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New Approach in Biometrics to Combat the Automated Teller Machine Frauds: Facial Recognition

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Abstract:
There is an urgent need for improving security in banking region. In this paper discussion is made about the face recognition technology, an important field of biometrics which will be employed for the purpose of checks on frauds using ATMs. The recent progress in biometric identification techniques, has made a great efforts to rescue the unsafe situations at the ATM. Several facial recognition techniques are studied which include two approaches, appearance based and geometric based. A new facial recognition technique: 3-D technique is also reviewed in the paper. These techniques are widely used in e-passports and on the airports for entry of travellers and others. ATM systems today use no more than an access card and PIN for identity verification. If the proposed technology of facial recognition becomes widely used, faces would be protected as well as PINs.

Keywords: ATM Security, Face Recognition, Biometrics

Introduction to Biometrics:

The term 'biometric' is based on the Greek nouns bio (life) and metric (measure) and means 'measurement of living species'. Biometric technologies imply that unique or distinctive human characteristics of a person are collected, measured and stored for the automated verification of a claim made by that person or the identification of that person. Biometric systems only compare information submitted.

The idea that parts of our body can be used to identify our unique selves is not new. Prints of hand, foot and finger have already been used in ancient times because of their unique characteristics. Since the early twentieth century, fingerprints used to be collected by police and have been used manually for decades. Palm prints were also successfully used in the early 1900s to solve murder cases. Only in the last decades of the twentieth century, computer aided techniques started developing. Hand geometry was used for one of the first fully automated checks against a stored reference. In 1985, the idea that an iris was unique, was promulgated. Other techniques for the automated measuring of face, speech and fingerprint were proposed and developed. Later on, new biometric characteristics, such as vascular patterns, are used in recognition systems. Analysis of human DNA is generally still considered not sufficiently automated to consider it as a biometric technology.

Biometric Characteristics Used in Biometric Systems

Universal: Universal means that the biometric characteristic shall (in principle) be present with all human beings.

Persistent: The biometric characteristic also needs to be persistent, i.e. does not change over (some) time. Examples of biometric characteristics which meet according to experts this criterion in a convincing way include fingerprint and iris.

What is meant by Face Recognition?

Face recognition basically relates to the task of identifying an already detected face as a known or unknown face. Face detection is to identify an object as a face and locate it in the input image while face recognition is to decide if this face is someone known or unknown depending on the database of faces it uses to validate this input image.

An image of the face can easily be captured. For purposes of a face recognition system, 2 dimensional (2D) or 3 dimensional (3D) images taken by commercially available or other cameras are used. Infrared illumination is for facial scans sometimes deployed.

Fig1 Facial image taken of visitor for access control purposes and issuance of badge at the European parliament.

Face recognition techniques

Recognition algorithms can be divided into two main approaches, geometric, which looks at distinguishing features and photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances; the second approach is quite prone to the limitations caused by facial variations such as illumination, 3D pose and expressions. Popular recognition algorithms include Principal Component Analysis using eigen faces, Linear Discriminant 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

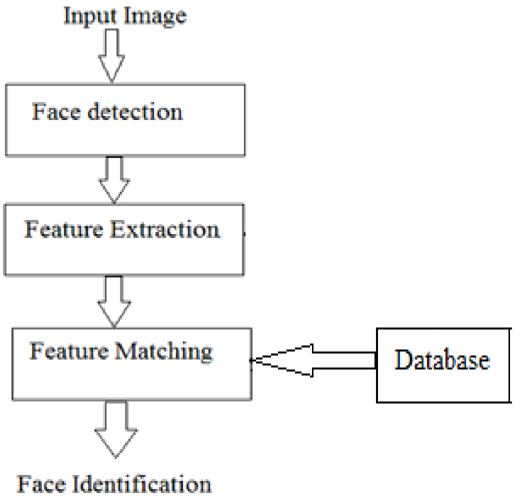

Fig 2 Appearance based technique

Appearance or photometric based Approaches

1. The Eigenface Method

Kirby and Sirvoich first used eigenfaces for recognition. Inspired by their work, Turk and Pentland proposed eigenfaces method based on Principal Component Analysis (PCA) for face recognition. The main procedure in PCA is based on Karhumen-Loeve transformation. PCA is a well-known linear dimensionality reduction technique which finds a set of mutually orthogonal basis functions and uses the leading eigenvectors of the sample.

