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Automatic Lesion Detection System (ALDS) for Skin Cancer

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***Abstract*— Technology aided platforms provide reliable tools in almost every field these days. These tools being supported by computational power are significant for applications that need sensitive and precise data analysis. One such important application in the medical field is Automatic Lesion Detection System (ALDS) for skin cancer . Computer aided diagnosis helps physicians and dermatologists to obtain a "second opinion" for proper analysis and treatment of skin cancer. Precise segmentation of the cancerous mole along with surrounding area is essential for proper analysis and diagnosis. This paper is focused towards the development of improved ALDS framework based on probabilistic approach that initially utilizes active contours for segmenting out the mole and later Neural Networks are applied for the classification of the segmented mole. After lesion segmentation, the selected features are classified to ascertain that whether the case under consideration is melanoma or non-melanoma. The approach is tested for varying datasets and comparative analysis is performed that reflects the effectiveness of the proposed system.**

Keywords— Melanoma; Active Contours; ANN Classifier

I. INTRODUCTION

Cancerous mole on skin is a most frequently befalling malignancy in fair skinned populations. Malignancy is a description of the "stage" of cancer. All cancers are fatal however Melanoma comes with the highest risk and found very frequently in the fair skinned people aging less than 50 years for men and more than 50 years for women. During the recent few years, the frequency of melanoma treatment cases has increased extensively, lasting at the top in all the cancers with respect to its management. About 76,380 new cases of melanoma (46,870 for males and 29,510 for females) and about 10,130 cases of new melanoma related life expires are expected during the year 2017 in the United States. Non-melanoma skin cancers, such as Squamous Cell Carcinoma (SCC) or Basal Cell Carcinoma (BCC), contribute to the substantial indispositions among fair skinned Asians.The most important thing from a doctor's point of view is to distinguish and flawlessly identify lesion area. Failure to correctly identify and subsequent delayed treatment of a lesion may lead to advanced stages of cancer. Therefore, early detection is of major importance for the dermatologists. In the process of skin cancer screening, clinicians usually detect the suspected lesion region by visual checkup that is highly dependent on observer skills and is likely to have human error. In European countries, it is highly emphasized to the clinicians to have careful attention and precision in distinguishing and analyzing the skin cancers . Hence by the evolution of improved algorithms and techniques, clinicians may seek "second opinion" from the Automatic Lesion Detection System (ALDS) software to refine their diagnostic performance. The main focus of the proposed research work is to develop a detection framework which can illustrate the non-pigmented skin malignancies along with the pigmented skin growth. The test dataset utilized for this work is the database of Dermatology Service of Hospital, Pedro Hispano (Matosinhos, Portugal) known as PH2 .The PH2 database is based on the process of manual segmentation, the clinical diagnosis, and the identification of several dermoscopic structures which is performed by professional dermatologists. It contains a total of 200 hundred images which include both melanoma and non-melanoma cases. All the images in this dataset are taken under the same conditions through Tuebinger Mole Analyzer system using a magnification of 20x. The Paper is focused on combined segmentation approach that utilizes active contour techniques on the Region of Interest (ROI). The merged mask obtained is then utilized by diagnosis system to map the level of malignancy. The ALDS is motivated by the approach reported by Chang et al from Graduate Institute of Medicine, College of Medicine, Kaoshiung Medical University, Kaohsiung, Taiwan.

II. BACKGROUND / RELATED WORK

Several computer aided diagnostic systems have been developed based on the modern image processing and computer vision algorithms. With the help of algorithms, the accuracy of the detection and analysis of suspected skin lesion has remarkably improved compared to human visual checkup. By the recent advancements in the image acquisition technology and computer vision algorithms, there has been increased interest in the medical field with an objective to minimize the error and ambiguities in the investigative procedures by yielding a trustworthy "second opinion" for the clinicians. Some of these systems include: Solar Scan designed by the polar technics Ltd in Australia, Dermo Genius-Ultra worked out by LINOS Photonics Inc. DB Dermo-MIPS designed by the University of Siena Italy etc. In spite of all these studies, it is worldwide accepted that the accuracy of such systems can be increased no matter to which extent, it is still

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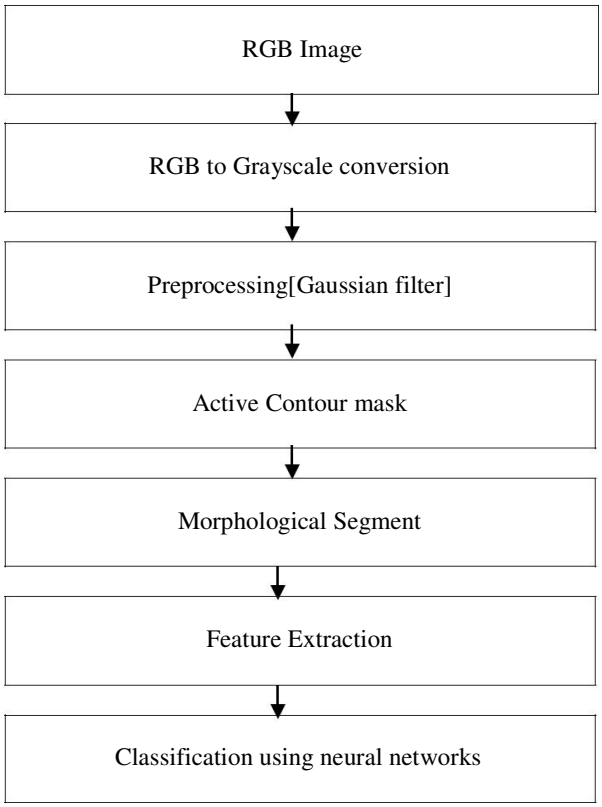
less. Due to same, this area is under grooming research and requires precise computer adopted algorithms to achieve robust diagnostic processes and tasks.

III. PROPOSED ALGORITHM / APPROACH

In the proposed research work cancerous mole evaluation has been implemented for the detection of malignant melanoma(skin cancer mole) on any part of body. The algorithm consists of several steps starting from the input phase of preprocessing ranging to the analysis in the form of likelihood of Lesion Malignancy.



1. *Preprocessing*: It includes the process of acquiring the images of the required area. In our case we are using PH² database. All the images have resolution of 765x573 pixels. This dataset contains both melanoma and non-melanoma images. These Images are refined by applying a Gaussian filter and hair removal process using dull razor software .

1.1 *Gaussian Filter*: In image processing, a Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen, distinctly different from the bokeh effect produced by an out-of-focus lens or the shadow of an object under usual illumination. Gaussian smoothing is also used as a pre-processing stage in computer vision algorithms in order to enhance image structures at different scales— scale space representation and scale space implementation. The Gaussian filter is a non-uniform low pass filter.

2. *Segmentation of Cancer Mole*: This phase segments out the cancerous mole autonomously. The segmented region plays an important role to calculate certain features required for further analysis. We have used the active contour algorithm for segmentation. Active contours help to learn the point distribution model and to identify the closed contour. Their individual performance varies and at times goes low in complex cases. This technique essentially helps to crop the desired region that nearly match the ground truth segmented masks.

2.1 *Active Contour*: It is a region segmentation technique and is defined as an energy minimizing spline used to locate the object where image structures, such as boundaries exists. Snakes are active contour models. They lock onto nearby edges, localizing them accurately. It does detection of edges, lines, and subjective contours.

2.2 *Segmentation Results*: The resulted mask undergoes certain morphological operations like image dilation and image spur for removing spur pixels to get the smoothness and the boundary continuity. As a result, the final mask contains the exact boundary and the necessary surrounding area of the skin lesion.

2.3 *Similarity Measure*: Once the merged results are obtained, the similarity is computed with reference to the ground truth. This is done by calculating the Structural Similarity Index (SSIM), Jaccard coefficient and Sorenson-Dice coefficient of the computed mask and the ground truth mask provided in the dataset. These coefficients are widely used for the matching purpose and provide better quantitative insight to the change in structural information. In thresholding, pixels are allocated to categories according to the range of values in which a pixel lies.

3 *Morphological Processing*: Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest.

Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels. Some operations test whether the element "fits" within the neighborhood, while others test whether it "hits" or intersects

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the neighborhood. Some of the basic morphology operators are Dilation ,Erosion ,Opening ,Closing, Hit or Miss Transformation.

4. *Feature Extraction*: This part of algorithm computes the features related to shape, texture and color from the segment mole. Using these three features categories, this approach collects ABCD data of lesion mole where A defines the asymmetry, B corresponds to border Evolving, C is related to color variation and D is the diameter of the mole .The shape features includes image diameter, image compactness, ulnar variance and the image asymmetry. Compactness refers to the ratio of the object perimeter to its area. Ulnar variance is the measure of relative length of articular surfaces of some particular radius and the image asymmetry is the measure of asymmetry of the cancerous mole. The texture features include coarseness and Gray Level Co-occurrence Matrix (GLCM). Coarseness is the measure of different angle texture representation. GLCM is a histogram of co-occurring grayscale values for given offset over the image and provides the feature discriminatory attributes. It consists of different parameter which includes mean, correlation, homogeneity, contrast, energy, dissimilarity and kurtosis. The color related features include variance, skewness, and entropy. Variance is the measure of dispersion in the image. Entropy is the proportion of randomness and skewness is the measure of distributed asymmetry.

5. *Artificial neural networks* can be thought of as a model which approximates a function of multiple continuous inputs and outputs. The network consists of a topology graph of neurons, each of which computes a function (called an activation function) of the inputs carried on the in-edges and sends the output on its out-edges. The ANN classifier uses eight feature inputs that include mean, correlation, homogeneity, contrast, energy, kurtosis, dissimilarity and skewness. There are ten hidden neurons and one output neuron. Neural Classifier is trained using back propagation algorithm by providing the eight feature values of each case in input matrix and desired outputs in target matrix. An ANN is based on a collection of connected units or nodes called artificial neurons (a simplified version of biological neurons in an animal brain). Each connection (a simplified version of a synapse) between artificial neurons can transmit a signal from one to another. The artificial neuron that receives the signal can process it and then signal artificial neurons connected to it.

Conclusion and Future Work

The Automatic Lesion Detection System (ALDS) for skin cancer classification is the extended work of Chang et al. Initially sharpening filter is applied and also hair removal is performed using dull razor software that eventually produces more refined results. Incident rates of melanoma skin cancer have been rising since last two decades. So, early, fast and effective detection of skin cancer is paramount importance. If detected at an early stage, skin has one of the highest cure rates, and the most cases, the treatment is quite simple and involves excision of the lesion. Moreover, at an early stage, skin cancer is very economical to treat, while at a late stage, cancerous lesions usually result in near fatal consequences and extremely high costs associated with the necessary treatments. After all, the best way to lower the risk of melanoma is to limit the exposure to strong sunlight and other source of Ultraviolet light. Take care of all the necessary measures such as: protecting skin with clothing, wearing hat, using sunscreen, staying in the shade (etc.). Moreover, always stay alert about skin and do monthly skin-self exams to reduce the chance of getting any skin cancer which is a risk to human life.

The final output given by the system will help the dermatologist to detect the lesion and its type, accordingly with his knowledge he will examine the patient to draw a final conclusion whether it can be operated or not or any other way to cure it for e.g. using medicines or ointments, etc. Skin cancer detection System will help Dermatologist to diagnose melanoma in early stages. The future scope of the skin cancer detection system is that it can be more accurate and efficient. The ABCD rule of skin cancer detection is the most adopted method of skin cancer in the world. The scope is that the system can be implemented in the stand alone application. The system can be more reliable and robust. The system may provide the Encryption of data and authentication for the users so that there is no unauthorized access of the data of the patient, because if there is unauthorized access is performed on the data then the data integrity may be lost. In future it is more interactive and use friendly for checking the lesion that if it is cancerous or not.

