System for Disease detection by analyzing finger nails Color and Texture

Vipra Sharma[1], Aparajit Shrivastava[2]

[1]M.Tech Dept. of CSE, SRCEM, Banmore, Gwalior,India
[2]Dept. of CSE, SRCEM, Banmore, Gwalior,India

Abstract— *paper is about the concept how the finger nails color and texture are the indicator of health. The diseases in human body can be observed by analyzing nail color and texture, as disease can cause change in color of nail like yellow, green, black, blue and red. Similarly texture of nails also affected by disease. In the proposed system or model the color and texture of nail is scrutinized and detection is performed by comparing the color and texture with the pre-defined value for healthy nail. The methodology involves taking image of back side of palm region then segmenting the nail area from rest of the image, this concept is called Image segmentation that separates particular object from rest of the image, thereafter the detection is performed on the segmented area to detect whether the body is healthy or not.*

Keywords—Color Analysis, Image Segmentation, Texture Analysis.

I.   INTRODUCTION

Medical science has progressed drastically and developed innumerable methods to diagnose disease in human body. There are various methods like pathological test, MRI, X-Ray and etc, nail color and texture detection is one of these various methods. Although the methods named above gives accurate result but their processes are very costly and cumbersome to perform. For e.g. In pathological test blood taking for sample to perform test is quite painful.

A. Color of Fingernails

Study of Dermatology says that various health problems can be analyzed by change in finger nail color. The most common diseases can be diagnosed by nail color are Liver disease, half pink and half white nails, yellow nails, white nails, red nails, blue nails, black nails, heart conditions and diabetes.

B. Texture of Fingernails

Textural changes in fingernail can be caused by various diseases. Generally healthy nails are soft, shiny and smooth in appearance while disease illness can cause the brittle, rough, pitted, vertical lines on the nail surface.

The proposed system or model is being developed to detect the disease based on nail color and texture; various diseases can be diagnosed by analyzing the color and texture of nail. As the human eyes have limitation in color recognition and texture analysis, while the computer is able to detect millions of colors and slight changes in texture.

In the proposed system the algorithm is designed in such a way that it will take the back side palm image, performs segmentation process to extract the nail region from rest of the image then perform the color and texture detection method on the segmented nail portion and gives the output whether the nail is healthy or not. This algorithm is being developed in such a way that it will automatically diagnose the disease after taking the input image, while on other hand the pathological test needs lot of patience as these test can take even more than 24 hours, quite painful and the patient must be present for the test whereas this proposed system only needs the image of finger nail, that could be send over the internet via mail. Hence the proposed system will be beneficial in number of manner than the methods used in current scenario [7].

To examine the nail the following steps have to be followed:

1. Input Image.
2. Extract the nail region to be examined.
3. Analyzing the nail texture.
4. Analyzing the nail color.
5. Comparing the nail color and texture values with the pre-defined values for the healthy nail.
6. Condition of the nail is identified.
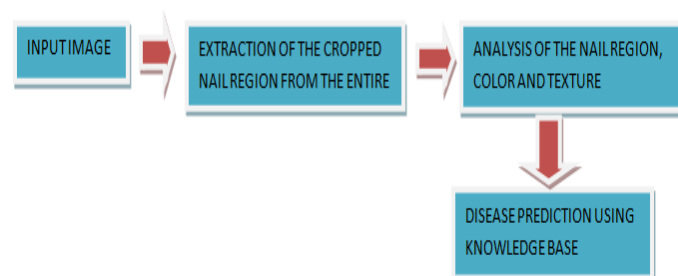7. Gives the conclusion and diagnose the disease.

Fig.1 General Texture and Color Analysis

C. *Need for the system*

Following reasons can be considered for requirement of the system:

1. Computer can identify more than sixteen millions colors very easily, while human eyes are limited to classify the color and some people also suffers from color blindness therefore analyzing the nail color via computer can be proved to be superior than human eyes [5].

2. The resolution of human eye vision is limited, slight changes in neighboring pixel values cannot be identify by the Human eyes while computer are developed with capability to detect every pixel precisely.

3. Pathological test are complicated and agonizing, patient need to be present for pathological test, while analysis performed by the system is tranquil.

   The proposed system is useful for the distant patient and doctor communication purpose, as patient is not able to present for checkup or doctor residing at some far place then patient can consult doctor by sending picture of finger nail, doctor can diagnose the symptoms and provide appropriate prescription for the diagnosed disease.

