425 - val_loss: 3.6357 - val_accuracy: 0.2521 -
val_precision: 0.2521
Epoch 28/100
15/15 [==============================] - ETA: 0s - loss: 0.4132 - accuracy:
0.8341 - precision: 0.8502
Epoch 28: accuracy did not improve from 0.84698
15/15 [==============================] - 49s 3s/step - loss: 0.4132 - accur
acy: 0.8341 - precision: 0.8502 - val_loss: 3.4660 - val_accuracy: 0.2292 -
val_precision: 0.2292
Epoch 29/100
15/15 [==============================] - ETA: 0s - loss: 0.4630 - accuracy:
0.8104 - precision: 0.8460
Epoch 29: accuracy did not improve from 0.84698
15/15 [==============================] - 54s 4s/step - loss: 0.4630 - accur
acy: 0.8104 - precision: 0.8460 - val_loss: 3.6898 - val_accuracy: 0.2313 -
val_precision: 0.2313
Epoch 30/100
15/15 [==============================] - ETA: 0s - loss: 0.4993 - accuracy:
0.8147 - precision: 0.8356
Epoch 30: accuracy did not improve from 0.84698
15/15 [==============================] - 48s 3s/step - loss: 0.4993 - accur
acy: 0.8147 - precision: 0.8356 - val_loss: 3.1534 - val_accuracy: 0.2313 -
val_precision: 0.2313
Epoch 31/100
15/15 [==============================] - ETA: 0s - loss: 0.4175 - accuracy:
0.8556 - precision: 0.8628
Epoch 31: accuracy improved from 0.84698 to 0.85560, saving model to MOBILE
NET.h5
15/15 [==============================] - 48s 3s/step - loss: 0.4175 - accur
acy: 0.8556 - precision: 0.8628 - val_loss: 3.4238 - val_accuracy: 0.2479 -
val_precision: 0.2479
Epoch 32/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.4229 - accuracy:
0.8417 - precision: 0.8495
Epoch 32: accuracy did not improve from 0.85560
15/15 [==============================] - 48s 3s/step - loss: 0.4229 - accur
acy: 0.8417 - precision: 0.8495 - val_loss: 3.2844 - val_accuracy: 0.2542 -
val_precision: 0.2542
Epoch 33/100
15/15 [==============================] - ETA: 0s - loss: 0.3413 - accuracy:
0.8708 - precision: 0.8846
Epoch 33: accuracy improved from 0.85560 to 0.87083, saving model to MOBILE
NET.h5
15/15 [==============================] - 48s 3s/step - loss: 0.3413 - accur
acy: 0.8708 - precision: 0.8846 - val_loss: 3.4053 - val_accuracy: 0.4104 -
val_precision: 0.4128
Epoch 34/100
15/15 [==============================] - ETA: 0s - loss: 0.2923 - accuracy:
0.8966 - precision: 0.9079
Epoch 34: accuracy improved from 0.87083 to 0.89655, saving model to MOBILE
NET.h5
15/15 [==============================] - 49s 3s/step - loss: 0.2923 - accur
acy: 0.8966 - precision: 0.9079 - val_loss: 3.7910 - val_accuracy: 0.2583 -
val_precision: 0.2583
Epoch 35/100
15/15 [==============================] - ETA: 0s - loss: 0.4206 - accuracy:
0.8500 - precision: 0.8632
Epoch 35: accuracy did not improve from 0.89655
15/15 [==============================] - 51s 3s/step - loss: 0.4206 - accur
acy: 0.8500 - precision: 0.8632 - val_loss: 3.1347 - val_accuracy: 0.2417 -
val_precision: 0.2417
Epoch 36/100
15/15 [==============================] - ETA: 0s - loss: 0.3423 - accuracy:
0.8813 - precision: 0.9011
Epoch 36: accuracy did not improve from 0.89655
15/15 [==============================] - 49s 3s/step - loss: 0.3423 - accur
acy: 0.8813 - precision: 0.9011 - val_loss: 3.1384 - val_accuracy: 0.2271 -
