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NAIL IMAGE PROCESSING FOR DISEASE DETECTION USING ANN

Juna V V*1

*1M. tech. student, Dept. of Electronics and communication College Of Engineering , Thalassery, Kerala, India.

ABSTRACT

In human being early detection is very much important in our health domain a system based on nail analysis predicts the diseases using the extracted features of our nail. For segmentation the image here we uses OTSU method of thresholding The prediction is done by the ANN (Artificial neural network) classifier looks for the features of color ,shape and texture from the segmented image. Nail image processing can overcome the human eye limitation and improve the prediction accuracy. It can perform a major role in the medical field.

Keywords: Nail image processing, Early detection, Nail analysis .Otsu thresholding, Nail diseases.

I. INTRODUCTION

We are more concern about our health and physical fitness. But we detect disease which effect our body in its second stage or last. Thus there need a proper evaluation for our body, it must be taken as a part of our daily routine ,Nail analysis must taken as needed for our health analysis. A healthy nail is smooth and pink or consistent in colour. Anything that effects the growth of our nail, that means the bad body condition can be visible on our nails. The problems in internal organs can be found out on our nail because it is farthermost part of our body. So a computer based analysis is needed because it can clearly classify more than 16 millions of colors and also there are some limitations for human eye capabilities, and some peoples are suffer from ophthalmological diseases. And also human eye has limited resolution so it cannot identify the intensity variation of near by pixels. The system identifies the nail diseases using several steps ,like segmentation ,feature extraction and classification .The proper segmentation done by thresholding and colour, shape and texture features are extracted and using these extracted features ANN classifies and find out the related disease based on data base. The input provided to the system is the back side of the palm, and it must be taken in a proper way. Input image is captured by camera. Number of diseases can be detected using these method.

II. METHODOLOGY

This paper proposes an image preprocessing method, which take the palm image as input. Both the palms images are taken by a perfect camera with proper light. The images are need to be taken in a dark background with maintain minimum distance between the fingers. The fingers must be nail-polis free. To extract the region of interest the input images are changed into gray image because it is difficult to perform the further processing in rgb plane. It eliminate the hue and saturation values from HSV and preserves the value. For segmentation the image here we uses OTSU method of thresholding .After the noise removal the original image is compared with the binary image produced by OTSU method and obtain the segmented image. Adaptive equalization is used for improving the image quality. And some morphological operation like erode, dilate and adaptive equalization are used three times for the image to minimize the noise . Image segmentation is used here to separate the foreground from the background. When segmentation is performed ,obtain the nail ROI on the finger and is extracted. First, the finger contour is sharpened by noise removal, which eliminated the pixel below 500 and the histogram equalization is implemented .Afterwards, the original image is multiplied by the binary image obtained by Otsu thresholding, the nail ROI is extracted. The extracted features which are given in a vector are matches with the existing dataset trained and the diseases are find out using the ANN classification. In ANN , the one-versus-rest approach is used. Here we have used classes for number of diseases and one class for unaffected nails. In the method- ANN classification were trained , for example, Hang versus not-Hang, Glomus versus not-Glomus, Anonychia versus not-Anonychia, Healthy versus not-Healthy. Finger nails and the related organs are shown in the table 1 .

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III. MODELING AND ANALYSIS

Table.1. Finger relation with body parts

SN.	Finger name	Organ
1	The thumb	Brain, excretory system and reproductive system
2	Index finger	Liver, gall bladder or nervous system
3	Middle finger	Heart and circulatory system
4	Ring finger	Reproductive and the hormonal system
5	Little finger	Digestive system

Table.2 Nail disorders and related disease

SN.	**Category**	**Nail Abnormality**
1	Dermatosis	Onycholysis, splinter hermorrhage, Darier's disease ,alopecia
2	Change in shape	Clubbing , koilonychia
3	Change in surface	Bau's lines, meruhrcke's line, leuonychia
4	Change in color	Terry's nails ,linday's nails, red lunula ,splinter hermorrhage ,yellow nail syndrome

A. Pre-condition for the input

- Back side of the palm :The input image taken is the back side of the palm were the nail is seen
- Nail polish free :The input image must be nail polish free and need to avoided tar like material or the ink which used for voting etc.
- Illumination :Input must taken in a proper illumination,other wise the light variation will effect our input image.

B. Segmentation

Image segmentation is a method which used to separate the region of interest from its background region. Segmentation is toughest and important step in an image processing algoritham. That we need only the region that which we are going to analyse ,thus the background may cause error in our prediction. So further processing in ROI gives an accurate result. Thresholding are most preferable and widely used method to process segmentaion. From thresholding methods here we prefer OTSU thresholding method. Simply it coverts our region if interest in to white and the background as white.

C. Feature Extraction of nail

After the segmentation was performed, and colour, shape and texture various features of nail are obtained and recorded. There were many feature extraction methods. colour feature distinguish the most effective and comparing visual features. A combination of Histogram and Statistical based feature extraction approach used for obtaining the Colour feature is used as it provides high precision . Histogram is a method of probability

distribution consist of intensity level of the image and other one provide information about the characteristics of remaining intensity level distribution for the image. The statistical features used are shown in Table 3 presents the equations for calculating the mean, standard deviation, kurtosis and skewness of the RGB planes , where M and N represents the measurements and total number of pixels in the image, Pij represents colour value of ith column and jth row. Feature extraction is most important in an image processing technique, because based on these feature extraction the classification is performed. So the extracting features must be accurate and effective to provide the information for the classification. From these colour features most of the image information can be accrued.

Table.-3: Colour features

Sl.No	Name	Calculation
1	Mean(μ)	$\frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M}P_{i,j}$
2	Standard Deviation(σ)	$\sqrt{\frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M}(P_{ij}-\mu)^2}$
3	Skewness(θ)	$\frac{\sum_{i=1}^{N}\sum_{j=1}^{M}(P_{i,j}-\mu)^3}{MN\sigma^3}$
4	Kurtosis(γ)	$\frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(P_{i,j}-\mu)^4}{MN\sigma^4}$

Along with colour features, shape features also provide more powerful information for obtaining information about images. Shape of an object is consider as binary image indicating the dimension of the object. Shape features can be classified as boundary based and region-based. The boundary-based extracts features based on the outer boundary of the region while the region-based obtain features based on the complete region . Feature vectors extracted from boundary-based characterization provide a good description of the shape and for this reason, boundary based shape features are attained from the various regions of an image. Features like area, perimeter, compactness, eccentricity are obtained.

Table. 4 Shape features

S.no	Name	Calculation
1	Area	It is the number of pixels in the region described by the shape. It is measured as the count of the internal pixels
2	Perimeter	It is the number of pixels in the boundary of the shape
3	Compactness	It is a measure of how closely packed is the shape. Compactness= $\frac{(Region\ border\ length)^2}{Area}$
4	Eccentricity (Roundness)	It is the ratio of the longest chord of a shaped object to longest chord perpendicular to it

Another important feature can be obtain using image analysis is texture feature of an image . Texture feature find out by a matrixes analysis. It can be extracted using either statistical methods or transformation methods.

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The former approaches can be splited into two areas which are the spatial domain approach and the frequency domain approach. The last approach, are more effective than frequency domain approach . One of the most commonly used approaches to texture analysis, the Gray Level Co-occurrence Matrix (GLCM). The system has used 14 texture features that make use the spatial relationship of gray level values of pixels with in a region. The GLCM gives tabulation method of how often different combinations of pixel brightness values (grey levels) oriented in an image. Different texture features used are entropy, energy, contrast, homogeneity and correlation. The extracted texture features are shon in Table 5, where Pij is the image probabilities calculated for values of the GLCM and N is the level of GLCM.

Coarseness is to identify how large size at which a texture exists, even where smaller micro texture exists. Contrast is used to capture the dynamic range of grey levels in an image, along with the polarization of the distribution of black and white. Degree of Directionality is a global property over the considering region. Features mentioned in table 5are not differentiate between various patterns or orientation ,but it measures the complete degree of directionalities .this is calculated by the frequencies distributed of oriented local edges in opposition to their directional angles.

S.No	Name	Calculation
1	Entropy	$\sum_{i,j=0}^{N-1} P_{ij}(-lnP_{ij})$
2	Energy	$\sqrt{\sum_{i,j=0}^{N-1} {P_{ij}}^2}$
3	Contrast	$\sum_{i,j=0}^{N-1} P_{i,j}(i-j)^2$
4	Homogeneity	$\sum_{i,j=0}^{N-1} \frac{P_{i,j}}{1+(i-j)^2}$
5	Correlation	$\sum_{i=0}^{N_g-1}\sum_{j=0}^{N_g-1} P_{d\theta}(i,j)\frac{(i-\mu_x)(j-\mu_y}{\sigma_x\sigma_y}$

D. Classification

For classification Feed-forward ANN is shown the figure below for the classification the disease based on their values obtained from image segmentation process, feature extraction. It consist of three layers that are neurons: input; output; and hidden. The number of nodes are determined based on our need or requirement. It is generally trained and attuned ,so there given a proper input that have targeted output it's own. For the given situation the network is attuned based on the target, until the network output matches the target.