2. The Fisherface Method

Belhumeur, 1997 proposed the Fisherface method, a derivative of Fisher‟s Linear Discriminant (FLD) which includes linear discriminant analysis (LDA) to extract the most discriminant features. Also, it is a dimensionality reduction technique. Fisherface method uses both PCA and LDA.

3. Support Vector Machines

To improve the classification performance of the PCA and LDA subspace features, more sophisticated classifiers, support vector machines (SVM) are used.. SVM are the classifiers which are generally trained through supervised learning.

Guo, a scientist applied this method to face recognition. He used a binary tree classification technique in which a face image is iteratively classified as belonging to one of two classes. A binary tree structure is propagated up until the two classes denote individual subjects and a final classification decision can be made.

Feature Based or geometric based Approaches

1. Elastic Bunch Graph Matching (EBGM)

In this basically, faces are represented as graphs with nodes positioned at fiducial points (Eyes, nose...). The edges are labeled with 2D distance vectors with each node containing a set of 40 complex Gabor wavelet coefficients at different scales and orientations (phase, amplitude). They are called "jets" and the recognition is based on labeled graphs. Elastic bunch graph matching (EBGM) uses model graph to represent a human face and encodes local appearance using 'wavelet jets'.

2. Convolution Neural Networks

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The neural network approaches use a training set of face images in order to create a neural network based classifier. Kohonen was the first to demonstrate that a neural network could be used to recognize aligned and normalized faces. Since then a number of methods have been proposed. Lawrence describes a neural network approach for identification and verification of facial images. It used self-organizing map neural network and Convolutional networks.

A NEW approach in face recognition: 3-DIMENSIONAL RECOGNITION

A newly emerging trend, claimed to achieve improved accuracies, is three dimensional face recognition method. 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. 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.

A new to introduce a way to capture a 3D picture by using three tracking cameras that point at different angles; one camera will be pointing at the front of the subject, second one to the side, and third one at an angle. All these cameras will work together so it can track a subject’s face in real time and be able to face detect and recognize.

Notable users and deployments

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. 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 for verification. U.S. Department operates one of the largest face recognition systems in the world with over 75 million photographs that is actively used for visa processing. 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. Facial recognition systems are used as an alternative way to confirm employee attendance at work for the claimed hours..

Lessening the ATM frauds through proposed facial recognition technology

The first and most important step of this project is to develop a powerful facial recognition program that uses local feature analysis and whose target is facial verification. This program should be compilable on multiple systems, including Linux and Windows variants, and should also be customizable to the extent of allowing for variations in processing power of the machines onto which it would be deployed for usage. Then discussion is to familiarize ourselves with the internal workings of the program so that we can learn its strengths and limitations. Several sample images will be taken of several individuals to be used as test cases – one each for account images, which is placed in dataset and several each for live images, each of which would vary according to pose, lighting conditions, and expressions. Next step is to develop a simple ATM black box program. This program will serve as the theoretical ATM with which the facial recognition software will interact. It will take in a name and password, and then look in a folder for an image that is associated with that name. The image is taken from a separate folder of live images and then facial recognition program to generate a match level between the two is used. Finally it will use the match level to decide whether or not to allow access, at which point it will terminate. All of this is necessary, because we are not having access to an actual ATM or its software. Both pieces of software will be compiled and run on a Windows XP and a Linux system. Once they are

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both functioning properly, they will be tried to improve as much as possible to increase performance (decreasing the time spent matching) and to decrease memory footprint. So, basic technology of face recognition software will be:

1. Locates a moving object within the camera view
2. Determines if the moving object is face
3. Compares live faces with samples from database
4. Face recognition technology can work with both low resolution USB
5. Cameras and low or high resolution CCTV cameras.
6. Face searching technology captures all the faces in a cameras view .Then it stores each image in a separate folder for quick reviews-or for use with another face key technology. Each face is saved with a time and date stamp.

Search and match advisory technology: Search and match advisory technology is available to assist in the identification of facial images extracted from the video stream or from a watch list database. This function operates by comparing a person's photo to a database of faces and selecting the faces from the database which look the most like the subjects face. User's face is the key.

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. 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. It is also important for researchers to make available the datasets they used to each other, or have at least a standard dataset.

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