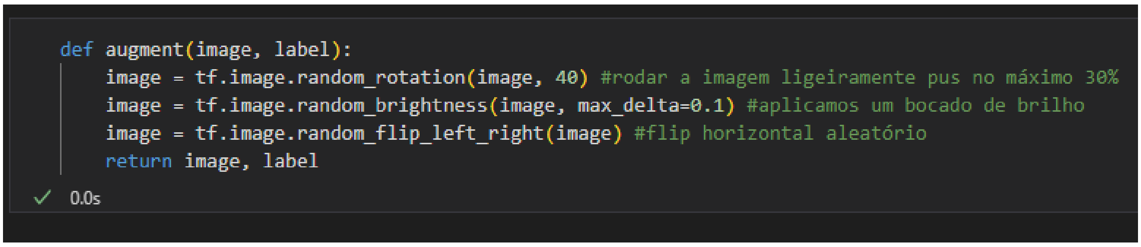
Modelo T com Fine Tunning e com Data Augmentation

Neste modelo realizamos apenas 3 treinos, pois mesmo após testarmos diferentes learning rates, descongelar mais que uma camada e alterar o número de épocas não conseguimos fazer com que a rede evoluísse.

Justificação: No nosso ponto de vista pensamos que o ocorrido foi devido ao facto de estarmos a utilizar a camada classificadora do modelo sem Fine Tunning e sem Data augmentation, pois a mesma não deve estar a ter capacidade para generalizar as novas características impingidas com o data augmentation.

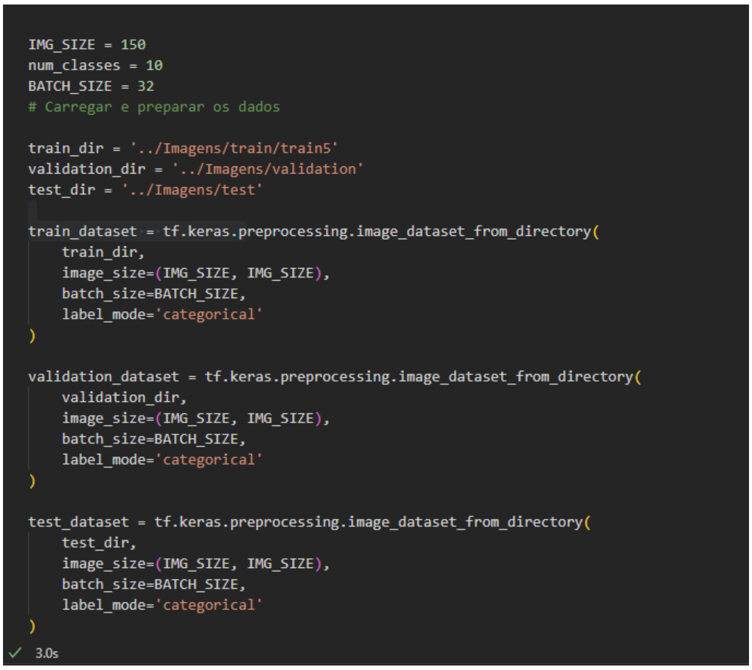


```
def augment(image, label):
    image = tf.image.random_rotation(image, 40) #rodar a imagem ligeiramente pus no máximo 30%
    image = tf.image.random_brightness(image, max_delta=0.1) #aplicamos um bocado de brilho
    image = tf.image.random_flip_left_right(image) #flip horizontal aleatório
    return image, label
```

✓ 0.0s

Figura 1 - Data Augmentation

Carregar as imagens e aplicar-lhes o data augmentation.

