ANALYSIS OF X–RAY DENTAL IMAGING WITH SPECIAL REFERENCE TO PAST AND PRESENT SCENARIO

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ABSTRACT

In this paper we present an over view about X-ray dental image past and present. An X-ray or Clinical medical image generally suffers from low contrast quality and degradations which vary from one region to another. Extraction of features in medical science and image processing is a matter of study and research. X-ray imaging is a widely used form of medical imaging. It is based on x-rays (or Rontgen rays), which are a form of electromagnetic radiation. In the spectrum of electromagnetic radiation, they have higher frequency than ultraviolet rays but (usually) lower than gamma rays. X-rays are capable of passing through human tissue more or less unaltered. The paper elaborately discusses the history of X ray dental image and the improvement taken place at present. Further the types of images are discussed, which can be used repeatedly unlike the disposable film. Other than that, they are ready in digital form. A digital image has many advantages over traditional film which is focused in the present paper with pictorial display.

1. INTRODUCTION

X-ray imaging is a widely used form of medical imaging. It is based on x-rays (or Rontgen rays), which are a form of electromagnetic radiation. In the spectrum of electromagnetic radiation, they have higher frequency than ultraviolet rays but (usually) lower than gamma rays. X-rays are capable of passing through human tissue more or less unaltered. Some tissue notably bones absorb more radiation than other say, softer tissue while air in the mouth or in bodily cavities has practically no effect at all on the radiation. Therefore, a film placed on the other side of the patient in view of the x-ray source will record an image of the bones and other tissue according to the transmission coefficients of various tissues.

Nowadays the film is usually replaced by a digital sensor or a phosphor imaging plate, which both have the functionality of the film, but the data on them can be erased. Therefore they can be used repeatedly unlike the disposable film. Other than that, they are ready in digital form. A digital image has many advantages over traditional film. It is effortless to distribute and image manipulation processes (gray value correction, sharpening etc.) are easier to implement. A film, an imaging plate or digital sensor is placed inside the patient’s mouth. X-rays are irradiated outside the mouth and the shadows” of the teeth and other tissues are cast on the recording medium, which stores the dental x-ray image.

2. TYPES OF IMAGING

2.1 Intra-Oral Imaging

In intra-oral imaging i.e. imaging within the mouth film, imaging plate or digital sensor is placed inside the patient’s mouth. X-rays are irradiated outside the mouth and the shadows” of the teeth and other tissues are cast on the recording medium, which stores the dental x-ray image.

2.2 Occlusion Imaging

Occlusion imaging is used when one wants to take a picture of either all or significant part of | upper or lower teeth together. A recording medium is placed horizontally between the patient’s upper and lower teeth, and x-rays are beamed either from above the nose or below the jaw, for upper or lower teeth, respectively.

3. HISTORY AND TECHNOLOGY OF X-RAY IMAGING

X-rays (or roentgen rays) were found by a German physics professor, Wilhelm Conrad Rontgen, on November 8, 1895. Rontgen, Director of the Physical Institute of the University of Wurzburg, was interested in work of Hertz and Lenard and many others on electrical discharges in vacuum tubes. He set up his own apparatus and followed and repeated the work of predecessors, namely the work done by Hertz and Lenard.

They had been carrying out experiments with Hittorf-Crookes tube, one kind of vacuum tube. The Hittorf-Crookes tube is a partially evacuated glass envelope with two electrodes separated by a distance of a few centimeters. When a potential difference of few thousand volts is connected between the electrodes, the partially ionized, rarefied gas in the tube is accelerated...
by the electrical field. Due to the high voltage, the ions accelerate and hit the cathode (negative electrode) with such energy, that they manage to release electrons from the surface of the cathode.

As electrically charged particles, the electrons are accelerated in the electric field away from the cathode and towards the anode (positive electrode). Should the voltage between the electrodes be huge enough, some of the accelerated electrons might overshoot, or go through the anode and strike the glass wall of the tube, emitting x-rays, though this wasn’t known at the time.

X-rays are part of the same electromagnetic radiation as visible light and radio waves, ranging from frequencies of $30 \times 10^{15}$ Hz to $30 \times 10^{18}$ Hz. In the spectrum of the electromagnetic radiation they are between lower frequency ultraviolet and higher frequency gamma-rays, although sometimes the frequencies of x-rays and gamma-rays overlap and the only difference between the two is the method the rays were generated. Gamma-rays are formed by transitions within atomic nuclei or matter-antimatter annihilation, while x-rays are generated when high-speed electrons are decelerated in matter.

An electron decelerating in matter was what happened in the Rontgen’s tube when the overshot electrons hit the glass, and when x-rays were emitted. While carrying out his experiments with cathode rays, Rontgen made a discovery of fluorescence of a paper screen covered with barium platinocyanide crystals. The paper screens were used to detect whether there were cathode rays present or not. To use these papers, a special kind of tube with aluminum window was needed to pass the cathode rays outside the tube. This time, however, there was fluorescence even when working with a glass tube which shouldn’t pass cathode rays. Rontgen realized he had found a new kind of radiation, and, unaware of the true nature of the radiation, called it the x-ray”.

Rontgen quickly experienced more with the rays and made a proceeding on them. The medical potential was understood soon and the first skeletal radiographs of a living hand were taken less than two months after the discovery of the radiation.

A modern dental x-ray tube is ultimately similar to the tube Rontgen used on his experiments. Figure 1 presents the tube. Electrons are emitted from filament that is heated by electric current. Voltage difference between a cathode and an anode forces the electrons to travel to the anode, where a tungsten target is located. X-rays are emitted when electrons decelerate in the target.

### 3.1 Modern Dental Imaging

Intraoral radiography was the first dental imaging method. In intraoral radiography, a certain recording medium is placed inside the patient’s mouth. X-ray tube, the source of x-rays is located outside the head so that the radiation passes through the object and hits the recording medium.

### 3.2 Views Used in Intraoral Radiography

There are several views used in intraoral radiography. They are used for different needs but are fundamentally similar:

a. **Periapical view** means the recording medium is located in the mouth so that it records an image of whole tooth including the crown and root.

b. **Bitewing view** means the recording medium is placed so that it records the image of the crowns of the teeth, which are usually the region of interest. One exposure records evenly the crowns of both maxillary (upper) and mandibular (bottom) teeth.

c. **Occlusal view** is used to get an image either from all maxillary or all mandibular teeth. The recording medium is placed between patient’s upper and lower teeth.

### 3.3 Tomography Imaging

The tomography imaging is in the patent from the year 1922, owned by M. Bocagen. In tomography imaging the recording medium is located outside the patient’s mouth and is hence in the group of extra oral imaging methods in dental imaging. The x-ray tube and recording medium are at the opposite sides of the object to be scanned.
4. ORTHOPANTOMOGRAPHY
During the years 1954-1960, Y. V. Paatero evolved the idea and finally, after few stages of development, introduced an orthopantomography where the focus point follows the teeth during the scan with rather narrow beam.

4.1 Digital Orthopantomography
Digital orthopantomography is a device in which the film is replaced by a digital sensor. The film size on non-digital devices varies between different apparatus but might be e.g. 15 × 30 cm². Digital sensor, however, might be significantly smaller. By using digital orthopantomography, panoramic image of teeth and skull can be composed of narrow slices.

4.2 Computed Tomography or CT
The most modern way to utilize x-rays in dental imaging is computed tomography or CT. For this application, frequent exposures are made from different directions of one imaging layer at the time. The data is run through a back projection process with computer which tries to conclude what sort of tissue there is and how it is distributed along the object. From the 3D-data collected by CT device, it is also possible to generate images similar to orthopantomography and intraoral imaging.

5. CONCLUSION
In this paper a novel X-ray dental image segmentation is presented. The proposed approach is part of digital Dental Identification System for locating missing and un-identified personnel based on their dental characteristics. The proposed X-ray imaging included an enhancement stage that eliminates poor image quality effects from the past to present. Our future work will address several important problems such as region-based image matching to case-based image matching, better for processing poor quality radiographs, and retrieval from the dental Image repository.

REFERENCES