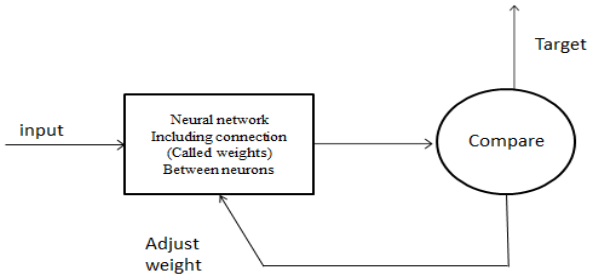

Figure 1. Neural network

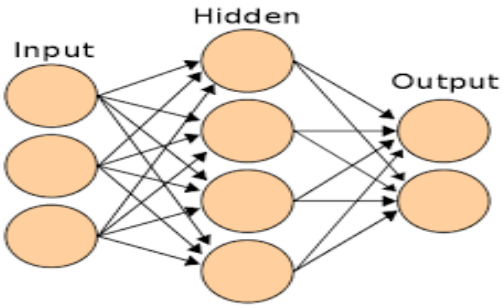

Figure.2 Nodes connecting layers

E .Disease detection

It is the final step in this method. The result obtained is the name of the corresponding disease which represented by the image. The feature extraction and classification accuracy is closely depended by this stage. ANN provides output label, which saved in the training data, the program analysis the label and return the disease name,. In this proposed method we uses different classes for various diseases, in the model- ANN classifiers are trained , considering, hangnail and non-hang, glomus and non-glomus, anonychia compares non-anonychia, healthy and non-healthy.

IV. RESULTS AND DISCUSSION

This paper implements an image processing method, trying to segment different parts of nail and find out the features of the input images using feature extraction methods. The implementation process consists of four steps. The both the left and right palm's back sides are taken using a perfect camera in proper light settings. .It should taken in a dark back ground. Image segmentation is a method which used to separate the ROI. It is the most. Segmentation is toughest and important step in an image processing algoritham. That we need only the region that which we are going to analyse ,thus the background may cause error in our prediction. So further processing in ROI gives an accurate result. Thresholding are most preferable and widely used method to process segmentaion. From thresholding methods here we prefer OTSU thresholding method. Simply it coverts our region if interest in to white and the background as black. The obtained binary image is use as a mask to separate the ROI from the original image.

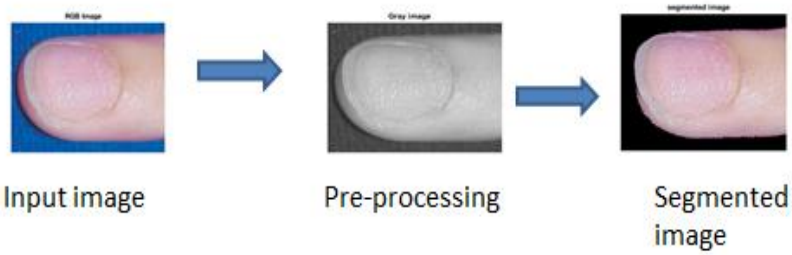

Figure 3: Simulated Results

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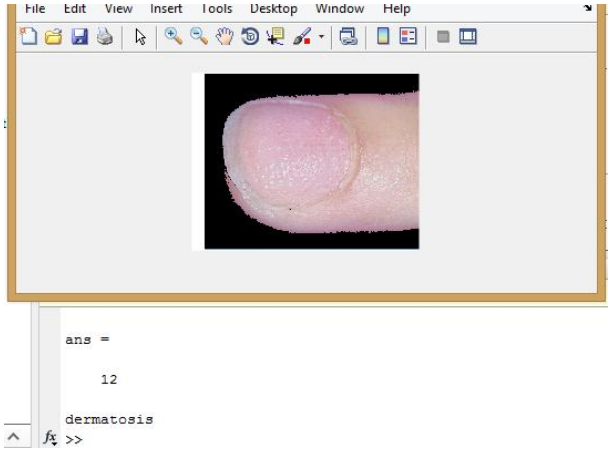

Figure 4: Output

In this proposed method we uses different classes for various diseases, in the model- ANN classifiers are trained , considering, hangnail and non-hang, glomus and non-glomus, anonychia compares not-anonychia, healthy and non-healthy

V. CONCLUSION

The experiment conducted based on nail image analysis results an new method for analyzing and detecting nail based diseases or the early stage symptoms that visible on our nails. Based on the result obtain we can say that the accuracy of the system is high and it can be followed by the other human body analysis we can find out the diseased person in a systematic method. The system uses simple methods for segmentation and feature extraction which followed by a classification method using ANN.

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