LetsGrowMore (LGMVIP) - "DATA SCIENCE INTERN"

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More Advanced Level Task

TASK-10- : ML Facial recognition to detect mood and suggest songs accordingly

Dataset link : https://www.kaggle.com/msambare/fer2013 (https://www.kaggle.com/msambare/fer2013)

In [2]:
```
pip install scikit-image
```

```
Collecting scikit-image
  Downloading scikit_image-0.19.2-cp310-cp310-win_amd64.whl (12.6 MB)
     ---------------------------------------- 12.6/12.6 MB 1.9 MB/s eta 0:00:00
Requirement already satisfied: numpy>=1.17.0 in c:\users\sbpat\appdata\local\programs\python\python310\lib\s
ite-packages (from scikit-image) (1.22.0)
Requirement already satisfied: packaging>=20.0 in c:\users\sbpat\appdata\local\programs\python\python310\lib
\site-packages (from scikit-image) (21.3)
Requirement already satisfied: scipy>=1.4.1 in c:\users\sbpat\appdata\local\programs\python\python310\lib\si
te-packages (from scikit-image) (1.7.3)
Collecting PyWavelets>=1.1.1
  Downloading PyWavelets-1.3.0-cp310-cp310-win_amd64.whl (4.2 MB)
     ---------------------------------------- 4.2/4.2 MB 2.8 MB/s eta 0:00:00
Collecting tifffile>=2019.7.26
  Downloading tifffile-2022.4.26-py3-none-any.whl (191 kB)
     ------------------------------------- 191.8/191.8 KB 3.9 MB/s eta 0:00:00
Requirement already satisfied: pillow!=7.1.0,!=7.1.1,!=8.3.0,>=6.1.0 in c:\users\sbpat\appdata\local\program
s\python\python310\lib\site-packages (from scikit-image) (9.0.0)
Collecting networkx>=2.2
  Downloading networkx-2.8-py3-none-any.whl (2.0 MB)
     ---------------------------------------- 2.0/2.0 MB 2.7 MB/s eta 0:00:00
Collecting imageio>=2.4.1
  Downloading imageio-2.18.0-py3-none-any.whl (3.4 MB)
     ---------------------------------------- 3.4/3.4 MB 3.1 MB/s eta 0:00:00
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in c:\users\sbpat\appdata\local\programs\python\pyth
on310\lib\site-packages (from packaging>=20.0->scikit-image) (3.0.7)
Installing collected packages: tifffile, PyWavelets, networkx, imageio, scikit-image
Successfully installed PyWavelets-1.3.0 imageio-2.18.0 networkx-2.8 scikit-image-0.19.2 tifffile-2022.4.26
Note: you may need to restart the kernel to use updated packages.
```

Importing Libraries

In [3]:

```
#Import Libraries/Packages
import numpy as np
import cv2
import os
import random
from skimage.io import imread
import pandas as pd
import seaborn as sns
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten, BatchNormalization, Conv2D,MaxPooling2D,Acti
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.callbacks import ReduceLROnPlateau, ModelCheckpoint
from tensorflow.keras.models import load_model
import matplotlib.pyplot as plt
from IPython.display import Audio

```

In [4]:

```
print("TensorFlow version :", tf.__version__)
print("Num GPUs Available: ", len(tf.config.experimental.list_physical_devices('GPU')))
```

```
TensorFlow version : 2.8.0
Num GPUs Available:  0
```

