Melanoma Skin Cancer Detection by Segmentation and Feature Extraction using combination of OTSU and STOLZ Algorithm Technique

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Abstract

Skin cancer exists in different forms like Melanoma, Basal and Squamous cell Carcinoma among which Melanoma is the most dangerous and unpredictable. In this paper, we implement an image processing technique for the detection of Melanoma Skin Cancer using the software MATLAB which is easy for implementation as well as detection of Melanoma skin cancer. The input to the system is the skin lesion image. This image proceeds with the image pre-processing methods such as conversion of RGB image to Grayscale image, noise removal and so on. Further Otsu thresholding is used to segment the images followed by feature extraction that includes parameters like Asymmetry, Border Irregularity, Color and Diameter (ABCD) and then Total Dermatoscopy Score (TDS) is calculated. The calculation of TDS determines the presence of Melanoma skin cancer by classifying it as benign, suspicious or highly suspicious skin lesion.

Keywords — *Lesion, Melanoma, Otsu, STOLZ, TDS*

I. INTRODUCTION

In imaging science, image processing is the processing of images using any form of signal processing for which input is an image, a series of images, or a video, such as a photograph or video frame. Skin cancers are cancers that arise from the skin. They are due to the development of abnormal cells that have ability to invade or spread to other parts of the body. Skin cancer is found in various types such as basal cell skin cancer (BCC), Squamous cell carcinoma (SCC) and melanoma among which melanoma is the most unpredictable. Melanoma begins in melanocytes (pigment cells). Most melanocytes are in the skin. Melanoma can occur on any skin surface. In men, it's often found on the skin on the head, on the neck or between the shoulders and the hips. In women, it's often found on the skin on the lower legs or between the shoulders and the hips. Melanoma is rare in people with dark skin. When it does develop in people with dark skin. It is usually found under the fingernails, under the toenails, on the palms of the hands, or on the soles of the feet. Melanoma is more likely than other skin cancers to spread to other parts of the body.[3] Therefore, in this project, Melanoma skin cancer is implemented using image processing techniques by using segmentation and feature extraction technique.

II. LITERATURE SURVEY

Skin cancer is the most common form of cancer, globally accounting for at least 40% of cases. It is especially common among people with light skin. The most common type of non-melanoma skin cancer, which occurs in at least 2-3 million people per year. Of non-melanoma skin cancers, about 80% are basal cell cancers and 20% squamous cell cancers. Basal cell and squamous cell cancers rarely result in death. In 2003, it was estimated that 105,000 people would receive a diagnosis of melanoma and a further 33,000 would die from the disease worldwide. In the United States, there were cause of less than 0.1% of all cancer deaths.[5]

Skin cancer detection using Digital Image Processing by et al. Sanjay Jaiswar, MehranKadri, Vaishali Gatty suggested a computer aided method used 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 analysis it to conclude about the presence of skin cancer. The lesion image analysis tools checks for the various melanoma parameters like asymmetry, border, color, diameter (ABCD) 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. [7]

Detection of Skin Cancer Using Image Processing Techniques by et.al. Chandrahasa M, Varun Vadigeriand Dixit Salecha suggested a method to detect ski cancer in early stages using smartphone application by analyzing properties of the cancer, Asymmetry, Border, Color, Diameter and Expansion

(ABCDE). These properties are analyzed using different image processing techniques like Grey scale conversion, segmentation, contour tracing and histogram analysis. [9]

Automatic Lesion Detection System (ALDS) for Skin Cancer Classification Using SVM and Neural Classifiers by et.al. Muhammad Ali Farooq, Muhammad Aatif Mobeen Azhar, Rana Hammad Raza suggested an important application in the medical field is Automatic Lesion Detection System (ALDS) for skin cancer classification. . This method is focused towards the development of improved ALDS framework based on probabilistic approach that initially utilizes active contours and watershed merged mask for segmenting out the mole and later SVM and Neural Classifier 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. [2]

The Melanoma Skin Cancer Detection and Feature Extraction through Image Processing Techniques by et al. Dr. S.Gopinathan, S. Nancy Arokia Rani suggested a method for an approach to detect the melanoma skin cancer and feature extraction through various image processing techniques .The input for the system is the skin lesion which is uncertain to be melanoma cancer. The image is pre-processed to ejection of hair and noise etc. and contributed a quality image. The Otsu thresholding and boundary tracing algorithm is used for image segmentation. The STOLZ algorithm is used for feature classification stage, the extracted features that are proceeded in order to assort the image as mole, benign, suspicious, highly suspicious skin lesions. [6] Among the following methods, the first and the fourth method is combined to implement this project as it gives proper accuracy in detecting Melanoma skin cancer. Our paper combines segmentation and feature extraction technique by using Otsu and STOLZ algorithm to give much better TDS calculation results and we have proposed the method that may detect the skin cancer at first stage and so can save many lives.

III. PROPOSED METHOD

The block diagram is a combination of Otsu and STOLZ algorithm

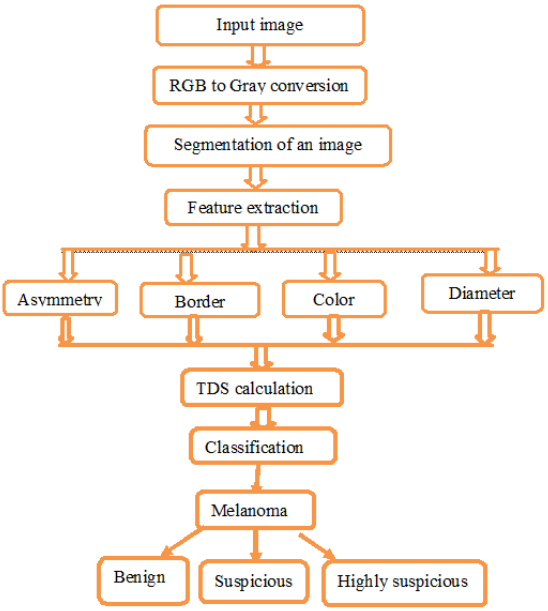

Fig.1: Block Diagram of the Proposed Method by Using Segmentation and Feature Extraction Technique by Otsu and STOLZ Algorithm

IV. BLOCK DIAGRAM DESCRIPTION

A. Input Image

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware based source, so that it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The input to the system is the skin lesion image which is taken from the medical database.

B. RGB to Grayscale conversion

Image enhancement includes image scaling, color normalization and contrast enhancement. Generally, the common color spaces are RGB, HSV, CIE LAB and CIE XYZ. In this technique, the ordinary image is first converted to RGB and then to grayscale. It makes an image suitable for a particular application. Further contrast enhancement takes place. Contrast enhancement is beneficial step to improve the perception for further processing such as to sharpen the image border, improve brightness of the image. At the end of the pre-processing step of skin cancer detection system, the resulting images are distinguishable from those initial images and almost are ready to feed the segmentation stage. [1]

C. Segmentation of an image:

The process of segmentation is to make things easier or change the representation of an image into something that is more understandable and simpler to analyze. Segmentation refers to the separation of an image into disjoint regions that are

uniform with respect to some property such as color, luminance and texture. [8] The segmentation techniques used for a dermoscopic images are thresholding, color based segmentation, clustering techniques, histogram equalization, discontinuity segmentation, Otsu's method and so on. In this method, the segmentation technique used is Otsu's thresholding based segmentation. Otsu's thresholding is Clustering based image segmentation technique or reduction of a grayscale image to a binary image which is explained in next section.

D. *Feature extraction*

In order to educate the masses to recognize melanoma in its early stages in 1985, group from New York University devised the ABCD acronym (Asymmetric, Border irregularity, Color, Diameter>6mm) [4].

1) *Asymmetry:*

Cancerous lesions are checked for symmetry in 0, 1, or 2 axes. It is considered as 0- biaxial symmetry, 1- mono axial symmetry, 2- biaxial asymmetry.

2) *Border irregularity:*

Most of the cancerous lesions are ragger, notched or blurred. Its value ranges from 0 to 8.
Border Irregularity can be calculated using the formula,

$$B = [(\text{perimeter})^2 / 4\pi A] \quad \ldots\ldots (1)$$

Where, A= Area of the lesion, $\pi = 22.7$

3) *Color:*

Cancerous skin lesion's pigmentation is not uniform. The presence of up to 6 known colors must be detected- white, red, light brown, dark brown, slate blue and black. Its values ranges from 0 to 6.

4) *Diameter:*

Cancerous lesions are greater than 6mm wide. Differential structures with at least five patterns are relevant for specific types of lesions. Any growth of a mole should be of concern. Its value ranges from 0 to 5.[10]

ABCD rule has proven more accurate and effectiveness in clinical practice with 76% diagnostic accuracy. The ABCD rule is also used by the American Cancer Society, American Academy of Dermatology and others worldwide to provide simple parameters for evaluation and identification of pigmented lesions that may need further examination. [4]

Otsu and STOLZ algorithm[11] are explained in the next section.

V. ALGORITHM

MATLAB R2010b is used for the implementation of the project.

A. *Otsu's Algorithm:*

Step 1: Input image (RGB image)
Step 2: Convert RGB image to Grayscale image using rgb2gray function.
Step 3: Add noise to the image using imnoise function.
Step 4: Filter out the noise from the image using Weiner filter.
Step 5: Use Otsu's segmentation method to segment the image.

B. *STOLZ Algorithm:*

Step 1: Convert the segmented image into binary image.
Step 2: Calculate Asymmetry of the binary image.
Step 3: Calculate the Border Irregularity of the binary image by calculating the area and perimeter of the lesion.
Step 4: Calculate the Color variation and diameter of the lesion.
Step 5: Find the Total Dermatoscopic Value (TDS) by substituting all the values of calculated parameters.

C. *Final Algorithm:*

Step 1: Input image (RGB image)
Step 2: RGB to Grayscale conversion.
Step 3: Segmentation of the image using Otsu's segmentation.
Step 4: Feature extraction using STOLZ algorithm.
Step 5: TDS calculation
Step 6: Determination of cancerous image.

VI. TDS CALCULATION

Dermoscopic images are basically digital photographs/images of magnified skin lesion, taken with conventional camera equipped with special lens extension. The lens attached to the dermatoscope acts like a microscope magnifier with its own light source that illuminates the skin surface evenly. Digital images acquired using photo dermatoscope are sufficiently high resolution to allow for precise analysis in terms of differential structures appearance. Dermatologist can create accurate documentation of gathered images, opening a path for computer analysis, where images are processed in order to extract information that can later be used to classify those images using TDS method. [7]

TDS (Total Dermatoscopy score) Index is an important tool used in the diagnosis of melanoma. Calculation of the TDS index is based on Asymmetry, Border irregularity, Color and Diameter of the skin lesion. Each of the criteria is then multiplied by a given weight factor to yield a Total Dermatoscopy Score.

The TDS Index is computed using the following equation:

TDS = 1.3A + 0.1B + O.5C +0.5D……..... (2)

If the TDS Index is less than 4.75, it is benign (noncancerous) skin lesion. If the TDS Index is greater than 4.75, and less than 5.45, it is suspicious case of skin lesion. If the TDS Index is greater than 5.45, it is malignant melanoma (cancerous) skin lesion. [7]

VII.RESULTS

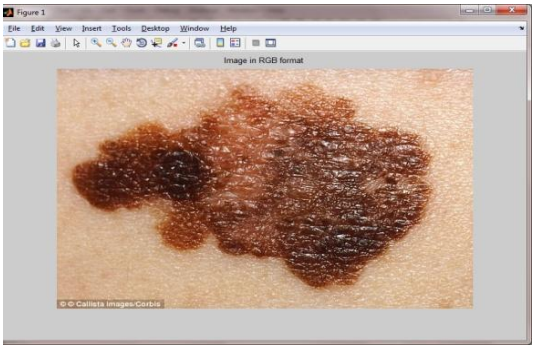

Fig.2: Image in RGB format

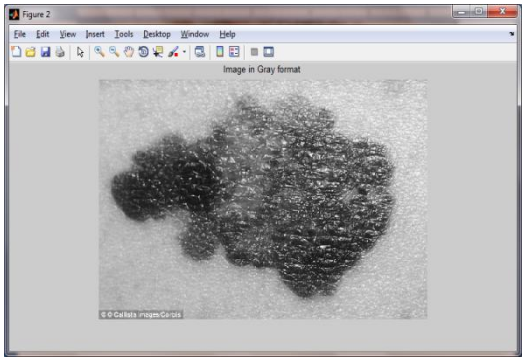

Fig.3: Image in Gray format

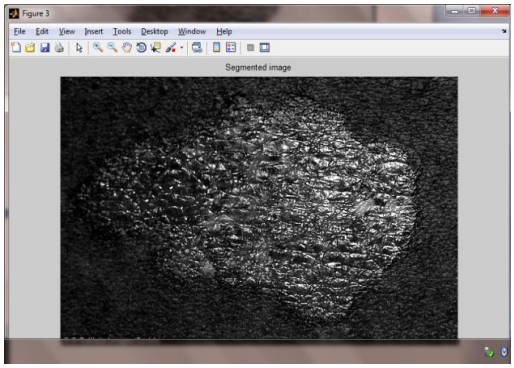

Fig.3: Segmented image

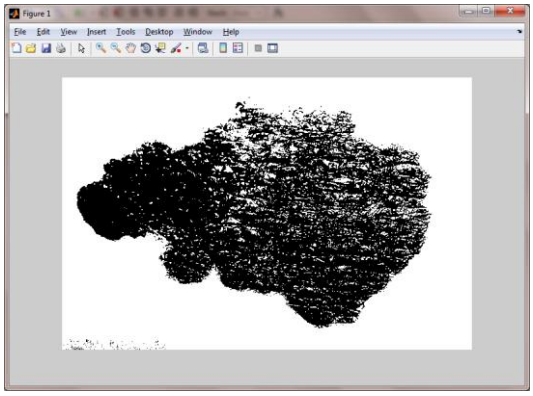

Fig.3: Binary image

Table 1: Evaluation Parameters of the Result Obtained for the Proposed System.

Features	Results of the Proposed Method	Results from Reference Papers using Other Methods
TDS	5.647	5.49
Asymmetry	2	2
Border Irregularity	0.47	0.4
Color	2	2
Diameter	4	3.7
Level of cancer	Highly suspicious	Highly suspicious

VIII. DESCRIPTION OF THE PAPER

The paper explains a simple and efficient way of detecting Melanoma skin cancer which has 4 stages. The first stage describes the conversion of original image (RGB image) to Grayscale image. The second stage is obtained by performing Otsu's segmentation on the Grayscale image. The third stage includes the feature extraction parameters by STOLZ algorithm, which is then used to calculate the TDS value in the last stage. The last stage concludes about the presence of Melanoma skin cancer by classifying it as benign, suspicious or highly suspicious skin lesion. The detection will help the dermatologist to aid the patients with the proper treatment required to cure the cancer

IX.CONCLUSION

Melanoma is a serious and sometimes life threatening cancer. It can occur in any part of the body that contains melanocytes. The main cause of melanoma is excessive exposure to ultraviolet radiation reaching the skin. UV rays from the sun and other sources can damage skin cells, causing the cells to grow abnormally. Early detection of cancer can help the patient to have a proper treatment.

The proposed method detects Melanoma skin cancer with proper accuracy. 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 ways to cure it for e.g. using medicines or ointments, etc. Skin cancer detection system will help dermatologist to diagnose melanoma in early stages.

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