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FACE RECOGNITION (Pattern Matching and Bio-Metrics)

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Abstract: Government agencies are using maximum numbers of resources to improving security systems as result of recent terrorist events that dangerously exposed flaws and weaknesses in today's safety mechanisms. Badge or password- based authentication procedures are too easy to hack. Biometrics represents a valid alternative but they suffer of drawbacks as well. Iris scanning, for example, is very reliable but too intrusive; fingerprints are socially accepted, but not applicable to non- consentient people. On the other hand, face recognition represents a good compromise between what's sociallyacceptable and what's reliable, evenwhen operating under controlled conditions. In last decade, many algorithms based on linear/nonlinear methods, neural networks, wavelets, etc. have been proposed. Nevertheless, Face Recognition Vendor Test 2002 shown that most of these approaches encountered problems in outdoor conditions. This lowered their reliability compared to state of the art biometrics.

Keywords: badge or password, Biometric, fingerprints, socially, face recoginition, neural network,

What is Face Recognition?

Face recognition technology is the least intrusive and fastest biometric technology. It works with the most obvious individual identifier –the humanface.

Instead of requiring people to place their hand on a reader or precisely position their eye in front of a scanner, face recognition systems unobtrusively takepictures of people's faces as they enter a defined area. There is no intrusion or delay, and in most cases the subjects are entirely unaware of the process. They donot feel "under surveillance" or that theirprivacy has been invaded.

HISTORY:

Humans have always had the innate ability to recognize and distinguish between faces, yet computers only recently have shown the same ability. In the mid 1960s, scientists began work on using the computer to recognize human faces. Since then, facial recognition software has come a long way.

Identix®, a company based in Minnesota, is one of many developers of facial recognition technology. Its software, FaceIt®, can pick someone'sface out of a crowd, extract the face fromthe rest of the scene and compare it to a database of stored images. In order for this software to work, it has to knowhow to differentiate between a basic faceand the rest of the background. Facial recognition software is based on the ability to recognize a face and then measure the various features of the face.

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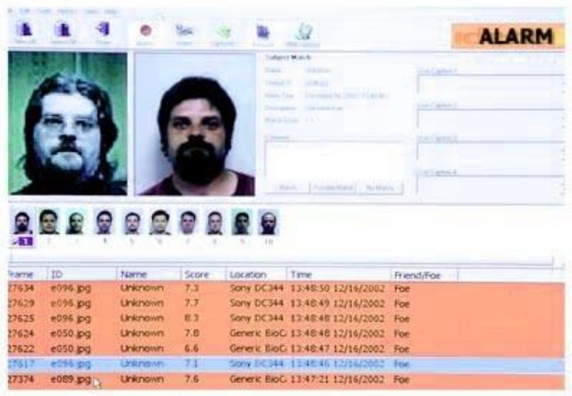
Every face has numerous,distinguishable landmarks, the different peaks and valleys that make up facialfeatures. FaceIt defines these landmarks as nodal points. Each human face hasapproximately 80 nodal points. Some of these measured by the software are:

- Distance between the eyes
- Width of the nose
- Depth of the eye sockets
- The shape of the cheekbones
- The length of the jaw line



rame	ID	Name	Score	Location	Time	Friend/Foe
27634	e096.jpg	Unknown	7.3	Sony DC344	13:48:50 12/16/2002	Foe
27629	e096.jpg	Unknown	7.7	Sony DC344	13:48:49 12/16/2002	Foe
27625	e096.jpg	Unknown	8.3	Sony DC344	13:48:48 12/16/2002	Foe
27624	e050.jpg	Unknown	7.8	Generic BioC	13:48:48 12/16/2002	Foe
27622	e050.jpg	Unknown	6.6	Generic BioC	13:48:47 12/16/2002	Foe
27617	e096.jpg	Unknown	7.1	Sony DC344	13:48:46 12/16/2002	Foe
27374	e089.jpg	Unknown	7.6	Generic BioC	13:47:21 12/16/2002	Foe

FaceIt software compares the face print with otherimages in the database.

