# Advanced Computer Vision Project-1

## The Real Problem

### What is Face recognition?

“Say hello to the future” the tagline of iPhoneX marked the advent of face recognition into mainstream apps using it as a feature to unlock the phone. This marks a milestone in itself as far as facial recognition technology is concerned. - Deepa Naik

Facial recognition is a category of biometricc software that maps an individual's facial features mathematically and stores the data as a face print. The software uses deep learning algorithms to compare a live capture or digital image to the stored face print in order to verify an individual's identity.

### Facial recognition is being used in many businesses

You’re used to unlocking your door with a key, but maybe not with your face. As strange as it sounds, our physical appearances can now verify payments, grant access and improve existing security systems. Protecting physical and digital possessions is a universal concern which benefits everyone unless you’re a cybercriminal or a kleptomaniac of course. Facial biometrics are gradually being applied to more industries, disrupting design, manufacturing, construction, law enforcement, and healthcare.

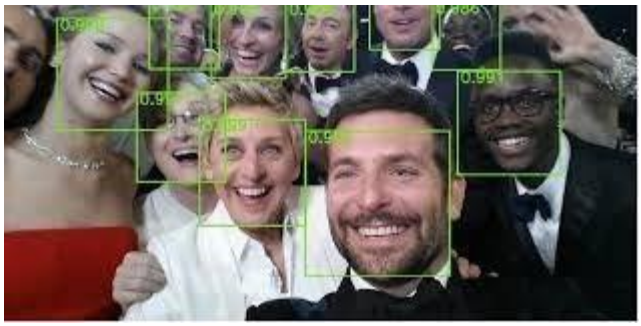
### Understanding Face Recognition Software

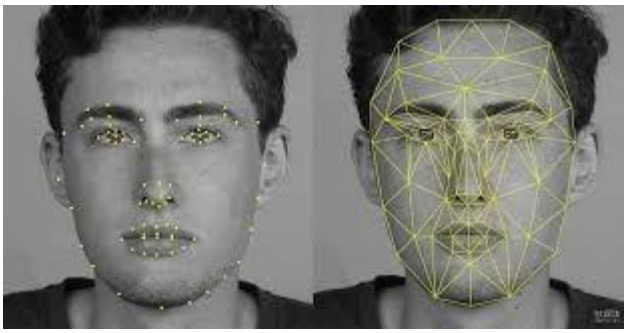
Face recognition deals with Computer Vision a discipline of Artificial Intelligence and uses techniques of image processing and deep learning. Face recognition algorithms can be further classified based on whether they are used on 2D or 3D images or on finding faces in motion, like in a video.

### Face Detection vs. Face Recognition

Though they sound similar, the complexity involved in both is vastly different. In Face Detection, the computer recognizes the face within an image and locates its position. If you have used face changer app on Snapchat, you are using face detection. Face recognition deals with identification to establish whose face it is by matching it to an existing face database. You can refer to the images below for the distinction.

***Face detection*** ***Face recognition***





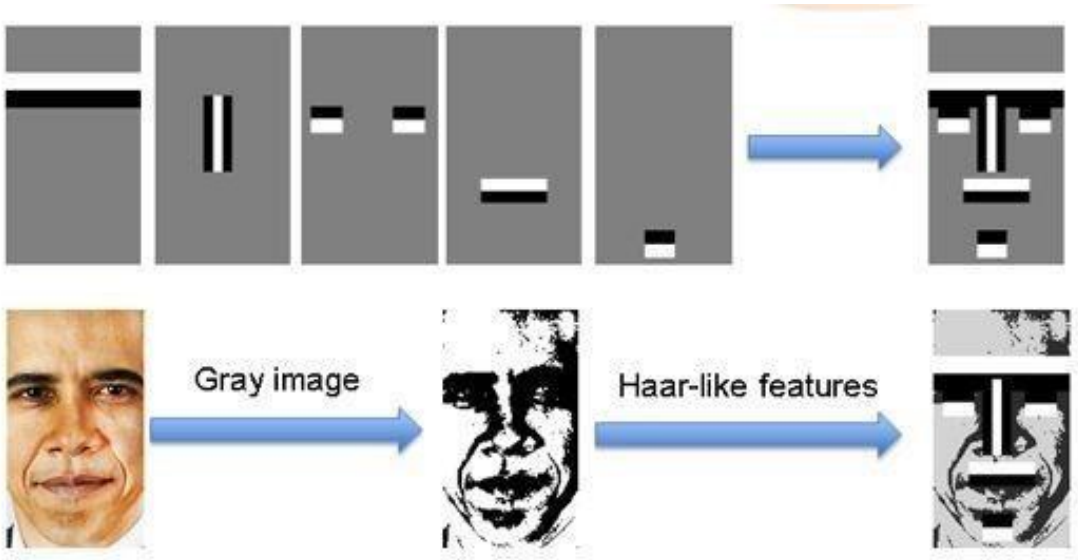
Apart from identification, other typical features are

