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Analysis of Various Techniques to Diagnosis Skin Cancer Diseases – A Quick Review

T.D. Srividya[1], Dr. V. Arulmozhi[2]

Research Scholar[1], Associate Professor, Department of Research-Ph.D Computer Science[2], Tirupur Kumaran College for Women, Tirupur, India

srividyamurthy@gmail.com

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Abstract

Skin cancer is one of the deadly forms of tumors in humans. It is dangerous that it develops quickly and effortlessly metasizes. The skin cancer is visually diagnosed, by an initial clinical screening followed by clinical examination and biopsy. Late identification of the malignant melanoma is in charge of 75% of deaths connected with skin growths. Increasing rate of skin cancer is high in the present scenario. This paper aims at reviewing various techniques available for the detection and classification of various skin cancers. The aim is to improve the feature of the image and to transform the image into segments to get more significant image and it will be easy to examine the image using genetic algorithm. The proposed methodology includes genetic algorithm operators such as crossover, Mutation and Adaptive GA. Genetic Algorithm was proven to be the most powerful optimization technique in a large solution space.

Keywords: Dermoscope, Segmentation, Crossover, Mutation, Malignant

INTRODUCTION

Skin plays a major role in regulating body metabolisms. Skin cancer is the abnormal growth of melanocytic cells in the skin [1]. It occurs due to over exposure to Ultraviolet (UV) radiation. The death rate is high in case of Melanoma skin cancer. If not diagnosed early, leads to death [2].Skin cancer may be classified as benign or malignant .The clinical examination is time consuming, so CAD techniques are introduced to detect the cancer [4].The death rate of melanoma cancer is three times more when compared to other cancer types[7]. The ABCD rule helps to conclude the findings with that of clinical results. In the early stages of cancer even moles appear to be cancerous. The most fatal form of cancer is skin classified as malignant melanoma and non-malignant melanoma. Extra care and caution should be rendered when examining such individuals, as they might have multiple melanomas and unusual mole. Medical images play vital role in assisting health care providers in proper diagnosis and correct treatment [3].

A digital dermoscope acquires images that contribute to early screening of melanoma and all automated systems use dermoscopic images [6]. Melanoma can be cured completely if it is detected at an early stage. The National Cancer Institute surveyed that one out of 5 Americans will develop cancer in their lifetime[15].Dermatologists use the ABCDE rule to help people mark the signs of melanoma on their skin[1].Digital image processing techniques can identify the features more accurately and provide the appropriate status on disease. Consequently the use of computer-aided systems becomes very essential to overcome these limitations [7].

The proposed scheme uses image pre-processing, segmentation, feature extraction, adaptive genetic algorithm. The goal of segmentation is to make images easier and/or change the appearance of an image to make it more meaningful and easier to analyze. The genetic algorithm operators like mutation, crossover and fitness value are used[16].The GAs is designed to create processes in natural system important for evolution.

LITERATURE SURVEY

Nisha et al[1] proposed a method for performing histogram equalization which will distribute all the colors of the image in a way that the brightest spot of the processed image will be color and the darkest points will be black. Pauline et al[2] have devised a methodology for pre-processing which covers a number of features like image illumination, image scale fitting or image resolution normalization. Mohammed Khalad et al[3] analyzed the concept by image-resizing, cropped, and filtering by using three filters: Weiner, Gabor, and Adaptive median filter. The Edge detection based method is used which uses SFS and 42 images of microscopic slides are used.

Rademaker M et al[4] proposed a methodology in which CAD method was introduced. The Probability Density Function(PDF), Gray level Co-Occurrence(GLCM) matrix are used. The histopathological image was

re-sized, cropped and filtered by three filters. The pixels are separated by MEDS algorithm. Hybrid genetic algorithm is used in this work. M Chaitanya Krishna et al[5] uses CAD to differentiate normal and melanoma skin cancer lesion. Pre-processing of the image is done based on image illumination equalization, color range normalization and image scale fitting or image resolution normalization. The segmentation techniques used are threshold based, edge detection based and clustering techniques. The step and change detection are employed here and TDS formula is given.

