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Skin Lesions Detection Using Statistical Texture

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ABSTRACT

Skin cancer is the most common type of cancer.The deadliest form of skin cancer is melanoma and its incidence has been rising at a rate of 3% per year. Due to the costs for dermatologists to monitor every patient, there is a need for an computerized system to evaluate a patient's risk of melanoma using images of their skin lesions captured using a standard digital camera. As challenge in implementing such a system is locating the skin lesion in the digital image. In Proposed method, a novel texture-based skin lesion segmentation algorithm is used and to classify the stages of skin cancer using probabilistic neural network. Probabilistic neural network will give better performance in this system to detect stages in skin lesion. To extract the characteristics from various skin lesions and its features gives better classification with probabilistic neural network. There are five different skin lesions commonly grouped as Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Melanocytic Nevus / Mole (ML), Squamous Cell Carcinoma (SCC), Seborrhoeic Keratosis (SK). The system will be used to classify the queried images automatically to decide the stages of abnormality. The lesion diagnosis system involves two stages of process such as training and classification. A classifier will be used for classification based on learning with some training samples of each stage. The accuracy of the proposed scheme is higher in discriminating cancer and it attains classification accuracy is high of skin lesions.

Keywords— Median filter, Texture based skin lesion segmentation, Grey level co-occurrence matrix, Probabilistic Neural Network

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I. INTRODUCTION

Cancer can be defined as a disease in which there is fractious growth of cells and in disorderly manner. Skin cancers are the cancers that arise from the skin. They are due to the the development of abnormal cell that have the ability to spread to the other parts of the body. Skin cancers can be cured at high rates if treated early. Conventionally dermoscope is used to detect the skin lesion and later diagnosis can be done. Dermascopy is a bloodless clinical test to detect the skin lesions accurately. But due to the cost and lack of training to the dermatologists, it handling is difficult. So a new computerized approach for detection of skin lesions from digital images has been made. The proposed method comprises first step is preprocessing the images to remove the noise using adaptive filter. After pre-processing the segmentation is done by using texture filters. After that the features like contrast, correlation, energy, homogeneity, entropy, correlation are extracted from the segmented image using GLCM (Grey Level Co-occurence Matrix).Finally classify the lesion as cancerous or normal

using Probabilistic Neural Network. The performance of the system is figured out with accuracy, specificity and sensitivity.

II. LITERATURE SURVEY

In the recent years, there has been tremendous research on skin lesions detection. The detection of skin lesions mainly consists of segmentation and classification-

2.1 Skin Lesion Image Segmentation Techniques

Pathology identification is performed by the image classification technique and then the treatment is planned based on the nature of abnormality. After treatment, it is highly essential to estimate the response of the patient to the treatment. In case of skin lesion abnormalities, the size of the affected area may decrease which indicates a positive effect and sometimes it may increase which shows a negative effect. In any case, it is important to perform a volumetric analysis on skin lesion images. Image segmentation covers this objective by extracting the abnormal portion from the image which is useful for analyzing the size and shape of the abnormal region. This method is also called as "pixel based classification" since the individual pixels are clustered unlike the classification techniques which categorizes the whole image. Several research works are reported in the area of medical image segmentation.

2.1.1 Image Segmentation based on Hybrid (Neural + Fuzzy) Techniques

Several hybrid neuro-fuzzy approaches for image analysis are also reported in the literature. The effects of various membership functions on the ANFIS training and testing process. The foundation for the ANFIS based research is provided in this work. A hybrid neuro-fuzzy approach is used for image segmentation. The conventional fuzzy clustering algorithm combined with the MLP neural network is used for segmentation. Selection of appropriate convergence criterion is the major drawback of this approach. An optimal neuro-fuzzy probablistic C-means algorithm is proposed. A comparative analysis between the conventional techniques is also performed in this work. This work mainly aimed at improving the segmentation efficiency of noisy skin lesions images. The drawback is the slow convergence rate due to the fact that many complex steps are involved in this algorithm. A combinational approach of SOM, SVM and fuzzy theory is implemented.

An extensive analysis is performed with the other segmentation techniques to show the superior nature of the proposed approach. A reflex fuzzy min-max neural network for clustering techniques is developed. The reflex mechanism of skin together with fuzzy rules has been used to reduce the misclassification rate. The results are also compared with the conventional techniques and found to be useful for improving the segmentation efficiency. No specific application is reported in this work. Wavelet based neuro fuzzy segmentation is proposed. A neural architecture with fuzzy rules is used for implementation in this work. This work is not experimented on skin lesions images. The combination of SOM and FCM algorithm for skin lesion image segmentation is experimented. But the drawback of this technique is that it is not suitable for skin lesions of varying size. The convergence rate reported in this work is also very low which another drawback of this technique. A fuzzy kohonen neural network is implemented. This technique is completely dependent on the input features which are the drawback of this system. The qualitative and quantitative analysis results are inadequate when compared with the other technique.

2.2 Skin Image Classification Techniques

The important process in the automated system is skin image classification. The main objective of this step is to differentiate the different abnormal images based on the optimal feature set. Several conventional classifiers are available for categorization but most of the earlier works depend on Artificial Intelligence (AI) techniques which yield highly accurate results than the conventional classifiers. The usage of Artificial Neural Networks (ANN) to improve the accuracy of the classifier [11]. An interactive tool to classify the healthy and the affected skin lesions images is proposed. But the accuracy proposed in this system is very low compared to the AI techniques. Though this approach claimed a faster convergence rate, it may not be much useful because of its low accuracy.

Only the lack of faster convergence rate of the conventional neural networks is also explain. This layan emphasis on the requirement of modified neural networks with superior convergence rate for image classification applications. A hybrid approach such as combination of wavelets and Support Vector Machine (SVM) for classifying the abnormal and the normal images. The hybrid SVM is better than the kohonen neural networks in terms of performance measures [17]. But the major drawback of this system is the small size of the dataset used for implementation. The classification accuracy results may reduce when the size of the dataset is increased. A modification of conventional SVM such as Least Square SVM (LS-SVM) for skin lesion recognition. Both bi-level classification and multi class classification are performed in this work to show the superior nature of the proposed method over the conventional classifiers. An extensive comparative analysis is performed between the SVM, neural classifier and the statistical classifiers. Results suggested the advantages of SVM in terms of classification accuracy. Only bi-level classification is performed in this work which is inadequate for judging the nature of the automated system [18].

A comparative analysis is also performed with SVM. This work inferred that the transform based PNN is superior to the SVM in terms of classification accuracy. The training of ANN is dependent on input data and hence a wide variety of pattern is desirable for high accuracy. A time efficient neural network such as PNN is used by for pattern classification problems .Emphasis was given for convergence time than the classification accuracy. The results concluded that the PNN is superior over conventional neural networks in terms of training time period. Probabilistic Neural classifier is used in this work.

III. RESEARCH ELABORATION

Methodology-

Proposed System comprises 3 main steps. These are:

- Segmentation using Texture filters.

- GLCM (Grey Level Co-occurrence Matrices) based Feature Extraction.
- Classification is done by Neural Network (PNN).

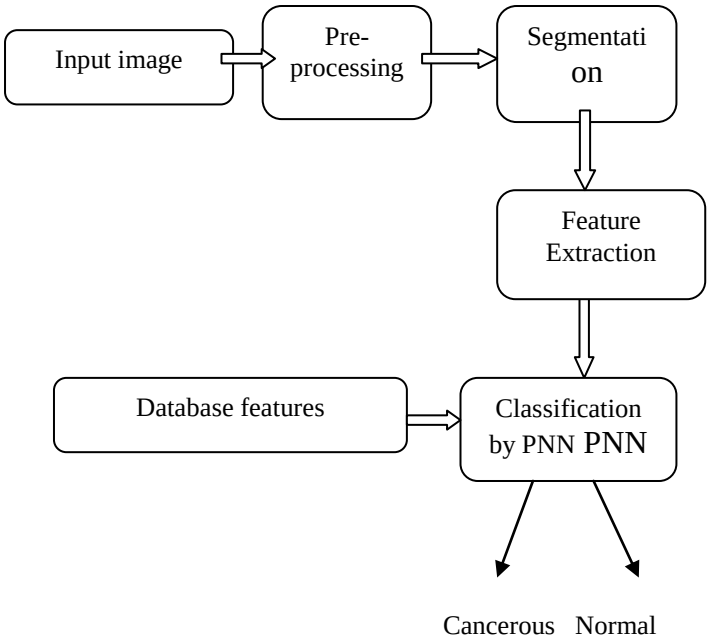


Fig .1: Proposed System Block Diagram

- **Pre-processing**

Before extracting meaningful information from the images ,it becomes necessary to apply some pre-processing procedures. The first step in the computerized analysis of skin lesion images is the pre-processing of an image. The main aim of pre-processing techniques is image enhancement and image restoration. Preprocessing involves image resizing, conversion from RGB to grey level image, noise removal etc. Due to noise in image we conduct filtering technique called median filtering. In this work, we employed 3*3 median filter to smoothen the image. The Preprocessed results of original image is shown in figure 2(a) and 2(b) and 2(c).

a

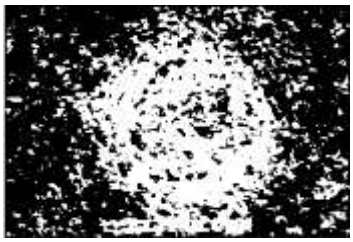
b

c

Fig. 2. (a) Input image; (b) Grey level image; (c) Median filtered image

- **Segmentation**

Segmentation is the most important part of image processing as it increases the accuracy. A correct separation of a skin lesion from the healthy skin plays a key role in the effectiveness of any automated diagnosis system. In segmentation texture is created by entropy filter and that texture image is created into black and white image. After that the morphological operations such as opening which removes connected components from black and white image and closing is done over textured image. The segmentation results are shown in figure 3(a) and 3(b).



a

b

Fig.3 (a) Black and White image (b) Image after morphological Operations

- **Feature Extraction**

Texture is the innate property of all surfaces that describes regular repeatation of elements in the image. Texture is characterized by the spatial distribution of grey levels in a neighbourhood. Feature extraction is done by using Grey Level Co-occurrence Matrix. The grey level co-occurrence matrices represent the spatial distribution and the dependence of the grey levels within local area. The important information is taken out from the matrix as the texture representation. The texture features are

- Energy
- Contrast
- Correlation
- Homogneity
- Entropy

Energy: A feature which measures the overall probability of having distinctive gray scale patterns in the image, defined as

$$\sum_{i=1}^{m}\sum_{j=1}^{n}(GLCM(i,j))^2$$

Contrast: A feature which measures the variance in gray scale levels across the image, defined as

$$\sum_{i=1}^{m}\sum_{j=1}^{n}(i-j)^2 GLCM(i,j)$$

Correlation: Correlation that brings out how correlated a reference pixel to its neighbor over an image, defined as

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\frac{\{i\times j\}\times GLCM(i,j)-\{\mu_x\times\mu_y\}}{\sigma_x\times\sigma_y}$$

Homogneity: A feature which measures the closeness of gray levels across the image, defined as

$$\sum_{i=1}^{m}\sum_{j=1}^{n}\frac{GLCM(i,j)}{1+|i-j|}$$

Entropy: A feature which measures the randomness of gray-level distribution is the the entropy, defined as

$$-\sum_{i=1}^{m}\sum_{j=1}^{n}GLCM(i,j)\log(GLCM(i,j))$$

- **Classification**

The Probabilistic Neural Network is well suited for an optimal binary classifier, which classifies the skin lesions as cancerous or normal. PNN is a feed forward neural network, which was derived from the Bayesian network and a statistical algorithm called Kernel Fisher discriminant analysis.

IV.OUTCOMES

Table 5 show the criteria for the decision of cancer classes which is based on the features values of skin lesion. For provided input images we got the features values.

Image No.	Energy	Contrast	Correlation	Homogeneity	Entropy	Decision
1	0.9873	3.1149	0.1736	0.0230	2.6078	BCC
2	2.1817	1.3596	0.2130	0.0299	1.7804	AK
3	14.2210	2.1874	0.0351	0.0671	0.1325	SCC
4	10.4963	2.1658	0.0045	0.0671	0.1491	SK
5	5.3922	4.2689	0.0875	0.8083	0.0157	ML
6	03815	4.3691	0.0000	0.0000	0.0208	NORMAL

Table I: Features Values

V.CONCLUSION

An automated Computer based early detection of skin cancer is proposed. It proves to be a better diagnosis method .The images were collected and they are processed by image processing techniques using Matlab software. The 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 features of the segmented images are extracted and based on the features, the images are classified as Cancerous or Non-cancerous using Neural Network classifier. The proposed system defines an effective way to detect the skin lesion more accurately and faster by segmenting the lesions images of different scales. Moreover, it has got good accuracy and higher levels of quality. As the proposed system involves neural network, it achieves higher accuracy.

For the available database of normal & abnormal images it is observed that:

1. Contrast of normal Images is more than cancerous Images.
2. Correlation, energy, homogeneity and entropy of normal images is less than cancerous Images.

Applications-

Medical applications

VI. FUTURE SCOPE

A large data collection and explanation of process, including added testing on extensive variety of images, will be the future work.

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