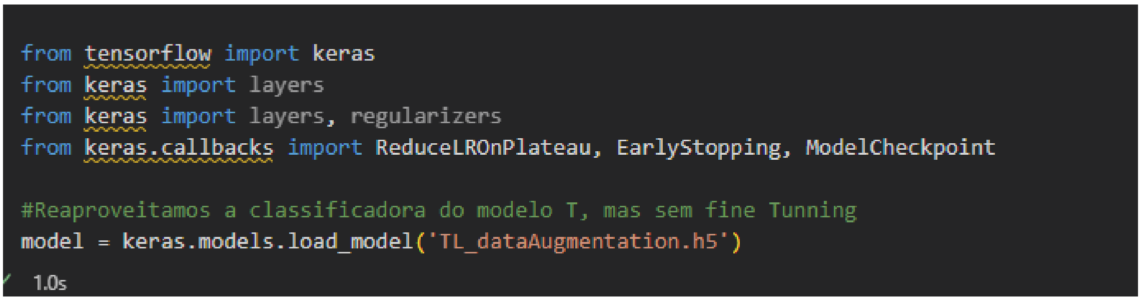


```
IMG_SIZE = 150
num_classes = 10
BATCH_SIZE = 32
# Carregar e preparar os dados

train_dir = '../Imagens/train/train5'
validation_dir = '../Imagens/validation'
test_dir = '../Imagens/test'

train_dataset = tf.keras.preprocessing.image_dataset_from_directory(
    train_dir,
    image_size=(IMG_SIZE, IMG_SIZE),
    batch_size=BATCH_SIZE,
    label_mode='categorical'
)

validation_dataset = tf.keras.preprocessing.image_dataset_from_directory(
    validation_dir,
    image_size=(IMG_SIZE, IMG_SIZE),
    batch_size=BATCH_SIZE,
    label_mode='categorical'
)

test_dataset = tf.keras.preprocessing.image_dataset_from_directory(
    test_dir,
    image_size=(IMG_SIZE, IMG_SIZE),
    batch_size=BATCH_SIZE,
    label_mode='categorical'
)
```

✓ 3.0s

Figura 2 - carregar as imagens

Carregar a camada classificadora do modelo sem fine Tunning.

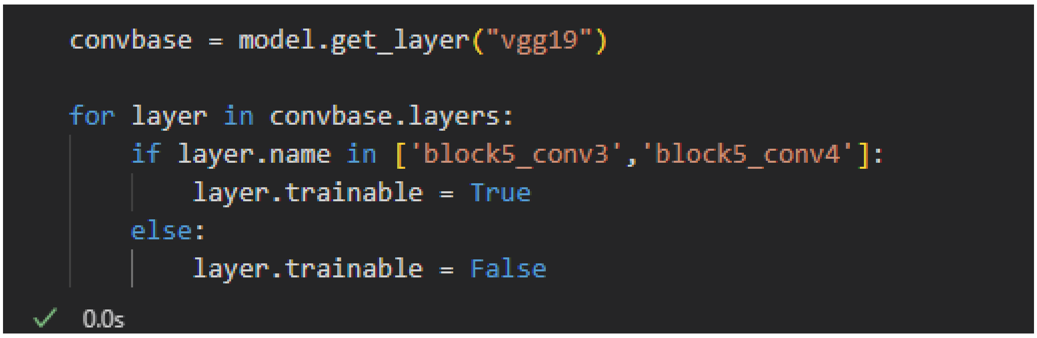


```
from tensorflow import keras
from keras import layers
from keras import layers, regularizers
from keras.callbacks import ReduceLROnPlateau, EarlyStopping, ModelCheckpoint

#Reaproveitamos a classificadora do modelo T, mas sem fine Tunning
model = keras.models.load_model('TL_dataAugmentation.h5')
```

✓ 1.0s

Figura 3 - Load da classificadora

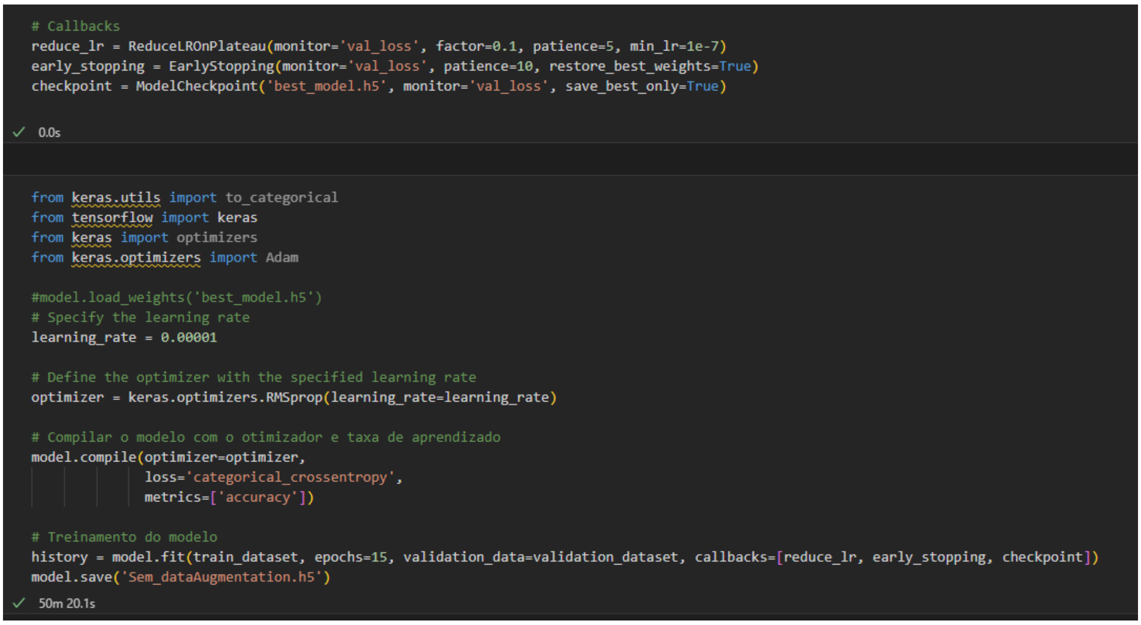
Descongelar as duas últimas camadas da VGG19.



```
convbase = model.get_layer("vgg19")

for layer in convbase.layers:
    if layer.name in ['block5_conv3','block5_conv4']:
        layer.trainable = True
    else:
        layer.trainable = False
```

✓ 0.0s

Figura 4 - Descongelar as camadas



```
# Callbacks
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.1, patience=5, min_lr=1e-7)
early_stopping = EarlyStopping(monitor='val_loss', patience=10, restore_best_weights=True)
checkpoint = ModelCheckpoint('best_model.h5', monitor='val_loss', save_best_only=True)
```

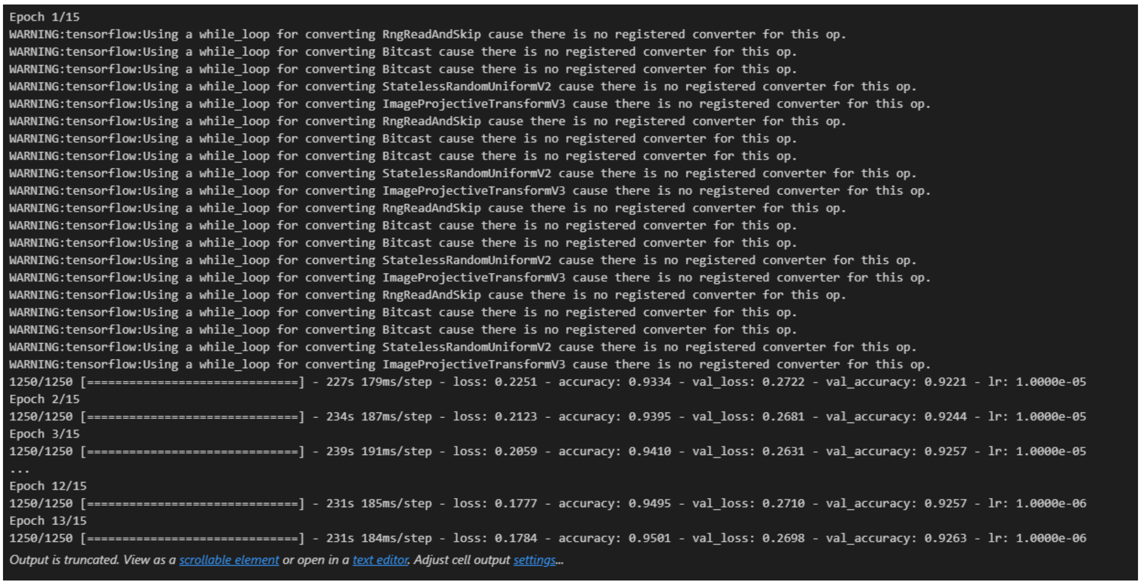
✓ 0.0s

```
from keras.utils import to_categorical
from tensorflow import keras
from keras import optimizers
from keras.optimizers import Adam

#model.load_weights('best_model.h5')
# Specify the learning rate
learning_rate = 0.00001

# Define the optimizer with the specified learning rate
optimizer = keras.optimizers.RMSprop(learning_rate=learning_rate)

# Compilar o modelo com o otimizador e taxa de aprendizado
model.compile(optimizer=optimizer,
              loss='categorical_crossentropy',
              metrics=['accuracy'])

# Treinamento do modelo
history = model.fit(train_dataset, epochs=15, validation_data=validation_dataset, callbacks=[reduce_lr, early_stopping, checkpoint])
model.save('Sem_dataAugmentation.h5')
```

✓ 50m 20.1s

Figura 5 - Callbacks e alguns hiperparâmetros

O early_stopping fez o modelo parar de treinar na 13ª época pois o calor do loss já não estava a diminuir significativamente.



```
Epoch 1/15
WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting StatelessRandomUniformV2 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
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WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
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WARNING:tensorflow:Using a while_loop for converting StatelessRandomUniformV2 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
1250/1250 [==============================] - 227s 179ms/step - loss: 0.2251 - accuracy: 0.9334 - val_loss: 0.2722 - val_accuracy: 0.9221 - lr: 1.0000e-05
Epoch 2/15
1250/1250 [==============================] - 234s 187ms/step - loss: 0.2123 - accuracy: 0.9395 - val_loss: 0.2681 - val_accuracy: 0.9244 - lr: 1.0000e-05
Epoch 3/15
1250/1250 [==============================] - 239s 191ms/step - loss: 0.2059 - accuracy: 0.9410 - val_loss: 0.2631 - val_accuracy: 0.9257 - lr: 1.0000e-05
...
Epoch 12/15
1250/1250 [==============================] - 231s 185ms/step - loss: 0.1777 - accuracy: 0.9495 - val_loss: 0.2710 - val_accuracy: 0.9257 - lr: 1.0000e-06
Epoch 13/15
1250/1250 [==============================] - 231s 184ms/step - loss: 0.1784 - accuracy: 0.9501 - val_loss: 0.2698 - val_accuracy: 0.9263 - lr: 1.0000e-06
Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...
```
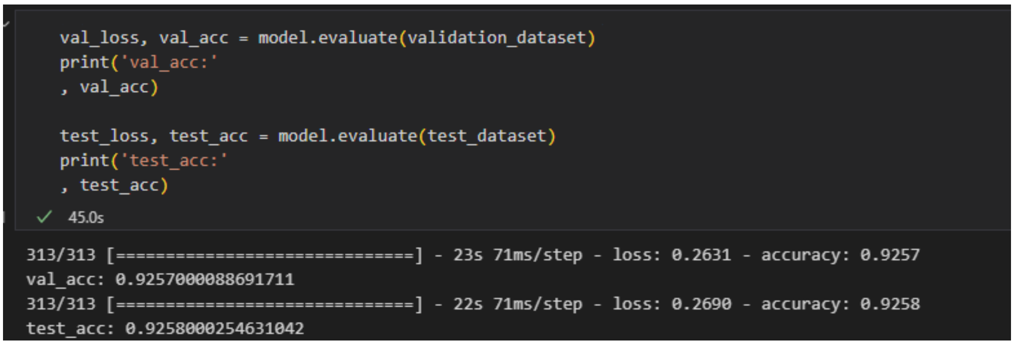

Figura 6 - Output



```
val_loss, val_acc = model.evaluate(validation_dataset)
print('val_acc:'
, val_acc)

test_loss, test_acc = model.evaluate(test_dataset)
print('test_acc:'
, test_acc)
```

```
313/313 [==============================] - 23s 71ms/step - loss: 0.2631 - accuracy: 0.9257
val_acc: 0.9257000088691711
313/313 [==============================] - 22s 71ms/step - loss: 0.2690 - accuracy: 0.9258
test_acc: 0.9258000254631042
```

Figura 7 - Validation and Test acc

Na análise do gráfico podemos ver que existe uma evolução na accuracy de treino, mas que o validation não acompanha essa curva de crescimento.

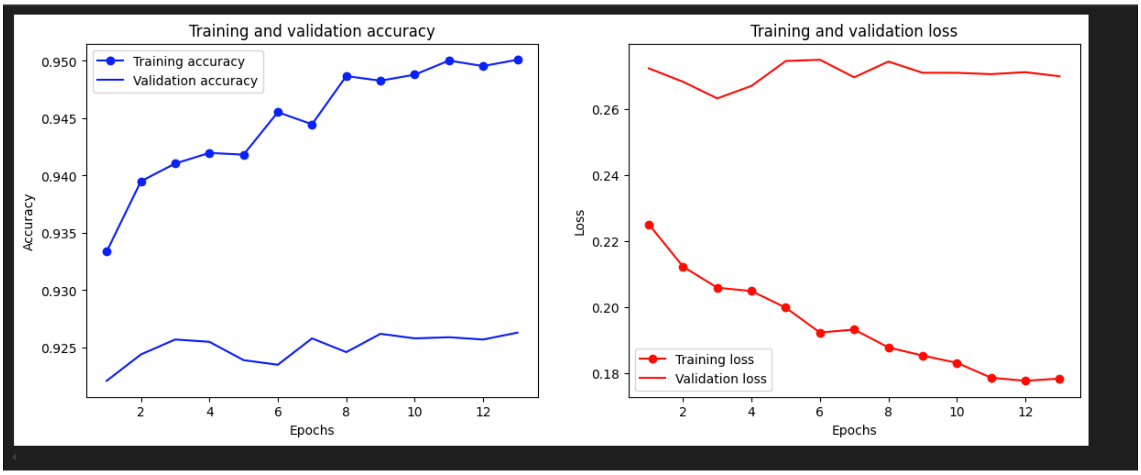
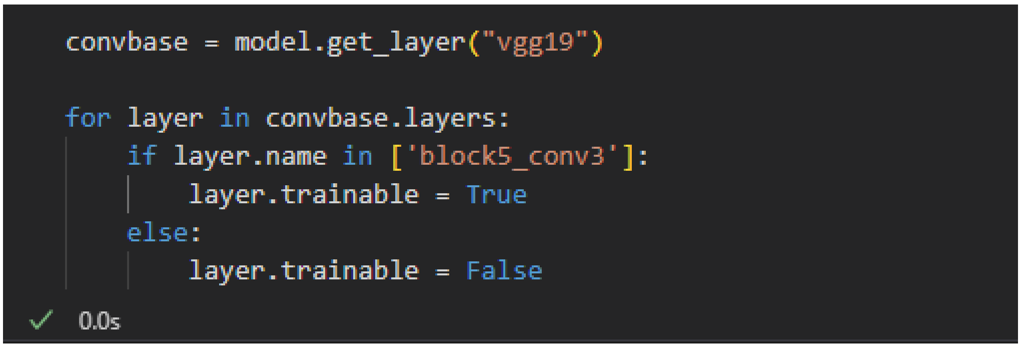


Figura 8 - Gráfico

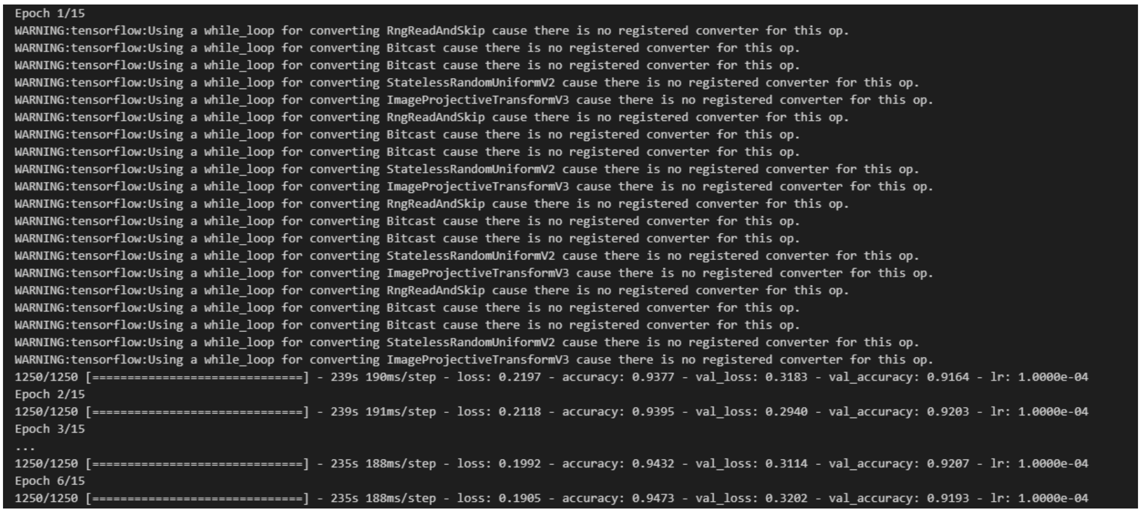
Resumidamente nos treinos que foram realizados, descongelamos apenas uma camada.



```
convbase = model.get_layer("vgg19")

for layer in convbase.layers:
    if layer.name in ['block5_conv3']:
        layer.trainable = True
    else:
        layer.trainable = False
```

✓ 0.0s

Figura 9 - Primeiro treino



```
Epoch 1/15
WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting StatelessRandomUniformV2 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
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WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
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WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting RngReadAndSkip cause there is no registered converter for this op.
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WARNING:tensorflow:Using a while_loop for converting Bitcast cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting StatelessRandomUniformV2 cause there is no registered converter for this op.
WARNING:tensorflow:Using a while_loop for converting ImageProjectiveTransformV3 cause there is no registered converter for this op.
1250/1250 [==============================] - 239s 190ms/step - loss: 0.2197 - accuracy: 0.9377 - val_loss: 0.3183 - val_accuracy: 0.9164 - lr: 1.0000e-04
Epoch 2/15
1250/1250 [==============================] - 239s 191ms/step - loss: 0.2118 - accuracy: 0.9395 - val_loss: 0.2940 - val_accuracy: 0.9203 - lr: 1.0000e-04
Epoch 3/15
...
1250/1250 [==============================] - 235s 188ms/step - loss: 0.1992 - accuracy: 0.9432 - val_loss: 0.3114 - val_accuracy: 0.9207 - lr: 1.0000e-04
Epoch 6/15
1250/1250 [==============================] - 235s 188ms/step - loss: 0.1905 - accuracy: 0.9473 - val_loss: 0.3202 - val_accuracy: 0.9193 - lr: 1.0000e-04
```

Figura 10 - Output

A rede parou de treinar na 6 época devido ao early_stopping, por isso decidimos recomeçar o processo e descongelar mais uma camada, o que originou a rede final apresentada no começo do documento.