An Efficient Approach Of Image Segmentation For Skin Cancer Detection

Sonali Gothi, Raju Baraskar, Shikha Agrawal

Abstract: Melanoma cancer is that the uncontrolled growth of strange skin cells It happens once unrepaired deoxyribonucleic acid (DNA) damages to skin cells trigger mutations, or genetic defects, that lead the skin cells to multiply without delay and type malignant tumors. this kind of activities is defined as AN automatic skin lesion designation (ASLD). In this paper, implement an image processing technique for the detection of Melanoma Skin Cancer. Firstly the input to the system is the skin lesion image. This image proceeds with the image pre-processing methods such as the conversion of RGB image to Grayscale image with noise removal. Further image segmentation is used to segment the image, OTSU thresholding, k-means clustering, and GVF technique are used to segment the pictures followed by feature extraction that features parameters like asymmetry, Border Irregularity, Color and Diameter (ABCD) For the classification methodology Total Dermatoscopy Score (TDS) is used in order to assort whether the lesion is cancerous or not. It is found to be working satisfactorily with a detection accuracy, Sensitivity, and Specificity. the improved approach gives a better result than the previous approach for melanoma skin cancer detection.

Index Terms: Melanoma, Image Segmentation (OTSU thresholding, K-means Clustering, GVF Segmentation), TDS.

1. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is an image, like video frame or photograph and output, may be image or characteristics associated with that image. Usually, the Image Processing system includes treating images as two-dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms the core research area within engineering and computer science disciplines too. Image processing basically includes the following three steps:

a. Importing the image with an optical scanner or by digital photography.
b. Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
c. The output is the last stage in which result can be altered image or report that is based on image analysis.

Application of image processing is:

i. Computerized photography (e.g., Photoshop).
ii. Space image process (e.g., Edwin Hubble space telescope pictures, celestial body probe images).
iii. Automatic character recognition (zip code, registration number plate recognition)
iv. Fingerprint/face/iris recognition.
v. Industrial applications (e.g., product inspection/sorting)

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Nowadays malignant melanoma carcinoma has been progressively known as the major reason behind deaths. it's a condition or a disorder that develops from the melanocytes, that produce a pigment referred to as melanin. So, malignant melanoma regions seem as black or brown in color. however a number of them don't produce melanin; they seem as pink, tan or white color. Compared to all or any different skin cancers like Basal Cell carcinoma (BCC) and squamous cell carcinomas (SCC), the malignant melanomas are the foremost dangerous kind. Since it will simply have an effect on the opposite elements of the body. Normally this malignant melanoma begins on the skin surface where it is easy to see and treat. Then it grows deep into the skin and reaches the blood vessels. Finally, it'll unfold to different elements of the body and have an effect on numerous organs.Melanoma skin cancers have different stages which are Stage 0, Stage1, Stage 2, Stage 3, and Stage 4 [1].

Stage 0: Cancer is merely within the outermost layer of skin and is thought of as skin cancer in place.

Stage 1: Cancer is up to two millimeters (mm) thick. it does not unfold to body fluid nodes or alternative sites, and it's going to or might not be cancerous.

Stage 2: Cancer is a minimum of 1.01-millimeter-thick and it's going to be broader than 4 millimeters. it's going to or might not be cancerous, and it does not, however, unfold to body fluid nodes or alternative sites.

Stage 3: Cancer has spread to one or more lymph nodes or nearby lymphatic channels, but not too distant sites. Original cancer may no longer be visible. If it is visible, it may be broader than 4 mm, and it may also be ulcerated.

Stage 4: Cancer has unfolded to distant body fluid nodes or organs, like the brain, lungs, or liver.

In the digital image processor, we tend to use computer algorithms to perform the image process. Actually, digital image process has several advantages over the analog image processing; first it provides a high sort of algorithms to be used with the computer file, second, we are able to avoid some method problems like creating noise and signal distortion throughout the signal process. within the 2000s, quick computers became obtainable for signal process and digital image processing has become the favored sort of image process. due to that, the signal image process became a flexible technique, and conjointly the most affordable [2].

I. PROPOSED METHOD

The main components of the projected system are pre-processing, OTSU thresholding, K-means Clustering, and GVF segmentation, Feature extraction that includes parameters like Asymmetry, Border Irregularity, Color and Diameter (ABCD) and then Total Dermatoscopy Score (TDS) are calculated. The calculation of TDS determines the presence of Melanoma skin cancer by classifying it as a benign, suspicious or highly suspicious skin lesion. The block diagram for the projected system is shown below.