val_precision: 0.2276
Epoch 37/100
15/15 [==============================] - ETA: 0s - loss: 0.4031 - accuracy:
0.8667 - precision: 0.8750
Epoch 37: accuracy did not improve from 0.89655
15/15 [==============================] - 49s 3s/step - loss: 0.4031 - accur
acy: 0.8667 - precision: 0.8750 - val_loss: 2.9034 - val_accuracy: 0.2792 -
val_precision: 0.3333
Epoch 38/100
15/15 [==============================] - ETA: 0s - loss: 0.3027 - accuracy:
0.8922 - precision: 0.9073
Epoch 38: accuracy did not improve from 0.89655
```

```
15/15 [==============================] - 47s 3s/step - loss: 0.3027 - accur
acy: 0.8922 - precision: 0.9073 - val_loss: 3.0976 - val_accuracy: 0.3271 -
val_precision: 0.2955
Epoch 39/100
15/15 [==============================] - ETA: 0s - loss: 0.3042 - accuracy:
0.8944 - precision: 0.9051
Epoch 39: accuracy did not improve from 0.89655
15/15 [==============================] - 47s 3s/step - loss: 0.3042 - accur
acy: 0.8944 - precision: 0.9051 - val_loss: 3.3025 - val_accuracy: 0.2542 -
val_precision: 0.2511
Epoch 40/100
15/15 [==============================] - ETA: 0s - loss: 0.3817 - accuracy:
0.8562 - precision: 0.8688
Epoch 40: accuracy did not improve from 0.89655
15/15 [==============================] - 48s 3s/step - loss: 0.3817 - accur
acy: 0.8562 - precision: 0.8688 - val_loss: 2.9925 - val_accuracy: 0.4625 -
val_precision: 0.4744
Epoch 41/100
15/15 [==============================] - ETA: 0s - loss: 0.3343 - accuracy:
0.8792 - precision: 0.9002
Epoch 41: accuracy did not improve from 0.89655
15/15 [==============================] - 48s 3s/step - loss: 0.3343 - accur
acy: 0.8792 - precision: 0.9002 - val_loss: 3.2905 - val_accuracy: 0.4708 -
val_precision: 0.4912
Epoch 42/100
15/15 [==============================] - ETA: 0s - loss: 0.3184 - accuracy:
0.8729 - precision: 0.8836
Epoch 42: accuracy did not improve from 0.89655
15/15 [==============================] - 49s 3s/step - loss: 0.3184 - accur
acy: 0.8729 - precision: 0.8836 - val_loss: 3.1255 - val_accuracy: 0.3229 -
val_precision: 0.3261
Epoch 43/100
15/15 [==============================] - ETA: 0s - loss: 0.4179 - accuracy:
0.8604 - precision: 0.8691
Epoch 43: accuracy did not improve from 0.89655
15/15 [==============================] - 50s 3s/step - loss: 0.4179 - accur
acy: 0.8604 - precision: 0.8691 - val_loss: 2.3692 - val_accuracy: 0.4521 -
val_precision: 0.4796
Epoch 44/100
15/15 [==============================] - ETA: 0s - loss: 0.3509 - accuracy:
0.8708 - precision: 0.9017
Epoch 44: accuracy did not improve from 0.89655
15/15 [==============================] - 48s 3s/step - loss: 0.3509 - accur
acy: 0.8708 - precision: 0.9017 - val_loss: 2.1178 - val_accuracy: 0.4042 -
val_precision: 0.4057
Epoch 45/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.4149 - accuracy:
0.8542 - precision: 0.8568
Epoch 45: accuracy did not improve from 0.89655
15/15 [==============================] - 49s 3s/step - loss: 0.4149 - accur
acy: 0.8542 - precision: 0.8568 - val_loss: 1.3252 - val_accuracy: 0.5750 -
val_precision: 0.6190
Epoch 46/100
15/15 [==============================] - ETA: 0s - loss: 0.3127 - accuracy:
