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Dental Image Matching By Canny Algorithm for Human Identification

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Abstract

In this paper we collect some dental radiographs from the internet & doctor's clinic. A mathematical morphology approach is offered to the problem of teeth segmentation. We are presenting human identification by canny algorithm using image processing in MATLAB. We matched all edges of d1 image with other images and the results show that from compare to other approaches our radio graphic approach exhibits the lowest failure rate among all approaches studied.

Keywords

Input image (query image), reference image (general mage), canny, edge detection.

1. Introduction

In the history of civilization, identification of human based on dental information was first reported in the empire of Roman, when Agripina, mother of Nero's ordered the killing of Loilla Paulina, who was later identified by her dental caries and bad dental occlusion (Couto, 2009). The first treatise on human identification using dental records was conducted, in 1897, by Dr. Oscar Amoedo Valdés (1863-1945), a Cuban doctor, who was president of the French Dental Society and also the professor of the Paris Dental School, who applied a dental-based technique of human identifiaction in order to reveal the identity of victims of a disaster which occurred in Paris (Amoedo, 1897).

After Dr. Amoedo's work, the Forensic Dentistry gave more attention, and worked on the importance of using dental records for identification of human is nowadays accepted widely across the world. (Chen & Jain, 2005). During the last decade, for identifying the victims of massive disasters, such as the 9/11 terrorist attack in New York (O'Shaughnessy, 2002) and the tsunami in Asia (Thepgumpanat, 2005),dental records have been extensively used in order to identify the victims of massive disasters,Biometric system play an important role in identifying individuals based on some physiological and behavioural characteristics. Such as fingerprints, eyes, lips, voice and signature. While most of these characteristics are not suitable for reference images identification, especially under the severe circumstances like airplane crashes, dental features that qualify the reference images identification. Dental features such as teeth sizes, rotation, spacing between teeth and sinus pattern, as well as characteristics of dental work and restorations are manifested in root and crown morphology. Identification of a person based on their dental records is an interesting concept in Forensic dentistry. Radiograph images are used because these are more permanent rather than fingerprints, iris or other facial features of a person. It has certain advantages like, they remain available even either several hours of death of a person. These dental records are acquired, then after it is used for matching with the database records by means of this shape, relative distance between each tooth and etc. For this , dental features like root, crown are segmented. All these extracted features provides ROI (Region of Interest) that contains important data used for later steps. 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

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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.

In this all the images (reference images) and input image(query image) are use in the hole process of the human identification. All the images are pass these process. First image classification then image enhancement next is image segmentation then feature exaltation next matching algorithm then gets human identification. The proposed system is implemented with five modules those are:

1. Image classification
2. pre-processing
3. segmentation
4. feature extraction
5. dental image matching and human identification

2. Image Classification

In this phase collection of various general dental radiographs are done. These radiograph imags are stored in a template and can be used as a database. The information such as name an address of the person to which the radiograph belongs is stored separately.

They are classified as periapical, panoramic, and bitewing dental images[5] as shown in figures (1) to (2). Bitewing images has certain the features like both upper and lower jaws signifying bite. While periapical images has features like a nasal area, sinuses etc. particular jaw either lower jaw or upper jaw image. For most dental processing bitewing images. are used [6]. The dental radiograph can be divided into teeth areas (having highest intensity), Bone areas (having average intensity) and background area (having lowest intensity).

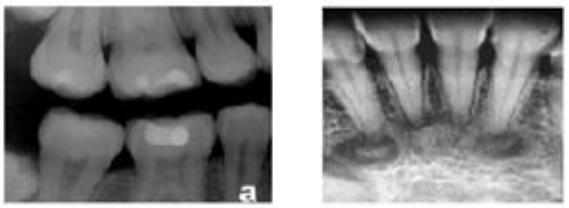

Figure 1: bitewing dental [11] and lower periapical dental images [12]

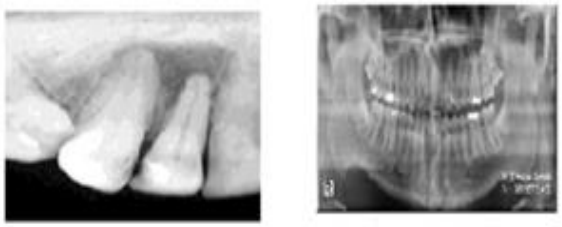

Figure 2: Upper periapical dental [13] and panoramic dental images [14]

The intensity of bone area and teeth area are much similar. So, they should be separated for fruitful feature extraction.

3. Pre-Processing

Automatic extraction of dental contours [6] is a very tedious problem. The radiographs may contain some noise so pre-processing are required to filter out unwanted noise. First Dental radiograph are converted into gray scale image. From the Histogram unwanted intensities can be seen and filter out from the image[9].

A. Size matching

In the matching reference and input images the size of image will same initially [4]. In the matching the images we will substract both the image. So in this we get same size of image is use. Because we get intensity matrix for all the image and get answer of those image which we get subtract from other. So size matching is important parameter of hole project.

B. Shape matching

The shapes of the crowns of the segmented teeth are used to find a match between the query case and the cases in the reference database. The matching is performed by finding features like rotation, scale and translation. that results in a minimum matching distance [1].

4. Segmentation

Radiograph is segmented into regions such that each region contains only a single tooth. There are three steps of Segmentation algorithm. [2]:

I. Filtering of noise
II. To isolate the teeth from the background thresholding is required.

We start with the detection of gap valley between the upper jaw and the lower jaw, bones between the teeth. We define internal noise as the internal noise help to emphasize the teeth with respect to the background. First step is to apply iterative thresholding technique then after adaptive thresholding is applied to segment the teeth from both the background and the bone areas [3]. In the iterative thresholding technique, initial threshold is estimated from an area around the edges, where the pixels around these areas have high contrast. To obtain a new threshold, the original image is first segmented using the initial threshold to separate the image into teeth areas and background areas, then the mean gray values for the two areas are obtained [7]. The new threshold is nothing but the average of the two mean gray values. This process is repeated until there is no change in the value of threshold. As a result of the iterative thresholding technique, binary image is available. The result of iterative thresholding always includes parts of the bones in the detected teeth areas. To enhance the segmentation results, we follow by applying adaptive thresholding to the result of masking the original image with the binary image. The adaptive thresholding thresholds a pixel at the centre of a defined window by comparing its value with the average gray value of the nonzero pixels inside this window. The final result is also a binary image and the segmentation result is always better than using only the iterative thresholding [8].

5. Feature Extraction

Edge is a point in the image where intensities are changing rapidly. Edge detection refers to the various mathematical and algorithmic methods by which a computer is able to map out the 'edges' in an image as humans see them.

Edge detection is fundamental in processes such as image processing, matching vision and computer vision[15].

A. Canny Edge Detection

We can derive the optimal edge operation to find step edges in the presence of white noise, where "optimal" means [10]

1. Good detection(minimum the probability of detecting false edges and missing real edge)
2. Good localization (detected edges must be close to the true edges)
3. Single response (return only one point for each true edge point)

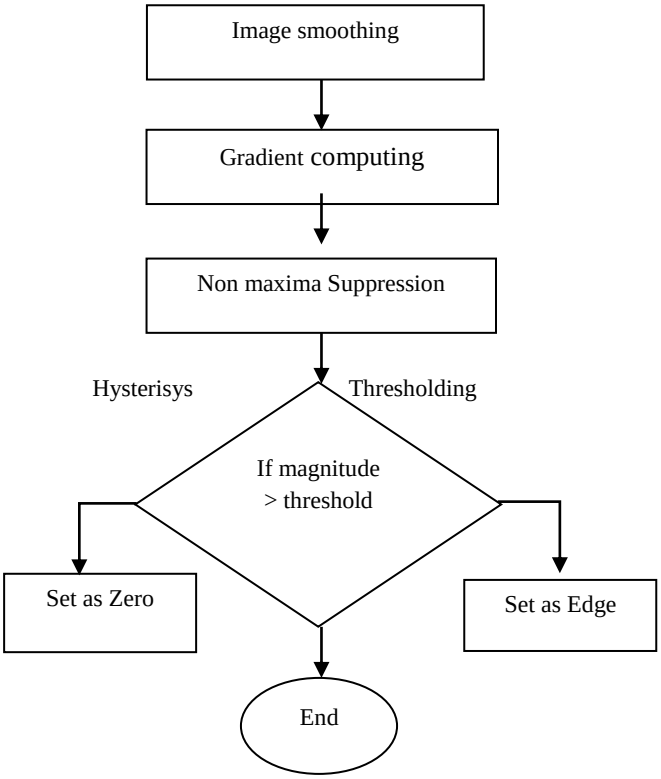

Figure 3: Canny algorithm flow chart

Canny algorithm was made by J Canny in 1986.In the algorithm shown in the figure 3, the first step is image smoothing this is use for noise removing from the image. There is low pass filter.Then next is gradient filter is their. The equation for one dimension filter is

