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To Achieve Automatic Image Segmentation of Skin Cancer Lesions Using Fuzzy C-MEANS Clustering With Automatic Image Annotation

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Abstract - In computer vision, digital image segmentation is the process of partitioning a digital image into multiple segments which are sets of pixels, also known as super pixels. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. An automatic image segmentation is a lifeblood of segmentation process and also automatic image annoation is neccessary to provide a meta-information about lesion and image at result of image.In our research work, we have developed an algorithm equipped with automatically segments an input image which auotmatically recognizes a skin cancer lesion area and ignores other non-affected skin area. This algorithm also eqquiped with an automatic image annotation process which brings a meta-information about the image and segmented skin lesion at final output.

Keywords - Data Mining, Association Rule Mining (ARM), Apriori Algorithm, Ant Colony Optimization(ACO), FP-Growth.

I. INTRODUCTION

Due to an advancement of medical equipment technology, mostly all the medical organisations uses electronic imaging devices to capture the cancerous lesions from skin, internal organ ulcers, status of fractured bones by x-ray and muscles by ultrasound and activity of brain fucntionality by MRI devices for proper and effective diagnosis. Mostly the output of these devices are in the form of images and imaged output is most of the times can not be properly analysed by looking at results into it with a naked eye. Sometime doctors fail to recognise the total infected area and depth due to noise in output and size of lesion or infectious area. To overcome this problem digital image segmentation has been proposed.

The goal of this work is design and build an algorithm which will automatically recognize and segment a target lesion area from skin and will provide an automatic meta-information on result of segmented image by image annotation process.

II. LITERATURE REVIEW

Nadia Smaoui, Souhir Bessassi et al. proposed a work "A developed system for melanoma diagnosis" that is based on a combination of a segmentation method and an analytical method and aims to improve these two methods in order to develop an interface that can assist dermatologists in the diagnostic phase. As a first step, a sequence of preprocessing is implemented to remove noise and unwanted structures from the image. Then, an automatic segmentation approach locates the skin lesion.

Dr. Shubhangi, Nagaraj et al. have proposed a novel method called "Human Skin Cancer Recognition and Classification by Unified Skin Texture and Color Features". Many approaches have been proposed to determine the skin cancer. An extensive literature survey is done to study the state-of-art techniques for skin cancer recognition; level set active contours (LSAC), skin lesion segmentation (SLS) and multidirectional gradient vector flow (MGVF) have given considerable results. A technique based on stochastic region merging (SRM) and region adjacency graph (RAG) is adopted in the proposed method. Segmenting the skin lesion from macroscopic images is a very challenging problem due to some factor such as, illumination variation, presence of hair, irregular skin color variation and multiple unhealthy skin regions. To solve all these factors we have introduced a new approach called novel iterative stochastic region merging likelihood for segmenting the skin lesion from macroscopic images based on the discrete wavelet transformation (DWT).

Aswin.R.B, J. Abdul Jaleel, Sibi Salim et al. proposed a method called "Implementation of ANN Classifier using MATLAB for Skin Cancer Detection", in which a dermoscopy image of skin cancer is taken and it is subjected to various pre-processing and image enhancement. The cancer affected region is separated from the healthy skin using Segmentation. In order to reduce the complexity of classification, some unique features of malignant and benign melanoma are extracted. 2D Wavelet transform is the Feature Extraction Method used. These features are given as the input to the Artificial Neural Network Classifier. It classifies the given data set into cancerous or non-cancerous.

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Alessia Amelio, Clara Pizzuti et al. proposed a color image segmentation method called "Skin Lesion Image Segmentation Using a Color Genetic Algorithm" based on Genetic Algorithms in discriminating skin lesions. Experimental results show that the segmentation approach is able to detect lesion borders quite accurately, thus coupled with a merging technique of the surrounding region could reveal a promising method for isolating skin tumor.

Jeffrey Glaister and David A. Clausi et al. has compared his segmentation results on melanoma skin cancer images by proposing a method called "Segmentation of Skin Lesions From Digital Images Using Joint Statistical Texture Distinctiveness". This method proposed a segmentation algorithm based on texture distinctiveness (TD) to locate skin lesions in photographs. This algorithm is referred to as the TD lesion segmentation (TDLS) algorithm. The main contributions are the introduction of a joint statistical TD metric and a texture-based region classification algorithm. TD captures the dissimilarity between learned representative texture distributions.

III. PROBMLEM STATEMENT

Digital image segmentation techniques are very impessive for segmenting a part of a whole image. Over the past few years, digital image segmentation has become very popular due to its significance in the area of medical applications.

There are many techniques available which segments a target area of an image as a part from a whole image for better understanding and analysis of that area. As per literature survey, it is observed that some algorithms does not detects a target area automatically and needs manually segmented images as an input to algorithm. Secondly, it is also observed that the final output images carries only segmented area but no information about image and about that area which may be difficult for analyser to understand and conclude from the results accurately. So an algorithm should detect a target area automatically which is to be segmented and secondly it should provide an information about image at its output form better understanding about image and about its segmented result. Thus, the main issues related with proposed work is to automatically recognize and segment an image along with automatic image annotation method at image result.

IV. OBJECTIVES OF THESIS

In this thesis the research is carried out keeping in the view the following objectives:

To study TDLS method of segmentation by Jeffrey Glaister and David A. Clausi et al.

To obtain automatic image segmentation by automatically recognizing the infected area.

To achieve an automatic image annotation process on an image segmentation results to serve as an automatic meta-information for output of segmented image. Image annotation process will be useful for a non expert viewer of an image to get an ease in reading the various attributes of result of image segmentation.

To undertake a large data set of skin cancer digital images which consists of different nature of skin lesions to be segmented automatically.

V. PROPOSED ALGORITHM

- Select an RGB melanoma skin cancer image from disk for segmentation.
- Extract the red component of an image for automatic recognition of infected area on skin.
- Choosing debauchies wavelet for decompostion and reconstruction.
- Choose a level of debauchies wavelet working for decomposition and reconstrcution.
- Decompose an image upto 5 levels.
- Extract all approximation and detail coefficients and group them separately according to their horizontal, vertical and diagonal property.
- Apply thresholding process and calculate variable thresholds for horizontal, vertical and diagonal detail coefficients while denoising and smoothing an image.
- Reconstruct of approximation and detailed coefficients levelwise according to their horizontal, vertical and diagonal property.
- Start automatic segmentation of automatically recognised infected area from image using fuzzy c-means clustering algorithm.
- Using fuzzy c-means clustering technique, make clusters according to data points with similar and highest degree of membership.
- Displaying final automatic segmentation result with automatic image annotation.

VI. RESULTS AND DISCUSSIONS

The performance of proposed system is compared with the classical TDLS algorithm which was using manually segmented images and which was lacking in automatic image annotation feature. The main target of proposed system was to carry out automatic segmentation of lesion area and to add a feature of automatic image annotation to serve as meta-information about resulting image. Our system succeeded in achieving these two targets and differs from TDLS method in these two cases.

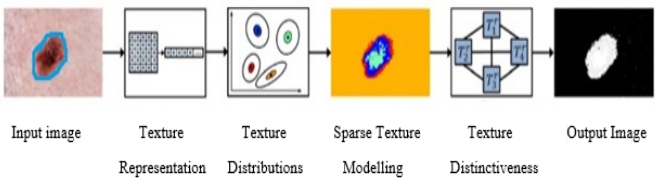

Figure 1: Diagram of TDLS system shows manually segmented image and no annotation.

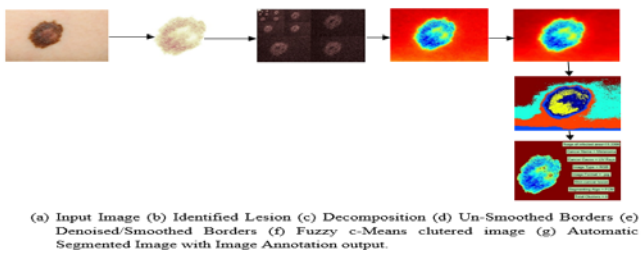

Figure 2: Diagram of proposed system shows steps of

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automatic segmentation with automatic image annotation at final output.

Proposed system succeeded in achieving automatic segmentation of same nature of skin cancer lesion images and automatic image annotation and differs from TDLS method by Jeffrey Glaister and David A. Clausi et al. in following cases.

Comparision with respect to Segmentation

Proposed work was initiated by taking two main aims in mind out of which one was to automatically segment the same skin cancer lesions images instead of manual that was in TDLS method by Jeffrey Glaister and David A. Clausi et al.

In TDLS method by Jeffrey Glaister and David A. Clausi et al., a manually segmented image was given as input to a segmentation algorithm, but in our proposed system, there is no need to segment an input image manually before an input to segmentation algorithm, as it automatically detects the target lesion area from an image and segments that area properly. Following are visual illustration of comparision between the two systems as per segmentation.

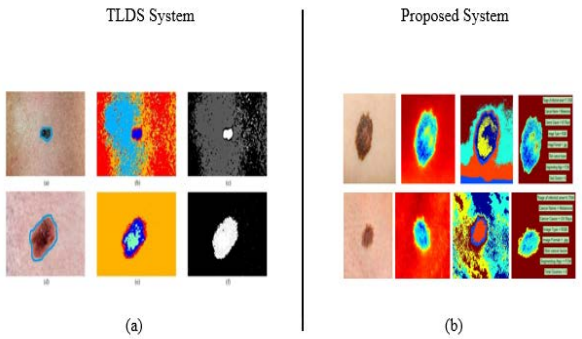

Figure 3: (a) shows TDLS working and (b) shows working of proposed system.

As we can observed from above comparision that TDLS uses manually segmented images of skin cancer lesion but on the other hand our proposed system does not need to sement any image manually, as it takes image as input, recognizes lesion area automatically and by applying fuzzy c-means clustering, it takes out segmented area from digital image.

Comparison with respect to Automatic Image Annotation

Automatic image annotation is an automatic process to take out the meta-information about output image along with other details about objects of images. By using this, doctors can deploy the meta-information on resultant images to a non-expert for his ease in understanding about image output. Second aim of proposed work was to apply an automatic image annoation process on the output image to provide a meta-information about the image output and lesion along with cause of lesion.

In TLDS method by Jeffrey Glaister and David A. Clausi et al. the output image does not carry out any meta-information with it regarding an image output and lesion along with cause of lesion and was a matter of future scope. In our proposed system, an output image carry out a meta-information regarding an image output and lesion along with cause of lesion as we used automatic image annotation in proposed work which describes a final image output.

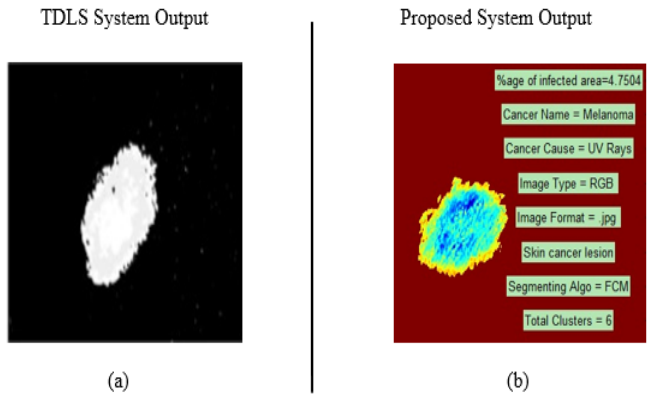

Figure 4: (a) shows segmented image of TDLS without annotation and (b) shows segmented image with annotation (meta-information).

VII. OBJECTIVES ACHIEVED

- Achieved an automatic image segmentation by automatically recognizing the infected area.
- Achieved an automatic image annotation process on an image segmentation results to serve as an automatic meta-information for output of segmented image. Image annotation process will be useful for a non expert viewer of an image to get an ease in reading the various attributes of result of image segmentation.
- Undertaken a large data set of skin cancer digital images which consists of different nature of skin lesions to be segmented automatically.

VIII. CONCLUSION AND FUTURE SCOPE

The proposed system, "To Achieve Automatic Segmentation of Skin Lesions from Digital Images using Fuzzy c-Means Clustering with Automatic Image Annotation" is carried out using different methods and by adding some new features like automatic image segmentation using Fuzzy c-Means Clustering and Automatic Image Annotation which was a future scope in TDLS method by Jeffrey Glaister and David A. Clausi et al. Images which are used throughout work, belongs to dermquest database which consists various skin cancer images. It is concluded that the proposed system has added new features into it which were stated in future scope of classical TDLS method. Proposed system is better than TDLS in following cases:

Proposed system includes an automatic image annotation which is useful to provide a meta-information at a resulting image about output and lesion, which is helpful to doctors and non-expert to know about segmented part of image with an ease.

Proposed system segments an image using automatic segmentation by the help of Fuzzy c-Means Clustering.

Work done in this thesis can be extended in future with little variations. Some of the directions to this work are:

Use of implemented methodology with TDLS based segmentation.

Use of implemented methodology with other segmentation methods such as Histogram-based Segmentation, Edge Detection, Graph Partitioning, Compression Segmentation, Region-Growing Segmentation, Split-and-Merge Segmentation.

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