0.9000 - precision: 0.9104
Epoch 46: accuracy improved from 0.89655 to 0.90000, saving model to MOBILE
NET.h5
15/15 [==============================] - 49s 3s/step - loss: 0.3127 - accur
acy: 0.9000 - precision: 0.9104 - val_loss: 1.1438 - val_accuracy: 0.6333 -
val_precision: 0.6600
Epoch 47/100
15/15 [==============================] - ETA: 0s - loss: 0.3345 - accuracy:
0.8667 - precision: 0.8822
Epoch 47: accuracy did not improve from 0.90000
15/15 [==============================] - 48s 3s/step - loss: 0.3345 - accur
acy: 0.8667 - precision: 0.8822 - val_loss: 1.5387 - val_accuracy: 0.6062 -
val_precision: 0.6137
Epoch 48/100
15/15 [==============================] - ETA: 0s - loss: 0.3406 - accuracy:
0.8979 - precision: 0.9019
Epoch 48: accuracy did not improve from 0.90000
15/15 [==============================] - 48s 3s/step - loss: 0.3406 - accur
acy: 0.8979 - precision: 0.9019 - val_loss: 1.1507 - val_accuracy: 0.6979 -
val_precision: 0.7006
Epoch 49/100
15/15 [==============================] - ETA: 0s - loss: 0.3140 - accuracy:
0.8793 - precision: 0.8933
Epoch 49: accuracy did not improve from 0.90000
15/15 [==============================] - 47s 3s/step - loss: 0.3140 - accur
acy: 0.8793 - precision: 0.8933 - val_loss: 0.4965 - val_accuracy: 0.8188 -
val_precision: 0.8315
Epoch 50/100
15/15 [==============================] - ETA: 0s - loss: 0.2804 - accuracy:
0.9000 - precision: 0.9089
Epoch 50: accuracy did not improve from 0.90000
15/15 [==============================] - 48s 3s/step - loss: 0.2804 - accur
acy: 0.9000 - precision: 0.9089 - val_loss: 0.2981 - val_accuracy: 0.8979 -
val_precision: 0.9101
Epoch 51/100
15/15 [==============================] - ETA: 0s - loss: 0.2964 - accuracy:
0.9000 - precision: 0.9051
Epoch 51: accuracy did not improve from 0.90000
```

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15/15 [==============================] - 48s 3s/step - loss: 0.2964 - accur
acy: 0.9000 - precision: 0.9051 - val_loss: 0.9634 - val_accuracy: 0.7563 -
val_precision: 0.7597
Epoch 52/100
15/15 [==============================] - ETA: 0s - loss: 0.2753 - accuracy:
0.9104 - precision: 0.9139
Epoch 52: accuracy improved from 0.90000 to 0.91042, saving model to MOBILE
NET.h5
15/15 [==============================] - 49s 3s/step - loss: 0.2753 - accur
acy: 0.9104 - precision: 0.9139 - val_loss: 0.4605 - val_accuracy: 0.8313 -
val_precision: 0.8383
Epoch 53/100
15/15 [==============================] - ETA: 0s - loss: 0.2735 - accuracy:
0.8958 - precision: 0.9027
Epoch 53: accuracy did not improve from 0.91042
15/15 [==============================] - 48s 3s/step - loss: 0.2735 - accur
acy: 0.8958 - precision: 0.9027 - val_loss: 0.5904 - val_accuracy: 0.8250 -
val_precision: 0.8309
Epoch 54/100
15/15 [==============================] - ETA: 0s - loss: 0.2891 - accuracy:
0.9000 - precision: 0.9091
Epoch 54: accuracy did not improve from 0.91042
15/15 [==============================] - 48s 3s/step - loss: 0.2891 - accur
acy: 0.9000 - precision: 0.9091 - val_loss: 0.6164 - val_accuracy: 0.8021 -
val_precision: 0.8093
Epoch 55/100
15/15 [==============================] - ETA: 0s - loss: 0.2467 - accuracy:
