Article ECORFAN Journal
ANATOMY June 2015 Vol.2 No.2 126-132

Dental Radiology processing for abscess detection

SANCHEZ, María*†, MOLINAR, Jesús, VAZQUEZ, Sandra and ORDOÑEZ, Felipe

Received January 8, 2014; Accepted June 12, 2015

Abstract

A reliable diagnosis of pathologies by dental professionals, requires specialized tools, mainly processing digital radiography. In this paper we present the development of a technique for detecting dental abscess by processing a radiological image, thus supporting dentists to make an accurate diagnosis of this pathology.

Dental Radiology, Image Processing, Dentistry, Dental Abscesses Detection

Citation: SANCHEZ, María, MOLINAR, Jesús, VAZQUEZ, Sandra and ORDOÑEZ, Felipe. Dental Radiology processing for abscess detection. ECORFAN Journal-Bolivia 2015, 2-2: 126-132

* Correspondence to Author (email: msanchez@itcg.edu.mx)
† Researcher contributing first author.

Introduction

Currently in the age of digitization, numerous application areas are involved in digital image processing, in order to improve image quality for correct human interpretation or to facilitate the search for information. Dentistry is a science of health required for its diagnosis, digital x-ray images with good quality, as it is essential for making a good analysis of dental curing repair or replacement.

Digital radiography is a tool that facilitates and improves the quality of diagnosis of medical specialists, but it is still an expensive technology, which has unfortunately prevented from being used by most dentists specialists in Mexico. In the European Community and the USA 90% of dental specialists use digital equipment, while Mexico less than 10% use them.

The extra-oral imaging techniques, although used in conjunction with special projections have their limitations. The basic problem of the patient's exposure to radiation and the implications has prompted researchers to implement new techniques where exposure is limited, without affecting the quality of radiography and interpretations, and consequently the diagnosis.

Computer technology applied to the field of radiography has made the acquisition, handling, storage, transmission and enhancement of digital images possible.

Few investigations have been carried out for the detection of dental diseases by analyzing a radiographic image. Pereira [1], carried out an analysis with statistical tools of quality intraoral radiography.

A comparison of the information from dental radiography and CT with respect to the detection of lesions of endodontic and its relationship with its neighboring anatomical structures such as the mandibular canal is presented in [2]. A study to determine the diagnostic accuracy of Chargecoupled Devices (CCD) Photo Stimulable Phosphor (PSP) and radiography in the detection of cavities devices are disclosed in [3]. In [4] the authors propose a segmentation scheme of each tooth periapical radiographs and used for recognition of the teeth, Otsu thresholds and analysis of connected components and the delimitation of the teeth by monitoring limits and morphological operations. In [5] the authors developed a system of image analysis and dental X-ray diagnosis of tooth decay whor has anomalies. Segmentation has been done by applying the integral projection technique to remove the individual tooth and therefore the characteristics of tooth maps surface generated for analysis and detection process.

They have carried out some studies on segmentation and edge detection in images through Matlab. A system of recognition of a Latin American tropical fruit using computer vision techniques presented in [6]. In [7] it carried out an analysis of the operators to detect edges in images, to find some flaw in non-cylindrical glass containers by Matlab tool. In [8] have developed TecLines, a free Matlab-based layout to locate and quantify the guideline patterns from satellite data and digital elevation models (tectonic analysis).

This research considers the dental abscess pathology, because it is a dental disease that if is not treated early, can cause complications such as tooth loss, spread of infection to soft tissue, jaw and other areas of the body resulting in brain abscess, endocarditis, pneumonia or other complications [9].

ISSN-On line: 2410-4191

Abscesses are detected in a dental radiographic image in order to facilitate the diagnosis to dental professionals.

This article is organized as follows: section 1, the theoretical foundation that supports this research is presented; in Section 2, the materials and methods used are detailed; in section 3, the results and discussion which has been reached in this work, and finally in section 4 disclosed the conclusions of the investigation.

Theoretical basis

Digital Radiology

Obtaining an X-ray is entering virgin radiography (X-ray sensitive) in the patient's mouth for that; a team that emits X-rays to activate the intraoral image plate is used. Subsequently the specialist obtained the radiation printing tooth by a developing process and fixing the image onto film measuring 3x2 cm. Once dry the radiography is mounted on a light panel and it works by monitoring the picture. Thereafter, having invested about 5 minutes based on the image it can continue to work on the damaged tooth.

Furthermore, digital technology makes a similar process that was described above is based on a (X-ray) sensor designed specially for dental use and the size of a radiograph. The X-ray equipment is the same, but now through the sensor with the interface hardware attached to it digital images that can be stored on a computer. The images of the teeth are obtained by extra-oral radiographic techniques. Among some of the new techniques extrabucl radiology are: Xerorradiografía, Zeugmatografía, Radiovisiography, Stereo-rradiografía, thermography [10]; each has its principle of operation, its advantages, disadvantages and use in the field of medicine.

Filmless X-rays or electronic imaging has an important impact in the dental field. Because the use of electronic images results in a decrease of the radiation dose to the patient was quickly accepted in dental practice. Furthermore, when is used these tools using chemical highly polluting the environment is avoided, because they are removed 100% waste substances, at a time were used to obtain intraoral radiography.

There are several methods for obtaining digital images. Some of them are [10]:

– Digital Conventional radiography using a flatbed scanner and transparency adapter.

– Digital Conventional radiography using a coupling device in the camera.

– Semi-direct digital image using photostimulable phosphor sheet.

– Direct digital image using a coupling device, metal semiconductor and other electronic devices.

Some of the advantages of digital radiography are [10]:

Obtain immediate image.

Do not require conventional film processing, process which can lead errors in product revealed poor handling of the developer substances.

– Automated Image Analysis.

– Storage of patient information.

– Teleradiology (image transfer to different places).

ISSN-On line: 2410-4191

- Education and patient interaction.

- Elimination or digital subtraction of background images and grayscale display in reverse, for example, the images appear radiolucent and radiopaque white black.

Some of the disadvantages of digital radiography are [10]:

- High cost, especially the panoramic systems.

- It requires lots of storage on the hard drive for images.

- In direct digital radiography, the sensor and the computer are directly connected, making the placement of intraoral level sensor to a difficult process.

- Loss of definition and image resolution when compared to conventional films when printed.

- The manipulation of the images may stray to other uses; in some systems the difficulty of simultaneously displaying multiple images (images of the entire oral cavity) occurs; printed images may be distorted with time.

- Legal ramifications - is questionable use of digital images as evidence during a trial, as they are manipulated images.

Image Processing

The image processing consists of a series of steps involving the improvement, restoration, analysis and in some cases, changes of digital images. Image processing aims to improve the look of them and make more evident in certain details that want to note.

The main objective is to improve the diagnosis more efficiently using the information contained therein. The main operations relating to image processing are enhancement, restoration, analysis, understanding and synthesis [10].

Within the image processing include: Pattern recognition, also called reading patterns, identifying shapes and shape recognition. Patterns are obtained from segmentation processes, feature extraction and description, where each object is represented by a collection of descriptors.

Pattern recognition is a primary part in some intelligent systems for decision-making, and is applicable in manufacturing tasks, visual inspection, medical diagnosis, speech recognition, etc. Depending surveyed different procedures for data analysis and classification algorithms are followed.

Morphological filters are able to influence image structures, previously designated by defining structural member. All morphological operations on images perform their function, using a structural element called reference structure [12].

Thresholding is a method that covers digital image segmentation and seeks a threshold value that allows binarizing the image, properly separating the background and the object to be separated. The main objective is to get the best T (threshold) right between the gray values into images that allow optimal separation between the object and the background value.

The erosion process refers to removing one layer of pixels in a structure.

ISSN-On line: 2410-4191

Dental Diseases

Among the most common dental diseases are: cavities, gingivitis, periodontitis, physical trauma (strokes) and dental abscess. A brief explanation of each [11] is as follows:

a) Gingivitis. It is involving inflammation of the gums caused by an infection (bacteria) or the accumulation of plaque and tartar. If not attended in time, it can affect the bone and become periodontitis.

b) Periodontitis. It is a progressive infection of the gums and bone loss around the tooth, causing the loosening of teeth.

c) Dental Caries. It is a multifactorial disease characterized by the destruction of tissues resulting from tooth demineralisation caused by acids generated by plaque bacteria. There are different types of decay: Interproximal caries, occlusal caries, Caries buccal or lingual, Recurrent Caries and Caries Horse.

d) Dental abscess. It is a collection of infected material (pus) in the center of a tooth due to a bacterial infection. A tooth abscess is a complication of tooth decay. It can also occur when a tooth is broken or chipped. Openings in the tooth enamel allow bacteria to infect the center of the tooth (the pulp). The infection can spread from the root of the tooth to the bone that support [3].

Materials and methods

For image processing was used Matlab, given the range of tools offered by the programming environment, with a primary focus on the toolbox: Image Acquisition and Image Processing, which are geared specifically for image processing.

A sample of ten dental digital imaging with the pathology of abscess was considered.

The image obtained from dental digital radiography is a grayscale image. Radiography is processed through several stages to perform detection of pathology.

The methodology for conducting the detection, is described below:

a) Preparation of the radiographic image in grayscale.

b) Thresholding. It was observed that the best value T after performing the histogram of the images to be treated is 90, a value that was used in this investigation. The resulting image is a binary image.

c) Erosion. Experimentally it was found that the size of the radius must magnitude 5 and the reference structure disk.

d) Determining patterns that distinguish one object from another. Measuring a set of properties within the different regions identified as objects in the binary image was performed. He carried out the calculation of the centroids for the connected components in the image. To do this, the regions previously were in the image and a matrix was obtained with different numbered tags that mark the existence of different objects in the image.

e) Mapping of external borders of the objects and the boundaries of the holes within objects. To perform this operation the bwboundaries function was used [13] Matlab.

f) Preparation of the object with more pixels.

g) To present the image to the detection of pathology.

ISSN-On line: 2410-4191

Results and Discussion

In the previous section the methodology used for the detection of dental abscesses is described. In this section the results obtained after applying the methodology are shown.

Figures 1 and 2 show two cases of abscess detection investigated in this work. From the original image performs thresholding and erosion process, as shown in Figures 1 and 2 subsection b. Figures 1 and 2 paragraph c, show the labeling of the objects found in the image from a centroid, marked with an "*".

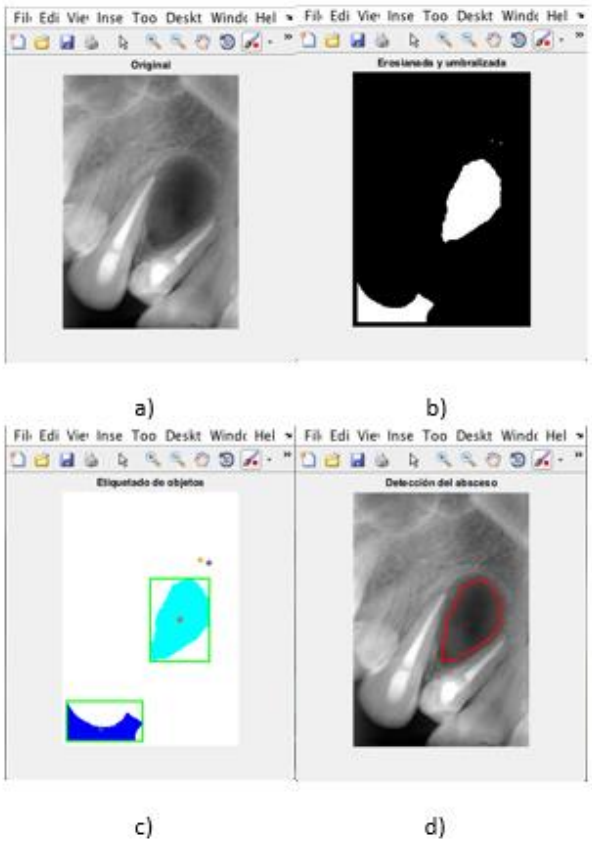

Figure 1 Case 1 abscess detection. Image: a) Original, b) eroded and thresholded, c) labeling objects, d) Detection of the abscess.

