AUTOMATED SCREENING SYSTEM FOR ACUTE SKIN CANCER DETECTION USING NEURAL NETWORK AND TEXTURE

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Abstract - *Many types of skin cancer exist now-a-days. Melanoma is the type skin cancer which has increases the majority of death rate. The early detection and intervention of melanoma implicate higher changes of cure. Melanoma is detected by shape, size, color and texture of the skin lesion of melanoma in the early days. The existing system used clinical diagnosis for identifying whether it is benign, Atypical and melanoma types of skin lesion and it also take more time for analysis. Malignant melanoma are asymmetrical, have irregular borders, notched edges, and color variations are detected using the techniques thresholding for Segmentation and Principle Component Analysis for feature extraction. But it has the accuracy of melanoma is only 80%. The proposed system provides automatic screening system for real time skin lesion by giving the input image that is capture from the smart phones. This system will automatically detect whether the given image has melanoma by using texture segmentation, hair detection and exclusion, Gray Level Co-occurrence Matrix (GLCM) for feature extraction and neural network for classification techniques. The image database contains about 50 of skin lesion images includes benign, Atypical and Melanoma. The alert will be provided about the medicine to seek. The proposed result shows the system is efficient and accuracy of melanoma detection is increased by 97%.*

Key Words **:** *Skin Cancer, Melanoma, Image Segmentation, Feature Extraction, Classification.*

1.INTRODUCTION:

Skin cancer increases the death rate now-a-days. There are numerous types of skin cancers. Our key contribution is to focus on 5 common classes of skin lesions. They are Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Melanocytic Nevus / Mole (ML), Squamous Cell Carcinoma(SCC), Seborrhoeic Keratosis (SK). Recent studies have shown that there are approximately three commonly known types of skin cancers. These include melanoma, basal cell carcinoma (BCC), and squamous cell carcinomas (SCC). Basal cell carcinoma (BCC) type of skin cancer is the starting stage and it can be cured. Squamous cell carcinomas (SCC) type of skin cancer is the critical stage but it can be cured by the medicines. But the Melanoma type of skin cancer is also the critical stage it can't be cured. Melanoma is the most dangerous type of skin cancer. Globally, in 2012, it occurred in 232,000 people and resulted in 55,000 deaths. Melanoma is also known as malignant melanoma. These types of cancer develop from the pigment containing cells known as melanocytes.

Melanomas typically occur in the skin but may rarely occur in the mouth, intestines or eyes. In women they most commonly occur on the legs, while in men they are most common on the back. Sometimes they develop from a mole with concerning changes including an increase in size, irregular edges and change in color, itchiness, or skin breakdown. The primary cause of melanoma is ultraviolet light (UV) exposure in those with low levels of skin pigment. The UV light may be from either the sun or from tanning devices. About 25% of melanoma is developed from moles. Those with many moles, a history of affected family members, and who have poor immune function are at greater risk. Most people are cured if spread has not occurred. Melanoma has become more common since the 1960s in areas that are mostly Caucasian. There are many types in melanoma skin lesion. These are some types of melanoma which occur commonly. Superficial spreading melanoma can start in legs and spreads across the surface of the skin. Nodular melanoma can spread more quickly and it is found on chest, back, head and neck. Lentigo maligna melanoma is found on older people face and neck like stain on the skin. Acral melanoma is the rarest type and it is found on palms of the hands, feet's, under fingernails or toenails.

Before, Researchers have suggested that the use of non-invasive methods in diagnosing melanoma requires extensive training unlike the use of naked eye. The clinicians can able to identify melanoma skin lesion only by the exact symptoms and by using the shape, color, size and texture of the skin lesion. So that the accuracy of identifying what type of skin cancer the skin lesion belongs to is not accurate. Though most people diagnosed with skin cancer have higher chances to be cured, melanoma survival rates are lower than that of non-melanoma skin cancer. The skin cancer is identified by using the classification techniques. It is done by getting the input image of one of the human skin lesion and it is given as the input. The classification used for classifying whether the skin cancer exists or what type of melanoma this skin lesion has is identified in this process. Existing system can store only small number of skin lesions of melanoma to identify and to classify image.

But in this paper, the skin cancer can be identified automatically by capturing the image from the smart phones which has the melanoma skin lesion part and it is given as the input. This skin lesion part is sent to the process for identifying and detecting what type of melanoma it has. This detection has several processes and steps. The input image is followed with the Pre-processing of the image, Image Segmentation, Feature Extraction to extract the lesion part from the original image and finally Classification process. Here the accuracy of detecting the skin lesion is increased by 97% from the existing techniques. By this, the melanoma is detected early and it can be prevented before it reaches the critical stage.

1.1 PAPER ORGANIZATION:

The rest of this paper is organized as follows: Section II describes related works on skin cancer image recognition. Section III explains the components of the existing system. Section IV explains the components of proposed system to assist in the skin cancer prevention and detection. In Section V, we conclude the paper with future work

2. RELATED WORKS:

This paper has some related works according to the basics of this system. Karargyris et al. have worked on an advanced image-processing mobile application for monitoring skin cancer. An advanced software framework for image processing backs the system to analyze the input images. Their image database was small, and consisted of only 6 images of benign cases and 6 images of suspicious case.

Omar Abuzaghleh et al, has developed an Non-invasive Real-Time Automated Skin Lesion Analysis System for Melanoma Early Detection and prevention used only the dermoscopic images. Normal images are not taken.

Doukas *et al.* developed a system consisting of a mobile application that could obtain and recognize moles in skin images and categorize them. As indicated by the conducted tests, Support Vector Machine (SVM) resulted in only 77.06% classification accuracy.

Massone *et al.* introduced mobile teledermoscopy: melanoma diagnosis by one click. Teledermoscopy enabled transmission of dermoscopic images through e-mail or particular web-application. This system lacked an automated image processing module and was totally dependable on the availability of dermatologist to diagnose and classify the dermoscopic images. Hence, it is not considered a real-time system.

Wadhawan *et al.* proposed a portable library for melanoma detection on handheld devices based on the well-known bag-of-features framework. However, their system didn't allow the user to capture images using the smart phone.

Ramlakhan and Shang introduced a mobile automated skin lesion classification system. Their system consisted of three major components: image segmentation, feature calculation, and classification. Experimental results showed that the system was not highly efficient, achieving an average accuracy of 66.7%, with average malignant class recall/sensitivity of 60.7% and specificity of 80.5%.

These works has the specified problem. In prior work, it do not achieve high accuracy, smart phones are not used and also do not have preventing measures. To overcome these problem we propose some techniques in this paper it also increases the accuracy.

3. EXISTING SYSTEM

Skin cancer has been increasingly identified as one of the major causes of deaths. There are numerous types of skin cancers. Melanoma has been considered as one of the most hazardous types in the sense that it is deadly, and its prevalence has slowly increased with time. Melanoma is a condition or a disorder that affects the melanocyte cells thereby impeding the synthesis of melanin. A skin that has inadequate melanin is exposed to the risk of sunburns as well as harmful ultra-violet rays from the sun. Most people diagnosed with skin cancer have higher chances to be cured; melanoma survival rates are lower than that of non-melanoma skin cancer

In the early days, the analysis of skin lesion is identified by shape, size, color and texture of that lesion. The clinical diagnosis identifies the lesion by using the naked eye, so it cannot said to be a accurate disease. This type of result produces the wrong results. To overcome these disadvantages, some methods have been introduced. These methods are used to find the skin lesion correctly.

Techniques used in the existing system to find what type of skin lesions are,

i. Image Segmentation - Multilevel Thresholding.
ii. Feature Extraction - Principle Component Analysis.

3.1 PRINCIPLE COMPONENT ANALYSIS

PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables. Depending on the field of application, it is also named the discrete Karhunen–Loève transform (KLT), the Hotelling transform or proper orthogonal decomposition (POD). The algorithm flow of PCA is,

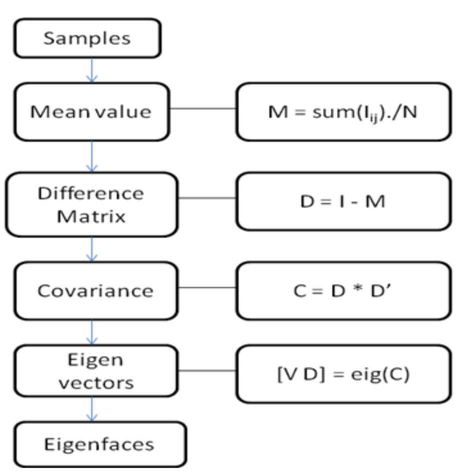

Fig - 1: PCA algorithm flow

The steps used to calculate the PCA values:

i. Input.
ii. Subtract the mean.
iii. Calculate the covariance matrix
iv. Calculate the eigenvectors and eigen values of the covariance matrix
v. Choosing components and forming a feature vector
vi. Deriving the new data set.

3.2 MULTILEVEL THRESHOLDING

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and k-means clustering. Recently, methods have been developed for thresholding computed tomography (CT) images. The key idea is that, unlike Otsu's method, the thresholds are derived from the radiographs instead of the (reconstructed) image. The design steps are as follows,

i. Set the initial threshold T= (the maximum value of the image brightness + the minimum value of the image brightness)/2.
ii. Using T segment the image to get two sets of pixels B (all the pixel values are less than T) and N (all the pixel values are greater than T);
iii. Calculate the average value of B and N separately, mean up and un.
iv. Calculate the new threshold: T= (ub+un)/2
v. Repeat Second steps to fourth steps upto iterative conditions are met and get necessary region from the brain image.

The detection and prevention of the skin lesion is not achieved accurately by using these techniques. This type of segmentation is not convenient for skin lesions. Accuracy is less in classification process. More time consumption for analyzing skin lesion. Less accuracy, due to less number of features set.

4. PROPOSED SYSTEM:

In prior system, the identification of skin cancer takes more time. The only way of finding skin cancer is in clinical diagnosis. But here we can automatically detect the skin lesion. The damaged image is taken from the smart phones and we can send that as the input for verification. It does not take more time for detecting. We can also store large number of feature set images for classification. Nearly 150 images can be stored for comparison. It finally display what type of skin cancer it belongs to.

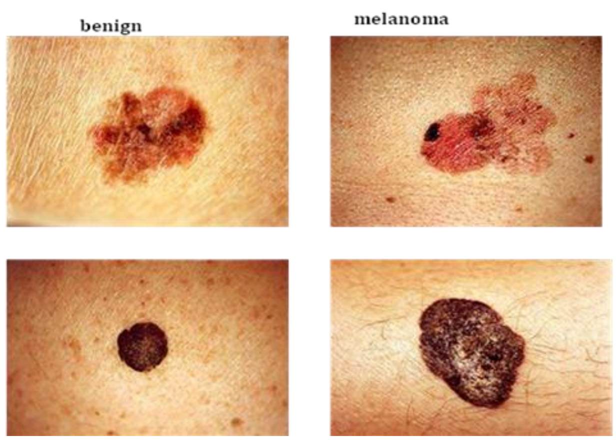

Fig – 2: Sample benign and Melanoma images

Skin image recognition on smart phones has become one of the attractive and demanding research areas in the past few years. Melanoma is that the deadliest variety of carcinoma. Incidence rates of malignant melanoma are increasing, particularly among non-Hispanic white males and females, however survival rates are high if detected early. Owing to the prices for dermatologists to screen each patient, there's a desire for an automatic system to assess a patient's risk of malignant melanoma victimization pictures of their skin lesions captured employing a customary smart phone images.

One challenge in implementing such a system is locating the skin lesion within the digital image. In projected technique a unique texture-based skin lesion segmentation algorithmic rule is projected. And classify the stages of carcinoma victimization Probabilistic neural network. As a result of in skin lesions stages are there therefore probabilistic neural network can offer higher performance during this system. The projected framework has higher segmentation accuracy compared to all or any alternative tested algorithms. GLCM algorithm that is employed to feature extracts the image. The techniques used in the proposed system are,

- Pre-processing - median filter
- Image Segmentation - Texture filters.
- Feature Extraction - Gray Level Co-occurrence Matrix
- Classification - Neural Network (PNN).

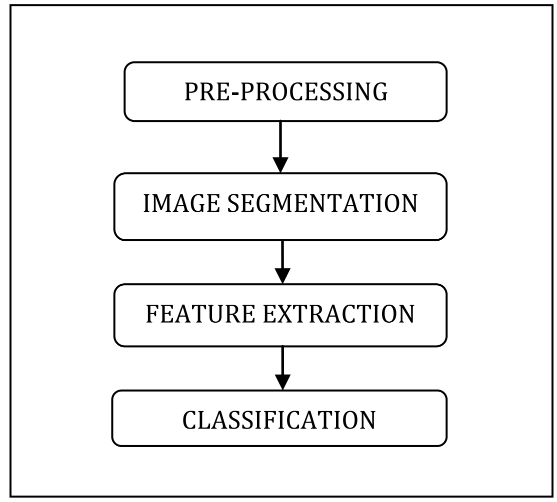

Fig - 3: flow chart for proposed system

4.1 Pre-Processing:

Pre-processing is the process of getting an input image for the process and that image has been converted into a gray scale image. From the Gray scale image , the thresholding can be used to create binary images (digital images that has two possible values for each pixel). It carries the intensity information of black and white. In the pre-processing process, it increases the pixel sixe from 256 pixel as 512 pixels to show the damaged part clearly in large size. It may also filter the noise in the input image by using the median filter. To reduce the noise like salt and pepper, Gaussian filter etc.

4.2 Image Segmentation:

Texture is used for segmentation process. Entropy filter is used to create the texture image. Texture is that innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment. In short, it is a feature that describes the distinctive physical composition of a surface. Texture features are extracted from Generalized Co-occurrence Matrices (GCM) that is the extension of the co-occurrence matrix to multispectral images. Texture properties include Coarseness, Contrast, Directionality, Line-likeness, Regularity and Roughness.

Texture is one of the most important defining features of an image. It is characterized by the spatial distribution of gray levels in a neighborhood. In order to capture the spatial dependence of gray-level values, which contribute to the perception of texture, a two-dimensional dependence texture analysis matrix is taken into consideration. This two-dimensional matrix is obtained by decoding the image file; jpeg, bmp, etc. The most popular statistical representations of texture are Co-occurrence Matrix, Tamura Texture, Wavelet Transform.

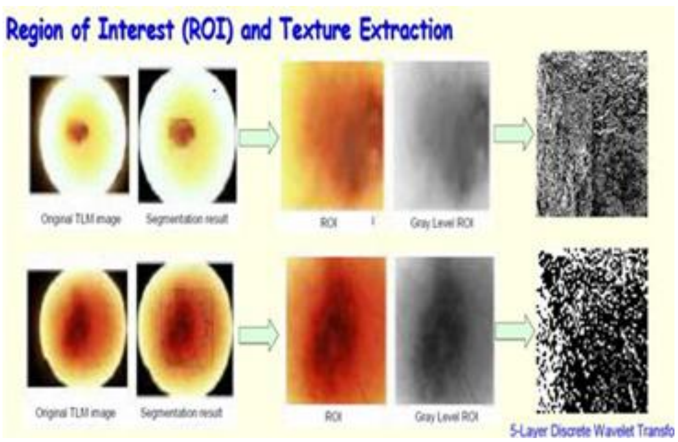

Fig - 4: Texture Extraction

4.3 Feature Extraction:

Feature Extraction is done by the Gray Level Co-Occurrence Matrix. It is also called GLCM. The Co-Occurrence matrix originally proposed by R.M. Haralick, the co-occurrence matrix representation of texture features explores the grey level spatial dependence of texture. A mathematical definition of the co-occurrence matrix is as follows :

- Given a position operator ***P(i,j)***,
- let ***A*** be an n x n matrix
- whose element ***A[i][j]*** is the number of times that points with grey level (intensity) ***g[i]*** occur, in the position specified by ***P***, relative to points with grey level ***g[j]***.
- Let ***C*** be the ***n* x *n*** matrix that is produced by dividing ***A*** with the total number of point pairs that satisfy ***P***. ***C[i][j]*** is a measure of the joint probability that a pair of points satisfying ***P*** will have values ***g[i]***, ***g[j]***.
- ***C*** is called a co-occurrence matrix defined by ***P***.
- Examples for the operator ***P*** are: "***i*** above ***j***", or "***i*** one position to the right and two below ***j***", etc. This can also be illustrated as follows… Let *t* be a translation, then a co-occurrence matrix C_t of a region is defined for every grey-level *(a, b)*.

$$C_t(a,b) = card\{(s,s+t) \in R^2 \mid A[s]=a, A[s+t]=b\}$$

Here, $C_t(a, b)$ is the number of site-couples, denoted by *(s, s + t)* that are separated by a translation vector *t*, with *a* being the grey-level of *s*, and *b* being the grey-level of *s + t*. For example; with an 8 grey-level image representation and a vector *t* that considers only one neighbor. At first the co-occurrence matrix is constructed, based on the orientation and distance between image pixels. The meaningful statistics are extracted from the classical co-occurrence matrix as the texture representation. Haralick proposed the following feature extraction methods are Energy, Contrast, Correlation, Homogeneity and Entropy.

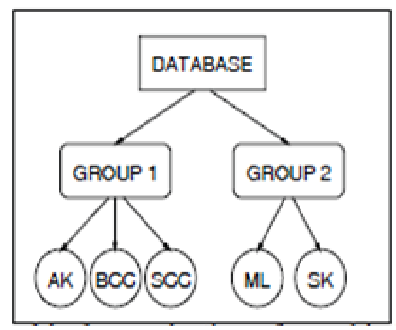

Fig - 5: Hierarchical organization of skin lesion clauses

4.4NEURAL NETWORK FOR CLASSIFICATION:

Neural networks are predictive models loosely based on the action of biological neurons. The extracted part of the skin lesion is classified by the Probabilistic Neural Network (PNN). It has many classifier for identifying the correct type of the skin cancer. It compares with the feature set images.

