

# Face Recognition Using Image Processing

Sarwagya Kishan & Vishnu Prabhakaran

Computer Science– Keene State College

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Dr. Meenalosini Vimal Cruz

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## Introduction

The problem of face recognition in images and videos has been widely researched in the field of computer vision and image processing. Not only is the recognition of faces useful in applications such as image classification and retrieval, it can also be thought of as an essential intermediate step in areas such as biometrics, social media and security. In general, due to the variety of scene parameters such as illumination, scaling, camera characteristics, as well as the variability within the large set of objects humans consider to be faces, face recognition becomes a complex classification problem in a high dimensional space

## Facial Feature Extraction

Facial features, such as eyes, nose, and mouth as well as their spatial relationships are very important in various applications like face recognition, facial expression detection, face tracking, lip reading etc. Hence, after detecting the face region from a cluttered image we should extract various features from the face, and then we verify them for our recognition purpose.

### Methods Used:

**Generic Methods: Edge Detection, grayscale distribution**

**Wavelet Transform**

**Color Segmentation Based Techniques**

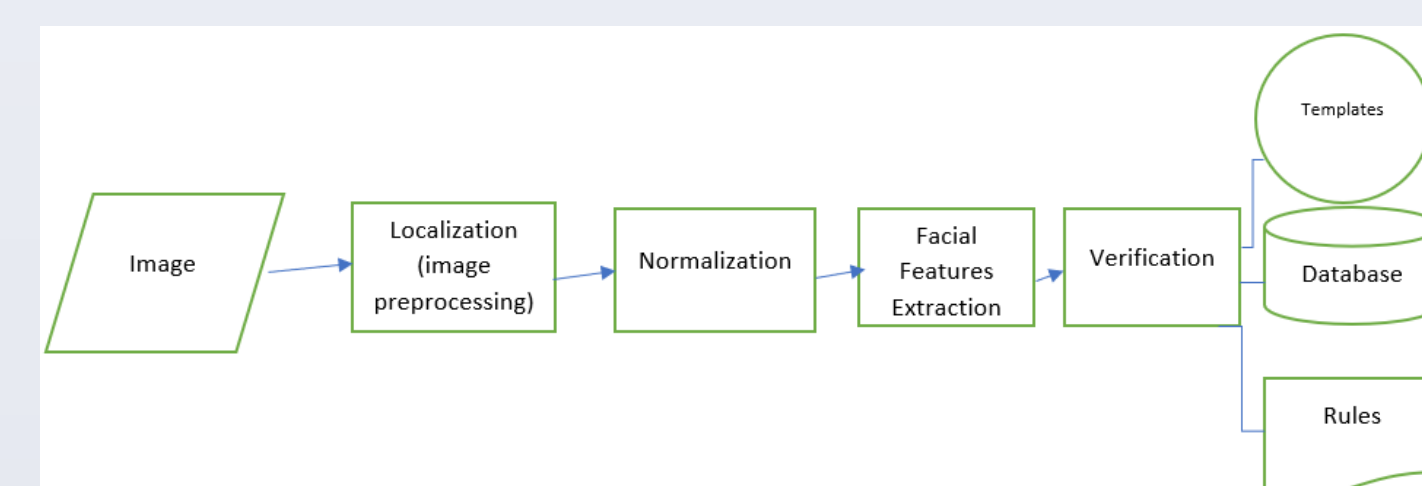
## Steps of Face Detection

- **Localization**
- **Normalization**
- **Facial Feature Extraction**
- **Verification**

### Techniques:

**Template Matching Method**

**Knowledge Based Method**



## Facial Expression Recognition

Gestures of the body are read by an input sensing device such as a web-cam. It reads the movements of the human body and communicates with computer that uses these gestures as an input. These gestures are then interpreted using algorithm either based on statistical analysis or artificial intelligence techniques. The primary goal of gesture recognition research is to create a system which can identify specific human gestures and use them to convey information.