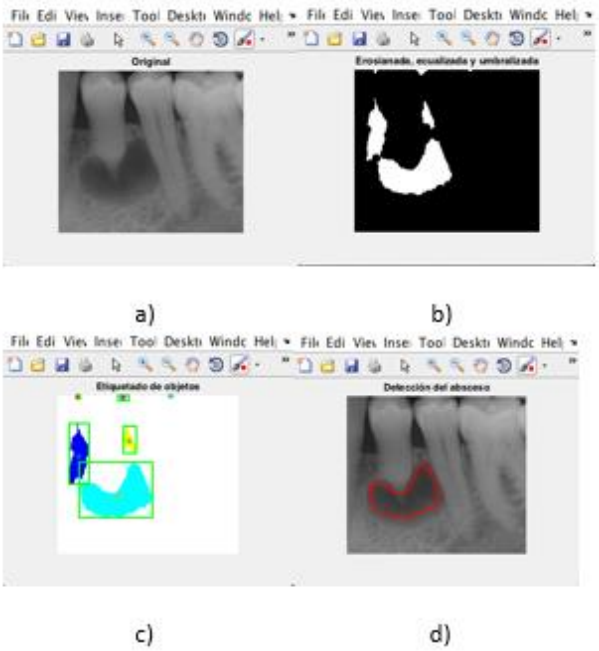

Figure 2 Case 2 abscess detection. Image: a) Original, b) eroded and thresholded, c) labeling objects, d) Detection of the abscess.

Como puede observarse en las figuras 1 y 2 inciso d, se detecta claramente el absceso en las imágenes. Los resultados obtenidos en estas imágenes, fueron similares a los probados con otras imágenes y la misma patología.

Conclusions

As a result of the investigation it is concluded that the development of a technique for detecting pathology abscess, facilitates the diagnosis of periapical abscesses to dental professionals by processing a dental X-ray image. In addition, the methodology is right for this type of pathology detection.

Future work will be performed analysis and more radiographic images and other diseases more accurately validate the detection technique employed in this work.

ISSN-On line: 2410-4191

References

Pereira Valbuena, E. G. Análisis radiográfico del grado de obliteración de la sutura palatina media como posible orientador en la estimación de la edad: diseño de estudio/Radiographic analysis of the obliteration of the mid-palatal suture as a possible point of orientation in the estimation of age: design for a study (Doctoral dissertation, Universidad Nacional de Colombia).

Velvart, P., Hecker, H., & Tillinger, G. (2001). Detection of the apical lesion and the mandibular canal in conventional radiography and computed tomography. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 92(6), 682-688.

Abesi, F., Mirshekar, A., Moudi, E., Seyedmajidi, M., Haghanifar, S., Haghighat, N., & Bijani, A. (2012). Diagnostic accuracy of digital and conventional radiography in the detection of non-cavitated approximal dental caries. Iranian Journal of Radiology, 9(1), 17.

Lin, P. L., Huang, P. Y., Huang, P. W., Hsu, H. C., & Chen, C. C. (2014). Teeth segmentation of dental periapical radiographs based on local singularity analysis. Computer methods and programs in biomedicine, 113(2), 433-445.

Rad, A. E., Amin, I. B. M., Rahim, M. S. M., & Kolivand, H. (2015). Computer-Aided Dental Caries Detection System from X-Ray Images. In Computational Intelligence in Information Systems (pp. 233-243). Springer International Publishing.

Montoya Holguin, C., Cortés Osorio, J. A., & Chaves Osorio, J. A. (2014). Sistema automático de reconocimiento de frutas basado en visión por computador. Ingeniare. Revista chilena de ingeniería, 22(4), 504-516.

Ruiz Flores, B., & Ullauri Ulloa, F. (2009). Detección de fallas en envases de vidrío no cilindricos utilizando localización de bordes mediante la herramienta de matlab.

Rahnama, M., & Gloaguen, R. (2014). Teclines: A matlab-based toolbox for tectonic lineament analysis from satellite images and dems, part 1: Line segment detection and extraction. Remote Sensing, 6(7), 5938-5958.

Marx, J., Walls, R., & Hockberger, R. (2013). Rosen's Emergency Medicine-Concepts and Clinical Practice. Elsevier Health Sciences.

Sikri, V.K. (2012). Fundamentos de Radiología Dental. Caracas-Venezuela: Amolca.

Olga A.C. Ibsen. (2014). Patología oral para el higienista dental. : ELSEVIER/Masson.

Cuevas, E., Zaldívar, D., & Pérez, M. (2010). Procesamiento digital de imágenes con MATLAB y Simulink. Alfaomega Ra-Ma (México).

Gonzalez, R. C., Woods, R. E., & Eddins, S. L. (2004). Digital image processing using MATLAB. Pearson Education India.

ISSN-On line: 2410-4191