COMPARISON OF BACK PROPOGATION NEURAL NETWORK AND SUPPORT VECTOR MACHINE IN AUTOMATIC SKIN CANCER DETECTION

Mithu Elza Mathew
Dept. of Electronics and Communication Engg
College of Engineering, Karunagappally
Kollam, Kerala, India
Mithuelzamathew123@gmail.com

Deepa V S
Dept. of Electronics and Communication Engg
College of Engineering, Karunagappally
Kollam, Kerala, India
deepam_vs@yahoo.co.in

***Abstract*— Skin cancer is a type of tumor that grows in skin cells. It has become most prevalent cancer among white and non-white population around the world. Successful treatment can be achieved if we can detect skin cancer at its earlier stage. Usually doctors use biopsy method for detecting skin cancer but it is painful and time consuming. This paper proposes an automatic method for detecting skin cancer which uses various image processing and pattern recognition techniques. Different stages of detection involves-collecting dermoscopic images, filtering the images for removing hairs and noises by morphological operations, feature extraction by Gray Level Co-occurrence matrix (GLCM) and finally classification of benign and malignant skin cancer. This paper also compares Back Propagation Neural Network (BPN) based and Support Vector Machine (SVM) based classifiers which are used for classifying the data set into malignant or benign. BNN is one of the efficient methods for pattern recognition. They are used as a model for simulation of the workings of a brain. SVM is also used for pattern recognition and has good accuracy.**

Keywords—Skin cancer, GLCM, BPN,SVM

I. INTRODUCTION

Cancer is a disease affecting the cells in the body. There are different types of cells in the body and there are different type of cancers arise from different types of cells. Cancer begins when cells in a part of the body grows abnormally and multiply without control. Different types of cancer behave differently. They grow at different rate and respond to different treatments.

Skin cancer is a type of cancer affecting the skin cells. Skin is the largest organ of the body. It has three layers. They are epidermis, dermis and hypodermis. Epidermis is the top most layer. It consists of three type of cells. The flat cells at the top of this layer are called squamous cells. The cells under the squamous cell are basal cells. The cells found in the lower part of epidermis are melanocytes and they are also responsible for skin color pigmentation.

Skin cancer can be divided into two types. They are malignant and benign. Malignant melanoma develops from melanocytes. They are much less common than benign melanoma. Benign melanoma can be divided into basal cell carcinoma (BCC) which develops from basal cells and squamous cell carcinoma (SCC) which develops from squamous cells. Other types of skin cancers such as Kaposi Sarcoma, lymphoma also comes under benign melanoma.

Malignant melanoma is the dangerous form of skin cancer. It can spread to other parts of the body. Recovery of melanoma depends on the diagnosis and removal of melanoma in its early stages. Early detection of skin gives us the greatest chance for successful treatment. So for a fast and reliable detection of skin cancer automatic skin cancer diagnosis system has proposed.

II. AUTOMATIC SKIN CANCER DETECTION SYSTEM- AN OVERVIEW

Malignant melanoma is the most dangerous human skin disease. It is the deadliest form of all skin cancer. It is life threatening and incurable in advanced stage. It is very difficult to identify the existence of skin cancer during the initial stage. The features of malignant melanoma appear to be similar to that of benign melanoma during the early stages. So it becomes quite difficult to distinguish malignant melanoma from benign. If we can diagnose malignant melanoma during its early stage itself we can reduce the death rate and cost of treatment. So we proposed an automatic skin cancer detection system. It is basically a classification system which classify whether the given input dermoscopic image is malignant or benign. Here the classification is based on the features extracted from the dermoscopic images of skin cancer. Different types of classifiers are available and each of them have merits and merits. Performance of each classifier depends on the characteristic of the data to be classified. In this paper, we discuss about two efficient classifier such as Artificial Neural Network based classifier and Support Vector Machine based classifier.

III. METHODOLOGY

The proposed methodology for classifying malignant melanoma and benign melanoma is shown in Fig. 1. Various steps are image acquisition, preprocessing, feature extraction, classification.

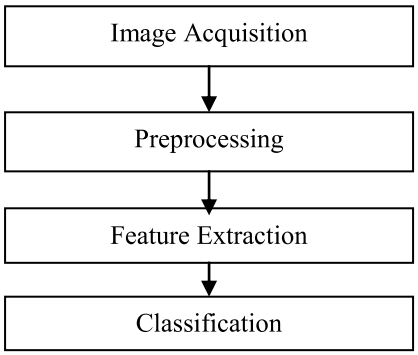

Fig.1.Block diagram

A. Image Acquisition

Dermoscopy, a noninvasive skin imaging technique is used for acquiring the images of affected skin. The device used for acquiring the image is called Dermatoscope. This technique use incident light and oil immersion to visualize subsurface structures.

Dermoscopy is also known as Epiluminescence Light Microscopy. Physicians use ELM device to improve the visual inspection of skin lesion. It reveals most of the pigmented structures and various color shades that is not visible to our naked eye. Dermatoscope and dermoscopic image is shown in Fig. 2. Dermoscopic image have great potential to diagnose malignant melanoma but its interpretation time is quite high even for experienced dermatologist. So computer aided diagnosis system can assist the dermatologist for the diagnosis

Fig.2. Dermatoscope and dermoscopic image

B. Preprocessing

The dermoscopic image obtained can be of different size. First step of preprocessing is to resize the image to a standard size. The second step of preprocessing is to remove noises such as hairs or bubbles from the image. Its result is shown in Fig.3

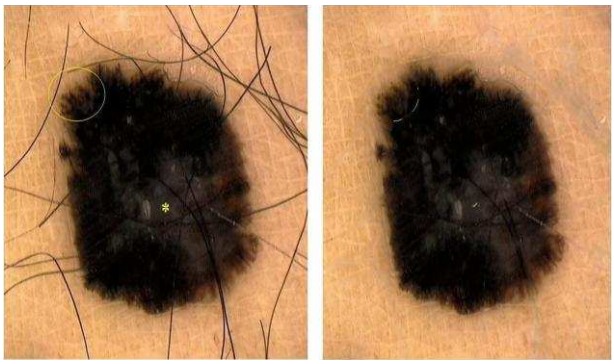

Fig.3. Hair removal by morphological closing operation.

The presence of hair may occlude some of the important features present in the image. The presence of hair can be avoided by morphological closing operation. It is done by identifying the hair pixels in the image and then replaces them with neighboring non hair pixels.

C. Feature Extraction

There are some unique features that distinguish malignant melanoma from benign melanoma. The feature extraction technique is used to extract features that provide meaningful interpretation about the image. Feature extraction technique can be of two type- first order and second order feature extraction technique. In the first order feature extraction technique the features are extracted based on individual pixel. They do not consider spatial relationship among different pixels. In the second order feature extraction technique the features are extracted based on the relationship between neighboring pixels. Gray level co-occurrence matrix (GLCM) comes under second order feature extraction technique.

GLCM is a powerful tool of feature extraction and it gives joint probability occurrence of gray level of two pixels. It is a tabulation of how often different combinations of pixels brightness values occur in an image [4]. The GLCM is a square matrix where the number of rows and columns are equal to total number of gray levels in the image. Consider I as an image and it has N number of gray levels. Let C be the gray level co-occurrence matrix of order N. The element (i,j) of the matrix C can be defined as number of times a pixel with intensity value i is adjacent to a pixel with intensity vale j. The adjacency can be horizontal, vertical, left and right diagonal. The image in the gray scaled version is used for extracting the features. After GLCM is computed features are extracted such as mean, energy, homogeneity, correlation, skew and kurtosis. Energy can be considered as the measure of uniformity among the pixels. If the distribution of gray level is constant, then energy is maximum. Correlation measure linear dependency among neighboring pixels. Skewness measure asymmetry. Kurtosis is a measure of whether the data are peaked or flat relative to normal distribution. Table 1 show features extracted from benign and malignant image.

D. Classification

Classification is the most significant step in automatic skin cancer detection system. This stage identifies malignant melanoma from other skin diseases based on the features extracted from the image. Wide ranges of classifiers are available and each of them has merits and demerits. The performance of each classifier depends on the characteristic of data to be classified. Here we discuss about two classifiers.

1. Artificial Neural Network (ANN) Classifier

ANN consists of several small processing units which are interconnected. ANN can be considered as an iterative process that requires many presentations of the training sets. It is an adaptive system that changes its structure based on the external and internal information that flows through the network during training [5]. Due to the nonlinear processing capability of neurons, Neural Network can solve highly complex problem. Here a feed forward multilayer network is used and Back Propagation (BPN) Algorithm is used.

The network consists of input layers, hidden layers and output layers. Initially the weights value of input layer and

hidden layer are adjusted randomly. Training is done based on the desired output. During the forward pass, according to the initial weight and activation function used, the network gives an output. The actual output is then considered with desired output. If both outputs are not same, an error is produced. During the reverse pass the error is propagated and the weights of the input and hidden layer are adjusted. The whole process is continued till the error is zero. We train the network with known values and after training and it can perform decision making.

2. Support Vector Machine (SVM) classifier

Support vector machine is a supervised learning model based on modern statistical learning theory. It gives some useful bounds on the generalization capacity of machines for learning tasks. The SVM algorithm constructs a separating hyperplane in the input space, one which maximize the margin between the two data sets. In order to calculate the margin, two parallel hyperplanes are constructed, one on each side of the seperating hyperplane, which are pushed up against the two data sets.

The basic SVM takes a set of input data and then for each input it predicts one of the two possible outcomes. The classification process consists of training phase and testing phase. The known data is given in training phase and unknown data is given in the testing phase. The basic training algorithm can only construct linear separation and different kernel functions can be used to include nonlinearities in the model.

Table 1. Feature Extraction

Features	Benign image 1	Benign image 2	Malignant image 1	Malignant image2
Mean	42.589	42.4678	32.3672	36.4915
Skew	-1.153	-0.5624	-0.1773	0.2536
Kurtosis	3.6194	2.8519	1.8435	1.8908
Contrast	0.079	0.0802	0.1048	0.1227
Energy	0.3244	0.3127	0.2044	0.1694
Homogeneity	0.9602	0.9599	0.9520	0.9436
Correlation	0.9672	0.9461	0.9594	0.9689

IV. PERFOMANCE EVALUATION

The performance of classification system can be evaluated in terms of confusion matrix, sensitivity, specificity and accuracy. The terms can be defined as follows:

a) Sensitivity (tru possitive fraction): the result indicates positively(disease)

$$sen = \frac{TP}{TP+FN} \quad (1)$$

b) Specificity (true negative fraction): the result indicates negatively (non disease)

$$spec = \frac{TN}{TN+FP} \quad (2)$$

c) Accuracy: the proability that diagnostic test is performed correctly.

$$Accur = \frac{Tp+TN}{TP+TN+FP+FN} \quad (3)$$

Where,
TP(True Possitive)= correctly classified possitive cases
TN(True Negative)= correctly classified negative cases
FP(False Negative)= incorrectly classified negative cases
FN(False Negative)= incorrectly classified positive cases

V. CONCLUSION

A computer aided skin cancer detection system is proposed. It gives a better diagnosis than biopsy method. It is advantageous to patients, by which they can identify skin cancer without going to hospital. Here we proposed two type of classifiers. We can measure its sensitivity, specificity and accuracy as per the equations based on that we can find which classification method is better. Theoretically SVM have many advantages over Neural Network. SVM are less prone to over fitting when compared to back propagation. Another advantage of SVM is that they provide a unified framework in which different machine architecture can be generated through an appropriate choice of kernel.

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