

STUDY OF THE TEMPORAL EVOLUTION OF WHITENING IN TEETH UNDERGOING MOUTHWASHES USING DIGITAL IMAGE PROCESSING

ESTUDIO DE LA EVOLUCIÓN TEMPORAL DEL BLANQUEAMIENTO
EN DIENTES SOMETIDOS A ENJUAGUES BUCALES UTILIZANDO
PROCESADO DIGITAL DE IMAGENES



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ABSTRACT

Currently, many patients are interested in esthetic dentistry treatments for various reasons: from the search for personal satisfaction, up to needs labor type. The esthetic dentistry reference in our society is determined by several factors, including one that produces more dissatisfaction is abnormal tooth color or that does not meet the patient's expectations. For this reason it has been designed and implemented an algorithm in MATLAB that captures, digitizes, pre-processing and analyze dental imaging by allowing to evaluate the degree of bleaching caused by the use of mouthwash. The samples analyzed were human teeth extracted, which were subjected to different concentrations of mouthwash of several brands or manufacturers that offer teeth whitening when using these products, different concentrations of hydrogen peroxide were also used because this is the component principal in whitening products.

Keywords: Image Processing, Tooth Whitening, Human Teeth, Esthetic Dentistry.

RESUMEN

En la actualidad, muchos pacientes están interesados en tratamientos de odontología estética, por diversas razones: desde la búsqueda de la satisfacción personal, hasta necesidades de tipo laboral. La referencia de la odontología estética en nuestra sociedad está determinada por varios factores, entre ellos uno que produce más insatisfacción es el color anormal del diente o que no cumple las expectativas del paciente. Por esta razón se ha diseñado e implementado un algoritmo en MATLAB que captura, digitaliza, pre-procesa y analiza imágenes dentales, al permitir evaluar el grado de blanqueamiento causado por el uso del enjuague bucal. Las muestras analizadas fueron dientes humanos extraídos, que fueron sometidos a diferentes concentraciones de enjuague bucal de varias marcas o fabricantes que ofrecen blanquear los dientes cuando se utilizan estos productos, también se utilizaron diferentes concentraciones de peróxido de hidrógeno ya que este es el principal componente de los productos para blanqueamiento dental.

Palabras claves: Procesamiento de Imágenes, blanqueamiento dental, Dientes humanos, Odontología Estética.

1. INTRODUCTION

The teeth have multiple shades and colors depending on certain factors such as age, sex, race; however, the teeth are very vulnerable and sensitive to the effects of toxic chemical contaminants and other drugs, especially during development, can be affected in both the composition of the dental structure common color thereof (1).

Our society is undergoing a process of growing cult of aesthetics dental and for this reason the demand for dental treatment claim that, plus morph functionally rehabilitate the tooth, your appearance will return natural (2). The aesthetic dental disciplines are responsible for trying to meet these requirements, and highlights including tooth whitening because it is a treatment that allows to achieve satisfactory results for the patient and the dentist within a reasonable time and with a high degree of safety (3) (4).

Today dentistry provides an opportunity to restore the unique characteristics of each patient as each colored natural tooth has many optical features that increase its complexity (5).

To date, consumers worldwide have acquired millions of whitening or dental teams hoping to get a radiant smile. Teeth whitening products come in the form of gel, strips or sleeves dental, and can be used both in the dentist at home. Hydrogen peroxide is the bleaching component of these products. In general, the whitening power of the amount of hydrogen peroxide.

Toothpastes and mouthwashes may also contain low concentrations of hydrogen peroxide as a disinfectant to prevent plaque and gum inflammation (6).

This article is developed in four parts: the first shown block diagram system design, implementation followed where detailed explanation of how the materials used for development of the same. Then shown results and finally the conclusions which comes after such results analysis.

2. METHODOLOGY

2.1 Design

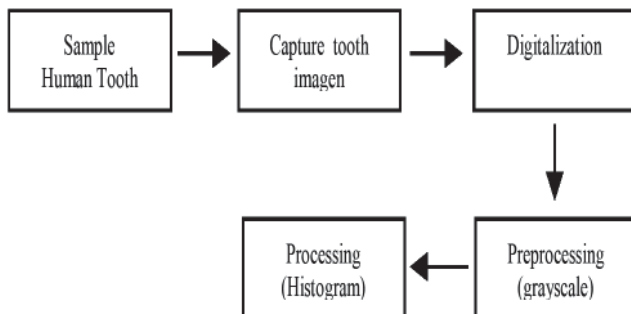


Figure 1. Block Diagram of the system design

The system input is the image of a human tooth which is digitized, passed gray scale and finally applies a histogram which will determine my level of whitening your teeth at the interval of time that has been immersed into hydrogen peroxide (figure 1).

2.2. Implementation

Was developed an algorithm in MATLAB that captures, digitizes, pre-processing and analyze dental imaging by allowing evaluating the degree of bleaching caused by the use of mouthwash.

The image Capture is making by a Microfix digital Microscope. The captured image belongs to an upper premolar tooth that has been previously immersed in 20ml of hydrogen peroxide at 12 volumes (3.6%) in different time intervals 0h, 24h, 48h ... 240h. These images are segmented and passed to gray scale and then apply a histogram. Figure (2-3)

The Microfix digital Microscope is a digital microscope connects to the USB port of your computer or laptop and allows you to view close ups of objects with up to 200x magnification (7).

Hydrogen peroxide (H_2O_2) is a colourless liquid with a bitter taste and is highly soluble in water to give an acidic solution. H_2O_2 is an oxidising agent with a wide number of industrial applications in for example, bleaching or deodorising textiles, wood pulp, hair, fur and foods, in the treatment of water and sewage, as a seed disinfectant and neutralising agent in wine distillation. Low concentrations of H_2O_2 have been found in rain and surface water, in human and plant tissues, in foods and beverages and in bacteria (8).

Risks commonly reported with tooth whitening include increased tooth sensitivity and mild gingival irritation. The degree of these side effects is directly related to the concentration of the peroxide bleach component, duration of the treatment, and the non-bleach composition of the product used.

Tooth sensitivity usually occurs at the time of treatment and can last several days; gingival irritation begins within a day of the treatment and can also last several days. There are additional risks that have been reported from in vitro studies which include tooth erosion, tooth mineral degradation, increased susceptibility to demineralization, and pulpal damage.

The ultimate endpoint for tooth whitening is dependent upon the tooth itself, with common wisdom telling us that all treatment regimens will eventually arrive at the same whitening endpoint. This is not exactly true as some very aggressive regimens can damage the tooth through dehydration and demineralization such that the tooth temporarily appears whiter (9).

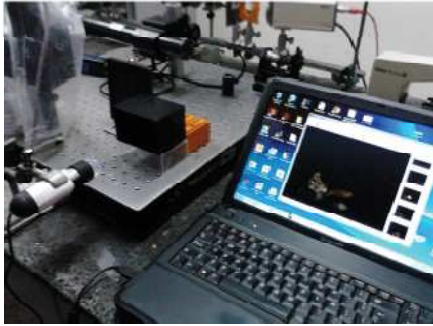


Figure 2. assembly System

Histograms are the basis for numerous spatial domain processing techniques. Histogram manipulation can be used effectively for image enhancement and addition to providing useful image statistics. The histogram of a digital image with gray levels in the range $[0, L-1]$ is a discrete function $h(r_k) = n_k$, where r_k is the K th gray level and n_k is the number of pixels in the image having gray level r_k .

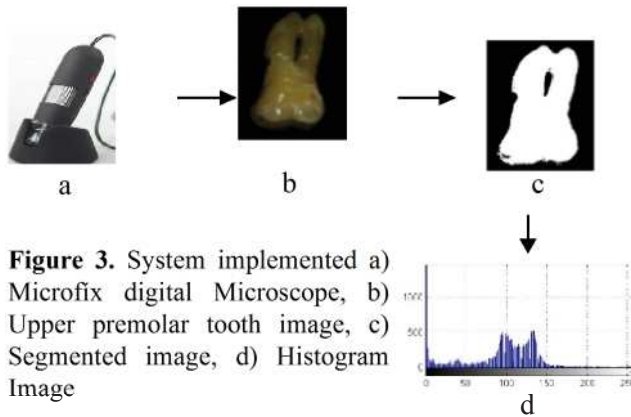


Figure 3. System implemented a) Microfix digital Microscope, b) Upper premolar tooth image, c) Segmented image, d) Histogram Image

It is common practice to normalize a histogram by dividing each of its values by the total number of pixels in the image, denoted by n . Thus, a normalized histogram is given by $(r_k) = \frac{n_k}{n}$, for $k=1, \dots, L-1$. Loosely speaking, $p(r_k)$ gives an estimate of the probability

of occurrence of gray level r_k . The horizontal axis of each histogram plot corresponds to gray level values, r_k . The vertical axis corresponds to values of $h(r_k) = n_k$ or $p(r_k) = \frac{n_k}{n}$ if the values are normalized. Note that the sum of all components of a normalized histogram is equal to 1 (10).

In Matlab was implemented the instructions `imhist(I)` that calculates the histogram for the intensity image I and displays a plot of the histogram. The number of bins in the histogram is determined by the image type, if I is a grayscale image, `imhist` uses a default value of 256 bins or if I is a binary image, `imhist` uses two bins.

RESULTS

The human tooth sample was immersed 20ml of hydrogen peroxide at 12 volumes (3.6%). Intervals were study time 0, 24, 48, 144 and 240 hours and lighting for the capture of the images were the same. Figure (4 - 5).

Capture image to 0 hours

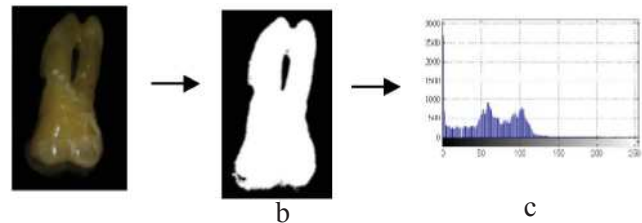


Figure 4. 0 hours processing image. a) Upper premolar tooth image, c) Segmented image, d) Histogram Image

In figure 4 showing teeth extracted without submitting to the solution of hydrogen peroxide and is our point of reference for determining the histogram obtained through the degree of whitening.

Capture image to 24 hours

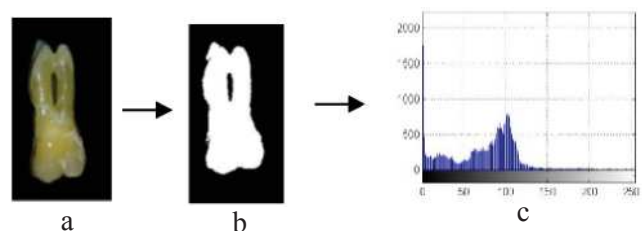


Figure 5. 24 hours processing image. a) Upper premolar tooth image, c) Segmented image, d) Histogram Image

In the histogram we obtain a graph where the number of pixels displayed per each gray level that appears in the picture. In figure 5 (24 hours). Displacement is not very noticeable, indicating a very poor grade in whitening.

Capture image to 48 hours

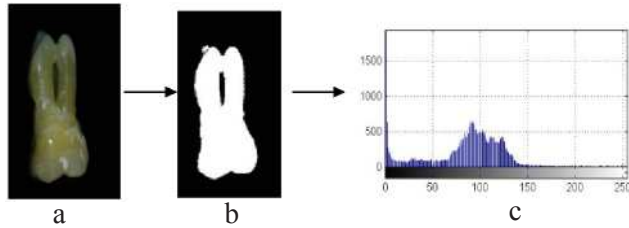


Figure 6. 48 hours processing image. a) Upper premolar tooth image, c) Segmented image, d) Histogram Image

Therefore the sample is left submerged in an interval of 24 hours for a total of 48 hours and then analyzing the behavior. Figure 6.

The shift of the histogram at this time was mild and decides to increase the range of Dip tooth in the hydrogen peroxide solution for about 96 hours for a total of 144 hours.

Capture image to 144 hours

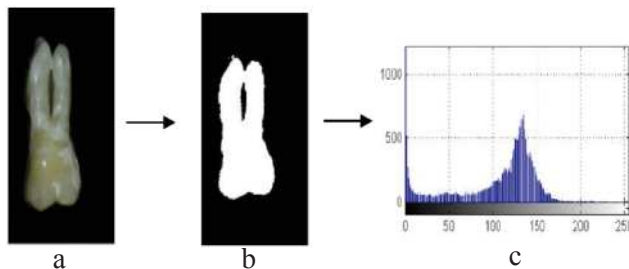


Figure 7. 144 hours processing image. a) Upper premolar tooth image, c) Segmented image, d) Histogram Image

In Figure 7, the tooth is shown physically visible changes to its normal color and the histogram obtained.

Capture image to 240 hours

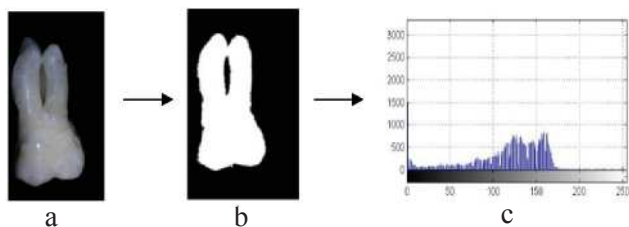


Figure 8. 240 hours processing image. a) Upper premolar tooth image, c) Segmented image, d) Histogram Image

The variation is noticeable in comparison with the first histogram obtained in Figure 4 also show a degree of whitening although emerging degradation in the tooth enamel.

In Figure 8 the tooth immersed shown in the peroxide solution at an interval of 96 hours to 240 hours total noticing whitening highly found on the tooth and shift the histogram in the. Importantly analyzed in this range there is a large loss of tooth enamel due to the time that the tooth was immersed.

By comparing the images can be seen at a glance that tooth periodically used hydrogen peroxide bleaching has a level which can also check with the running of the white level histogram.

4. CONCLUSION

Today, hydrogen peroxide is the most popular, easily accessible, and, the most important factor, handy treatment for cheap home teeth bleaching.

Noting the above graphic results, use peroxide concentration (12 volumes (3.6%) give an excellent result in different times in which was submerged human teeth extracted.

This technique can be a novel method for determining the degree of tooth whitening in accordance to aesthetic the preferred by patient taking into account the supervision of dentist for him to do the analysis optical, and the determinate the diagnosis or changes tooth bleaching of such as the patient glaze.

This research will enable future the analysis and study of the differences mouthwash or other substances that offer dental whitening

Using hydrogen peroxide for teeth whitening might have some unpleasant sensations and burning in the gums but the ultimate result will definitely exceed your expectations, will get clean and snow-white teeth but though, lacking the enamel.

5. ACKNOWLEDGMENT

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