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Application of Feature Extraction Used in Biometric Identification

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Abstract

After the extraction of various features we can manipulate them to get important information such as from a pair of eyes we can extract the iris pair to uniquely identify the person or from a mouth we can extract the lips or teeth for applications such as person identification, gender identification etc. Furthermore extraction of these features is not an easy task due to their variation in scale, rotation, pose, expression, presence or absence of some structural component, occlusion, illumination and image condition etc. Hence a huge number of researches are taking place considering these limitations and providing suitable solutions to overcome them. In this paper we have described three applications such as person identification using lip prints, teeth contour and iris pattern based on the concept of feature extraction that are very popular in biometric science.

Keywords: Biometric identification, cheiloscopy, groove structure, teeth contour, iris pattern, person identification..

Introduction

Biometric is a unique statistical analysis that automatically recognizes or verifies the identity of a human being by analyzing various human characteristics as shown in the following figure. All these analysis procedure should go through a four-step process of capture, extraction, comparison and matching. In this process we first capture the samples of the biometric characteristic. Then we extract various features and convert them to a mathematical code which is stored as the biometric template for that person. The template may reside in the biometric system itself, or in any other form of memory storage, such as a computer database, a smart card or a barcode. The individual then interacts with the biometric system to verify his or her identity and obtain matching or nonmatching.

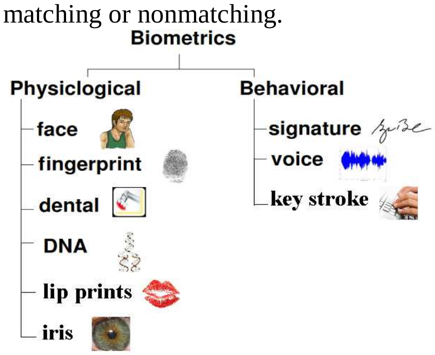

Figure 1: Classification of biometric applications

In the next sections we will illustrate how a person can be uniquely identified by using various facial features like lip prints [1] [2] [4] [5] [6] [7] [14]; finger prints [19]; teeth contours [18] [22] [23]; iris pattern [26]-[32], etc.

Person Identification Using Lip Prints

It is very difficult to implement a person's identity. Some common techniques are used in this context are based on dental, fingerprint and DNA comparisons, but one of the most interesting emerging method of human identification is human lips recognition [6] [7] [8] [9]. Lip prints are unique in nature and do not change during the whole life of a person. Even in twins, whose patterns are somehow similar but no two lip prints are identical in detail.

Identification of humans based on Lip prints are examines using a forensic investigation technique known as Cheiloscopy [8] [11] [25]. Samples of Lip prints have to be obtained within 24 hours of time of death to prevent erroneous data that would result from post mortem alterations of lip. Lip print pattern also depends on the position of mouth that is whether mouth is opened or closed. The following flow diagram shows how a person can be uniquely identified using their lip groove pattern.

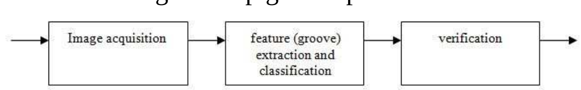

Figure 2: Flow diagram of person identification using lip prints

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Image Acquisition

The external surface of lip forms the characteristic of a person and has numerous patterns, referred to as lip prints, lip prints can be obtained at the crime scene from clothing, cups, glasses, cigarettes, windows and doors. The survey shows that, the red part of human lips are very much useful in personal identification, but also they can be used in gender identification, cosmetics surgery etc.

Feature (groove) Extraction and Classification

The arrangement of lines on the red part of human lips is individual and unique for each human being. These line arrangements are called groove. In closed mouth position grooves are more prominent, where as in open position the grooves are relatively less prominent and difficult to interpret [12] [13]. These groove patterns are very much useful for person identification.

Depending on the pattern of groove lip prints can be classified into ten types:

A = complete vertical
B = incomplete vertical
C = complete bifurcated
D = incomplete bifurcated
E = complete branched
F = incomplete branched
G = reticular pattern
H = X or comma form
I = horizontal
J = horizontal with other forms (vertical, bifurcate or branching).

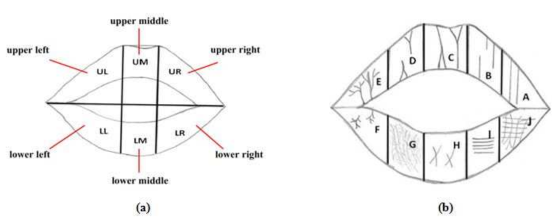

Figure 3: (a) Diagram showing the sectional division of lip print; (b) Diagram showing the various lip-groove types.

From a huge number of statistical analyses, it is concluded that, for each person there is a unique groove pattern in each section. Also for each gender [3] [15] there are some commonalities in groove pattern. So whenever we want to analyze lips, we first divide the lip structure into six parts. After that, we recognize the groove contours to match them against the above ten types and then compare it with the database records. Similarly, in case of person identification we analyze the pattern in all the six sections and based on the rules stated above, then we can conclude that whether the person is male or female. Other than these application domains, there are some limitations, which are needs further study and they are the effect of age and seasonal influences on the groove patterns.

Verification

Once we extract the various groove patterns for each section, we can build the feature vectors for both the test samples and reference samples. After that, we make a comparison between them to find out the best match. According to literature Euclidean distance is a very popular statistical measure, which computes the distance between two vectors to find out the match. In this context we can use a threshold value to make a decision on whether to accept or reject the reference sample. If we do not find any match which satisfies the threshold value, we can choose another reference sample from our database.

Person Identification Using Teeth Contour

Identification of a person based on their dental records is an interesting concept in Forensic dentistry [17]. Here we use radiograph image, which are more permanent rather than fingerprints, iris or other facial features of a person [16]. Not only this, they remain available even either several hours of expiry of a person. These dental records are then matched to the database records by means of this shape, relative distance between each tooth and etc. For this purpose, we need to segment each of the dental features like crown, root. Each of these extracted features represents ROI (Region of Interest) that contains important data used for later steps [21]. The segmentation of dental features can be done either by region-based method where different objects and regions are identified by using model based approach where we use a specific model and try to adjust its parameters to fit the processed objects or regions. These model-based approaches are very different to implement but they are more successful and reliable. In short we can say that a person's identification using teeth contour involves three steps: image acquisition, enhancement, and image segmentation [20].

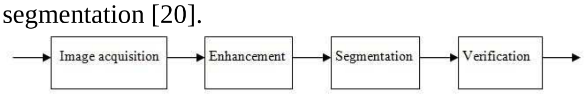

Figure 4: Block diagram of person identification using teeth contour.

Image Acquisition

According to forensic experts, we need to record the contour or shape of the individual tooth rather than the whole jaw because each individual tooth gets rotated and moved from its AM position due to the decay of gums and body tissues. Hence a tooth based retrieval procedure is required in addition to eliminate gum and body tissues problems as stated above. In figure 5, we identify three main classes of objects; teeth, gum, and air. A tooth maps to an area with mostly bright gray scales (except for the pulp tissue) while the gum maps to areas with mid-range gray scales, and air maps to dark gray scales. Thus, a significant contrast in gray scales within a small area of a dental radiograph indicates a transition from one object to another. In order to assist segmentation, it is desirable to transform poor quality dental radiographs using in a way that insures an appreciable degree of contrast between the dominant gray scales used in capturing the different classes of objects.

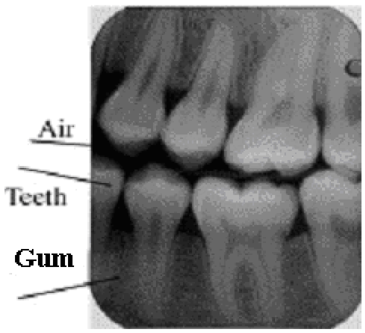

Figure 5: A typical dental X-ray image

Enhancement

Different X-ray images have different resolutions, orientations and luminance content, depending on the ray type of the machine and the dentist who took it. Several images suffer from low resolution and lighting, which would affect the quality of the desired segmentation. Hence edge enhancement is crucial for many images in order to obtain successful segmentation results. Enhancement of a dental radiograph is the process of producing an improved quality image out of a degraded quality input image of a dental radiograph. The term "higher quality" is a fuzzy term that should be further explained. Quality of an image is a measure of its suitability for an application-specific manipulation.