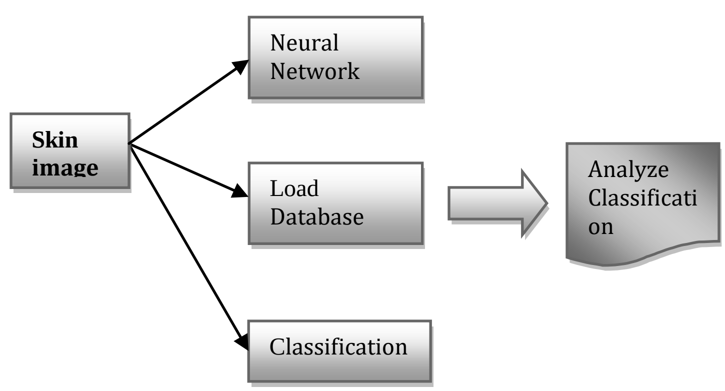

Fig – 6: Classification

4.4.1 Probabilistic Neural Networks (PNN):

Probabilistic (PNN) and General Regression Neural Networks (GRNN) have similar architectures, but there is a fundamental difference: Probabilistic networks perform classification where the target variable is categorical, whereas general regression neural networks perform regression where the target variable is continuous. If you select a PNN/GRNN network, DTREG will automatically select the correct type of network based on the type of target variable.

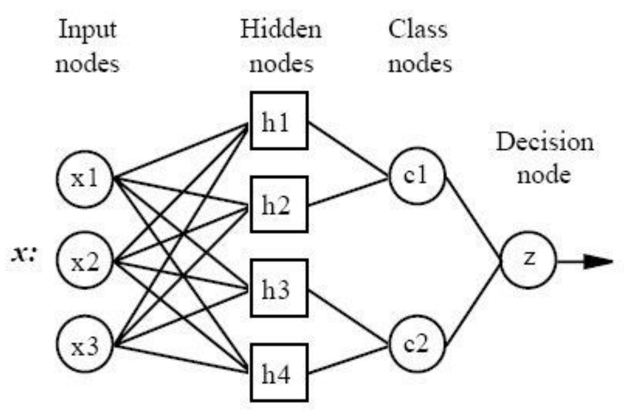

Fig - 7: Architecture of PNN

For example the experimental results of the benign, Atypical and melanoma is given as,

Table-1: Experimental values.

	Classifier 1	Classifier 2	Classifier 3
Benign	93.5%	96.3%	88.6%
Atypical	90.4%	95.7%	83.1%
Melanoma	94.3%	97.5%	100%

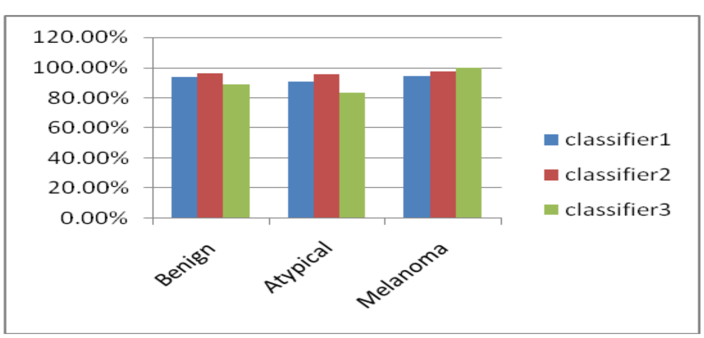

Chart-1: Performance results of values.

5. CONCLUSION AND FUTURE WORK

Early detection is vital, especially concerning melanoma, because surgical excision currently is the only life-saving method for skin cancer. This paper presented the components of a system to aid in the malignant melanoma prevention and early detection. An automated image analysis module where the user will be able to capture the images of skin moles and this image processing module classifies under which category the moles fall into whether benign, atypical, or melanoma. An alert will be provided to the user to seek medical help if the mole belongs to the atypical or melanoma category. The proposed automated image analysis process included Image Segmentation, Feature Extraction, and Classification. The image processing technique is introduced to detect and exclude the hair from the images, preparing it for further segmentation and analysis, resulting in satisfactory classification results. By using the techniques in proposed system , the accuracy is increased.

Future work is depends on the analysis of skin lesion in the smart phone itself according to the skin lesion given as the input. And then the mobile alert is given to the user as the warning message about the skin cancer to do the further steps according to the melanoma type detected.

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