$$G(x) = e^{\frac{-x^2}{2\sigma^2}} \qquad (1)$$

For two dimension filter the equation is

$$G(x,y) = e^{\frac{-(x^2+y^2)}{2\sigma^2}} \qquad (2)$$

in this the Gaussian curve is shown in the figure. In this the curve line is circle.

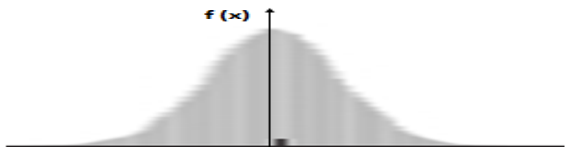

Figure 4: Gaussian curve

Then suppress non maxima along this direction.

6. Implementation

In the implementation the reference images were stored in the program. And new input image are new image which is match with all the reference images and get priority for this matching here we put small idea for this.

The input image is shown in the figure below:

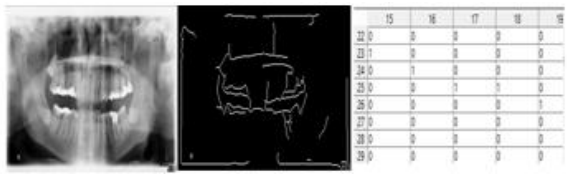

Figure 5: d1 , canny operated d1, values of d1

Figure 6 d1 have a input image(querry image) which image is compare with reference images(general images). The figure 5 shows the input image with Appling canny algorithm on the input image, & shows the intensity matrix of the input image. It is only the overview of the intensity matrix the original matrix have all the pixel of the image which is 166x304.

Reference images are shown below:

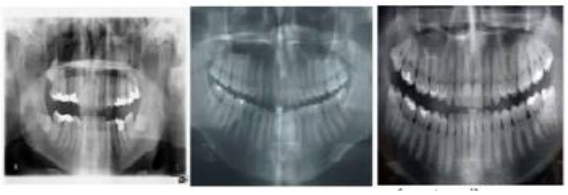

Figure 6: d1 ,d2, d3 [16]

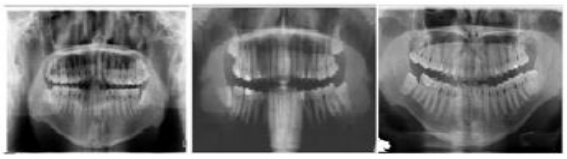

Figure 7: d4 ,d5, d6 [16]

Figure 8: d7 ,d8, d9 [16]

Reference image which compare with the original image d1 is input image and all other d1, d2, d3, d4, d5, d6, d7, d8, d9 are the reference images which is we use to compare with the input image.

In this the reference images are in the gray scale in this first we convert thr colour image in to a gray image so in the intensity matrix the values are in between 0-255 it is 2^8. It is maximum value of the intensity matrix.when we applied canny algorithm so it is necessary to convert the colour image in to gray image. In this intensity matrix we show the sample of the intensity matrix the intensity matrix is much more higher than it is shown above the total value of the intensity matrix is 158*320.When the image is in the gray scale so directly apply canny algorithm on the figure.

Apply canny algorithm on the reference image:

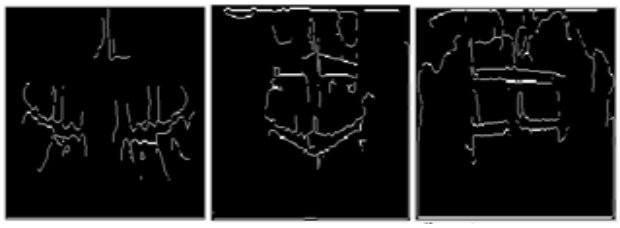

Figure 9: Canny operated d1,d2,d3

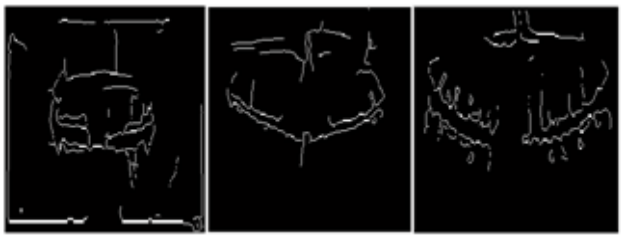

Figure 10: Canny operated d4,d5,d6

Figure 11: Canny operated d7,d8,d9

The above figure shows the applied canny algorithm on the reference images so, the figure is shown like

this way when we apply canny algorithm so the gray image is convert in to black and white image.when we show the intensity matrix of the above figure which is applied by the canny algorithm it shown in the next image .

