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Artificial Intelligence framework for Skin Cancer detection and classification

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ABSTRACT :-

Melanoma is the dangerous form of skin cancer. Rate of melanoma incidence have been increasing nowadays. It is found to be common among non-Hispanic white males and females, but survival rates are high if detected early. Due to the costs for dermatologists to examine every patient, there arises a need for an automated system to assess a patient's risk of melanoma using images of their skin lesions captured using a standard digital camera. One challenge in implementing such a system is locating the skin lesion in the digital image. In the proposed method the image is processed, segmented and spatially gray level dependency matrix (SGLD)features are extracted. Then the features are compared with the given database and classification is done using back propagated artificial neural network (BP-ANN). The proposed framework has higher accuracy compared to other tested algorithms.

Keywords: Skin Cancer, Feature extraction, and Neural Network

1. INTRODUCTION

Human Cancer is an intricate disease caused primarily by genetic inconstancy and accumulation of multiple molecular alternations [1-2]. During the clinical appearance, breast, skin, colon, a large percentage of prostate and ovarian cancer patients are hidden and metastatic colonies [3]. Among many types of cancer, Skin cancers are the most common form of cancers in human

[4]. The human body has vast organ called skin. It separates the inward parts of the body and furthermore frames outer condition. The skin is a paramount organ that protects against body sensitivity, infection, pollution, odor, and it regulates body temperature. There are numerous side effects like skin drying, fatty

acids, hair, and acne, which may cause or damage the skin surface. They might be caused by sensitivities, aggravations, hereditary issues and invulnerable framework issues. Every one of these side effects can bring about numerous diseases like skin break out, alopecia, dermatitis, and ringworms causing mutilation in look andfeel of distinctive distressed. Diseases, for example, growth identified with Skin can be caused by numerous unmistakable reasons [5]. Unusual growth of skin cells due to skin cancer is often shown in the body's sunlight but can occur anywhere in the body. It promotes when an unrepaired DNA damage to the skin cells and mostly caused by ultraviolet radiation of the sun or tanning beds, trigger metamorphosis which leads to the skin cells multiply promptly and malignant tumors form. Some skin cancer can spread and cause confusion in the nearby tissue cells [6]. Sun is the most known cause of skin cancer. But it fully does not paraphrase that skin cancer usually develop on the skin exhibited to sunlight. Also, it can be exhibited to environmental threats, radiation analysis, and even legacy could play a role [7]. There are three types of skin cancer, they are- Basel cell cancer, squamous cell carcinoma, and malignant melanoma cancer. The first two does not grow quickly, but the third one growth quickly. Melanoma is much less common than skin cancer of basal cells and squamous cells, but it is much more dangerous than the other two types. However, it is much more hazardous if it is not found early. This is the reason for most of the deaths related to skin cancer (75%) [8]. Bleeding, itching and a mass under the skin are other implications of cancerous change.

2. RELATED WORK

An automated system for detection and classification of one of the skin three types of skin cancerous proposed here: Melanoma, Basal cell carcinoma, Squamous cell carcinoma .There are a certain features of these types of skin cancers, which can be extracted using the proper feature extraction algorithm [9]. Various algorithms such as segmentation and characterization are used for the classification of chaotic skin jungle from a macroscopic image. A new system for characterizing digital images of skin lesions has been presented [10]. A scheme for automated detection of skin diseases by analyzing the texture recognition approaches based on gray level co-occurrence matrix (GLCM) is discussed here. The characteristic features of the test and the reference images and analyzed the skin diseases using texture analysis are extracted. Texture analysis is one of the fundamental aspects of human vision by which we differentiate between surfaces and objects [11]. Segmentation of the skin lesion of the surrounding skin in dermoscopic images using the segmentation algorithm of the neural network. Various segmentation approaches were used to the dermoscopic images to segment the skin lesions and calculated with 3 different metrics, such as sensitivity, accuracy and border error. Segmentation performance shows that Neural Network based lesion segmentation has high sensitivity, accuracy and less border error [12][13].

A study on past and present technology for skin cancer detection are given in detail with their relevant tools. Then it goes on discussing briefly about features, advantages or disadvantages of each of them, discussed the mathematics initial required to process the image of skin cancer lesion using the proposed scheme. [14]. A technique for the early detection of skin cancer problem is proposed. The diagnosis procedure for the treatment of malignant melanoma from other skin diseases, using digital image processing approaches and artificial neural networks. Dermoscopic images were composed and they are processed by numerous Image processing approaches. The cancerous region is separated from the healthy skin by the method of segmentation. [15]. The detection of melanoma based on region growing segmentation and the ABCD rule used for the detection of malignancy of brunette skin lesion is discussed. [16]. A method for detecting the border and identifying the occurrence and propagation of cancer by analyzing the variations of the RGB spectrum of lesion skin images using novel Six Sigma threshold and region connectivity concepts is presented in [17]. An automated method for melanoma diagnosis is applied on a set of dermoscopy images. Multilayer perceptron classifier to classify based on the extracted characteristics or to classify the gray-level cooccurrences matrix (GLCM) and the melanocytic navigator and the malignant melanoma [18].

