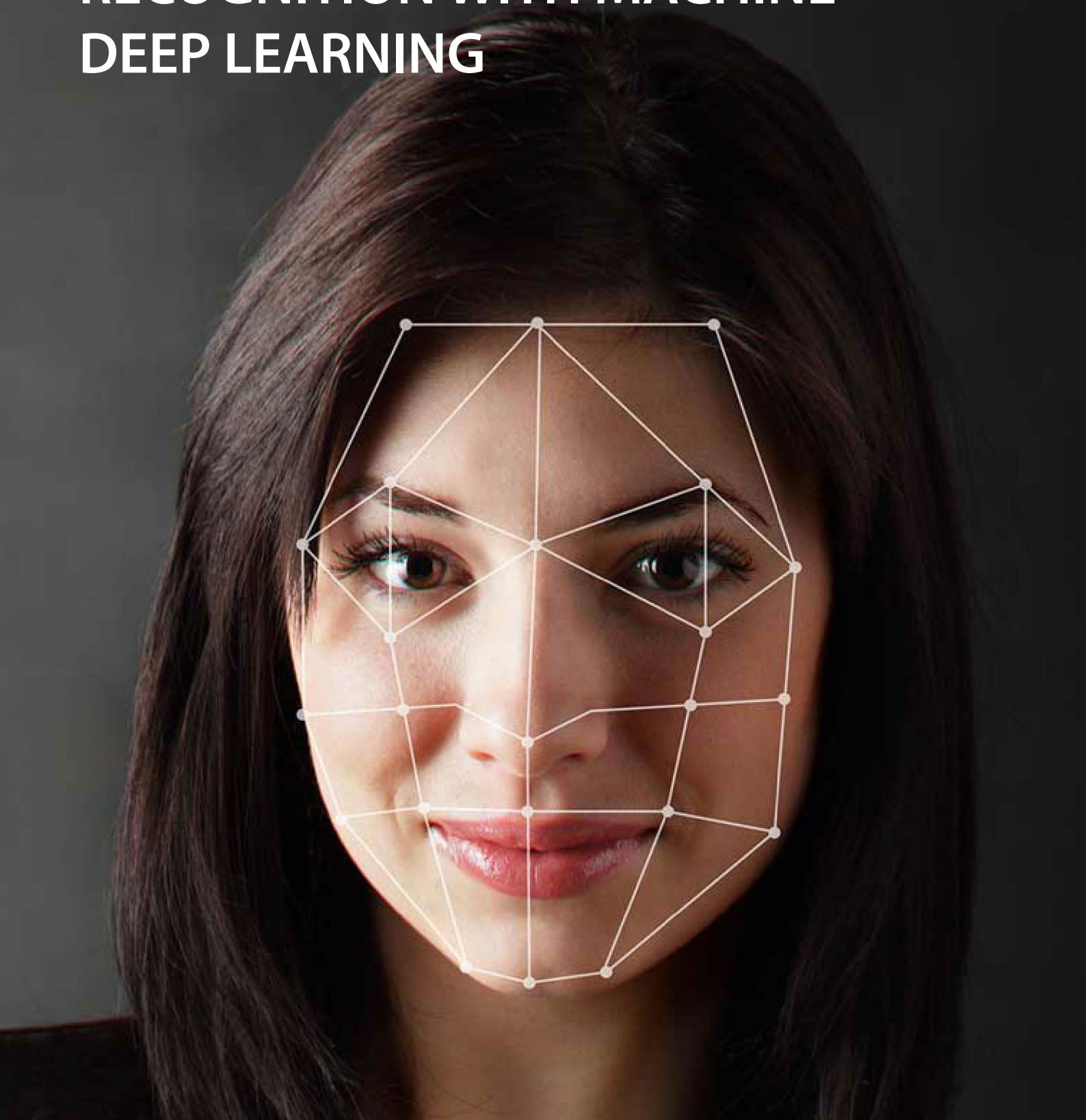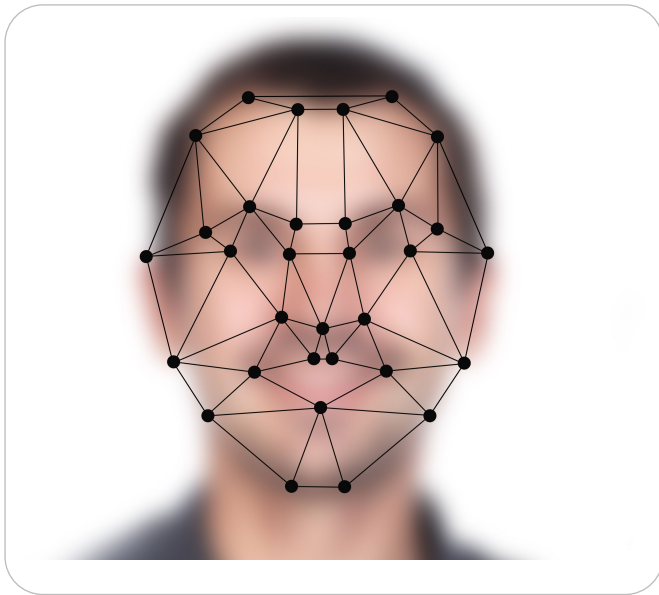# ZKTECO COLLEGE- FUNDAMENTAL OF FACE RECOGNITION WITH MACHINE DEEP LEARNING

What is Face Recognition?

Face Recognition is one of the effective biometrics authentication and security methods that is often seen in movies. Face Recognition uses near-infrared ray or visible light reflection to capture face features to process recognition and authentication. Features are usually captured from an image or video.
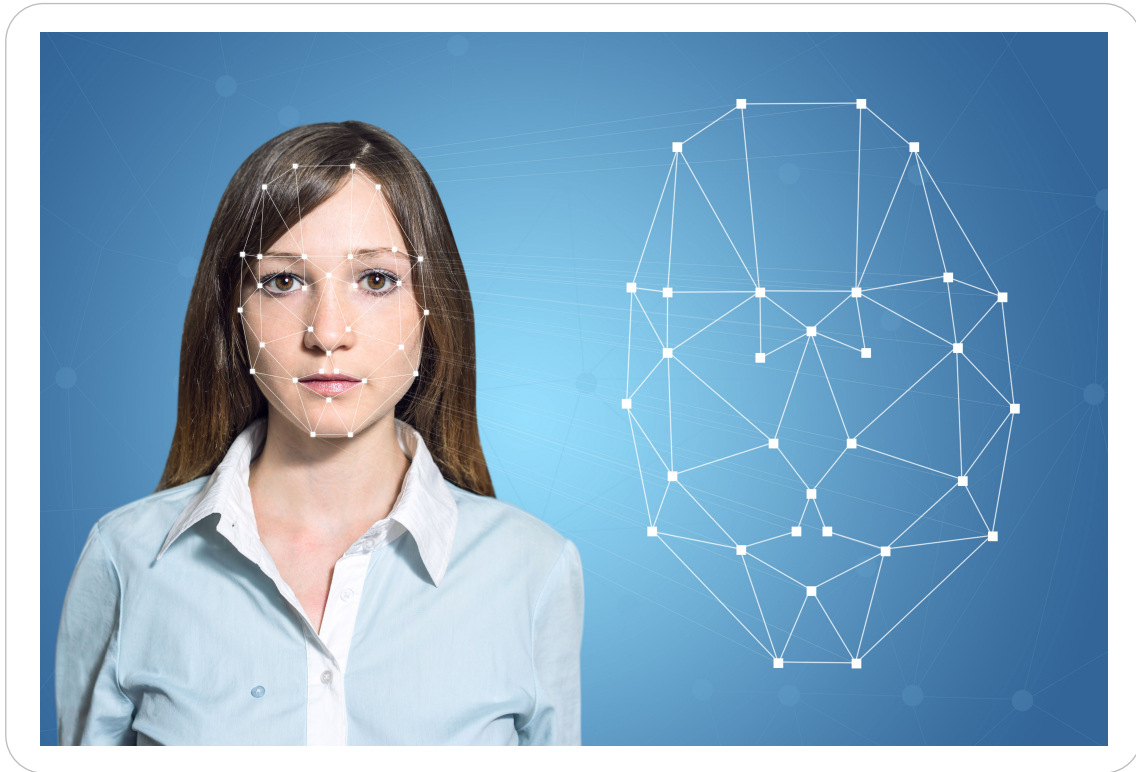
History

Since ancient times, face of human being has been the most obvious feature as a personal identity. It is also the most acceptable recognition method. In the past, face of criminals were drawn in the wanted circular.

Since 1964, modern face recognition method started to be developed by Woody Bledsoe, Helen Chan Wolf and Charles Bisson. They worked on using computer to recognize human's face.
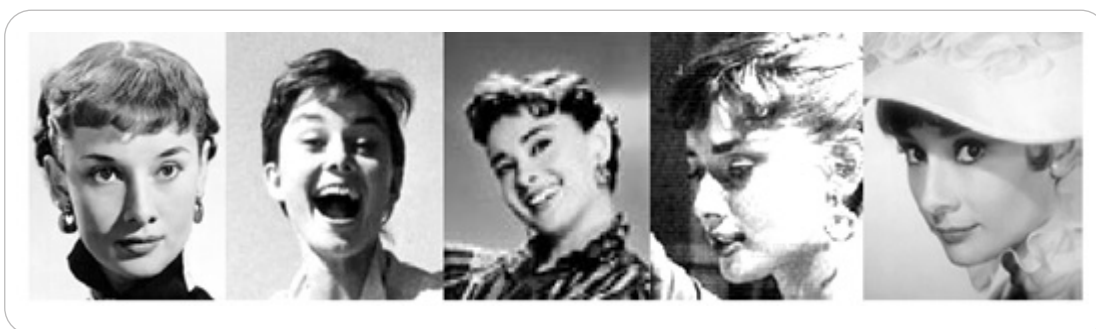
Definition of Face Recognition

Using near-infrared ray or visible light reflection to capture the features of human face is the fundamental principle of face recognition.Features of human face include eyes, ears, nose, mouth and their distributions. The distributions of these organs were set since your birth. Comparing with other biometrics recognition techniques, face recognition has its unique feature: non-aggressive to human. It is a "passive" recognition that users need not to get close and touch the device.

As face recognition devices can be placed everywhere, the devices can be highly concealed. Therefore, users can recognize the target person quickly without contact at a long distance. Thus face recognition is used broadly in public security system with a large scale of application.
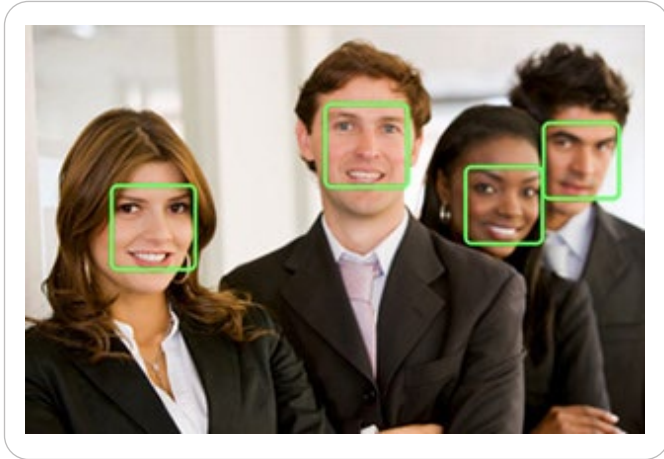
Difficulties of Face Recognition

Although faces of different people may have similar structure, the process of face images capturing from the same person may be affected by several different factors, such as capturing device, facial expression, ornaments, hair style, pose, lighting, saved image and background.

Technical Algorithm –
The Architectures of Face Recognition

Face Recognition Features
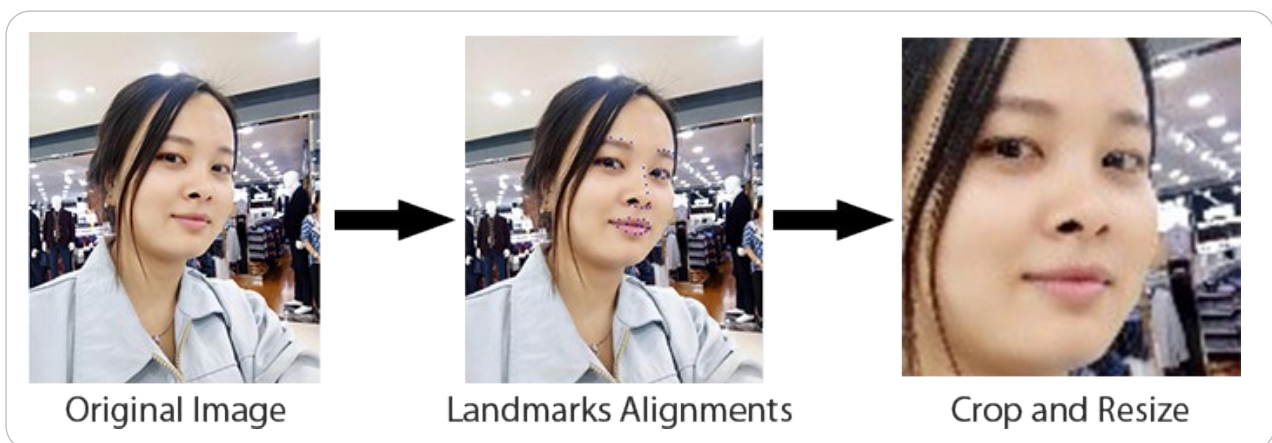

Face Detection:

Detecting whether the image contains human face through Deep Learning.

Face Landmarks:

Finding the landmarks and distributions of the detected face. Landmarks can be 5-68 in amount, depends on the device.
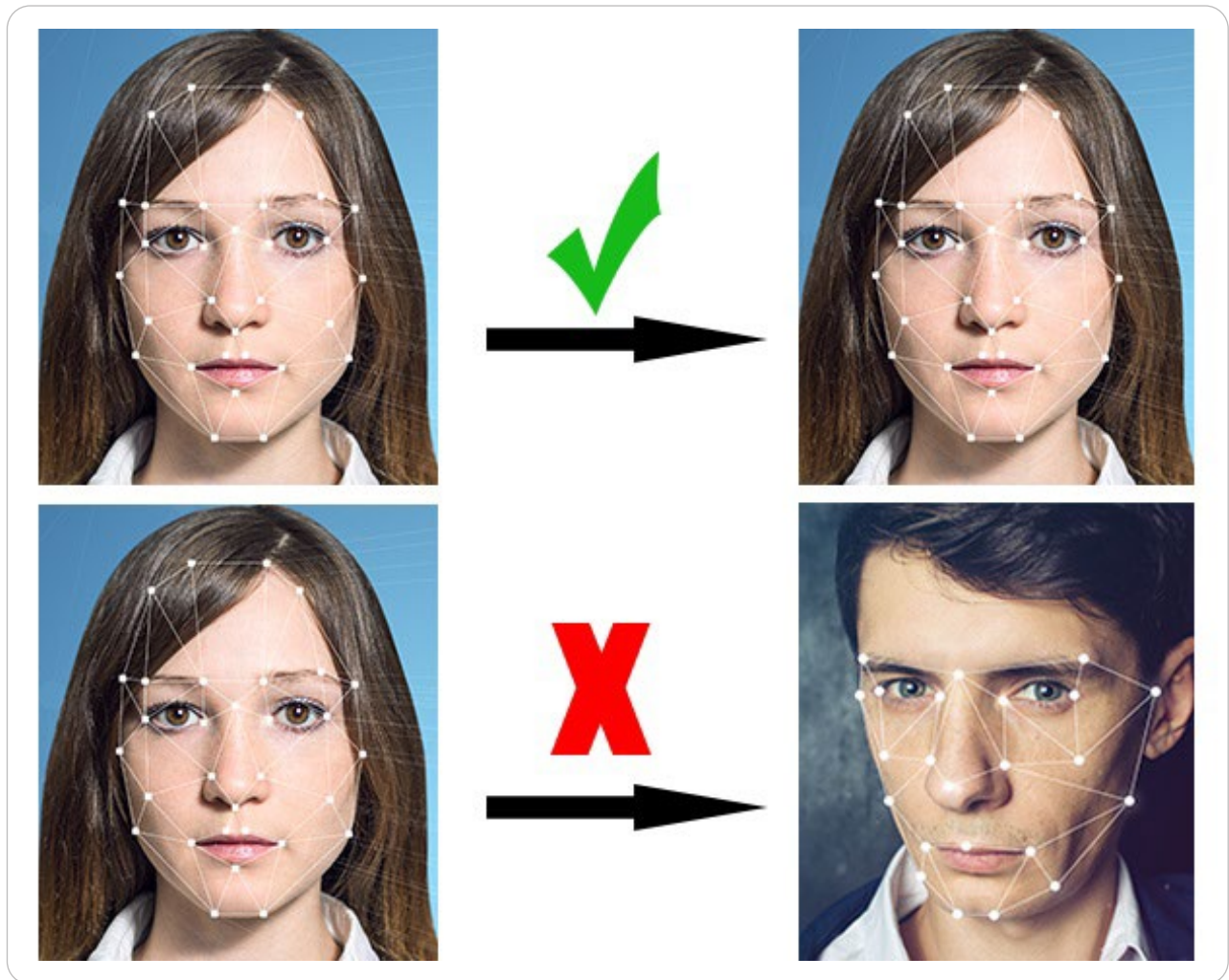

Face Alignment:

Original Image   Landmarks Alignments   Crop and Resize

Analyzing the landmarks of input facial image and aligning the image with the pre-saved facial template by cropping and resizing.
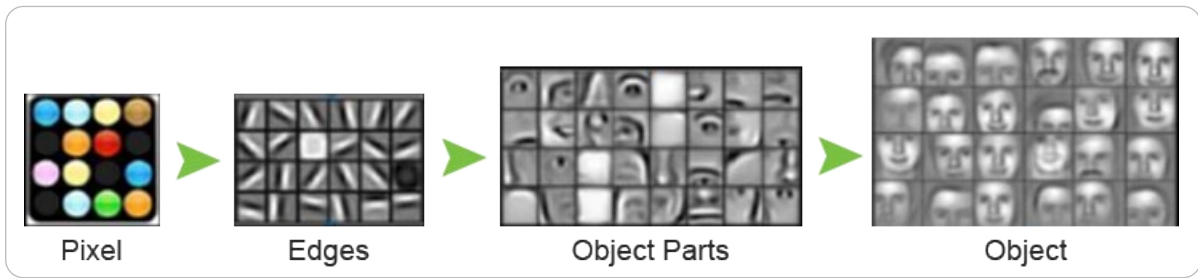
Face Comparing process:

To confirm the identity of detected facial image or search and compare the detected facial image with facial images in the database. This process will finally find out if there is a pre-saved image can match with the detected image and thus confirm the identity.

Advantages of Deep Learning

Deep Learning use a variation of multilayer perceptrons designed to require minimal preprocessing. It uses relatively little pre-processing compared to other image classification algorithms, while the network learns the filters in traditional algorithms was hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage.

When applied to facial recognition, Deep Learning achieved a surprisingly fast in recognition speed and a large decrease in error rate.

Hierarchical Learning

Pixel → Edges → Object Parts → Object

Hierarchical learning is a machine deep learning method of natural progression from low level to high level structure as seen in natural complexity. Start from pixel level, machine can then learn how to recognize "Edges", "Object parts" and whole "Objects" progressively. It is easier to monitor what is being learnt and to guide the machine to better subspaces. A good lower level representation can be used for many distinct tasks. Through hierarchical learning method, the accuracy and speed of latest face recognition technique are far better than before.

ZKTeco's face recognition algorithm had been examined by templates of more than 20 races of human in 180 countries and set up a huge database.