0.9125 - precision: 0.9236
Epoch 55: accuracy improved from 0.91042 to 0.91250, saving model to MOBILE
NET.h5
15/15 [==============================] - 59s 4s/step - loss: 0.2467 - accur
acy: 0.9125 - precision: 0.9236 - val_loss: 1.7731 - val_accuracy: 0.5479 -
val_precision: 0.5696
Epoch 56/100
15/15 [==============================] - ETA: 0s - loss: 0.2925 - accuracy:
0.8979 - precision: 0.8989
Epoch 56: accuracy did not improve from 0.91250
15/15 [==============================] - 58s 4s/step - loss: 0.2925 - accur
acy: 0.8979 - precision: 0.8989 - val_loss: 2.1981 - val_accuracy: 0.5792 -
val_precision: 0.5856
Epoch 57/100
15/15 [==============================] - ETA: 0s - loss: 0.2042 - accuracy:
0.9292 - precision: 0.9346
Epoch 57: accuracy improved from 0.91250 to 0.92917, saving model to MOBILE
NET.h5
```

```
15/15 [==============================] - 53s 4s/step - loss: 0.2042 - accur
acy: 0.9292 - precision: 0.9346 - val_loss: 2.5067 - val_accuracy: 0.5000 -
val_precision: 0.5010
Epoch 58/100
15/15 [==============================] - ETA: 0s - loss: 0.2440 - accuracy:
0.9116 - precision: 0.9161
Epoch 58: accuracy did not improve from 0.92917
15/15 [==============================] - 52s 3s/step - loss: 0.2440 - accur
acy: 0.9116 - precision: 0.9161 - val_loss: 2.4388 - val_accuracy: 0.6146 -
val_precision: 0.6186
Epoch 59/100
15/15 [==============================] - ETA: 0s - loss: 0.2558 - accuracy:
0.9167 - precision: 0.9257
Epoch 59: accuracy did not improve from 0.92917
15/15 [==============================] - 59s 4s/step - loss: 0.2558 - accur
acy: 0.9167 - precision: 0.9257 - val_loss: 2.4003 - val_accuracy: 0.5688 -
val_precision: 0.5717
Epoch 60/100
15/15 [==============================] - ETA: 0s - loss: 0.2417 - accuracy:
0.9159 - precision: 0.9256
Epoch 60: accuracy did not improve from 0.92917
15/15 [==============================] - 51s 4s/step - loss: 0.2417 - accur
acy: 0.9159 - precision: 0.9256 - val_loss: 2.6502 - val_accuracy: 0.6208 -
val_precision: 0.6232
Epoch 61/100
15/15 [==============================] - ETA: 0s - loss: 0.3633 - accuracy:
0.8815 - precision: 0.8860
Epoch 61: accuracy did not improve from 0.92917
15/15 [==============================] - 50s 3s/step - loss: 0.3633 - accur
acy: 0.8815 - precision: 0.8860 - val_loss: 1.0227 - val_accuracy: 0.7146 -
val_precision: 0.7325
Epoch 62/100
15/15 [==============================] - ETA: 0s - loss: 0.3766 - accuracy:
0.8534 - precision: 0.8631
Epoch 62: accuracy did not improve from 0.92917
15/15 [==============================] - 50s 3s/step - loss: 0.3766 - accur
acy: 0.8534 - precision: 0.8631 - val_loss: 2.7647 - val_accuracy: 0.4458 -
val_precision: 0.4499
Epoch 63/100
15/15 [==============================] - ETA: 0s - loss: 0.3095 - accuracy:
0.8813 - precision: 0.8938
Epoch 63: accuracy did not improve from 0.92917
15/15 [==============================] - 54s 4s/step - loss: 0.3095 - accur
acy: 0.8813 - precision: 0.8938 - val_loss: 2.2120 - val_accuracy: 0.5896 -
val_precision: 0.5924
Epoch 64/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.3054 - accuracy:
0.8854 - precision: 0.8926
Epoch 64: accuracy did not improve from 0.92917
