## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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SYNOPSIS OF MINOR PROJECT ON

# Face Detection, Facial Expression Detection, and Age Gender Detection


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# Face Detection, Facial Expression Detection, and Age Gender Detection Web App

## Abstract

Deep learning has advanced progressively in the last years and now demonstrates state-of-the-art performance in various fields. In the era of big data, transformation of data into valuable knowledge has become one of the most important challenges in computing. Therefore, we will review multiple algorithms for face recognition that have been researched for a long time and are maturely developed, and analyze deep learning, presenting examples of current research.

To provide a useful and comprehensive perspective, in this paper we categorize research by deep learning architecture, including neural networks, convolutional neural networks, depth-wise Separable Convolutions, densely connected convolutional networks, and present brief descriptions of each study.

## Introduction

With the continuous expansion of the society as well as an immediate requirement for fast and efficient automatic identity verification, biometric technology has developed rapidly in recent years. As one of the most important biometric identification technologies, face recognition attracts more and more attention due to its applications in a wide range of areas.

## Objectives

• Implement face recognition in an optimum way in terms of runtime onto a web-application and run it and optimize it for embedded systems. Various algorithms and methodologies are studied, and hardware resources planning will be done to achieve the goal.

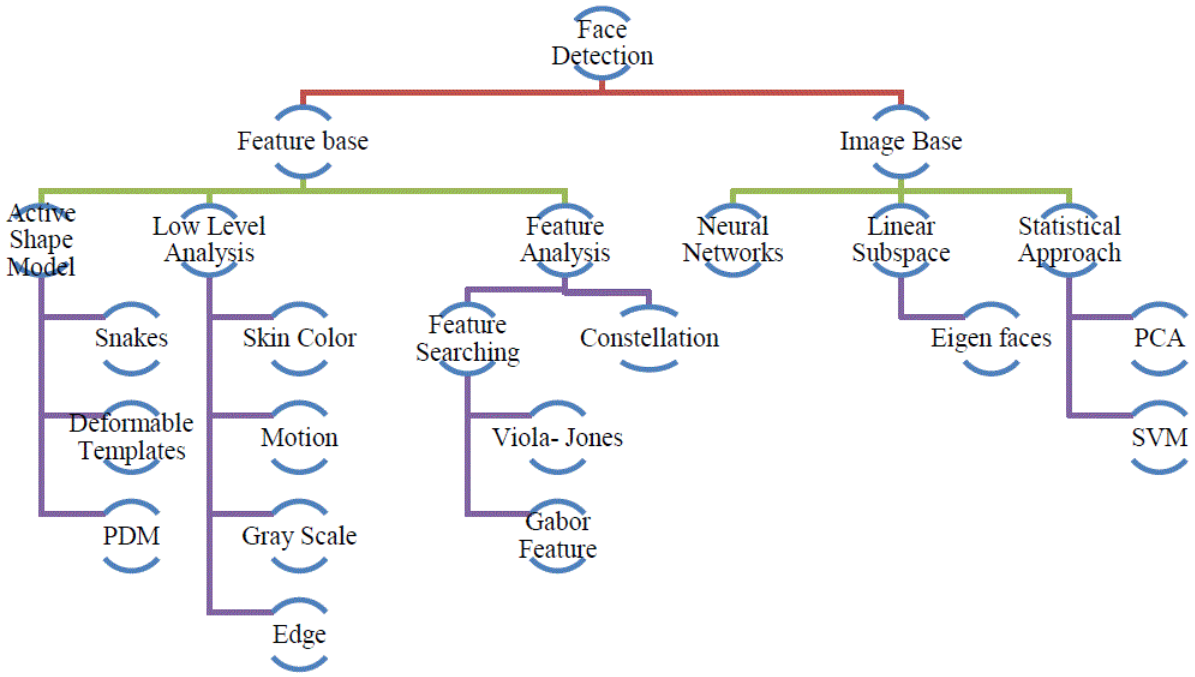
• Compare different face recognition models based on performance and accuracy.

• Use neural networks to map the characteristics of a human face to a face descriptor, also sometimes referred as face embeddings.

