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Performance Evaluation on Segmentation of Dental CT Images for Individual Recognition

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Abstract: *The purpose of programmed dental segmentation is to identify the person based on dental computed tomography (CT) images. Teeth play important key role in forensic dentistry. We segment the teeth image. The segmentation process consists of Otsu thresholding, morphological processing, orthogonal lines and volume of interest (VOI). In this paper, a segmented tooth is useful for the feature extraction and classification stages.*

Keyword: *Biometrics; Dental image classification; Image segmentation; Human identification; Region of interest*

1. INTRODUCTION

Biometrics consists of methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits [2-5]. It is also used to identify individuals in groups that are under surveillance. The goal of forensic dentistry is to identify people based on their dental records in morden dentistry two very common types of imaging are CT-scan images and also panoramic imaging. CT-scan images of the teeth are acquired for many purposes like dental implants, jaw reconstruction and surgery [10-14]. Even though CT-scan images have many benefits and lot of information in them .panoramic projection in CT-scan images can also be used for teeth segmentation. Teeth are the hardest tissues in the human body and they play key roles in forensic medicine. An automated dental segmentation system for human identification in forensic dentistry requires automatic recognition of teeth in dental images [7]. In forensic dentistry, dental radiology plays the major role in the identification of victims in mass casualties besides DNA.

The identification is carried out by comparing post-mortem (PM) images with ante-mortem (AM) dental records of missing people to find similar records [1]. If we limit the comparison of the teeth to the ones that have the same number, this will decrease the search space and increase the robustness of the system [8]. In this regard, accurate knowledge of teeth arrangement and developing dental recognition techniques may effectively fulfill the demands of the forensic radiology investigations. In the literature, dental recognition mostly applied conventional dental radiography images [9]. In the recent years along with the development of CT-scans of the dentition is performed for most dental practitioners. To the best of our knowledge, a few studies exist describing the general use of CT for forensic identification as well as suggesting that CT of the dentition might be a practicable and reliable tool for easy and fast identification [16-18]. Therefore, the objective of the work here is to automate the teeth recognition process of forensic dentistry in CT images [20].

This paper is organized as follows: Section 2 describes the system concept and presents the methodology for dental recognition and Section 3 provides the results obtained using our algorithm. Final Section provides conclusion and future work.

2. LEVEL 1 HEADING

Our proposed work is based on dental recognition using teeth segmentation and morphological processing with MATLAB as a tool to acquire and process the CT images. The first step of dental segmentation starts with the Region of interest (ROI) localization and then classifies to analyze the bonny tissue [21-23]. After ROI we are moving out to volume of interest (VOI) localization followed segmentation as described in Fig.1.

2.1 ROI Localization

Region of Interest (ROI) is some times to process a single sub region of an image leaving other region un changed. The Region of Interest is based on angle adjustment method. Teeth may appear skew due to shooting, injury and some root area may not appear as well [28]. The true length width ratio of tooth may not be available without angle adjustment of the tooth. In this algorithm we choose a cropped mandible region is used to find the Region of interest [29].

2.2 Otsu Thresholding

It is important in picture processing to select an adequate threshold of gray level for extracting object

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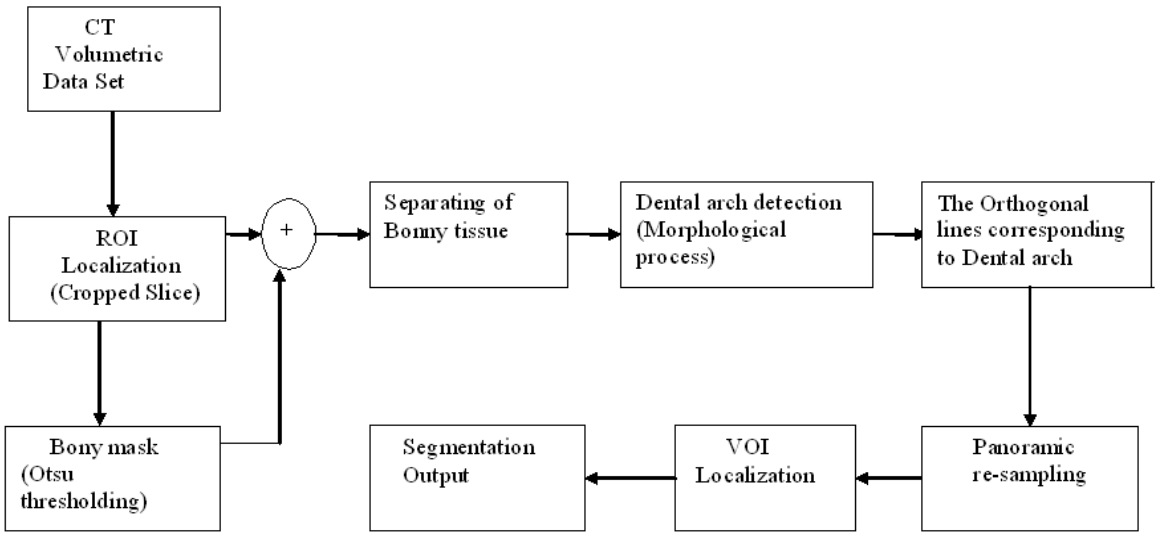