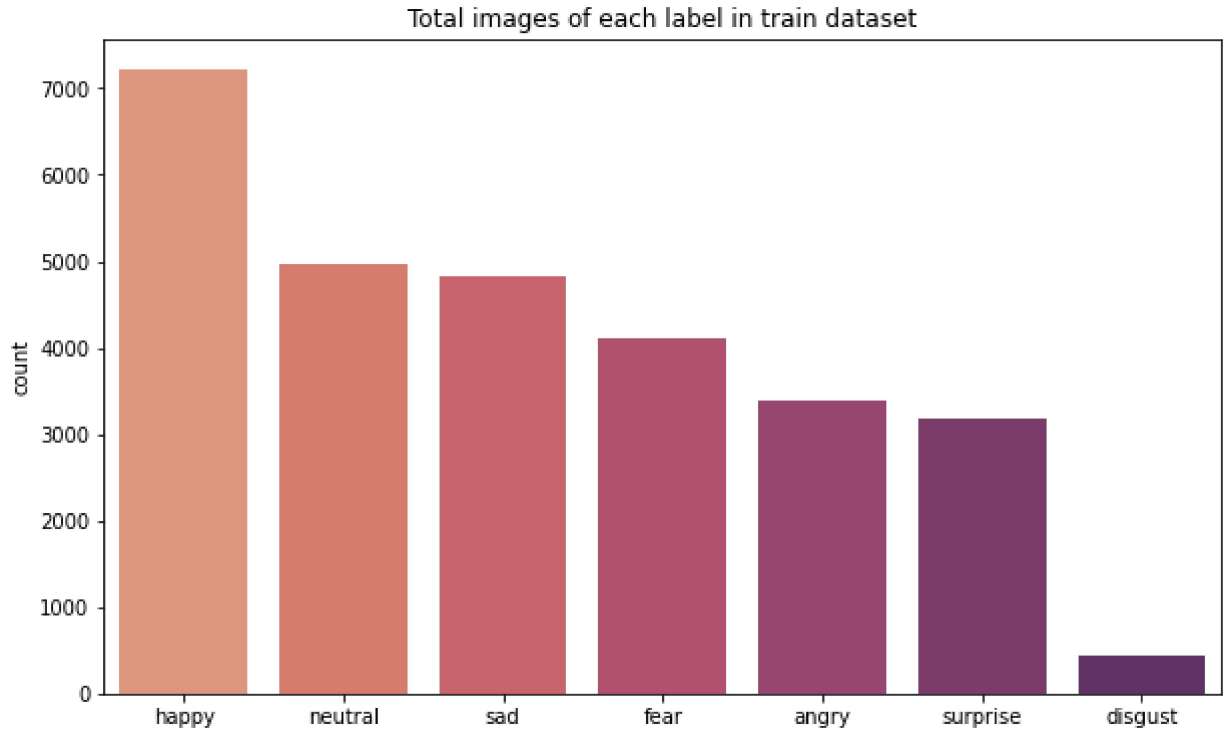
Data Visualization

In [13]:

```
# Data Visualization
from skimage.io import imread
train_dir = "train/"
test_dir = "test/"
total_labels = len(os.listdir(train_dir))

fig, ax = plt.subplots(nrows=5, ncols=total_labels, figsize=(35, 25))
for x in range(5):
    for y,v in zip(range(total_labels),os.listdir(train_dir)):
        ax[x][y].imshow(imread(train_dir+v+'/'+os.listdir(train_dir+v)[x]), cmap='gray')

plt.show()
```

In [14]:

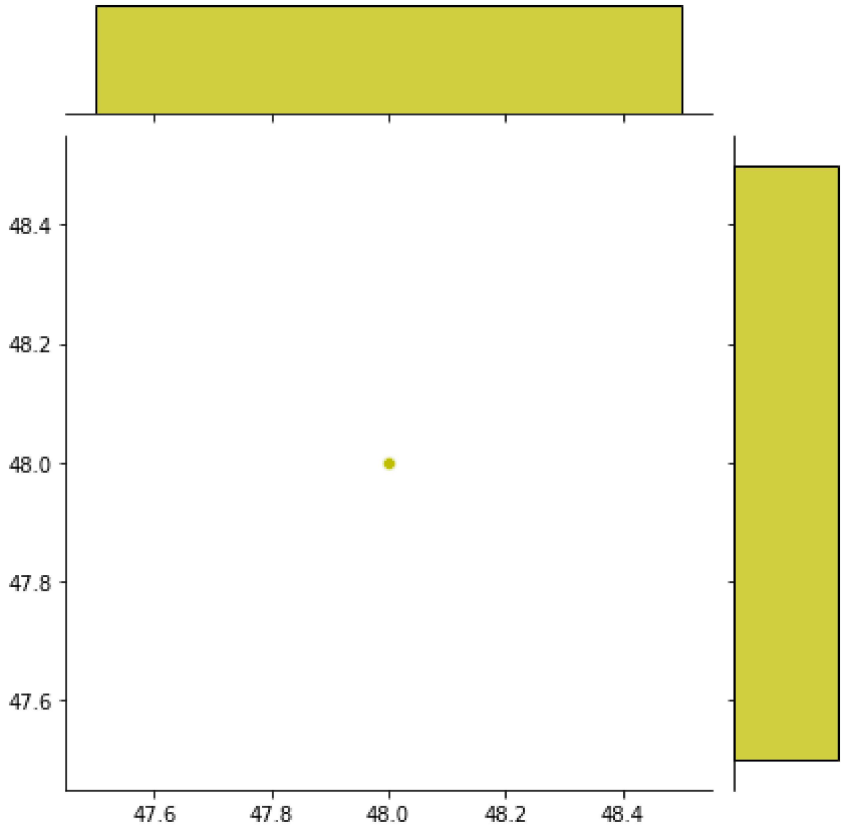
```
df = {}
for i in os.listdir(train_dir):
    directory = train_dir + i
    df[i] = len(os.listdir(directory))
df = pd.DataFrame(df, index=["total"]).transpose().sort_values("total", ascending=False)

plt.figure(figsize=(10,6))
sns.barplot(x=df.index, y="total", palette="flare", data=df)
plt.ylabel("count")
plt.title("Total images of each label in train dataset")
plt.show()

```



In [15]:

```
happy = os.listdir(train_dir+'happy/')
dim1, dim2 = [], []

for img_filename in happy:
    img = imread(train_dir+'happy/'+img_filename)
    d1, d2 = img.shape
    dim1.append(d1)
    dim2.append(d2)

img_shape = (int(np.mean(dim1)), int(np.mean(dim2)), 1)
sns.jointplot(dim1, dim2,color='y')
plt.show()
```

```
C:\Users\sbpat\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_decorators.py:36: FutureWa
rning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argu
ment will be `data`, and passing other arguments without an explicit keyword will result in an error or misi
nterpretation.
  warnings.warn(
```


48.4
48.2
48.0
47.8
47.6
47.6
47.8
48.0
48.2
48.4

In [16]:

```python
# Data Preprocessing
train_gen = ImageDataGenerator(rescale=1/255,
                               rotation_range=40,
                               width_shift_range=0.2,
                               height_shift_range=0.2,
                               shear_range=0.2,
                               zoom_range=0.2,
                               horizontal_flip=True,
                               fill_mode='nearest')

test_gen = ImageDataGenerator(rescale=1/255)

img_shape = (int(np.mean(dim1)), int(np.mean(dim2)), 1)

train_generator = train_gen.flow_from_directory(directory=train_dir,
                                                target_size=(img_shape[0], img_shape[1]),
                                                color_mode='grayscale',
                                                batch_size=64,
                                                class_mode='categorical',
                                                shuffle=True)

test_generator = test_gen.flow_from_directory(directory=test_dir,
                                                target_size=(img_shape[0], img_shape[1]),
                                                color_mode='grayscale',
                                                batch_size=64,
                                                class_mode='categorical',
                                                shuffle=False)

```

```
Found 28111 images belonging to 7 classes.
Found 7178 images belonging to 7 classes.
```