In this intensity matrix we show the sample of the intensity matrix the intensity matrix is much more higher then it is shown above the total value of the intensity matrix is 158*320.

Table 1: Matching rate of d1 with d1to d9

	d1-d1	**d1-d2**	**d1-d3**	**d1-d4**	**d1-d5**
Matching pixels	48009	44882	44864	44884	44076
Mismatching pixels	0	2791	2800	2790	3194
maximum	48009	47673	47664	47674	47270
minimum	0	0	0	0	0
	d1-d6	**d1-d7**	**d1-d8**	**d1-d9**	
Matching pixels	44552	43694	43734	38434	
Mismatching pixels	2956	3385	3365	6015	
Maximum	47508	47079	47099	44449	
Minimum	0	0	0	0	

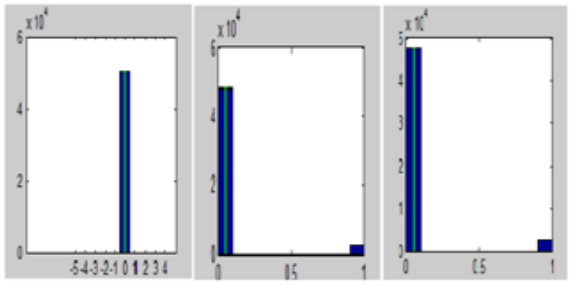

Figure 12: Comparisons of d1-d1,d1-d2,d1-d3

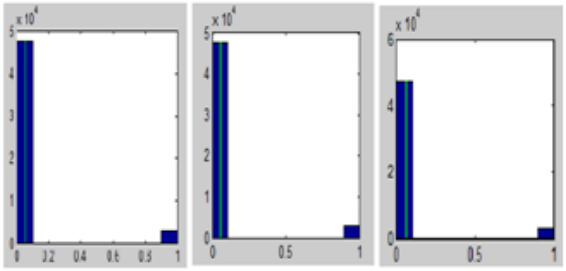

Figure 13: Comparisons of d1-d4,d1-d5,d1-d6

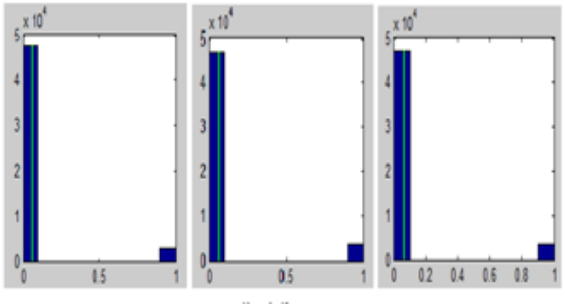

Figure 14: Comparisons of d1-d7,d1-d8,d1-d9

In above graphs & Table we can see that d1 is compared with all other images, here edges & background are in form of 0's & 1's. When we are going to match edges, edges are having pixel intensity of 1's and other background values are in the form of 0's.

So when we derived matrix form after applying canny algorithm, we subtract one image from another & get resultant matrix in form of 0's & 1's.

Here if we get 0's means => match pixels
If we get 1's => mismatch pixels

So from graph & table we can directly say that which person's radiograph is more matched with d1. So this technique can use for human identification.

7. Conclusion and Future Work

Dental biometrics is more time invariant tool than other so here we used to recognize persons in the forensic domain. We presented an automatic dental image segmentation using canny algorithm and presented graphs using histogram in mathematical morphology. Experimental results show that number of 1's in final intensity matrix shows matching result of reference image and input image lower the number of 1's shows higher the matching ratio between reference image and input image. This paper helps to identify human of any age, also it helps identifying human after death just having its radiograph record of its present or past age. So this technique can be used in real domain means if we collect some radiographs of one person with different time slot & match with another person's radiographs, by matching percentage we will be able to identify the person.

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