Figure 1 Block Diagram of Proposed Method

from their background [24]. Otsu thresholding is a simple yet effective global automatic thresholding method for binarzing gray scale image such as foregrounds and backgrounds. The algorithm assumes that the image to be thresholded contains two classes of pixels as [26]. Foreground and background then calculates the optimum threshold separating those two classes so that their combined spread is minimal [27].

2.3 Separating Bonny Tissue

It separate the bonny tissue from non bonny tissue .In this stage the full image of teeth is visible. We add the roi image and Otsu threshold image to separate the bonny tissue [25].

2.4 Volume of Interest (VOI)

We separate the tooth such that each block has a tooth in it. The volume of interest improves the accuracy of segmentation [6].

2.5 Segmentation

Segmentation is a process which subdivides an image into its constituent regions or objects. Teeth segmentation in CT images is a challenging task for various computer assisted dental procedures. The aim of our dental segmentation method is to extract each tooth contour in CT slices [15]. The segmentation method consists of five steps: region of interest localization, Otsu thresholding, separation of bonny tissues, morphological processing and volume of interest localization [19]. Algorithm used for this work is given below.

In Otsu's method we exhaustively search for the threshold that minimizes the intra-class variance (the variance within the class), defined as a weighted sum of variances of the two classes. Weights ω_i are the probabilities of the two classes separated by a threshold‘t’ and σ_i^2 are variances of these two classes.

1. Compute histogram and probabilities of each intensity level
2. Set up initial $\omega_i(0)$ and $\mu_i(0)$
3. Step through all possible thresholds t = 1, 2,3,.. maximum intensity
   - Update ω_i and μ_i
   - Compute $\sigma_b^2(t)$
4. Desired threshold corresponds to the maximum $\sigma_b^2(t)$.

level 2 headings shall be in times new roman 11 with bold face. Capitalize each word except the connective words such as and, of, etc.

3. RESULTS

The performance of the proposed method was evaluated using date collected from different CT images. This techniques was implemented by MATLAB 2004a software package .The Size of the image chosen is 200x200.

Figure2 Input image

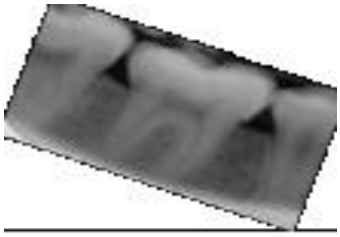

Figure 3 ROI (clockwise)

Figure 4 ROI (Anti clockwise)

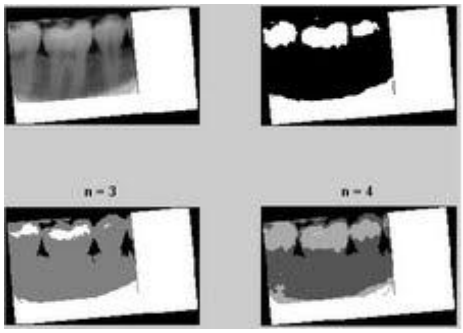

Figure 5 Threshold image

Figure 6 Orthogonal line

Figure 7 Segmentation output

4. CONCLUSION AND FUTURE WORK

We have carried out the segmentation of teeth and now we are trying for feature extraction. In the feature extraction stage, we have introduced a multi resolution method using Wavelet Fourier Descriptor (WFD). Wavelet Descriptors and Fourier Descriptors are one of the most popular techniques for shape analysis and Description in the category of contour based approach. We planned to employ a feed-forward neural network classifier to discriminated different teeth from other.

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