Dermoscopic Image Classification Using Image Processing Technique For Melanoma Detection

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Abstract- In recent days, melanoma cancer is seen as one of the most dangerous forms of the cancers found in people. Skin cancer is found in various types such as basal, squamous cell carcinoma among which melanoma skin cancer is the most unpredictable. The detection of the beginning stage of melanoma cancer can be helpful to cure it. Digital image processing can play important role in medical image diagnosis and also proved by many existing systems. In this paper, we presented a digital image processing method for the detection of melanoma Skin cancer and classify by machine learning techniques. The input to the method is the skin lesion image and then by applying image processing and classification techniques, it analyses it to conclude about the presence of skin cancer. The skin cancer image analysis techniques check for the various melanoma features like color, border, texture, and shape analysis for segmentation and feature extraction stage. The extracted features are used to classify the image as no cancer, beginning melanoma cancer, and highly melanoma cancer.

Index Terms- Melanoma Skin Cancer, Image Preprocessing, Segmentation, Feature Extraction, Classification.

1. INTRODUCTION

The malignant melanoma is caused due to ultraviolet radiation and damages the DNA indirectly. The reactive oxygen species and free radical are the two main causes of DNA damage. Melanoma is poisonous cancer and it can be cured at the beginning stages of cancer. The classification of skin cancer melanoma using images is a challenging task in the appearance of skin cancer [20]. Therefore, to overcome all these issues, digital image processing is applied for detecting melanoma skin cancer [2, and 4]. The techniques work on the image so there is no physical contact with skin, so this is non-invasive. The first stage is image preprocessing of the image of skin cancer which is followed by image segmentation after it is followed by feature extraction. The extracted features are used for classification the image as no cancer, beginning cancer and melanoma cancer [10, 17, and 21].

Paper is prepared as follows; section II presents related work on different classification techniques used for skin cancer detection. Section III includes the methodology and architecture flow diagram of Skin Cancer Disease. Section IV presents the image processing methods and classification techniques and its description. Section V provides the result analysis of melanoma cancer detection. Section VI contains a conclusion of the paper.

2. RELATED WORK

Suleiman Mustafa et. al. [3] proposed a computerized framework for recognizing melanoma skin cancer from plain photos of influenced skin locales. Wilson F. Cueva et. al. [22] proposed a framework for the detection of melanoma by getting Asymmetry, Border, Color, and Diameter (ABCD of melanoma). Farzam Kharaji Nezhadian et. al. [26] displayed another calculation to arrange dermoscopic images into malignant and generous. The technique depends on eye-derivation, conclusion of melanoma in beginning time is troublesome for dermatologist. The skin features are extracted using the techniques such as border detection, image segmentation, and texture feature. The Bayes-a networks was used with SVM and CART. The model proposed in the paper eliminates the usage of video microscopy and ELM which involves a high noise [36]. Reduce the noise using the image enhancement technique. Classification algorithms are applying and predict the stages of the lung cancer [37]. Uzma Bano Ansari et. al. [38] proposed skin cancer detection framework by using SVM for early detection of skin cancer. The diagnosing strategy utilizes Image processing strategies and SVM calculation. The assessment results inferred that the proposed arrangement of skin cancer detection whether image is cancerous or non-cancerous. Exactness of proposed framework is 95%.

In this paper [39] Yuexiang Li et. al, chipped away at two deep learning strategies named as the LIN and the LFN, to address three primary undertakings i.e. Segmentation of Lesion, Feature Extraction of Lesion Dermoscopic, Lesion Classification rising in the zone of skin lesion image processing. Creator proposed a deep learning system comprising of two FCRN, all the while delivering the division result and the coarse characterization result.

Yading Yuan et. al. in [40], introduced a completely programmed strategy for skin lesion division by ideal use of a prepared 19-layer deep CNNs which doesn't depends on earlier learning of the information. Here in [41] Supriya Joseph et. al., proposed a non-intrusive robotized skin lesion investigation framework for the beginning of melanoma utilizing digital image processing procedures and portable innovations. The test result is assessed on PH2 database. Yu-A Chung et. al. [42], proposed a deep Siamese CNN (SCNN) design that can be prepared with just parallel image match data to learn image portrayals with less supervision included. The aftereffects of the test demonstrate that creator's framework i.e. deep SCNN is practically identical to the cutting edge single administered CNN, and requires significantly less supervision for preparing. Haofu Liao [43], exhibited an examination on practicality of developing a general skin sickness finding framework utilizing CNN. Assessment aftereffects of framework demonstrate that, proposed system can accomplish as high as 73.1% Top-1 exactness and 91.0% Top-5 precision when testing on the Dermnet dataset. For the test on the OLE dataset, Top-1 and Top-5 correct nesses are 31.1% and 69.5%. N. C. F. Codella et. al. [44] The deep learning with set up machine learning approaches assessed utilizing the biggest freely accessible benchmark dataset of dermoscopic images. New cutting edge execution levels are illustrated, prompting a change in the territory under recipient working trademark bend of 7.5%, in normal exactness of 4%, and estimated 95%.

3. PROPOSED METHODOLOGY FOR IDENTIFICATION AND DETECTION

The methodology used for skin cancer melanoma detection using digital image processing is as available in following figure. The skin dermoscopic image is input first in raw form on which classification is applied to identify whether it is supposed to be a beginning cancer or melanoma cancer or no cancer. Then image preprocessing techniques are applied to increase the image quality. The edge detection techniques and Otsu thresholding method are used for segmentation of the input image. The image is then after made available to perform the feature extraction. The features considered for an experiment are color, size, statistical, abcd and texture. The statistical, abcd and texture features are the important features of skin cancer. After that extracted features are additionally passed into an algorithm for classification which classifies beginning of cancer, skin cancer melanoma or normal by paralleling its feature value [2].

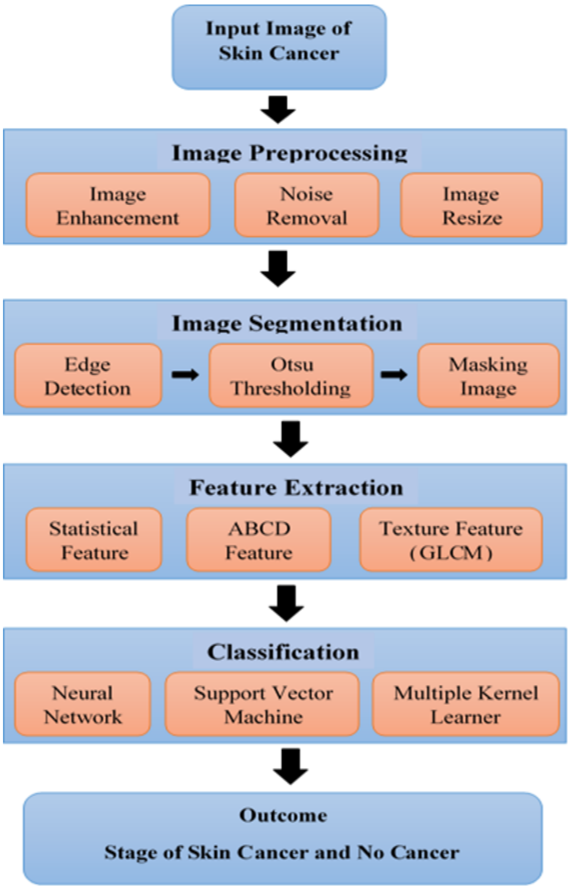

Fig. 1. Working of Proposed Methodology.

3.1. *Image Pre-processing*

The image given to the algorithm can be obtained by any camera such as a mobile or lighting condition. Therefore, it requires to be preprocessed. Here, the image preprocessing includes contrast adjustment and image denoising, image resizing [6, and 7]. The dermoscopic insert image is taken and the image is resized with 200X200 subsequently applied. In our work, the median filter is applied to eliminate the noise in the skin images [19].

3.2. *Image Segmentation*

Segmentation is the strategy for designating a modernized picture into various portions. The Otsu thresholding method which is the region of shading image or large a grayscale of the image [6] is applied. In this stage, the Otsu technique is applied on an image in RGB planes. First, edge detection techniques applied and then after that automatic thresholding proposed by Otsu applied [35]. Binary image for each plane is obtained and finally it produced for masking of cancer image [27]. We used the masking technique to increase the accuracy of the segmented image. The main extracting foreground form background is, cancer extracting from the skin [16, and 32].

3.3. *Feature Extraction*

Feature extraction is the way to characterize the arrangement of features which will be most effectively worked. The key features of skin cancer are statistical, texture and ABCD feature [5, and 6]. Hence, we extract the color, size, statistical, abcd and texture features from a segmented image of skin cancer [14, and 33]. Statistical features including mean, standard deviation, autocorrelation, median, and mode are extracted from the image [7]. Texture feature extracted as GLCM features from the curvelet domain and this feature includes contrast, correlation, energy, entropy, homogeneity [13]. The ABCD feature identifies Asymmetry (colour/structure), Border, Colour, and Diameter [11, and 28].

3.4. *Classification*

Classification is an essential stage for distinguishing skin cancer composes. Using image processing for skin cancer melanoma, implemented some available methods for image classification. There are two vital stages in the arrangement. They are preparing a training and testing stage. In the preparing stage, the pre-decided information and its related class names are utilized for classification [8]. In the classification step, it classifies images as beginning cancer or melanoma cancer or no cancer. In this work, many types of classification techniques are applied for detecting the skin cancer images and their performance are lastly compared [1, 31, and 34].

3.4.1. *Using Neural Network*

It is the supervised learning algorithm. In this work, the calculation is decayed in the accompanying four steps: Initialization of weights, after that feed-forward calculation, then forward propagation of errors, and at last biases and weights are updating [9]. In this work different features like color, size, texture and statistical feature are given to network. This algorithm gives 80.43% accuracy [24].

3.4.2. *Using SVM*

SVM is a kernel approach for constructing machine learning that minimizes the generalization errors. SVM constructed by a set of the hyperplane that separate classes [15]. The SVM decision boundary is the line separating region containing them. Different features are applied to support vector machine [12, 29, and 30]. This algorithm gives 86.17% accuracy.

3.4.3. *Using Multiple Kernel Learning*

It is also a supervised learning method which refers to various ML techniques that uses multiple sets of kernels. MKL include (i) the capability to choice for parameters and an optimal kernel from multiple sets of kernels. (ii) Combining dataset from different bases that have different concepts of similarity. This algorithm gives 90.3% accuracy.

4. RESULT ANALYSIS AND DISCUSSION

4.1. *Dataset*

A dataset of Skin Cancer images is collected from the International Skin Cancer Images: Melanoma Project ISIC https://isic-archive.com. And another dataset of melanoma images is collected from the DermIS (http://www.dermis.net) and DermQuest (http://www.dermquest.com) database [18]. The dataset contains 1150 dermoscopic images of skin which is classified into three classes: beginning cancer or melanoma cancer or no cancer.

4.2. *Result Analysis*

The implementation work is carried out using image processing toolkit - MATLAB R2018a. Performance analysis helps to identify most efficient classification technique used for skin cancer image by analyzing parameters values. Performance analysis carried out based on application of three different classification methods, with consideration of accuracy, precision, f-measure, and recall [25] parameters. Table 1 shows the detail of cancer image test set experiment with its accuracy, precision, f-measure, and recall [23].

Table 1. Performance analysis of different classification algorithms.

Algorithm	Accuracy	Precision	Recall	F-Measure
ANN	0.80	0.803	0.801	0.797
SVM	0.86	0.864	0.868	0.863
MKL	0.90	0.900	0.897	0.890

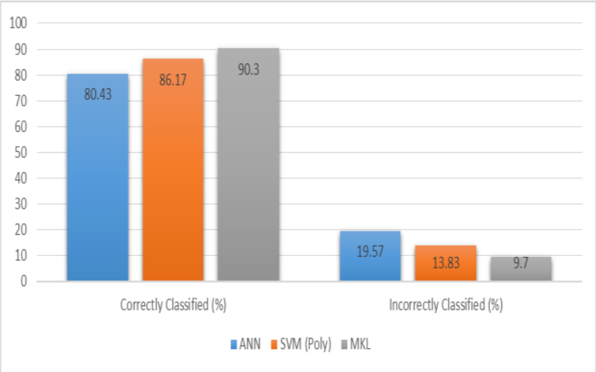

Fig. 2. Accuracy of correctly and incorrectly

First, the image of skin cancer is input and then implemented preprocessing techniques. Then after, edge detection techniques and thresholding and masking method are applied to the image. It is presented in the following figures.

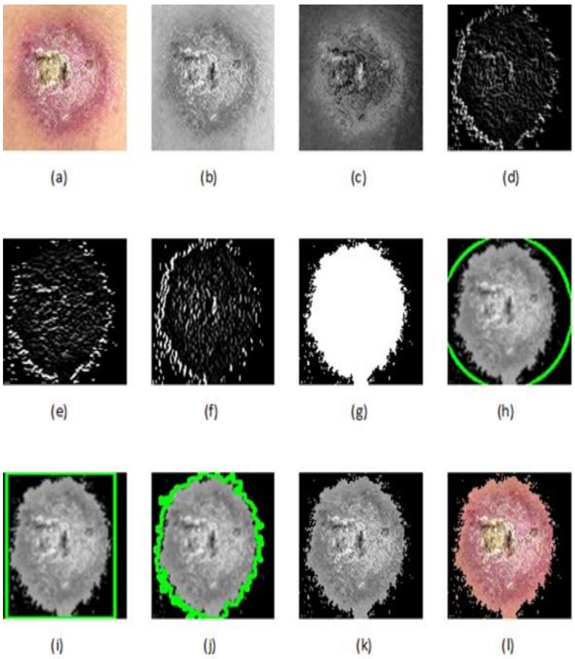

Fig. 3. No Cancer Image Segmentation (a) Original image (b) Remove noise (c) Grayscale image (d, e, f) Edge detection method (g) Otsu thresholding (h, i, j) Masking (k) Final grayscale image (l) Final color image

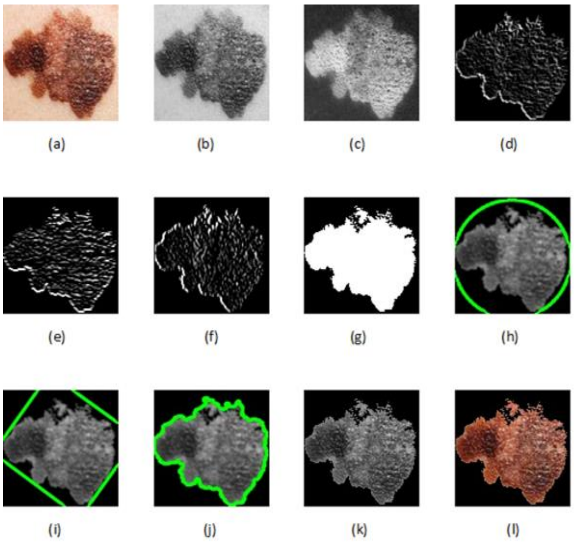

Fig. 4. Beginning Stage Cancer Image Segmentation (a) Original image (b) Remove noise (c) Grayscale image (d, e, f) Edge detection method (g) Otsu thresholding (h, i, j) Masking (k) Final grayscale image (l) Final color image

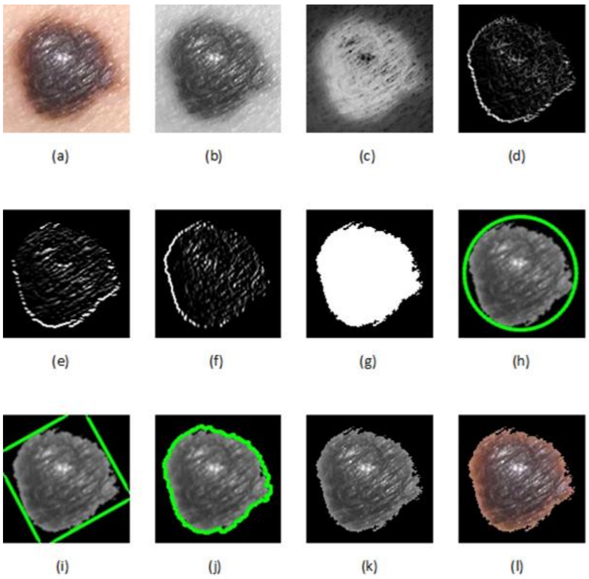

Fig. 5. Melanoma Cancer Image Segmentation (a) Original image (b) Remove noise (c) Grayscale image (d, e, f) Edge detection method (g) Otsu thresholding (h, i, j) Masking (k) Final grayscale image (l) Final color image

Second, the feature extraction of skin cancer is carried out to obtain ABCD rule features and statistic features for identifying skin cancer melanoma. That is, for a given skin cancer, Asymmetry (color/structure), Border irregularity, Color patterns, and Diameter are identified. As shown in the flowing figure, image of the skin cancer melanoma is efficiently extract for normal skin to melanoma cancer using the ABCD feature extraction.

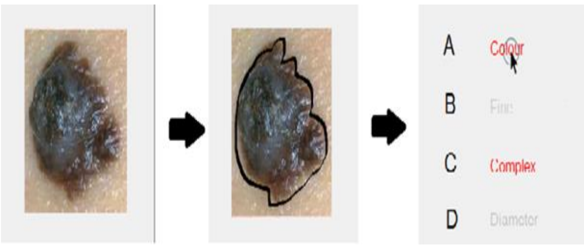

Fig. 6. Melanoma Cancer Feature Extraction (a) Original image (b) Extract melanoma cancer (c) ABCD feature extraction

Third, the different classification techniques are implemented applied to the segmented image to classify the image. As shown in the flowing figure, the image of the skin is efficiently classifying for No cancer image, beginning cancer image and Melanoma cancer image using the classification method.

Fig. 7. Outcome of No Cancer Detection

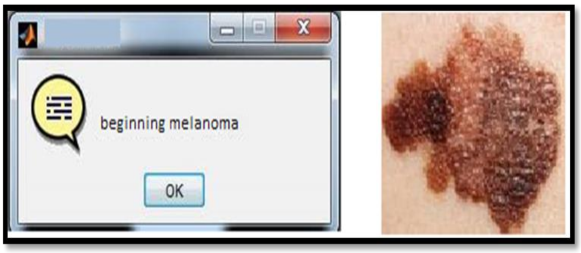

Fig. 8. Outcome of Beginning Cancer Detection

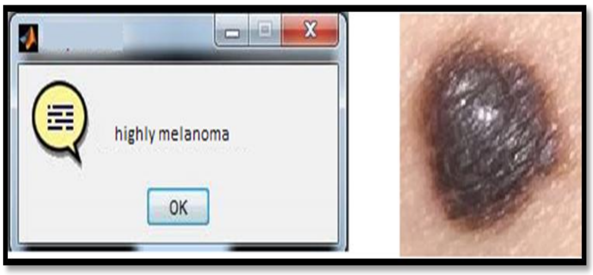

Fig. 9. Outcome of Highly Melanoma Cancer Detection

5. CONCLUSION

This paper discusses an approach of identifying and classifying skin dermoscopic image using image processing and classification techniques. An image is preprocessed, segmented and selected features are extracted. Different classification techniques are applied on these extracted features and their performance is measured by several parameters. Based on the experiment, it can be concluded that the MKL (multiple kernel learner) classification techniques are one of the efficient method used to diagnose the melanoma skin cancer more accurately. This work is more helpful for the research scholars where the medical field may not be available. Since the techniques are more robust and user-friendly for any conditions images, it can serve the purpose of automatic diagnostics of the Melanoma Skin Cancer.

In future work, plan to explore different types of skin lesion images to better assess our lesion classification model. This will be done by considering other datasets or using images from the Internet. It would also be interesting to investigate other training algorithms for classification, and it may be useful to perform skin detection, especially when handling the varying skin colors of people of different ethnicities.

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