In [1]:

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

```
Drive already mounted at /content/drive; to attempt to forcibly remount, c
all drive.mount("/content/drive", force_remount=True).
```

In [2]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import keras
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.applications import MobileNetV2,ResNet50,VGG19
from tensorflow.keras.layers import AveragePooling2D
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Input
from tensorflow.keras.models import Model
from tensorflow.keras.applications.mobilenet_v2 import preprocess_input
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.models import load_model
from sklearn.preprocessing import LabelBinarizer
from sklearn.preprocessing import OneHotEncoder
from tensorflow.keras.utils import to_categorical
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
import cv2
import os
import argparse
from imutils import paths
import warnings
warnings.filterwarnings("ignore")
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: F
utureWarning: pandas.util.testing is deprecated. Use the functions in the
public API at pandas.testing instead.
  import pandas.util.testing as tm
```

In [3]:

```
basemodel = MobileNetV2(weights="imagenet",include_top= False, input_tensor =Input(shap
e=(224,224,3)))
x = basemodel.output
x = AveragePooling2D(pool_size=(7,7))(x)
x = Flatten()(x)
x = Dense(128,activation = "relu")(x)
x = Dropout(0.6)(x)
x = Dense(2, activation = "softmax")(x)
model = Model(inputs=basemodel.input,outputs=x)
```

```
WARNING:tensorflow:`input_shape` is undefined or non-square, or `rows` is
not in [96, 128, 160, 192, 224]. Weights for input shape (224, 224) will b
e loaded as the default.
```

In [4]:

```
for layer in basemodel.layers:
  layer.trainable = False
```

In [5]:

```
model.summary()
```

```
Model: "functional_1"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
input_1 (InputLayer)            [(None, 224, 224, 3) 0
__________________________________________________________________________________________________
Conv1_pad (ZeroPadding2D)       (None, 225, 225, 3)  0           input_1[0][0]
__________________________________________________________________________________________________
Conv1 (Conv2D)                  (None, 112, 112, 32) 864         Conv1_pad[0][0]
__________________________________________________________________________________________________
bn_Conv1 (BatchNormalization)   (None, 112, 112, 32) 128         Conv1[0][0]
__________________________________________________________________________________________________
Conv1_relu (ReLU)               (None, 112, 112, 32) 0           bn_Conv1[0][0]
__________________________________________________________________________________________________
expanded_conv_depthwise (Depthw (None, 112, 112, 32) 288         Conv1_relu[0][0]
__________________________________________________________________________________________________
expanded_conv_depthwise_BN (Bat (None, 112, 112, 32) 128         expanded_conv_depthwise[0][0]
__________________________________________________________________________________________________
expanded_conv_depthwise_relu (R (None, 112, 112, 32) 0           expanded_conv_depthwise_BN[0][0]
__________________________________________________________________________________________________
expanded_conv_project (Conv2D)  (None, 112, 112, 16) 512         expanded_conv_depthwise_relu[0][0
__________________________________________________________________________________________________
expanded_conv_project_BN (Batch (None, 112, 112, 16) 64          expanded_conv_project[0][0]
__________________________________________________________________________________________________
block_1_expand (Conv2D)         (None, 112, 112, 96) 1536        expanded_conv_project_BN[0][0]
__________________________________________________________________________________________________
block_1_expand_BN (BatchNormali (None, 112, 112, 96) 384         block_1_expand[0][0]
__________________________________________________________________________________________________
block_1_expand_relu (ReLU)      (None, 112, 112, 96) 0           block_1_expand_BN[0][0]
__________________________________________________________________________________________________
block_1_pad (ZeroPadding2D)     (None, 113, 113, 96) 0           block_1_expand_relu[0][0]
__________________________________________________________________________________________________
```

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__________________________
block_1_depthwise (DepthwiseCon (None, 56, 56, 96)   864         block_1_p
ad[0][0]
__________________________________________________________________________
__________________________
block_1_depthwise_BN (BatchNorm (None, 56, 56, 96)   384         block_1_d
epthwise[0][0]
__________________________________________________________________________
__________________________
block_1_depthwise_relu (ReLU)   (None, 56, 56, 96)   0           block_1_d
epthwise_BN[0][0]
__________________________________________________________________________
__________________________
block_1_project (Conv2D)        (None, 56, 56, 24)   2304        block_1_d
epthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_1_project_BN (BatchNormal (None, 56, 56, 24)   96          block_1_p
roject[0][0]
__________________________________________________________________________
__________________________
block_2_expand (Conv2D)         (None, 56, 56, 144)  3456        block_1_p
roject_BN[0][0]
__________________________________________________________________________
__________________________
block_2_expand_BN (BatchNormali (None, 56, 56, 144)  576         block_2_e
xpand[0][0]
__________________________________________________________________________
__________________________
block_2_expand_relu (ReLU)      (None, 56, 56, 144)  0           block_2_e
xpand_BN[0][0]
__________________________________________________________________________
__________________________
block_2_depthwise (DepthwiseCon (None, 56, 56, 144)  1296        block_2_e
xpand_relu[0][0]
__________________________________________________________________________
__________________________
block_2_depthwise_BN (BatchNorm (None, 56, 56, 144)  576         block_2_d
epthwise[0][0]
__________________________________________________________________________
__________________________
block_2_depthwise_relu (ReLU)   (None, 56, 56, 144)  0           block_2_d
epthwise_BN[0][0]
__________________________________________________________________________
__________________________
block_2_project (Conv2D)        (None, 56, 56, 24)   3456        block_2_d
epthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_2_project_BN (BatchNormal (None, 56, 56, 24)   96          block_2_p
roject[0][0]
__________________________________________________________________________
__________________________
block_2_add (Add)               (None, 56, 56, 24)   0           block_1_p
roject_BN[0][0]
                                                                 block_2_p
roject_BN[0][0]
__________________________________________________________________________
__________________________
block_3_expand (Conv2D)         (None, 56, 56, 144)  3456        block_2_a
dd[0][0]
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__________________________________________________________________________________________________
____________________________
block_3_expand_BN (BatchNormali (None, 56, 56, 144)  576         block_3_e
xpand[0][0]
__________________________________________________________________________________________________
____________________________
block_3_expand_relu (ReLU)      (None, 56, 56, 144)  0           block_3_e
xpand_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_3_pad (ZeroPadding2D)     (None, 57, 57, 144)  0           block_3_e
xpand_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_3_depthwise (DepthwiseCon (None, 28, 28, 144)  1296        block_3_p
ad[0][0]
__________________________________________________________________________________________________
____________________________
block_3_depthwise_BN (BatchNorm (None, 28, 28, 144)  576         block_3_d
epthwise[0][0]
__________________________________________________________________________________________________
____________________________
block_3_depthwise_relu (ReLU)   (None, 28, 28, 144)  0           block_3_d
epthwise_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_3_project (Conv2D)        (None, 28, 28, 32)   4608        block_3_d
epthwise_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_3_project_BN (BatchNormal (None, 28, 28, 32)   128         block_3_p
roject[0][0]
__________________________________________________________________________________________________
____________________________
block_4_expand (Conv2D)         (None, 28, 28, 192)  6144        block_3_p
roject_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_4_expand_BN (BatchNormali (None, 28, 28, 192)  768         block_4_e
xpand[0][0]
__________________________________________________________________________________________________
____________________________
block_4_expand_relu (ReLU)      (None, 28, 28, 192)  0           block_4_e
xpand_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_4_depthwise (DepthwiseCon (None, 28, 28, 192)  1728        block_4_e
xpand_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_4_depthwise_BN (BatchNorm (None, 28, 28, 192)  768         block_4_d
epthwise[0][0]
__________________________________________________________________________________________________
____________________________
block_4_depthwise_relu (ReLU)   (None, 28, 28, 192)  0           block_4_d
epthwise_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_4_project (Conv2D)        (None, 28, 28, 32)   6144        block_4_d
epthwise_relu[0][0]
__________________________________________________________________________________________________
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__________________________
block_4_project_BN (BatchNormal (None, 28, 28, 32)   128         block_4_p
roject[0][0]
__________________________________________________________________________
__________________________
block_4_add (Add)               (None, 28, 28, 32)   0           block_3_p
roject_BN[0][0]
                                                                 block_4_p
roject_BN[0][0]
__________________________________________________________________________
__________________________
block_5_expand (Conv2D)         (None, 28, 28, 192)  6144        block_4_a
dd[0][0]
__________________________________________________________________________
__________________________
block_5_expand_BN (BatchNormali (None, 28, 28, 192)  768         block_5_e
xpand[0][0]
__________________________________________________________________________
__________________________
block_5_expand_relu (ReLU)      (None, 28, 28, 192)  0           block_5_e
xpand_BN[0][0]
__________________________________________________________________________
__________________________
block_5_depthwise (DepthwiseCon (None, 28, 28, 192)  1728        block_5_e
xpand_relu[0][0]
__________________________________________________________________________
__________________________
block_5_depthwise_BN (BatchNorm (None, 28, 28, 192)  768         block_5_d
epthwise[0][0]
__________________________________________________________________________
__________________________
block_5_depthwise_relu (ReLU)   (None, 28, 28, 192)  0           block_5_d
epthwise_BN[0][0]
__________________________________________________________________________
__________________________
block_5_project (Conv2D)        (None, 28, 28, 32)   6144        block_5_d
epthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_5_project_BN (BatchNormal (None, 28, 28, 32)   128         block_5_p
roject[0][0]
__________________________________________________________________________
__________________________
block_5_add (Add)               (None, 28, 28, 32)   0           block_4_a
dd[0][0]
                                                                 block_5_p
roject_BN[0][0]
__________________________________________________________________________
__________________________
block_6_expand (Conv2D)         (None, 28, 28, 192)  6144        block_5_a
dd[0][0]
__________________________________________________________________________
__________________________
block_6_expand_BN (BatchNormali (None, 28, 28, 192)  768         block_6_e
xpand[0][0]
__________________________________________________________________________
__________________________
block_6_expand_relu (ReLU)      (None, 28, 28, 192)  0           block_6_e
xpand_BN[0][0]
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block_6_pad (ZeroPadding2D)     (None, 29, 29, 192)  0           block_6_e
xpand_relu[0][0]
__________________________________________________________________________
_____________________
block_6_depthwise (DepthwiseCon (None, 14, 14, 192)  1728        block_6_p
ad[0][0]
__________________________________________________________________________
_____________________
block_6_depthwise_BN (BatchNorm (None, 14, 14, 192)  768         block_6_d
epthwise[0][0]
__________________________________________________________________________
_____________________
block_6_depthwise_relu (ReLU)   (None, 14, 14, 192)  0           block_6_d
epthwise_BN[0][0]
__________________________________________________________________________
_____________________
block_6_project (Conv2D)        (None, 14, 14, 64)   12288       block_6_d
epthwise_relu[0][0]
__________________________________________________________________________
_____________________
block_6_project_BN (BatchNormal (None, 14, 14, 64)   256         block_6_p
roject[0][0]
__________________________________________________________________________
_____________________
block_7_expand (Conv2D)         (None, 14, 14, 384)  24576       block_6_p
roject_BN[0][0]
__________________________________________________________________________
_____________________
block_7_expand_BN (BatchNormali (None, 14, 14, 384)  1536        block_7_e
xpand[0][0]
__________________________________________________________________________
_____________________
block_7_expand_relu (ReLU)      (None, 14, 14, 384)  0           block_7_e
xpand_BN[0][0]
__________________________________________________________________________
_____________________
block_7_depthwise (DepthwiseCon (None, 14, 14, 384)  3456        block_7_e
xpand_relu[0][0]
__________________________________________________________________________
_____________________
block_7_depthwise_BN (BatchNorm (None, 14, 14, 384)  1536        block_7_d
epthwise[0][0]
__________________________________________________________________________
_____________________
block_7_depthwise_relu (ReLU)   (None, 14, 14, 384)  0           block_7_d
epthwise_BN[0][0]
__________________________________________________________________________
_____________________
block_7_project (Conv2D)        (None, 14, 14, 64)   24576       block_7_d
epthwise_relu[0][0]
__________________________________________________________________________
_____________________
block_7_project_BN (BatchNormal (None, 14, 14, 64)   256         block_7_p
roject[0][0]
__________________________________________________________________________
_____________________
block_7_add (Add)               (None, 14, 14, 64)   0           block_6_p
roject_BN[0][0]
                                                                 block_7_p
roject_BN[0][0]
__________________________________________________________________________
```

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__________________________
block_8_expand (Conv2D)         (None, 14, 14, 384)  24576       block_7_a
dd[0][0]
__________________________________________________________________________
__________________________
block_8_expand_BN (BatchNormali (None, 14, 14, 384)  1536        block_8_e
xpand[0][0]
__________________________________________________________________________
__________________________
block_8_expand_relu (ReLU)      (None, 14, 14, 384)  0           block_8_e
xpand_BN[0][0]
__________________________________________________________________________
__________________________
block_8_depthwise (DepthwiseCon (None, 14, 14, 384)  3456        block_8_e
xpand_relu[0][0]
__________________________________________________________________________
__________________________
block_8_depthwise_BN (BatchNorm (None, 14, 14, 384)  1536        block_8_d
epthwise[0][0]
__________________________________________________________________________
__________________________
block_8_depthwise_relu (ReLU)   (None, 14, 14, 384)  0           block_8_d
epthwise_BN[0][0]
__________________________________________________________________________
__________________________
block_8_project (Conv2D)        (None, 14, 14, 64)   24576       block_8_d
epthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_8_project_BN (BatchNormal (None, 14, 14, 64)   256         block_8_p
roject[0][0]
__________________________________________________________________________
__________________________
block_8_add (Add)               (None, 14, 14, 64)   0           block_7_a
dd[0][0]
                                                                 block_8_p
roject_BN[0][0]
__________________________________________________________________________
__________________________
block_9_expand (Conv2D)         (None, 14, 14, 384)  24576       block_8_a
dd[0][0]
__________________________________________________________________________
__________________________
block_9_expand_BN (BatchNormali (None, 14, 14, 384)  1536        block_9_e
xpand[0][0]
__________________________________________________________________________
__________________________
block_9_expand_relu (ReLU)      (None, 14, 14, 384)  0           block_9_e
xpand_BN[0][0]
__________________________________________________________________________
__________________________
block_9_depthwise (DepthwiseCon (None, 14, 14, 384)  3456        block_9_e
xpand_relu[0][0]
__________________________________________________________________________
__________________________
block_9_depthwise_BN (BatchNorm (None, 14, 14, 384)  1536        block_9_d
epthwise[0][0]
__________________________________________________________________________
__________________________
block_9_depthwise_relu (ReLU)   (None, 14, 14, 384)  0           block_9_d
epthwise_BN[0][0]
```

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__________________________________________________________________________________________________
__________________________
block_9_project (Conv2D)        (None, 14, 14, 64)   24576       block_9_d
epthwise_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_9_project_BN (BatchNormal (None, 14, 14, 64)   256         block_9_p
roject[0][0]
__________________________________________________________________________________________________
__________________________
block_9_add (Add)               (None, 14, 14, 64)   0           block_8_a
dd[0][0]
                                                                 block_9_p
roject_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_10_expand (Conv2D)        (None, 14, 14, 384)  24576       block_9_a
dd[0][0]
__________________________________________________________________________________________________
__________________________
block_10_expand_BN (BatchNormal (None, 14, 14, 384)  1536        block_10_
expand[0][0]
__________________________________________________________________________________________________
__________________________
block_10_expand_relu (ReLU)     (None, 14, 14, 384)  0           block_10_
expand_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_10_depthwise (DepthwiseCo (None, 14, 14, 384)  3456        block_10_
expand_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_10_depthwise_BN (BatchNor (None, 14, 14, 384)  1536        block_10_
depthwise[0][0]
__________________________________________________________________________________________________
__________________________
block_10_depthwise_relu (ReLU)  (None, 14, 14, 384)  0           block_10_
depthwise_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_10_project (Conv2D)       (None, 14, 14, 96)   36864       block_10_
depthwise_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_10_project_BN (BatchNorma (None, 14, 14, 96)   384         block_10_
project[0][0]
__________________________________________________________________________________________________
__________________________
block_11_expand (Conv2D)        (None, 14, 14, 576)  55296       block_10_
project_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_11_expand_BN (BatchNormal (None, 14, 14, 576)  2304        block_11_
expand[0][0]
__________________________________________________________________________________________________
__________________________
block_11_expand_relu (ReLU)     (None, 14, 14, 576)  0           block_11_
expand_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_11_depthwise (DepthwiseCo (None, 14, 14, 576)  5184        block_11_
```