3. PROPOSED METHODOLOGY

A. INPUT IMAGE

Dermoscopy, also known as Dermoscopy or Epiluminescence Light Microscopy (ELM)[3]. It is a kind of imaging technique used to examine lesions with a dermoscopy. The process is done by placing an oil immersion between the skin and the optics. Lens of a microscope is placed directly, illuminating sub-

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surface structures. The lighting can magnify the skin that improve on reveal most of the pigmented structure, different color shades that is not visible to naked eye; and allows direct viewing and analysis of the epidermis. The image obtained from such a dermoscopy is called Dermoscopic Image. These images are then resized into a standard pixel value of 512 x 512.

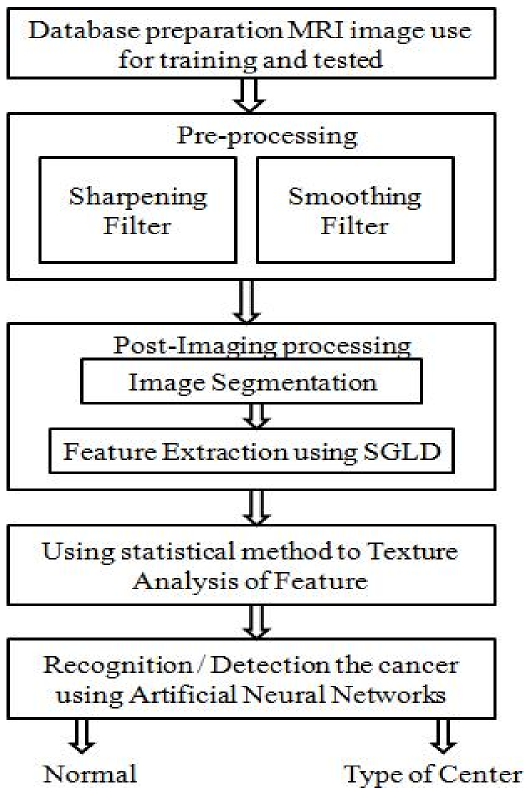

Fig. 1: Skin cancer detection and classification.

B. PREPROCESSING

Images are often corrupted by impulse noise due to transmission errors, malfunctioning pixel elements in the camera sensors, faulty memory locations, and timing errors in analog-to-digital conversion. The goal of noise removal is to suppress the noise while preserving image details[4]. A variety of techniques have been proposed to remove impulse noise. Noise is perturbations of the pixel values. Noise arises in the sensor or the imaging process. Image filters produce a new image from an original by operating on the pixel values. Filters are used to suppress noise, enhance contrast, find edges, and locate features. To enhance the quality of images, we can use various filtering techniques which are available in image processing. There are various filters which can remove the noise from images and preserve image details and enhance the quality of image. The common noise which contains the image is impulse noise. The impulse noise is salt and pepper noise (image having the random black and white dots). Sharpening and smoothing filter is the filter that removes most of the noise in image.

C. SEGMENTATION

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.

Morphological image processing is a collection of nonlinear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images.pattern of ones and zeros specifies the shape of the structuring element. Some operations test whether the element "fits" within the neighborhood, while others test whether it "hits" or intersects the neighborhood.

A morphological operation on a binary image creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image. Zero-valued pixels of the structuring element are ignored, i.e. indicate points where the corresponding image value is irrelevant.Dilation has the opposite effect to erosion – it adds a layer of pixels to both the inner and outer boundaries of regions. Results of dilation or erosion are influenced both by the size and shape of a structuring element. Dilation and erosion are dual operations in that they have opposite effects. Let f c denote the complement of an image f, i.e., the image produced by replacing 1 with 0 and vice versa. If a binary image is considered to be a collection of connected regions of pixels set to 1 on a background of pixels set to 0, then erosion is the fitting of a structuring element to these regions and dilation is the fitting of a structuring element (rotated if necessary) into the background, followed by inversion of the result.

D. FEATURE EXTRACTION

Feature extraction in image processing is a technique of redefining a large set of redundant data into a set of features of reduced dimension. Transforming the input data into the set of features is called feature extraction. Feature selection greatly influences the classifier performance; therefore, a correct choice of features is a very crucial step. Various features extracted includes contrast, correlation, energy, entropy, homogeneity:

Contrast: Returns a measure of the intensity contrast between a pixel and its neighbor over the whole image.

