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DIAGNOSIS OF MELANOMA SKIN CANCER USING NEURAL NETWORK

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ABSTRACT

Malignant melanoma is the appearance of sores that cause bleeding and is the deadliest form of skin cancer. Incidence rates of melanoma have been increasing, but survival rates are high if detected early. With the advancement of technology, early detection of skin cancer is possible. The proposed framework consists of image segmentation, followed by comprehensive feature set extraction and neural network classification with higher segmentation accuracy. The system uses enhanced image processing to segment the images without manual intervention. From the segmented image, it extracts a comprehensive set of pixel features and RGB colour components of the digital image. As the experience and training-based learning is an important characteristic of neural networks, the features were fed automatically to a Back-Propagation Neural Network (BPNN) classifier. It classifies the given data set into cancerous or non-cancerous to identify the skin cancer easily.

Keywords: *Melanoma, skin cancer, Back Propagation Neural Network, Classifier*

1. INTRODUCTION

Melanoma skin cancer is a malignant tumour of melanocytes which is causing a large number of deaths and it has been also found that its incidence rates have been on rapid increase. These tumours' originate in the pigment-producing melanocytes, a skin cell producing the melanin pigment in the basal layer of the epidermis, which provides protective shielding from Ultraviolet radiations. Melanoma accounts for approximately 75% of deaths associated with skin cancer. Recent trends have stated that melanoma can be less dangerous if detected at an early stage i.e. if detected at earlier Stage, the survival rate of the effected person increases to 96% . The diagnosing methodology uses Image processing techniques and Artificial Neural Networks for the classification of Malignant Melanoma from other skin diseases. An automatic classification system, which can accurately classify skin lesions with sensitivity comparable to an expert, would increase the chances of early diagnosis and treatment and decrease the fatality rate of melanoma. The system uses enhanced image processing to segment the images without manual intervention. From the segmented image, it extracts a comprehensive set of features using new and improved techniques. The classifier also helps reduce the unnecessary biopsies conducted based on visual classification. Furthermore, if the classification system uses machine learning and artificial intelligence techniques, its accuracy can increase as it encounters more examples of lesions. If the classifier could be made widely available to the physician community, it has the potential to reach even higher levels of sensitivity and specificity and can classify the images better than expert dermatologists. Computer based diagnosis can improve the speed of skin cancer diagnosis which works according to the disease symptoms.

The proposed system uses genetic algorithm and the back propagation algorithm to classify the skin lesions.

2. LITERATURE SURVEY

A.F Jerant, Johnson JT, Sheridan CD, Caffrey TJ [8] proposes a technique to detect cancer in early stage. Aggressive local growth and metastasis are common features of malignant melanoma, which accounts for 75 percent of all deaths associated with skin cancer. Early detection greatly improves the prognosis of patients with malignant melanoma. The differential diagnosis of pigmented lesions is challenging, although the ABCD and seven-point checklists are helpful in determining which pigmented lesions require excision. Sun exposure remains the most important risk factor for all skin neoplasms. The incidence of skin cancer is increasing by epidemic proportions Thus, patients should be taught basic "safe sun" measures: sun avoidance during peak ultraviolet-B hours, proper use of sunscreen and protective clothing; and avoidance of sun tanning.

Nobuyuki Otsu proposes[14] a nonparametric and unsupervised method of automatic threshold selection for picture segmentation is presented. An optimal threshold is selected by the discriminant criterion, namely, so as to maximize the separability of the resultant classes in gray levels. The procedure is very simple, utilizing only the zeroth- and the first-order cumulative moments of the gray-level histogram. It is straightforward to extend the method to multi-threshold problems. Several experimental results are also presented to support the validity of the method. They may be recommended as the most simple and standard one for automatic threshold selection that can be applied to various practical problems.

Harald Ganster, Axel Pinz, Reinhard Röhrer, Ernst Wildling, Michael

Binder, and Harald [13] proposes a computerized technique for detecting melanoma at early stage. In the initial step basic segmentation algorithms are applied together to determine the binary mask of the skin lesion together with a fusion strategy. Inorder to determine the malignancy of the lesion the local and global parameters is evaluated. Significant features are then selected from this set by application of statistical feature subset selection methods. The final classification delivers a sensitivity of 87% with a specificity of 92%.

