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Research Article

A NOVEL APPROACH FOR PIGMENTED EPIDERMIS LAYER SEGMENTATION AND CLASSIFICATION

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Abstract

Skin cancers are caused due to abnormal cells developed in skin cells .This abnormality leads to pigmentation in the epidermal (skin) layer causing lesion. These lesions can be cancerous or non-cancerous. Malignant Melanoma is the aggressive one which can be fatal if not diagnosed early. Hence automated system or real time analysis is developed for diagnosing the pigmented skin lesion. In this paper, we propose a very simple but novel method for edge detection.This method is implemented in MATLAB environment, an efficient fuzzy logic based algorithm which detect the edges present in the input images. Also, a Graphical User Interface (GUI) in MATLAB has been designed which load the image, and each level of resultant image is displayed. The implemented algorithm results has been compared with the standard filters and standard edge detection algorithm. The results obtained by this method are compared with the existing standard algorithms and experimental results comparatively found better results and good scope of application for detection of pigmented epidermal layer.

Keywords: Skin Cancer, Melanoma, segmentation, Fuzzy Inference System.

Introduction

In human body; normal cells grow and divide to form new cells as per the body requirement. A new cell replaces the normal cells which are old or damaged .But sometimes this cyclic process goes wrong. The old or damaged cells don't die as they should and new cells form though the body doesn't need them. These extra cells often form a mass of tissue called a growth or tumor. Such growth on the epidermal (skin) layer is known as skin cancer. It can be cancerous or non-cancerous. Cancerous is divided into two types-non melanoma and melanoma. Melanoma is a cancer that begins in the

melanocytes. So melanoma tumors are usually brown or black as Most of the melanoma cells still make melanin. Every year Melanoma has been increasing at an alarming rate of 3% [3]. In United States American Cancer Society's Recent statistics for melanoma in 2015, that will be diagnosed is almost 74,000 people and 5.4 million cases of non-melanoma skin cancer, including basal cell and squamous cell carcinoma [4] .For at least 30 years, The rates of melanoma have been a continual uprising .Therefore, with the availability of simple and economical treatments, Skin cancer can be treated and cured at a very higher rates. Diagnosis is needed for skin cancer at an early stage for the benefit of human race. Many researchers are working in hardware and software development area using various different techniques [1]-[2].

Diagnosis of malignant melanoma in its early stages reduces fatality. So the basic aim of this proposed paper is for non-experts/clinicians/doctors to have an efficient, simple and automatic skin cancer, diagnostic system with the use of available software.

Background Work

Omar abuzaghleh et al [5] proposed a novel real-time automated image analysis technique for early detection of melanoma in the skin.Two major components: Real time alert and Dermoscopy Image analysis which helps to identify UV level rate and also identify skin lesion. Chen Lu et al [6] presents a new method for epidermal area segmentation in skin whole Side image (WSI).

Aswin et al [7] this paper presents a new system for detecting the skin cancer at an early stage by GLCM (Gray Level Co-occurrence Matrix). Mariam Ahmed et al [8] have designed a new automated system for diagnosing pigmented skin lesions for both clinical image (standard camera) and dermoscopic image (Dermascope) can be used in this system. This method used to extract the region of Interest (ROI) & provides its feature. Mohammad Khalad et al [9] presents a novel Computer-Aided Diagnostic (CAD) system for the melanocytic skin segmentation in the histopathalogical image thatdiagnoses the skin biopsies. Emre Celebi et al [10] proposed an automated system for dermoscopic images based on K-Means clustering for clinical images. This method has acquired an overall accuracy of 72%, Sensitivity of 62% and Specificity of 76%. Jeffery et al [11], a novel segmentation method based on the texture of the skin of the photographic pigmented skin lesion image by TDLS segmentation.

It Segments the lesion part and figure the presence of lesion. Francesco Peruch et al [12] proposed a new approach for automated segmentation system based in MEDS (Mimicking Expert Dermatologists Segmentation) model this method

mimicks the process of dermatologist. Henceforth, different techniques have been researched by researchers in K-means clustering, threshold based Otsu method, TDLS segmentation, neural network for skin lesion analysis and image processing.

We have studied these techniques and proposing fuzzy logic based edge detection of skin lesion image. The proposed method will try to overcome disadvantages cited by above existing method.

Method

The loaded input image has noise so we have to preprocess image for enhancement and noise reduction. Median filter has been used for pre-processing, then segmentation is done fuzzy based edge detection method (FIS) and feature is extracted. Based on its feature the images are classified according to its types.