### Techniques Used

**Neural Networks**

**Template Matching**

**Affectiva – MIT based emotion measurement company utilizing facial expression (emotion) recognition based techniques in the real world**

## Face Recognition

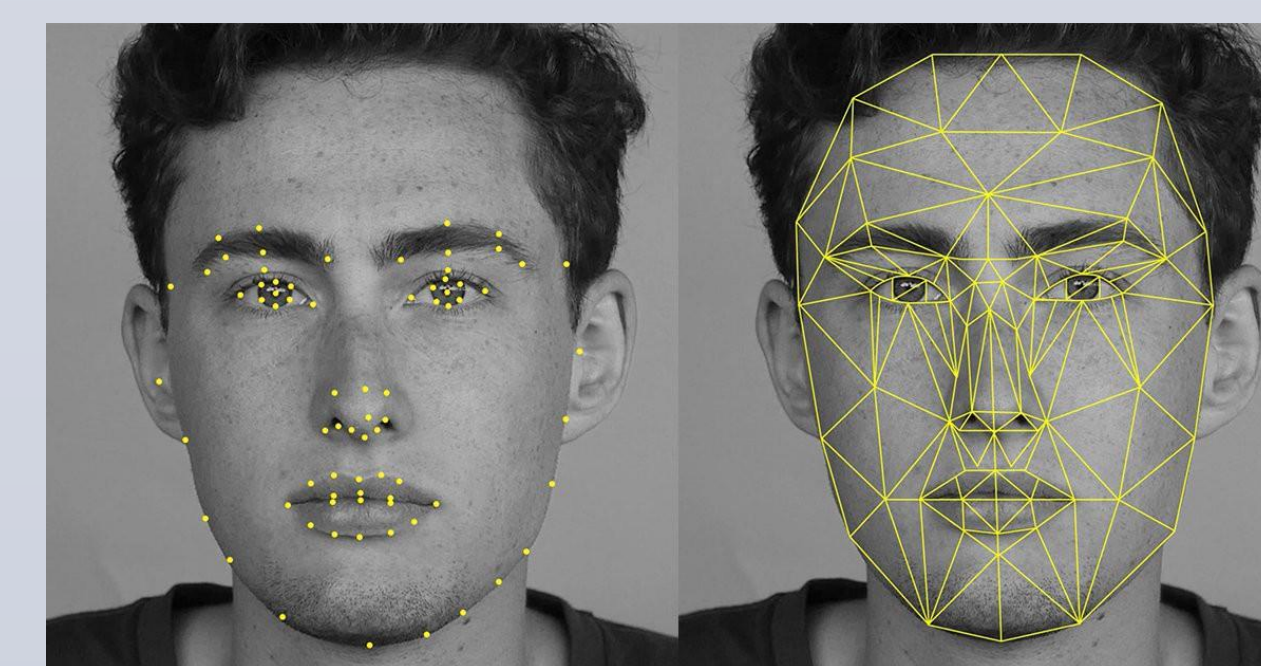
Face detection is the first step towards many applications; one of them is face recognition. To recognize a face, we first detect the face and then we compare it with a set of known individuals present in a database to verify the identity of the person. The concept of face recognition can be further extended to various biometric approaches including fingerprint, iris/retina and voice recognition. Face recognition techniques can be classified as two main approaches: Geometric approach or Feature-based approach where we analyze various features by means of their relationships and holistic approach such as Eigenfaces, neural networks.