Jeffrey Glaister, Robert Amelard, Alexander Wong and David A. Clausi [3] paper presents a multistage illumination algorithm to remove the illumination variations in images containing skin lesions. The first step includes a Monte Carlo Nonparametric Modelling Strategy that gives an estimate of the illumination map. A set of representative texture distributions are learned from an illumination-corrected photograph and a texture distinctiveness metric is calculated for each distribution In the second step Parametric Modelling Strategy is used to draw a final estimation of the illumination map. Better segmentation, classification and visual results are shown by the final illumination map estimate

N.Ezhilventhan, S.Sathiya [2] paper proposes the detection and classification of skin lesion images taken with digital camera. and headed the research to computerized analysis by using digital image processing techniques. Initially the image is preprocessed to remove impulse noise using adaptive median filter .The image is segmented and the textural features are extracted by Gray Level Co-occurrence Matrix (GLCM) from segmented skin lesion image. Finally classify the lesion as a benign or malignant by using Support Vector Machine (SVM) classifier. The result clearly differentiates

the benign and malignant with desired accuracy, specificity and sensitivity.

3. PROPOSED METHOD

The proposed system uses digital image processing technique and Artificial Intelligence for the classification purpose. The input to the system is Dermatoscopic Images which are in digital format. Usually such images contain noises, so they are undergone pre-processing. In order to preserve the edges, Post-processing is done. To separate the cancerous region from healthy skin, segmentation is done. There are some unique features for the cancerous images. Those features are extracted and given as inputs to the Back propagation Neural Network (BPNN) Classifier. The BPNN classifies Malignant Melanoma from Benign Melanoma. Thus detecting whether patient is having skin cancer or not.

The proposed system involves following stages in diagnosing the skin cancer. They are as follows.

1. Pre-processing of digital dermatoscopic image
2. Segmentation of image
3. Feature Extraction from the segmented result
4. Classification of cancerous skin

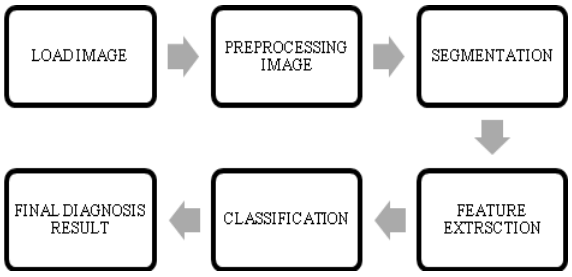

Figure 1. Architecture of the proposed system

3.1. Preprocessing

A common feature of dermatoscopic images is the non-uniform background. The non-uniformity is caused by several inherent factors such as water or air bubbles (resulted from the immersion acquisition step), the thick hair that occlude areas of interest, skin lines and other cutaneous skin lesions (desquamation, dry skin) that can prevail upon on wrong diagnostic or obstruct

useful information in the regions of interest. In order to avoid that, images are subjected to various image processing techniques.

Pre-processing is done to removes the noise, fine hair and bubbles in the image. For smoothing image from noise, median filtering is used. Median filtering is a common step in image processing. Median filtering is used for minimizing the influence of small structures like thin hairs and isolated islands of pixels like small air bubbles. It is a non-linear digital filtering technique used to detect edges of the image and to smoothen it. Histogram Equalization method is used in adjusting contrast of an image. The global contrast of the image is increased by adjusting the intensities. The areas which have a lower contrast are given a higher contrast.

Figure.2 Input image

With this the image becomes easier to analyze and the visual quality is improved. The pre-processed image is then subjected to segmentation. The sample image of skin lesion before and after Pre-processing is shown below.

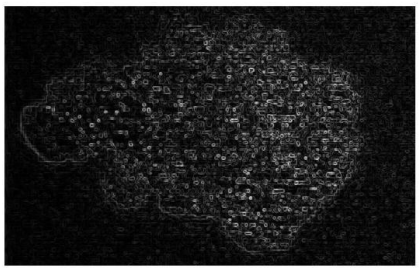

Figure 2.2 Pre-processed image

3.2. Segmentation

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify the representation of an image which is more meaningful and easier to analyze. Segmentation is one of the most important steps in accurately determining skin lesion.