In this step, radiograph images are automatically post-enhanced and segmented. In the post enhancement stage, dental radiographs contain three distinctive regions: background, teeth, and bones. Usually the teeth regions have the highest intensity, the bone regions have high intensity that sometimes is close to that of the teeth, and the background has a distinctively low intensity. It is easy to separate the background by threshold-based methods, but these methods usually fail to discriminate teeth from bones, especially in cases of uneven exposure. To overcome this problem, the first step we use is to enhance the image's contrast. top-hat and bottom-hat filters can be used to extract light objects (or, conversely, dark ones) on a dark (or light) but slowly changing background. We use both the top-hat and the bottom-hat filters on the original image, and combine the results by adding to the original image the result of the top-hat filter, and subtracting the result of the bottom-hat filter, so that the teeth areas can be enhanced and the bone and background areas can be suppressed as well. Figure 6d shows a result of the enhancement algorithm.

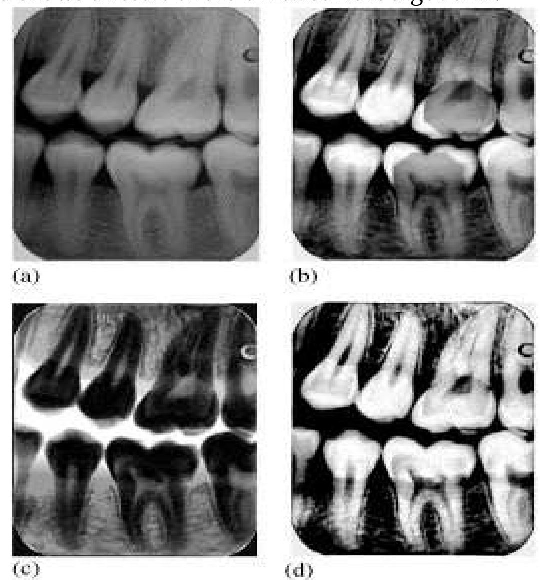

Figure 6: An example of dental image enhancement: (a) original image; (b) result of top-hat filtering; (c) result of bottom-hat filtering; (d) the final enhancement result

3.3 Segmentation

Image segmentation is typically defined as the process of extracting objects from the image background. Subtracting the object location from the rest of the image usually performs it. This object location is usually calculated by an edge detection [24] technique, an intensity measure or a target recognition algorithm. However most of these techniques suffer from different types of noise due to low resolution or poor lighting, which results in un-successful segmentation.

Segmentation subdivides an image into it's constitute regions or objects. In the Dental Image perspective, segmentation is to recognize and label individual tooth in the X-Ray image or parts of the tooth such as crown and root of the tooth. Each tooth or object extracted from the image represents Region of Interest (ROI) that contains important data used for later steps. ROI is defined as a rectangular part of the image that focuses on one object of the extracted objects from the image. The following image represents an X-ray image and the specified object inside the rectangle represents the ROI. Figure 8b shows ROI extracted from the dental image.

In most of the segmentation algorithms, the segmentation is done either by extracting region based features, that can identify different objects and regions, or by applying a model and try to adjust its parameters to fit the processed objects or regions. Although the model based approaches are more

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complicated but they are more successful and reliable. For a complete review of image segmentation the reader is referred to [4]. Mathematical morphology is a topological and geometrical based approach for image analysis. It is a powerful technique in extracting different shapes and structures in different applications such as texture classification, pattern analysis and content-based image coding and retrieval. Morphological filtering is typically defined as grouping different pixels in the images based on their color, spatial frequency and intensity. Objects in the morphologically processed image are usually well identified by a group of pixels that represent the objects shape. The main morphological filters used in shape reconstruction (grouping different objects) are Erosion, Dilation, opening and closing.

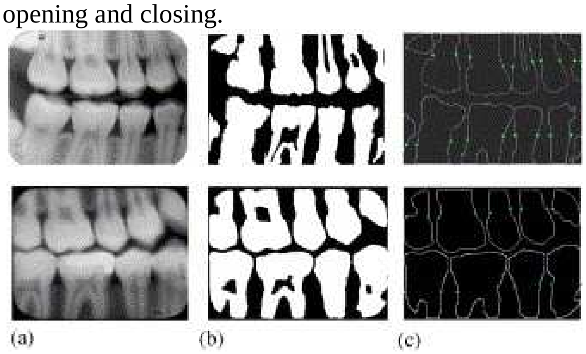

Figure 7: Teeth segmentation and separation of crowns and roots: (a) original images; (b) results of adaptive thresholding; (c) refined teeth contours with points that separate the roots and crowns

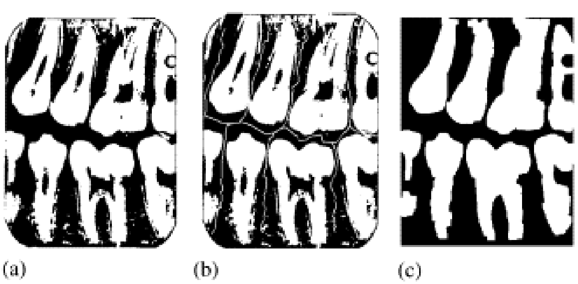

Figure 8: An example of teeth segmentation: (a) result of adaptive thresholding; (b) teeth regions isolation using the result from ROI localization; (c) result after morphological operations.

Person Identification Using Iris Pattern

Iris recognition is a process of recognizing a person by analyzing the random pattern of the iris. Iris is a muscle within the eye that regulates the size of the pupil, controlling the amount of light that enters the eye [27]. Also the color of iris depends on the amount of melatonin pigment within the muscle [26]. No two irises are alike, and based on this concept we can uniquely identify a person.

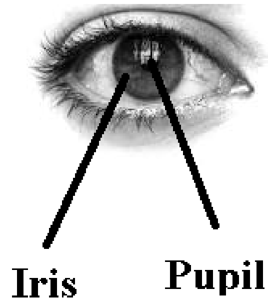

Figure 9: Picture of eye

An automated iris recognition system consists of three modules. In the first module, we capture an image, after capturing the image, we localize the iris excluding the noise such as eyelashes, eyelids etc. In the last module we perform some comparative analysis using some database entries.

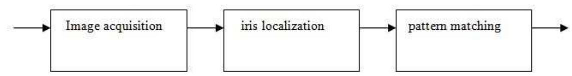

Figure 10: Block diagram of person identification using iris pattern

Image Acquisition

The first task of iris recognition is to extract the iris boundaries because if we extract the iris improperly due to some noise like eyelashes, eyelids, pupil the algorithm may lead to poor performance. There are many challenges in an automated iris recognition system. One of them is to acquire a high quality image of the iris acquire images of the iris with sufficient resolution and sharpness to support recognition. It is important to have good contrast in the interior iris pattern without resorting to a level of illumination [10] [30]. Also we should remove all the artifacts presence in the image.