### Techniques:

**Holistic based face recognition**

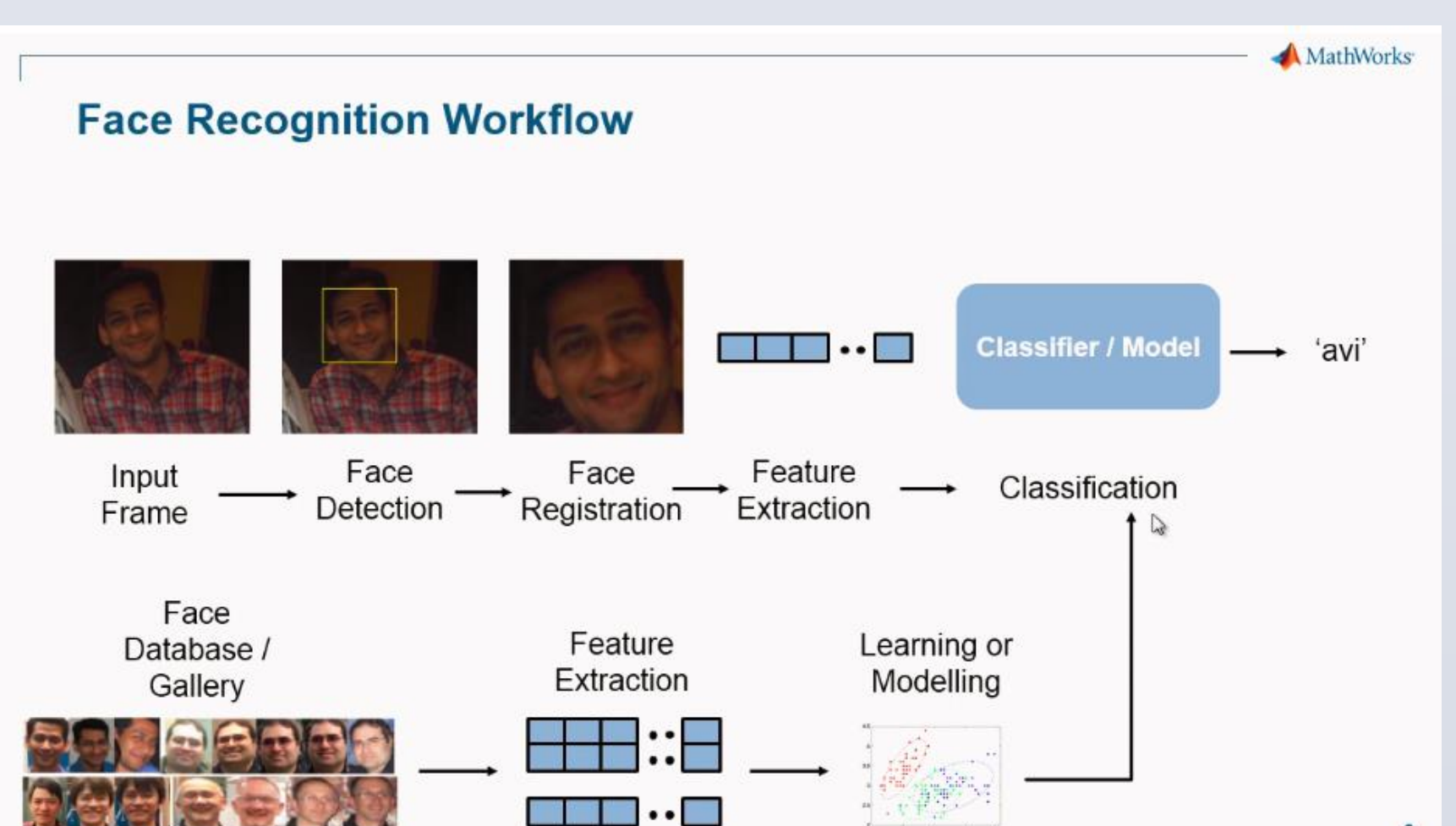
- **Statistical Approach**

- **Principal Component Analysis:** PCA is a technique based on the concept of **eigenfaces** and was first introduced by Kirby and Sirovich in 1988. It is one of the more successful techniques of face recognition and easy to understand and described using mathematics. This method uses Eigen faces. Eigen faces have been used to track human faces. They use a principal component analysis approach to store a set of known patterns in a compact subspace representation of the image space, where the Eigen vectors of the training image set span the subspace.



## EigenFaces

Eigen faces have been used to track human faces. They use a principal component analysis approach to store a set of known patterns in a compact subspace representation of the image space, where the Eigen vectors of the training image set span the subspace. In this method, the input image and images of the eigenface gallery should be the same size and we have to normalize the input image so that the eyes, nose and mouth are properly lined up i.e. we only consider the face region and that should be a frontal face. In case of a non-frontal face it may result poor performance. The primary advantage of this approach is that, it reduces the dimension of the data by some compression technique.



## Conclusion

❖ Face recognition system is one of those technology marvels where a machine can act almost as intelligently as that of a human, that is it can recognize a human from its face and distinguish them from the rest. This study provides an overview understanding of how face recognition applications are developed and what techniques are available.

## References

Face Recognition with MATLAB - Video. (n.d.). Retrieved from <https://www.mathworks.com/videos/face-recognition-with-matlab-98076.html>  
Li, S. Z., & Jain, A. K. (2005). *Handbook of face recognition*. New York: Springer.