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Skin Lesion Analysis - Feature Extraction Methods Using Dermoscopy Image

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Abstract - Skin malignancy is viewed as one of the most perilous type of disease found in human. Skin malignant growth is found in different types such as Squamous cell carcinoma, Basal and most erratic Melanoma. Early detection of skin malignancy is fundamental wellbeing prerequisite for the patient and a basic errand for the dermatologist. The genuine reasoning is that the possibility of patient's endurance is high whenever analyzed early and can save victims and spare casualties. The advancement in present technologies have been explored to utilize automated and mechanized framework for skin lesion analysis. Skin lesion analysis has various significant diagnostic feature parameters such as color, area perimeter, diameter and texture parameters such as size, shape and depth. In the diagnosis of dermoscopic images, the non-infected and malignant skin lesion is classified using feature and texture parameters. In this paper various dermoscopy image analysis strategies have been surveyed, to investigate and choose a fitting technique for early detection of skin ailments. This survey work will be a pathway to researcher and clinical specialists.

Keywords: Melanoma, Machine Learning, Deep Learning, CNN, Dermoscopy

1. INTRODUCTION

Skin lesion disease is viewed as the most hazardous type of tumors. In the event that skin maladies are not diagnosed in before, it might prompt inconveniences in the body like spreading of the contamination from one individual to the next [2]. This cancer can be forestalled by researching the contaminated area at a beginning phase. Skin tone and skin shading are significant factors in skin cancer identification. Shading and coarseness of skin are outwardly unique. Processing of dermoscopy images for skin analysis requires efficient automatic image processing techniques to recognize the skin lesion. The skin lesion characteristics are broadened, with the goal that it is moving position to devise an effective and robust algorithm with efficient calculation for the discovery of skin cancer and its seriousness. Melanoma is a type of tumour that emerges by a skin cell called melanocytes. Melanoma most commonly occur on the legs for female, and for male they are most commonly occur on the back. Few lesions are also developed from mole, variations like expansion in shape, sporadic dissimilarity, shading of color, irritation and breakouts in skin. It is uncommon in individuals with more obscure skin. Melanoma occurs higher comparing squamous and basal cell, perilous too and it spreads or metastasizes mostly.

The Melanoma diagnosis Organization gauges that these sort of skin ailments leads to 25% of mortal passing. Early distinguishing and recognition will assist with limiting the death toll. The dermatologist generally depend on manual eye forecast strategies for distinguishing, perceiving and reviewing of illnesses on skin [5]. This sort of strategy for diagnosing is very time taking. Also, the expert isn't sensibly estimated and isn't opportune open to the patients. There are issues with the proficiency in manual evaluating framework and prediction of values are not precise.

Computer vision tasks incorporate strategies for acquiring, processing, dissecting and analysing computerised images. To create mathematical or emblematic values, for example all ways of choices. It is utilized for recognition and reviewing of skin ailment for the identification of Melanoma. It can direct constant finding for illnesses precisely, quickly and adequately by breaking down the sorts and attributes of sicknesses. An image recognition process incorporates image pre-processing, segmentation, feature extraction and detection. Dermoscopy image Pre-handling incorporates resizing, thresholding and filtering [2]. The image segmentation legitimately impacts the dependability of extraction and the exactness in detection of Melanoma [2]. It also incorporates the threshold methods, edge detection, clustering methods and segmentation methods with the recognition techniques based on neural network or statistical pattern.

Image segmentation techniques and classification techniques used in melanoma identification is machine learning techniques and CNN based segmentation in Deep Learning. The streamlined indication is obtained through a technique known as conversion of image. Gaussian regression process technique is moderate, not so much exact but rather more costly contrasting to Support Vector Machine. In Machine learning, GPR (Gaussian process) is a regression model which uses bayesian technique to work on smaller values. Gaussian process regression model has an efficiency of learning unpredictable values for prediction and functioning admirably on smaller datas. This regression model gives the vulnerability estimations on the forecasts. The k-means is an important clustering algorithm which has profound pool of informations, methods and activities. The algorithm is more efficient and reliable to classify the data to cluster, it is applicable for smaller datasets too. This algorithm is utilized consequently to isolate diseased and non-diseased region. In deep Learning, the CNN algorithm is used to categorize images by various aspects like predicting the information of the input data and differentiating the datas with the given input images. This method is used to identify the benign and malignant skin disorder, which assists with improving the precision rate.

In this paper, the second section describes the basics of malignancy in Skin, the third section includes the overview of system, the fourth section summarizes the related work, the fifth section concludes with the conclusion and references.

2. SKIN MALIGNANCY

The largest organ of the body is skin. The skin comprises of three layers: epidermis, dermis and hypodermis. The Melanocytes are available in the layer called epidermis [2]. Melanocytes are melanin-delivering neural peak inferred cells situated in the base layer of the skin's epidermis, center layer of the eye, inward ear, vaginal epithelium, meninges, bones and heart. Melanin is a dark shade of skin cell which is responsible for skin shading. It

contains unique organelles called melanosomes and prompts pigmentation through keratinocytes. Melanin present in the cells protect from the UV radiation. Melanocytes additionally have a function of protecting from in the invulnerable framework. Melanocytes have a role in the immune system.

Metastasis has perplexing cycle that includes the spread of a tumor or malignancy to inaccessible pieces of the body from its unique site. Metastasis is a pathogenic specialist's spread from an underlying site to an alternate or auxiliary site inside the body. It normally utilized when alluding to metastasis by a harmful tumor. It is commonly recognized from malignant growth attack, which is the immediate expansion and infiltration by disease cells into neighboring tissues. Disease happens after cells are hereditarily modified to multiply quickly and uncertainly. This implies if disease metastasizes to the lungs, the optional tumor is comprised of irregular bosom cells, not of strange lung cells. The tumor in the lung is then called metastatic bosom malignancy, not cellular breakdown in the lungs. Metastasis is a key component in disease organizing frameworks. The prospects of remedial therapy are extra-ordinarily decreased, or completely eliminated when a malignancy has metastasized. It is the cycle of spreading the threatening tumors to different pieces of body through blood. There are three kinds of malignant growth of tumors in Skin lesion: Basal-cell carcinoma, Squamous cell carcinoma and Melanoma [2]. The BCC is a sort of malignant growth regularly found in the head, bears because of the impact in radiation. The draining are found at the focal point of injury and shows up as layered spots. The SCC is occured because of irregular development of squamous cell in epidermis. SCC seems as though flaky dark patches, bruises, neck and moles.

Fig. 1. Differentiation of images - Benign and Malignant Skin lesion.

Melanoma, a perilous type of malignant growth in skin. It is found in earthy colored, dark

shading. It occurs mostly in incidental Ultraviolet presentation, particularly in the individuals who are hereditarily inclined to ailment. In [2] the event that Melanoma is perceived and treated early it is consistently reparable.

Some of the erratic features are:

- Irregularity in edges,
- Asymmetric lesion of skin,
- Tone changes and Diameter of injury Some of the facts behind skin ailments:
- Penetration of UV radiations,
- Actions of engineered substances,
- Solar radiation and
- Undergoing treatments in radiation.

3. SYSTEM OVERVIEW

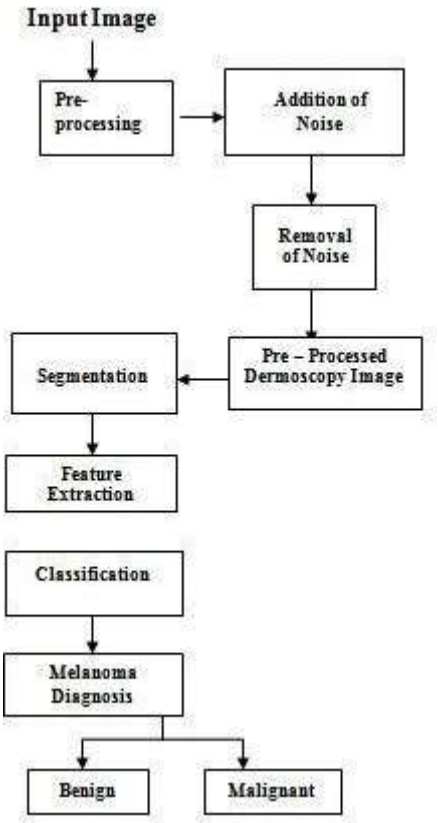

Fig. 2. Skin Lesion Diagnosis - System Overview

4. RELATED WORK

4.1 Support Vector Machine

In [8] the dermoscopy image analysis is done, where pre-preprocessed dermoscopy images utilizes three techniques. A gray-scale images gives brilliance data infomation about the skin

lesion brightness[1]. That have the force of incentive somewhere in the range of 0 and 256, the range 0 focus on darker shade and 256 focus on lighter shade. Middle channel is a nonlinear channel which assists with eliminating the clamor, dainty hairs. Difference improvement was accomplished for expanding the nature of the image using median filter[3][6]. A most extreme entropy thresholding technique was

utilized to fragment region of interest to oppressed pictures[4]. The image was portioned with the assistance of most extreme entropy applied to the histogram of gray scale image. Surface highlights was removed utilizing GLCM strategy. The yield from GLCM has the contribution to Support vector machine, in arranging into carcinogenic and non-infected region[7].

