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In [1]:

```
from keras.layers import Input, TimeDistributed
from keras.layers import LSTM
from keras.models import Model
```

```
Using TensorFlow backend.
```

In [2]:

```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import os
from glob import glob


from PIL import Image
np.random.seed(123)
from sklearn.preprocessing import label_binarize
from sklearn.metrics import confusion_matrix
from sklearn.utils import shuffle
import itertools

import keras
from keras.utils.np_utils import to_categorical  # use for converting labels to one-hot-enc
from keras import backend as K
from keras.layers import Dense, Dropout, Flatten, Conv2D, MaxPool2D
from keras.layers.normalization  import BatchNormalization
from keras.optimizers import Adam
from keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import ReduceLROnPlateau
from sklearn.model_selection import train_test_split
```

In [3]:

```
images_df = pd.read_csv("/Users/harit/Desktop/drowsiness_data/77k_trial_2.csv")
images_df.head()
```

Out[3]:

	id	image_id	label
0	0	drowsy0	0
1	1	drowsy1	0
2	2	drowsy2	0
3	3	drowsy3	0
4	4	drowsy4	0

In [4]:

```
path  = []
count=0

for i in images_df['id']:
    if i < 40309:
        path.append("/Users/harit/test_data/drowsy"+str(i)+".jpg")
    else:
        path.append("/Users/harit/test_data/vigilant"+str(i)+".jpg")
    while i > 85441:
        break

print(len(path))
images_df['path'] = path
images_df = shuffle(images_df)
```

```
85442
```

In [5]:

```

images_dict = {
    '0': 'Drowsy',
    '1': 'Vigilant'}
```

In [6]:

```
import cv2
#from tqdm import tqdm
def Dataset_loader():
    IMG = []
    read = lambda imname: np.asarray(Image.open(imname).convert("RGB"))
    for IMAGE_NAME in images_df['path']:
        img = read(IMAGE_NAME)
        img = cv2.resize(img, (100,75))
        IMG.append(img)
    return IMG
images_df['image'] = Dataset_loader()
```

In [7]:

```
x = images_df['image']
y = images_df['label']
```

In [8]:

```
x_train_o, x_test_o, y_train_o, y_test_o = train_test_split(x, y, test_size=0.30,random_sta
```

In [9]:

```
x_train = np.array(x_train_o.tolist())
x_test = np.array(x_test_o.tolist())
```

In [21]:

```
y_train = to_categorical(y_train_o, num_classes = 10)
y_test = to_categorical(y_test_o, num_classes = 10)
```

In [11]:

```
print(x_train.shape)
print(x_train[0].shape)
```

```
(59809, 75, 100, 3)
(75, 100, 3)
```

In [12]:

```
x_train=x_train.reshape(x_train.shape[0],100,75,3)
x_test=x_test.reshape(x_test.shape[0],100,75,3)
```

In [13]:

```
print(x_train.shape)
```

```
(59809, 100, 75, 3)
```

In [40]:

```
batch_size=2000
num_classes=10
epochs=5
row_hidden=10
col_hidden=10
```

In [16]:

```
y_train=keras.utils.to_categorical(y_train,num_classes)
y_test=keras.utils.to_categorical(y_test,num_classes)
row,col,pixel=x_train.shape[1:]

#4d input
x=Input(shape=(row,col,pixel))
```

In [17]:

```
encoded_rows=TimeDistributed(LSTM(row_hidden))(x)

#encoded colomns

encoded_colomns=LSTM(col_hidden)(encoded_rows)
```

In [18]:

```
prediction=Dense(num_classes,activation='softmax')(encoded_colomns)
model=Model(x,prediction)
model.compile(loss='categorical_crossentropy',optimizer='rmsprop',metrics=['accuracy'])
```

In [41]:

```
#training
result=model.fit(x_train,y_train,batch_size=batch_size,epochs=epochs,verbose=1,validation_d
```

```
Train on 53828 samples, validate on 25633 samples
Epoch 1/5
53828/53828 [==============================] - 1373s 26ms/step - loss: 1.252
4 - accuracy: 0.5319 - val_loss: 1.0659 - val_accuracy: 0.5822
Epoch 2/5
53828/53828 [==============================] - 1545s 29ms/step - loss: 0.913
8 - accuracy: 0.6838 - val_loss: 0.7671 - val_accuracy: 0.7703
Epoch 3/5
53828/53828 [==============================] - 1476s 27ms/step - loss: 0.669
4 - accuracy: 0.8728 - val_loss: 0.5669 - val_accuracy: 0.9689
Epoch 4/5
53828/53828 [==============================] - 1517s 28ms/step - loss: 0.489
8 - accuracy: 0.9648 - val_loss: 0.4077 - val_accuracy: 0.9763
Epoch 5/5
53828/53828 [==============================] - 1466s 27ms/step - loss: 0.368
5 - accuracy: 0.9734 - val_loss: 0.3038 - val_accuracy: 0.9866
```

In [23]:

```
x_train, x_validate, y_train, y_validate = train_test_split(x_train, y_train, test_size = 0
```

In [24]:

```
loss, accuracy = model.evaluate(x_test, y_test, verbose=1)
loss_v, accuracy_v = model.evaluate(x_validate, y_validate, verbose=1)
print("Validation: accuracy = %f  ;  loss_v = %f" % (accuracy_v, loss_v))
print("Test: accuracy = %f  ;  loss = %f" % (accuracy, loss))
model.save("detection_model_24.h5")
```

```
25633/25633 [==============================] - 55s 2ms/step
5981/5981 [==============================] - 11s 2ms/step
Validation: accuracy = 0.539876  ;  loss_v = 1.814104
Test: accuracy = 0.537588  ;  loss = 1.814634
```