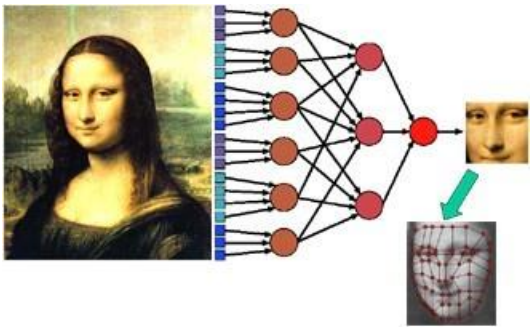
These nodal points are measured creating a numerical code, called a face print, representing the face in the database.

In the past, facial recognition software has relied on a 2D image to compare or identify another 2D image from the database. To be effective and accurate, the image captured needed to be of aface that was looking almost directly at the camera, with little variance of light or facial expression from the image in the database. This created quite a problem.

In most instances the images were not taken in a controlled environment. Even the smallest changes in light or orientation could reduce the effectiveness of the system, so they couldn't be matched to any face in the database, leading to a high rate offailure. In the next section, we will look at ways to correct the problem.

TECHNOLOGY

Our technology is based on neural computing and combines the advantages of elastic and neural networks. Neural computing provides technical information processing methods that are similar to the way information is processed in biological systems, such as the human brain. They share some key strengths, like robustness fault-resistance and the ability to learn from examples. Elastic networks can compare faciallandmarks even if images are not identical, as is practically always the case in real-world situations. Neuralnetworks can learn to recognize similarities through pattern recognition.



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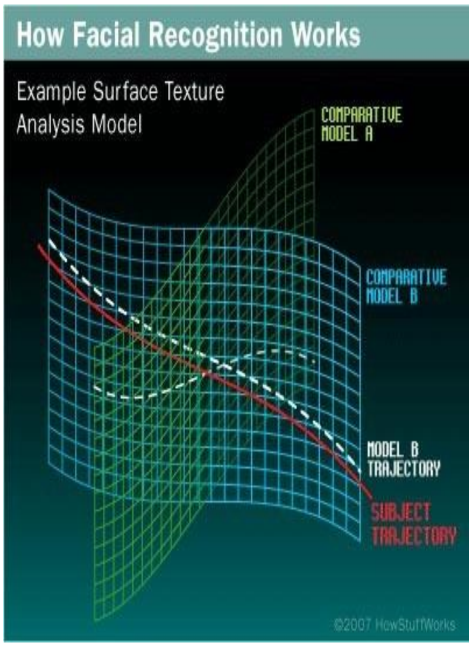
3D FACIAL RECOGNITION

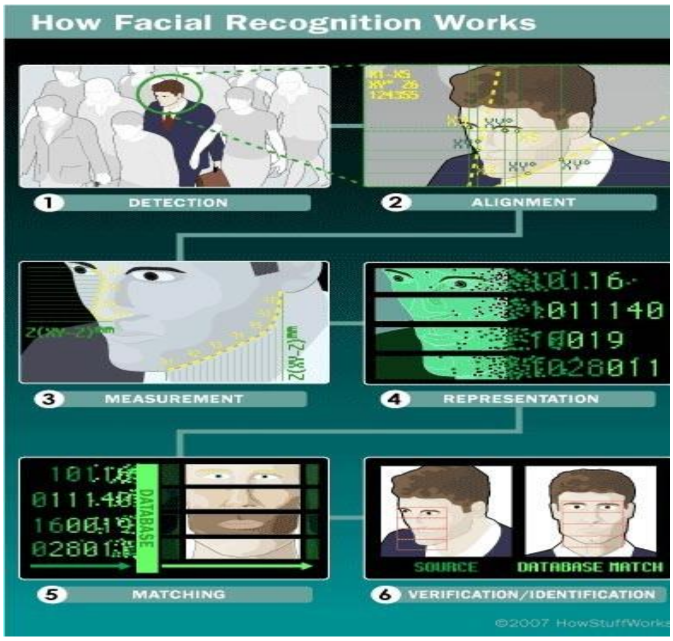
Capturing a real-time 3D image of a person's facial surface, 3D facial recognition uses distinctive features ofthe face -- where rigid tissue and bone is most apparent, such as the curves of the eye socket, nose and chin -- to identify the subject. These areas are all unique and don't change over time.