Nabin K Mishra et al[6] discusses various aspects of lesion segmentation where machine learning algorithms are used. The three mentioned features are lesion segmentation, feature segmentation and classification. Ebtihal Aalmansour et al [7] put forth a conclusion that the death rate of melanoma is three times than other cancers. The proposed method uses two types of texture feature and compared it with the state of the art method. Four color feature formulas are given. GLCM and SVM classifiers are used. The dataset contains 69 dermoscopic images, 43 melanoma images and 26 non-melanoma images collected from Dermatology Information System (Dermis). He concludes that color is very important to distinguish melanoma and non-melanoma.

Sonali et al [8] combined thresholding segmentation techniques to establish boundaries in segmentation technique with Fuzzy C-Means segmentation.Cheng Leut et al [9] devised a segmentation technique based on histopathological image. First by using mean shift and local region recursive segmentation (LRRS) and the LDED.S Gopinathan et al [10] proposes Otsu thresholding that segments the lesion from the entire image. For further segmentation Boundary tracing algorithm is used. The results are presented in the form of tables and charts. For classification of the image Stolz algorithm is used. The pre-processing stage includes image resizing, hair removal, brightness etc. the class probability is computed from histogram. An algorithm is proposed in this work.

Swathi K et al [11] uses CAD techniques in which four stages are identified. Various classifiers are used and 84 directional filters are used. Hina Sood et al [12] devised a method for merging of segmentation using Genetic algorithm. The lesion segmentation is compared with other algorithms. Various segmentation methods employed here are adaptive thresholding, Fuzzy based split and merge , Gradient Vector flow(GVF) and Expectation Maximization Level (EM-LS).He also concluded an another approach to detect skin lesion is to find out the best thresholds with the help of mutli-level adaptive thresholding. The formulas for sensitivity, specificity, accuracy are given and he concluded by providing a unique algorithm.

Sanjay Jaiswar et al[13] uses lesion tool checks for various melanoma parameters like ABCD by texture, size, shape analysis for image segmentation and feature stages. The segmentation techniques are threshold based, clustering techniques and edge detection based. TDS is calculated. He concludes that systems may

provide encryption of data and authentication for users so that there is no unauthorized access of data of the patient. In future it is more interactive and user friendly for checking lesion is cancerous or not.

Ruchika Sharma et al [14] reviews the segmentation methods based on edge detection, thresholding and region based, clustering, K-Mean clustering, Fuzzy C-Means and segmentation based on ANN. He concludes this paper by showing comparison between all available segmentation techniques. Nishima sachdeva et al [15] analyses the ABCD feature extraction and used Otsu segmentation and PCA method. The proposed scheme uses wavelet transformation for image improvement, denoising and histogram analysis. In this paper GA are used to simultaneously select significant features as input to ANN and automatically determine the optimal number of hidden node. Here classification is done by PCA method. Savitha et al [16] proposed a new technique NTGAMC using GA to find the maximum clique problem. The crossover and mutation are adopted with formulas. In this work, the GA and graph theory concepts are merged to optimize the problem.

Anil K Jain et al [17] developed a direct boundary construction approach using pattern recognition. The popular network used is Self-Organising map and Kohonen network. Throughout this paper the classification is on 3 datasets. The watanabe's ugly duckling theorem is used. A feed forward NN is employed and the Decision tree classifier.

Alireza Fasih et al [18] proposed CNN templates derived by GA after an optimization process. The GA is exploited for the training process in order to determine the best genes according to the pre-defined requirements. The CNN and GA was proved to be very effective. Roy Jackson Monteiro et al [19] compares various segmentation techniques and concludes that edge detection is good.Nicholas Clintona et al [20] analyses different segmentation techniques in his work and gives a comparative study. Any type of images can be segmented .The object based segmentation is proved to be superior in his work.

PROPOSED METHODOLGY

1. Image Pre-processing

Images are acquired using a digital dermatoscope taken with a conventional camera. The main step towards a complete analysis of skin lesion is to differentiate the lesion from the healthy skin. It has been observed that dermoscopy images often contain artifacts such as uneven illumination, dermoscopic gel, black frames, ink markings, rulers, air bubbles, and intrinsic cutaneous features that can affect texture[1][2]. Thus, it requires some preprocessing steps to facilitate the segmentation process by the removal of unwanted objects [3].

When working with dermoscopic images, other pre-processing features include image illumination equalization, color range, image scale fitting or image resolution normalization [2][5]. An elementary operation of a image normalization is resolution matching. Assume that the image size is in pixels and all the

images are in the same proportion, it is easy to find the images of smallest resolution and then scale to match the size of the smallest one.

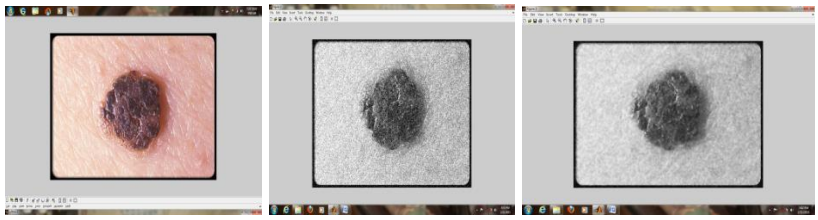

Figure 1 (a) Original Image; (b) RGB to Grayscale Image; (c) Enhanced by removing the noises from the Grayscale Image.

Very common operation in preprocessing is color components normalization, known as histogram equalization. Image histogram is the distribution of color values in between extreme colors used in the palette. Assume the situation in which the brightest points of the grayscale image are not white and the darkest points are not black, by performing histogram equalization will redistribute all the colors of the image, that brightest spot of the processed image will be colored and the darkest regions of the image will be black[1].

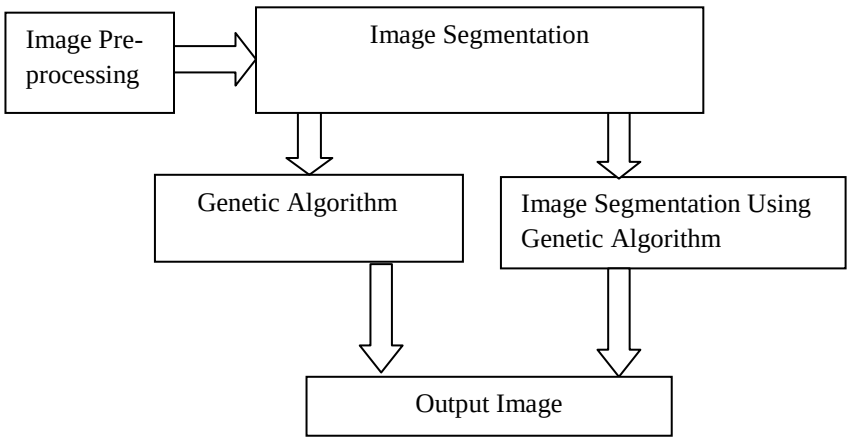

Fig. 2 Block Diagram of the Proposed System

2. Image Segmentation

Threshold Based Segmentation

One of the most common techniques of contrast enhancement is Histogram Equalization(HE) which generates the uniform distribution of pixel values which results in enhanced image with cumulative histogram[10]. Because of its simplicity and effective performance the histogram equalization will increase without affecting the global contrast [15]. The histogram of an image is defined as a discrete function. P (rk) = nk / n -----> (1)

Where rk , nk , n and k are defined as the kth grey level, the number of pixels in an image with that grey level, the total number of pixels in whole of image and k =0, 1, 2, …, L-1. P (rk) is a probability estimation of the occurrence of grey level rk [4].

Clustering technique

Clustering methods attempt to group together patterns that are similar in some sense. Although clustering is used as a synonym for (agglomerative) segmentation techniques, we use it here to denote techniques that are primarily used in exploratory data analysis of high-dimensional measurement patterns[14].

Segmenting an image is similar to applying clustering technique to an image for segmentation.

Edge detection Based

To identify an object in an image, this knowledge of edge detection method is used. The aim of edge detection is to identify points in a digital image in which the image brightness change sharply. A fundamental tool in image processing, machine vision and computer Vision is edge detection. It is used particularly in the areas of feature detection and feature extraction [3] . The position at which the intensity level of an image changes sharply are associated into a set of curved line segments called as edges. The problem of finding discontinuities in 1D signal is known as step detection and the problem of finding signal discontinuities over time is known as change detection [5]. This approach to segmentation is called matching [19].

Region Based

A homogeneous subset of the image based on gray level or texture is defined as region. A group of connected pixels are said to be the regions for an image. In this approach, each and every pixel is selected to a particular object or region. The segmentation algorithms are more immune to noise and simple compared to edge detection method [8][14].

The region based method partition an image according to some predefined criteria whereas edge based method divide the intensity based on edges [19][20]. In the region-based segmentation, pixels which are corresponds to a particular object are grouped together and marked [12]. Region-based segmentation uses appropriate thresholding techniques. The significant principles upon which it depends are value similarity and spatial proximity.

3. Genetic algorithm

In Genetic algorithm for obtaining optimal solution, a population of strings called chromosomes provides candidate solution. Frequently it starts from randomly generated individuals. For every generation, from the whole population, the fitness of every individual among multiple individuals are randomly selected and modified. The new population is then used in the next iteration of the algorithm [18].

Parameter	Threshold	Clustering	Region	Edge Detection
Speed	Fast	Fast	Slow	Fast
Computation Complexity	Less	Rapid	Rapid	Rapid
Accuracy	Moderate	Moderate	Fine	Fine
Multiple Object Detection	Poor	Fair	Fair	Fair

Table 1 Comparative Analysis of various segmentation techniques

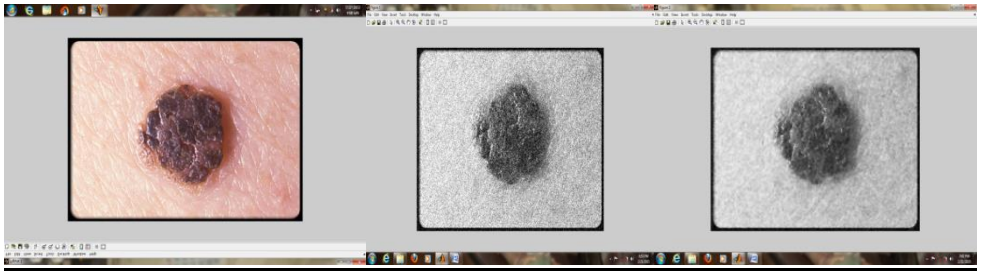

Fig.3 (a) Original Image with Hair Noise; (b) RGB to Grayscale Image; (c) Enhanced image

The algorithm terminates when the maximum number of generations produced or a satisfactory fitness level is reached. To get an optimal solution in an efficient search space genetic algorithm is used. It needs less prior information about the problems to be solved than the conventional optimization schemes, such as the K-nearest neighbor, which often require the derivative of the objective functions[14]. The operators of genetic algorithm such as crossover and mutation depends on th e fitness value individually. Based upon the combination of characteristic feature of the parents the new child or chromosome is built[18]. So in order to get a new enhanced image than the original genetic algorithm is applied.

Crossover

Crossover process is used to prepare a child solution with the help of more than one parent. Through this we can vary programming of one chromosome from the other. Crossover process includes crossing over between the best selected chromosomes. In this any one of the value of any of the chromosomes crosses over with the value of some other chromosome. GA is applied to best threshold using fitness function.

Mutation

The child chromosomes are generated from the parent chromosome which operates at the bit level of the image. Generating child chromosomes include changing one of the values among each chromosome. This results in an equal number of parent and child chromosomes, sharing certain characteristics.

Fitness value

A function which gives a fitness value, which denotes the best chromosome. The fitness value for both the

parent and child is evaluated by substituting the value to define parameters with the fitness function. This fitness function is referred to extract the best chromosome in the selection process.

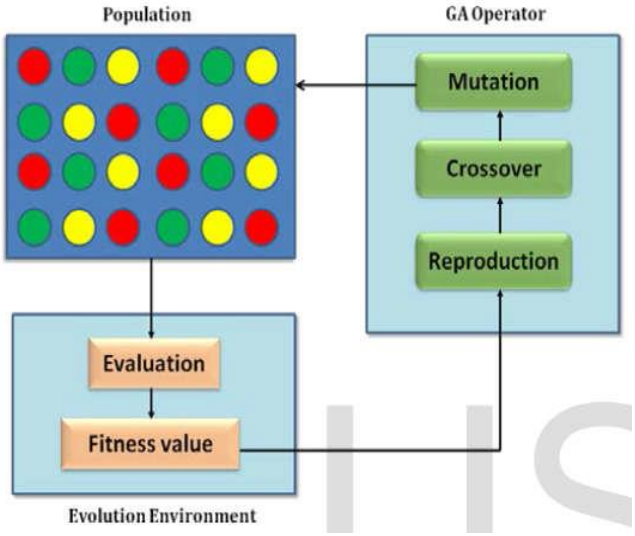

Fig. 4 Genetic Algorithm Process

GENETIC ALGORITHM PROCEDURE

A simple GA (Fig 4) consists of five steps

- Start with a randomly generated population of N chromosomes, where N is the size of population, l – length of chromosome x.
- Calculate the fitness value of function φ(x) of each chromosome x in the population.
- Repeat until N off springs are created: Probabilistically select a pair of chromosomes from current population using value of fitness function.
- Produce an offspring yi using crossover and mutation operators, where i = 1, 2, …, N.
- Replace current population with newly created one. 5. Go to step 2.

IMAGE SEGMENTATION USING GENETIC ALGORITHM

The genetic algorithm techniques for image segmentation include parameter selection and pixel level segmentation. For improving the output of existing image segmentation, the first method is employed to modify the parameters of an existing image. The second method is pixel level used to perform region labeling. For most of the image segmentation, the parameter selection method is preferred often.

The adaptive image segmentation consists following steps

1. Compute image statistics.

2. Generate an initial population.

3. Segment the image using initial parameters.

4. Compute the segmentation quality measures.

5. Do (stopping conditions)

- select individuals by the reproduction operator
- generate new population using the crossover and mutation operators
- segment the image using new parameters
- Until compute the segmentation quality measures End

6. Update the knowledge base using the new knowledge structures.

CONCLUSIONS AND FUTURE WORK

Genetic Algorithm can be used as a very promising unbiased optimization method; it constantly gains popularity in image processing. The algorithm allows performing robust search without trapping in local extremes. Every approach is unique, with different information encoding types, reproduction and selection schemes. Depending on the selected chromosome encoding scheme, crossover, mutation and fitness function lies the success of optimization.

A comparative study of various segmentation methods are proposed in this work. The edge detection based segmentation proves to be the best approach for image segmentation. A unique method of image segmentation using genetic approach is proposed in this work. As it was shown, one chromosome can contain a whole image or only a small part of it, a whole parameter range or only the most descriptive ones. Crossover can be performed in various manners, for example by exchanging information at one brake point or at several one. Different strategies may be used for genetic information transfer and parallel evolution may be adopted. Genetic Algorithms (GAs) are basically the natural selection process which it takes input and computes an output where multiple solutions might be taken.

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