In [25]:

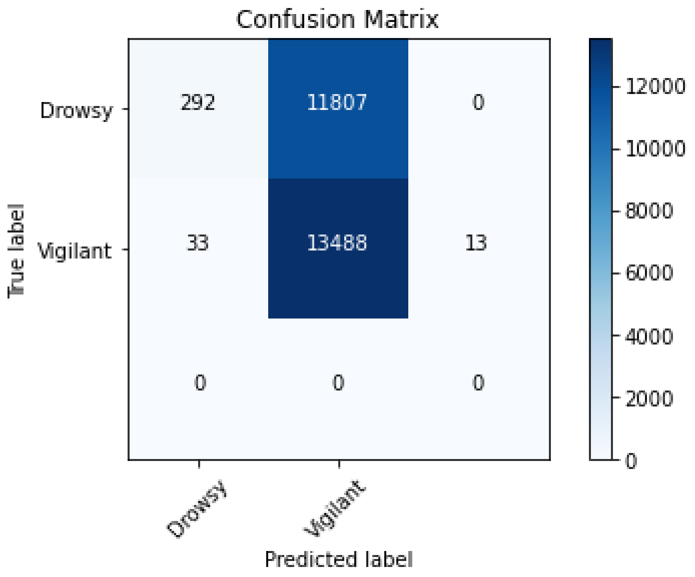
```
# Predict the values from the validation dataset
Y_pred = model.predict(x_test)
# Convert predictions classes to one hot vectors
Y_pred_classes = np.argmax(Y_pred,axis = 1)
# Convert validation observations to one hot vectors
Y_true = np.argmax(y_test,axis = 1)
# compute the confusion matrix
confusion_mtx = confusion_matrix(Y_true, Y_pred_classes)
```

In [42]:

```
# Function to plot confusion matrix
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
                          cmap=plt.cm.Blues):
    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]

    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, cm[i, j],
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

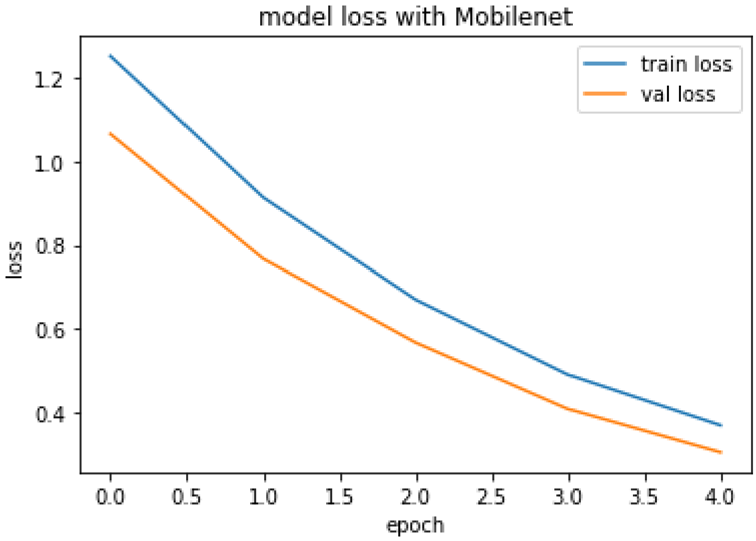
In [27]:

```
# plot the confusion matrix
cm_plot_labels = ['Drowsy', 'Vigilant']

plot_confusion_matrix(confusion_mtx, cm_plot_labels, title='Confusion Matrix')
#plot_confusion_matrix(confusion_mtx, classes = range(7))
```



In [43]:

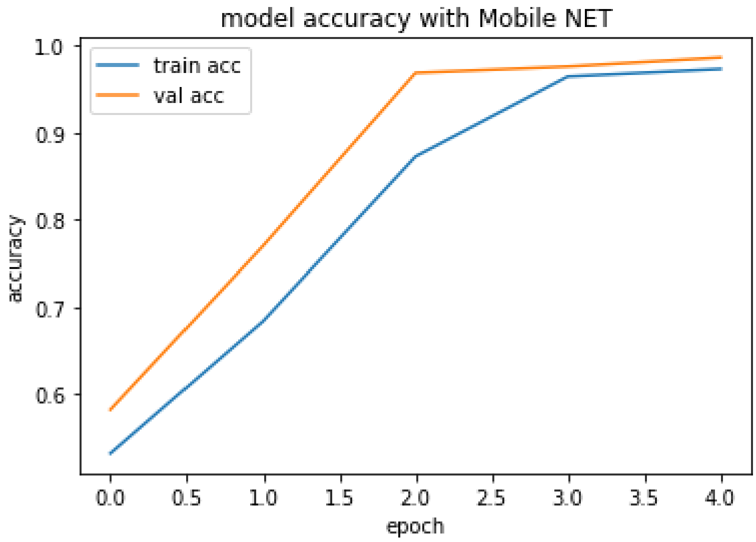
```
# loss
plt.plot(result.history['loss'], label='train loss')
plt.plot(result.history['val_loss'], label='val loss')
plt.legend()
plt.title('model loss with Mobilenet')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.show()
plt.savefig('LossVal_loss')
```



```
<Figure size 432x288 with 0 Axes>
```

In [44]:

```
# Accuracies
plt.plot(result.history['accuracy'], label='train acc')
plt.plot(result.history['val_accuracy'], label='val acc')
plt.title('model accuracy with Mobile NET')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend()
plt.show()
plt.savefig('AccVal_acc')
```



```
<Figure size 432x288 with 0 Axes>
```

In [ ]:

In [ ]:

In [ ]: