Main

Part 1 - Face Detection

In this project, we aim to construct a face detection model. We used a method haar to extract features. After that, by applying extracted features to cascade method, we were able to dectect people's faces and also count the number of faces through pictures as well as webcam. Pre-trained cascade was used from OpenCV.

Part 1.1 - Face Detection without Rotation on Image

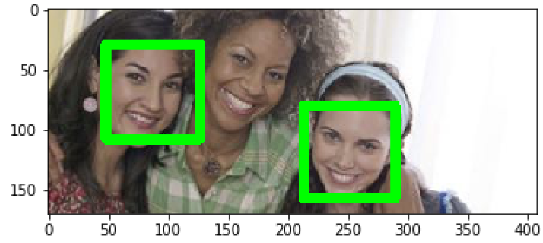
We started off the project with face detection on an image.

In [ ]:

```
# loading function
%load ../lib/count_face.py
```

In [38]:

```
# implementing model
counting_face()
```



Part 1.2 - Face Detection with Rotation

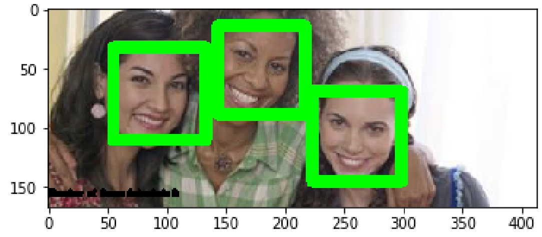
After implementation of Part 1, we realized the OpenCV front face cascade could not detect rotated face. Hence, we made some adjustments and declared additional functions to allow our model to analyze images from different rotation angle.

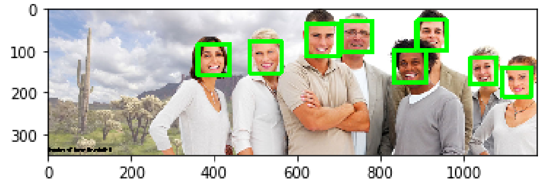
In [ ]:

```
# loading function
%load ../lib/counting_faces_image.py
```

In [40]:

```
# implementing model
face_dectect_image()
```





Part 1.3 - Real Time Face Detection with WebCam

After we improved our model, we wanted to further develop our model. Therefore, in this part, we implemented real time face detection using WebCam.

In [4]:

```
# loading function
%load ../lib/counting_faces_webcam
```

In [5]:

```
# Face Detection with Rotation using WebCam
```

```
face_dectect_webcam()
```

Part 2 - Object Detection API using Tensorflow

After we constructed our model in Part 1, we realized there exist some limitations in cascade model. Cascade model tends to have lower accuracy in side faces or partially showed faces. Also, cascade cannot detect highly rotated faces. To overcome such limitations, a popular and powerful approach is the use of tensorflow. In this section, we implement object detection with a pretrained model, Tensorflow Object Detection API. This model requires intallation of tensorflow. Further instruction of the installation can be referred to https://github.com/tensorflow/models/tree/master/research/object_detection (https://github.com/tensorflow/models/tree/master/research/object_detection). This model can detect and categorize object, including person, bottle, cellphone, etc. However, cascada model would result better if only faces are showed on an image while this API model would result better if more parts of human body are showed.

Part 2.1 - Object Detection API with Tensorflow on Image

Similar to Part 1.1, we started off with object detection using image.

In [46]:

```
%load ../doc/tensorflowFn.py
```

In [ ]:

```
# Tensorflow Object Detection API using Tensorflow on Image
# this part requires installation of tensorflow and Tensorflow Object Detection API
# detail information can be referred to https://github.com/tensorflow/models/tree/master/research/
object_detection
from PIL import Image
import numpy as np

directory = '../data/test_image/tensorflow/'
PATH_TO_TEST_IMAGES_DIR = directory
TEST_IMAGES_NAMES = os.listdir(directory)
TEST_IMAGE_PATHS = [os.path.join(PATH_TO_TEST_IMAGES_DIR, TEST_IMAGES_NAMES[i]) for i in range(1,l
en(TEST_IMAGES_NAMES))]

# Size, in inches, of the output images.
IMAGE_SIZE = (12, 8)

#
def load_image_into_numpy_array(image):
        (im_width, im_height) = image.size
        return np.array(image.getdata()).reshape((im_height, im_width, 3)).astype(np.uint8)

#

# implementing model
for image_path in TEST_IMAGE_PATHS:
    image = Image.open(image_path)
    image_np = load_image_into_numpy_array(image)
    # expand dimension
    image_np_expanded = np.expand_dims(image_np, axis=0)
    # actual detection
    output_dict = run_inference_for_single_image(image_np, detection_graph)
    # visualization of detected image
    vis_util.visualize_boxes_and_labels_on_image_array(
        image_np,
        output_dict['detection_boxes'],
        output_dict['detection_classes'],
        output_dict['detection_scores'],
        category_index,
        instance_masks=output_dict.get('detection_masks'),
        use_normalized_coordinates=True,
        line_thickness=8)
    plt.figure(figsize=IMAGE_SIZE)
    plt.imshow(image_np)
```

Part 2.2 - Real Time Object Detection API with Tensorflow using WebCam

Part 2.1 resulted in highly accurate result detecting most of the objects into their corresponding categories. We further improved the model by implementing the model using WebCam as an input. The result was again very accurate.

In [ ]:

```
%load ../doc/tensorflowFnVideo.py
```

In [ ]:

```
# ## tensorflow webcam object detection
# this part requires installation of tensorflow and Tensorflow Object Detection API
```

```python
# this part requires installation of tensorflow and Tensorflow Object Detection API
# detail information can be referred to https://github.com/tensorflow/models/tree/master/research/
object_detection


detection_graph = tf.Graph()
with detection_graph.as_default():
    od_graph_def = tf.GraphDef()
    with tf.gfile.GFile(PATH_TO_CKPT, 'rb') as fid:
        serialized_graph = fid.read()
        od_graph_def.ParseFromString(serialized_graph)
        tf.import_graph_def(od_graph_def, name='')

label_map = label_map_util.load_labelmap(PATH_TO_LABELS)
categories = label_map_util.convert_label_map_to_categories(label_map, max_num_classes=NUM_CLASSES
, use_display_name=True)
category_index = label_map_util.create_category_index(categories)


cap = cv2.VideoCapture(0)
with detection_graph.as_default():
    with tf.Session(graph=detection_graph) as sess:
    ret = True
    while (ret):
        ret,image_np = cap.read()
        image_np_expanded = np.expand_dims(image_np, axis=0)
        image_tensor = detection_graph.get_tensor_by_name('image_tensor:0')
        boxes = detection_graph.get_tensor_by_name('detection_boxes:0')
        scores = detection_graph.get_tensor_by_name('detection_scores:0')
        classes = detection_graph.get_tensor_by_name('detection_classes:0')
        num_detections = detection_graph.get_tensor_by_name('num_detections:0')
        (boxes, scores, classes, num_detections) = sess.run(
                [boxes, scores, classes, num_detections],
                feed_dict={image_tensor: image_np_expanded})
        vis_util.visualize_boxes_and_labels_on_image_array(
            image_np,
            np.squeeze(boxes),
            np.squeeze(classes).astype(np.int32),
            np.squeeze(scores),
            category_index,
            use_normalized_coordinates=True,
            line_thickness=8)
```