Creating the Model

In [17]:

```
# Create the Model
model = Sequential()

model.add(Conv2D(filters=64, kernel_size=(3,3), padding='same', activation='relu', input_shape=img_shape))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.2))

model.add(Conv2D(filters=128, kernel_size=(3,3), padding='same', activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.2))

model.add(Conv2D(filters=512, kernel_size=(3,3), padding='same', activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.2))

model.add(Conv2D(filters=512, kernel_size=(3,3), padding='same', activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.2))

model.add(Flatten())

model.add(Dense(512, activation='relu'))
model.add(Dropout(0.2))

model.add(Dense(1024, activation='relu'))
model.add(Dropout(0.2))

model.add(Dense(units=len(os.listdir(train_dir)), activation='softmax'))

model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 48, 48, 64)        640

 batch_normalization (BatchN  (None, 48, 48, 64)       256
 ormalization)

 max_pooling2d (MaxPooling2D  (None, 24, 24, 64)       0
 )

 dropout (Dropout)           (None, 24, 24, 64)        0

 conv2d_1 (Conv2D)           (None, 24, 24, 128)       73856

 batch_normalization_1 (Batc  (None, 24, 24, 128)      512
 hNormalization)

 max_pooling2d_1 (MaxPooling  (None, 12, 12, 128)      0
 2D)

 dropout_1 (Dropout)         (None, 12, 12, 128)       0

 conv2d_2 (Conv2D)           (None, 12, 12, 512)       590336

 batch_normalization_2 (Batc  (None, 12, 12, 512)      2048
 hNormalization)

 max_pooling2d_2 (MaxPooling  (None, 6, 6, 512)        0
 2D)

 dropout_2 (Dropout)         (None, 6, 6, 512)         0

 conv2d_3 (Conv2D)           (None, 6, 6, 512)         2359808

 batch_normalization_3 (Batc  (None, 6, 6, 512)        2048
 hNormalization)

 max_pooling2d_3 (MaxPooling  (None, 3, 3, 512)        0
 2D)

 dropout_3 (Dropout)         (None, 3, 3, 512)         0
```

```
 flatten (Flatten)           (None, 4608)              0

 dense (Dense)               (None, 512)               2359808

 dropout_4 (Dropout)         (None, 512)               0

 dense_1 (Dense)             (None, 1024)              525312

 dropout_5 (Dropout)         (None, 1024)              0

 dense_2 (Dense)             (None, 7)                 7175

=================================================================
Total params: 5,921,799
Trainable params: 5,919,367
Non-trainable params: 2,432
_________________________________________________________________
```

Training the model

In [18]:

```
# Train the model
model.compile(optimizer=Adam(learning_rate=0.0001,
                             decay=1e-6),
              loss='categorical_crossentropy',
              metrics=['accuracy'])

