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A Survey on Automated Segmentation of Microscopy Imaged Melanocytic Lesions

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Abstract: This paper discusses the various methods used for the detection, segmentation of skin lesion. Medical diagnosis with the help of image processing techniques is increasing day by day and has been well established. Dermoscopy is one of the major imaging modalities used in the diagnosis of skin lesions such as melanoma and other pigmented lesions. In order to minimize the diagnostic errors that result from the difficulty and subjectivity of visual interpretation, the development of computerized image analysis techniques is important. This paper presents an approach for the analysis of skin lesion detection methodology, which consists of image acquisition, pre-processing, segmentation melanoma skin cancer diagnosis.
Keywords - Dermatoscopy, Melanoma, Segmentation, Melanocytic Lesion

1. INTRODUCTION

Melanoma is a type of skin cancer which is less common than basal and skin cancer but it is one of the most aggressive types of cancer. It can be healed by surgical excision; if recognized in the early stage. So it becomes very important and useful to develop an automated melanoma recognition system. Malignant melanoma accounts for 75 percent of all deaths associated with skin cancer in United States**[1]**. Australia and New Zealand exhibit one of the highest rates of skin cancer incidence in the world, almost Visual analysis of a melanocytic lesion is segmentation of all points in the image as part of the lesion or of the surrounding, non lesion skin. A skin lesion is a part of the skin that has an abnormal growth or appearance compared to skin around it. A mole (nevus) is a benign skin tumour that develops from melanocytes which are found in uppermost skin layer epidermis. These skin cells make a brown pigment called *melanin*. Melanin gives the skin its tan or brown colour. Melanoma can originate in any part of the body that contains melanocytes. Nearly all moles (nevi) are harmless, but a person who has many moles can raise risk of melanoma. The standard method to evaluate skin growth in order to rule out melanoma is by biopsy followed by histopathological examination. The challenge lies in identifying the lesions that have the highest probability for being melanoma. Mostly dermoscopy is used for the diagnosis of skin cancer. It is a non-invasive skin imaging technique which uses a hand-held lighted magnifier to analyze skin lesions by observing newly defined and descriptively named subsurface structures (e.g., dots, streaks, veils, networks). Due to the difficulty and subjectivity of human interpretation, computerized analysis of dermoscopy images has become an important research area. The general approach for CAD is to find the location of lesion and also to determine an estimate of the probability of disease. For diagnosis of skin lesion, it is important to understand the relevance of the different dermoscopic features, which are pattern analysis, lesion specific features & color and symmetry. The typical architecture of CAD system includes selection of training samples, image pre-processing, segmentation, feature extraction and classification. The aim of the pre-processing step is to eliminate the background noise and improve the image quality for the purpose of determining the focal areas in the image. Image segmentation is an important step in image analysis, pattern recognition, and computer vision. An accurate segmentation of skin images can help the diagnosis to define well the region of cancer.

II. RELATED WORK

A. Validation Of Segmentation Techniques For Digital Dermoscopy ABCDE Rule[2]

The segmented image is then for extracting feature details such as texture, color and shape. These extracted features are given as an input to the classifier to classify the skin lesion as either malignant or benign. In the conventional procedure, following diagnosis

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methods are mainly used ABCDE rule of dermoscopy. The clinical diagnosis of melanoma is commonly based on the ABCD rule, an analysis of four parameters asymmetry, border irregularity, color, and dimension, or the 7-points checklist which is a scoring method for a set of different characteristics depending on color, shape, and texture. Dermoscopy is a non-invasive diagnosis technique for the in observation of pigmented skin lesions used in dermatology.

The characteristics needed to diagnose a melanoma as malignant are shown in Figure:1

