RESEARCH REVIEW JOURNALS
Volume-03
Issue-11
November -2018

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

A Review on Melanoma Skin Cancer Classification

[1]Bhumika Parmar & [2]Bijal Talati

[1]Research Scholar, Computer Engineering Department, Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat (India)
[2]Professor Computer Engineering Department, Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat (India)

ARTICLE DETAILS

Article History
Published Online: 10 November 2018

Keywords
Carcinoma, Blood Vessels, Thermos regulations, Nodular Melanoma, Sun exposure, BCC, SCC, TDS, NMSC, GLCM, LBP

***Corresponding Author**
Email: bhumi3519[at]yahoo.com

ABSTRACT

Malignant melanoma is a kind of skin cancer that begins in melanocytes. It can influence on the skin only, or it may expand to the bones and organs. It is less common, but more serious and aggressive than other types of skin cancer. It is responsible for the majority of deaths related to skin cancer. The algorithm consists of four steps: preprocessing, segmentation, features extraction, and classification to classify melanoma types. Identification of Skin lesion Melanoma at different Stages based on Total Dermoscopic Score (TDS). The identification of the melanoma stages are important for early treatment and to analyze the depth of spreading the melanocytic cells to the other parts of the body. Purpose of the research is to extract more melanoma features for early diagnosis and recognize the types of Skin Cancer is primarily important for effective treatment, which cause improve and increase the survival rate from Skin cancer patients. To minimize the diagnostic error caused by the complexity of visual interpretation and subjectivity, it is important to develop a technology for computerized image analysis. Early melanoma skin cancer diagnostic system using computer-based techniques is more efficient than the conventional biopsy methods. The cost involved as well as the time taken for detection is less in computer-based techniques. This system will be a great help in early detection of malignant melanomas or faster, cheaper, more intuitive and efficient treatment.

1. Introduction

Melanoma and Non-melanoma are the two kinds of skin cancer. Basal cell carcinoma (BCC) and Squamous cell carcinoma (SCC) comes under NMSC. On progression of this Actinic Kerasotes (AK) can lead to a squamous cell carcinoma (SCC). If these cancer cells are malignant then it is called as Malignant Melanoma. Malignant melanoma is occur due to uncontrolled, dangerous, harmful, and life threatening tumor. Changes in appearance of the mole or on the regular skin can be a sign of melanoma. Non melanoma skin cancers are less aggressive than melanoma. Melanoma skin cancers are the most serious form of skin cancer which starts in the melanocyte cell. Malignant melanoma divided into four types: Superficial Spreading Melanoma Nodular Malignant Melanoma, Lentigo malignant melanoma, Acral Lentiginous Melanoma [1]. Largest organ in the human body is Skin and is composed of three layers epidermis, dermis, Hypodermis. Skin has three main functions represented in the protection, sensation, and thermoregulation functions. Epidermis is formed by three cells squamous cell, basal cell, melanocyte cell. If these cells are affected then is called as squamous cell cancer, Basal cell cancer, and melanoma. Melanocyte cell produces a protective Skin darkening pigment called melanin the color of the skin is due to the presence of pigment called melanin. So melanin acts as a protective shield against radiations, Sunburn damages. People with dark skin color have less melanoma occurrence whereas compared to fair skinned. In 1930 there were one melanoma patient among 1500 people. In 1993 there were one melanoma patient among 100 people. But in the year 2015 there were one melanoma patient among 48 people. So we can see the ratio of increasing melanoma all these are due to factors of ,too much exposure to sun, UV radiation, sunburns, more usage of tanning Beds, due to lack of Vitamin D and B3. Melanoma is a treatable disease if it is diagnosed early[3]. Earlier diagnosis and timely treatment lead to improve and survive cancer patients 93% [4]. Medical records Skin Cancer is curable if it is recognized early Stages [1]. Due to Early detection techniques of Melanoma the Organ transplant recipients has a greater risk of getting melanoma compared to non-recipients.

Figure 1. Skin cance

2. Related Work

In[1] Abbas H. Hassin Alasadi, Baidaa M. Alsafy describes melanoma types as Superficial Spreading Melanoma Nodular Malignant Melanoma ,Lentigo malignant melanoma, Acral Lentiginous The sensitivity of NN in diagnosing malignant melanoma types was 95.6%, while the specificity was 92.2% and the accuracy was 93.9% with NN classifier.

In [2] Reshma M suggested that Lesion Margin Feature, Shape, age,sun exposure, Gender, and Intensity Pattern Features correlated to decide the type of melanoma for detection of types of melanoma .They identify stages based ABCD rule for counting TDS value .Based on TDS value ranges they identify melanoma cancer in three stages benign stage ,suspected stage and malignant stage.

In [3] Farzam Kharaji Nezhadian and Saeid Rashidi extracted features using color and texture feature using RGB and 2-D wavelet transform(VMS,TC parameters) together to detect melanoma with more accuracy of 97% by SVM.

In [4] Nay Chi Lynn and Zin Mar Kyu describes method for helping the patient to identify the skin cancer without going to hospitals. They used ABCD rule and segmentation and SVM classifier for identifying melanoma from skin lesion image with accuracy 78.2%.

In [5] J.C.Kavitha, Suruliandi.A describes the texture and color features for identifing the melanoma from dermoscopy images.she analyzed that when texture combined with RGB color space provides better classification accuracy with 93%.

In [6] Surya Kant Singh, Anand Singh Jalal analyzed that CLBP gives better rate of recognition as compared to other feature vector for classification of colored image in skin cancer in both RGB and HSV color space accuracy 94.40 by using Complete Local Binary Pattern over RGB Color Model. This accuracy was about 70% on using 200 feature vectors in only two class.

In [7] Prashant Bhati and Manish Singhal describes ABCD parameters from skin lesion images to count TDS(Total Dermoscopic Score).Based on that classify Skin cancer as Benign(TDS< 5.9) and Malignant melanoma(TDS>5.9) with sensitivity of 92.30% and specificity of 84.61%.

3. Methodology

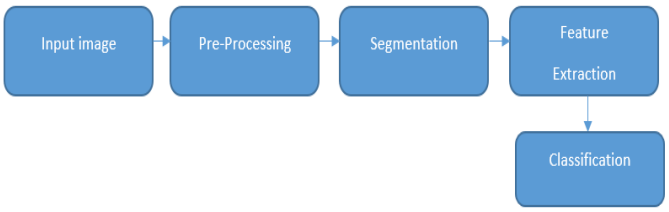

Figure 2. Basic Steps

A. Skin Images:

The International Skin Imaging Collaboration (ISIC) is an international effort to improve melanoma diagnosis.

B. Pre-Processing :

Preprocessing step includes noises removal for enhance the images.

i. Median Filter:

Median Filtering is an image filtering method that makes the skin cancer image smoother. In which each pixel value in an image is exchanged with the median value of its neighboring pixels including itself. It is used for decreasing the effect of small structures such as thin hair and separated unwanted pixels such as air bubbles. To reduce the noise while keeping the edges, the median filter is applied.

ii. Gaussian filter:

A Gaussian filter is used on the image to reduce the noise. Gaussian filter is a low pass filter that suppresses high frequency detail while preserving the low frequency components of the image. A sigma value of 0.5 was chosen to enable noise filtering while still keeping the edge components of the images.

iii. Dull Razor algorithm:

It identifies the dark hair locations by a generalized grayscale morphological closing operation, then It verifies the shape of the hair pixels as thin and long structure, and replace the verified adjacent pixels by a bilinear interpolation. It smooth the replaced hair pixels with an adaptive median filter.

iv. canny edge detection

It is a multi-step algorithm that can detect edges with noise suppressed at the same time. For extracting the shape features of images using Canny edge detection

C. Segmentation

Image segmentation is the process of extraction of desired region of interest and plays a vital role in medical images for the analysis of anatomical organs and anomalies like tumor, cyst.

i. Thresholding:

It computes a global threshold that can be used to convert an intensity image to a binary image.

ii. Active counter Model:

It is used to extract the boundaries of objects in an image Segment image into foreground and background using active contours.

iii. Mean Shift algorithm:

It do not have to specify the number of clusters. The algorithm itself finds the best number of clusters for the given data. Mean shift clustering is a powerful, non-parametric iterative method that does not require prior knowledge of the number of clusters and does not limit the shape of the clusters.

iv. Otsu's Segmentation:

It is based on single threshold, it is not suitable for images with low contrast. Good accuracy in extracting the lesion. This techniques involves iterating through all possible threshold values and calculating a measure of spread for pixel levels each side of threshold. The ultimate goal is set background spread is at minimum.

v. Sobel edge detection algorithm:

To detect boundary of noisy image sobel edge detection is used.

vi. K-Mean Clustering

It is generate joined set of data in the form of clusters. Clustering is minimized the group variance. This minimization will help in segmentation process

D. Feature Extraction:

RELIEF algorithm; It is filter based feature selection methods, is an effective, simple, and widely used approach to feature weight estimation. The weight for a feature of a measurement vector is defined in terms of feature relevance.

i.Shape:

ABCD rule:

Asymmetry: Melanoma lesions are often irregular, or not symmetrical, in shape. Benign moles are usually symmetrical Border: Non-cancerous moles have smooth, even borders. Melanoma lesions usually have irregular borders that are difficult to define.

Color: The presence of more than one color (blue, black, white, red, light and brown, blue gray) or the uneven distribution of color can sometimes be a warning sign of melanoma. Benign moles are usually a single shade of brown or tan

Diameter: Melanoma lesions are often greater than 6 millimeters in diameter.

ii.Texture:

GLCM:

Contrast: Contrast measures the amount of local variations in an image.

Co-relation: Correlation is a measurement of gray tone linear dependencies in the image.

Energy: Energy is a measurement of texture uniformity of an image, the more homogeneous the image, the larger the value.

Homogeneity: Homogeneity is a measurement of the amount of local uniformity present in the image.

LBP: The LBP describes texture with smallest primitives called textons (or, histograms of texture elements).

For each pixel in an image, a binary code is produced by thresholding, its neighborhood with the value of the center pixel.

iii.Color:

Color is important feature descriptor for the classification of melanoma. If the particular region is affected the skin lesions region change the color effectively. Relative color histograms in different color spaces are constructed to identify the melanoma.

Color Histogram: Color histograms in different color spaces are constructed to identify the melanoma. The 3-D histogram is constructed for the color spaces such as RGB, LAB, HSV, HUE and OPP.

RGB color space: RGB color space represents a mixture of Red, Green and Blue. The color component is represented by the mixture coefficients of these three colors.

HSV color space: Hue Saturation and Brightness (HSV and HIS) are the color spaces related to human description of color.

OPP Color Space: The edges are strengthened in biologically inspired color spaces.

Color Moment:

Mean: Arithmetic average obtained by summing up all the observation & dividing the total by the No. of Observations

STD: Square root of the average of the sum of the squares of deviations taken from the mean. It is commonly used statistical measures to demonstrate data variability.

Skewness: Mathematically defined as the averaged cubed deviation from the mean divided by the standard deviation cubed. If the result of the computation is greater than zero, the distribution is positively skewed. If it's less than zero, it's negatively skewed. If equal to zero, it's roughly symmetric.

E. Classification

i. DT

Decision tree breaks down a data set into smaller and smaller subsets while at the same time an associated decision tree is incrementally developed. The final result is a tree with decision nodes and leaf nodes. A decision node has two or more branches and a leaf node represents a classification or decision.

ii. ANN

Artificial Neural Network (ANN) is used to process feature rich data. ANN is also extensively used as classifier for analyzing the EEG signals.

iii. KNN

K-nearest neighbor (KNN) is capable to produce high performance results even for complex applications. The KNN uses a distance of features in a data set to determine which data belongs to which group. A group is formed when the distance within the data is close while many groups are formed when the distance within the data is far.

iv. SVM

Support vector machine is supervised learning models. It is a kind of learning algorithm which is used to analyze the data and recognize the data patterns. It is mainly applicable for solving the binary problems.

v. R-F

It is operated by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees. Random decision forests correct for decision trees' habit of over fitting to their training set.

4. Comparative Study

Table I. Comparison Between Segmentation Method

Techniques	Advantage	Disadvantage
Cluster Base K-Means	Works for noisy images	Works with fixed distance

Color Base HSV Lab	It is give optimize results for feature extraction associated with image pixels	Overlapping and miss segmentation due to pixels closely related to each other

Table II. Comparison Between Feature Extraction Method

Features	Methods	Advantages	Limitation
Shape	Area, Perimeter, Major and Minor Axis[1]	Easy to implement, Less Complex, Less Time	Works with Binary Image only
Color	Color histogram[5]	Simple to use Fast Computation	Lost spatial information No color similarity
	Color Co-occurrence Matrix(CCM)	It captures the color variations in image	Computation time is High.
	RGB	When the texture feature is combined with RGB color space it provides a better results	The color spaces are not perceptually uniform, and it depends on the acquisition setup.
	HSV,HSI	color dominates the texture feature	color dominates the Texture feature and it provides better accuracy. But it may not be the same for all cases
	Color Moment[1]	Create robust feature set. High Accuracy. Low Computation	Not Cover Invariant Property
Texture	2-D Wavelet Transform[3]	Less retrieval time	Poor performance compared to the Gabor wavelet transform
	Gabor filter	Achieves highest retrieval results	Only consider Gray scale images
	LBP	Save memory with a non-uniform pattern there is 2p possible combinations while for uniform LBP there are patterns of p(p-1)+2. It does calculation in integer	It is less accurate
	GLCM[1,5]	more effective in texture feature extraction and the high classification accuracy	Works with Gray scale images
	Haralic features	Computational accuracy of feature vectors is high, Classification accuracy is high	Due to 13 features the computation of feature vectors is complex and time consuming. High Dimensionality

Table III. Comparison Between Classification Method

Features	Methods	Merits	Demerits
Classification	SVM[3,4,5]	Achieves optimal class boundaries by finding the maximum distance between classes. Less misclassification Robust & Faster Required less memory less complex than ANN Good generalized ability	SVM is binary classifier, to do a multi-class classification, pair-wise classifications can be used Expensive trial and run
	ANN[2]	Suitable for complex problem Robust to noisy data	Expensive training Complex Sub-optimal Time consuming
	KNN[4]	Effective if the training data is large.	Computation cost is quite high. It is computationally expensive to find the k nearest neighbors when the dataset is very large. give False positive image retrieval
	Decision Tree[4]	It reduces overfitting and is therefore more accurate. Easy to Implement Works with all types of data. Multi classification Support	It may not work if the dependent variables considered in the model are linearly related. Therefore one has to remove correlated variable by some other technique
	R-F	It computes proximities between pairs of cases that can be used in clustering, locating outliers, or (by scaling) give interesting views of the data. The capabilities of the above can be extended to unlabeled data, leading to unsupervised clustering, data views and outlier detection.	Random forests have been observed to over fit for some datasets with noisy classification/regression tasks.

5. Conclusion and Future Scope

In this paper explain three features shape, size and color based advantages and disadvantages. It is also observed that the classification result changes when we change the different classifier. So making theory is used for combining features and combine color and cluster based methods for actual part segmentation. This system is batter works for skin cancer classification. In Future by use of image processing and combining two or more algorithms system would give batter output for medical education.

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