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# Scope of Face Recognition Techniques

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***Abstract:*** **A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems.**

***Keywords:*** **Facial recognition, Eigen Vector, Biometrics, Euclidean Distance. Signal System, Image, Image Segmentation.**

## I. INTRODUCTION

A face recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database.

It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems. Some facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition. A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient facial features, providing a sort of compressed face representation. Recognition algorithms can be divided into two main approaches, geometric, which looks at distinguishing features, or photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances.

Popular recognition algorithms include Principal Component Analysis using ***eigen faces, Linear Discriminate Analysis, Elastic Bunch Graph Matching using the Fisherface algorithm, the Hidden Markov model, the Multilinear Subspace Learning using tensor representation, and the neuronal motivated dynamic link matching.***

## II. TRADITIONAL TECHNIQUES

Some facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition. A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient facial features, providing a sort of compressed face representation.

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## III. 3-DIMENSIONAL RECOGNITION

A newly emerging trend, claimed to achieve improved accuracies, is three-dimensional face recognition. This technique uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face, such as the contour of the eye sockets, nose, and chin.

One advantage of 3D facial recognition is that it is not affected by changes in lighting like other techniques. It can also identify a face from a range of viewing angles, including a profile view. Three-dimensional data points from a face vastly improve the precision of facial recognition. 3D research is enhanced by the development of sophisticated sensors that do a better job of capturing 3D face imagery. The sensors work by projecting structured light onto the face. Up to a dozen or more of these image sensors can be placed on the same CMOS chip—each sensor captures a different part of the spectrum.

Even a perfect 3D matching technique could be sensitive to expressions. For that goal a group at the technique applied tools from metric geometry to treat expressions as isometries a company called Vision Access created a firm solution for 3D facial recognition. The company was later acquired by the biometric access company Bioscrypt Inc. which developed a version known as 3D FastPass.

## IV. SOFTWARE FOR FACE RECOGNITION

Notable software with face recognition ability includes:

- digiKam (KDE)
- iPhoto (Apple)
- OpenCV (Open Source)
- Photoshop Elements (Adobe Systems)
- Picasa (Google)
- Picture Motion Browser (Sony)
- Windows Live Photo Gallery (Microsoft)
- Lightroom (Adobe)

## V. IMAGE PROCESSING OPERATIONS

The Image Processing Toolbox is a collection of functions that extend the capability of the MATLAB ® numeric computing environment. The toolbox supports a wide range of image processing operations, including:

- Geometric operations
- Neighborhood and block operations
- Linear filtering and filter design
- Transforms
- Image analysis and enhancement
- Binary image operations
- Region of interest operations

Many of the toolbox functions are MATLAB M-files, series of MATLAB statements that implement specialized image processing algorithms. You can view the MATLAB code for these functions using the statement:

type function_name

You can extend the capabilities of the Image Processing Toolbox by writing your own M-files, or by using the toolbox in combination with with other toolboxes, such as the Signal Processing Toolbox and the Wavelet Toolbox.

## VI. IMAGES IN MATLAB AND THE IMAGE PROCESSING TOOLBOX

The basic data structure in MATLAB is the array, an ordered set of real or complex elements. This object is naturally suited to the representation of images, real-valued, ordered sets of color or intensity data. (MATLAB does not support complex-valued images.)

MATLAB stores most images as two-dimensional arrays (i.e., matrices), in which each element of the matrix corresponds to a single pixel in the displayed image. (Pixel is derived from picture element and usually denotes a single dot on a computer display.) For example, an image composed of 200 rows and 300 columns of different colored dots would be stored in MATLAB as a 200-by-300 matrix. This convention makes working with images in MATLAB similar to working with any other type of matrix data, and makes the full power of MATLAB available for image processing applications. For example, you can select a single pixel from an image matrix using normal matrix subscripting:

I(2,15)

This command returns the value of the pixel at row 2, column 15 of the image I.

## VII. NOTABLE USERS AND DEPLOYMENTS

The London Borough of Newham, in the UK, previously trialled a facial recognition system built into their borough-wide CCTV system.

The German Federal Police use a facial recognition system to allow voluntary subscribers to pass fully automated border controls at Frankfurt Rhein-Main international airport. Subscribers need to be European Union or Swiss citizens. Since 2005 the German Federal Criminal Police Office offers centralized facial recognition on mugshot images for all German police agencies.

Recognition systems are also used by casinos to catch card counters and other blacklisted individuals.

The Australian and New Zealand Customs Services have an automated border processing system called SmartGate that uses facial recognition. The system compares the face of the individual with the image in the e-passport microchip, certifying that the holder of the passport is the rightful owner.

The Pennsylvania Justice Network searches crime scene photographs and CCTV footage in the mugshot database of previous arrests. A number of cold cases have been resolved since the system became operational in 2005. Other law enforcement agencies in the United States, including the Los Angeles County Sheriff, use arrest mugshot databases in their forensic investigative work. As of 2013, there is no unified nationwide database of face pictures mapping to names, but there are some efforts to create one.

U.S. Department of State operates one of the largest face recognition systems in the world with over 75 million photographs that is actively used for visa processing.

The Tocumen International Airport in Panama operates an airport-wide surveillance system using hundreds of live facial recognition cameras to identify wanted individuals passing through the airport.

## VIII. ADDITIONAL USES

In addition to being used for security systems, authorities have found a number of other applications for facial recognition systems. While earlier post-9/11 deployments were well publicized trials, more recent deployments are rarely written about due to their covert nature.

At Super Bowl XXXV in January 2001, police in Tampa Bay, Florida used Viisage facial recognition software to search for potential criminals and terrorists in attendance at the event. 19 people with minor criminal records were potentially identified.

In the 2000 presidential election, the Mexican government employed facial recognition software to prevent voter fraud. Some individuals had been registering to vote under several different names, in an attempt to place multiple votes. By comparing new facial images to those already in the voter database, authorities were able to reduce duplicate registrations.Similar technologies are being used in the United States to prevent people from obtaining fake identification cards and driver's licenses.

There are also a number of potential uses for facial recognition that are currently being developed. For example, the technology could be used as a security measure at ATMs. Instead of using a bank card or personal identification number, the ATM would capture an image of the customer's face, and compare it to the account holder's photo in the bank database to confirm the customer's identity.

Facial recognition systems are used to unlock software on mobile devices. An independently developed Android Marketplace app called Visidon Applock makes use of the phone's built-in camera to take a picture of the user. Facial recognition is used to ensure only this person can use certain apps which they choose to secure.

Face detection and facial recognition are integrated into the iPhoto application for Macintosh, to help users organize and caption their collections.

Also, in addition to biometric usages, modern digital cameras often incorporate a facial detection system that allows the camera to focus and measure exposure on the face of the subject, thus guaranteeing a focused portrait of the person being photographed. Some cameras, in addition, incorporate a smile shutter, or take automatically a second picture if someone closed their eyes during exposure.

Because of certain limitations of fingerprint recognition systems, facial recognition systems are used as an alternative way to confirm employee attendance at work for the claimed hours.

Another use could be a portable device to assist people with prosopagnosia in recognizing their acquaintances.

## IX. PROS AND CONS

Among the different biometric techniques, facial recognition may not be the most reliable and efficient. However, one key advantage is that it does not require the cooperation of the test subject to work. Properly designed systems installed in airports, multiplexes, and other public places can identify individuals among the crowd, without passers-by even being aware of the system. Other biometrics like fingerprints, iris scans, and speech recognition cannot perform this kind of mass identification. However, questions have been raised on the effectiveness of facial recognition software in cases of railway and airport security.

**Weaknesses:**

Face recognition is not perfect and struggles to perform under certain conditions. Ralph Gross, a researcher at the Carnegie Mellon Robotics Institute, describes one obstacle related to the viewing angle of the face: "Face recognition has been getting pretty good at full frontal faces and 20 degrees off, but as soon as you go towards profile, there've been problems." Other conditions where face recognition does not work well include poor lighting, sunglasses, long hair, or other objects partially covering the subject's face, and low resolution images. Another serious disadvantage is that many systems are less effective if facial expressions vary. Even a big smile can render the system less effective. For instance: Canada now allows only neutral facial expressions in passport photos. There is also inconstancy in the datasets used by researchers. Researchers may use anywhere from several subjects to scores of subjects, and a few hundred images to thousands of images. It is important for researchers to make available the datasets they used to each other, or have at least a standard dataset. On 18 January 2013 Japanese researchers created a privacy visor that uses nearly infrared light to make the face underneath it unrecognizable to facial recognition software.

## X. SCOPE AND CONCLUSION

First we input a known image and observed the Euclidean distance. This distance tells us how close the input image is from the image on our training set. Based on maximum and minimum distances we can make a decision of whether the face is a known face, an unknown face or not a face at all.

This model can be designed using other various programming techniques and the languages such as C++, JAVA, etc. but matlab can do this with ease using its image processing applications and tool box.

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