INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 6)
Available online at: www.ijariit.com

Skin cancer detection using Digital Image Segmentation

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ABSTRACT

Detection of skin cancer in the earlier stage is very important and critical. In recent days, skin cancer is seen as one of the most hazardous forms of the Cancers found in Humans. Skin cancer is found in various types such as Melanoma, Basal and Squamous cell Carcinoma among which Melanoma is the most unpredictable. The detection of Melanoma cancer in early stage can be helpful to cure it. Computer vision can play important role in Medical Image Diagnosis and it has been proved by many existing systems. In this paper, we present a computer-aided method for the detection of Melanoma Skin Cancer using Image processing tools. The input to the system is the skin lesion image and then by applying novel image processing techniques, it analyses it to conclude about the presence of skin cancer. The Lesion Image analysis tools check for the various Melanoma parameters Like Asymmetry, Border, Colour, Diameter. By texture, size and shape analysis for image segmentation and feature stages. The extracted feature parameters are used to classify the image as Normal skin and Melanoma cancer lesion.

Keywords— *Melanoma, Image processing, Skin cancer, Image segmentation, Contour tracing, Edge detection*

1. INTRODUCTION

In skin health, diagnosis or diagnostics is the process of identifying a skin texture or problem by its signs, symptoms and the result of various diagnosis procedures [1]. The conclusion reached through this process is called a diagnosis. The diagnosis system is a system that can be used to analyse any problem by answering some questions that lead to a solution to the problem. Skin Cancer Detection System [2] is the system to identify and recognize skin cancer symptoms and diagnose melanoma in early stages. The user can take early prevention of their health. Skin Cancer Detection System will help save lots of doctor's time and could help to diagnose more accurate. It also can easily assess the future development of skin via dialysis today's age of the skin and put forward the best characteristic skin cancer project to client [3]. Here are some of the main research papers and articles for the same.

Cancer arises when the genes of one DNA cell, that control cell division and reproduction, are damaged. Damaged genes make the cells divide and grow without control or order, becoming a malignant tumour [4]. In the case of melanoma, the damage to DNA is caused by overexposure to ultraviolet rays (UV), and the affected cells are the melanocytes that produce melanin (pigmentation of the skin). Usually, the first tumour that develops is found on the skin. If melanoma is not detected, it grows and spreads along with the first layer of skin before penetrating into the deeper layers and finally, comes into contact with the lymph vessels and the blood [6].

The early detection of skin cancer increases the chances of a cure unlike when it is discovered in advanced stages. In this way, it could reduce the mortality rate for this type of disease. Also, recent studies have shown that the values of performance on the classification of melanoma to a dermatologist, are in the range of 75 to 84 % [6]. It also can easily assess the future development of skin via dialysis today's age of the skin and put forward the best characteristic skin cancer project to client [3]. Here are some of the main research papers and articles for the same.

2. LITERATURE SURVEY

Melanoma is a type of deadly skin cancer affects the region of skin which is exposed directly to UV radiation which shows a rapid death chance. To lower the death rate early detection methods are adapted. According to the statistical information available, it has been proved that the melanoma incidence rates showed an increase of 2% to 7% per year in between 2006-2010 and the death rate showed an increase of 1.1% in males and 0.2% in females per year. According to the recent survey of 2014, it has been stated that the total effects of melanoma are around 76,100 and the deaths are around 9,710[8]. To decrease the death rate, image processing is used for the detection of skin cancer. By using this methodology early detection of skin cancer can be achieved. It lessens the burden of Dermatologists.

A solution to this problem is using image processing to detect skin cancer. Segmentation is the first step in early detection of skin cancer. To analyse, it is necessary to accurately locate and isolate the lesions. In these three unsupervised segmentation methods for skin, lesions have been discussed. The gradient vector flow gets inactive contour to boundary concavities, even when the noise is present and using colour-based segmentation. It is possible to reduce the computational cost avoiding feature calculation for every pixel in the image Feature extraction is considered as the most critical state of threat skin cancer screening system.

3. PROBLEM

From the last two decades, melanoma skin cancer is on the rise. So, early detection of skin cancer is very important. If detected at an early stage, skin cancer can be cured, and in most cases, the treatment is simple and involves excision of the lesion. Moreover, at an early stage, skin cancer is very economical to treat, while at a late stage, melanoma skin cancer gets difficult to cure and costs a very large amount for the treatment.

Image pre-processing before analysis of any image set can take place, pre-processing should be performed on all the images. This process is applied to make sure that all the images are consistent in the desired characteristic. When working with microscopic images, pre-processing can cover number of features like image illumination equalization, colour range normalization, image scale fitting, or image resolution normalization. This can be dependent on defined prerequisites and methods applied in post-processing.

4. RESEARCH FRAMEWORK

4.1. Pre-processing part

Median filtering has been used for pre-processing part. It focuses on elimination of salt and pepper noises. A technique where the window's centre value is replaced by the value which is the median of the 8 neighbourhood point's pixel values. It is a nonlinear filter. It is also a sliding window spatial filter and considered as the most commonly used smoothing filter. This filter with suitable mask size eliminates the artefacts in dermo copy images.

4.2 Erosion

Erosion is one of the two basic operators in the area of mathematical morphology, the other being dilation. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels (i.e. white pixels, typically). Thus, areas of foreground pixels shrink in size, and holes within those areas become larger.

5. APPLICATION OF PROPOSED SYSTEM

Skin Cancer detection using digital image segmentation follows the following techniques like Median filtering, erosion and segmentation by median filtering. Median filtering has been used for the pre-processing part. It focuses on elimination of salt and pepper noises. A technique where window's centre value is replaced by the value which is the median of the 8 neighbourhood point's pixel values. Erosion is one of the two basic operators in the area of mathematical morphology and the dilation. It is typically applied to binary images, but there are versions that work on grayscale images. Segmentation using K-Means is a least-squares partitioning method that divides a collection of objects into K groups. Histogram thresholding and slicing techniques are used to segment the image. They might be connected specifically to a picture yet can likewise be joined with pre-and postprocessing methods.

6.MODULE DESCRIPTION

Median filter

Median filtering is a nonlinear operation. And this performance is often used in image processing to reduce "salt and pepper" noise. Besides the median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. The median filter replaces a pixel via the median pixel of all the neighbourhoods:

$$y[m,n]=median\{x[i,j],(i,j)\in w\}$$

Where w represents a neighbourhood centred around a location.

Erosion

Erosion is represented by $\ominus$ is one of two fundamental operations in morphological image processing from which all other morphological operations are based. It was originally defined for binary images, later being extended to grayscale images, and subsequently to complete lattices.

The erosion of the binary image A by the structuring element B is defined by:

$$A \ominus B = \{z \in E | B_z \subseteq A\}$$

where B_z is the translation of B by the vector z

$$B_z = \{b + z | b \in B\}, \forall z \in E.$$

Grey Scale Erosion n grayscale morphology, images are functions mapping a Euclidean space or grid E into,

where $(f \ominus b)(x) = \inf_{y \in B}[f(x+y) - b(y)]$ is the set of reals.

Denoting an image by f(x) and the grayscale structuring element by b(x), where B is the space that b(x) is defined, the grayscale erosion of by b is given by Where "inf" denotes the infimum.

7. ALGORITHM

The algorithm of skin cancer detection iterates over two steps:

1. Compute the mean of each cluster.
2. Compute the distance of each point from each cluster by computing its distance from the corresponding cluster mean. Assign each point to the cluster it is nearest to.
3. Iterate over the above two steps until the sum of squared within-group errors cannot be lowered any more.

The algorithm for k-means13 clustering is following as:

1. Initialize the number of cluster k and centre.
2. For each pixel of an image, calculate the Euclidean distance d, between the centre and each pixel of an image using the relation given below.

$$d = \|p(x,y) - c_k\|$$

3. Assign all the pixels to the nearest centre based on distance.
4. After all, pixels have been assigned, recalculate new position of the centre using the relation given below.

$$c_k = \frac{1}{k} \sum_{y \in c_k} \sum_{x \in c_k} p(x,y)$$

5. Repeat the process until it satisfies the tolerance or error value.
6. Reshape the cluster pixels into an image.

8. RESULTS

We all know that skin cancer has multiplied to such an extent that it's very important to detect the disease at its initial stages. In order to solve this issue, we have come up with the method of image segmentation to detect early sign of skin cancer due to raised concentration in certain parts of the skin. We have used a MATLAB code to detect the same and prove its efficiency. For formulating the code, we have used the k-means algorithm. The aforesaid images are a specimen of how the code works and produces the desired output. The RGB image is taken and the greyscale image is obtained from RGB and then the segmentation using the gradient vector flow technique is performed. With the various feature extraction and analysis, we can the output.

From last two decades melanoma skin cancer is on the rise. So, early detection of skin cancer is very important. If detected at an early stage the skin cancer can be cured and in most cases the treatment is simple. The treatment involves excision of the lesion. At an early stage, skin cancer is very easy to treat and is cost-efficient while at a late stage the melanoma skin cancer gets really difficult to cure and also costs a very large amount for the treatment. Four analyses are done when skin lesion is suspected as melanoma. If the suspected skin lesion goes through only the three of these, it might be melanoma or not. For this reason, all four measures are considered to decide whether a skin lesion is melanoma or not.

Input

Fig. 1: Skin affected with melanoma

Output:

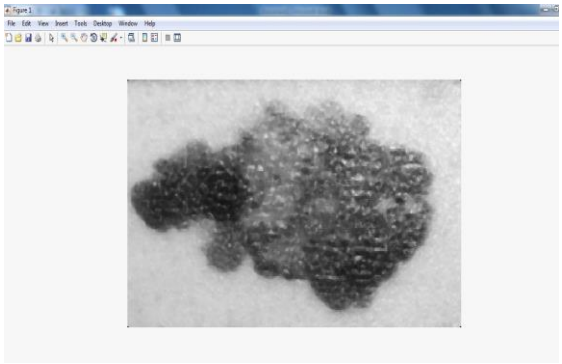

Fig. 2: The image after performing the edge detection

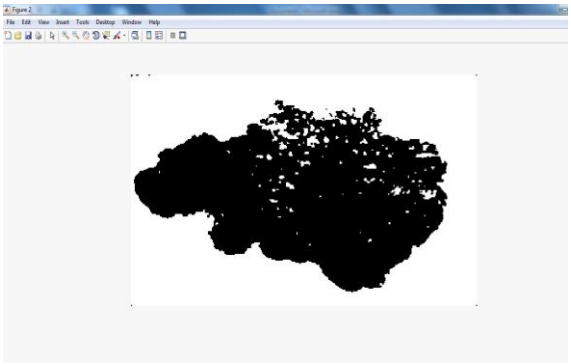

Fig. 3: The image after performing image segmentation

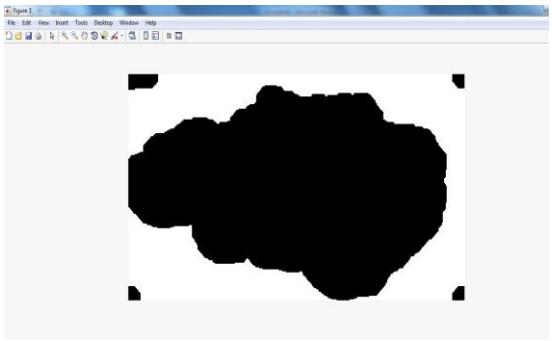

Fig. 4: The image formed after the k-means algorithm

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