Support Vector Machine utilised for characterizing the melanoma is proposed. Median filtering is utilized to eliminate noises. At that point, the dermoscopy images are sectioned using K-means technique[8]. It assists with clustering dermoscopy preprocessed images as distinct classes. The ROI have been processed from extricating the features[23]. The resultant value acquired distinguishes the region into inner and outer by extricating the shading of skin lesion and texture. The principle component analysis (PCA) is used to remove the irrelevant and redundant features. Finally a Support vector machine classification have been built for diagnosing infected and non-infected region[9][16]. Histogram adjustment have been utilized for improving differentiation of dermoscopy images. Otsu's thresholding strategy was utilized to portion the skin lesion into closer view and foreground view. From Region of interest, for example, mean, variance and standard deviation was separated by various classifying methods[10]. Some of the classifiers are Neural network, Decision tree-based classifier, Support vector machine and Boosted tree-based classifier. At last, tentatively demonstrated that SVM is better than others with precision rate 93%.

In [12] SVM was used to perform skin lesion analysis. In the pre-processing phase, Median filters were applied in order to perform smoothing and percentage of contrast in the input images were enhanced as the images may not be supposed as a homogenous one. The process of segmentation is performed in a sequence of Otsu's thresholding technique, image filling, continued by morphological opening operation and histogram equalization[11][12][13]. Ostu's technique was used to obtain the ed images .The empty portions present in the images were filled with various image filling techniques. The outcomes of morphological technique were transformed into gray-scale images. The features like border, color and texture were extracted from the input images. The dimensions of the input image were reduced using Principal Component Analysis (PCA). Finally lesion classification was performed by the combination of SVM along with radial basis function. Gaussian model for filtering has been utilized to smoothen skin lesion and GLCM model for image enhancement is utilized for improving the quality of the skin lesion image. K-means technique was proposed for segmenting the required portion and GLCM technique was proposed for classifying the required portion. This technique gives information about the contrast, correlation, cluster prominence, cluster shade and demonstrated it as superior to other classifier with precision rate of 94.3%.

4.2 Bayesian Classifier

In [14] preprocessing, directional filtration methods are used for eliminating the unwanted noises from the input skin lesion-image. Un-occupied regions present in the input image are occupied by maxi pixel-range to 8-adjacent pixel-range [2]. For subjective image, active

contour based segmentation is used[17][24]. The s-fractal textural analysis (SFTA) technique is utilised for feature-extraction using color correlogram and segmentation for the correct classification. The color correlogram is also used to find the color correlation of pixels. It also gives fractal-dimension for the data about the intricacy and the structure for limitations. The proposed Bayesian-classifier is used along with color-correlogram and SFTA to classify the skin lesion into benign and melanoma. This method utilizes the dermoscopy input image-dataset for analyzing the resultant value which combines color-correlogram, feature and texture parameters.

4.3 Neuro Fuzzy System

In [15] clustering technique is used for classification of skin lesion. The median filter is utilized for noise removal and shift-clustering method have been utilised in segmenting preprocessed image. In the clustering process, shift strategy was been utilised for gathering earlier information about the number of clusters present[18]. It also includes feature extraction method, for example, mean, total-variance and texture- skewness and color-space. The GLCM technique have been utilized for obtaining the texture features by statistic method. For classification process, the neuro fuzzy system utilizes the technique which combines both the adaptive and the inference with neuro network.

An inference method is proposed in neuro fuzzy system for the classification of lesion. This technique have been assisted with distinguishing the regulations in the appropriate fuzzy system[19]. A dull razor procedure was utilized for eliminating the artifacts. A framework of this model has been utilized for segmentating the skin lesion. Then, that image is incorporated with the method called ABCD rule. This method is generally utilized by clinical laboratories for diagnosing the skin ailments with the guidance of dermatologists, the same method is inculcated to the system for diagnosis. This method has foremost parameters, Asymmetric, Boundary, Colour and Diameter of the skin lesion have been calculated[20]. This versatile method which has the most efficient result is applied as feature extraction method and the inference system is utilized for classifying the skin lesion images[21][22].

4.4 K - Nearest Neighbor Classifier

The k-NN method is utilized for classification, feature extraction and regression process. A median filtering technique is used for addressing problem which reduces the noise from the image. The Generalized Co-occurrence Matrix is used for feature extraction using color features which removes RGB color-space and texture features [2]. Finally for image classification, k-NN classifier is used with texture features for extracting skin lesion image. This technique deals with the extraction methodology for shading and surface component. Based on the GCM strategy, it eliminated the texture features which are exploited for finding mean and standard deviation of color correlogram. From the selected feature it identifies the most significant features for the improved outcome using k-NN classifier for the skin lesion.

4.5 Calculating Dermoscopy Value

The conversion of image is done using the color space method called YUV and for segmenting the skin ailments the Ostu method of thresholding is used. The ABCD (Asymmetry, Border, Color, Diameter) rule is been used for calculating the total value of dermoscopy.

Total Dermoscopy value = [(Asymmetry value * 1.3) + (Border value * 0.1) + (Color value * 0.5) + (Diameter value * 0.5)]

If the Total Dermoscopy value is < 6 then benign orelse malignant.

4.6 Artificial Neural Network Classifier

In [19] ANN was utilised for skin lesion detection and classification. ANN was found to be the most suitable technique due to its parallel architecture. Such architecture would be helpful in deriving lotmany features from the input image. Initially the median filter was utilised in the pre-processing phase, to extract the non-linear features and also it helps in noise removal. It is also possible to preserve the edge related information using median filter.Followed by pre-processing, segmentation was done by thresholding techniques. Threshold segmentation accepts input images either in the form of color or gray scale, whose output will be in the form of binary image. The process is done by scanning the images pixel-wise, depending upon the value of the pixel, it can be categorised either as an object or background. Extracted features were in the form of texture, color, border and symmetry, are inputed into ANN classifier for further processing. In case of extracting the texture, Gray Level Co-occurrence Matrix (GLCM) have been found to be most suitable technique. Additional information like energy, contrast, mean, correlation can also be achieved using GLCM.

In [20] the dermoscopic images were utilised for lesion analysis and non-linear median filters were used to eliminate the noise or bubbles present in input images. In order to perform binary segmentation of the input images Threshold based segmentation was proposed, then two dimensional wavelet transformation techniques were applied for extracting the features. These extracted features were then forwarded to the MLP and then input weights were modified using back propagation, thereby enhancing the classification accuracy. Apart from the use of threshold based techniques statistical region merging algorithm (SRM) was utilised for segmentation process. As the name implies, in SRM algorithm, segmentation was performed in two different phases: choosing a regional space in the input images and merging the values together by applying merging criteria. Further, 2D wavelet transformation technique was applied in order to extract the features, which can be used further for classification. Biowavelet methods have 2 phases, for decomposition. In first phase, the details of the extracted features of the input images are analysed and these features were then passed on to Auto-associative Network classifier and back-propagation NN classifier for comparison. It was found that BNN shows improved accuracy of 91% in comparison with associative networks.

5. CONCLUSION

In this study, the fundamental ideas of skin disease and different non-intrusive strategies on dermoscopic images for classifying the skin lesion into benevolent and dangerous is surveyed. The classification of skin lesion into benign and malignant, includes several phases such as preprocessing, segmentation, feature extraction and classification. The survey brings together the most widely used image processing techniques for classification and early prediction of skin cancer. Machine learning techniques like bayesian classifier, neuro fuzzy systems, K-NN and SVM performs well for feature extraction. When the size of the input data increases, machine learning techniques tend to perform slow and hence lack in accuracy and this can be improved by deep learning architectures like ANN and CNN. Out of all the deep learning frameworks CNN performs well for medical imaging related applications like disease diagnosis and classification, due to its efficient feature extraction. CNN extracts the

features present in the images in different phases like low level, mid-level and high level in the forms of curves, lines and edges. The future scope can be focused on skin lesion analysis using CNN. Thus, Computer based image processing and its development in the field of clinical dermoscopy has been explained in detail. This review work is expected to be a helping tool for researchers, medical practitioners and scientist. This review is helpful in coming out with future scope of work in the field of medical image processing.

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