• Compute the Euclidean distance between two face descriptors and decide whether twofaces are similar based on a threshold value.

# Literature Survey:

Face detection is a computer technology that determines the location and size of human face in arbitrary (digital) image. The facial features are detected and any other objects like trees, buildings and bodies etc are ignored from the digital image. It can be regarded as a specific case of object-class detection, where the task is finding the location and sizes of all objects in an image that belong to a given class. Face detection, can be regarded as a more general case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). Basically there are two types of approaches to detect facial part in the given image i.e. feature base and image base approach. Feature base approach tries to extract features of the image and match it against the knowledge of the face features. While image base approach tries to get best match between training and testing images.




## Fig: Detection Methods

Based on low level visual features like color, intensity, edges, motion etc . Skin Color Base Color is a vital feature of human faces. Using skin-color as a feature for tracking a face has several advantages. Color processing is much faster than processing other facial features. Under certain lighting conditions, color is orientation invariant. This property makes motion estimation much easier because only a translation model is needed for motion estimation. Tracking human faces using color as a feature has several problems like the color representation of a face obtained by a camera is influenced by many factors (ambient light, object movement, etc

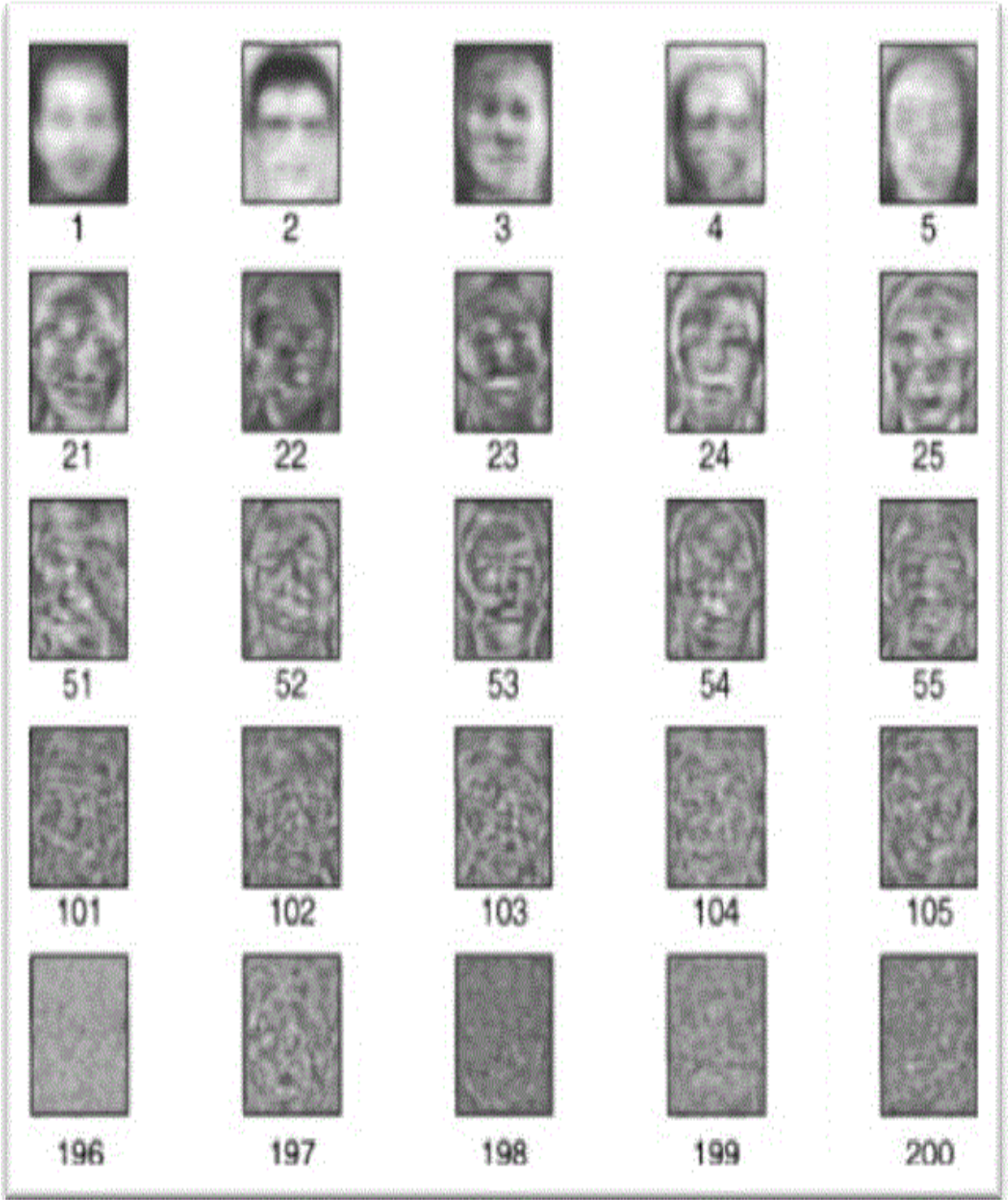



**Fig: Face Detection**

# Approach: Performing Face Detection with Deep Learning

Our goal is to perform face detection with deep learning. To keep things simple, we will make use of pretrained neural networks. We can accomplish that by loading a picture for each subject that is going to be facially recognized, this will be our reference data. Then, it is possible to compare the input image and the reference data. It is possible to approximate similarities, gender, age, and emotions.

## Face Detection Models

The system we built on Node.js will make use of the following three

Face detection models.

## SSD MobileNet v1

One of the main face detectors that is going to be used as a model is a SSD (Single Shot

Multibox Detector), which is consists of a CNN based on MobileNet V1 . SSD MobileNet is a face detection model that has been pretrained on the WIDERFACE dataset which is a publicly available.

