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Burn Depth Analysis Using Multidimensional Scaling And K-Nn Classifier

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Abstract— This method is designed for hospitals where there are no expert surjeons.In this method the physical features the experienced surjeons would consider in finding the depth of the burn is considered.surjeons have to correctly find the depth of burn by seeinf the colours that is present in the burned image if wrongly assumed due to inexperience or sight problem then the patient would suffer from wrong treatment.based on different burn depths there are different colours.First the burned images are segmented and converted the result to mathematical features using multidimensional scaling.And then they are given to k nearest neighbour classifier.Here we have also performed with Support vector machine classifier so that we can compare our result such as accuracy with the knn classifier.

Index Terms— Burn, color, k-nearest neighbor (k-nn classifier, Support vector machine (svmclassifier), multidimensional scaling (MDS).

I. INTRODUCTION

For a favorable evolution of a burn injury, it is essential to initiate the correct first treatment. To develop an appropriate course of treatment, it is necessary to know the depth of the burn. As the cost of maintaining a burn treatment unit is high, it would be desirable to have an objective or automatic system to give a first assessment at primary health-care centers, where there is a lack of specialists. At that place this would be helpful to diagnose the burn depth. First for that we have to understand the type of burn depths. As the cost of maintaining a burn treatment unit is high, it would be desirable to have an objective or automatic system to give a first assessment at primary health-care centers, where there is a lack of specialists

Severity of a burn patient depends upon three main factors: extension and location, age and burn depth. These three factors control the life expectancy, first treatment and the eventual requirement to referral to a burn center

Burns are often classified according to their depth into four groups

1) First-degree burns or epidermal burns are usually red, dry, and painful. Burns initially termed first-degree are often actually superficial second-degree burns, with sloughing occurring the next day.

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2) Superficial dermal burns are moist, red, and weeping; blanches with pressure. They are painful to air and temperature.

3) Deep dermal burns are wet or waxy dry; variable color (patchy to cheesy white to red) and do not blanch with pressure.

4) Full-thickness burns are generally leathery in consistency,dry, insensate, and waxy. These wounds will not heal, exceptby contraction and limited epithelial migration, with resulting hypertrophic and unstable cover.

This is an important issuebecause the users will need to apply the characterization methodonly for each camera and not each time the illumination systemchanges.

II. MATERIAL AND METHODS

Material

20 images were acquired with a Canon EOS 300D in the first-aid room at the Burn Unit, Virgen del Rocío Hospital, Seville, Spain. Camera characterization was performed to maintain colors in the photographs faithful to real colors. The psychophysical experiment was performed with 20 burn images. The image pixels were converted into sRGB in this characterization procedure.

III. PROCEDURE SCHEME

According to experts to determine the burn depth a set of features have to be identified. These features were employed to develop a tool to classifyburns into their depths. The procedure followed to developa tool to classify burns consists of three main steps.

1) Psychophysical experiment. Images were presented inpairs to eight plastic surgeons affiliated to the Burn Unit ofVirgen del Rocío Hospital, Seville, Spain. The experimentfollowed the rules dictated in Rec. ITU-R BT.500–10.As a result a similarity matrix, where each element representsthe similarity between two images, was obtained.

2) Multidimensional scaling. Images are represented in amultidimensional space where proximities between images arecorrelated with similarities obtained in step 1). The dimensionalityfor this space was determined with the stress formula.

3) Interpretation of the coordinates: feature identification. Inthis phase physical measures correlated to the coordinateshave been identified. This stage consisted of three substeps.

- 3.1 Brainstorming to identify features in the imagescorrelated to their coordinates in the multidimensionalspace.

•3.2 Translation of these features to numerical parameters.
•3.3 Model fitting to adjust a polynomial, whose independent variables are these numerical parameters, to thecoordinates.

IV. EXPERIMENT

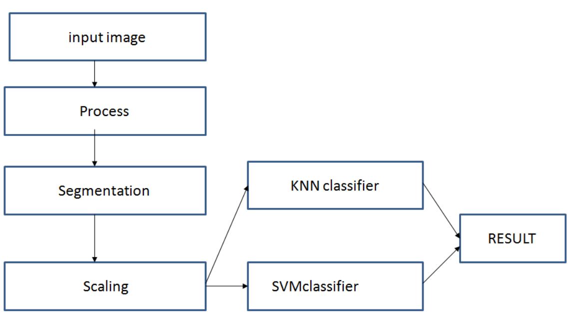
The experiment was conducted with the help of eight plastic surgeons affiliated to the Burn Unit of Virgen del Rocío Hospital, Seville, Spain. The environmental conditions were controlled in order to avoid undesirable brightness The person who was undergoing the test was seated in front of the computer with a distance of 75 cm from the screen and a maximum angle of 30 to the normal of the screen. The display is of size 17 in, 16:9 format, LCD, 1280 960 pixel resolution.The experiment consists of the following steps.

Its elements, are the proximity or similarity values. with , and are the score assigned in the experiment, that is, the level of similarity between image and image according to the expert.

$$\Delta = \begin{bmatrix} \delta_{11} & \delta_{12} & \cdots & \delta_{1I} \\ \delta_{21} & \delta_{22} & \ddots & \delta_{2I} \\ \vdots & \vdots & \ddots & \vdots \\ \delta_{I11} & \delta_{I2} & \cdots & \delta_{II} \end{bmatrix}$$

The block diagram used for detecting the burn depth is

Block diagram



V. MULTIDIMENSIONAL SCALING

MDS is a set of mathematical and statistical methods for identifying the configuration of m points in space that satisfies the given m (m − 1) / 2 inter-point distances. MDS uses a set of proximity values that describe the similarity of pairs of objects, and the class to which each object belongs.

(1) The objective of MDS is to find the best configuration of points in a space ofdimension which will represent the objects and the distances among them like in a map
If we define as the Euclidean distance between point and point , a matrix whose elements are , for ,can be constructed

(2) The objective is to find the configuration that attained amatrix highly correlated with matrix . Regarding to the dimensionality , there is a difference between the best dimension and the most suitable dimension . The best dimension refers to the number of dimensions that gives the fewest error (stress). The most suitable dimension refers to the number of dimensions that has ameaning regarding to the problem under study. There is a rule that dictates the maximum number of meaningful dimensions that can be obtained with afixed number of input objects

(3) According to (3), the maximum number of meaningful dimensions is in this problem. Finally, is chosen for this paper.

Interpretation of the Coordinates

In this step the three coordinates have been analyzed in order to infer a physical meaning for each one and then numerical parameters that correlate with them have been identified.

This aim was achieved in three substeps.

1 Brainstorming was Designed to Infer the PhysicalMeaning for Each Coordinate:The 20 images were shown in a 3-D projection: coordinate1 versus coordinate 2 on one side, and coordinate 1 versuscoordinate 3 on the other side. These graphics are shownSix experts in digital image processing take part in thebrainstorming.They were asked to identify physical features in the imagesthat motivated their location in each coordinate.As a result of the brainstorming the three coordinates were identifiedas follows.

• Dimension 1: This dimension was labeled as amount ofpink in the image. We can appreciate that in this dimensionimages are well separated into two groups: imagesResult of MDS: images are placed in a 3-D space. (a) 3-D projectionrepresenting coordinate 1 versus coordinate 2. (b) 3-D projection representingcoordinate 1 versus coordinate 3.mostly pink or reddish and images with nonsaturatedcolors (white, brown, green, pale rose). This can also berelated with the level of damage of the skin. While pinkimages correspond to superficial injuries, the others aredeep burns with a high level of damage. Dimension 1 wasalso labeled as vividness or moisture in the skin, becausethere are two brown images aligned with the pink onesthat have in common with them only this attribute.

• Dimension 2: This dimension was considered as texture ofthe color during the brainstorming. That is, images withlow values in coordinate 2 have very homogeneous colorswhile images with high values in this coordinate presentinhomogeneous colors, with dots or blisters.

• Dimension 3: This dimension was hard to interpret. Finally the consensus was that more colorful images hadhigher values in this dimension and whitish images had low values. In summary, this dimension is related tocolorfulness.These feautures are then translated into numerical features

Fig.5 Translation and model fitting

VI. CLASSIFICATION PROCEDURE.

As it was mentioned above, in the Labcolor system, 2 × norms corresponds to perceptual similarity, thus representing the optimal distance metric for that space. That means that this will be a good measure to classify colors into the three groups, each corresponding to one aspect (two of them are of the same group) of burn wound.

KNN Classification

Fig. 6.1 Classification using KNN classifer

SVM CLASSIFICATION

In this study we wanted to check the discriminant power of the eight features from Table IV, that were selected because they were correlated with the three coordinates in the MDS analysis. These features were employed as inputs to a support vector machine (SVM). This SVM was trained with the 20 images used in the experiment. Afterwards, the remaining 74 images were employed to analyze the classification performance.

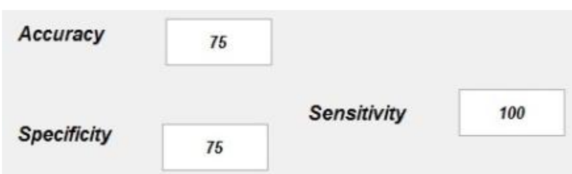


Fig. 6.2 Classification using SVM classifier

VII. EXPERIMENTAL RESULTS

We apply the segmentation and classification algorithms on various burn images. Those images are digital photographs taken by physicians following a specific protocol. All the images were diagnosed by a group of plastic surgeons, affiliated to the Burn Unit of the Virgen Del Rocío Hospital, from Seville. The assessments were validated one week later, as it is the common practice when handling with burned patients. Two of the images correspond to superficial dermal depth, two to deep dermal depth, and one image full thickness and the remaining is cluster.

A. SEGMENTATION RESULTS

To perform the segmentation, a previous characterization of the hue and saturation component histograms for both normal and burnt skin was needed. This was done in order to fix the parameters hc and in equations (1) and (2). In all the cases, the burn wound was segmented correctly from the normal skin. Fig. 1 to 3 show the segmentation results for one image from each of the three types defined below. Fig 2. A represent original images and Fig. b represent the segmented ones. In the segmented images we have marked with violet color the segmented region on grayscale images.

B. CLASSIFICATION RESULTS

In k nearest neighbour classifier the segmented burn image is classified by seeing nearest pixel.In usinf knn classifier we get accuracy of 87.6%. It gives accurate result more compared to that of classified with the SVM classifier.SVM classifier the burn depth but not so accurate.With SVM we can get only results with 75% only but in knn classifier we can classify burn depths with more accurate results.

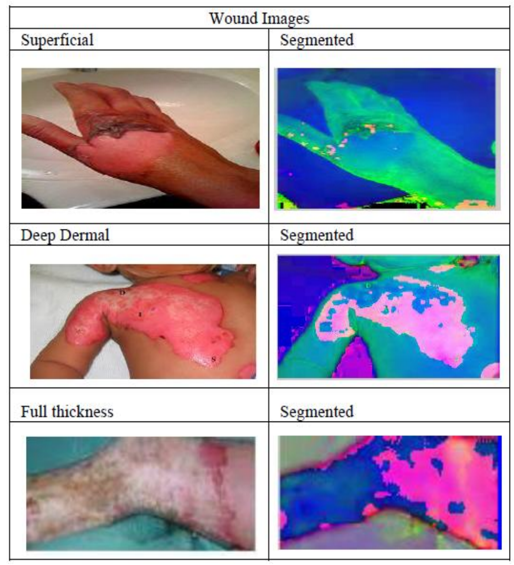
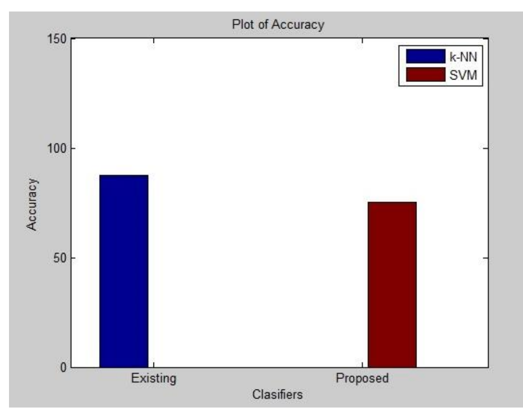


Fig 7.(a) Original Superficial (b) Deep Dermal (c) full thickness



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