Correlation: Returns a measure of how correlated a pixel is to its neighbor over the whole image. Its range is between -1 and 1. Correlation is 1 or -1 for a perfectly positively or negatively correlated image.

Energy: Returns the sum of squared elements in the SGLD. It ranges from 0 and 1. Energy is 1 for a constant image.

Entropy: It returns a scalar value representing the entropy of grayscale image. Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

Homogeneity: Returns a value that measures the closeness of the distribution of elements in the SGLD to the SGLD diagonal. Its values range from 0 to 1.Homogeneity is 1 for a diagonal SGLD.

E. NEURAL NETWORK

BP-ANN is a deep learning approach that models human brain and consists of several artificial neurons. Neuron in BP-ANN tend to have fewer connections than biological neurons. Each neuron in BP-ANN receives a few inputs. An activation function is applied to these inputs which results in activation level of

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neuron (output value of the neuron). Knowledge about the learning task is given in the form of examples called training examples. An Artificial Neural Network is specified by: Neuron model, which is the information processing unit of the NN, an architecture that contain a set of neurons and links connecting neurons. Each link has a weight, a learning algorithm which is used for training the NN by modifying the weights to model a particular learning task correctly on the training examples. The aim is to obtain a NN that is trained and generalizes well. The neuron is the basic information processing unit of a NN. It consists of a set of links, describing the neuron inputs with weights W1, W2,…Wm, an adder function (linear combiner) for computing the weighted sum of the inputs: Activation function φ for limiting the amplitude of the neuron output. Here bias is denoted as „b‟,

$$\mathbf{u} = \sum_{j=1}^{m} \mathbf{w}_j \mathbf{x}_j$$

$$y = \varphi(u + b)$$

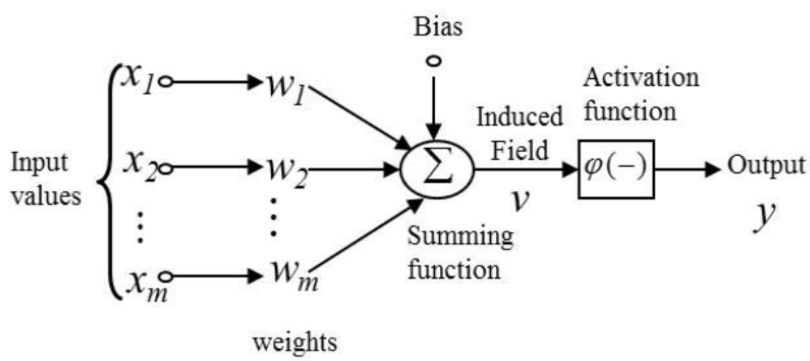

Fig. 2: Neuron diagram

The neuron diagram is shown in the above diagram where bias b has the effect of applying a transformation to the weighted sum u

$$v = u + b$$

In this proposed system, a feed forward multilayer network is used. The neural network classifier structure consists of Input layer, Hidden layer, and Output layer. The hidden and output layer adjusts weights value based on the error output in classification.

4. SIMULATIONAL RESULTS

This section details the results of automatic classification on images that acquired by means of dermoscopy technique. Database consists of 101 dermoscopy images, previously diagnosed, 45 of them are melanomas and are non-melanomas. SGLD features were used for feature extraction and neural network for classification. 5 features are selected and these input fed to neural input layer. Corresponding values of each features are extracted and then compared with the values of database using neural networking. Fig 5 shows the output of each stages. The proposed method trained with 75% and tested with 25% of the total number of images. At the end of the training process updated weight values are

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stored. Then the performance value is measured. Final result is shown in Fig .3

(a)

(b)

(c)

(d)

(e)

(f)

Fig. 3: Input and detected region of skin cancers.(a)Malignant – Melanoma, (b) Malignant - Basal Cell Carcinoma (c) Malignant - Basal Cell Carcinoma (d) Benign - Melanocytic Nevi (e) Benign - Melanocytic Nevi (f)Benign - Seborrheic Keratoses

5. CONCLUSION

A Computer aided skin cancer detection system can achieve a new discovery of detecting benign or malignant skin lesions and separating them from healthy skins. The diagnosing methodology uses Digital Image Processing Techniques and Artificial Neural Networks for the classification of Malignant

Melanoma from benign melanoma. Dermoscopic images were collected and they are processed using median filter are used to remove salt and pepper noise. After preprocessing images is segmented using maximum entropy method. Maximum entropy thresholding is used to find out region of interest. The unique features of the segmented images are extracted using feature extraction techniques. This Methodology has got 86.66% accuracy. By varying the Image processing techniques and training algorithms of ANN, the accuracy is improved for this system and the images are classified as cancerous or non-cancerous.

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