Main Features of Face Recognition
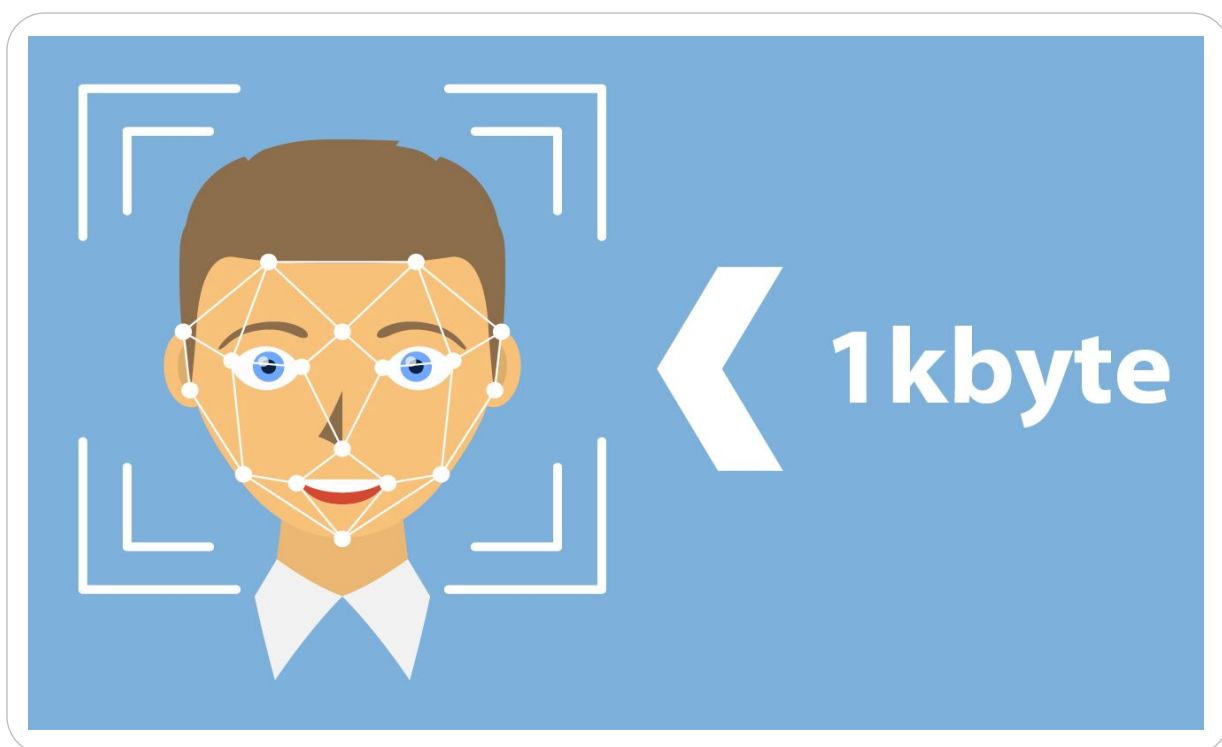
Adaptive to the environment:

Suitable to use in both indoor and outdoor.

Touchless Authentication

No need to touch the device, and thus more hygienic and causing lesser inconvenience.

Small Storage Space Required:

The template of facial image is lower than 1Kbyte.

Main Types of Face Recognition System

1. Identification: Who is this?

1:N comparing, find several facial images which are similar to the input (detected) image from the database.

2. Verification: Is this someone?

1:1 comparing, ensure whether the input image is someone registered in the database.

3. Watch List: Is this the person we are looking for?

Identification and verification, ensure whether the facial image is on the watch list. If yes, it is necessary to identify who he/she is.

Rating of Face Recognition System

1. Identification:

• N Cumulative Match Score: the rate of correct result of previous N times of process.

2. Verification:

• FAR (False Acceptance Rate): the instance of a security system incorrectly verifying or identifying an unauthorized person.
• FRR (False Rejection Rate): the instance of a security system failing to verify or identify an authorized person.

3.Watch List:

• FAR: the rate of false alarming while the input image dose not match with any facial image on the watch list.
• N-Selected Accumulated Detection Rate: the rate of outputting correct result when the input image is on the watch list.

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