15/15 [==============================] - 53s 4s/step - loss: 0.3054 - accur
acy: 0.8854 - precision: 0.8926 - val_loss: 1.9321 - val_accuracy: 0.5896 -
val_precision: 0.6066
Epoch 65/100
15/15 [==============================] - ETA: 0s - loss: 0.2037 - accuracy:
0.9396 - precision: 0.9470
Epoch 65: accuracy improved from 0.92917 to 0.93958, saving model to MOBILE
NET.h5
15/15 [==============================] - 52s 4s/step - loss: 0.2037 - accur
acy: 0.9396 - precision: 0.9470 - val_loss: 1.6254 - val_accuracy: 0.6625 -
val_precision: 0.6887
Epoch 66/100
15/15 [==============================] - ETA: 0s - loss: 0.1846 - accuracy:
0.9246 - precision: 0.9401
Epoch 66: accuracy did not improve from 0.93958
15/15 [==============================] - 49s 3s/step - loss: 0.1846 - accur
acy: 0.9246 - precision: 0.9401 - val_loss: 2.0758 - val_accuracy: 0.5813 -
val_precision: 0.6040
Epoch 67/100
15/15 [==============================] - ETA: 0s - loss: 0.2028 - accuracy:
0.9271 - precision: 0.9305
Epoch 67: accuracy did not improve from 0.93958
15/15 [==============================] - 52s 4s/step - loss: 0.2028 - accur
acy: 0.9271 - precision: 0.9305 - val_loss: 2.8297 - val_accuracy: 0.3729 -
val_precision: 0.3742
Epoch 68/100
15/15 [==============================] - ETA: 0s - loss: 0.2965 - accuracy:
0.8858 - precision: 0.8962
Epoch 68: accuracy did not improve from 0.93958
15/15 [==============================] - 52s 3s/step - loss: 0.2965 - accur
acy: 0.8858 - precision: 0.8962 - val_loss: 4.2517 - val_accuracy: 0.3063 -
val_precision: 0.3048
Epoch 69/100
15/15 [==============================] - ETA: 0s - loss: 0.2644 - accuracy:
0.9052 - precision: 0.9129
Epoch 69: accuracy did not improve from 0.93958
15/15 [==============================] - 50s 3s/step - loss: 0.2644 - accur
acy: 0.9052 - precision: 0.9129 - val_loss: 3.6273 - val_accuracy: 0.3625 -
val_precision: 0.3683
Epoch 70/100
15/15 [==============================] - ETA: 0s - loss: 0.1699 - accuracy:
0.9417 - precision: 0.9513
Epoch 70: accuracy improved from 0.93958 to 0.94167, saving model to MOBILE
NET.h5
```

```
15/15 [==============================] - 57s 4s/step - loss: 0.1699 - accur
acy: 0.9417 - precision: 0.9513 - val_loss: 4.9575 - val_accuracy: 0.3333 -
val_precision: 0.3305
Epoch 71/100
15/15 [==============================] - ETA: 0s - loss: 0.2496 - accuracy:
0.9125 - precision: 0.9239
Epoch 71: accuracy did not improve from 0.94167
15/15 [==============================] - 58s 4s/step - loss: 0.2496 - accur
acy: 0.9125 - precision: 0.9239 - val_loss: 0.9234 - val_accuracy: 0.7021 -
val_precision: 0.7137
Epoch 72/100
15/15 [==============================] - ETA: 0s - loss: 0.2199 - accuracy:
0.9187 - precision: 0.9244
Epoch 72: accuracy did not improve from 0.94167
15/15 [==============================] - 52s 3s/step - loss: 0.2199 - accur
acy: 0.9187 - precision: 0.9244 - val_loss: 3.3144 - val_accuracy: 0.4083 -
val_precision: 0.4046
Epoch 73/100
15/15 [==============================] - ETA: 0s - loss: 0.2418 - accuracy:
0.9042 - precision: 0.9135
Epoch 73: accuracy did not improve from 0.94167