Using depth and an axis of measurement that is not affected by lighting, 3D facial recognition can even be used in darkness and has the ability to recognize a subject at different view angles with the potential to recognize up to 90 degrees (aface in profile). Using the 3D software, the system goes through a series of steps to verify theidentity of an individual. DetectionAcquiring an image can be accomplishedby digitally scanning an existing photograph (2D) or by using a video image to acquire a live picture of a subject (3D). Alignment : Once it detects a face, the system determines the head's position, size and pose. As stated earlier, the subject has the potential to be recognized up to 90 degrees, while with 2D, the head must beturned at least 35 degrees toward the camera.

Measurement : The system then measures the curves of the face on a sub-millimeter (ormicrowave) scale and creates a template.

A newly-emerging trend in facialrecognition software uses a 3D model, which claims to provide more accuracy.





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The system translates the template into a unique code. This coding gives each template a set of numbers to represent the features on a subject's face.

Matching

If the image is 3D and the database contains 3D images, then matching will take place without any changes being made to the image. However, there is a challenge currently facing databases that are still in 2D images. 3D provides alive, moving variable subject being compared to a flat, stable image. New technology is addressing this challenge. When a 3D image is taken, different points are identified. For example, theoutside of the eye, the inside of the eye and the tip of the nose will be pulled out and measured. Once those measurements are in place, an algorithm will be applied to the image to convert it to a 2D image.

Verification or Identification In verification, an image is matched to only one image in the database (1:1). For example, an image taken of a subject may be matched to an image in the Department of Motor Vehicles database to verify the subject is who he says he is. If identification is the goal, then the image is compared to all images in the database resulting in a score for each potential match (1:N). In this instance, you may take an image and compare it toa database of mug shots to identify who the subject is. Next, we'll look at how skin biometrics can help verify matches.

SURFACE TEXTURE ANALYSIS

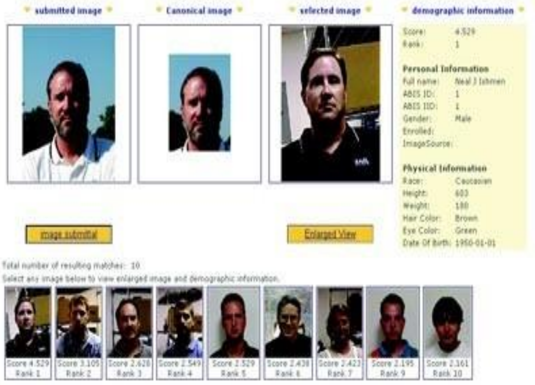
The image may not always be verified oridentified in facial recognition alone. Identix® has created a new product to help with precision. The development of FaceIt®Argus uses skin biometrics, the uniqueness of skin texture, to yield even more accurate results.

The process, called Surface TextureAnalysis, works much the same way facial recognition does. A picture is taken of a patch of skin, called a skin print. That patch is then broken up into smaller blocks. Using algorithms to turn the patch into a mathematical, measurable space, the system will then distinguish any lines, pores and theactual skin texture. It can identify differences between identical twins, which is not yet possible using facial recognition software alone. According toIdentix, by combining facial recognition with surface texture analysis, accurate identification can increase by 20 to 25 percent.

FaceIt currently uses three different templates to confirm or identify the subject: vector, local feature analysis and surface texture analysis.

- The vector template is very smalland is used for rapid searchingover the entire database primarilyfor one-to-many searching.
- The local feature analysis (LFA) template performs a secondary search of ordered matchesfollowing the vector template.
- The surface texture analysis(STA) is the largest of the three.It performs a final pass after the LFA template search, relying on the skin features in the image, which contains the most detailed information.

By combining all three templates, FaceIt® has an advantage over other systems. It is relatively insensitive to changes in expression, including blinking, frowning or smiling and hasthe ability to compensate for mustacheor beard growth and the appearance of eyeglasses. The system is also uniform with respect to race and gender.



Score: 4.529
Rank: 1

Personal Information
Full name: Neal J Ishmen
ABIS ID: 1
ABIS IID: 1
Gender: Male
Enrolled:
ImageSource:

Physical Information
Race: Caucasian
Height: 603
Weight: 180
Hair Color: Brown
Eye Color: Green
Date Of Birth: 1950-01-01

Total number of resulting matches: 10
Select any image below to view enlarged image and demographic information.

Score 4.529 Rank 1
Score 3.105 Rank 2
Score 2.628 Rank 3
Score 2.549 Rank 4
Score 2.529 Rank 5
Score 2.438 Rank 6
Score 2.423 Rank 7
Score 2.195 Rank 9
Score 2.161 Rank 10

However, it is not a perfect system. There are some factors that could get in the way of recognition, including:

□ Significant glare on eyeglasses orwearing sunglasses
□ Long hair obscuring the central part of the face
□ Poor lighting that would cause the face to be over- or under- exposed
□ Lack of resolution (image was taken too far away)

Identix isn't the only company with facial recognition systems available. While most work the same way FaceIt does, there are some variations. For example, a company called Animetrix, Inc. has a product called FACEngine ID® SetLight that can correct lightingconditions that cannot normally be used, reducing the risk of false matches. Sensible Vision, Inc. has a product that can secure a computer using facialrecognition. The computer will onlypower on and stay accessible as long as the correct user is in front of the screen. Once the user moves out of the line of sight, the computer is automaticallysecured from other users.

CURRENT & FUTURE USESOF FACIAL RECOGNITION SYSTEMS

The ideal solution

All of this makes face recognitionideal for high traffic areas open tothe general public, such as:

- Airports and railway stations
- Casinos
- Cash points
- Stadiums
- Public transportation
- Financial institutions
- Government offices
- Businesses of all kinds

In the past, the primary users of facial recognition software have been law enforcement agencies, who used thesystem to capture random faces in crowds. Some government agencies havealso been using the systems for security and to eliminate voter fraud. The U.S. government has recently begun a program called US-VISIT (United StatesVisitor and Immigrant Status IndicatorTechnology), aimed at foreign travelers gaining entry to the United States. Whena foreign traveler receives his visa, he will submit fingerprints and have his photograph taken. The fingerprints and photograph are checked against adatabase of known criminals and suspected terrorists. When the travelerarrives in the United States at the port of entry, those same fingerprints and photographs will be used to verify that the person who received the visa is the same person attempting to gain entry.

Hard to fool

Face recognition is also very difficult tofool. It works by comparing facial landmarks - specific proportions and angles of defined facial features - whichcannot easily be concealed by beards, eyeglasses or makeup.

However, there are now many more situations where the software is becoming popular.

□ As the systems become less expensive, making their use morewidespread.

□ They are now compatible with cameras and computers that are already in use by banks and airports. Registered Travelerprogram will provide speedy security screening for passengers who volunteer information. At the airport there will be specific lines for the Registered Traveler to go through that will move more quickly, verifying the traveler by their facial features.

□ Other potential applications include ATM and check-cashing security. After a ~~customerconsents, the ATM~~ or check- cashing kiosk captures a digital image of him. The FaceIt software then generates a face print of the photograph to protectcustomers against identity theft and fraudulent transactions.

● By using the facial recognitionsoftware, there's no need for a picture ID, bankcard or personal identification number (PIN) to verify a customer's identity. This way business can prevent fraudfrom occurring.

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DRAWBACKS OF THIS TECHNOLOGY

While all the examples above work with the permission of the individual, not all systems are used with your knowledge. These systems were taking pictures of allvisitors without their knowledge or their permission. Opponents of the systems note that while they do provide security in some instances, it is not enough tooverride a sense of liberty and freedom. Many feel that privacy infringement is too great with the use of these systems, but their concerns don't end there. They also point out the risk involved with identity theft. Even facial recognition corporations admit that themore use the technology gets, the higher the likelihood of identity theft or fraud.

CONCLUSION

As with many developing technologies, the incredible potential of facial recognition comes with some drawbacks,but manufacturers are striving to enhance the usability and accuracy of the systems. Face recognition promises latest security invents in the upcoming trends based on bio-metrics and pattern matching techniques and algorithms.

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