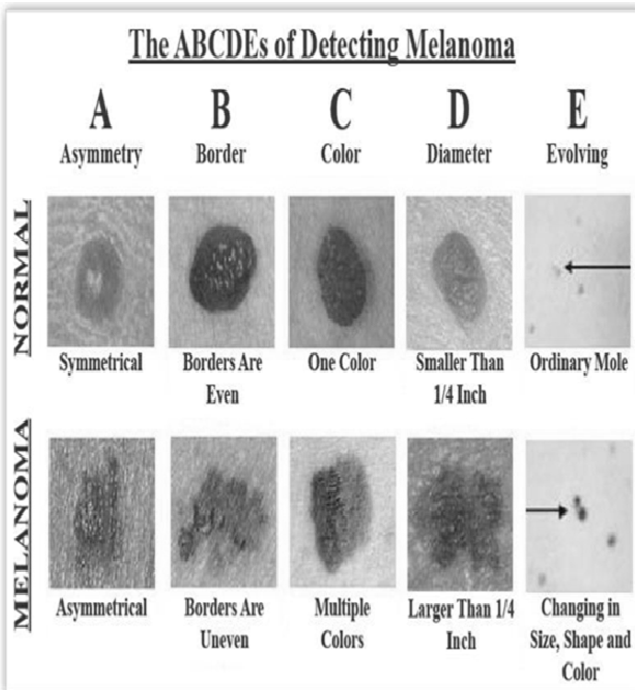

Figure: 1 The ABCDE of Detecting Melanoma

B. Stabilized Inverse Diffusion Equations Non-Linear Diffusion Technique Termed

"Stabilized Inverse Diffusion Equation" (SIDE)[**3**], SIDE allows the intensity value within a region to change in response to forces exerted by adjoining regions; these forces are a function of the difference in region intensity values:

$$u_i = \frac{1}{m_i}\sum_{j\epsilon A_i} F(u_j - u_i)\, P_{ij} \qquad (1)$$

u_i is the intensity value within the i-th region, m_i is the area of this region (i.e., the number of pixels in it), the sum is over all the neighbors of the i-th region, and p_{ij} refers to the length of the boundary between region i and its neighbor j . The force function is monotonically decreasing and discontinuous at the origin. Two adjoining regions are merged when the difference in their intensities reaches zero (when the difference changes sign or falls below a small threshold).however, that their algorithm is faster, more robust, and preserves edges better than other forms of non-linear diffusion. The SIDE algorithm is initialized by assigning each pixel to a separate region. The algorithm then merges regions until ultimately only a single region remains, with an intensity is equal to the mean value for the image. Therefore, the number of regions to be produced by the segmentation must be specified as a parameter.

C. Border Detection In Dermoscopy Images Using Statistical Region Merging

Statistical Region Merging (*SRM*)[**4**] is a recent color image segmentation technique based on region growing and merging. The method models segmentation as an inference problem, in which the image is treated as an observed instance of an unknown theoretical image, whose statistical (true) regions are to be reconstructed. The advantages of this method include its simplicity, computational efficiency, and excellent performance without the use of quantization or color space transformations. Let *I* be an observed image that contains *ij* pixels, each of which is comprised of *R; G;B* color channel values belonging to the set *f*0*;* 1*; : : : ; g*

¡ 1*g* (where *g* = 256 for 8 bit *RGB* images). *I* is an observation of a true image *I* in which pixels are perfectly represented by a family of distributions from which each of the observed color channel is sampled. The optimal statistical regions in *I* share a homogeneity property such that inside any statistical region and given any color channel, the statistical pixels have the same expectation, whereas the expectations of adjacent statistical regions differ in at least one color channel.

D. Melanocytic Lesion Segmentation In 1D Colour Space Blur Filter To The Image Projected On The 1D Space, In Order To Reduce Noise[5]

We blur the grayscale image corresponding to the projection on the first principal component. we replace the value of each pixel with the average colour in the 11_11 pixel square surrounding it. This filter provides results comparable to those of a Gaussian filter, but is far more computationally efficient, requiring a single scan of the image and no floating point operations. The main reason for the extreme computational performance of 1D-PCA is the fact that the 1D colour histogram can be processed extremely quickly, only a handful of simple operations are required for each of its 256 points, without any need of costly iterations. And since PCA, colour histogram creation, and morphological post processing all boil down to “streaming” the image while performing a few simple operations on each of its pixels, the total cost of segmenting.

E. Comparison Of Segmentation Methods For Melanoma Diagnosis In Dermoscopy Images[6]

Six different segmentation methods of the three types: Thresholding, Edge-based, and Region-based. The methods are:

- Adaptive Thresholding (AT);
- Gradient Vector Flow (GVF);
- Adaptive Snake (AS);
- Level Set Method Of Chan. (C-LS);
- Expectation-Maximization Level Set (EM-LS);
- Fuzzy-Based Split-And-Merge algorithm (FBSM).

Lesion segmentation can be obtained by comparing the color of each pixel with a threshold . The pixel is classified as active (lesion) if it is darker than the threshold. The output of this step is a binary image. Morphological post-processing is then applied to fill the holes and to select the largest connected component in the binary image. It was experimentally found that the blue component in the red-green-blue (RGB) representation is the one which allows the best discrimination in most dermoscopic images.

III. CONCLUSION

The following paper gives a survey on the various algorithms that are used for better segmentation like the segmentation by region merging, singular value decomposition. The other methods like PCA are found to be more efficient, though these algorithms are old, yet are found be useful for our application. The computer aided dermoscopy is still in its development stages and are to be well established, as subjective analysis is to be converted to an objective mode. The statistical analysis and the error rectification has to be done in most of the algorithms so that we obtain a good reliable algorithm.

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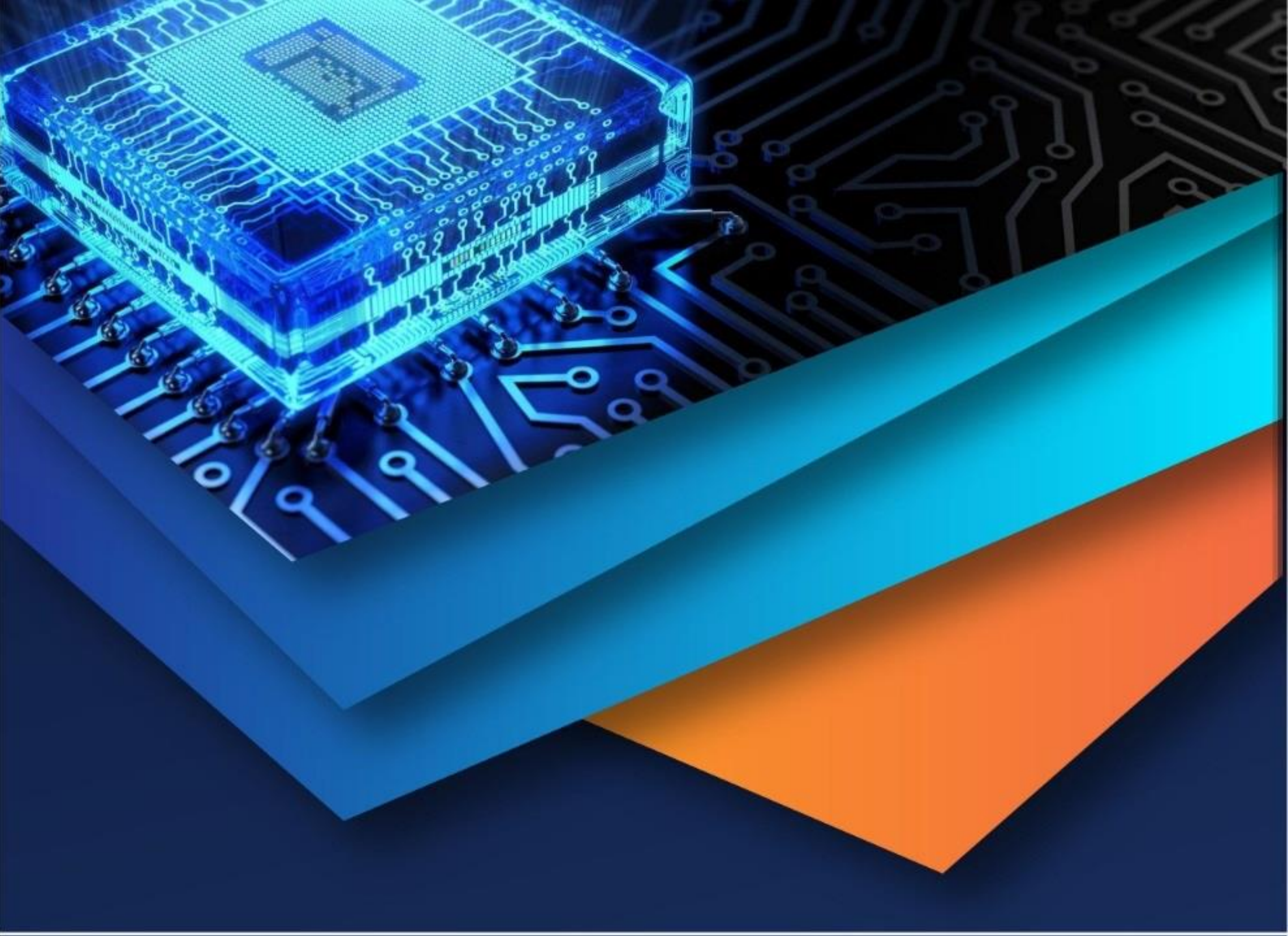

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