Project : Facial Expression Recognition Using CNN

By : Anirban Debnath, Arpan Datta, Sachin Sarkar, Sayan Mondal

Objective : Model will predict the emotion of a person by analyzing the Image.

Mounting to drive to access Dataset and Images

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Importing the required Python Libraries

```
import cv2
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
import keras
from keras.models import Sequential
from keras.layers.core import Flatten, Dense, Dropout, Activation
from keras.layers.convolutional import Conv2D, MaxPooling2D, ZeroPadding2D
from keras.preprocessing import image
from keras.optimizers import Adam
from keras.utils.np_utils import to_categorical
from keras.layers import BatchNormalization
from keras.regularizers import l2
```

Importing the Dataset FER2013 as a csv file. This are the some images in FER2013 Dataset

```
dataset = pd.read_csv('/content/drive/MyDrive/face_emotions/fer2013.csv')
print(dataset.head())
print(dataset.info())
```

```
   emotion                                             pixels     Usage
0        0  70 80 82 72 58 58 60 63 54 58 60 48 89 115 121...  Training
1        0  151 150 147 155 148 133 111 140 170 174 182 15...  Training
2        2  231 212 156 164 174 138 161 173 182 200 106 38...  Training
3        4  24 32 36 30 32 23 19 20 30 41 21 22 32 34 21 1...  Training
4        6  4 0 0 0 0 0 0 0 0 0 0 0 0 3 15 23 28 48 50 58 84...  Training
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 35887 entries, 0 to 35886
Data columns (total 3 columns):
 #   Column   Non-Null Count  Dtype 
---  ------   --------------  ----- 
 0   emotion  35887 non-null  int64 
 1   pixels   35887 non-null  object
 2   Usage    35887 non-null  object
dtypes: int64(1), object(2)
memory usage: 841.2+ KB
None
```

Let divide the Dataset into Training and Testing

```
x_train,y_train,x_test,y_test = [],[],[],[]
for index,row in dataset.iterrows():
  val = row['pixels'].split(' ')
  try:
    if 'Training' in row['Usage']:
      x_train.append(np.array(val,'float32'))
      y_train.append(row['emotion'])
    elif 'PublicTest' in row['Usage']:
      x_test.append(np.array(val,'float32'))
      y_test.append(row['emotion'])
  except:
    print("Error occured at index :",index,"and row :",row)
```

Preprocessing the Dataset

```
x_train = np.array(x_train,'float32')
y_train = np.array(y_train,'float32')
x_test = np.array(x_test,'float32')
y_test = np.array(y_test,'float32')

y_train = to_categorical(y_train,num_classes=7)
y_test = to_categorical(y_test,num_classes=7)

x_train /= 255.0
x_test /= 255.0

x_train = x_train.reshape(x_train.shape[0],48,48,1)
x_test = x_test.reshape(x_test.shape[0],48,48,1)

print("x_train Shape : ",x_train.shape)
print("x_test.shape : ",x_test.shape)
```

```
x_train Shape :  (28709, 48, 48, 1)
x_test.shape :  (3589, 48, 48, 1)
```

CNN Model Building

```
num_features = 64
num_labels = 7

model = Sequential()

model.add(Conv2D(num_features, kernel_size=(3, 3), activation='relu', input_shape=(48,48,1),
                 data_format='channels_last', kernel_regularizer=l2(0.01)))
model.add(Conv2D(num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2, 2), strides=(2, 2)))
model.add(Dropout(0.5))

model.add(Conv2D(2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2, 2), strides=(2, 2)))
model.add(Dropout(0.5))

model.add(Conv2D(2*2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(2*2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2, 2), strides=(2, 2)))
model.add(Dropout(0.5))

model.add(Conv2D(2*2*2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(2*2*2*num_features, kernel_size=(3, 3), activation='relu', padding='same'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2, 2), strides=(2, 2)))
model.add(Dropout(0.5))

model.add(Flatten())

model.add(Dense(2*2*2*num_features, activation='relu'))
model.add(Dropout(0.4))
model.add(Dense(2*2*num_features, activation='relu'))
model.add(Dropout(0.4))
model.add(Dense(2*num_features, activation='relu'))
model.add(Dropout(0.5))

model.add(Dense(num_labels, activation='softmax'))

model.summary()
```

```
Model: "sequential"
_________________________________________________________________
```

```
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d (Conv2D)              (None, 46, 46, 64)        640       
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 46, 46, 64)        36928     
_________________________________________________________________
batch_normalization (BatchNo (None, 46, 46, 64)        256       
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 23, 23, 64)        0         
_________________________________________________________________
dropout (Dropout)            (None, 23, 23, 64)        0         
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 23, 23, 128)       73856     
_________________________________________________________________
batch_normalization_1 (Batch (None, 23, 23, 128)       512       
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 23, 23, 128)       147584    
_________________________________________________________________
batch_normalization_2 (Batch (None, 23, 23, 128)       512       
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 11, 11, 128)       0         
_________________________________________________________________
dropout_1 (Dropout)          (None, 11, 11, 128)       0         
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 11, 11, 256)       295168    
_________________________________________________________________
batch_normalization_3 (Batch (None, 11, 11, 256)       1024      
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 11, 11, 256)       590080    
_________________________________________________________________
batch_normalization_4 (Batch (None, 11, 11, 256)       1024      
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 5, 5, 256)         0         
_________________________________________________________________
dropout_2 (Dropout)          (None, 5, 5, 256)         0         
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 5, 5, 512)         1180160   
_________________________________________________________________
batch_normalization_5 (Batch (None, 5, 5, 512)         2048      
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 5, 5, 512)         2359808   
_________________________________________________________________
batch_normalization_6 (Batch (None, 5, 5, 512)         2048      
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 2, 2, 512)         0         
_________________________________________________________________
dropout_3 (Dropout)          (None, 2, 2, 512)         0         
_________________________________________________________________
flatten (Flatten)            (None, 2048)              0         
_________________________________________________________________
dense (Dense)                (None, 512)               1049088   
_________________________________________________________________
dropout_4 (Dropout)          (None, 512)               0         
_________________________________________________________________
dense_1 (Dense)              (None, 256)               131328    
_________________________________________________________________
dropout_5 (Dropout)          (None, 256)               0         
```

Compile and Fitting training dataset to the CNN Model

```
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
model.fit(x_train,y_train,batch_size=287,epochs=100,verbose=1,validation_data=(x_test,y_test),shuffle=True)
```

```
Epoch 1/100
101/101 [==============================] - 72s 201ms/step - loss: 2.5269 - accuracy: 0.1931 - val_loss: 1.8721 - val_accuracy: 0.2494
Epoch 2/100
101/101 [==============================] - 18s 179ms/step - loss: 1.8672 - accuracy: 0.2310 - val_loss: 1.8357 - val_accuracy: 0.2494
Epoch 3/100
101/101 [==============================] - 19s 188ms/step - loss: 1.8389 - accuracy: 0.2412 - val_loss: 1.8239 - val_accuracy: 0.2494
Epoch 4/100
101/101 [==============================] - 19s 189ms/step - loss: 1.8270 - accuracy: 0.2431 - val_loss: 1.8035 - val_accuracy: 0.2494
Epoch 5/100
101/101 [==============================] - 19s 185ms/step - loss: 1.8070 - accuracy: 0.2516 - val_loss: 1.8136 - val_accuracy: 0.2499
Epoch 6/100
101/101 [==============================] - 18s 181ms/step - loss: 1.7724 - accuracy: 0.2768 - val_loss: 1.7286 - val_accuracy: 0.3073
Epoch 7/100
101/101 [==============================] - 18s 183ms/step - loss: 1.7275 - accuracy: 0.3046 - val_loss: 1.6905 - val_accuracy: 0.3338
Epoch 8/100
101/101 [==============================] - 19s 186ms/step - loss: 1.6257 - accuracy: 0.3584 - val_loss: 1.6505 - val_accuracy: 0.3310
Epoch 9/100
101/101 [==============================] - 19s 185ms/step - loss: 1.5647 - accuracy: 0.3858 - val_loss: 1.4724 - val_accuracy: 0.4202
Epoch 10/100
101/101 [==============================] - 19s 185ms/step - loss: 1.5034 - accuracy: 0.4065 - val_loss: 1.6236 - val_accuracy: 0.3667
Epoch 11/100
101/101 [==============================] - 18s 183ms/step - loss: 1.4890 - accuracy: 0.4189 - val_loss: 1.4368 - val_accuracy: 0.4305
Epoch 12/100
101/101 [==============================] - 18s 182ms/step - loss: 1.4690 - accuracy: 0.4264 - val_loss: 1.3796 - val_accuracy: 0.4634
Epoch 13/100
101/101 [==============================] - 18s 182ms/step - loss: 1.4074 - accuracy: 0.4597 - val_loss: 1.3919 - val_accuracy: 0.4600
Epoch 14/100
101/101 [==============================] - 19s 184ms/step - loss: 1.3813 - accuracy: 0.4784 - val_loss: 1.3211 - val_accuracy: 0.4937
Epoch 15/100
101/101 [==============================] - 18s 183ms/step - loss: 1.3381 - accuracy: 0.4943 - val_loss: 1.2817 - val_accuracy: 0.5088
Epoch 16/100
101/101 [==============================] - 18s 183ms/step - loss: 1.2782 - accuracy: 0.5211 - val_loss: 1.3293 - val_accuracy: 0.4823
Epoch 17/100
101/101 [==============================] - 19s 184ms/step - loss: 1.2650 - accuracy: 0.5214 - val_loss: 1.2187 - val_accuracy: 0.5378
Epoch 18/100
101/101 [==============================] - 19s 184ms/step - loss: 1.2483 - accuracy: 0.5331 - val_loss: 1.2589 - val_accuracy: 0.5288
Epoch 19/100
101/101 [==============================] - 18s 183ms/step - loss: 1.2056 - accuracy: 0.5504 - val_loss: 1.2470 - val_accuracy: 0.5330
Epoch 20/100
101/101 [==============================] - 19s 183ms/step - loss: 1.1885 - accuracy: 0.5583 - val_loss: 1.2105 - val_accuracy: 0.5358
Epoch 21/100
101/101 [==============================] - 18s 183ms/step - loss: 1.2051 - accuracy: 0.5519 - val_loss: 1.2132 - val_accuracy: 0.5411
Epoch 22/100
101/101 [==============================] - 18s 182ms/step - loss: 1.1768 - accuracy: 0.5646 - val_loss: 1.1856 - val_accuracy: 0.5433
Epoch 23/100
101/101 [==============================] - 18s 182ms/step - loss: 1.1903 - accuracy: 0.5616 - val_loss: 1.1720 - val_accuracy: 0.5603
Epoch 24/100
101/101 [==============================] - 18s 182ms/step - loss: 1.1340 - accuracy: 0.5809 - val_loss: 1.1964 - val_accuracy: 0.5564
Epoch 25/100
101/101 [==============================] - 18s 182ms/step - loss: 1.1097 - accuracy: 0.5918 - val_loss: 1.2161 - val_accuracy: 0.5564
Epoch 26/100
101/101 [==============================] - 18s 182ms/step - loss: 1.1188 - accuracy: 0.5956 - val_loss: 1.2102 - val_accuracy: 0.5386
Epoch 27/100
101/101 [==============================] - 18s 182ms/step - loss: 1.0960 - accuracy: 0.5938 - val_loss: 1.1592 - val_accuracy: 0.5592
Epoch 28/100
101/101 [==============================] - 18s 182ms/step - loss: 1.0581 - accuracy: 0.6108 - val_loss: 1.1182 - val_accuracy: 0.5790
Epoch 29/100
```

```
101/101 [==============================] - 18s 182ms/step - loss: 1.0559 - accuracy: 0.6130 - val_loss: 1.1386 - val_accuracy: 0.5751
Epoch 30/100
```

Save Model to Json

```
fer_json = model.to_json()
with open('fer.json','w') as json_file:
  json_file.write(fer_json)
model.save_weights('fer.h5')
```

Now our model is trained and ready to Predict now.

let test the model and get result and output

```
categories = ['angry','disgust','fear','happy','neutral','sad','surprise']

plt.figure(figsize=(14,9.5))

plt.subplot(2,2,1)
img = cv2.imread('/content/anirban_denath.jpeg')
img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)
face_cascade = cv2.CascadeClassifier('/content/haarcascade_frontalface_default.xml')
faces = face_cascade.detectMultiScale(img,1.1,4)
for (x,y,w,h) in faces:
  cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0))
  roi_gray = img[y:y+w,x:x+h]
img = cv2.cvtColor(roi_gray,cv2.COLOR_RGB2GRAY)
img = cv2.resize(img,(48,48))
img_pixels = image.img_to_array(img)
img_pixels = np.expand_dims(img_pixels,axis=0)
img_pixels /= 255
pred = model.predict(img_pixels)
max_index = np.argmax(pred[0])
emotion = categories[max_index]
print(emotion)
print(pred[0])
plt.imshow(roi_gray)
plt.title(emotion,fontsize=30)

plt.subplot(2,2,2)
img = cv2.imread('/content/arpan_datta.jpeg')
img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)
face_cascade = cv2.CascadeClassifier('/content/haarcascade_frontalface_default.xml')
faces = face_cascade.detectMultiScale(img,1.1,4)
for (x,y,w,h) in faces:
  cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0))
  roi_gray = img[y:y+w,x:x+h]
img = cv2.cvtColor(roi_gray,cv2.COLOR_RGB2GRAY)
img = cv2.resize(img,(48,48))
img_pixels = image.img_to_array(img)
img_pixels = np.expand_dims(img_pixels,axis=0)
img_pixels /= 255
pred = model.predict(img_pixels)
```

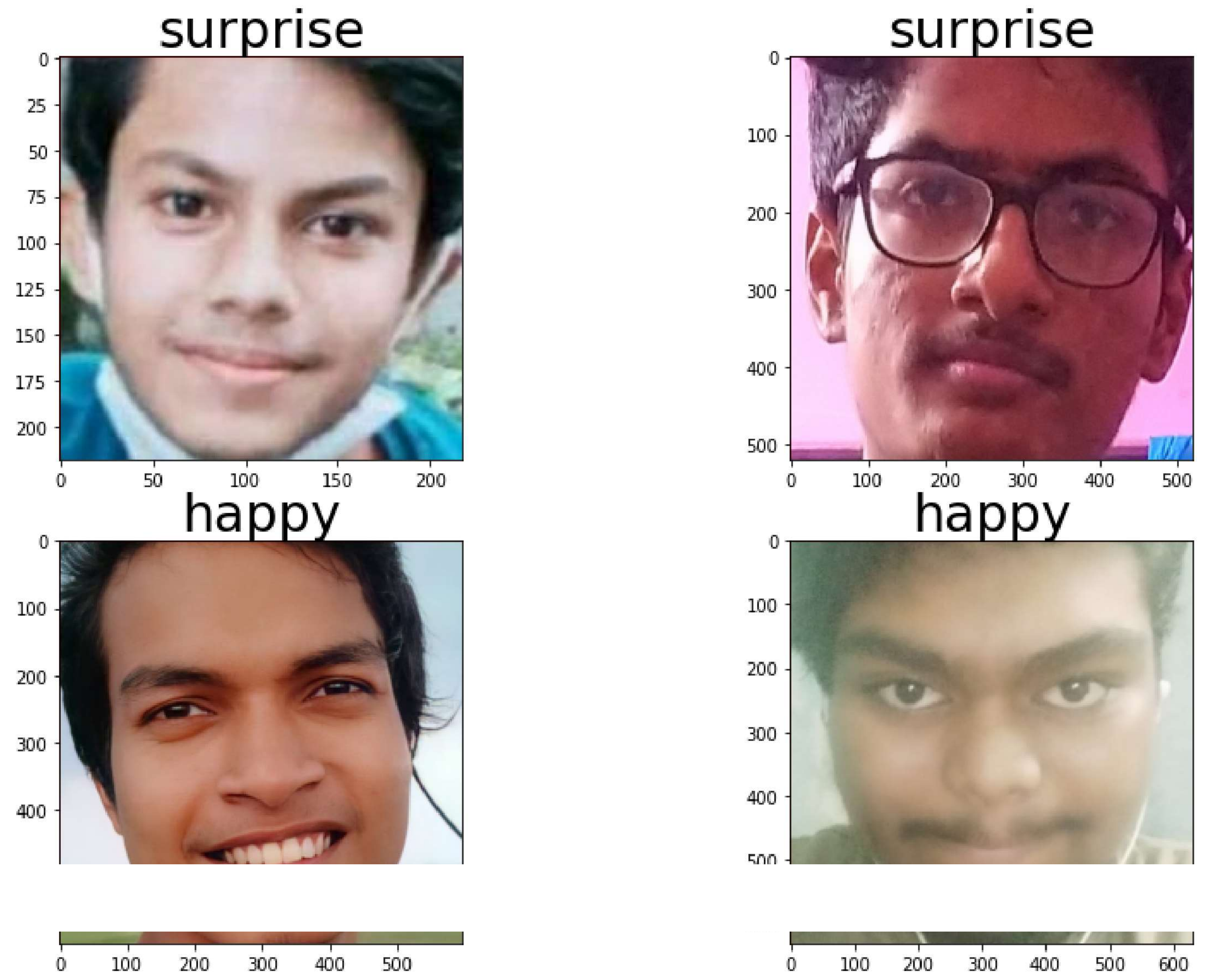
```
max_index = np.argmax(pred[0])
emotion = categories[max_index]
print(emotion)
print(pred[0])
plt.imshow(roi_gray)
plt.title(emotion,fontsize=30)

plt.subplot(2,2,3)
img = cv2.imread('/content/sayan_mondal.jpeg')
img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)
face_cascade = cv2.CascadeClassifier('/content/haarcascade_frontalface_default.xml')
faces = face_cascade.detectMultiScale(img,1.1,4)
for (x,y,w,h) in faces:
  cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0))
  roi_gray = img[y:y+w,x:x+h]
img = cv2.cvtColor(roi_gray,cv2.COLOR_RGB2GRAY)
img = cv2.resize(img,(48,48))
img_pixels = image.img_to_array(img)
img_pixels = np.expand_dims(img_pixels,axis=0)
img_pixels /= 255
pred = model.predict(img_pixels)
max_index = np.argmax(pred[0])
emotion = categories[max_index]
print(emotion)
print(pred[0])
plt.imshow(roi_gray)
plt.title(emotion,fontsize=30)

plt.subplot(2,2,4)
img = cv2.imread('/content/SachinSarkar.jpeg')
img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)
face_cascade = cv2.CascadeClassifier('/content/haarcascade_frontalface_default.xml')
faces = face_cascade.detectMultiScale(img,1.1,4)
for (x,y,w,h) in faces:
  cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0))
  roi_gray = img[y:y+w,x:x+h]
img = cv2.cvtColor(roi_gray,cv2.COLOR_RGB2GRAY)
img = cv2.resize(img,(48,48))
img_pixels = image.img_to_array(img)
img_pixels = np.expand_dims(img_pixels,axis=0)
img_pixels /= 255
pred = model.predict(img_pixels)
max_index = np.argmax(pred[0])
emotion = categories[max_index]
print(emotion)
print(pred[0])
plt.imshow(roi_gray)
plt.title(emotion,fontsize=30)

plt.show()
```

```
surprise
[4.8938429e-04 2.3620137e-09 9.3871182e-05 4.5723301e-01 2.5112189e-03
 1.5378767e-04 5.3951877e-01]
surprise
[4.6844523e-02 1.6783021e-04 4.1101608e-02 2.7136039e-02 6.0933489e-02
 1.2440691e-02 8.1137586e-01]
happy
[1.6053488e-11 8.6290733e-28 8.7686065e-13 1.0000000e+00 5.9242090e-11
 1.6721588e-13 9.8784803e-09]
happy
[8.255025e-03 9.084641e-06 6.219322e-03 6.430771e-01 2.188899e-02
 6.937715e-03 3.136128e-01]
```



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