- **Emotion Detection**
- **Age Detection**
- **Gender Detection**
- **Attention Measurement**
- **Sentiment Detection ● Ethnicity Detection**


**How Does Face Recognition Work?**

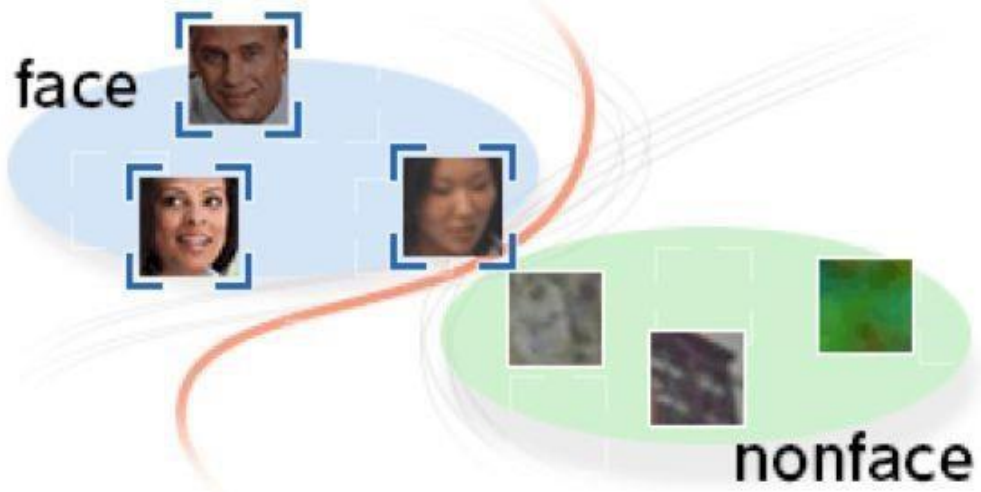
Until the year 2000, there were many different techniques to detect the face, but all were either slow or unreliable, or both. A major change happened in 2001, when Viola and Jones invented Haar-based cascade classifier, a technique used to identify object and it was improved by Lienhart and Maydt in 2002. The result of identifying objects was fast enough (identifying in real-time on normal PC) and was reliable (more than 95% accuracy).

There are two approaches to the facial recognition: Feature-Based Face Recognition and Appearance-Based Face Recognition. Haar-like features are the rectangle which is divided into different rectangles. First, the image is grayscaled, then the haar-like features (rectangle) are shifted through the image, comparing similar image rectangles with Haar-like features, similar ones are marked.

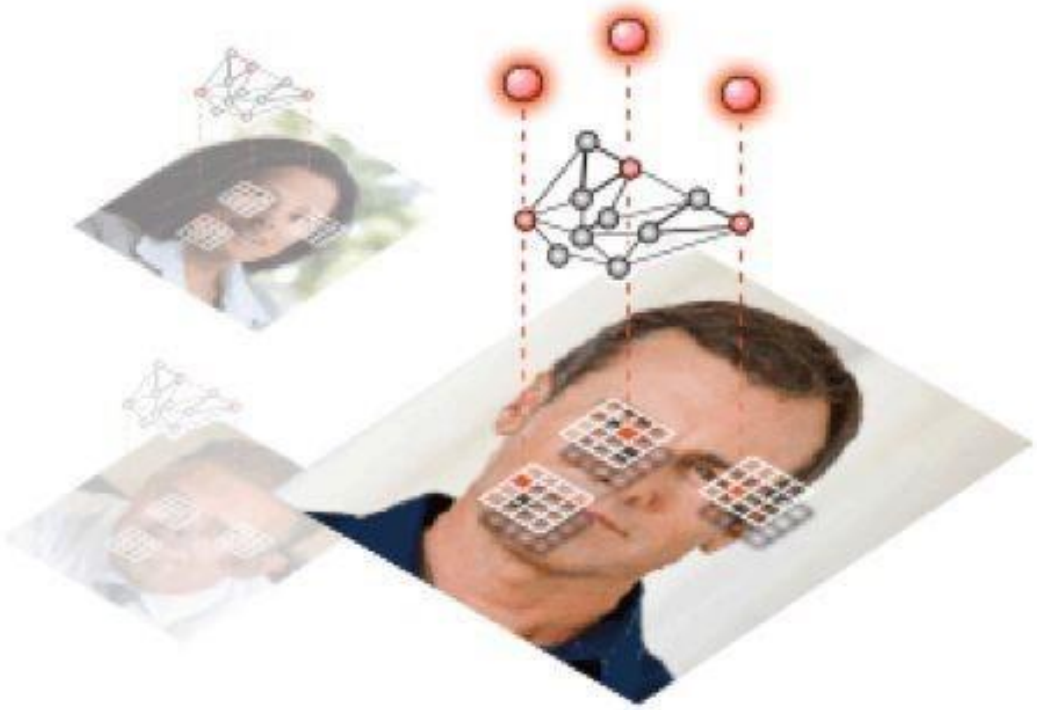



The following are three main steps in the face recognition using haar-like method: Step 1.

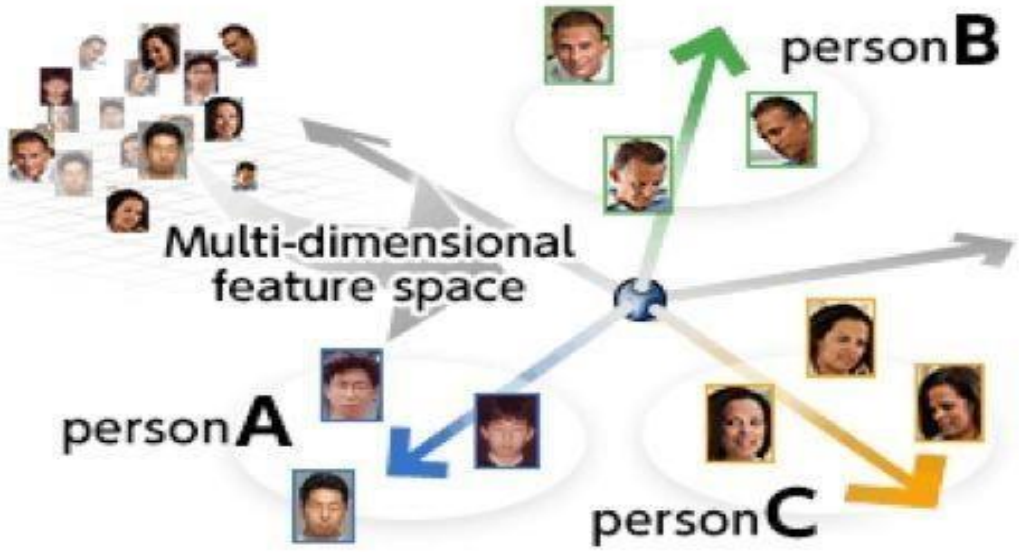
Detects the “position of the face”




Step 2. Finds the “feature of the face”



Step 3. Search and identify of the “detected face” in the database.



## Project Description

In this hands-on project, the goal is to build a face recognition system, which includes building a face detector to locate the position of a face in an image and a face identification model to recognize whose face it is by matching it to the existing database of faces.

Please Note: As part of this project, you will be building a face detection system. Post the course on Advanced Computer vision, you will be using this code as a base to build the face recognition system over this model!

### Face Detector

We will be using transfer learning on an already trained model to build our detector. We will perform transfer learning on Mobile Net model which is already trained to perform object detection. We will need to train the last 6-7 layers and freeze the remaining layers to train the model for face detection. To be able to train the Mobile Net model for face detection, we will be using WIDER FACE dataset which already has the bounding box data for various images with single face and multiple faces. The output of the model is the bounding box data which gives the location of the face in an image. We learn to build a face detection model using Keras supported by Tensorflow

## Overview

In this problem we use "Transfer Learning" of an Object Detector model to detect any object according to the problem in hand.

Here, we are particularly interested in detecting faces in a given image. Below are the steps involved in the project.

1. To use already trained model, we will import the model and its supporting files for the model to function.

2. Set the parameters for the model

3. Import the dataset for the model to train on. For this, we are using the WIDER FACE dataset.

4. Get the labels for these images, so that we can use this information while training for detecting faces with the given model using transfer learning. (5 points)

5. Making the model ready for training by freezing some layers in which we are not updating the weights while training. We need to train the top 6-7 layers. (10 points)

6. load the weights of the Mobile Net model given in file "`mobilenet_1_0_224_tf.h5`"

7. Set the optimizers, loss functions, epochs, learning rate, batch size, check pointing, early stopping etc. (5 points)

8. Train the model

9. Load the best saved weights (5 points)

10. Predict using test images (5 points)

Instructions for all the above steps are given in the notebook.

***Mobile net explained***

1. https://medium.com/@yu4u/why-mobilenet-and-its-variants-e-g-shufflenet-are-fast-1c7048b9618d
2. https://hackernoon.com/creating-insanely-fast-image-classifiers-with-mobilenet-intensorflowf030ce0a2991.

Mobile Net paper : https://arxiv.org/pdf/1704.04861.pdf

***WIDER FACE: A Face Detection Benchmark Dataset***

---

WIDER FACE dataset is a face detection benchmark dataset, of which images are selected from the publicly available WIDER datase t. We choose **32,203** images and label **393,703** faces with a high degree of variability in scale, pose and occlusion as depicted in the sample images. WIDER FACE dataset is organized based on 61 event classes. For each event class, we randomly select 40%/10%/50% data as training, validation and testing sets. We adopt the same evaluation metric employed in the PASCAL VOC datase t. Similar to MAL F and Caltec h datasets, we do not release bounding box ground truth for the test images. Users are required to submit final prediction files, which we shall proceed to evaluate.

## Reference

Acknowledgement for the datasets.
http://mmlab.ie.cuhk.edu.hk/projects/WIDERFace/