## Tiny Face Detector

The face recognition API implements an optimized face detector called Tiny Face Detector .The Tiny Face Detector has a really good performance of detection, making it much faster, smaller and less resource consuming compared to the SSD MobileNet V1 face detector model. This model is highly optimized for mobile and web interfaces. The face model has been trained to predict bounding boxes with complete cover facial feature points; therefore it produces better results on face landmark detections

# MTCNN (Multi-task Cascaded Convolutional Neural Networks)

Lastly, there is also another face detector implemented called MTCNN (Multi-task Cascaded Convolutional Neural Network) which is used for experimental purposes. This face model can detect a wide range of face bounding box sizes. However, it consumes a lot of resources and it is not completely optimized. MTCNN is a 3-stage cascaded CNN, which simultaneously returns 5 face landmark points with bounding boxes and scores for each face.The MTCNN will return the bounding boxes for each face and it will also include a probability score from (0.00 to 1.0). The scores can be used to filter the bounding boxes as a tolerance value.

# Phases used for face detection, face extraction, and face recognition:


# PROGRAMMING ENVIRONMENT & TOOLS USED:

- **Python**
- **Tensorflow**: An open-source machine learning and neural network toolkit.
- **Scikit-learn:** Simple and efficient tools for data mining and data analysis.
- **Scipy:** An open-source library for scientific and technical computing.
- **Numpy:** A python library supporting large ,multi-dimensional arrays with large-library of functions for operating on these arrays.
- **OpenCV:** An open source library of functions aimed at real-time computer vision.
- **ReactJS:** To build front-end of our web-application.
- **NodeJs and Express:** To maintain back-end functionality of our web-application.

# Possible Outcome:

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition did not have a recognition accuracy over 90%, due to the limited number of eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate .The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area.

Furthermore, many of the test subjects did not present an expressionless, frontal view to the system. They would probably be more compliant when a 6'5'' policeman is taking their mugshot! In mugshot matching applications, perfect recognition accuracy or an exact match is not a requirement. If a face recognition system can reduce the number of images that a human operator has to search through for a match from 10000 to even a 100, it would be of incredible practical use in law enforcement.

The automated vision systems implemented in this thesis did not even approach the performance, nor were they as robust as a human's innate face recognition system. However, they give an insight into what the future may hold in computer vision.

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