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expand_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_11_depthwise_BN (BatchNor (None, 14, 14, 576)  2304        block_11_
depthwise[0][0]
__________________________________________________________________________________________________
__________________________
block_11_depthwise_relu (ReLU)  (None, 14, 14, 576)  0           block_11_
depthwise_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_11_project (Conv2D)       (None, 14, 14, 96)   55296       block_11_
depthwise_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_11_project_BN (BatchNorma (None, 14, 14, 96)   384         block_11_
project[0][0]
__________________________________________________________________________________________________
__________________________
block_11_add (Add)              (None, 14, 14, 96)   0           block_10_
project_BN[0][0]
                                                                 block_11_
project_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_12_expand (Conv2D)        (None, 14, 14, 576)  55296       block_11_
add[0][0]
__________________________________________________________________________________________________
__________________________
block_12_expand_BN (BatchNormal (None, 14, 14, 576)  2304        block_12_
expand[0][0]
__________________________________________________________________________________________________
__________________________
block_12_expand_relu (ReLU)     (None, 14, 14, 576)  0           block_12_
expand_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_12_depthwise (DepthwiseCo (None, 14, 14, 576)  5184        block_12_
expand_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_12_depthwise_BN (BatchNor (None, 14, 14, 576)  2304        block_12_
depthwise[0][0]
__________________________________________________________________________________________________
__________________________
block_12_depthwise_relu (ReLU)  (None, 14, 14, 576)  0           block_12_
depthwise_BN[0][0]
__________________________________________________________________________________________________
__________________________
block_12_project (Conv2D)       (None, 14, 14, 96)   55296       block_12_
depthwise_relu[0][0]
__________________________________________________________________________________________________
__________________________
block_12_project_BN (BatchNorma (None, 14, 14, 96)   384         block_12_
project[0][0]
__________________________________________________________________________________________________
__________________________
block_12_add (Add)              (None, 14, 14, 96)   0           block_11_
add[0][0]
                                                                 block_12_
project_BN[0][0]
```

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__________________________________________________________________________________________________
____________________________
block_13_expand (Conv2D)        (None, 14, 14, 576)  55296       block_12_
add[0][0]
__________________________________________________________________________________________________
____________________________
block_13_expand_BN (BatchNormal (None, 14, 14, 576)  2304        block_13_
expand[0][0]
__________________________________________________________________________________________________
____________________________
block_13_expand_relu (ReLU)     (None, 14, 14, 576)  0           block_13_
expand_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_13_pad (ZeroPadding2D)    (None, 15, 15, 576)  0           block_13_
expand_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_13_depthwise (DepthwiseCo (None, 7, 7, 576)    5184        block_13_
pad[0][0]
__________________________________________________________________________________________________
____________________________
block_13_depthwise_BN (BatchNor (None, 7, 7, 576)    2304        block_13_
depthwise[0][0]
__________________________________________________________________________________________________
____________________________
block_13_depthwise_relu (ReLU)  (None, 7, 7, 576)    0           block_13_
depthwise_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_13_project (Conv2D)       (None, 7, 7, 160)    92160       block_13_
depthwise_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_13_project_BN (BatchNorma (None, 7, 7, 160)    640         block_13_
project[0][0]
__________________________________________________________________________________________________
____________________________
block_14_expand (Conv2D)        (None, 7, 7, 960)    153600      block_13_
project_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_14_expand_BN (BatchNormal (None, 7, 7, 960)    3840        block_14_
expand[0][0]
__________________________________________________________________________________________________
____________________________
block_14_expand_relu (ReLU)     (None, 7, 7, 960)    0           block_14_
expand_BN[0][0]
__________________________________________________________________________________________________
____________________________
block_14_depthwise (DepthwiseCo (None, 7, 7, 960)    8640        block_14_
expand_relu[0][0]
__________________________________________________________________________________________________
____________________________
block_14_depthwise_BN (BatchNor (None, 7, 7, 960)    3840        block_14_
depthwise[0][0]
__________________________________________________________________________________________________
____________________________
block_14_depthwise_relu (ReLU)  (None, 7, 7, 960)    0           block_14_
depthwise_BN[0][0]
__________________________________________________________________________________________________
```

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__________________________
block_14_project (Conv2D)       (None, 7, 7, 160)    153600      block_14_
depthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_14_project_BN (BatchNorma (None, 7, 7, 160)    640         block_14_
project[0][0]
__________________________________________________________________________
__________________________
block_14_add (Add)              (None, 7, 7, 160)    0           block_13_
project_BN[0][0]
                                                                 block_14_
project_BN[0][0]
__________________________________________________________________________
__________________________
block_15_expand (Conv2D)        (None, 7, 7, 960)    153600      block_14_
add[0][0]
__________________________________________________________________________
__________________________
block_15_expand_BN (BatchNormal (None, 7, 7, 960)    3840        block_15_
expand[0][0]
__________________________________________________________________________
__________________________
block_15_expand_relu (ReLU)     (None, 7, 7, 960)    0           block_15_
expand_BN[0][0]
__________________________________________________________________________
__________________________
block_15_depthwise (DepthwiseCo (None, 7, 7, 960)    8640        block_15_
expand_relu[0][0]
__________________________________________________________________________
__________________________
block_15_depthwise_BN (BatchNor (None, 7, 7, 960)    3840        block_15_
depthwise[0][0]
__________________________________________________________________________
__________________________
block_15_depthwise_relu (ReLU)  (None, 7, 7, 960)    0           block_15_
depthwise_BN[0][0]
__________________________________________________________________________
__________________________
block_15_project (Conv2D)       (None, 7, 7, 160)    153600      block_15_
depthwise_relu[0][0]
__________________________________________________________________________
__________________________
block_15_project_BN (BatchNorma (None, 7, 7, 160)    640         block_15_
project[0][0]
__________________________________________________________________________
__________________________
block_15_add (Add)              (None, 7, 7, 160)    0           block_14_
add[0][0]
                                                                 block_15_
project_BN[0][0]
__________________________________________________________________________
__________________________
block_16_expand (Conv2D)        (None, 7, 7, 960)    153600      block_15_
add[0][0]
__________________________________________________________________________
__________________________
block_16_expand_BN (BatchNormal (None, 7, 7, 960)    3840        block_16_
expand[0][0]
__________________________________________________________________________
__________________________
```

```
block_16_expand_relu (ReLU)     (None, 7, 7, 960)    0           block_16_
expand_BN[0][0]
__________________________________________________________________________
_____________________
block_16_depthwise (DepthwiseCo (None, 7, 7, 960)    8640        block_16_
expand_relu[0][0]
__________________________________________________________________________
_____________________
block_16_depthwise_BN (BatchNor (None, 7, 7, 960)    3840        block_16_
depthwise[0][0]
__________________________________________________________________________
_____________________
block_16_depthwise_relu (ReLU)  (None, 7, 7, 960)    0           block_16_
depthwise_BN[0][0]
__________________________________________________________________________
_____________________
block_16_project (Conv2D)       (None, 7, 7, 320)    307200      block_16_
depthwise_relu[0][0]
__________________________________________________________________________
_____________________
block_16_project_BN (BatchNorma (None, 7, 7, 320)    1280        block_16_
project[0][0]
__________________________________________________________________________
_____________________
Conv_1 (Conv2D)                 (None, 7, 7, 1280)   409600      block_16_
project_BN[0][0]
__________________________________________________________________________
_____________________
Conv_1_bn (BatchNormalization)  (None, 7, 7, 1280)   5120        Conv_1[0]
[0]
__________________________________________________________________________
_____________________
out_relu (ReLU)                 (None, 7, 7, 1280)   0           Conv_1_bn
[0][0]
__________________________________________________________________________
_____________________
average_pooling2d (AveragePooli (None, 1, 1, 1280)   0           out_relu
[0][0]
__________________________________________________________________________
_____________________
flatten (Flatten)               (None, 1280)         0           average_p
ooling2d[0][0]
__________________________________________________________________________
_____________________
dense (Dense)                   (None, 128)          163968      flatten
[0][0]
__________________________________________________________________________
_____________________
dropout (Dropout)               (None, 128)          0           dense[0]
[0]
__________________________________________________________________________
_____________________
dense_1 (Dense)                 (None, 2)            258         dropout
[0][0]
==========================================================================
========================
Total params: 2,422,210
Trainable params: 164,226
Non-trainable params: 2,257,984
__________________________________________________________________________
_____________________
```

In [6]:

```
model.compile(loss="binary_crossentropy",optimizer="Adam",metrics=['accuracy'])
```

In [7]:

```
batch_size  = 32
epochs = 20
```

In [8]:

```
path = '/content/drive/My Drive/Finalproject/dataset/'
imagePaths = list(paths.list_images(path))
images = []
labels = []
for imagePath in imagePaths:
              label = imagePath.split(os.path.sep)[-2]
              image = load_img(imagePath, target_size=(224, 224))
              image = img_to_array(image)
              image = preprocess_input(image)
              images.append(image)
              labels.append(label)
images = np.array(images)
labels = np.array(labels)
```

In [9]:

```
print(images.shape)
print(labels.shape)
```

```
(1376, 224, 224, 3)
(1376,)
```

In [10]:

```
np.unique(labels)
```

Out[10]:

```
array(['with_mask', 'without_mask'], dtype='<U12')
```

In [11]:

```
encoder = LabelBinarizer()
labels = encoder.fit_transform(labels)
labels = to_categorical(labels)
```

In [12]:

```
x_train , x_test ,y_train,y_test = train_test_split(images, labels, test_size=0.20,rand
om_state=7,stratify=labels)
```

In [13]:

```
datagen = ImageDataGenerator(rotation_range =20,
                             zoom_range=0.20,
                             width_shift_range=0.2,
                             height_shift_range=0.2,
                             shear_range = 0.2,
                             horizontal_flip =True,
                             fill_mode = "nearest")
```

In [14]:

```
ear = model.fit(datagen.flow(x_train,y_train,batch_size=batch_size),
                steps_per_epoch = len(x_train) // batch_size,
                validation_data = (x_test,y_test),
                validation_steps = len(x_test) // batch_size,
                epochs = epochs)
```