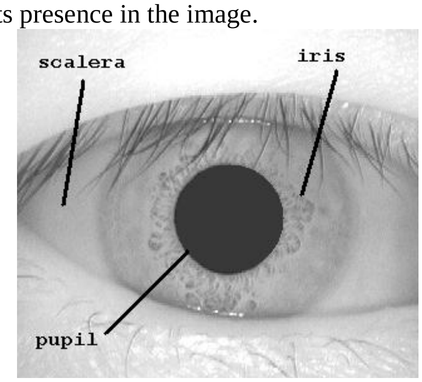

Figure 11: Details of eye

Iris Localization

Image acquisition does not capture image containing only the iris part instead it captures iris images as a part of a large image, which contains surrounding eye regions. Therefore, before recognizing the iris we first localize the iris from an eye image. Further, if the eyelids are occluding part of the iris, then only that portion of the image below the upper eyelid and above the lower eyelid should be included [31] [32]. Typically, the limbic boundary is imaged with high contrast, owing to the sharp change in eye pigmentation that it marks. The eyelids, however, can occlude the upper and lower portions of this boundary. The papillary boundary can be far less well defined. The image contrast between a heavily pigmented iris and its pupil can be quite small. Further, while the pupil typically is darker than the iris, the reverse relationship can hold in cases of cataract: the clouded lens leads to a significant amount of backscattered light. Like the boundary, eyelid contrast can be quite variable depending on the relative pigmentation in the skin and the iris. The eyelid boundary also can be irregular due to the presence of eyelashes. Taken in tandem, these observations suggest that iris localization must be sensitive to a wide range of edge contrasts, robust to irregular borders, and capable of dealing with variable occlusion. A very well known localization algorithm is Daugman's algorithm [26].

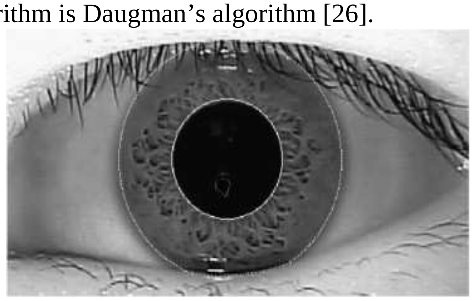

Figure 12: The results of iris localization by Daugman's algorithm

Pattern Matching

In pattern matching module we compare the localized iris image with existing database entry. Prior to comparison, we must preprocess the localized image using some transformation process such as shift, scale, rotation etc [28] [29]. After locating an iris, a 2D Gabor wavelet filters are used to map the segments of the iris into phasors. These phasors include information on the orientation and spatial frequency and the position of these areas. This information is used to map the IrisCodes. IrisCode using phase information describes Iris patterns, which are collected in the phasors. This phase information does not influence by contrast, imaging system, illumination levels. The phase characteristic of an iris can be described using 256 bytes of data using polar coordinate system. Some control bytes are also used in this description to exclude eyelashes, reflection(s) and other unwanted data.

To recognize iris, we first compare two IrisCodes. The IrisCodes difference is called Hamming Distance(HD). This HD is used as a test of statistical independence. If the HD indicates that less than one-third of the bytes in the IrisCodes are different, the IrisCode fails the test of statistical significant, indicating that the IrisCodes are from the same iris. Therefore, the key concept to iris recognition is failure of the test of statistical independence.

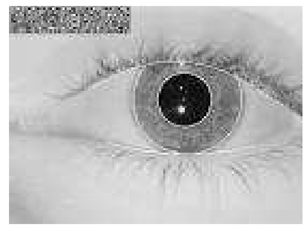

Figure 13: Iris with IrisCodes

Conclusions

Recently, face detection techniques have been employed in different applications such as person identification using lip prints, teeth contour, iris pattern, which are also the subjects to be focused of this paper. Hence, before developing any kind of method of your choice, if you go through this paper, you will definitely get an overview of various ways of person identification process that uses the concept of feature extraction.

References

[1] Tsuchihasi Y. " Studies on Personal Identification by Means of Lip Prints." Forensic Science, 3:3. , 1974

[2] Kasprzak J, Leczynska B (2001) Chieloscopy. "Human identification on the basis of lip Prints" (in Polish). CLK KGP Press,Warsaw, 2001

[3] Sonal, V., Nayak, C.D., Pagare, S.S.: "Study of Lip-Prints as Aid for Sex Determination", MedicoLegal Update 5(3) (2005).

[4] Tsuchihasi, Y.: "Studies on Personal Identification by Means of Lip Prints" Forensic Science 3(3) (1974).

[5] Suzuki K., Tsuchihashi Y.: "Personal identification by means of lip prints", J.Forensic Med. 17:52-57, 1970.

[6] Choras Michal, Human Lips Recognition , in M. rzyñski et al. (Eds): Computer Recognition Systems 2, Advances in Soft Computing, Springer, 2007 Volume 45,838-843.

[7] Williams TR. Lip prints – Another means of identification. J Forensic Ident 1991; 41 (3): 1904.

