Note : Data is uploaded in kaggle kernel

Importing required libraries (Dependencies)

In [1]:

```
import os
import cv2
import random
import numpy as np

from sklearn.model_selection import train_test_split
import tensorflow as tf
from keras.utils import np_utils
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Dense,Flatten,BatchNormalizatio
from tensorflow.keras.models import Sequential
```

Listing out the folders of training and testing images

In [2]:

```
print(os.listdir("../input/state-farm-distracted-driver-detection/imgs"))
```

```
['test', 'train']
```

Creating varibles having path of training and testing directories

In [3]:

```
training_dir = '../input/state-farm-distracted-driver-detection/imgs/train'
testing_dir = '../input/state-farm-distracted-driver-detection/imgs/test'
```

Dictionary with classes and habits

In [4]:

```
class_dict = {'classes': ['c0','c1','c2','c3','c4','c5','c6','c7','c8','c9'],
              'habits' : ['safe driving','texting - right',
                          'talking on the phone - right','texting - left',
                          'talking on the phone - left','operating the radio',
                          'drinking','reaching behind','hair and makeup','talking to pas
```

Preparing training data :

In [5]:

```
# Creating empty list to append the training data
training_data = []
```

Creating the list of training data with image and its class

In [6]:

```
def create_training_data():

    # Creating the path for each in category as well as image
    # Reading each image in gray scale and resizing it to 240 x 240
    # Appending the resized image and its class in list (img_100026.jpg,'c0')
    # Returning the len of training data

    for category in class_dict['classes'] :
        path = os.path.join(training_dir,category)
        class_idx = class_dict['classes'].index(category)

        for image in os.listdir(path):
            image_path = os.path.join(path,image)
            img = cv2.imread(image_path,cv2.IMREAD_GRAYSCALE)
            resized_img = cv2.resize(img,(240,240))
            training_data.append([resized_img,class_idx])
    return len(training_data)
```

In [7]:

```
create_training_data()
```

Out[7]:

```
22424
```

Preparing the testing data :

In [8]:

```
# Creating empty list to append the testing data
testing_data = []
```

Creating the list of testing data with image and resized image

In [9]:

```
def create_testing_data():

    # Creating the path for each image
    # Reading each image in gray scale and resizing it to 240 x 240
    # Appending the image and resized image
    # Returning the len of testing data

    for image in os.listdir(testing_dir):
        image_path = os.path.join(testing_dir,image)
        img = cv2.imread(image_path,cv2.IMREAD_GRAYSCALE)
        resized_img = cv2.resize(img,(240,240))
        testing_data.append([image,resized_img])
    return len(testing_data)
```

In [10]:

```
create_testing_data()
```

Out[10]:

```
79726
```

Shuffling the training data randomly

In [11]:

```
training_data = random.sample(training_data, len(training_data))
```

In [12]:

```
# Creating two list one with features and other with labels
x = []
labels = []
for features, label in training_data:
    x.append(features)
    labels.append(label)
```

One-hot Encoding

In [13]:

```
# E.g. --> if class 0 is predicted then y will be [1,0,0,0,0,0,0,0,0,0]

y = np_utils.to_categorical(labels,num_classes=len(class_dict['classes']))
```

Reshaping x to 240 x 240 x1

In [14]:

```
x = np.array(x).reshape(-1,240,240,1)
x[0].shape
```

Out[14]:

```
(240, 240, 1)
```

Shape of x and y

In [15]:

```
x.shape,y.shape
```

Out[15]:

```
((22424, 240, 240, 1), (22424, 10))
```

Splitting the data into 75%-25% (training=75,testing=25)

In [16]:

```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.25,random_state=50)
```

In [17]:

```
x_train.shape,x_test.shape,y_train.shape,y_test.shape
```

Out[17]:

```
((16818, 240, 240, 1), (5606, 240, 240, 1), (16818, 10), (5606, 10))
```

Model Architecture

In [18]:

```
model = Sequential()
```

In [19]:

```
####################### CNN Layer 1 ##################################

model.add(Conv2D(32,(3,3),activation='relu',input_shape=(240,240,1)))
model.add(BatchNormalization())
model.add(Conv2D(32,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization(axis = 3))
model.add(MaxPooling2D(pool_size=(2,2),padding='same'))
model.add(Dropout(0.2))

####################### CNN Layer 2 ##################################

model.add(Conv2D(64,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(64,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization(axis = 3))
model.add(MaxPooling2D(pool_size=(2,2),padding='same'))
model.add(Dropout(0.3))

######################## CNN Layer 3 ####################################

model.add(Conv2D(128,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization())
model.add(Conv2D(128,(3,3),activation='relu',padding='same'))
model.add(BatchNormalization(axis = 3))
model.add(MaxPooling2D(pool_size=(2,2),padding='same'))
model.add(Dropout(0.5))

######################## Dense Layer & Output Layer #####################

model.add(Flatten())
model.add(Dense(units = 512,activation='relu'))
model.add(BatchNormalization())
model.add(Dropout(0.5))
model.add(Dense(units = 128,activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(10,activation='softmax'))
```

Summary of Model :

In [20]:

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d (Conv2D)              (None, 238, 238, 32)      320       
_________________________________________________________________
batch_normalization (BatchNo (None, 238, 238, 32)      128       
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 238, 238, 32)      9248      
_________________________________________________________________
batch_normalization_1 (Batch (None, 238, 238, 32)      128       
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 119, 119, 32)      0         
_________________________________________________________________
dropout (Dropout)            (None, 119, 119, 32)      0         
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 119, 119, 64)      18496     
_________________________________________________________________
batch_normalization_2 (Batch (None, 119, 119, 64)      256       
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 119, 119, 64)      36928     
_________________________________________________________________
batch_normalization_3 (Batch (None, 119, 119, 64)      256       
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 60, 60, 64)        0         
_________________________________________________________________
dropout_1 (Dropout)          (None, 60, 60, 64)        0         
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 60, 60, 128)       73856     
_________________________________________________________________
batch_normalization_4 (Batch (None, 60, 60, 128)       512       
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 60, 60, 128)       147584    
_________________________________________________________________
batch_normalization_5 (Batch (None, 60, 60, 128)       512       
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 30, 30, 128)       0         
_________________________________________________________________
dropout_2 (Dropout)          (None, 30, 30, 128)       0         
_________________________________________________________________
flatten (Flatten)            (None, 115200)            0         
_________________________________________________________________
dense (Dense)                (None, 512)               58982912  
_________________________________________________________________
batch_normalization_6 (Batch (None, 512)               2048      
_________________________________________________________________
dropout_3 (Dropout)          (None, 512)               0         
_________________________________________________________________
dense_1 (Dense)              (None, 128)               65664     
_________________________________________________________________
dropout_4 (Dropout)          (None, 128)               0         
_________________________________________________________________
dense_2 (Dense)              (None, 10)                1290      
=================================================================
Total params: 59,340,138
Trainable params: 59,338,218
Non-trainable params: 1,920
_________________________________________________________________
```

Compiling the model

In [21]:

```
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['acc'])
```

In [22]:

```
# Stop model if accuracy of the model doesn't changes by more than 0.01
# Patience = 5 : After each 5 epochs if no improvement is there then training will be st

es = EarlyStopping(monitor='val_acc',patience= 5,min_delta=0.01)
```

Fitting the Model:

1. Batch Size = 128
2. Epochs = 12

In [23]:

```
 model.fit(x_train,y_train,batch_size=128,epochs=12,verbose=1,validation_data=(x_test,y_
```

```
Epoch 1/12
132/132 [==============================] - 53s 404ms/step - loss: 1.2938 - acc: 0.5953 -
val_loss: 0.3049 - val_acc: 0.9167
Epoch 2/12
132/132 [==============================] - 51s 387ms/step - loss: 0.1949 - acc: 0.9413 -
val_loss: 0.0517 - val_acc: 0.9850
Epoch 3/12
132/132 [==============================] - 51s 388ms/step - loss: 0.0840 - acc: 0.9750 -
val_loss: 0.0431 - val_acc: 0.9886
Epoch 4/12
132/132 [==============================] - 51s 387ms/step - loss: 0.0607 - acc: 0.9815 -
val_loss: 0.0248 - val_acc: 0.9923
Epoch 5/12
132/132 [==============================] - 51s 387ms/step - loss: 0.0573 - acc: 0.9819 -
val_loss: 0.0279 - val_acc: 0.9945
Epoch 6/12
132/132 [==============================] - 51s 388ms/step - loss: 0.0550 - acc: 0.9839 -
val_loss: 0.1317 - val_acc: 0.9600
Epoch 7/12
```

```
132/132 [==============================] - 51s 388ms/step - loss: 0.0455 - acc: 0.9863 -
val_loss: 0.0233 - val_acc: 0.9943
```

Out[23]:

```
<tensorflow.python.keras.callbacks.History at 0x7f6d6002c8d0>
```

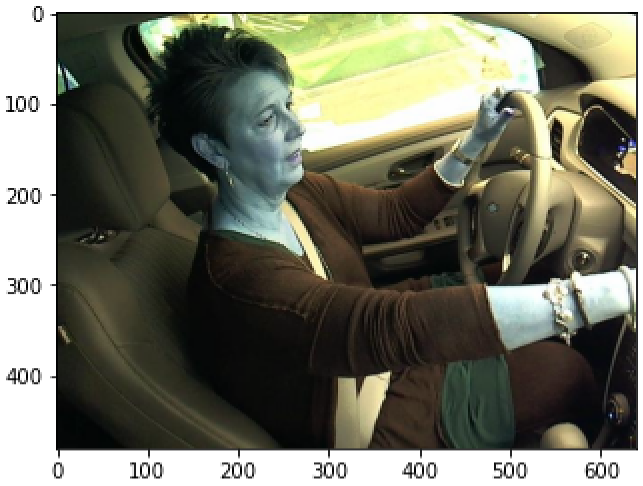
Predicting on the testing data :

In [36]:

```python
import matplotlib.pyplot as plt

testing_image = np.array(testing_data[5][1]).reshape(-1,240,240,1)
preds = model.predict(testing_image)
class_id = np.argmax(preds[0])
class_output = model.output[:, class_id]
path = '../input/state-farm-distracted-driver-detection/imgs/test'+'/'+testing_data[5][0
img_array = cv2.imread(path)
plt.imshow(img_array)
print(' class '+str(class_id)+' --> '+class_dict['habits'][class_id])
```

```
class 5 --> operating the radio
```



In [ ]: