

SCANNING TOOL AND HOLOGRAPHIC PROJECTION FOR THE SPECIALIZATION OF DERMATOLOGY AND PLASTIC SURGERY

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ABSTRACT

Skin cancer is one of the fastest growing diseases in the world. Early detection and treatment are key to reducing mortality caused by this disease, especially in its most lethal form (melanoma). However, the criteria for diagnosis of skin lesions is diffuse, subjective, and is based more on factors like experience of the doctor and specific situations, rather than quantifiable and truthful criteria. This project seeks to provide a scientific alternative detection to these methods, by designing a device capable of mapping the skin tissue, based on technology available in the marketing that ensures repeatability and traceability of the processes of detection.

Interviews with experts in the field of dermatology and vision systems, as well as a literature survey related to the study area, agree that although there are advances in scanning and digitizing of skin lesions, there is still a way to go to be able to obtain repeatable data that can be used for diagnosis. The proposed device seeks to further advance technology in this area.

Keywords: *skin cancer, melanoma, dermatology, plastic surgery, detection, classification, scanning, repeatability, traceability.*

1. Introduction

This paper describes the need for a device to support medical areas of dermatology and reconstructive plastic surgery in order to carry out more quantitative, scientific assessments with less variability of criterion possible, which in turn counts with the ability to properly store the results of tests performed, in order to use the results for subsequent comparisons and evaluations of possible progress of the patients' dermatological diseases.

2. General objective

Design a system with the ability to detect different types of skin cancers such as melanoma and other skin related diseases.

3. Specific objectives

Perform quantitative studies of the skin, in relation to its topography, appearance, color, and changes in general.

Determine in the physiognomy of the human skin. Develop detailed specifications and construction schematics, for manufacturing the resulting device.

4. Justification

Melanoma cancer is one of the rarest types of cancer but it represents the highest number of cancer death in the world [1-3].

During the past four decades this type of disease has increased by 200% in the United States of

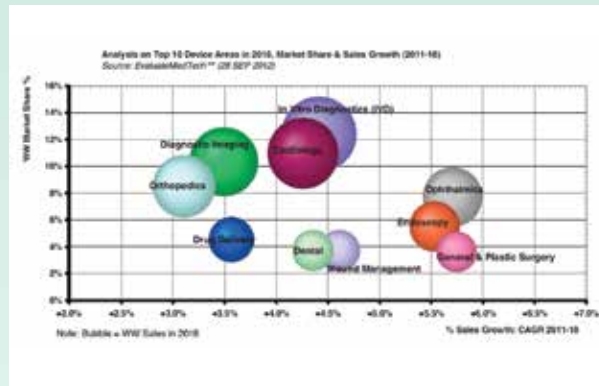


Figure 1: Analysis of Top 10 areas of medical devices for 2018

America and in the same way there have been similar increases detected in other regions such as Europe [3].

In 2015 there were more than 73 000 [2] new cases of this type of cancer detected, from these about 9 900 people died from this disease only in the United States of America, where the death rate is probably lower compared to other latitudes because of the great technological medical advances available in that region.

In some parts of the world, especially the Western World cities, melanoma has become a fairly common disease. According to the World Health Organization, around the world about 132 000 new cases of melanoma are diagnosed each year [4]. This incident is aggravated in caucasian populations that are generally located in lower latitudes, with the highest incidents in countries like Australia, where there are almost twice as much of this type of diseases compared to European cities.

Currently, dermatologists do not have a tool that allows the implementation of quantitative studies that support qualitative assessments made by doctors on the condition of the skin. Nowadays, there is no device capable of making comparisons between exams made to patients.

On the contrary, everything is based mainly on subjective judgment of the doctor, hindering the early detection and prevention of skin diseases.

The device shall have the ability to perform, store and compare studies to be made to a person, giving specialists a tool in order to get accurate, fast and assertive decisions and diagnoses benefiting the patient being treated.

In the international context during the last three years, the global trend of medical investment in the area of diagnostic imaging occupies one of the top three places in amount of investment as shown by Figure 1.

5. State of the Art

According to Linden [1], the incidence of malignant melanoma is increasing more than any other type of cancer. To minimize or reduce mortality rates, an appropriate and early detection is imperative. Early diagnosis of this disease is something that is becoming more and more important to save human lives. With the advancement of technology, tools have been developed to diagnose skin cancer more quickly and efficiently, however there are certain deficiencies as indicated by Ogorzalek [2] Despite all these developments there is still a wide margin for misinterpretations of images related to skin lesions. Additionally, the ability to detect malignant skin lesions varies depending on the physician [3,4]; and except for people at high risk or a history of skin cancer, there is a debate about the frequency of medical check-up, who should do the check and who should get it.

The possible methods to diagnose cancer in an early manner have been discussed extensively. In 2000 there was the second meeting of consensus on public opinion research and its main

conclusions were that four algorithms, namely, pattern analysis, ABCD rule, Menzies scoring method and the checklist of 7 points are good ways to evaluate skin lesions. All four methods share common concepts and allow the selection of specific features that are possible to perform with the help of the computer "(Orgalek et al, [2]). This information in particular and the study mentioned by Linden [1], it is concluded that developments in imaging will help to the detection and diagnosis of skin cancer and in the long-term allow live detection and increased certainty of the detection and analysis of skin cancer. These are fundamental basis of the current research, and are expressed as a starting point for the work shown in this report.

As for technologies that help detect the skin surface, there are two main types: scanners and digitizers [5]. Scanning is the process by which images in three dimensions are converted to digital form by using optical or video tools; meanwhile, digitization is to trace and document the three-dimensional shapes on a computer. There are also dynamic and static systems depending on how they take images. The dividing line between the different categories is slightly blurry, with the emergence of new technologies in recent years, however it works as the foundation for the next section, which deals with the steps needed for image capture and processing for 3D scanning.

Capture and image processing

A detection system for skin cancer or melanomas is typically composed of some basic processes as: image acquire, processing, segmentation of lesions, feature extraction and classification. The first stage of the system relates to the process of how the image is taken, generally through photographs or from a previously existing physical record. The segmentation of lesions found is the main process of the detection system, because it defines the

area considered prone or affected by cancer or melanoma. Once segmented the region of interest, it is possible to submit it to comparisons and studies such as type of edges, color, topography, changes in size, among others, in order to be compared with those algorithms previously exposed.

In relation to the detection method in which the current research is based, a technique called "ABCD rule" is used [6,7]. It has been decided to use this technique, because it is standardized and its potential to be used with a technology that captures in 3D. This technique involves obtaining the diameter and height of the injury, usually overlooked, because most dermatologic images have no reference points to determine and compare the sizes of lesions. Once the characteristics of the lesion are determined and measured, image processing continues and leads to the classification by the treating physician.

Design elements to consider

Based on what was exposed in the previous sections, it was decided and define the design to focus the project to address the main problems currently found on the tools of image capturing, and beyond designing the method or deal with the capture algorithm, submit a practical and economical solution using components available on the market. Therefore, the research is based more on the subtlety of integration, and how to fill a market gap.

To this end, it has been decided to use as part of the device a high resolution camera with capabilities of optical coherence tomography (OCT) [4] of 5 layers to be able to represent a three-dimensional injury. OCT technique provides an assessment by a cross section cut, and the imaging taken by layers, of the epidermis and dermis. It allows the analysis of collagen and other physical characteristics of the skin [8]. This could help solve some challenges

during image acquire, such as uneven illumination, as shown in the example of Figure 2. Taking into account the experience of the company in the area of visual inspection for different production and quality processes, a prototype has been developed already, as shown in Figure 3.

As for the challenge of segmentation of images [9], the thresholding method has been selected, which



Figure 2: Uneven illumination.



Figure 3: Funcional Prototipe

is based on calculating the thresholds in the black and white images, based on pixel density values in the images that generate the inspection, as shown in an example in Figure 4. Finally, and as option tool for discretionary use by the treating physician, an algorithm is going to be used, which aims to take pictures previously stored in a database, to be able to make comparisons with injuries previously analyzed, related or based on a method called Linear Discriminant Analysis (LDA) [10].



Figure 4: Thresholding method

6. Conclusions

- The technology presented is meant to make more accurate diagnosis of the dermal state, helping in choosing the most appropriate treatment for each client.
- Increasingly, the skin analysis based on principles scientifically recognized are more valued, since they have many advantages over visual analysis performed by a specialist.
- The equipment designed allows the identification of skin lesions using cameras that achieve sharper and better quality images as well as being suitable for all types of contextures according to your design.

- The built prototype enables professionals in dermatology, scan, detect, select, play and compare studies performed on patients.

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