A Review of Teeth Cancer Using Semi-Supervised Approach

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Abstract – Dental X- ray image segmentation (DXIS) is an vitally necessary process in Practical dentistry for diagnosis of periodontitis diseases from an Xray image. DXIS have been investigated to get high accuracy of segmentation. In this paper, we propose a new cooperative scheme that applies semi-supervised Fuzzy clustering algorithm to DXIS. Specifically, the Otsu method is used to remove the Background area from an X-ray dental image. The FCM algorithm is chosen to remove the Dental Structure area from the results of the previous steps. Atlast, Semi-supervised Entropy regularized Fuzzy Clustering algorithm (eSFCM) is opted to clarify and improve the results. The proposed framework is evaluated on a real collection of dental X-ray image dataset. The usefulness and significance of this research are fully demonstrated within the extent of real-life application.

Index Terms – Dental image segmentation , Fuzzy clustering , X ray images , Semi- supervised fuzzy clustering.

1. INTRODUCTION

Dental X-ray image segmentation (DXIS) is an indispensable process in practical dentistry for diagnosis of periodontitis diseases from an Orthopantomogram X-ray image.It has been said that DXIS is one of the most important and necessary steps to analyze dental images in order to get valuable information for medical diagnosis support systems and other recognition tool. It was shown that performance of a clustering algorithm is enhanced when additional information provided by users is attached to inputs of the algorithm. Specialized data mining methods for DXIS have been investigated to achieve high accuracy of segmentation. However, traditional image processing and clustering algorithms often meet challenges in determining parameters or common boundaries of teeth samples.

An X-ray dental image consists of three main parts ,they are (i)*Teeth area*, (ii) *Dental structural area*, (iii) *Background area*. The structure of X-ray dental images makes the segmentation more complicated than traditional image segmentation. The connection between various parts of an X-ray dental image and low quality of the image due to noises, low contrast, errors on image scanning, etc.degrade the segmentation performance.

2. RELATED WORK

Shuo Li, Thomas Fevens and Song Li proposed an automatic variational level set segmentation framework for Computer Aided Dental X- rays Analysis (CADXA) in environment. The segmentation contains two stages: a training stage and a segmentation stage. During the training stage,the images are segmented using hierarchical level set region detection. Feature extraction followed by principal component analysis (PCA) and results are used to train a support vector machine (SVM) classifier. The experimental results show that the advanced method is able to provide an automatic pathological segmentation. As well, the experimental results show that the proposed segmentation framework is able to speed up the level set segmentation in clinical environments.

Dangxiao Wang, Xiaohan Zhao, Jing Xiao proposed a configuration-based optimization approach to simulate the exploration and diagnosis of carious tissues in dental operations. Haptic simulation is a crucial component to enhance virtual surgical training systems.To simulate the six Degree-of-Freedom (6DoF), two interaction states are introduced,(1) the sliding state which simulate the exploration on the surface of and inside of the caries and (2) Penetration criteria is defined to trigger the switch between the two states. Experimental results show that decays with different levels of stiffness and friction coefficients can be stably simulated. The proposed approach could be used for training delicate motor skill in a narrow oral cavity, which needs collaborated control

of tool posture and insertion/extraction force, while avoiding damages to adjacent healthy tissues of the tongue and gingiva.

OmaimaNomir, Mohamed Abdel-Mottaleb present a system for automating that will process by identifying people from dental X-ray images.The system automatically segments dental X-ray images into individual teeth and remove the contour of each tooth.Here a new method was developed for teeth separation based on integral projection. Also a new method was developed for representing and matching teeth contours using signature vectors.Apostmortem (PM) and anantemortem (AM) database are given. Matching scores are produced based on the distance between the signature vectors of AM and PM teeth.Experimental results on a small database of dental radiographs are encouraging.

MohammadH. Mahoor, MohamedAbdel-Mottaleb proposed an algorithm to classify and assign numbers to teeth in bitewing dental images. The goal is to use the final product of this algorithm in an automated dental identification system.Here Bayesian classification is used to classify the teeth in a bitewing image into molars and premolars.It will correct the misclassification of some teeth in order to obtain high precision results. This method is capable of classifying and assigning absolute index number to the teeth with high accuracy.

Toshiaki Kondo, S. H. Ong, and Kelvin W. C. Foong proposed an automated method for tooth segmentation from the three-dimensional (3-D) digitized image captured by a laser scanner. It will avoid the complexity of directly processing 3-D mesh data by detecting features on two range images computed from the 3-D image. The result can determine both interstice locations and orientations . Finally, the teeth are spaced from the gums by delineating the gum margin. The algorithm was found to be robust and accurate.

Abdolvahab Ehsani Rad . MohdShafry Mohd Rahim .Amjad Rehman .Tanzila. The important issue in dental image analysis is the lack of image database. Periapical dental X-ray images which are suitable for any analysis and accepted by many dental experts are collected. This type of dental radiograph imaging is common andinexpensive.It is used for dental disease diagnosis and abnormalities detection. Database contains120 various Periapical X-ray images from top to bottom jaw.It comparethe image analysis techniques and improve the performance .