Skin cancer image pre-processing stage

Pre-processing means the image is filtered, enhanced, resized and prepares the image for next step segmentation (i.e., from ordinary image to first RBG then gray scale and binary) [13][14][15].

Fig. 5 shows the image preparation. In this method median filter is used Filters using this technique are called median filters. Preprocessing skin cancer image algorithm steps as follows:

1. Read the skin input image.
2. Convert the color image into gray scale and black/ White image.
3. Image is filters the noise by median 2-D Filtering on the grayscale image.
4. Resize the image.
5. Contrast of the image is enhanced by adjust function.

Image segmentation stage

It is a process of extracting the information from the input image to group similar pixels together of that region. There are many image segmentation techniques, based on threshold, edge ,region , clustering, markov random field or hybrid methods are used for segmentation as shown in fig 6 [16][17][18].

Segmentation plays a vital role in cancer detection. The main aim of this process is to segregate the similar region, the process is achieved by the feature of given image, such as edges or texture which are needed for segmentation. In our paper we propose segmentation based on edge detection with help of new fuzzy based (Fuzzy Inference System) method

Feature extraction

Feature extraction is nothing but extracting the vital information based on the properties of an input image .Here, the segmented image is extract features such as texture, color and shape. Some of the important properties includes texture, shape, smoothness, area, regularity and the description of shapes includes are length, breadth, aspect ratio, area, location, parameter, compactness, etc.

In our paper we have extracted the lesion from the image and studied its area of spreading, length and irregularity .The basic feature extraction process is shown in figure 7.

Classification

The extracted feature is classified based on the lesion's feature. Based on the shape, length and texture of the skin lesion, it is classified whether the image is melanoma, basal cell skin cancer, squamous cell or benign (non-cancerous).the threshold value is set and values classifies the type of lesion image.

Proposed Work

The proposed algorithm is stated step-by-step below:

1. The input image is given to the process, the image get enhanced by preprocessing techniques.
2. The preprocessing techniques include color conversions, resizing and filtering.
3. After preprocessing, the image is passed through segmentation process (edge based).
4. The lesions part is segmented by using the FIS (Fuzzy Inference System).
5. Having crisp membership functions (gaussian). The inputs (P1, P2, P3 & P4) are fuzzified into various fuzzy sets.
6. Fuzzy rules for each crisp input shown in Table 1 below.
7. Centroid method is used for Defuzzification.
8. Fuzzy output value is the pixel value containing the edge and non-edge regions of the image.

The features of the segmented part are analyzed and the lesion is classified based on its features by calculating its length , size and area.

Results:

The novel approach introduced for edge detection has been tested with different pigmented skin lesion images and also GUI designed for this technique is shown below in Fig 1.

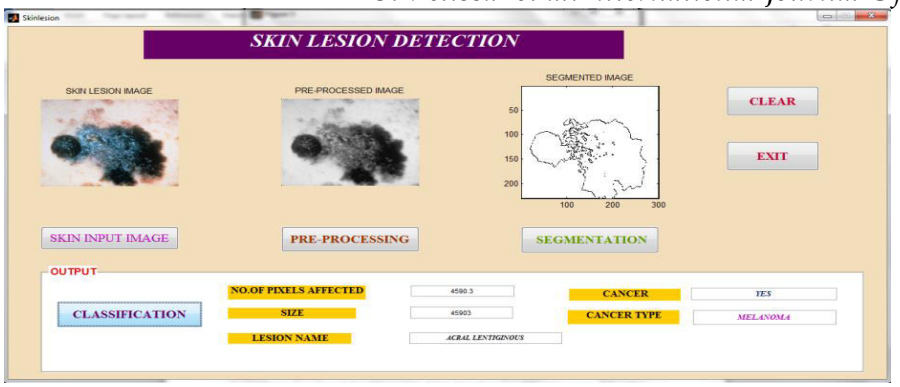

Fig-1: GUI designed for Skin lesion detection.

1. Comparison of filters:

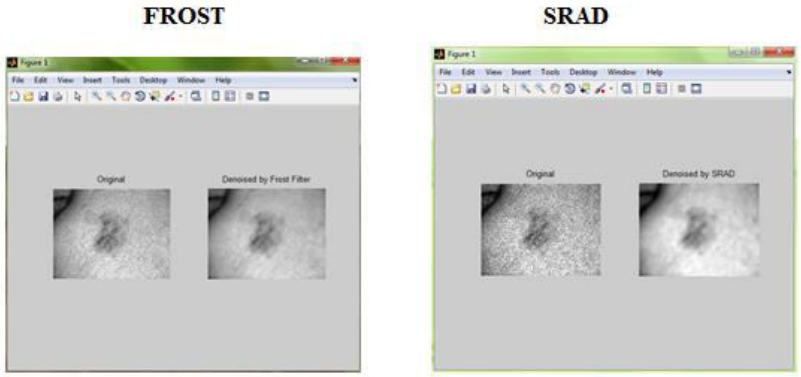

Fig-2: Frost and Srad Filters.

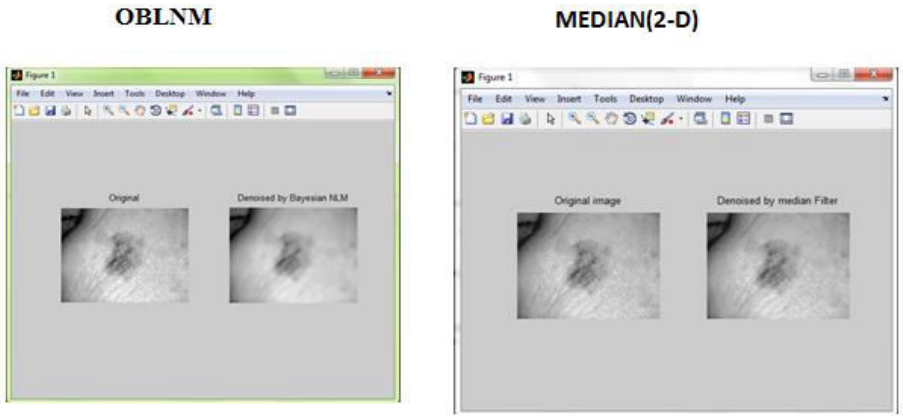

Fig-3: Oblnm and Median(2-D) Filters.

Graphical representation of filters:

Higher the value of SNR, greater is the performance of filters. Median filters have higher value of 34.75 than other filters, thus it has best performance in removal of noises.SNR values of the compared filters are tabulated below:

Table-1: Different Filters SNR value.

FILTERS	MEDIAN(2D)	OBLNM	FROST	SRAD
SNR	34.57	27.828	19.734	14.274

2. Comparison of Edge Detection Techniques:

The novel fuzzy based edge detection method developed for skin lesion was tested on different types of skin images and the resultant output images were compared with existing algorithms. Now ,the output images of novel algorithm is scrutinized with existing methods which provide distinct edges and thus FIS (i.e. Fuzzy Inference System)shows better edge than the standard existing. The outputs are shown below in Fig(4 & 5) compares with "Log"," Canny" ,"Roberts"& "TDLS" and our fuzzy based (FIS)edge detection method. It is observed that the fuzzy method output has been able to generate better result and distinct edges than other algorithms. Thus the Fuzzy rule and fuzzy conditions helps to detect edges of the input image with a high efficiency

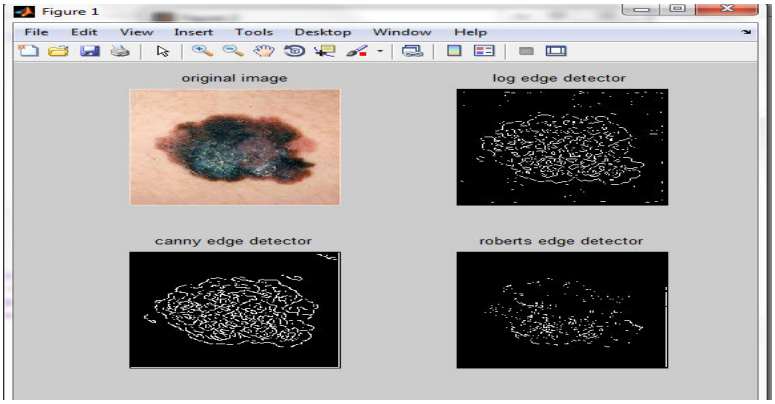

Fig-4: 'log', 'canny'& 'roberts' edge detection.

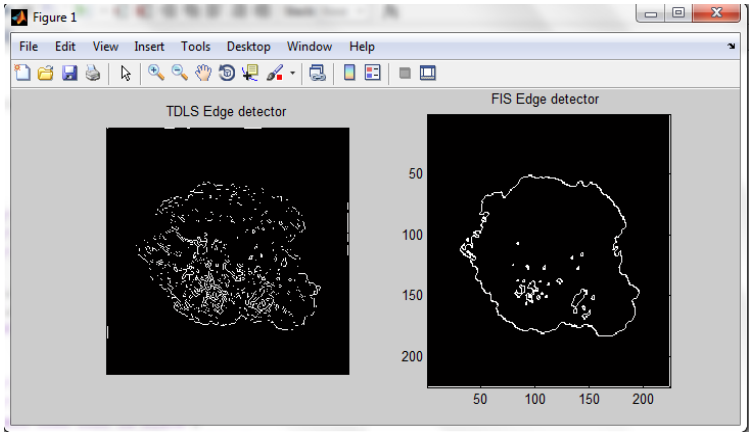

Fig-5: TDLS &FIS edge detector.

3. Proposed Skin Lesion Detection Outputs.

3.1 Cancerous Type

3.1.1 Non Melanoma

The output of non-melanoma skin cancer has been shown in fig (6 & 7)

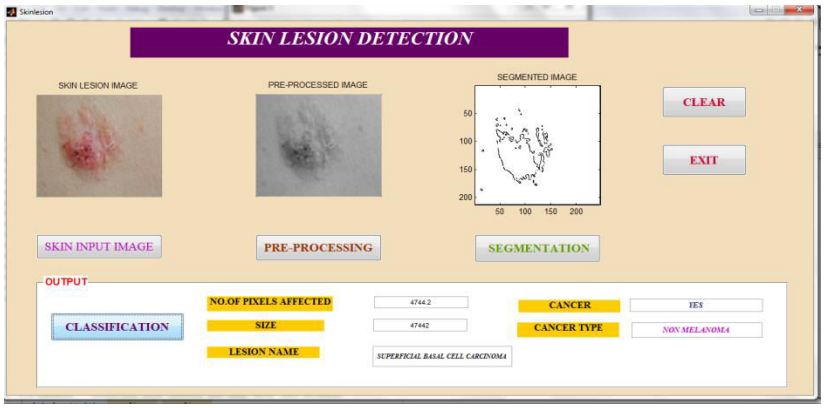

Fig-6: Basal cell skin cancer.

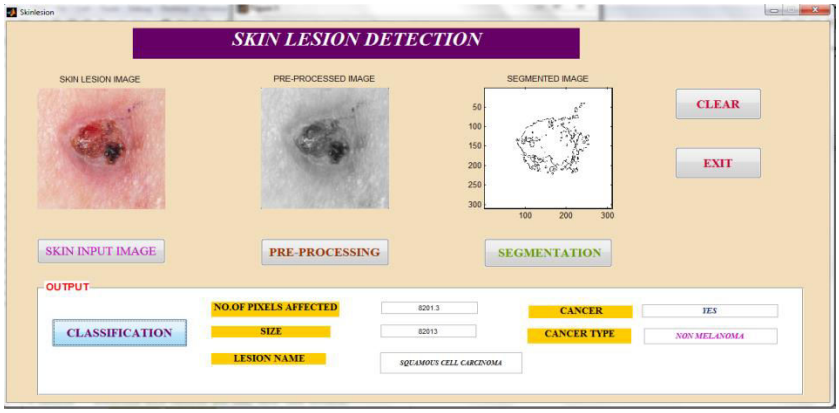

Fig-7: Squamous cell skin cancer.

3.1.2 MELANOMA

The output of melanoma skin cancer has been shown in fig (8 & 9)

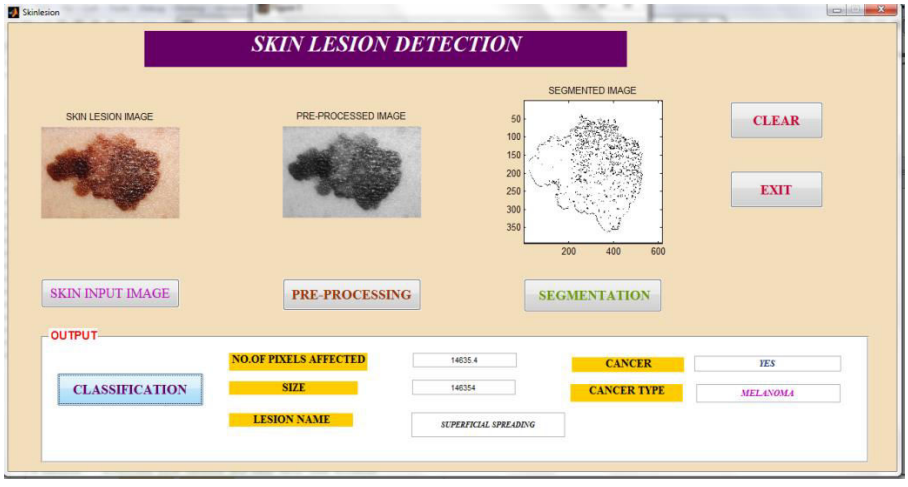

Fig-8: Superficial spreading.

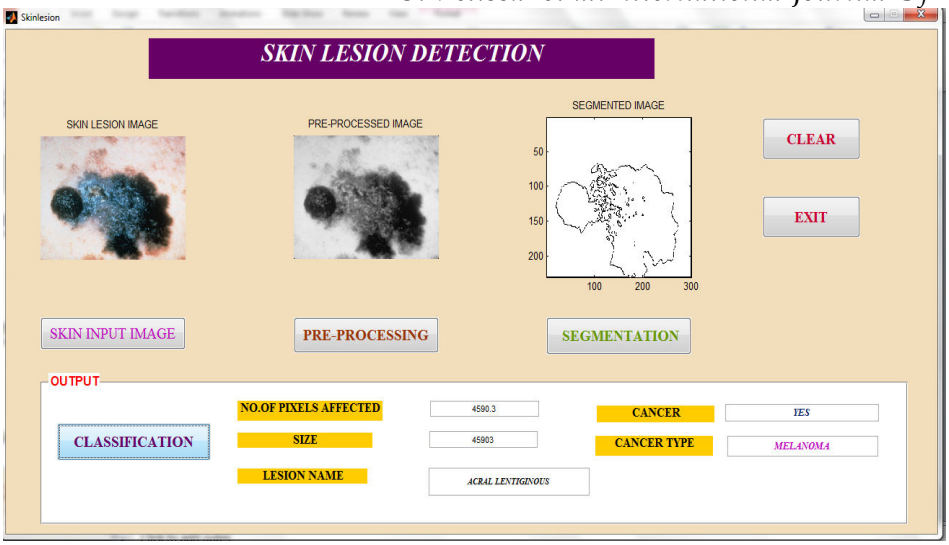

Fig-9: Acrallentiginous.

3.2 Non-cancerous

The output of Non-Cancerous skin lesion type is shown below in fig 10.

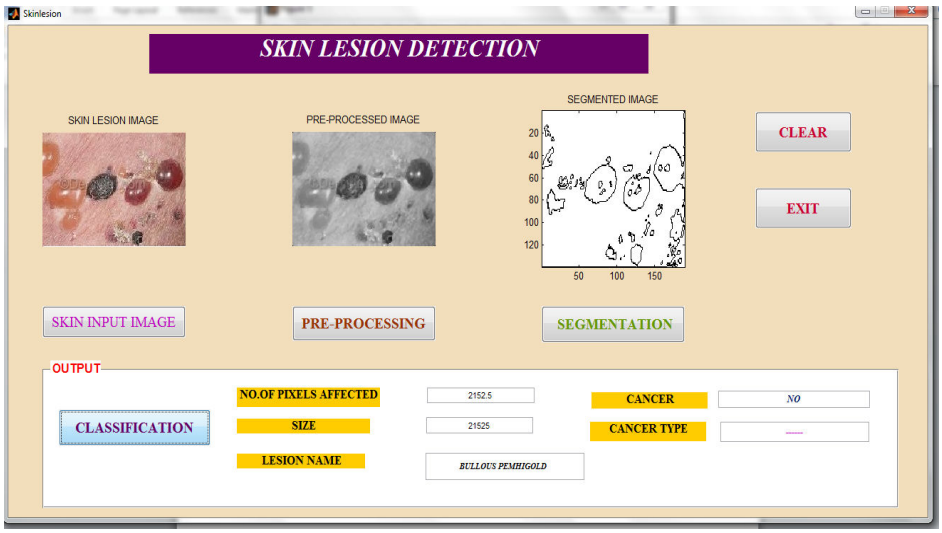

Fig-10: Bullous pemhigold Non-cancerous type.

Conclusion

In this paper, we have emphasized to design and develop a very small, simple and very efficient fuzzy based segmentation by edge detection method which connects the concept of image processing and artificial intelligence. Here, in the MATLAB environment the proposed algorithm is developed and GUI is designed based on the work. Various standard filters and edge detection techniques are compared and displayed. The compared results have shown the accuracy of median (2-D) filter over the other standard filters. Similarly the accuracy of edge detection using newly designed Fuzzy Inference System(FIS)over the other edge detection methods are displayed .the extracted features from edge detection is

classified based on its types. Thus, fuzzy based algorithm has acquired edges of various images of skin lesion; edge is detected and classified successfully based on its feature. Outputs have been displayed to the readers for easy understanding of the accuracy of algorithms. More than 50 images have been trained to identify the lesion type.Thus, the proposed algorithm exhibits a better and good scope of application for detection of pigmented epidermal layer. In future work, the proposed method can be extended to examining the Magnetic Resonance Images MRI for edge detection.

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