Chapter 31
Dental Image Segmentation Using Clustering Techniques and Level Set Methods

Prabha Sathees
Hindustan Institute of Technology and Science, India

ABSTRACT

Segmentation is necessary for dental images for finding the parts of the teeth, surrounding tissues, and bones. The human identification system in dental methodology is a tedious and time-consuming process. The automatic identification system is the best solution for dental diagnosis and dental treatment systems. Choosing an appropriate region of interest with high accuracy and success rate is a challenging one. This can be attained with the help of proper segmentation methodologies. The segmentation techniques proposed for the root canal treatment are analyzed and compared. Clustering techniques and level set methods with different edge maps are implemented for the proper analysis of segmentation in dental images. Finally, the integration of coherence-enhanced diffusion filtering in basic level set segmentation methodology seems to be effective in improving the segmentation performance of dental images.

INTRODUCTION

Identification of decayed tooth is the vital part in the analysis of dental images. Root canal treatment is necessary due to the inflammation or infection in the pulp. Issues in the root canal may also arise due to gum disease which leads to the need for root canal treatment (Tiwari & Yardi, 2006). The observation of dental diagnosis and treatment has been made easy from the information of dental X-ray image. These radiographs are very useful for medical specialists of analyzing dental images from hidden dental structures (Jiayin & Zhicheng, 2010; Joao & Hugo, 2011; Shuo, Thomas, Adam, 2006; Lai & Lin, 2006; Lai, Lin, Huang, 2010; Hui & Oksam, 2010). The natural cavity that present within the center of the tooth is nothing but root canal. The soft tissue within the root canal is pulp. The development of root of the tooth depends on blood vessels and nerves present in the pulp (Cremers, 2003). The normal tooth is classified as three regions that is crown, neck and root part. The top part of the tooth is crown and the

DOI: 10.4018/978-1-6684-7544-7.ch031

bottom end is root part. The pulp expands from top to bottom end of the tooth thereby connecting the tip of surrounding tissues.

Root Canal Treatment (RCT) in endodontics is suggested for severely infected tooth pulp. If any one of the teeth are broken, decayed, or having loose filling, bacteria can infiltrate the pulp, causing it to become infected. To ensure the efficacy of any future dental treatment, infected tooth pulp must be treated as soon as possible. Root canal treatment involves the removal of the infected or inflamed dental nerve followed by the cleaning, shaping, disinfection and obturation (filling) of the space that the nerve occupied within the pulp of the tooth (Johnson & Guttmann, 2007). This procedure is usually carried out when a tooth has an abscess or when the nerve at the centre of the tooth has become inflamed due to decay, fracture or a crack. Often the only alternative to this treatment is having the tooth extracted. After clearing the area of bacteria, the tooth is treated with a special filling material that seals out potential pathogens that may cause re-infection. Placement of crown at atop in treated tooth for reinstate the outer structure as well as functionality back to the tooth (Michen, Pearson, Rahbaran, Gulabilava, 2003). If there is damage in middle and bottom part of the tooth, then root canal treatment is recommended. The size and shape of the root canals vary from person to person. This is the reason for the precise recognition of root canal as a key step for further analysis.

The decayed teeth extraction method is the regular process for the cleaning of roots in order to avert the damage transferred to neighborhood teeth. The step involved in the treatment procedure of the tooth contains the removal ofthe damaged area, appareling and cleansing and the final stage contains the filling and closing it (Shafer, 2006). For this process, radiographs help in determining the prognosis by comparison with post operative and follow up action. Various image processing techniques are employed for accurate detection of location and shape of the root canal. The primary identification in root canal treatment is to asset the aspect of impairment area in tooth (Ahmed, Taib, Khalid, Ahmad, Taib, 2011). The need for segmentation of image is an important and a tough assignment for medical practitioners since areas of gum and pulp drop down into similar level of intensities (Jain & Chauhan, 2017).

Segmentation is an important step in processing of a variety of medical images (Manickavasagam, Sutha, & Kamalanand, 2014; Kamalanand, & Ramakrishnan, 2015; Vaishnavi, Jeevananthan, Begum, & Kamalanand, 2014; Rajinikanth, Fernandes, Bhushan, & Sunder, 2018; Rajinikanth, Satapathy, Dey, & Vijayarajan, 2018) .The dental x-ray image segmentation would be complex owing to the pattern and intensity distinction within the single dental x-ray images and also across different dental x-ray images. Dental image analysis systems are analyzed by many researches however it has to be considered to find the suitable technique (Lai & Lin, 2008). A segmentation method is implemented for the segmentation of tooth using integral projection and Bayes rule where a semi-automatic approach is used for the confinement of tooth (Anil & Hong, 2004). In the reported work of segmentation, three steps have been carried out, first one is image enhancement, second one is region of interest localization and final step results from the Snake method after performing morphological operations (Jindan & Mohamed, 2005). In order to segment dental x-ray, a method depends on thresholding has been proposed using the adaptation technique (Omaima & Mohamed, 2005). The Swarm-intelligence is combined with cellular-automata model approach has been introduced to segment dental images (Keshtkar & Gueaieb, 2006). Mathematical morphology approach is introduced in the crisis of teeth segmentation, thereby improvement in segmentation is achieved by a set of morphology refinement activityand connected components are used for investigation to achieve the ambition of interested area (Eyad, DiaaEldin, Gamal & Hany, 2006). In order to identify the region of lesions, semi-automatic lesion detection structure is generated in dental images from the coupling of two level set functions and then the derivation of initial contour