[8] Sivapathasundharam B, Ajay Prakash P, Sivakumar G. Lip prints (Cheiloscopy). Indian J Dent Res 2001; 12: 234-7.
[9] Tsuchihashi Y. Studies on personal identification by means of lip prints. Forensic Sci 1974; 3: 23348.
[10] Y. Zhu, T. Tan, and Y. Wang, "Iris Image Acquisition System", Chinese Patent Application, No.99217063.X, 1999.
[11] Kasprzak J. Possibilities of cheiloscopy. Forensic Sci Int 1990; 46: 145 – 151.
[12] Vahanwalla SP, Parekh BK. Study on Lip Prints as an Aid to Forensic Methodology. J Forensic Med and Toxicol. 2000; 17(1): 12-18.
[13] Saraswathi TR, Mishra G, Ranganathan K. Study of lip prints. J Forensic Dent Sci 2009;1:28-31.
[14] Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using lip prints. Forensic Sci Int 2005; 149: 129132.
[15] Shailesh M Gondvikar, Atul Indurkar,Shirish Degwekar,Rahul Bhowate. Cheiloscopy for sex determination. J Forensic Dent Sci 2009;1;2:5660.
[16] Adams BJ .The diversity of adult dental pattern in the United States and implications for personal identification .J Forensic Sci 2003;48:497-503.
[17] Pretty IA, Sweet D. A look at forensic dentistry Part 1: The role of teeth determination of human identity. Br Dent J 2001;190:359-366.
[18] Robert Howell, " Dental Remains", Dental Task Force Technical Report by the Criminal Justice Information Service, Federal Bureau of Investigation on Forensic Identification.
[19] Integrated Automatic Fingerprint Identification System (IAFIS), Technical report by the Federal Bureau of Investigation, Criminal Justice Information Services Division, March 5th 2002.
[20] N. R. Pal and S. K. Pal, "A review on image segmentation techniques", Pattern Recognition, Vol. 26, No. 9, pp. 1277 -- 1294, 1993.
[21] Shrikanth Sharma, Monika Aggarwal, " Determination of Unique feature set from Dental Image Graphs as Bio-Metric Information using Image Processing Techniques", IOSR Journal of Engineering (IOSRJEN),ISSN: 2250-3021 Volume 2, Issue 6 (June 2012), PP 11-15.
[22] A. K. Jain, H. Chen, and S. Minut. Dental biometrics," Human identification using dental radiographs", In Proc. of 4 AVBPA, Guildford, UK, pages 429–437, June, 2003.
[23] A. K. Jain and H. Chen, "Matching of dental x-ray images for human identification", Technical Report MSU-CSE-03-33, Department of Computer Science, Michigan State University, East Lansing, Michigan, November 2003.
[24] Prof. Samir Kumar Bandyopadhyay, "Contour detection of teeth by pixel manipulation", Journal of Current Computer Science and Technology Vol. 1 Issue 5 [2011] 165-170.
[25] Prof. Samir Kumar Bandyopadhyay, " Feature Extraction of Human Lip Prints", Journal of Current Computer Science and Technology Vol. 2 Issue 1 [2012] 01-08
[26] John Daugman, " Iris Recognition for Personal Identification", The Computer Laboratory of Cambridge.
[27] F. H. Adler, Physiology of the Eye, St. Louis, MO: Mosby, 1965.
[28] L. Berggren, "Iridology: A critical review," Acta Ophthalmoligica, vol. 63, pp. 1-8, 1985.
[29] L. Flom and A. Safir,c"Iris recognition system", U.S. Patent 4 641 349, 1987.
[30] K. Hanna, R. Mandelbaum, L. Wixson, D. Mishra, and V.Paragana, "A system for nonintrusive human iris acquisition", in Proc. Int. Association for Pattern Recognition Workshop on Machine Vision Applications, Tokyo, Japan, 1996, pp. 200-203.
[31] R. G. Johnson, "Can iris patterns be used to identify people", Los Alamos National Laboratory, CA, Chemical and Laser Sciences Division, Rep. LA-12331-PR, 1991.
[32] J. E. Siedlarz, "Iris: More detailed than a fingerprint", IEEE Spectrum, vol. 31, p. 27, Feb. 1994.