

AN EFFICIENT APPROACH TO SEGMENT SCALING IN PSORIASIS SKIN IMAGE

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Abstract-Psoriasis is a chronic inflammatory skin disease that affects over 3% of the population. Various methods are currently used to evaluate psoriasis severity and to monitor therapeutic response. The PASI system of scoring is subjective and suffer from poor inter and intra-observer concordance. So a Pixel Labelling Algorithm includes color, contrast and image texture is used. The process involved is scaling segmentation of the image. The Markov random field (MRF) is used to smooth a classification from a support vector machine (SVM) that utilizes a feature space derived from image color and scaling texture. So initially the image is contrasted to find the affected area. Classification is done based on the level of severity. A bisected factor based clustering algorithm is used. The final image is a classified image showing the vague scale detected, along with level of severity and estimated growth rate.

Keywords: Feature Extraction, Image Segmentation, Markov random field (MRF), Support Vector Machine (SVM), Psoriasis, Erythema.

I. INTRODUCTION

Psoriasis is a chronic, inflammatory, non-contagious skin disorder which is characterized by red plaques covered by silvery-white scales. It is caused by genetic fault where immune system is somehow mistakenly triggered which produce skin cells faster and thicker than normal.

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The drawback in most method is that the exact affected area is not properly classified. Subtracting the green band from blue band in RGB color space can effectively discriminate lesion from healthy skin. However, this method may not work well for dark skin cases. Also the PASI system of scoring is widely used for evaluating psoriasis severity. It has a visual analogue scale to score the thickness, redness (erythema), and scaling of psoriasis lesions. However, PASI scores are also suffering from poor inter and intra-observer concordance. A pixel labelling algorithm had been utilized to segment psoriasis lesion.

Based on this, the severity of the disease is classified. For classification, the ground truth is found. The ground truth tells the majority amount of affected area.

II. RELATED WORKS

2.1 LITRATURE SURVEY

Juan Lu, Ed Kazmierczak, Jonathan H.Manton and Rodney Sinclair [1] proposed that the most effective way to locate erythema region is using two features. First is to initially contrast the image using scaling contrast map. It is used to enhance the conspicuousness of scaling against erythema. The other is a Gabor feature. Color of scaling can be similar to normal skin, if the skin is fair, making it difficult to differentiate between scaling and normal skin using color alone. So a Gabor filter is used to extract the texture from the image. This is segmented using an SVM and MRF is used to smoothen the image. Combined operation of SVM and MRF effectively separates scaling from skin image. Here the segmentation is

evaluated with images having different lighting conditions, skin types and psoriasis types. Finally the ground truth obtained shows the affected area. By integration of SVM into MRF, the internal structures of images are considered and that increases the classification accuracy. The main idea of this paper is to automatically segment and scale the skin image to directly detect the affected area. The limitation is the possibility that the ground truth is not accurately marked.

M.Meier and P.B.Sheth [2] proposed a method to quantify the severity of psoriasis in an effective manner. Objective measures used to quantify the severity of psoriasis, including the body surface area involved, Physician's global assessment, Psoriasis Area and Severity Index, and quality of life measures, are all assessments useful in management and therapeutics. The measures patently provide valuable guidance, but it is also clear that they are not sufficient to explain the treatment choice. A standardized protocol or mathematical model for evaluating psoriasis severity in day-to-day clinical practice is present. The clinical spectrum of psoriasis includes plaque, guttate, small plaque, inverse erythrodermic, and pustular variants. The determinants of the clinical severity of psoriasis, the risk of comorbidities, and the quality of life are influenced by multiple factors. Includes variations in quality of skin involved and distribution of skin lesions.

R.Achanta,F.J.Estrada [3] proposed a method of finding salient regions in images, using low level features of color and luminance, which is easy to implement, noise tolerant, and fast for real time applications. Identifying visually salient regions is useful in applications such as object based image retrieval, adaptive content delivery, adaptive region-of-interest based image compression, and smart image resizing. It is fast and easy to implement. It generates saliency maps at the same resolution as the input image. These maps are used in segmenting whole objects with the aid of a relatively simple segmentation technique. The map is added pixel wise to get final saliency maps. The input image is then over-segmented

and the segments whose average saliency exceeds a certain threshold are chosen. Saliency is determined as the local contrast of an image region with respect to its neighborhood at various scales. This is tried on a wide range of images. It generates high resolution saliency maps that allow better salient object segmentation. However it is not effective when sufficient contrast is not present. Presence of holes and extra segments is an issue here. So this method was ineffective.

I.Naldi and D.Gambini [4] proposed a system where the classification of the skin disease is done in detail. Uncommon forms have been detected and recognized. Since psoriasis is present throughout life, when examining population data, it is expected that point prevalence and lifetime prevalence would increase with age. Quality of life refers to quantitative estimates of the overall impact of a disease on the physical, social, and psychological well-being of the patient. These measures point to the multidimensional nature of disease assessment and outcome, which also include evaluation of disease associated discomfort, level of disability and social disruptions. The PASI does not provide direct information. The index does not make any difference between different pattern distributions and clinical subgroups, so are poor to assess disease varieties. The evolution of skin lesions remains unclear, and the extent of skin involvement can range from none to generalized body involvement. The proportion of patients in general population reporting systemic treatment does not exceed 20%. So this paper helped to categorize in a much more effective manner thus enabling a chance to organize the severity and the types. Distinction should be made between severe psoriasis and psoriasis that severely affects quality of life. A standardized diagnostic criterion is not present.

Z.Kato and T.Chuen [5] proposed a MRF segmentation model that combines both color and texture features. It is not restricted to a specific texture features. Any feature is suitable as long as feature value belong to a pixel class that can be modified by a Gaussian

distribution. It is possible to classify the different types of textures based on the training of corresponding parameters. Quality of segmentation is improved based on color-only and texture-only segmentations. A parameter estimation using EM algorithm is proposed and the combined features help to provide correct estimates. Unsupervised segmentation provides slightly lower quality results, but on real images, the results are comparable to supervised ones. The suboptimal but fast ICM is a good tradeoff between quality and computing time when using combined features. Although the implementation is sequential, the segmentation algorithm is highly parallel due to the local nature of the MRF model. Thus, a parallel implementation can further improve the computing speed. It uses a Multi-Variate Gaussian Distribution technique. Here MRF image segmentation model combines color and texture features. This way it is much more precise in finding the affected area based on image. But this method provides a slightly lower quality result. So the image quality is a matter of concern here.

D.Delgado, B.Ersboll and J.M.Carstensen [6] proposed a procedure to evaluate the severity of scaling and redness in psoriasis. The method automatically separates the different parts and extracts different parameters. In certain difficult cases such as uneven illumination it was noticed that allowing manual interaction increases efficiency and accuracy. The method provides objective measures that avoid the dependence of the physician in tracking of dermatological diseases. It was seen that one of the provided measures was highly correlated with the doctor scoring. Together with the other two measures a better lesion description is obtained. A decision tree is created to automatically score the degree of scaling in different images. Three variables are used as input to the model: the area of the scaling, the ratio between the area of scaling and the area of the lesion, and the ratio between the area of scaling and area of redness. Scoring using a clustering method. A K-Nearest Neighbor algorithm which is a robust algorithm to register Psoriasis images is used. Algorithm is automatic. Has high accuracy, speed and

parameter dependence. The selected images do not have shadows, scars or other elements that could spoil the results. The mean of the trichromatic bands was calculated in healthy and in red skin area for each image. The drawback is that the task of registration is difficult. Images exhibit high variability and complexity here. It assumes that the image to be registered is of same scale.

III. PROPOSED SYSTEM

Psoriasis skin segmentation images are digitally captured under controlled environment. In the proposed system the vague scaling which was difficult to detect is detected. An edge mapped luminance algorithm is used. Using this image, the growth rate estimation and classification based on the level of severity of Psoriasis is proposed. A bisected factor based clustering algorithm is used for this purpose.

IV. SYSTEM ARCHITECTURE

The feature scaling and segmentation overall system design shows how the detection of vague scaling can be achieved. The architecture is shown below in the Fig. 3.1

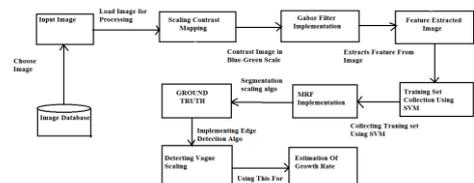


Fig 3.1 Overall System Design

In the existing system, from an image database, the input image is taken. It is contrasted based on intensity and color using a scaling contrast map. This is again subjected to a Gabor filter which is used to extract texture. The feature extracted image is saved separately so that the original image is not lost. Now an SVM is used to segment and smoothing of the image is done using MRF segmentation. In

the proposed system, the detection of vague scale is done to find the exact amount of affected area. The estimation of growth rate is done based on vague scale detection.

A. FEATURE EXTRACTION

Feature extraction includes implementing scaling contrast map to modify image based on color. The scaling contrast mapping is used to contrast image based on intensity and lightness of the image. This contrasted image is subjected to a Gabor filter. A Gabor filter is used to extract the texture feature in the image. The Gabor filter includes extraction of a texture based on the contrast to detect the affected area of psoriasis skin images. This is implemented using a Pixel labeling algorithm.

The scaling contrast map is defined as,

$$S = J(L^*) + J(\text{inv}(a^*))$$

Where $S_{x,y}$ is scaling contrast of image. Here J detects the contrast. L^* is lightness of image (0-black and 100-diffuse white).

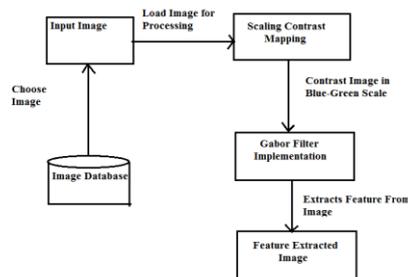


Fig 3.2 Feature Extraction

a^* is red-green dimension(positive-red and negative-green) b^* is blue-green dimension. $\text{Inv}(a^*_{x,y})$ is given as

$$\text{inv}(a^*) = \max_{i,j} (a^*_{i,j}) - a^*$$

It inverts the image in a^* dimension.

The multi center surround filter $J(\cdot)$ is given as

$$J(X) = \sum_{s=1}^3 \left(X - \frac{1}{N} \sum_{\substack{x-w(s) \leq m \leq x+w(s) \\ y-w(s) \leq n \leq y+w(s)}} X_{m,n} \right)$$

Where s is scale. w is window size, $w = d/2^s$, where d is large value of image width or height in pixels. N is number of pixels in window. Here $s \in \{1,2,3\}$. This scales cover the contrast analysis. The contrast filter $J(\cdot)$ compares the intensity of the current pixel with its surroundings at the different scales. In normal lighting conditions, if it is scaling, then $J(L^*)$ is still positive. In the presence of shadows $J(L^*)$ is still positive with sufficient contrast. In this way S is a robust method to change the illumination and shadows.

B. SVM AND MRF CLASSIFICATION

A support vector machine(SVM) identifies the normal and the affected skin. The SVM is used to cluster the normal skin and the scaling image. The MRF is used to smoothen the changes made so that it is restricted to that particular region. The set of possible scaling part L_{scaling} , and skin part L_{skin} are obtained and clustered ($C1$ and $C2$ respectively) using $L_{\text{scaling}} \cup L_{\text{skin}}$.

$F = \{(S, T) | (x) \in \text{dom } L_{\text{scaling}} \cup L_{\text{skin}}\}$ is set of all features.

Centroid is given by,

$$O_i = \frac{\sum_{C_i} W(L, C_i) F}{\sum_{C_i} W(L, C_i)}$$

Where O_i is centroid, C_i is class, W is weight function, L is location and F is feature space. The k-means algorithm is used for this purpose. It partitions the feature into those that are closer to scaling and those that are closer to normal skin. The MRF objective function is given as,

$$\omega = \text{argmax } P(A|\omega)P(\omega)$$

Where $P(A|\omega)$ is likelihood term of MRF obtained from SVM, A is set of features for all images that are not erythema, is segmentation of scaling part from skin part through set of image features.

V. EXPERIMENTAL RESULTS AND SCREENSHOTS



Fig 1. Image Selected Screen

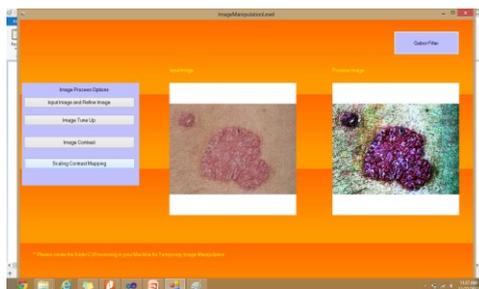


Fig 2. Scaling Contrast Mapped Image

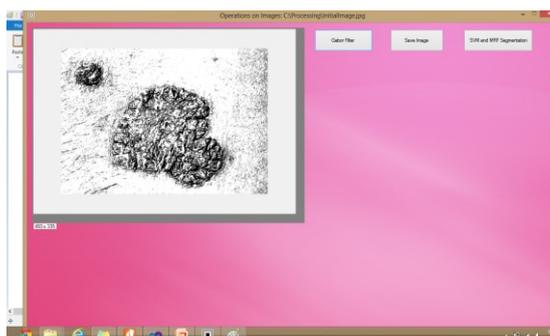


Fig 3. Gabor Filtered Image

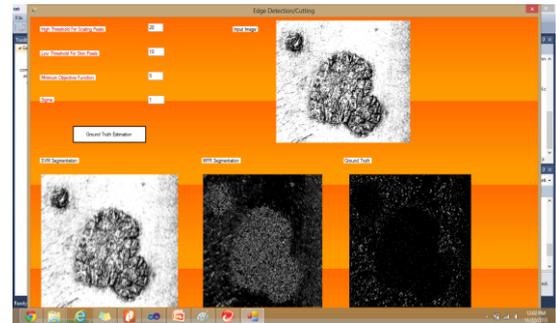


Fig 4. Ground Truth

VI. CONCLUSION AND FUTURE ENHANCEMENT

The pixel labelling algorithm is used to perform the feature space scaling of 2D segmented skin images for feature extraction and SVM and MRF classification. The Segmentation of scaling in the image is done using a K-means algorithm. Initially, the image is refined if the quality is poor and then it is subjected to feature extraction. The resulting image is a scaling contrasted and texture extracted image. This is the output of feature extraction module. This is again subjected to SVM and MRF segmentation. The SVM combined with MRF improve the classification. The classification, whether the image is scaling or normal, is done here. The final obtained image from the segmentation is the output image which is the ground truth. The ground truth shows the affected area in the psoriasis skin image. This image is unable to show the vague scale and some portions remain undetected. Also the edges are either mistaken as normal skin or affected skin. This portion is the key to estimate the growth rate of the disease. This region remains either undetected or mistaken so it can be further enhanced.

VII. REFERENCES

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