```
Epoch 1/20
34/34 [==============================] - 14s 414ms/step - loss: 0.1460 - a
ccuracy: 0.9391 - val_loss: 0.0161 - val_accuracy: 0.9964
Epoch 2/20
34/34 [==============================] - 12s 365ms/step - loss: 0.0353 - a
ccuracy: 0.9831 - val_loss: 0.0013 - val_accuracy: 1.0000
Epoch 3/20
34/34 [==============================] - 12s 367ms/step - loss: 0.0316 - a
ccuracy: 0.9888 - val_loss: 0.0072 - val_accuracy: 0.9964
Epoch 4/20
34/34 [==============================] - 12s 363ms/step - loss: 0.0463 - a
ccuracy: 0.9888 - val_loss: 0.0238 - val_accuracy: 0.9891
Epoch 5/20
34/34 [==============================] - 12s 363ms/step - loss: 0.0256 - a
ccuracy: 0.9925 - val_loss: 0.0173 - val_accuracy: 0.9928
Epoch 6/20
34/34 [==============================] - 13s 379ms/step - loss: 0.0200 - a
ccuracy: 0.9925 - val_loss: 0.0027 - val_accuracy: 1.0000
Epoch 7/20
34/34 [==============================] - 12s 364ms/step - loss: 0.0158 - a
ccuracy: 0.9925 - val_loss: 7.6483e-04 - val_accuracy: 1.0000
Epoch 8/20
34/34 [==============================] - 13s 371ms/step - loss: 0.0143 - a
ccuracy: 0.9934 - val_loss: 0.0059 - val_accuracy: 0.9964
Epoch 9/20
34/34 [==============================] - 12s 363ms/step - loss: 0.0104 - a
ccuracy: 0.9953 - val_loss: 0.0086 - val_accuracy: 0.9928
Epoch 10/20
34/34 [==============================] - 13s 371ms/step - loss: 0.0137 - a
ccuracy: 0.9916 - val_loss: 0.0021 - val_accuracy: 1.0000
Epoch 11/20
34/34 [==============================] - 12s 364ms/step - loss: 0.0141 - a
ccuracy: 0.9944 - val_loss: 0.0045 - val_accuracy: 0.9964
Epoch 12/20
34/34 [==============================] - 12s 363ms/step - loss: 0.0105 - a
ccuracy: 0.9953 - val_loss: 0.0056 - val_accuracy: 0.9964
Epoch 13/20
34/34 [==============================] - 12s 366ms/step - loss: 0.0078 - a
ccuracy: 0.9963 - val_loss: 0.0051 - val_accuracy: 0.9964
Epoch 14/20
34/34 [==============================] - 13s 369ms/step - loss: 0.0158 - a
ccuracy: 0.9963 - val_loss: 0.0121 - val_accuracy: 0.9928
Epoch 15/20
34/34 [==============================] - 12s 359ms/step - loss: 0.0048 - a
ccuracy: 0.9981 - val_loss: 0.0243 - val_accuracy: 0.9928
Epoch 16/20
34/34 [==============================] - 12s 367ms/step - loss: 0.0177 - a
ccuracy: 0.9925 - val_loss: 0.0248 - val_accuracy: 0.9928
Epoch 17/20
34/34 [==============================] - 13s 371ms/step - loss: 0.0309 - a
ccuracy: 0.9878 - val_loss: 0.0162 - val_accuracy: 0.9964
Epoch 18/20
34/34 [==============================] - 13s 375ms/step - loss: 0.0049 - a
ccuracy: 0.9981 - val_loss: 0.0084 - val_accuracy: 0.9964
Epoch 19/20
34/34 [==============================] - 12s 360ms/step - loss: 0.0034 - a
ccuracy: 0.9991 - val_loss: 0.0146 - val_accuracy: 0.9964
Epoch 20/20
34/34 [==============================] - 12s 362ms/step - loss: 0.0025 - a
ccuracy: 0.9991 - val_loss: 0.0136 - val_accuracy: 0.9964
```

In [15]:

```
y_pred = model.predict(x_test,batch_size = batch_size)
y_pred = np.argmax(y_pred , axis =1)
print(classification_report(y_test.argmax(axis=1),y_pred,target_names=encoder.classes_
))
```

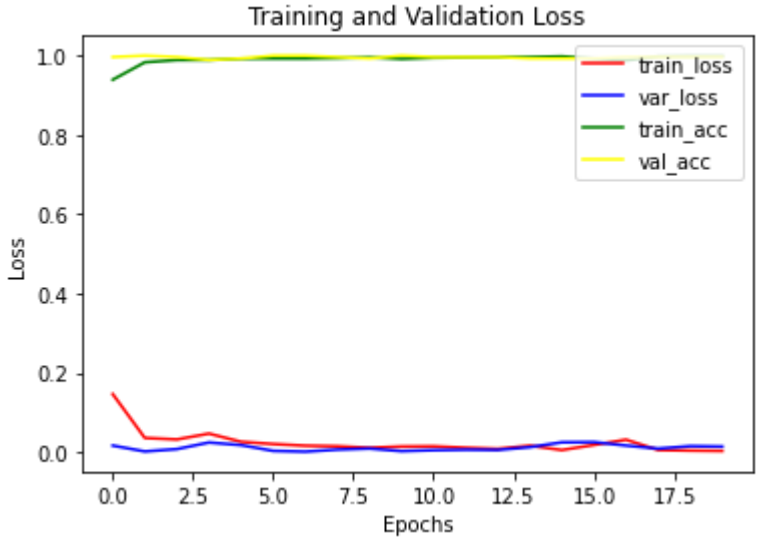
```
              precision    recall  f1-score   support

   with_mask       0.99      1.00      1.00       138
without_mask       1.00      0.99      1.00       138

    accuracy                           1.00       276
   macro avg       1.00      1.00      1.00       276
weighted avg       1.00      1.00      1.00       276
```

In [16]:

```
model.save("model",save_format="h5")
```

In [17]:

```
plt.plot(np.arange(0,epochs), ear.history['loss'],label='train_loss',color="red")
plt.plot(np.arange(0,epochs), ear.history['val_loss'],label='var_loss',color="blue")
plt.plot(np.arange(0,epochs), ear.history["accuracy"],label="train_acc",color="green")
plt.plot(np.arange(0,epochs),ear.history["val_accuracy"],label="val_acc",color="yellow"
)
plt.title("Training and Validation Loss")
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.legend(loc = "upper right")
plt.show()
```



In [43]:

```
prototxtPath = "/content/drive/My Drive/Finalproject/deploy.prototxt"
weightsPath  = "/content/drive/My Drive/Finalproject/res10_300x300_ssd_iter_140000.caff
emodel"
face_model = cv2.dnn.readNet(prototxtPath,weightsPath)
model = load_model("model")
```

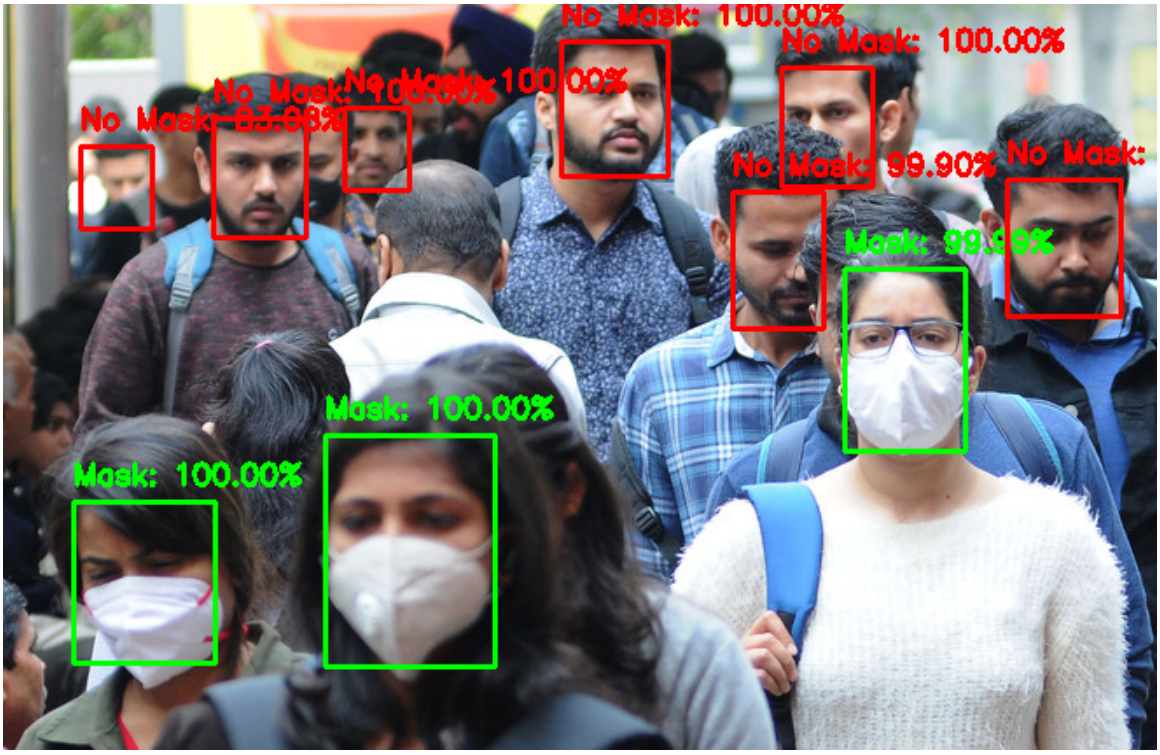
In [46]:

```
image = cv2.imread("/content/drive/My Drive/Finalproject/test/mine.jpg")
height,width = image.shape[:2]
blob = cv2.dnn.blobFromImage(image,1.0,(300,300),(104.0, 177.0 , 123))
face_model.setInput(blob)
detections = face_model.forward()
```

In [47]:

```
from google.colab.patches import cv2_imshow
threshold = 0.2
person_with_mask =0;
person_without_mask =0;
for i in range(0, detections.shape[2]):
  score = detections[0,0,i,2]
  if score > threshold:
    box = detections[0,0,i,3:7] * np.array([width,height,width,height])
    x_start, y_start, x_end, y_end = box.astype("int")
    x_start, y_start = (max(0, x_start), max(0, y_start))
    x_end, y_end = (min(width -1, x_end), min(height -1, y_end))

    face = image[y_start:y_end, x_start:x_end]
    face = cv2.cvtColor(face, cv2.COLOR_BGR2RGB)
    face = cv2.resize(face,(224,224))
    face = img_to_array(face)
    face = preprocess_input(face)
    face = np.expand_dims(face, axis=0)

    mask, withoutMask = model.predict(face)[0]

    if mask > withoutMask:
      label = "Mask"
      person_with_mask +=1
    else:
      label = "No Mask"
      person_without_mask +=1

    if label == "Mask":
      color = (0,255,0)
    else:
      color = (0,0,255)

    label = "{}: {:.2f}%".format(label, max(mask,withoutMask)*100)
    cv2.putText(image, label, (x_start,  y_start -10),cv2.FONT_HERSHEY_SIMPLEX, 0.55, c
olor, 2)
    cv2.rectangle(image, (x_start, y_start), (x_end, y_end), color,2)
print("Number of person with mask : {}".format(person_with_mask))
print("Number of person without mask : {}". format(person_without_mask))
cv2_imshow(image)
```

```
Number of person with mask : 3
Number of person without mask : 7
```



In [20]: