Assessment
Facial Recognition with Deep Learning in Keras Using CNN

DESCRIPTION

Project Objective:

Facial recognition is a biometric alternative that measures unique characteristics of a human face. Applications available today include flight check in, tagging friends and family members in photos, and "tailored" advertising. You are a computer vision engineer who needs to develop a face recognition programme with deep convolutional neural networks. Objective: Use a deep convolutional neural network to perform facial recognition using Keras.

Project Description and Scope:

ORL face database composed of 400 images of size 112 x 92. There are 40 people, 10 images per person. The images were taken at different times, lighting and facial expressions. The faces are in an upright position in frontal view, with a slight left-right rotation.

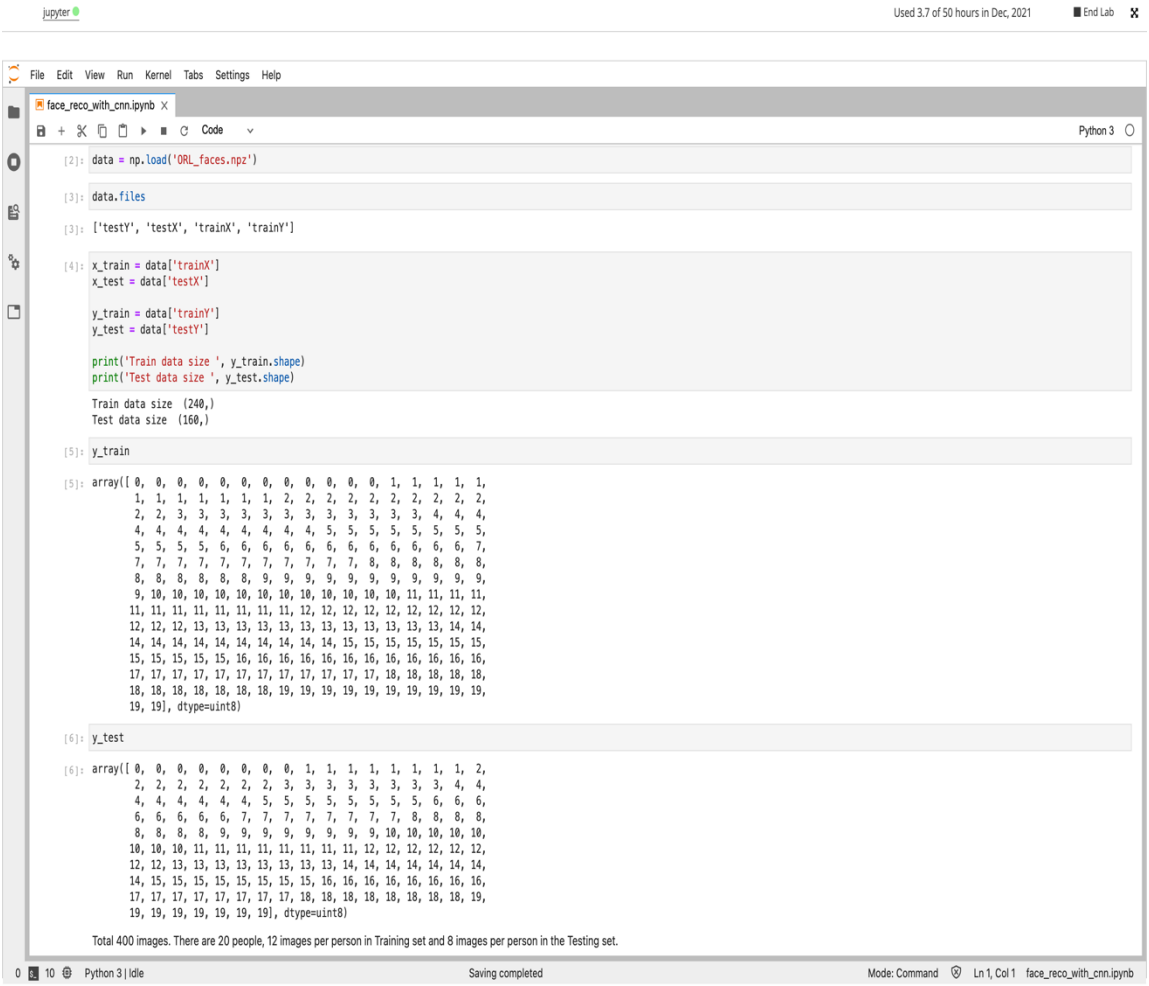
Link to the Dataset: https://www.dropbox.com/s/i7uzp5yxk7wruva/ORL_faces.npz?dl=0

Project Guidelines:

- Load the dataset after loading the dataset, you have to normalize every image.
- Transform the images to equal sizes to feed in CNN
- Build a CNN model that has 3 main layers:
    i. Convolutional Layer
    ii. Pooling Layer
    iii. Fully Connected Layer
- Iterate the model until the accuracy is above 90%

Dataset Info

ORL face database composed of 400 images of size 112 x 92. There are 20 people, 12 images per person in the Train dataset and 8 images per person in Test dataset.



All the images are normalized, reshaped and Train dataset is split into Train data and Validation dataset for model training.

Model Building

There are 4 Convolution layers with activation function as relu, 2 Max Pooling layers, 1 Flatten Layer, 2 Fully Connected Layers with activation function as relu, 2 Droput layers and 1 Output Layer with activation function as softmax.