15/15 [==============================] - 54s 4s/step - loss: 0.2418 - accur
acy: 0.9042 - precision: 0.9135 - val_loss: 1.8289 - val_accuracy: 0.5500 -
val_precision: 0.5458
Epoch 74/100
15/15 [==============================] - ETA: 0s - loss: 0.2346 - accuracy:
0.9167 - precision: 0.9181
Epoch 74: accuracy did not improve from 0.94167
15/15 [==============================] - 49s 3s/step - loss: 0.2346 - accur
acy: 0.9167 - precision: 0.9181 - val_loss: 2.9074 - val_accuracy: 0.5188 -
val_precision: 0.5245
Epoch 75/100
15/15 [==============================] - ETA: 0s - loss: 0.2569 - accuracy:
0.8979 - precision: 0.9122
Epoch 75: accuracy did not improve from 0.94167
15/15 [==============================] - 54s 4s/step - loss: 0.2569 - accur
acy: 0.8979 - precision: 0.9122 - val_loss: 2.6418 - val_accuracy: 0.5458 -
val_precision: 0.5556
Epoch 76/100
15/15 [==============================] - ETA: 0s - loss: 0.1565 - accuracy:
0.9438 - precision: 0.9455
Epoch 76: accuracy improved from 0.94167 to 0.94375, saving model to MOBILE
NET.h5
15/15 [==============================] - 56s 4s/step - loss: 0.1565 - accur
acy: 0.9438 - precision: 0.9455 - val_loss: 5.2767 - val_accuracy: 0.3229 -
val_precision: 0.3215
Epoch 77/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.2294 - accuracy:
0.9292 - precision: 0.9310
Epoch 77: accuracy did not improve from 0.94375
15/15 [==============================] - 51s 3s/step - loss: 0.2294 - accur
acy: 0.9292 - precision: 0.9310 - val_loss: 2.6367 - val_accuracy: 0.5917 -
val_precision: 0.5935
Epoch 78/100
15/15 [==============================] - ETA: 0s - loss: 0.1842 - accuracy:
0.9250 - precision: 0.9287
Epoch 78: accuracy did not improve from 0.94375
15/15 [==============================] - 59s 4s/step - loss: 0.1842 - accur
acy: 0.9250 - precision: 0.9287 - val_loss: 0.2064 - val_accuracy: 0.9208 -
val_precision: 0.9283
Epoch 79/100
15/15 [==============================] - ETA: 0s - loss: 0.2318 - accuracy:
0.9167 - precision: 0.9296
Epoch 79: accuracy did not improve from 0.94375
15/15 [==============================] - 54s 4s/step - loss: 0.2318 - accur
acy: 0.9167 - precision: 0.9296 - val_loss: 1.2037 - val_accuracy: 0.6917 -
val_precision: 0.7130
Epoch 80/100
15/15 [==============================] - ETA: 0s - loss: 0.1826 - accuracy:
0.9208 - precision: 0.9281
Epoch 80: accuracy did not improve from 0.94375
15/15 [==============================] - 52s 3s/step - loss: 0.1826 - accur
acy: 0.9208 - precision: 0.9281 - val_loss: 0.8501 - val_accuracy: 0.7250 -
val_precision: 0.7398
Epoch 81/100
15/15 [==============================] - ETA: 0s - loss: 0.1336 - accuracy:
0.9591 - precision: 0.9611
Epoch 81: accuracy improved from 0.94375 to 0.95905, saving model to MOBILE
NET.h5
15/15 [==============================] - 51s 3s/step - loss: 0.1336 - accur
acy: 0.9591 - precision: 0.9611 - val_loss: 0.6223 - val_accuracy: 0.8167 -
val_precision: 0.8280
Epoch 82/100
15/15 [==============================] - ETA: 0s - loss: 0.1598 - accuracy:
0.9396 - precision: 0.9453
Epoch 82: accuracy did not improve from 0.95905
15/15 [==============================] - 54s 4s/step - loss: 0.1598 - accur
