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DETECTION AND CLASSIFICATION OF SKIN CANCER USING THE ABCD RULE

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ABSTRACT

Skin cancer is the leading cause of death for people in the modern world. Skin cancer is an abnormal growth of skin cells that most frequently occurs on parts of the body that are exposed to sunlight. Early stages of the majority of skin malignancies can be cured Therefore, the patient's life can be saved by early and prompt detection of skin cancer. Early identification of skin cancer is now possible thanks to new technology. The biopsy procedure is the official way to diagnose skin cancer. Skin cells are removed, and the sample is then subjected to numerous laboratory tests. It takes a lot of time and is painful. For the early diagnosis of skin cancer disease, we have suggested an SVM-based skin cancer detection system. For the patients, it is better. A Support Vector Machine (SVM) algorithm and image processing techniques are used in the diagnosing methodology. A dermoscopy image of skin cancer is captured, then it is pre-processed using a variety of procedures to reduce noise and improve the image. The segmentation of the image is then performed using the Thresholding approach. The GLCM approach must be used to extract some visual features. These features are given as the input to the classifier. Support vector Machine (SVM) is a charity for classification purposes. It classifies the particular image into cancerous or non-cancerous.

Keywords: *Thresholding, SVM, GLCM, Digital Image, Classifier*

I.INTRODUCTION

Skin cancer is a deadly disease. The skin has three basic layers. Skin cancer begins in the outermost layer, which is made up of first-layer squamous cells, second-layer basal cells, and innermost or third-layer melanocytes cell. Squamous cells and basal cells are sometimes called non-melanoma cancers. Non-melanoma skin cancer always replies to treatment and rarely spreads to other skin tissues. Melanoma is more precarious than most other types of skin cancer. If it is not detected at the beginning stage, it quickly invades nearby tissues and spread to other parts of the body. The proper diagnosis method for skin cancer detection is the Biopsy method. A biopsy is a technique to remove a piece of tissue or a sample of cells from a patient body so that it can be analyzed in a laboratory. It is an uncomfortable method. Biopsy Method is time-consuming and aimed at the patient as well as the doctor because it takes a lot of time for testing. A biopsy is complete by removing skin tissues (skin cells) and that sample undergoes a series of laboratory testing [1]. There is a possibility of spreading the disease to another part of the body. It is riskier. Considering all the cases stated above, So Skin cancer detection consuming SVM is proposed. This methodology uses digital image processing techniques and SVM for classification. This procedure has inspired the early detection of skin cancers and requires no oil to be applied to your skin to achieve clear sharp images of your moles. In this way, it's a quicker and cleaner approach. But, most essentially, due to its higher magnification, Skin Cancer Detection Using SVM can prevent the unnecessary removal of perfectly harmless moles and skin lesions.

II. IMAGE ACQUISITION

Image acquisition Dermoscopic images are digital photographs/images of magnified skin lesions, taken with a conventional camera equipped with a special lens extension. The lens attached to the dermatoscopy acts like a microscope magnifier with its light source that illuminates the skin surface evenly. There are various types of dermoscopy equipment, but all of them use the same principle and allow registering skin images with x10 magnification and above. Due to the light source integrated into the dermatoscopy lens, there happens to be a problem with skin reflections. To counteract this problem, a liquid is used as a medium layer between the lens and the skin. In a modern dermatoscopy, the liquid is not necessary, because of the polarized light source that removes the reflection problem. Digital images acquired using a photo are sufficiently high resolution to allow for precise analysis in terms of differential structures' appearance.

A dermatologist can create accurate documentation of gathered images, opening a path for computer analysis, where images are processed to extract information that can later use to classify that image.

III. IMAGE PREPROCESSING

Image pre-processing before analysis of any image set can take place, preprocessing should be performed on all the images. This process is applied to make sure that all the images are consistent with the desired characteristic. When working with dermatoscopic images, pre-processing can cover many features like image illumination equalization, color range normalization, image scale fitting, or image resolution normalization. This can be dependent on defined prerequisites and methods applied in post- processing. An example of an elementary operation such as image normalization is resolution matching. Assuming that the image size in pixels is given, and all images are in the same proportion (e.g. aspect ratio of 4:3), it is easy to find the images of the smallest resolution and then scale the larger images to match the size of the smallest one. This operation allows calculating the features like lesion dimensions, lesion border length and lesions area coverage. It is possible to normalize the other parameters like color palette normalization, color saturation normalization, normalization of color components, and so on. A very common operation in preprocessing is color component normalization, known as histogram equalization. An image histogram is the distribution of color values between extreme colors used in the palette. Assuming the situation where the brightest points of the grayscale image are not white and the darkest points are not black, performing histogram equalization will redistribute all the colors of the image in a way that the brightest spot of the processed image will be color and the darkest regions of theimage will become black

III. PROPOSED SYSTEM

Skin cancer detection using SVM is defined as the process of detecting the presence of cancerous cells in the image. Skin cancer detection is executed by using GLCM and Support Vector Machine (SVM). Gray Level Co-occurrence Matrix (GLCM) is used to extract features from an image that can be used aimed at classification. SVM is a machine learning technique, mainly used for classification and regression analysis.

Block Diagram

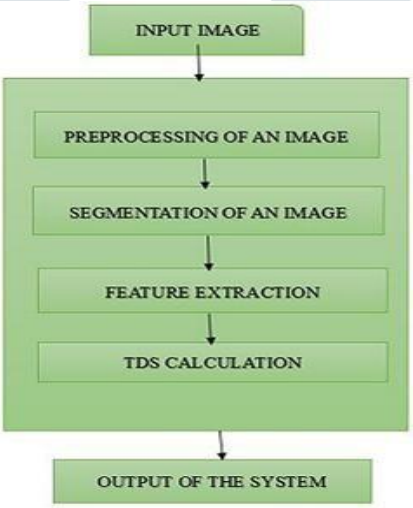

Fig 1. Block Diagram

Input image

Input to the proposed system is dermoscopic images, dermoscopic images are images taken by dermatoscopy. It is a kind of magnifier used to take pictures of skin lesions (body parts). It is a hand- held instrument that makes it very easier to diagnose skin disease.

Pre-processing

The goal of pre-processing is an improvement of image data that reduces unwanted distortions and enhances some image features important for further image processing. Image pre-processing involves three main things

1) Grayscale conversion

2) Noise removal

3) Image enhancement.

Grayscale conversion

Grayscale image contains only brightness information. Every pixel value in a grayscale image corresponds to an amount or quantity of light. The brightness graduation can be differentiated in the grayscale image. Grayscale image measures only light intensity. The 8-bit image will have brightness variation from 0 to 255 where '0' represents black and '255' represents white.

In grayscale conversion, a color image is converted into a grayscale image shown in fig (3). Grayscale images are easier and faster to process than colored images. All image processing techniquesare applied to grayscale images [4].

In our proposed, system colored or RBG image is converted into a grayscale image by using the weighted sum method by using the following equations

Grayscale intensity= 0.299 R + 0.587 G + 0.114 B

Noise Removal

The objective of noise removal is to detect and removed unwanted noise from the digital image. The difficulty is in deciding which features of an image are real and which are caused by noise. Noise is random differences in pixel values.

In our proposed system we are using the median filter to remove unwanted noise shown in fig (4). The median filter is nonlinear, it leaves edges invariant. The median filter is implemented by a sliding window of odd length [4]. Each sample value is sorted by magnitude, the centermost value is the median of a sample within the window, which is a filter output.

Image enhancement

The objective of image enhancement is to process an image to increase the visibility of thefeature of interest. Here contrast enhancement is used to get better-quality results shown in fig (5).

Segmentation

Segmentation is the process of removing the region of interest from a given image. Region of attention containing each pixel similar attributes. Here we are using maximum entropy thresholding for segmentation [5]. First of all, we have to take the gray level of the original image and then calculate the histogram of a grayscale image by using maximum entropy separate foreground from background. After maximum entropy, we obtained a binary image which is the black and white image

Segmentation Techniques

A. Threshold Based Segmentation

Histogram thresholding and slicing methods are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.

B. Clustering Techniques

Although clustering is sometimes 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. In this context, clustering methods attempt to group patterns that are similar in some sense. This goal is very similar to what we are attempting to do when we segment an image, and indeed some clustering techniques can readily be applied for image segmentation.

C. Edge Detection Based

When we know what an object we wish to identify in an image (approximately) looks like, we can use this knowledge to locate the object in an image. This approach to segmentation is called matching

Feature Extraction

As per the ABCD rule, the features which we need to extract include Asymmetry Index BorderColor Index Diameter.

A. Asymmetry Index

The asymmetry Index is computed with the following equation: AI=(A1+A2)/2Ar

Where A1= Area of the non-overlapped region along the minor axis of the lesion A2= Area of the non-overlapped region along the major axis of the lesion Ar= Area of lesion Implementation: Area of the lesion(Ar) can be calculated using bwarea over the binary image of the segmented region. For calculating non-overlapped area over the axis. The segmented region is divided along the lines passing through the centroid of the region Two separate areas are generated which are then adjusted so that the areas will be overlapped by flipping one area. Using XOR over the area will generate the non-overlapped region whose area is calculated using the bwarea function To generate area along the x-axis the bisection will be generated using the first Gx pixels and the next Gx pixels along the x-axis and bisecting line on the y axis. To generate area along the y-axis the bisection will be generated using the first Gy pixels and the next Gy pixels along the x-axis and bisecting line on the y-axis. After calculating the area of the regions Asymmetry index is calculated using the specified formula.

B. Border Irregularity

To calculate border irregularity, there are different measures such as the compactness index,fractal index, and edge abruptness.

1) Compact Index:: Compact Index can be determined by using the following equation:

CI=(P2L)=(4AL)

Where PL = Perimeter of the Lesion. AL = Area of the Lesion.

2) Fractal Dimension: Fractal set is provided by the ”box-counting” method. It returns two variableswhose differential log ratio provides the fractal dimension as the mean value along the 4-8 index.

3) Edge Variation: Edge variation is calculated using the following equation EI= ((Max- Min)%6+2)/100; Where Max and min are the lengths of the major and minor axis. Axis lengthsare calculated using the region props function.

C. Color Index

Color index is calculated by converting the input image to an HSV image value by checking the presence of the following colors. The length of all the available pixels with given values is divided by the total number of pixels. The presence of color is dependent on the value of the resultant not equalto zero. For each color present, the Color Index is +1.

D. Diameter

The diameter value is said to be 5 if the diameter of the lesion is greater than 6mm. For other values, the diameter is one less than its actual rounded value. To calculate Diameter the region props function is used to get the minor axis length of the lesion region. The resultant value is converted into mm value and the value is assigned to diameter [2].

1. TDS Calculation

The following formula is used

$$TDS = 1.3A + 0.1B + 0.5C + 0.5D$$

If the TDS Index is less than 4.75, it is a benign (noncancerous) skin lesion. If TDS Index is greater than 4.75 and less than 5.45, it is a suspicious case of skin lesion. If TDS Index is greater than 5.45, it is malignant melanoma (cancerous) skin lesion [2][3].

Classifier

The classifier is used to classify cancerous images from other skin diseases. For simplicity Support, a Vector machine classifier is used here. Svm takes a set of images and predicts for each input image belongs to which of the two categories of cancerous and non-cancerous classes. The purpose of SVM is to create a hyperplane that separates two classes with a maximum gap between them [2]. In our proposed system output of GLCM is given as input to the SVM classifier which takes training data, testing data, and grouping information which classifies whether the given input image is cancerous or non-cancerous shown in fig (7).

V. RESULTS

I have collected skin cancer images from the internet. They undergo various pre-processing techniques like grayscale conversion, median filter maximum entropy, and GLCM method, all features are given to SVM to classify a cancerous and non-cancerous image, the output of the above image wouldbe 'cancerous' as shown in fig (7).

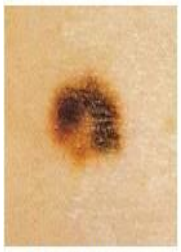

Fig 2: Input Image

Fig 3: Gray Scale Image

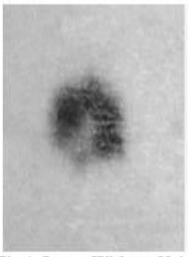

Fig 4: Image Without Noise

Fig 5: Enhanced image

Fig 6: Segmented Image

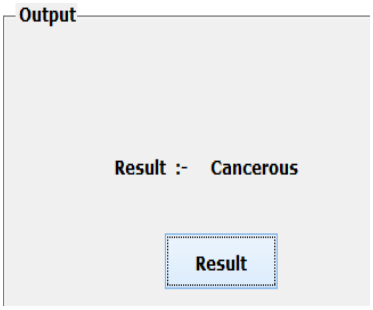

Fig 7: Output Image

formula.

Testing was performed on 20 sample images. Accuracy is calculated by using the following

$$\text{Accuracy} = \frac{TP+TN}{TP+FP+FN+TN}$$

Parameters	SVM classifier
TP	16
TN	03
FP	0
FN	1
Accuracy	95%

Table 1: Performance of SVM

VI. CONCLUSION

Incident rates of melanoma skin cancer have been rising for the last two decades. So, early, fast and effective detection of skin cancer is of paramount importance. If detected at an early stage, the skin has one of the highest cure rates, and the most cases, the treatment is quite simple and involves the 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 exposure to strong sunlight and other sources of Ultraviolet light. Take care of all the necessary measures such as: protecting the skin with clothing, wearing a 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.

It can be easily concluded that the proposed system of skin cancer detection can be implemented using gray level co-occurrence matrix and support vector machine to classify easily whether the image is cancerous or non-cancerous. The accuracy of the proposed system is 95%. It is a painless and timeless process than the biopsy method. It is more advantageous to patients.

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