

A conceptual image featuring a hand holding a glowing globe. The globe is composed of a grid of blue lines and is covered with numerous bright, glowing blue dots, suggesting a digital or networked world. The word "Welcome" is written in a large, white, sans-serif font across the center of the globe. The background is a dark blue gradient with some abstract light patterns.

Welcome



# ***Face & Eye Detection***

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# Introduction

- Face image processing is recently used for personal identification, facial expression detection, drowsiness detection and so on. The important face parts such as eyes, mouth are used to express facial feature.
- Active contour model.
- Deformable template model.
- Local smoothness of image density.
- Color information of image.
- Knowledge about shape and locationship of face parts are several methods used to detect face parts.



# Face Detection

- Identify and locate human faces in an image regardless of their
  - position
  - scale
  - in-plane rotation
  - orientation
  - pose (out-of-plane rotation)
  - and illumination



# Why Face Detection is Important?

- First step for any fully automatic face recognition system
- First step in many surveillance systems
- Face is a highly non-rigid object
- Lots of applications
- A step towards Automatic Target Recognition (ATR) or generic object detection/recognition





# Our method to detect eye&face

- When application of face image recognition is limited to the specific purpose, in the case which one face is always clearly obtained, algorithm for extracting face parts becomes extremely simple by using SYMMETRY.
- We focus bilateral symmetries between and within face parts and detect the symmetry measure on face parts using the gradient directions

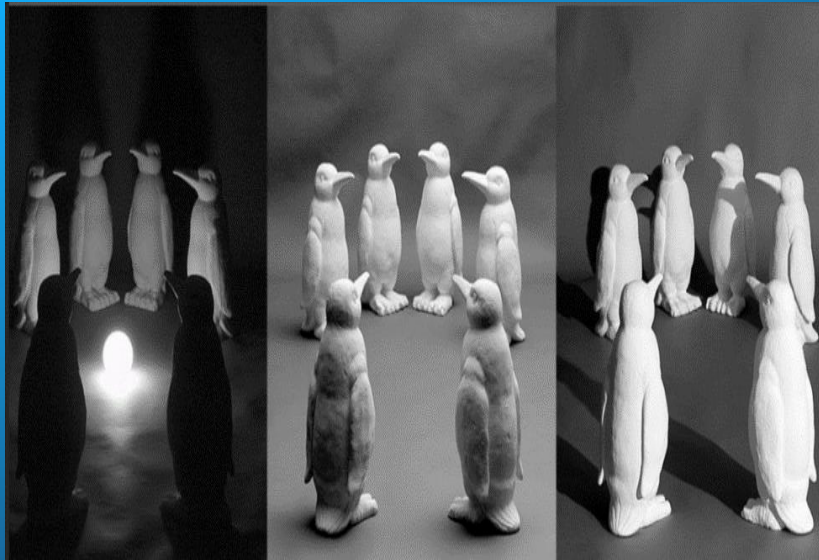


# Our method to detect eye&face

- We determine width and height of face parts extraction windows from horizontally and vertically projected histograms of symmetry measures.
- Then we use template matching method to detect eyes and mouth in those reduced search areas.

# Why is it so hard? So Many Reasons!

- Changing Lighting
- Scaling





# Why is it so hard? So Many Reasons!

- Viewpoint variations
- Non-rigid deformations





# Method of Face & Eye Detection

## Understanding HAAR Cascade Classifiers

### Face & Eye Detection



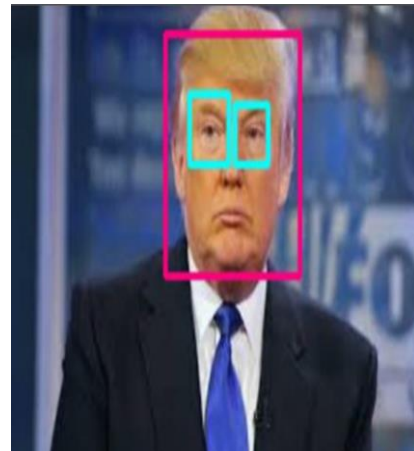
# HAAR Cascade Classifiers

As we saw in the previous section, we can extract features from an image and use those features to classify objects.

# What are HAAR Cascade Classifiers?

An object detection method that inputs Haar features into a series of classifiers to identify objects in an image. They are trained to identify one type of object, however, we can use several of them in parallel.

- Detecting eyes and face together.



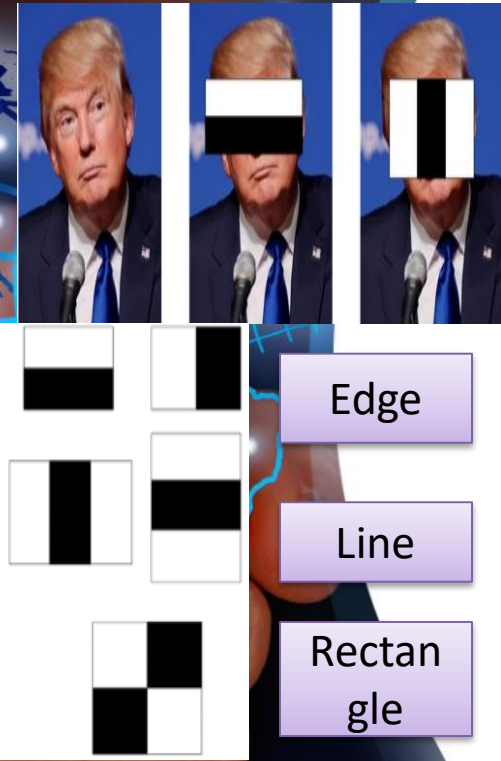
# HAAR Classifiers Explained

HAAR Classifiers are trained using lots of positive images and negative images.