acy: 0.9396 - precision: 0.9453 - val_loss: 0.5668 - val_accuracy: 0.8146 -
val_precision: 0.8245
Epoch 83/100
15/15 [==============================] - ETA: 0s - loss: 0.1373 - accuracy:
0.9563 - precision: 0.9640
Epoch 83: accuracy did not improve from 0.95905
```

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15/15 [==============================] - 53s 4s/step - loss: 0.1373 - accur
acy: 0.9563 - precision: 0.9640 - val_loss: 0.1365 - val_accuracy: 0.9563 -
val_precision: 0.9602
Epoch 84/100
15/15 [==============================] - ETA: 0s - loss: 0.1257 - accuracy:
0.9583 - precision: 0.9601
Epoch 84: accuracy did not improve from 0.95905
15/15 [==============================] - 54s 4s/step - loss: 0.1257 - accur
acy: 0.9583 - precision: 0.9601 - val_loss: 0.6763 - val_accuracy: 0.7958 -
val_precision: 0.7983
Epoch 85/100
15/15 [==============================] - ETA: 0s - loss: 0.1755 - accuracy:
0.9458 - precision: 0.9495
Epoch 85: accuracy did not improve from 0.95905
15/15 [==============================] - 55s 4s/step - loss: 0.1755 - accur
acy: 0.9458 - precision: 0.9495 - val_loss: 0.5229 - val_accuracy: 0.8313 -
val_precision: 0.8450
Epoch 86/100
15/15 [==============================] - ETA: 0s - loss: 0.1670 - accuracy:
0.9417 - precision: 0.9414
Epoch 86: accuracy did not improve from 0.95905
15/15 [==============================] - 52s 3s/step - loss: 0.1670 - accur
acy: 0.9417 - precision: 0.9414 - val_loss: 1.3200 - val_accuracy: 0.6396 -
val_precision: 0.6453
Epoch 87/100
15/15 [==============================] - ETA: 0s - loss: 0.1561 - accuracy:
0.9396 - precision: 0.9513
Epoch 87: accuracy did not improve from 0.95905
15/15 [==============================] - 56s 4s/step - loss: 0.1561 - accur
acy: 0.9396 - precision: 0.9513 - val_loss: 1.8097 - val_accuracy: 0.5688 -
val_precision: 0.5702
Epoch 88/100
15/15 [==============================] - ETA: 0s - loss: 0.2320 - accuracy:
0.9042 - precision: 0.9099
Epoch 88: accuracy did not improve from 0.95905
15/15 [==============================] - 53s 4s/step - loss: 0.2320 - accur
acy: 0.9042 - precision: 0.9099 - val_loss: 0.3623 - val_accuracy: 0.8813 -
val_precision: 0.8863
Epoch 89/100
15/15 [==============================] - ETA: 0s - loss: 0.1362 - accuracy:
0.9521 - precision: 0.9517
Epoch 89: accuracy did not improve from 0.95905
15/15 [==============================] - 52s 3s/step - loss: 0.1362 - accur
acy: 0.9521 - precision: 0.9517 - val_loss: 0.3999 - val_accuracy: 0.8562 -
val_precision: 0.8626
Epoch 90/100
```

```
15/15 [==============================] - ETA: 0s - loss: 0.1145 - accuracy:
0.9625 - precision: 0.9665
Epoch 90: accuracy improved from 0.95905 to 0.96250, saving model to MOBILE
NET.h5
15/15 [==============================] - 52s 3s/step - loss: 0.1145 - accur
acy: 0.9625 - precision: 0.9665 - val_loss: 0.5589 - val_accuracy: 0.8146 -
val_precision: 0.8255
Epoch 91/100
15/15 [==============================] - ETA: 0s - loss: 0.1368 - accuracy:
0.9479 - precision: 0.9478
Epoch 91: accuracy did not improve from 0.96250
15/15 [==============================] - 53s 4s/step - loss: 0.1368 - accur
acy: 0.9479 - precision: 0.9478 - val_loss: 1.5668 - val_accuracy: 0.6229 -
