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DETECTION OF MALIGNANT SKIN CANCER BASED ON AUTOMATED IMAGE ANALYSIS AND CLASSIFICATION

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***Abstract* -- Skin Cancer is a major concern in the world presently. Persons suffering from skin cancer, exhibit symptoms of discoloration of skins, black dots and rashes on skin. Early detection helps in faster recovery of the patients from the effect of skin cancer. Skin cancer manifests itself in many ways, each exhibiting different characteristics.**

This paper proposes on automated method for early detection and classification of four different types of skin cancers namely Melanoma, Basal cell carcinoma, Actinic Keratosis and Squamous cell carcinoma. The skin images on normal and abnormal are obtained from American Joint Committee on Cancer Database (AJCC). The skin lesion from the database images are segmented by using texture distinctiveness-based lesion segmentation and color based lesion segmentation. The Color features, Shape features, Texture features and Spectral features are extracted from segmented image. QGA (Quantum Genetic Algorithm) is used for Feature Selection and MCSVM (Multi Class Support Vector Machine) is used for classification.

Keywords— ***Color features, Gray Level Co-occurrence Matrix, Multiclass Support Vector Machine, Quantum Genetic Algorithm, Texture feature***

I. INTRODUCTION

Skin cancer is a fatal disease. For past 30 decades, skin cancer occurrence rate have been increasingly high. Skin cancer can be recovered if diagnosed and treated it in premature stage. Therefore early discovery is crucial issue for skin cancer patients. The increasing incidence of Malignant Skin Cancer cases has promoted the progress of an computerized system to aid in the malignant cancer prevention and early detection.

Skin cancer can be best identical by the statistical variation of color. Each type of skin cancer is having the certain distinctive characteristics. In this paper, we proposed technique for the segmentation, extraction, selection and classification of four different types of skin cancer (i.e) Basal Cell Carcinoma, Actinic Keratosis, Melanoma and Squamous Cell Carcinoma. Basal Cell Carcinoma and Squamous Cell Carcinoma are two main types of the non-melanoma skin cancers. The distinguishing characteristics of these skin cancers are as follows Actinic Keratosis has the resemblance of rough, dry or scaly patch of skin, usually less than 1 inch in diameter, which is a superior stage of Squamous Cell Carcinoma. This Cancer type is occurring in aged people, fair persons and also in immune-suppressed patients. They are mainly caused by high disclosure to UV radiation, tanning booths, and cancer causing chemicals. Basal Cell Carcinoma have a resemblance of pale moles, can be disrobed as smooth, symmetric in appearance and wart like bumps. This cancer is least risky type of cancer and may neither in flesh color, pale or can be reddish also and it does not spreads to other parts of the body, but it can move into bone or other tissue under skin. Melanoma appearance is much more variable. "ABCDE" method is generally used technique for the classification of melanoma appearance.

II. LITERATURE SURVEY

Existing researches developed a comparative color- based method, which reduces the misclassification of tumor caused by image to image variations in the skin color between the patients, which also caused by ambient lightning, photographic and digitization process. The first step in the paper is to establish a general idea and formation of typical image classification system for the skin cancer presumption. Most of the system consists of following procedures:

Image Pre-processing: To eliminate the noise and fine hair; Post-processing: To enhance the shape of the image. Segmentation: to remove good physical shape skin from the image and locate the Region of Interest. Feature Extraction: which extracts the functional information or Image properties from the segmented Image; finally, this information is used in the Classifier for the purpose of training and testing the images. The classification system usually supported by intelligent classifier such as Neural Network, KNN and Support Vector Machine.

III METHODOLOGY

A) SEGMENTATION AND FEATURE EXTRACTION

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Segmentation is nothing but a partitioning of images. Initially, the region of interest from the image is obtained. In thresholding techniques, the peak value for skin and peak value for lesion is determined and then threshold is selected in between these two peak points. The pixel intensity values less then threshold value are set as 1, and pixel intensity values greater than threshold value are set as 0. The skin lesion segmentation step is to find the border of the skin lesion. It is significant that this step is performed accurately because many features used to assess the risk of skin cancer types are derived based on the lesion border. The generic flow of our proposed approach is given as follows shown in fig 1.

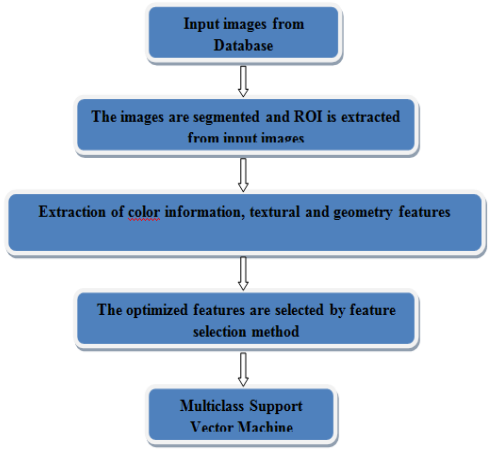

figure 1. Flow chart of our image processing algorithm

Our approach to finding the lesion border is texture distinctiveness-based lesion segmentation and color based lesion segmentation. In the second stage, the pixels in the image are classified as being part of the normal skin or lesion class. The images from database are shown in fig (2). To do this, the image is divided into a number of regions. These regions are combined with the texture distinctiveness map and color distinctiveness map to find the skin lesion.

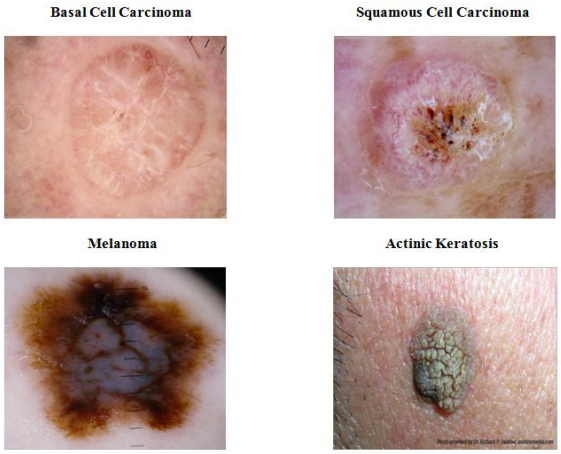

figure 2. Original images from database

From the segmented image as shown in fig (3), the features like Color features (mean and standard deviation), Shape features, and Texture features (GLCM) are extracted. Some of the color and texture features are considered based on the classification of the significant image regions-lesions, inner and outer margin, which are obtained based on a Euclidean distance transform. These features of skin cancer images are used to ensure the accuracy and efficiency of our proposed system.

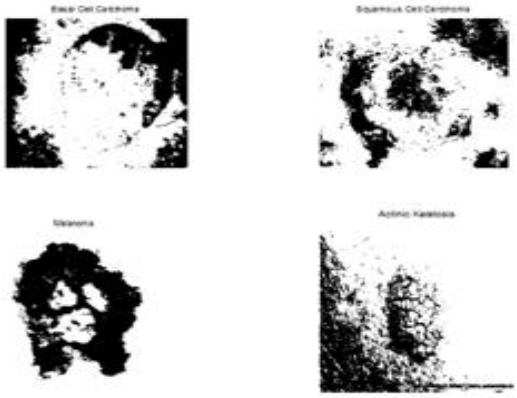

figure 3. Segmented images from original images

Shape Features: Lesion area; Major Axis Length; Minor Axis Length; Perimeter, Eccentricity; Equivalent diameter; Extent; Aspect Ration of lesion.

Color Features: The color information are used in dermoscopy analysis, such as mean color and color variance. Mean and Standard Deviation of each channel in RGB, HSV color space ratio; differences of mean and standard deviation from the different image regions for all color spaces are used for extract detailed information.

Texture Features: Image texture symbolizes the spatial organization intensity and color in an image and it can be characterized in many different ways. Some methods use pixel statistics. A typical approach consists in computing the statistics of pairs of neighboring pixels, using co-occurrence matrix. The finest method which performs a binary classification of the pixels in the neighborhood of each pixel and computes the statistics of neighboring pixel information is Gray Level Co-occurrence Matrix.

From Gray Level Co-occurrence Matrix(GLCM), various features are used for the skin cancer classification such as autocorrelation, Contrast, Correlation, Energy, Entropy, Homogeneity, maximum probability, sum of squares, sum average, sum variance , and so on.

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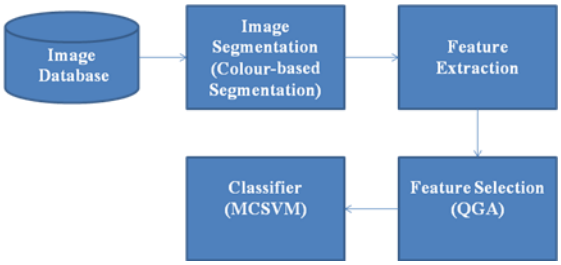

figure 4 Block Diagram of our proposed method

B. FEATURE SELECTION AND CLASSIFICATION

From the Extracted features, the relevant optimized features with minimal information loss are selected and given to the classifier. By selecting the optimized features, the workload of the classifier will be reduced and increase the classification performance accuracy. The Quantum Genetic Algorithm method is used for feature selection algorithm.

Quantum Genetic Algorithm (QGA) is the mixture of Quantum Computing and Genetic Algorithm; The Quantum Genetic Algorithm codes the chromosome with qubit and evolves the quantum states all the way through quantum gates. In QGA, qubit is used to accumulate and characterize one gene. The state of a qubit can be represented as $|\psi\rangle = |\alpha\rangle + |\beta\rangle$ where α and β are probability amplitudes of the corresponding states. . Normalization of the state to unity guarantees $|\alpha|^2+|\beta|^2=1$, where $|\alpha|^2$ gives probability that qubit will be found in '0'state and $|\beta|^2$ gives probability that qubit will be found in '1' state. According to this, a system with *m* qubits can contain information of 2^m states and any linear superposition of all possible states can be represented as follows:

$$\begin{bmatrix} \alpha_1 & \alpha_2 .. & \alpha_m \\ \beta_1 & \beta_2 .. & \beta_m \end{bmatrix} \quad |\alpha_i|^2 + |\beta_i|^2 = 1 (i = 1,2, \dots m) \qquad (1)$$

The structure of QGA is described as follows:
1. Initialize colony $Q(t)$, and t=0;
2. Create $P(t)$ by measuring $Q(t)$ states;
3. evaluate $P(t)$;
4. Store the best individual among $P(t)$ and its fitness;
5. Stop condition: The condition is fulfilled then output the best one, if not, go on;
6. Update $Q(t)$ with quantum rotation gate to get son colony $Q(t+1)$, then $t=t+1$, go to 2.

The flow of Quantum Genetic Algorithm is shown in following fig (5).

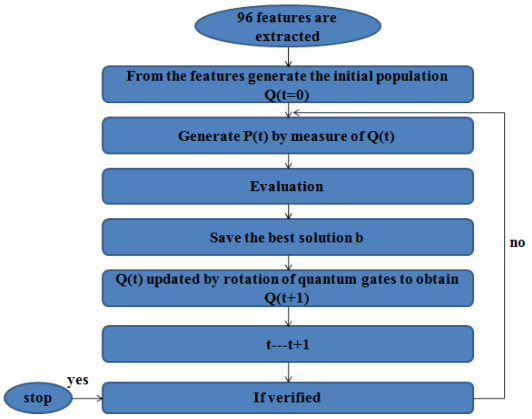

Figure 5. Generic Flow of QGA

The $Q(t)$ is the t-th generation dependency of quantum chromosomes, $P(t)$ is the linear superposition of all possible states of t-th generation colony. When the colony is initialized, all the quantum chromosomes have the same value it means that a quantum chromosome represents all possible superposition states with the same probability. In step 2, there is a random number belong to [0,1], if it bigger than| then it is endowed with 1, or endowed with 0. In step 6, updating $Q(t)$ with appropriate quantum gate to make the quantum chromosomes have better state.
As the update implementation mechanism, the quantum gate can be designed in compliance with the practical problem. Though many quantum gates can be selected, quantum rotation gate is preferable due to the calculation character of QGA. Commonly, $Q(t)$ is updated with quantum rotation gate which is chosen as quantum logic gate through the formula as:

$$\begin{vmatrix} \alpha_i^{t+1} \\ \beta_i^{t+1} \end{vmatrix} = \begin{bmatrix} \cos(\Delta\theta_i) & -\sin(\Delta\theta_i) \\ \sin(\Delta\theta_i) & \cos(\Delta\theta_i) \end{bmatrix} \begin{vmatrix} \alpha_i^t \\ \beta_i^t \end{vmatrix} \qquad (2)$$

Where Δθ is the rotation angle of quantum rotation gate and often be get from lookup table of QGA for convergence.

x_i b_i	$f(x) \geq f(b)$	$\Delta\theta_i$	$s(\alpha_i\beta_i)$			
			$\alpha_i\beta_i > 0$	$\alpha_i\beta_i < 0$	$\alpha_i = 0$	$\beta_i = 0$
0 0	false	0	0	0	0	0
0 0	true	0	0	0	0	0
0 1	false	0	0	0	0	0
0 1	true	0.05π	−1	+1	±1	0
0 0	false	0.05π	−1	+1	±1	0
0 0	true	0.05π	+1	−1	0	±1
1 1	false	0.05π	+1	−1	0	±1
1 1	true	0.05π	+1	−1	0	±1

Table 1: Lookup table of QGA.

Where x_i and $best_i$ is the *i*-th bit of x and best individual separately, *f(x)* is fitness of x, s(α_i β_i) is sign of θ_i. With the update operation of chromosomes by quantum rotation gate, it eventually reaches the optimum resolution.

The drawback in Support Vector machine is , it cannot classify more than two class classification. So, we propose the Multiclass Classification which combines the results of various binary SVM Classifiers. Multi class support vector machine with the combination of multiple binary classifiers are used to train and classify the random input images.

IV. EXPERIMENTS AND SIMULATION

A.Data-Set Preperation

We have collected the skin cancer images from AJCC database of different cancer type images. The resolution of each image was 256*256, these images are grouped into four classes Melanoma, Basal-cell Carcinoma, Actinic Keratosis, Squamous-cell Carcinoma. The image in each of the following class is 56 images respectively. These images are used to train the Multi-class support vector machine and also for classification purpose. Random image is given as input, which is classified by the MSVM into one of the four classes.

B.Result and Analysis

All the experiments were done in MATLAB 7.12.The images are segmented and features like texture features, color features and shape feature are extracted . From the extracted features, the optimized features are selected and given to the Classsifier. The accuracy of our proposed method is for training images which is far more better than the experiments performed by us using color coherence vector and global color histogram approach [5].The accuracy of our previously designed system was for RGB format images training images using color coherence vector-MSVM based classification and 71.84% with Global color histogram-MSVM based classification [5]. It can be clearly seen in fig.3 that approach used in this paper EXTRACTED FEATURES (COLOR, SHPAE AND TEXTURE) +QGA+MSVM gives accuracy of.

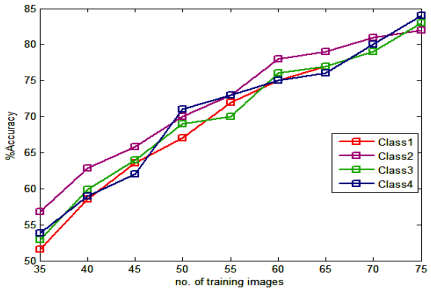

Figure 6. % Accuracy for each class for different no. of Images

V. CONCLUSION

In this paper, Automatic Detection and Classification method is experimented in order to find the Malignant Skin cancer types in the early stage. The image is segmented and features are extracted. The optimized features are selected and given to the classifier. For effective classification Multi Class Support Vector Machine is used. This technique produced very accurate results. It gives accuracy. Other systems can also be developed in combination of various features.

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BIOGRAPHIES

Jeyanthi.K received her Bachelor of Engineering in Bio-Medical Engineering from Vel Multi Tech Dr. Rangarajan & Dr. Sakuthala Engineering College, Master of Engineering degree in Applied Electronics from Jerusalem College of Engineering.