```

In [19]:

```
steps_per_epoch = train_generator.n // train_generator.batch_size
validation_steps = test_generator.n // test_generator.batch_size
num_epochs = 20

history = model.fit(train_generator,
                    epochs=num_epochs,
                    verbose=1,
                    #callbacks=callbacks,
                    validation_data=test_generator,
                    steps_per_epoch=steps_per_epoch,
                    validation_steps=validation_steps)
```

```
Epoch 1/20
439/439 [==============================] - 1666s 4s/step - loss: 1.8728 - accuracy: 0.2377 - val_loss: 2.444
0 - val_accuracy: 0.2479
Epoch 2/20
439/439 [==============================] - 1669s 4s/step - loss: 1.7967 - accuracy: 0.2564 - val_loss: 1.787
5 - val_accuracy: 0.2679
Epoch 3/20
439/439 [==============================] - 1725s 4s/step - loss: 1.7828 - accuracy: 0.2593 - val_loss: 1.719
2 - val_accuracy: 0.2916
Epoch 4/20
439/439 [==============================] - 1613s 4s/step - loss: 1.7722 - accuracy: 0.2663 - val_loss: 1.771
3 - val_accuracy: 0.2949
Epoch 5/20
439/439 [==============================] - 1241s 3s/step - loss: 1.7545 - accuracy: 0.2841 - val_loss: 1.713
9 - val_accuracy: 0.3083
Epoch 6/20
439/439 [==============================] - 1166s 3s/step - loss: 1.7321 - accuracy: 0.2978 - val_loss: 1.730
4 - val_accuracy: 0.3225
Epoch 7/20
439/439 [==============================] - 1177s 3s/step - loss: 1.7065 - accuracy: 0.3117 - val_loss: 1.590
7 - val_accuracy: 0.3712
Epoch 8/20
439/439 [==============================] - 1174s 3s/step - loss: 1.6698 - accuracy: 0.3302 - val_loss: 1.604
5 - val_accuracy: 0.3733
Epoch 9/20
439/439 [==============================] - 1173s 3s/step - loss: 1.6355 - accuracy: 0.3503 - val_loss: 1.484
1 - val_accuracy: 0.4248
Epoch 10/20
439/439 [==============================] - 1028s 2s/step - loss: 1.5945 - accuracy: 0.3724 - val_loss: 1.452
6 - val_accuracy: 0.4344
Epoch 11/20
439/439 [==============================] - 1086s 2s/step - loss: 1.5521 - accuracy: 0.3937 - val_loss: 1.428
6 - val_accuracy: 0.4577
Epoch 12/20
439/439 [==============================] - 1036s 2s/step - loss: 1.5221 - accuracy: 0.4070 - val_loss: 1.581
3 - val_accuracy: 0.4134
Epoch 13/20
439/439 [==============================] - 984s 2s/step - loss: 1.4914 - accuracy: 0.4213 - val_loss: 1.3892
- val_accuracy: 0.4605
Epoch 14/20
439/439 [==============================] - 985s 2s/step - loss: 1.4579 - accuracy: 0.4354 - val_loss: 1.3432
- val_accuracy: 0.4710
Epoch 15/20
```

```
439/439 [==============================] - 983s 2s/step - loss: 1.4303 - accuracy: 0.4454 - val_loss: 1.3578
- val_accuracy: 0.4738
Epoch 16/20
439/439 [==============================] - 988s 2s/step - loss: 1.4166 - accuracy: 0.4552 - val_loss: 1.3742
- val_accuracy: 0.4764
Epoch 17/20
439/439 [==============================] - 991s 2s/step - loss: 1.3908 - accuracy: 0.4646 - val_loss: 1.2980
- val_accuracy: 0.5015
Epoch 18/20
439/439 [==============================] - 989s 2s/step - loss: 1.3833 - accuracy: 0.4686 - val_loss: 1.2171
- val_accuracy: 0.5310
Epoch 19/20
439/439 [==============================] - 984s 2s/step - loss: 1.3661 - accuracy: 0.4809 - val_loss: 1.2117
- val_accuracy: 0.5325
Epoch 20/20
439/439 [==============================] - 986s 2s/step - loss: 1.3398 - accuracy: 0.4886 - val_loss: 1.2429
- val_accuracy: 0.5152
```

Saving the trained model

In [37]:

```
model.save("model.h5")

```

Evaluate the model

In [38]:

```
# Evaluate the model
test_loss, test_acc = model.evaluate(test_generator)
print("validation accuracy :", str(test_acc*100)+"%")
print("validation loss :", test_loss)
```

```
113/113 [==============================] - 63s 561ms/step - loss: 1.2417 - accuracy: 0.5157
validation accuracy : 51.57425403594971%
validation loss : 1.241727352142334
```

Plotting Training and Validation plot

In [39]:

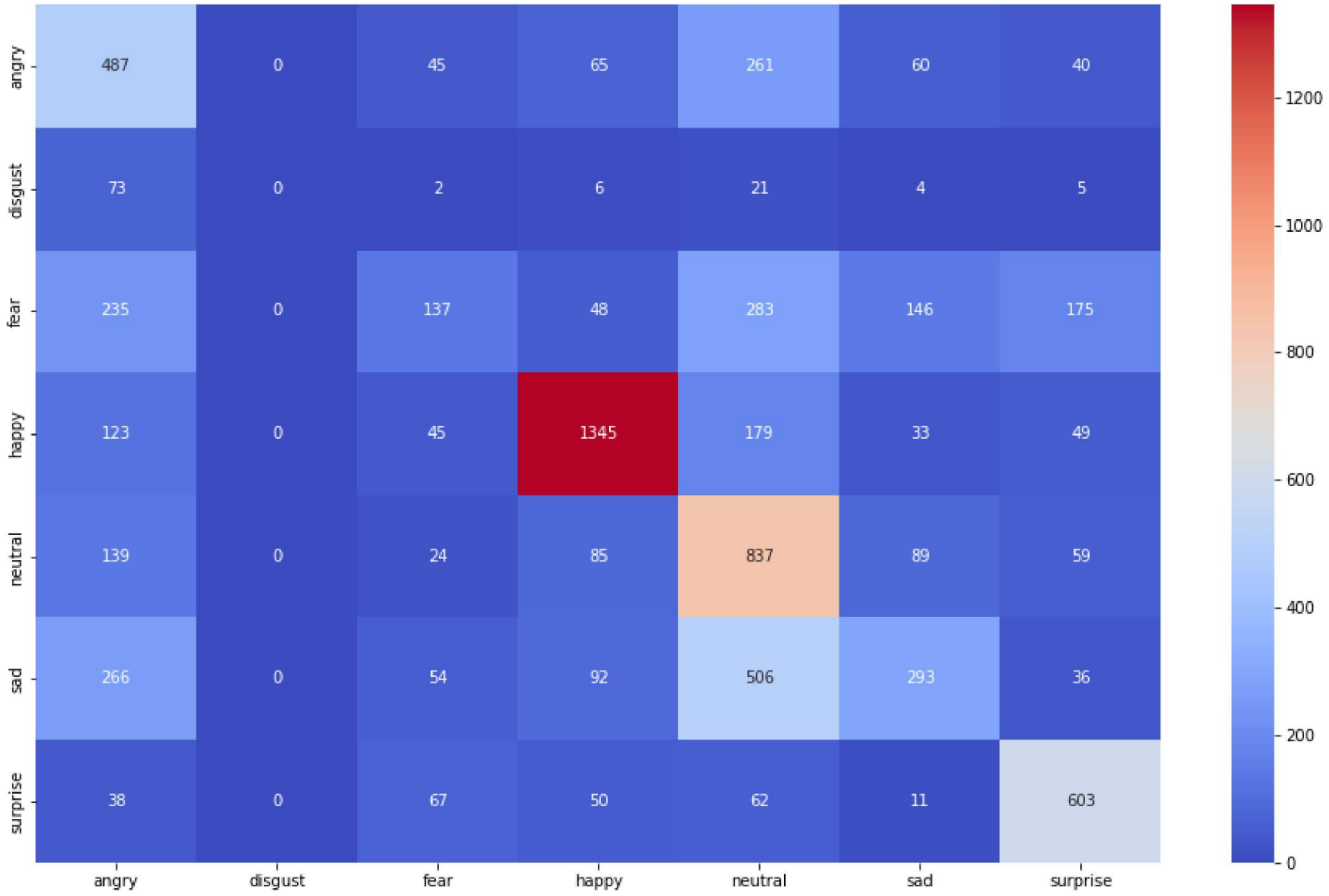
```
val_acc = history.history['val_accuracy']
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(len(val_acc))

fig, ax = plt.subplots(nrows=1, ncols=2, figsize=(20, 6))
ax[0].plot(epochs, val_acc, 'y', label='Training accuracy')
ax[0].plot(epochs, val_acc, 'magenta', label='Validation accuracy')
ax[0].legend(loc=0)
ax[1].plot(epochs, loss, 'y', label='Training loss')
ax[1].plot(epochs, val_loss, 'magenta', label='Validation loss')
ax[1].legend(loc=0)

plt.suptitle('Training and validation')
plt.show()
```