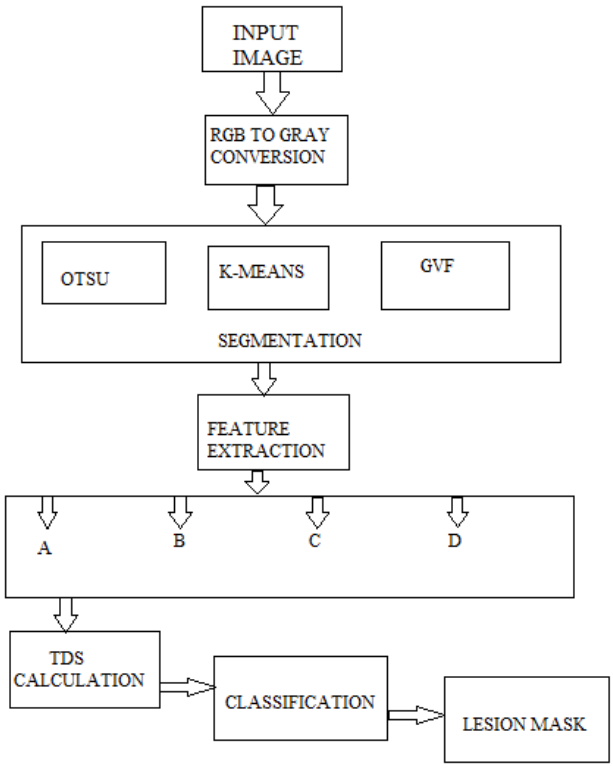


Figure 1. *Block diagram for the projected system*

A. PRE-PROCESSING

Pre-processing is the first step of an image processing technique. Hair detection and removal of the dermoscopic image are focused here [2] - [5]. The input to the system is the skin lesion image. This image proceeds with the image pre-processing methods such as the conversion of RGB image to Grayscale image, noise removal and so on.

B. IMAGE SEGMENTATION

Segmentation could be a method to partitioning an image into disjoint regions that are homogeneous with reference to a chosen property such as luminance, color, and texture. The aim of segmentation is to alter the illustration of an image into something that's a lot of significant and easier to analyze[6]. This step is very useful for proper feature extraction. Table 1 represents a comparison of various segmentation techniques used.

Table 1: *Comparison of Various Segmentation Techniques*

Segmentation Techniques	Descriptions
Thresholding Method	Based on the histogram peaks of the image to find a particular threshold value
Edge-Based Method	Based on discontinuity detection
Region-Based Method	Based on the partitioning the image into homogeneous regions
Clustering Method	Based on the topological interpretation
Watershed Method	Based on the working of differential equations
PDE Based Method	Based on the simulation of the learning process for decision making

In this paper, OTSU thresholding, K-means Clustering, and GVF segmentation are applied to obtain satisfactory results. The segmentation steps are detailed below.

i). OTSU THRESHOLDING

Otsu's methodology is applied to the filtered image to compute the global threshold value to minimize the variance of foreground and background pixels in a class [7]. It can perform clustering-based image thresholding and thus convert to a binary image. After thresholding, the image contains some black corners. These black corners are replaced with white pixels using a disk-shaped mask [8]. Now the edge of the resultant image becomes irregular. To remove the irregularities of the edges of the resultant image, morphological operations are applied.

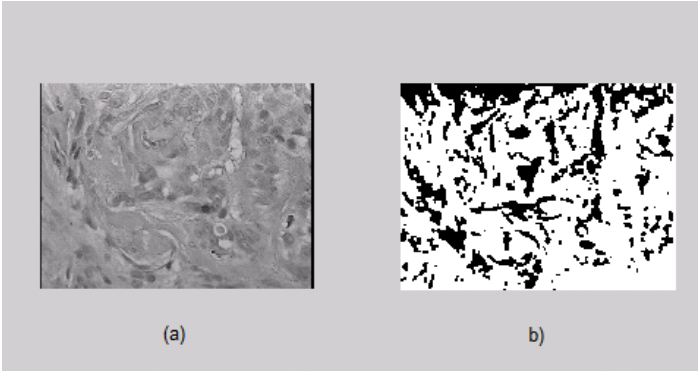


Figure 2. *OTSU Segmentation*

ii). K-MEANS CLUSTERING SEGMENTATION

K-means clustering is a partitioning method. This technique groups objects within the way that within-group variance is minimized. If the within-group variance is minimized then it provides the high featured segmented image. The working of this technique is as follows [19]:

a. Initialization of any 2 class centers randomly. These centers represent initial cluster centroids.
b. Calculate the value of histogram bin value distance between every image pixel and class centroids; assign every image pixel to its nearest class centroid.

c. Recalculate the new positions of centroids by calculating the mean histogram bin value of the same group.
d. If the value of centroids changes then repeat steps b and c

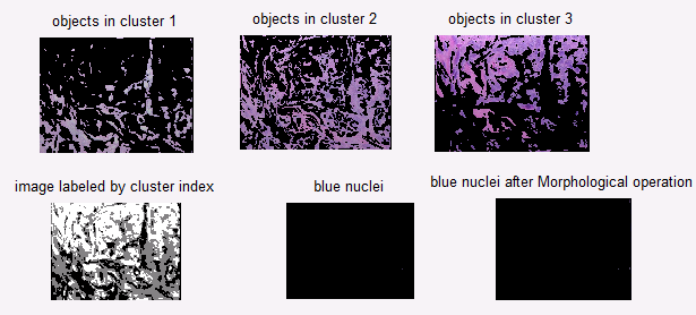


Figure 3. *K-means Clustering*

iii). GRADIENT VECTOR FLOW SEGMENTATION

Gradient vector flow (GVF) algorithm is a very popular and efficient algorithm used in various medical imaging problems [18]. Gradient vector flow algorithm is the extension of Snakes or active contour Gradient vector flow converge to boundary concavities and initialization close to the boundary is not required.

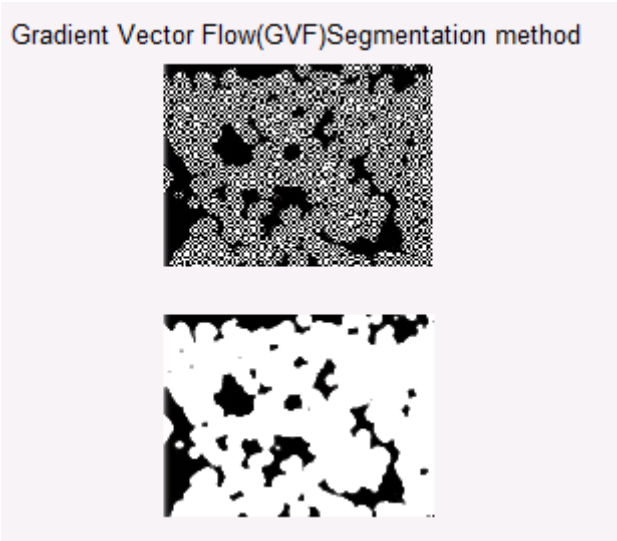


Figure 4. *The output of GVF Segmentation*

C. FEATURE EXTRACTION

Feature extraction is a very important stage because it has a direct influence on the classification results. In this study, features of the segmented lesions are computed by using the Stolz Algorithm, which is called the ABCD Rule which leads to the diagnosis of image acquisition. The feature extraction methodology of ABCD-rule dermoscopy is used because of its effectiveness and accuracy of detecting melanoma skin cancer. This method checks for four features that are Asymmetry (A), Border (B), Color (C) and Diameter (D)[9]. Asymmetry: One half of the lesion does not match the other. Border: The edges of the lesion are irregular, ragged, notched or blurred. Color: The color is not uniform. May include shades of brown or black. Or patches of pink, red, white or blue (variegated). Diameter: the spot is greater than a quarter of an inch.

D. CLASSIFICATION

For the classification of the image Total dermatoscopy score (TDS) is used in order to assert whether the lesion is cancerous or not. For the asymmetry evaluation, the lesion is bisected by two perpendicular axes positioned to produce the lowest possible asymmetry Score, Similarly, the border, color, and the diameter value has been detected [10]. The Total dermoscopic Score is used in the classification stage, which will be compared with TDS value, the classification has been done

IV. IMPLEMENTATION AND RESULT ANALYSIS

Confusion matrix was used for finding the accuracy of the classification. It is a table layout that allocates to visualize the performance of a supervised learning algorithm. Each row represents the instances in an actual class whereas each column represents the instances in a predicted class. Various other parameters like true positive rate (TPR), false-positive rate (FPR), true negative rate (TNR), false-negative rate (FNR), precision (P) and recall and F1 Score can similarly be found out.

i). DATASETS

After trained 32 images, we get a better result. The experimental result shows the best performance of detecting and assorting the cancer image. This approach gives a better result than the other system for melanoma skin cancer detection.

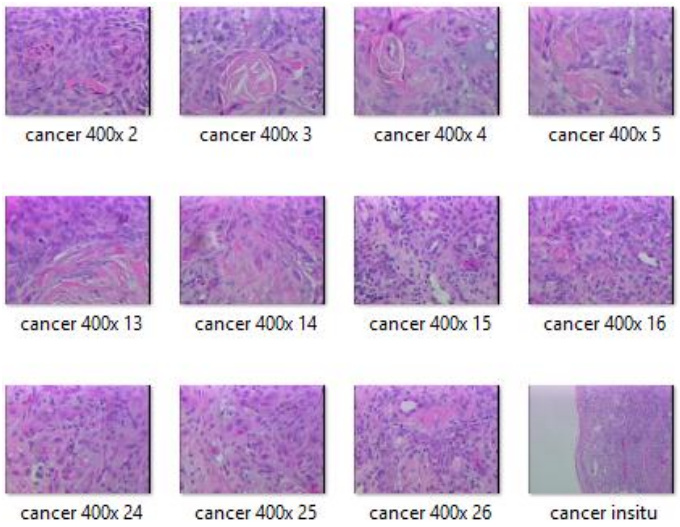


Figure 4. *Types of datasets*

These and some more parameters for evaluation. The result was evaluated on several parameters, such as:

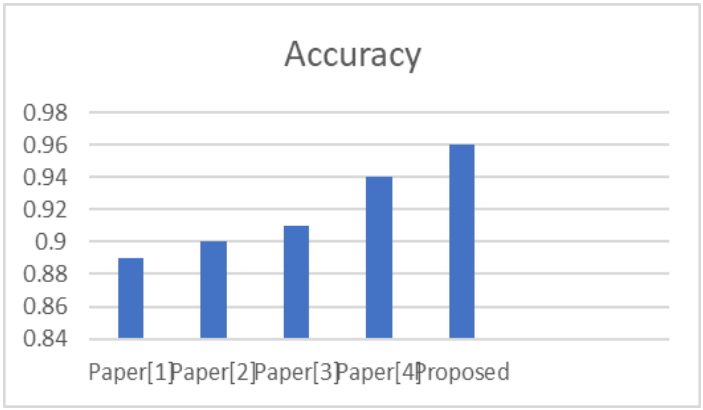
- Accuracy of the Classification
- Sensitivity/True Positive Rate
- Specificity/False Positive Rate
- Dice
- Jaccard

Table 2: *Results of Evaluation Experiment on Training Data*

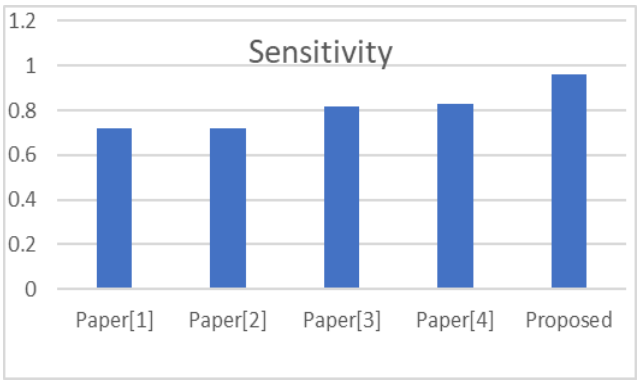
Methods	Evaluation Metrics (Average)				
	Dice	Jaccard	Accuracy	Sensitivity	Specificity
Maglo[1]	0.79	0.69	0.89	0.72	0.98
Celebi[2]	0.81	0.72	0.90	0.72	0.98
Barata[3]	0.85	0.78	0.91	0.82	0.98
Neda Zamani[4]	0.88	0.81	0.94	0.83	0.98
Proposed	0.98	0.96	0.96	0.96	1.00

ii). COMPARISON OF PROPOSED RESULT IN GRAPH

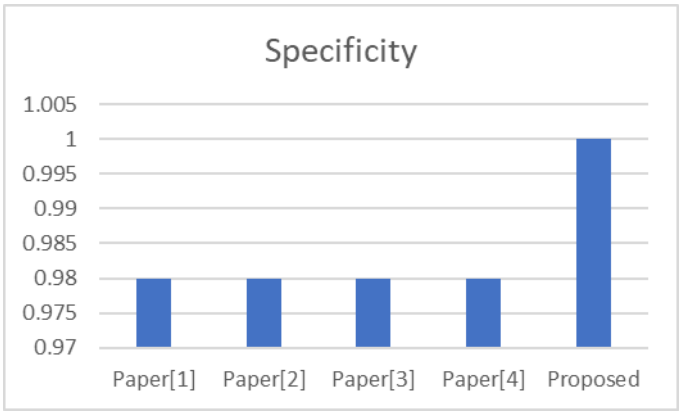
Below graph shows the comparison of accuracy between four different papers and the proposed method, and this paper accuracy is 96%.



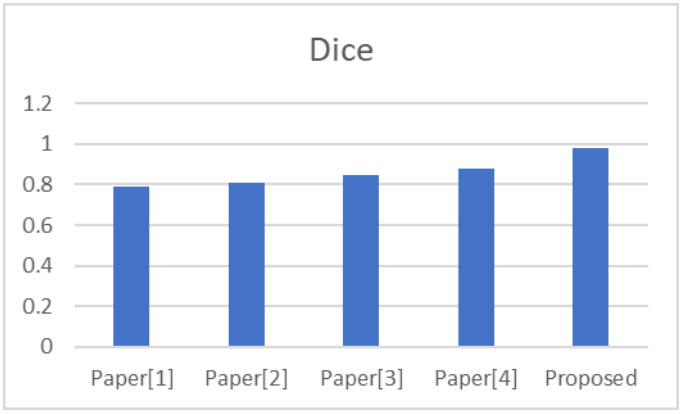
Below graph shows the comparison of sensitivity between four different papers and the proposed method, and this paper sensitivity is 96%.



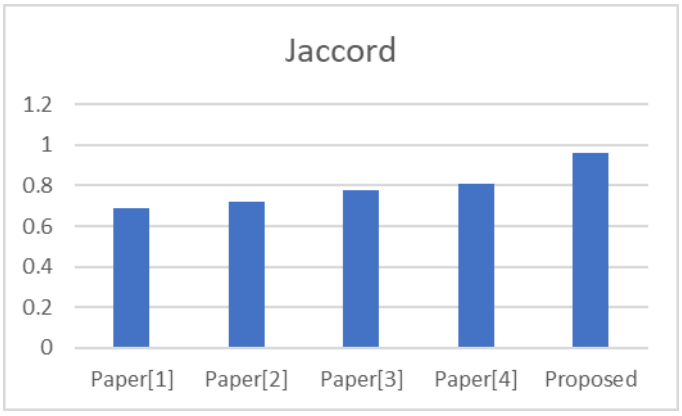
Below graph shows the comparison of specificity between four different papers and the proposed method, and this paper specificity is 100%.



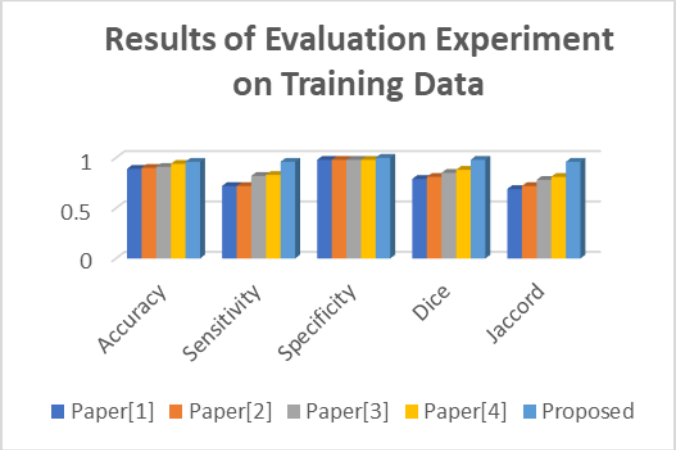
Below graph shows the comparison of dice between four different papers and the proposed method, and this paper dice is 98%.



Below graph shows the comparison of accord between four different papers and the proposed method, and this paper Jaccard is 96%.



Below graph shows the comparison of overall results of the evaluation experiment on training data.



This diagnosis system is evaluated using a database of 32 cancerous and non-cancerous images. It is found to be working satisfactorily with a detection accuracy of about 96%, Sensitivity 96%, Specificity 100%.

CONCLUSION

The proposed diagnosis system is evaluated using a database of 32 cancerous and non-cancerous images. The proposed system contains three steps, First, the input image is enhanced properly then, the lesion region is segmented from the image using the OTSU thresholding, k-means, and GVF segmentation and the features are extracted and classified by ABCD rule. Finally, Total Dermatoscopy Score (TDS) is used in the identification of melanoma In Otsu method the melanoma images, in which the lesion portion is protruded out are correctly classified than the lesion blended with the skin images.The future work on the skin cancer detection system can be more accurate and efficient.

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