P.L.Lin , Y.H.Lai , P.W.Huangpresent a dental classification and numbering system to segment, classify, and to number teeth in dental bitewing radiographs. Adaptive morphological transformation is proposed to improve both contrast and illumination evenness of the radiographs simultaneously. A binary linear support vector machine using the skew-adjusted relative length/width ratios of both teeth and pulps, and crown size is proposed to classify each tooth to molar or premolar. The overall results shows that the system has accuracy rates of 95.1% and 98.0% for classification and numbering.It classifies the teeth in four images that were reported as misclassified.

Phen-Lan Lin , Yan-HaoLai , Po-WheiHuang proposed an enhanced dental identification method based on the contours of teeth and dental work.To reduce the alignment error from unreliable contours, a point- reliability measuring method was proposed. For reducing the alignment error was due from incomplete tooth contours, an outlier detection method was proposed to prune the outliers from each contour and realign the pruned contours. . Experimental results show that this method can achieve (1) 94.3% and 100% image retrieval accuracy in the top-1 and -5 retrievals, when matching with the weighted HD; (2) 100% accuracy of top-2 image retrievals when being the same with both contours of teeth and dental works.

Abdolvahab Ehsani Rad, MohdShafry Mohd Rahim, Amjad Rehman, Ayman Altameem and Tanzila Saba helps us to understand the different image segmentation approaches used for dental X‑ray image analysis. Image segmentation is one of the important significant processes of dental X‑ray image analysis. Therefore, to obtain the proper result, it is the need to perform the accurate and efficient segmentation approach which proved itself in the aspect of X‑ray image segmentation. The methods discussed in this paper are: thresholding methods, active counter or snake method, level set methods, clustering methods, and region‑growing method.

Samir Shah, AymanAbaza, Arun Ross and HanyAmmar discussed about an automated dental identification system. Automating the postmortem identification of diseased individuals based on dental characteristics is receiving increased thing with the large number of victims in mass disasters. Extracting the contour of the teeth is a very challenging task. , This technique can extract the region contour in the presence of additive noise and in the lacking of well-defined image gradients. Experimental results indicate the benefits of the proposed approach.

Jindan Zhou, Mohamed Abdel-Mottaleb. This paper introduce a system for assisting in human identification using dental radiographs. The goal of the system is to archive antemortem (AM) teeth images and enable content-based retrieval images. During archiving, the system classifies the dental images to bitewing, periapical, and Panaromic eye views. Then it segments the teeth and bones in the bitewing images. During retrieval, the proposed framework retrieves from the AM database and the images with the most similar teeth to the PM image based on Hausdorff distance measure. Therefore the experiment provides a good results for separating each tooth into crown and root, and has a very good tool for human identification.

Yoshinori Yoshida, Yusuke Shinya Murakamiand TaijiSohmura . A virtual reality (VR) haptic dental training

work could be a promising tool for future dental education. One major challenge is toimprove a virtual tooth model which similarly reflected a real tooth having multiple layers with different mechanical hardness in everylayer.The multi-layered virtual tooth model was actively constructed in our virtual system. The developed model allows us tofeel tooth cutting which is same to that with a real tooth. Through a cutting experiment by using the real tooth, a spring sergeantand a damping coefficient of a dental hard tissue were determined 0.8 N/mm and 1.79 Nsec/mm. The constructed model introduced inthis study could be a promising tool for acquiring dental hand skills in a virtual learning system.

Shengguo Chen, Zhengxing Sun, Jieou, Yi Li present a semi-supervised image segmentation algorithm to segment the noisy image that includes a large amount of objects with the similar color features. It models the image's color feature through SSFCM based labeleddata.The pixels are divided into two types that are considered as labeled and unlabelled pixels. TheOverall results show the effectiveness of algorithm. It not only reduces the noise sensitivity of SSFCM but also avoids cumbersome operations.

Tran Manh Tuan, Tran ThiNgan , Le Hoang Son.In this paper, we will present a new semi-supervised fuzzy clustering algorithm named as SSFC-FS depends on Interactive Fuzzy Satisficing for the dental X-ray image segmentation problem.First of all, features of a dental X-Ray image are modeled into a spatial objective function.Secondly, the Interactive Fuzzy Satisficing method, which was considered as a useful tool to solve linear and nonlinear multi-objective problem. Thirdly, theoreticallyvalidation of the solutions including the convergencerate and the comparisonof other relevant methods is performed.Lastly, a newsemi-supervised fuzzy clustering algorithm that uses an iterative strategy is designed. This new algorithm was experimentally validated. The results revealed that the new algorithm has good clusteringquality than other methods such as Fuzzy C-Means, Otsu, eSFCM, SSCMOO and another version of SSFC-FS.

Eyad Haj Said, DiaaEldin M. Nassar, GamalFahmy, and Hany H. Ammar.Operating the process of postmortem identificationof individuals using dental records is receiving increased attention. Separating the teeth from dental radiographic films is an essential step for achieving highly automated postmortem identification.In this paper, a mathematical morphology approach is offered in teeth segmentation.We also propose a grayscale contrast stretching transformation to increase the performance level of teeth segmentation.The results show the additional level to its capability of manual bitewing and periapical dental radiographic views, our approach exhibits the lowest failure rate.

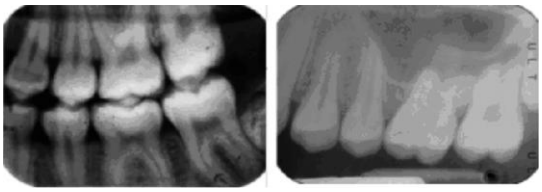

Fig.1(a) Bite-wing X-ray Fig.1(b) Periapical X-ray.

3. PROPOSED MODELLING

3.1The cooperative framework

The below figure illustrate the cooperative framework – eSFCM-Otsu in a block diagram. A given dental X-ray image with some user defined parameters such as the number of clusters (C), the fuzzifier (m) , the Otsu threshold (T) and the stopping threshold (ε) is inputted in the framework.

Since an X-ray image could not contain the Background area, a pre-processing procedure that checks whether the Background area exists or not is employed. It relies on the test grayscale samples of the Background part suggesting that a focused window of sample in the considered X-ray image could be (nearly) identical to those in the sample database by the mean of similarity metric. If so, the Otsu method is applied to remove the Background area from the image.

This method has the advantage of fast processing and can efficiently determine the background/ main parts so that it is utilized in this step. From the main areas extracted from the previous step, we continue applying FCM to classify the Teeth and the Dental Structure area.

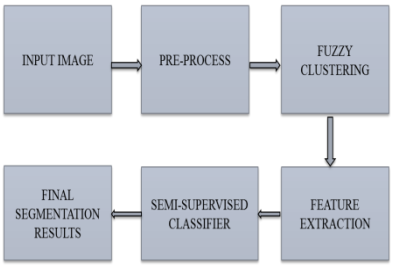

Fig.2 Block diagram of proposed system

4. RESULTS AND DISCUSSIONS

4.1 Input Image

The input image was resized and filtered through pre-processing system.

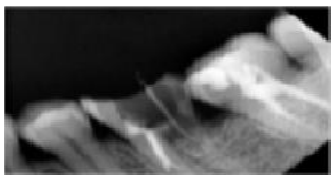

Fig.3 Input Image

4.2 The Otsu Method

Otsu method is used to convert gray scale image into binary image.

Fig.4 Otsu Image

4.3 Simulated Output

After conversion the input was clustered and then segmented.

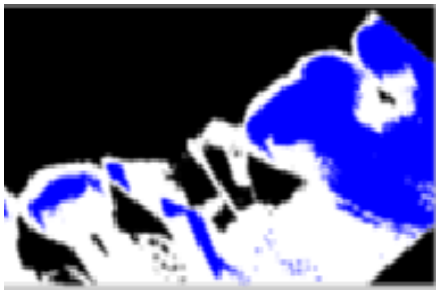

Fig.5 Sub-sided Output

4.4 Performance Parameters

4.4.1 Davies–Bouldin (DB): relates to the variance ratio criterion, which is based on the ratio between the distance inner group and outer group. Especially, quality of partition is determined by the following formula:

$$DB = \frac{1}{K} \sum_{l=1}^{k} Dl \qquad (4.4.1.1)$$

$$Dl = \max l \neq m \{Dl, m\} \qquad (4.4.1.2)$$

$$Dl, m = (\overline{dl} + \overline{dm}) / dm, l \qquad (4.4.1.3)$$

BASE WORK	PROPOSED WORK
DB_value1 = 3.0587	DB_value = 3.0059

Table 1 Comparison table

4.4.2 Performance Comparison

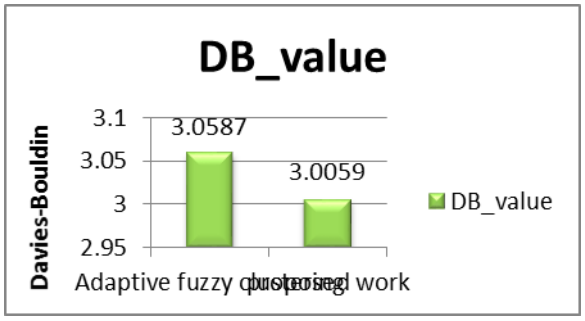

Fig.6 Davies-Bouldin Cluster Validity Measurement

5. CONCLUSION

The results show that the method can provide an integrated environment for training delicate movement of a dental tool within a narrow oral cavity. We will also work on extending the segmentation algorithm to handle the image with poor quality. A dental classification and numbering system, including an image enhancement method for improving segmentation teeth from other parts was presented. The importance of accuracy and assure of method is significant in medical application area. Therefore, validation of segmentation is not only achieving the result, rather the accuracy, precision, assure, and computational speed of segmentation, as well as reducing the amount of manual interaction are considerable.

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