# HAAAR Classifiers Explained



We then extract features using sliding windows of rectangular blocks. These features are single valued and are calculated by subtracting the sum of pixel intensities under the white rectangles from the black rectangles. So the researchers devised a method called Integral Images that computed this with four array references.

# HAAR Classifiers Explained

However, they still had 180,000 features and the majority of them added no real value.  
majority of them added no real value.



Relevant



Irrelevant



# HAAR Classifiers Explained

Boosting was then used to determine the most informative features, with Freund & Schapire's AdaBoost the algorithm of choice due to its ease of implementation. Boosting is the process by which we use weak classifiers to build strong classifiers, simply by assigning heavier weighted penalties on incorrect classifications. Reducing the 180,000 features to 6000, which is still quite a bit features.

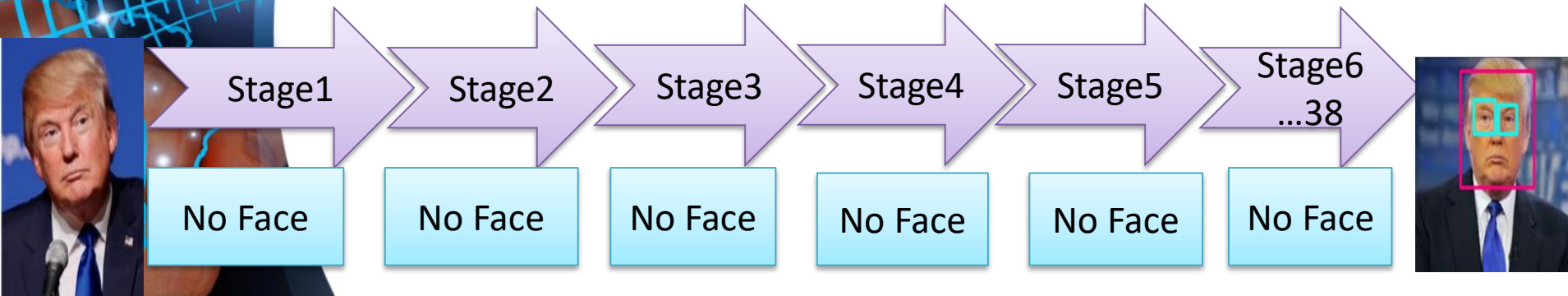


# HAAR Classifiers Explained

- Think about this intuitively, if of those 6000 features, some will be more informative than others. What if we used the most informative features to first check whether the region can potentially have a face. Doing so eliminates the need for calculating all 6000 features at once.

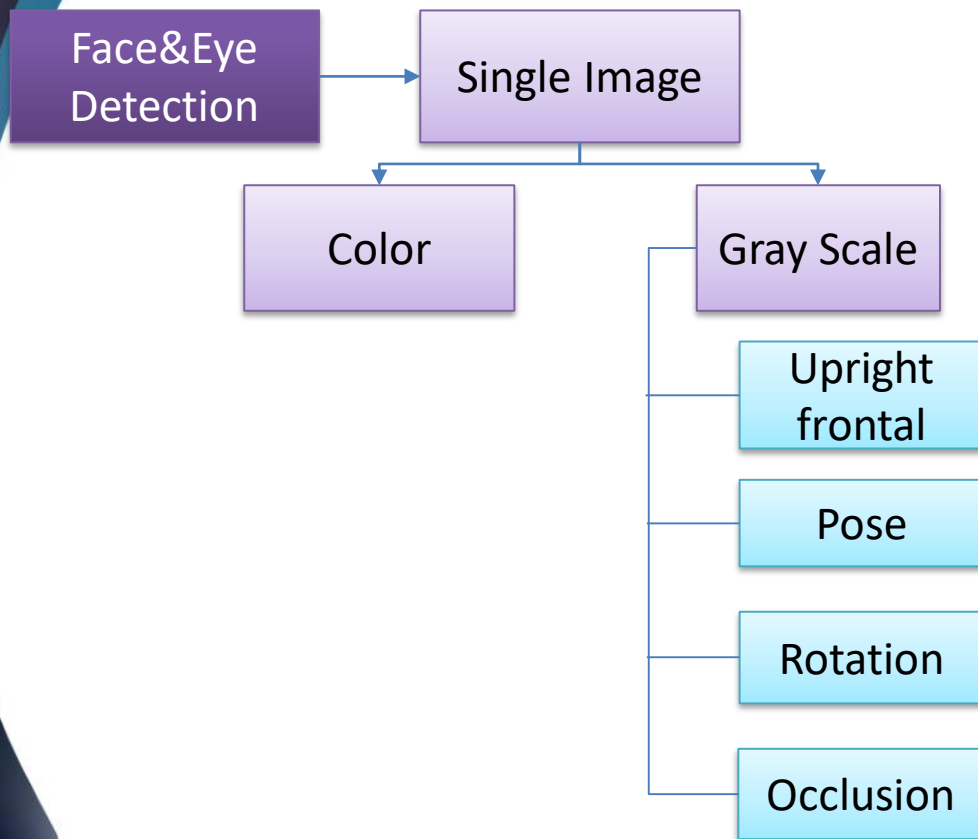
# HAAR Classifiers Explained

- This concept is called the Cascade of Classifiers - This concept is called the Cascade of Classifiers – for face detection, the Viola Jones method used 38 stages.





# Process of Face&Eye Detection





# Process of Face&Eye Detection

- Focus on detecting
  - upright, frontal faces
  - in a single gray-scale image
  - with decent resolution
  - under good lighting conditions
- See for detecting faces in low-resolution images



Thank You