val_precision: 0.6282
Epoch 92/100
15/15 [==============================] - ETA: 0s - loss: 0.1616 - accuracy:
0.9375 - precision: 0.9391
Epoch 92: accuracy did not improve from 0.96250
15/15 [==============================] - 53s 4s/step - loss: 0.1616 - accur
acy: 0.9375 - precision: 0.9391 - val_loss: 1.9177 - val_accuracy: 0.5583 -
val_precision: 0.5632
Epoch 93/100
15/15 [==============================] - ETA: 0s - loss: 0.1514 - accuracy:
0.9569 - precision: 0.9566
Epoch 93: accuracy did not improve from 0.96250
15/15 [==============================] - 49s 3s/step - loss: 0.1514 - accur
acy: 0.9569 - precision: 0.9566 - val_loss: 0.9020 - val_accuracy: 0.7437 -
val_precision: 0.7516
Epoch 94/100
15/15 [==============================] - ETA: 0s - loss: 0.2051 - accuracy:
0.9208 - precision: 0.9242
Epoch 94: accuracy did not improve from 0.96250
15/15 [==============================] - 49s 3s/step - loss: 0.2051 - accur
acy: 0.9208 - precision: 0.9242 - val_loss: 0.4296 - val_accuracy: 0.8896 -
val_precision: 0.8896
Epoch 95/100
15/15 [==============================] - ETA: 0s - loss: 0.2907 - accuracy:
0.9009 - precision: 0.9119
Epoch 95: accuracy did not improve from 0.96250
15/15 [==============================] - 48s 3s/step - loss: 0.2907 - accur
acy: 0.9009 - precision: 0.9119 - val_loss: 1.4436 - val_accuracy: 0.6917 -
val_precision: 0.6983
Epoch 96/100
15/15 [==============================] - ETA: 0s - loss: 0.1964 - accuracy:
0.9208 - precision: 0.9263
Epoch 96: accuracy did not improve from 0.96250
```

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15/15 [==============================] - 49s 3s/step - loss: 0.1964 - accur
acy: 0.9208 - precision: 0.9263 - val_loss: 0.8412 - val_accuracy: 0.7625 -
val_precision: 0.7735
Epoch 97/100
15/15 [==============================] - ETA: 0s - loss: 0.1367 - accuracy:
0.9458 - precision: 0.9553
Epoch 97: accuracy did not improve from 0.96250
15/15 [==============================] - 49s 3s/step - loss: 0.1367 - accur
acy: 0.9458 - precision: 0.9553 - val_loss: 0.7242 - val_accuracy: 0.8250 -
val_precision: 0.8291
Epoch 98/100
15/15 [==============================] - ETA: 0s - loss: 0.2155 - accuracy:
0.9375 - precision: 0.9414
Epoch 98: accuracy did not improve from 0.96250
15/15 [==============================] - 48s 3s/step - loss: 0.2155 - accur
acy: 0.9375 - precision: 0.9414 - val_loss: 0.7223 - val_accuracy: 0.8313 -
val_precision: 0.8379
Epoch 99/100
15/15 [==============================] - ETA: 0s - loss: 0.1668 - accuracy:
0.9458 - precision: 0.9495
Epoch 99: accuracy did not improve from 0.96250
15/15 [==============================] - 49s 3s/step - loss: 0.1668 - accur
acy: 0.9458 - precision: 0.9495 - val_loss: 0.5416 - val_accuracy: 0.8750 -
val_precision: 0.8821
Epoch 100/100
15/15 [==============================] - ETA: 0s - loss: 0.1779 - accuracy:
0.9310 - precision: 0.9346
Epoch 100: accuracy did not improve from 0.96250
15/15 [==============================] - 48s 3s/step - loss: 0.1779 - accur
acy: 0.9310 - precision: 0.9346 - val_loss: 0.5630 - val_accuracy: 0.8229 -
val_precision: 0.8274
```

- Accuracy Graph