More precisely, image segmentation is the process of assigning a

label to every pixel in an image such that pixels with the same label share certain characteristics. The constituent regions or objects are segmented i.e. subdivided to make the image more meaningful to analyze. Here each pixel in an object has a similar label and share certain visual characteristics. After segmentation, the output is a binary image. Segmentation is accomplished by scanning the whole image pixel by pixel and labelling each pixel as object or background according to its binarized gray level.

Segmentation removes the healthy skin from the image and finds the region of interest. The cancer cells remains in the image after segmentation. Segmentation is a process in which every pixel in a digital image is assigned with a label to differentiate among pixels sharing same label and characteristics.

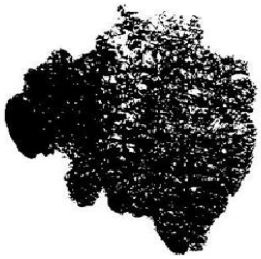

Figure 2.3 Segmented image

3.3. Feature Extraction

Feature extraction is the method by which unique features of skin lesion images are extracted. This method reduces the complexity in classification problems. There are certain features like geometry and colour which distinguish melanoma from benign lesions. By extracting those features, the classification can be made more efficient.

The Genetic Algorithm (GA) is a stochastic global search method that mimics the metaphor of natural biological evolution. GA operates on a population of potential solutions applying the principle of survival of the fittest to produce better approximations to a solution. At each generation, a new set of approximations is

created by the process of selecting individuals according to their level of fitness in the problem domain and breeding them together using operators borrowed from natural genetics. This process leads to the evolution of populations of individuals that are better suited to their environment than the individuals that they were created from, just as in natural adaptation.

Individuals, or current approximations, are encoded as strings, chromosomes, composed over some alphabet, so that the genotypes are uniquely mapped onto the decision variable domain.

The most commonly used representation in GAs is the binary alphabet although other representations can be used, e.g. ternary, integer, real-valued etc. Genetic Algorithm is a technique which makes it possible to get close results in less time even for infinite probabilities.

3.4. Classification

Back-propagation is a type of supervised training, where the network is provided with both the training inputs and the corresponding expected outputs. Using the expected output, the back-propagation training algorithm adjusts the weights of the connections backwards from output layer to the input layer. Since the nature of the error is not known, neural network training needs a large number of individual runs to determine the best possible solution.

Once the neural network is trained to a satisfactory level, it is ready to be used as classification tool for new input datasets with unknown classification. It classifies the given data set into cancerous or non-cancerous to identify the skin cancer easily. Back propagation neural network consist input layer, at least one hidden layer and output layer.

The hidden and output layer nodes adjust the weights value depending on the error in classification. In BPNN (Back

Propagation Neural Network) the signal flow will be in feed forward direction, but the error is back propagated and weights are updated to reduce error. The modification of the weights is according to the gradient of the error curve, which points in the direction to the local minimum. Thus making it much reliable in prediction as well as classifying tasks. Since fuzzy logic uses more advanced techniques to detect lesions, it is certainly preferable to a simple formula. However, unlike a machine learning based system, the accuracy of the system does not improve after the initial system parameters are chosen.

Neural networks can be thought of as continuously evolving function approximations. Since they can provide a concrete rule to analyse images, and yet learn to modify the rules from experience. It produces good classification effects in the system.

4. CONCLUSION

In summary, an automated Computer based early detection of skin cancer is proposed. It proves to be a better diagnosis method than the conventional Bioscopy method. Dermoscopic images were collected and they are processed by Image processing techniques using Mat-lab software. The dermoscopy image of skin cancer is taken and it is subjected to various pre-processing for noise removal and image enhancement. The cancerous region is separated from the healthy skin by the method of segmentation. From the segmented images neural network learns skin and lesion pixel values. The unique features of the segmented images were extracted and based on the features, the images were classified as Cancerous or Non-cancerous by Back Propagation Neural Network classifier. Any incorrectness in the segmented output of skin lesion is corrected with neural network.

The proposed system defines an effective way to detect the skin lesion

more accurately and faster by segmenting the lesion in images of different scales. Moreover, it has got good accuracy and higher levels of quality. As the proposed system involves concept of genetic algorithm and neural network, it achieves higher accuracy.

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