Plotting the confusion matrix

In [40]:

```python
# confusion matrix
from sklearn.metrics import classification_report, confusion_matrix

y_pred = np.argmax(model.predict(test_generator), axis=-1)
print(classification_report(test_generator.classes, y_pred, target_names=test_generator.class_indices.key

cm = confusion_matrix(test_generator.classes, y_pred)
plt.figure(figsize=(16,10))
sns.heatmap(cm, cmap=plt.cm.coolwarm, annot=True, fmt='.0f', xticklabels=test_generator.class_indices.key
plt.show()
```

```
C:\Users\sbpat\AppData\Local\Programs\Python\Python310\lib\site-packages\sklearn\metrics\_classification.py:
1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no p
redicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\sbpat\AppData\Local\Programs\Python\Python310\lib\site-packages\sklearn\metrics\_classification.py:
1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no p
redicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\sbpat\AppData\Local\Programs\Python\Python310\lib\site-packages\sklearn\metrics\_classification.py:
1318: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no p
redicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))

              precision    recall  f1-score   support

       angry       0.36      0.51      0.42       958
     disgust       0.00      0.00      0.00       111
        fear       0.37      0.13      0.20      1024
       happy       0.80      0.76      0.78      1774
     neutral       0.39      0.68      0.49      1233
         sad       0.46      0.23      0.31      1247
    surprise       0.62      0.73      0.67       831

    accuracy                           0.52      7178
   macro avg       0.43      0.43      0.41      7178
weighted avg       0.52      0.52      0.49      7178
```



Testing our model with new image

In [41]:

```
# Testing our model with new image
image = cv2.imread("images/Sad.jpg")
from IPython.display import Image
Image(filename='Sad.jpg')
```

Out[41]:

In [ ]:

```python
# Model Prediction
import cv2
from tensorflow.python.keras.models import load_model
import os


# # load the trained model
model = load_model("model.h5")
# A list of emoticon categories
EMOTIONS = ['Angry', 'Disgust', 'Happy', 'Sad', 'Surprise', 'Neutral']
# Load image
img = image

# Trim the image to 48 x 48, and turn the grayscale image, normalization
frame = cv2.resize(img,(48,48),interpolation=cv2.INTER_BITS2)
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY) / 255.0

# Reinvent the image dimension
gray = gray.reshape(1,48,48,1)

# Output the prediction
predicts = model.predict(gray)[0]
label = EMOTIONS[predicts.argmax()]
for (i,j) in zip(range(7),EMOTIONS):
    predictss = predicts[i]
    print("{:^10s}".format(j)+"prediction rate is   {0:.2f}%".format(predictss))
print( "\n\n The system considers this expression to be:",label)

```

Angry prediction rate is 0.24%

Disgust prediction rate is 0.00%

Happy prediction rate is 0.08%

Sad prediction rate is 0.27%

Surprise prediction rate is 0.26%

Neutral prediction rate is 0.10%

The system considers this expression to be: Sad

Song Recommdation

In [ ]:

```
# Song Recommdation
if (label=='Angry'):
    path="test\\Angry\\"
    files=os.listdir(path)
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Angry\\'+ d,autoplay=True)
    display(audio)

elif (label=='Disgust'):
    path="test\\Disgust\\"
    files=os.listdir(path)
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Disgust\\'+ d,autoplay=True)
    display(audio)

elif (label=="Happy"):
    path="test\\happy\\"
    files=os.listdir(path)
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Happy\\'+ d,autoplay=True)
    display(audio)

elif (label=='Sad'):
    path="test//sad//"
    files=os.listdir(path)
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Sad\\'+ d,autoplay=True)
    display(audio)
elif (label=='Surprise'):
    path="test\\Surprise\\"
    files=os.listdir(path)
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Surprise\\'+ d,autoplay=True)
    display(audio)

elif (label=='Neutral'):
    path="test\\Neutral\\"
    files=os.listdir(path)
```

```
    d=random.choice(files)
    print("Now Playing:",d)
    audio = Audio(filename='song\\Neutral\\'+ d,autoplay=True)
    display(audio)

```

Now Playing: English Sad Song Slow Music heart touching painful.mp3

Thank You !

In [ ]:
```
1
```