Sequential Model Summary

```
[13]: face_rec_model.summary()

Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 110, 90, 36)       360

conv2d_1 (Conv2D)            (None, 108, 88, 36)       11700

max_pooling2d (MaxPooling2D  (None, 54, 44, 36)        0
)

conv2d_2 (Conv2D)            (None, 52, 42, 64)        20800

conv2d_3 (Conv2D)            (None, 50, 40, 64)        36928

max_pooling2d_1 (MaxPooling  (None, 25, 20, 64)        0
2D)

flatten (Flatten)            (None, 32000)             0

dense (Dense)                (None, 1024)              32769024

dropout (Dropout)            (None, 1024)              0

dense_1 (Dense)              (None, 512)               524800

dropout_1 (Dropout)          (None, 512)               0

dense_2 (Dense)              (None, 20)                10260

=================================================================
Total params: 33,373,872
Trainable params: 33,373,872
Non-trainable params: 0
_________________________________________________________________
```

Model Training and Evaluation

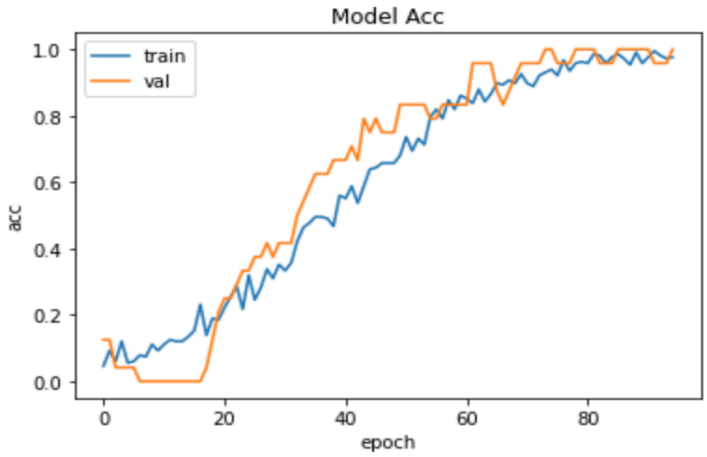
Loss function: Sparse Categorical Cross Entropy
Optimizer: Adam with learning rate=0.0001

```
[14]: face_rec_model.compile(
          loss='sparse_categorical_crossentropy',
          optimizer=Adam(learning_rate=0.0001),
          metrics=['accuracy']
      )

[15]: callback = EarlyStopping(monitor='loss', patience=3)

[16]: history = face_rec_model.fit(np.array(x_train), np.array(y_train),
                                   batch_size=batch_size,
                                   epochs=150,
                                   verbose=2,
                                   validation_data=(np.array(x_val), np.array(y_val)),
                                   callbacks=[callback]
                                   )

Epoch 1/150
1/1 - 21s - loss: 2.9956 - accuracy: 0.0463 - val_loss: 2.9941 - val_accuracy: 0.1250 - 21s/epoch - 21s/step
Epoch 2/150
1/1 - 13s - loss: 2.9941 - accuracy: 0.0926 - val_loss: 3.0013 - val_accuracy: 0.1250 - 13s/epoch - 13s/step
Epoch 3/150
1/1 - 13s - loss: 2.9766 - accuracy: 0.0602 - val_loss: 3.0072 - val_accuracy: 0.0417 - 13s/epoch - 13s/step
Epoch 4/150
1/1 - 11s - loss: 2.9862 - accuracy: 0.1204 - val_loss: 3.0117 - val_accuracy: 0.0417 - 11s/epoch - 11s/step
Epoch 5/150
1/1 - 11s - loss: 2.9758 - accuracy: 0.0556 - val_loss: 3.0155 - val_accuracy: 0.0417 - 11s/epoch - 11s/step
Epoch 6/150
```

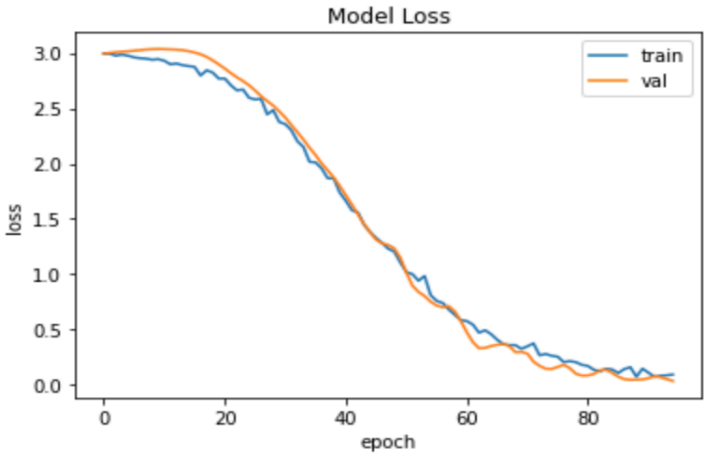
[18]:
```
eval = face_rec_model.evaluate(np.array(x_test), np.array(y_test), verbose=0)

print('Test loss ', eval[0])
print('Test Acc ', eval[1])
```

```
Test loss  0.21071676909923553
Test Acc  0.949999988079071
```

[19]:
```
plt.title('Model Acc')
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.xlabel('epoch')
plt.ylabel('acc')
plt.legend(['train', 'val'])
plt.show()
```



[20]:
```
plt.title('Model Loss')
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.xlabel('epoch')
plt.ylabel('loss')
plt.legend(['train', 'val'])
plt.show()
```



Conclusion

Model accuracy on the test data is 95%.

[23]:
```
acc_score = accuracy_score(y_test, y_pred)
print('Acc Score ', acc_score)
```

```
Acc Score  0.95
```

[24]:
```
cmatrix = confusion_matrix(y_test, y_pred)

ax = sns.heatmap(cmatrix, annot=True)
ax.set_title('Confusion Matrix')
ax.set_xlabel('Predicted Classes')
ax.set_ylabel('Actual Classes')

plt.show()
```