Chapter 2

Thresholding Techniques for Dental Radiographic Images: A Comparative Study

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ABSTRACT

Imaging techniques play a major role in improving the early detection and diagnostic process that helps dentists to make accurate diagnosis. One of the most useful medical images used by dentists is radiographic image, which is used for the treatment of various dental disorders. Segmentation is a fundamental step as it involves separation of an image into regions corresponding to the objects. A simple and natural way to segment such regions is through thresholding. In this chapter, various thresholding techniques such as Otsu’s method for global thresholding and Niblack’s, Bersen’s, and Sauvola’s techniques for local thresholding are extensively explained with the help of dental radiographic images.

INTRODUCTION

Tooth is the hardest substances in the human body. Tooth plays an important role in chewing as well as in speech. There are various regions present in the teeth. These include enamel, dentin, pulp, cementum and ligaments. The white and firm part of the teeth is called enamel, which is made up of a chemical called calcium phosphate, a rock-hard mineral. A hard tissue, which is next layer to the enamel, is dentin that contains microscopic tubes (Rad, Rahim & Norouzi, 2013). A soft structure of the teeth where nerves and blood vessels pass through is called pulp. Cementum is a tissue that connects the gums, jaw bones and root of the teeth strongly. Structures surrounding the teeth, condition of the teeth and dental disorders like lesions which is difficult to identify medically can be easily detected using dental imaging.

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Dental disorders are considered to be a major problem in recent days. Some of the common dental problems faced by humans are tooth decay, oral cancers, tooth erosion etc. There are various techniques to diagnose dental problems and the most commonly used technique is dental radiography (Amer & Aqel, 2015; Rad, Rahim & Norouzi, 2013; Said, Fahmy, Nassar & Ammar, 2004). Dental X-ray segmentation is important and necessary in medical diagnosis, which gives information to the doctors regarding dental diseases. Treatments such as dental crown, restoration and root canal are most commonly used diagnostic techniques. There are various modalities for diagnosing these disorders. One such modality is diagnosing it with the help of dental radiographs. Dental radiography is one of the most useful dental exams performed by dentists as it allows the identification of structures which are not revealed on the surfaces of the teeth.

A dental radiography is a technique where the production of radiographs of the teeth and adjacent structures are obtained due to exposure to x-rays (Rad, Rahim & Norouzi, 2013). A dental image provides information during dental procedures such as root canal therapy, placement of dental implants (Ribeiro, Dias, de Best, da Silva, Neves & Street, 2014). Dental imaging allows instant and easy transmission of images and electronic storage. They are used to detect wounds, disorders and surroundings of teeth and other parts of the mouth which is not identified medically. Segmentation of dental x-rays does not work well by using traditional techniques (Lai & Lin, 2008). In past decades, continuous evolution in radiological image lead to the development of image processing for medical images, which became a popular tool for researchers in medical fields, includes Dentistry. In the field of computer vision, digital images acts as a medium for carrying information (Subramanyam, Prasad & Anuradha, 2014). In the field of dentistry, segmentation is used to identify various structures such as jaws, wounds, abscess, bones etc (Subramanyam, Prasad & Anuradha, 2014).

Conversion from binary image to scanned grayscale image, while removing the background and preserving the target is an important step in image segmentation (Graham Leedham, Takru, Tan & Mian, 2003). It segments an image into separate regions or objects. Image understanding and content analysis is a critical step in segmentation of an image (Senthilkumaran & Vaithegi, 2016). The process of dividing an image with respect to some criterion, into group of pixels which are similar is called segmentation. Each segment should not intersect with each other, and adjacent segments must be heterogeneous. Thus segmentation deals with splitting an image into meaningful regions (Jayaraman, 2009). The first step in pre-processing of images is done by image segmentation where the objects of interest are extracted for further analysis (Sukhdeep Kaur, Manjit Sandhu & Jaipreet Kaur, 2016). Edge-based and region based approaches are two types on which segmentation is classified (Senthilkumaran & Vaithegi, 2016). Discontinuity and similarity are two properties on which the image segmentation is categorized Segmentation based on similarity is called Region method and on discontinuities is called as boundary method (Subramanyam, Prasad & Anuradha, 2014). In recent years, entropy based approaches have also gained significant interest for solving problems in biomedical image and signal processing (Rajinkanth, Raja, & Kamalanand, 2017; Alagumariappan, Krishnamurthy, Kandiah, & Ponnuswamy, 2017; Kamalanand, & Ramakrishnan, 2015; Alagumariappan, Rajagopal, & Krishnamurthy, 2016; Ambikapathy, & Krishnamurthy, 2018).

**CLASSIFICATION OF IMAGE SEGMENTATION**

Segmentation of image is classified broadly into two types: