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Diagnosis and Detection of Skin Cancer Using Artificial Intelligence

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Abstract- Skin cancers are the deadly form of cancers in humans. If skin cancer is detected at early stages, it can be cured completely. So an early detection of skin cancer can save the patients. Skin Cancers are of two types- Benign and Malignant Melanoma. Benign melanoma is not a deadly condition, but malignant melanoma is a deadly form. Both resemble same in appearance at the initial stages. Only an expert dermatologist can classify which one is benign and which one is malignant. The Artificial Neural Network based Classification methodology uses Image processing techniques and Artificial Intelligence. Main advantage of this computer based classification is that patient does not need to go to hospitals and undergo various painful diagnosing techniques like Biopsy. In this Computer Aided Classification, dermoscopy image of skin cancer is taken and it is subjected to various pre-processing for image enhancement. The cancer affected region is separated from the healthy skin using Threshold Segmentation. In order to reduce the complexity of classification, some unique features of malignant and benign melanoma are extracted. Such features are extracted using Gray Level Co-occurrence Matrix (GLCM) method. These features are given as the input nodes to the Artificial Neural Network. Back-Propagation Neural (BPN) Network is used for classification purpose. It classifies the given data set into cancerous or non-cancerous.

Keywords **-Melanoma, Biopsy, Threshold Segmentation, Gray Level Co-occurrence Matrix, Back Propagation Network, Artificial Neural Network.**

I. INTRODUCTION

Skin Cancer is the cancer affecting the skin. It is a deadly form of cancer. Skin cancer may appear as malignant or benign form. Skin cancer at its early stages can be cured. But when it is not recognized at its early stages, it begins to spread to other parts of the body and can be deadly. Benign Melanoma is simply appearance of moles on skin. A normal mole is usually an evenly colored brown, tan, or black spot on the skin. It can be either flat or raised. It can be round or oval. Moles are generally less than 6millimetres. Malignant melanoma is the appearance of sores that cause bleeding. Malignant Melanoma is the deadliest from of all skin cancers. It arises from cancerous growth in pigmented skin lesion. Malignant melanoma is named after the cell from which it presumably arises, the melanocyte. If diagnosed at the right time, this disease is curable. Melanoma diagnosis is difficult and needs sampling and laboratory tests [1]. Melanoma can spread out to all parts of the body through lymphatic system or blood. The main problem to be considered dealing with melanoma is that, the first affliction of the disease can pave the way for future ones. Biopsy is the conventional method for skin cancer detection, involving the removal of skin and it undergoes various laboratory tests. Laboratory sampling often causes the inflammation or even spread of lesion. So, there has always been lack of less dangerous and time-consuming methods. Computer based diagnosis can improve the speed of skin cancer diagnosis which works according to the disease symptoms. The similarities among skin lesions make the diagnosis of malignant cells a difficult task. But, there are some unique symptoms of skin cancer, such as: Asymmetry, Border irregularity, Color variation and Diameter. Those are popularly known as ABCD parameters. ABCD parameters. Asymmetry, Border irregularity, Color, Diameter [2]. Asymmetry is one half of the tumor does not match the other half. Border Irregularity is the unevenness of images. Color intensity change in the lesion region is irregular. Malignant melanoma is having a diameter greater than 6mm.

II. AUTOMATED SKIN CANCER CLASSIFICATION SYSTEM

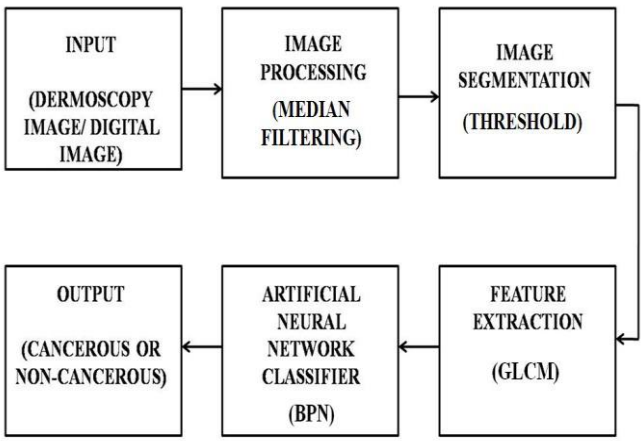

Fig. 1: Block Diagram Representation

Automatic early detection system is a classification system which distinguishes Malignant Melanoma from other skin diseases [1]. This methodology uses Digital Image Processing technique and Artificial Intelligence for the classification purpose. The input to the system is Dermoscopic Images which are in digital format. Usually

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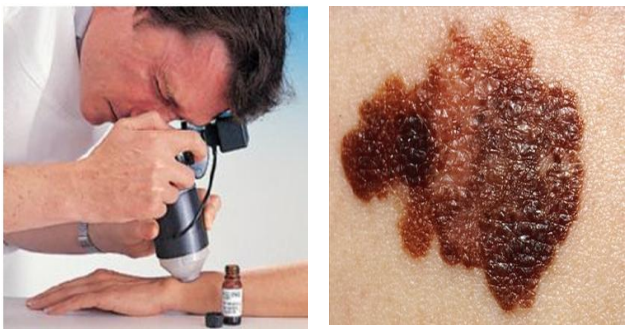
such images contain noises, so they are undergone Pre-processing. In order to preserve the edges, Post-processing is done. To separate the cancerous region from healthy skin, segmentation is done. There are some unique features for the cancerous images. Those features are extracted using Gray Level Co-occurrence Matrix method in MATLAB software [6]. These features are given as inputs to the Artificial Neural Network based classifier. It uses Back propagation Algorithm for classification. ANN classifies Malignant Melanoma from Benign Melanoma. Thus detecting whether patient is having skin cancer or not. The block diagram of skin cancer detection system is shown in Fig.1

A. Dermoscopy

Dermoscopy, also known as Dermatoscopy or Epiluminescence Light Microscopy (ELM). It is a kind of imaging technique used to exanimate lesions with a dermatoscope, shown in Fig. 2(a). The process is done by placing an oil immersion between the skin and the optics. Lens of a microscope is placed directly, illuminating sub-surface structures [2]. 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. ELM devices are currently being used by physicians to improve visual inspection of skin lesions. ELM with Digital Capture system is used in this methodology. The image obtained from such a dermatoscope is called Dermoscopic Image. It is shown in Fig. 2(b).



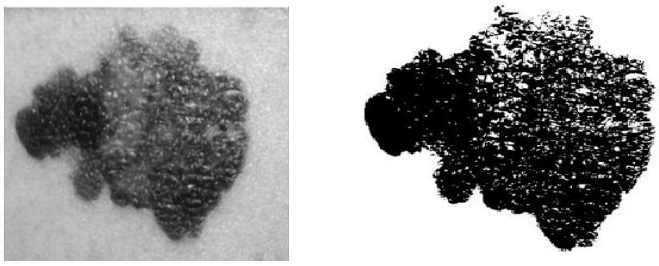
(a) Dermatoscopy (b) Dermatoscopic image

Fig. 2: Dermoscopic method

B. Image Processing

The Dermoscopic Image in Digital format is subjected to various Digital Image Processing Techniques. The standard image size is taken as 360x360 pixels. Usually the image consists of noises in the form of hairs, bubbles etc. These noises cause inaccuracy in classification. In order to avoid that, images are subjected to various image processing techniques. Image Processing consists of following procedures: Image Pre-processing and Post-processing [1]. 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. Post-processing is done to enhance the shape and edges of image. In addition, contrast enhancement can sharpen the image border and improve the accuracy for segmentation.

C. Segmentation



(a) Filtered image
(b)Segmented image

Fig. 3: Threshold Segmentation

Segmentation removes the healthy skin from the image and finds the region of interest. Usually the cancer cells remains in the image after segmentation. Segmentation used is Threshold Segmentation. Thresholding often provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colors in the foreground and background regions of an image [4]. The input to a Thresholding operation is typically a grayscale or color image. After segmentation, the output is a binary image. Segmentation is accomplished by scanning the whole image pixel by pixel and labeling each pixel as object or background according to its binarized gray level [5]. Fig. 3 shows segmentation technique.

D. Feature Extraction

There are some unique features that distinguish malignant melanoma from benign melanoma. Feature extraction extracts the eminent and important features of image data, from the segmented image. It makes the raw data more useful in processing. By extracting features, the image data is narrow down to a set of feature [7]. Feature extraction technique used is Gray Level Co-occurrence Matrix (GLCM). The enhanced image in gray scaled is given as input. GLCM is a matrix where the number of rows and columns is equal to the number of gray levels. The GLCM is a tabulation of how often different combinations of pixel brightness values (gray levels) occur in an image [9]. The GLCM is a powerful tool for image feature extraction by mapping the gray level co-occurrence probabilities based on spatial relations of pixels in different angular directions. The features extracted based on GLCM are: Contrast, Correlation, Energy, Mean, and Homogeneity. A homogeneous scene will contain only a few gray levels. It provides GLCM with only a few but relatively high values. Contrast is the measure of contrast or local intensity variation. Correlation is a measure of gray level linear dependence between the pixels at the specified positions relative to each other [10].

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E. Artificial Neural Network Classifier

Classifier is used for classifying Malignant Melanoma from other skin diseases. Based on the computational simplicity Artificial Neural Network (ANN) based classifier is used [4]. Neural Network is able to solve highly complex problems due to the nonlinear processing capabilities of its neurons. In this proposed system, a feed forward multilayer network is used. Back propagation (BPN) Algorithm is used for training. There must be 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 BPN 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.

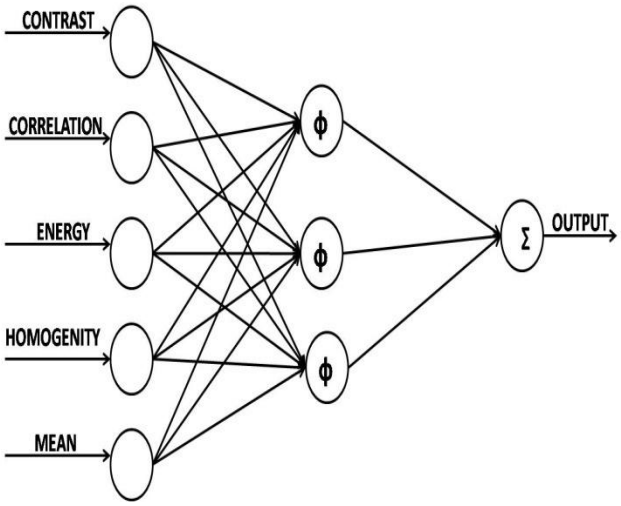

Fig. 4: Artificial Neural Network structure

In BPN, weights are initialized randomly at the beginning of training. There will be a desired output, for which the training is done. Supervisory learning is used here. During forward pass of the signal, according to the initial weights and activation function used, the network gives an output. That output is compared with desired output. If both are not same, an error occurs. During reverse pass, the error is back-propagated and weights of hidden and output layer are adjusted. The whole process then continues until error is zero. The network is trained with known values. After training, network can perform decision making. In this proposed methodology, Five Features were given as input to a multilayer feed forward network, as shown in Fig.4. There is one hidden layer with three hidden neurons. Output layer with one output neuron. Activation function used is linear function, which gives an output of 0 or 1. Zero represents non-cancerous or benign condition and one represents cancerous or malignant condition. NEURAL LAB is the software used for ANN classification. It is ANN simulation software which gives good results in classification. Since there are 5 features, input layer consists of 5 input neurons. There are 3 hidden neurons and one output neuron. The network is trained using known values of Malignant and Benign Melanoma features. Many epochs of training are repeated until Mean Square Error is less than minimum value. Then data for classification is given as input to classifier. 50 Malignant and Benign Melanoma Features were given for classification. The output of the classifier is either 0 or 1. One represents cancerous condition and Zero represents Non-cancerous condition. The network is trained using known values.

III. RESULTS

For the proposed system, Dermoscopic images were collected from Internet and hospitals. They were undergone Median Filtering. After that, Filtered images were segmented by Threshold Segmentation. Feature Extraction of images was done using GLCM. All these were done in MATLAB software. The obtained Features were given as inputs to a Feed Forward Neural Network. Activation function used is Log Sigmoid, which gives an output of 0 or 1. Zero represents non-cancerous or benign condition and one represents cancerous or malignant condition. The neural network is designed using NEURAL LAB software. Table 1 shows the results of classification

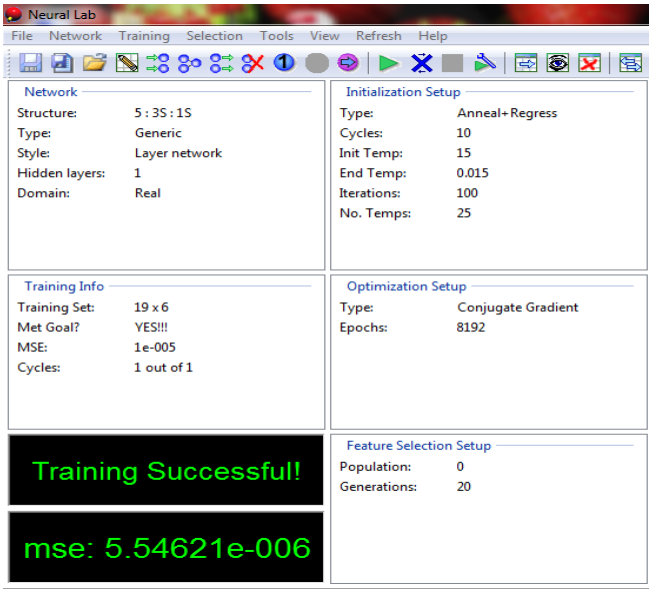

Fig. 5: NEURAL LAB software

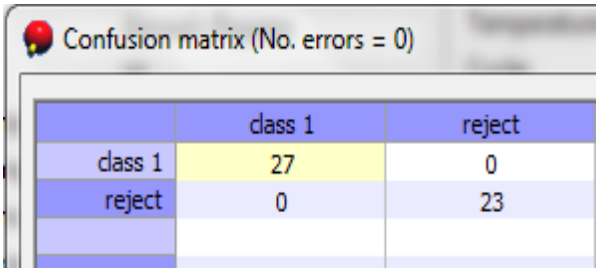

Fig. 6: Confusion Matrix of Classification

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Mean	Contrast	Correlation	Energy	Homogeneity	Output	Diagnosis
235.574	0.1238	0.9707	0.7578	0.9865	0	Non-cancerous
242.78	0.2309	0.9185	0.85	0.9838	0	Non-cancerous
192.157	0.1659	0.9839	0.4588	0.9722	1	Cancerous
247.692	0.2406	0.8567	0.9091	0.9844	0	Non-cancerous
217.036	0.1395	0.9808	0.6123	0.9847	1	Cancerous
222.486	0.0742	0.9878	0.6275	0.9871	1	Cancerous
237.965	0.1966	0.9416	0.7685	0.9824	0	Non-cancerous
214.599	0.5299	0.9034	0.4532	0.935	0	Non-cancerous
240.377	0.0686	0.9817	0.8457	0.9906	0	Non-cancerous
229.622	0.0805	0.9842	0.7065	0.9788	0	Non-cancerous
232.506	0.3593	0.8986	0.6646	0.9492	0	Non-cancerous
240.578	0.1816	0.9557	0.8643	0.9903	0	Non-cancerous
237.494	0.1065	0.9788	0.838	0.9932	0	Non-cancerous
191.549	0.1726	0.9868	0.491	0.9814	1	Cancerous
222.74	0.1777	0.7849	0.309	0.9153	0	Non-cancerous
188.802	0.1374	0.9861	0.3898	0.9738	1	Cancerous
236.316	0.0905	0.9759	0.7606	0.9846	0	Non-cancerous
206.977	0.1505	0.9879	0.635	0.9868	1	Cancerous
224.078	0.171	0.9716	0.6388	0.9701	0	Non-cancerous
203.782	0.3699	0.9135	0.337	0.9228	1	Cancerous
200.328	0.1843	0.9799	0.4884	0.968	1	Cancerous
223.931	0.1467	0.9772	0.6831	0.9858	0	Non-cancerous
204.974	0.1065	0.9885	0.5597	0.988	1	Cancerous
231.775	0.1356	0.9796	0.7934	0.9879	0	Non-cancerous
175.788	0.2871	0.9835	0.4315	0.9701	1	Cancerous
177.75	0.6204	0.9553	0.3798	0.9589	1	Cancerous
237.188	0.1124	0.9602	0.73	0.977	0	Non-cancerous
205.178	0.1815	0.9718	0.4758	0.9684	1	Cancerous
208.282	0.2255	0.9702	0.5255	0.9689	1	Cancerous
179.352	0.2252	0.9879	0.4977	0.9787	1	Cancerous
200.46	0.3724	0.9611	0.5051	0.9639	1	Cancerous
233.635	0.1117	0.9642	0.686	0.9815	0	Non-cancerous
222.351	0.1156	0.9874	0.7182	0.9836	0	Non-cancerous
200.578	0.2863	0.9652	0.4634	0.9633	1	Cancerous
176.177	0.4436	0.9318	0.2752	0.9238	1	Cancerous
174.002	0.2316	0.9683	0.3223	0.9563	1	Cancerous
192.667	0.1899	0.9804	0.4503	0.9797	1	Cancerous

Table 1: Results of Classification

IV. RESULT VALIDATION

The obtained results are validated with Diagnosis results prepared by doctors, using the conventional diagnosing procedures. Among the 50 images given for classification, the ANN based classifier gives the output of 27 cancerous and 23 non-cancerous conditions. When compared with the actual results, it was found that, there were 9 misclassifications. The obtained results show that the methodology has an accuracy

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of 82%. The error in classification will get reduced, as the number of samples taken for classification is increased. Table 1 shows the results of classification. Confusion Matrix is shown in Fig. 6.

V. CONCLUSION

A Computer aided skin cancer detection system is proposed in this paper. It proves to be a better diagnosis method than the conventional Biopsy method. Computer based skin cancer detection is more advantageous to patients, by which patients can detect the skin cancer without going to hospital or without the help of a doctor. It saves a lot of time for patients. 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 by various Image processing techniques. The unique features of the segmented images were extracted using GLCM. Based on the features, the images were classified as Malignant or Benign. This classification system has good accuracy of 82%. By varying the Image processing techniques and Classifiers, the accuracy of this system can be improved. If optimization techniques like Particle Swarm Optimization are incorporated with the classifier, more accurate results will be obtained.

VI. ACKNOWLEDGMENT

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