FACE:THE MOST ATTRACTIVE BIOMETRIC

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Abstract

Face Recognition has become one of the most attractive research area among Computer Vision and Image processing researchers.This technique is one of the least intrusive modalities in biometrics.Face is the only biometric that allows us to perform passive detection. Biometrics is a science that could assist in this recognition process.There is a number of reasons to make face biometric to be superior compared to other biometric. Face Contain Anatomical information which is unique to each person and no physical interaction is needed.There is a growing need for an accurate and automatic human recognition procedure. Pattern recognition techniques are an important component of intelligent systems and are used for data processing and decision making.FACE recognition in 2-D and 3-D has been addressed using a variety of methods, including alignment, subregion matching,mapping, and principal component analysis (PCA).

Index terms: Biometric,Face Recognition, 2D face recognition,3D face recognition.

1 Introduction

Interest in digital image processing methods stems from two principal application areas: improvement of pictorial information for human interpretation; and processing of image data for storage, transmission, and representation for autonomous machine perception. Pattern recognition and soft computing techniques has found many applications in Image Processing especially in classification and recognition scenario. Face Recognition has been described as the Holy Grail of biometric identification systems, due to a number of significant advantages over other methods of identification.

The term biometrics describes the quantifiable characteristics used in measuring features of biological organisms. We define recognition, in the context of biometric systems, as the capability to perform verification and identification. Verification is the process of comparing one biometric pattern with another biometric pattern, resulting in either a rejection or acceptance decision. Whereas identification is the process of comparing one biometric pattern with a set of two or more biometric patterns in order to determine the most likely match. Public acceptance and the general understanding of the capabilities of this new technology hinder the switch from legacy systems ,there are still great incentives to use biometrics.

Several biometric options emerging over the last few years. The most common being fingerprint, face and iris recognition but other examples included the retina, voice, skin texture, ear shape, gait (walking stride), hand geometry , vein pattern, thermal signature and hand-written signature. Face recognition offers several advantages over other biometrics some of them are Covert operation, Human readable media, Public acceptance.

2 Single Biometrics and Multi Biometric

The practice of using more than one biometric modality, sample, sensor, or algorithm to achieve recognition, commonly referred to as multi-biometrics, is a technique that is rapidly gaining popularity. By incorporating multi-biometrics into the recognition process, many of the short-comings of traditional single-biometric systems can be alleviated and overall recognition accuracy can be improved. Multi-biometrics can inherently increase system robustness by removing the dependency on one particular biometric approach. Further, a system that utilizes more than one biometric feature or matcher may be more difficult to deliberately spoof. In the simplest, traditional single-biometric system, one sensor images a particular trait (i.e. iris, face, or fingerprint) to produce a single image. The image is then processed and compared against a gallery using a matching algorithm to obtain a verification or identification result. A multi-biometric system aims to improve recognition rates (or address some other drawbacks of traditional systems) by providing redundancy at one or more of the steps in this recognition process.

A straightforward augmentation of the traditional biometric approach is to collect multiple images of the same biometric. Such systems, referred to as multi-sample. Similar to multi-sample biometrics is multi-instance biometrics, in which more than one physically unique sample of a single modality is acquired. Examples of multi-instance systems are systems that process more than one fingerprint (from different fingers) or both left and right irises. A multi-algorithm technique collects a single sample of a particular biometric, and performs matching using more than one algorithm. The results can then be fused using score-level, rank-level, or decision-level fusion. Multi-sensor approach, the same biometric is imaged with more than one sensor. The resulting samples can then be handled as in the multi-sample approach .A Multi-modal approach uses multiple physical traits (i.e. face and fingerprint) in the recognition process. Here, the fusion of the two modalities can occur in

several different ways. A straightforward method is to process each biometric separately and then to perform score-level or rank-level fusion. Alternatively, feature-level fusion can be used to extracted features from each modality.

3 2D and 3D Face Recognition

Face Recognition scenario can be classified as 2D face Recognition and 3D face recognition. In 2D face recognition the system effectiveness is highly dependent on image capture conditions. These conditions include Lighting conditions, Head orientation, Image quality, Facial expression and Partial occlusions. 2D approaches includes feature analysis, neural networks, graph matching , Support Vector Machines, as well as some of the more recent Bayesian approaches and Active Appearance Models. There has been much progress in frontal face detection and most face detection algorithms have a face recognition approach also. When a new test image is presented, parts of all possible sizes and positions are extracted, scaled to the same size as the training samples and then comparison is done. Different approaches are employed, In the Eigen faces algorithm, a training set of face images is first aligned according to some standard landmarks (often eye centers). Principal component analysis (PCA) is then applied to the training set to extract a set of Eigen faces (eigen vectors of the training images). These eigen faces describe the primary directions of variation in the training set. When a new probe face is obtained, it is first aligned with the training set. The aligned face is then projected into the face space" to express the probe image as a linear combination of the eigen faces, thus generating a set of coefficients for the eigenfaces. Each gallery image is also projected into the face space in this manner, and comparison between a probe and gallery image is accomplished by using a selected distance metric (i.e. Euclidean) to measure the distance between the vectors of eigen faces coefficients. Like Eigen face, the Fisher face algorithm first aligns a training set of face images, and then projects them into a reduced subspace. Unlike PCA, however, which uses the directions of maximum variation in the training set as projection directions, the fisher face algorithm uses Fisher Linear Discriminant Analysis to choose projection directions which maximize the ratio of between-class and within-class scatter. 2D face recognition has got limitations such as lighting condition, head orientations, image quality and partial occlusions. A possible solution for the above said limitations is to use 3D face recognition.

Compared to the research carried out into 2D face recognition, there has been relatively little research into 3D facial recognition. There appears to be three main reasons for this:

- Availability of data
- Range of applications
- Human analogy.

Newly emerging 3D cameras allow sub-second generation of 3D face models.Using 3D face models for recognition potentially provides the following benefits:

- Use of geometric depth information rather than colour and texture
- Ability to rotate face model in 3D space.
- 3D models captured to scale.

Majority of the 3d face biometrics Rely on ICP (Iterative closest Point). ICP is the method that is used for calculating the match score. The major limitation, its a computationally intensive process that can take several seconds per match-score calculation.

4 3D Scanning Technology

Minolta Vivid 910 scanner is used in much of the works. Minolta has some capture limitation and the Cost is also high. 3d scanners can be placed in 3 categories:

1. Active
2. Passive
3. Mechanical

Active scanners can calculate 3D from a variety of approaches. Active scanners possess limitation on the conditions in which they are able to operate and generally more expensive than passive scanners. The accuracy of active scanners makes them the current scanner of choice for most research applications. In passive scanners first a correspondence between pixel locations

on the 2D images is taken , then they try to obtain the 3Dstructure of the points. Five different commercial scanners

1. Qlonerator
2. FR1
3. FR2
4. Vivid 910
5. Polhemus fast track

The major steps in any 3D face recognition and verification are

1. Data capture
2. 3D face model production
3. 3D face model improvement
4. 3D face recognition/verification

The first three steps are for the purpose of producing a face image which will be utilized as a probe image. The gallery is a set of biometric data of known individuals. In recognition the probe image is compared to every image in the gallery .In verification scenario, the individuals presents a claimed identity to the system and the system determines whether or not the probe matches the gallery image for that subject alone.

5 Dataset

The largest publically available face dataset used for face recognition research is FRGC Dataset .This dataset is having images showing different variations in expressions. FRGC v2 database, the largest available database of 3D face images, composed of 4,007 images from 466 different subjects .All images have resolution of 640x480 and they were acquired by a Minolta Vivid 910 laser scanner. The most common facial expressions available in the database are: neutral, happy, sad, disgusting, surprised, and puffy cheek. In 2008, the National Institute of Standards and Technology (NIST) presented the Multiple Biometric Grand Challenge (MBGC) (National Institute of Standards and Technology (NIST), 2008). The MBGC dataset, which consisted of a collection of face and iris samples for numerous individuals, was provided to participating researchers to encourage multi-modal algorithm development.

The dataset included left and right iris stills, face stills with controlled and uncontrolled visible illumination, high-definition video with visible illumination, and near-infrared (NIR) video collected using the Iris on the Move (IOM) sensor. Other third party datasets are also available for researchers.

6 Conclusion

Face Continue to be the most attractive biometric due to its diverse advantages in single modality or multi modality environment.In the recent years face detection and recognition has become a popular area of research in computer vision, one of the most successful applications of image analysis and understanding. There has been much progress in frontal face detection and most face detection algorithms have a face recognition approach also. Automatic recognition of people is a challenging problem which has received much attention during the recent years due to its many applications in different fields such as law enforcement, security applications. Face recognition will continue to be a very difficult and challenging problem. Effective and coordinated effort between the computer vision, signal processing and psychophysics and neurosciences communities is needed.

7 References

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