

Texture Analysis of Skin Lesions

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Abstract: Skin cancers are cancers that arise from the skin due to the development of abnormal cells that have the ability to invade or spread to other parts of the body. It is the most common type of cancer and represents 50% all new cancers detected each year. Melanoma is the deadliest form of cancer and its incidence has been rising at a rate of 3% per year. There is a need for a computerized system to evaluate a patient's risk of melanoma using images of their skin lesions. In this paper, we go for texture analysis using GLCM parameters of various forms of cancer to understand the extent of damage that has occurred. The proposed method is also cost effective as the source for obtaining the images is a digital camera. The five categories of cancer considered in this paper are: Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Melanocytic Nevus / Mole (ML), Squamous Cell Carcinoma (SCC), Seborrheic Keratosis (SK). Each image goes through a series of processing steps and then a conclusion is drawn based on texture properties. Thus, the proposed method can be used to identify whether the patient has benign or malignant skin lesions.

Keywords: Melanoma, Skin Lesions, GLCM, Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Melanocytic Nevus / Mole (ML), Squamous Cell Carcinoma (SCC), Seborrheic Keratosis (SK), Benign Lesions And Malignant Lesions.

I. INTRODUCTION

The human skin is the outer covering of the body and is the largest organ of the integumentary system. The skin has up to seven layers of ectodermal tissue and guards the underlying muscles, bones, ligaments and internal organs. Melanoma, also known as malignant melanoma, is a type of cancer that develops from the pigment-containing cells known as melanocytes. They occur in the skin but may rarely occur in the mouth, intestines, or eye. Sometimes they develop from a mole with concerning changes including an increase in size, irregular edges, change in color, itchiness, or skin breakdown. The primary cause of melanoma is ultraviolet light (UV) exposure in those with low levels of skin pigment. About 25% develop from moles. Those with many moles, affected family members, and who have poor immune function are at Greater risk. A number of rare genetic defects such as xeroderma pigmentosum also increase risk. Reasons for approximately 75% of deaths related with skin cancer.

The majority of lesions presenting to dermatologists for assessment are covered by a narrow domain. Most systems ignore other benign lesions and crucially the two most common type of skin cancer: Squamous Cell Carcinoma and Basal Cell Carcinoma. In this paper we

focus on 5 common classes of skin lesions: Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Melanocytic Nevus / Mole (ML), Squamous Cell Carcinoma (SCC), Seborrheic Keratosis (SK). We have used high resolution color images acquired using standard digital camera.

After the images are acquired and read we segment the colored images using Otsu segmentation in two parts:

- (i) Quantization of full RGB image
- (ii) Plane by plane Quantization

Further processing of the image is done by converting image to gray scale and then preprocessing and enhancing it using median filter. Hence this step eliminates the noises and disturbances in the image. now the filtered image becomes the source to obtain the desired region of interest which is the affected area. The next step is to dilate the region of interest further in order to remove the background pixels and obtain only the desired foreground pixels of the affected region. Once this step is reached texture analysis is done on the affected area to find the extent of damage. Hence a valid conclusion whether the person is having a benign or malignant lesion can be drawn.

II. METHODOLOGY

- (1). High resolution images are obtained from a standard digital camera.
- (2). The image is acquired and read in the system.
- (3). The color image is segmented in two steps by Otsu's method.
- (4). The segmented image is converted into a gray scale image.
- (5). The gray scale image is filtered by a median filter for noise removal and image enhancement.
- (6). The filtered image is used to select the region of interest.
- (7). The desired region of interest is dilated.
- (8). The dilated region is used to obtain the texture features.
- (9). Based on the extracted feature the given image is either termed 'Benign' or 'Malignant'.

1. Obtaining High Resolution Images:

A digital camera is a device that produces images that can be stored in digital memory, displayed on a screen and printed on physical media. It has an optical system, typically using a lens with a variable diaphragm to focus light onto an image pickup device. The resolution of a digital camera is often limited by the image sensor that turns light into discrete signals. The brighter the image at a given point on the sensor, the larger the value that is read for that pixel. We have used 13 megapixel camera for obtaining the colored images of problem region.

2. Image Acquisition:

Digital imaging or digital image acquisition is the creation of photographic images, such as of a physical scene or of the interior structure of an object. Here we acquire the affected region from the subject and load it into the system for further analysis.

3. Image Segmentation:

Image segmentation is the process of partitioning a digital image into various segments. Each segment is regarded as a pixel in image processing. Segmentation is carried out in order to change or simplify an image into a form which can be easily analyzed and understood. Here we are using two steps by a method called Otsu's method for segmentation:

- (i). Quantization of full RGB image
- (ii). Plane by plane Quantization

In computer vision and image processing, Otsu's method is used to automatically perform clustering-based image thresholding. The algorithm assumes that the image contains two classes of pixels fore-ground pixels and background pixels, and it calculates the optimum threshold separating the two classes so that their combined spread is minimal, or equivalent.

(i). Quantization of Full RGB Image:

It is a process that reduces the number of distinct colors used in an image, usually with the intention that the new image should be as visually similar as possible to the original image. It is critical for displaying images with many colors on devices that can only display a limited number of colors, usually due to memory limitations, and enables efficient compression of certain types of images.

(ii). Plane by Plane Quantization:

It processes each RGB plane using the threshold vector computed from the given plane. It displays both posterized images and notes the visual differences in the two thresholding schemes.

4. Conversion of RGB Image to Gray Scale:

For further processing of the images we convert the RGB images into a gray scale.

5. Noise Elimination, Filtering and Image Enhancement by Median Filter:

Median filters are used as nonlinear digital filtering devices. They are mainly used to remove noise from an image or signal (noise elimination). It is used because in certain conditions it helps to preserve edges while removing noise. It also has a wide application in signal processing.

Image Enhancement: A method of improving the definition of an image by a computer program, which reduces the lowest grey level to black and the highest pictures to white, used for improvement to perceived image quality.

6. Region of Interest Selection:

The desired area in the complete image is selected for carrying out the further operations. This desired area is called as region of interest. Here we have selected the area affected by skin lesions as the region of interest. So, in the complete image we crop only the area affected by skin lesions and carry out further steps.

7. Image Dilation:

It is one of the basic operations in mathematical morphology. Originally it was developed for binary images, and then to complete lattices. This operation uses a structuring element for probing and expanding the shapes contained in the input image. This method helps to operate the foreground pixels and ignore the background pixels in an image.

8. Texture Analysis by GLCM Parameters:

GLCM is a statistical method of examining texture that considers the spatial relationship of pixels. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image. Later these functions create a GLCM, and then they extract statistical measures from this matrix. From every image acquired, region of interest is selected and GLCM parameters are found out using GLCM matrix. We have considered the following GLCM parameters:

- 1) Contrast = $\sum_{(i,j)} |i-j|^2 P(i,j)$
- 2) Correlation = $\sum_{(i,j)} P(i,j) \left[\frac{(i-\mu)(j-\mu)}{\sqrt{(\sigma)^2(\sigma)^2}} \right]$
- 3) Energy = $\sum_{(i,j)} P(i,j)^2$
- 4) Homogeneity = $\sum_{(i,j)} \frac{P(i,j)^2}{1+(i-j)}$

Where P =image, i,j =coordinates, $P(i,j)$ =Intensity value at i,j

9. Decision Making:

Based on the texture parameter values we conclude whether the skin lesion is malignant or benign.

III. RESULTS

For carrying out the proposed method, we have taken two images from each category that it mentioned above. The steps mentioned in the procedure is carried out on the images.



Fig 1. Steps 1, 2 And 3

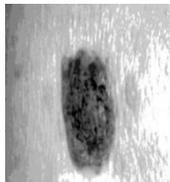


Fig 2. Steps 4 and 5

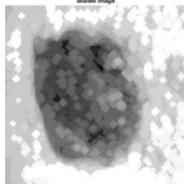


Fig 3. Step 6

Contrast is the difference in high intensity and low intensity pixels in an image. so, for this application if contrast is high it indicates that the image is affected one.

Correlation is the degree and type of relationship between two or more pixels in which they vary together over a period. Negative correlation means difference between two variables in which one variable increases as other decrease. So this indicates if correlation is high then the possibility of occurrence of cancer is high.

Energy is a term used to describe any user-defined function in image domain. It returns the sum of squared elements in GLCM. Energy is one for constant image, which might vary for moving image.

Homogeneity is the notion of double-raster characteristic of the piecewise-homogeneous image is used for stating

in a general case the problem of generating the image with given features. If homogeneity is more then the accuracy to analyze affected region is high.

IV. DISCUSSION

From the images used we can infer that all the images have high contrast thus they are all affected. Correlation is highest for image MN2 which is common type of lesion that leads to cancer. Melanositic nevus and squamous cell carcinoma images that we have used have high energy values and homogeneity values which indicates they are cancerous.

V. APPLICATIONS

1. Texture analysis of skin lesions
2. Early detection of melanoma
3. Differentiation of skin lesion as benign or malignant
4. Non-invasive detection of skin cancer stages
5. If risk-benefit factor is considered the level of risk is less.

VI. CONCLUSION

Thus, this method can help in easy detection of malignant stage of cancer by non-invasive method by texture analysis.

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