II. LITERATURE SURVEY

NAIL TEXTURE AND COLOR ANALYSIS:DISEASE SYMPTOMS

- Beau nail indicates: The horizontal line on the surface of the nail indicates beau nail. The disease that results beau nail are Myocardial infarction, Hypotension, shock, Hypocalcaemia, severe infection .(fig 2:a)[10]

- Nails pitting indicates: In nail pitting small pits over the surface of nail appears. The diseases that results nail pitting are "Psoriasis" ,"Alopecia areata", "Eczema" and "Lichen planus".(fig 2:b)[10]

- White nail indicates: color of nail changes to white. The diseases that results white nail are "Anemia", "Chemotherapy", "Renal failure", "Cirrhosis", "Diabetes mellitus", "Hereditary" (rare)(fig 2:c).[10]

- Red nail indicates : Color of nail changes to red. The diseases that results red nail are "Polycythemia" (dark), "Systemic lupus erythematosus", "Carbon monoxide" (cherry red), "Angioma", "Malnutrition" (fig 2: d) [10].

- Yellow nail indicates: Color of nail changes to yellow. The disease that results yellow nail Diabetes mellitus, Amyloidosis, Median/ulnar nerve injury, Thermal injury, Jaundice (fig 2:e)[10].

- Green or Black indicates: Color of nail changes to green or black. The diseases that results green or black color nails are Chronic*Pseudomonas* spp infection, Topical preparations, including chlorophyll derivations, methyl green, & silver-nitrate(among others),
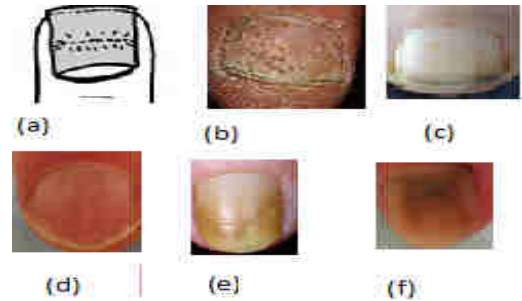Trauma (fig 2: f) [10].
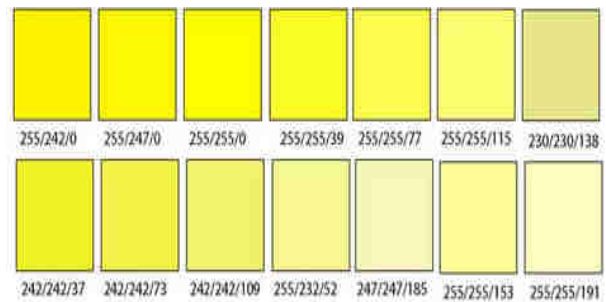

Fig. : Images of nails.

Fig. 3 Samples of yellow color palette [8]

A. IMAGE SEGMENTATION

Segmentation is a method of dividing an image into distinct homogenous region, each region containing pixels with identical attributes; basically image segmentation is the method of transforming low level image to high level image in terms of objects, features and scene. The achievement of image analysis is based on accuracy of segmentation procedure [3] [9].

B. TEXTURE ANALYSIS

Texture analysis refers to the characterization / classification of regions in an image by their texture content. Textures are the patterns made up of sub patterns or entities, has characteristics like color, size, shape, slope, brightness etc. Properties of sub patterns such as smoothness, granulation, frequency, phase, linearity, regularity, density, fineness, coarseness, etc describes the texture as a whole.

C. RGB COLOR MODEL

RGB color model consist of three primary colors i.e red, green, blue are mixed together to generate an Array of colors. The name of the model (RGB) is based on the initials of the

3 basic/ primary colors (red, green, and blue). The main aim of the RGB model is to represent the images in electronic equipments, such as televisions, computers, tablet and other electronic devices. it has also been used in traditional photography. Before the electronic age, the theory behind RGB color model is strongly based on human perception of colors. As RGB model is device dependent the RGB values are differently produced and represented by different devices, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels may be different for different manufacturer, or vary even in the same device over time. Therefore RGB color value does not gives the exactly same color until there is some kind of color management. RGB input devices are color TV, image scanners, video cameras, digital cameras and video games. Typical RGB output devices are TV sets of various technologies (such as CRT, LCD, plasmaetc.) , computer and mobilephone displays, video projectors, multicolor LED displays, and large screens such as Jumbo-Tron. On the other hand,Color printers are not RGB devices, but subtractive color devices (typically CMYK color model) [5].

D. GRAYSCALE IMAGE

Grayscale consist the range of monochromatic shades from black to white. Therefore, in grayscale image there are only shades of gray and no color exist. The digital images can be saved as grayscale (or black and white) images, even color images contain grayscale information, because there exist luminance value for each pixel, regardless of its color. Luminance can be specified as brightness or intensity, which can be measured on a scale from black (zero intensity) to white (full intensity). Most of the image file formats support a minimum of 8-bit grayscale, which provides 2^8 or 256 levels of luminance per pixel. There are some formats support 16-bit grayscale, which provides 2^{16} or 65,536 levels of luminance [5].

E. BINARY IMAGE

Binary means 2 values either 0 or 1. In binary image there are 2 possible values for each pixel either 0 or 1. Black and white these 2 colors are used in binary image. [1] The image has 2 parts Foreground and Background. Foreground color represents object and Background color represents rest of the image. In Digital image processing the operations like Dithering, Thresholding and Image segmentation results the binary image. There are some devices are limited to binary image, only binary image works with these devices such as fax machine, bi- level computer and laser printer [6].

F. INDEXED IMAGE

When there is data matrix(X) and color map matrix (map) in the image, the image is called Indexed Image. Map is an array in which there exist floating point values in the range [0, 1]. Each row in the matrix represents RGB color (red, green and blue). "Direct Mapping" is used in indexed image that maps the pixel value to values of color map [6].

G. MATLAB IMAGE FORMATS

The Proposed system will only cater to file formats such as BMP, GIF, JPEG, PNG and TIFF. Other formats will not be considered and for the same a logical code will be written to eliminate all other formats.
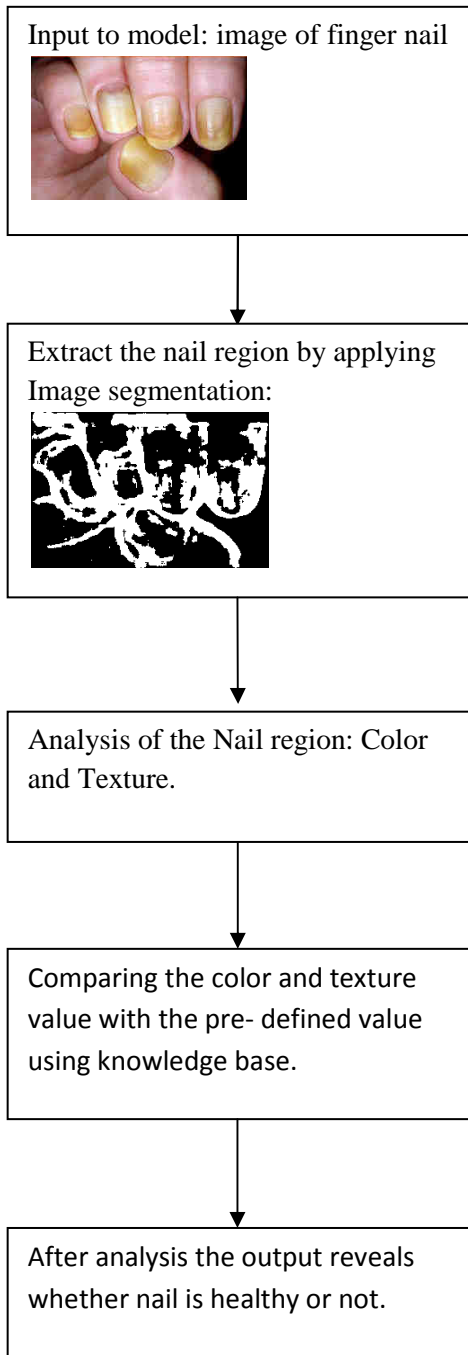
Format Name	Description	Recognized Extensions
BMP[f]	Windows Bitmap	.bmp
CUR	Windows Cursor Resources	.cur
FITS[f]	Flexible Image Transport System	.fts, .fits
GIF	Graphics Interchange Format	.gif
HDF	Hierarchical Data Format	.hdf
ICO[†]	Windows Icon Resources	.ico
JPEG	Joint Photographic Experts Group	.jpg, .jpeg
JPEG 2000[†]	Joint Photographic Experts Group	.jp2, .jpf, .jpx, j2c, j2k
PBM	Portable Bitmap	.pbm
PGM	Portable Graymap	.pgm
PNG	Portable Network Graphics	.png
PNM	Portable Any Map	.pnm
RAS	Sun Raster	.ras
TIFF	Tagged Image File Format	.tif, .tiff
XWD	X Window Dump	.xwd

III. PROPOSED METHODOLOGY

A set of methods or principles or rules for regulating the process is called Methodology.
The Proposed Model has four major steps:

- Input to the model: Scan the hand image consisting fingers, back side of palm region with proper brightness.
- Extract cropped Nail region from the entire Palm: Image segmentation method is applied on the input image to separate the nails area from the entire image.
- Scrutinizing the Nail region: Color and Texture of the segmented nail area is now being analyzed and determining whether the nail is healthy by comparing the segmented image with the dataset present.
- Disease Prediction by using Knowledge Database: The output is produced on the basis of analysis and the disease would be predicted if present.
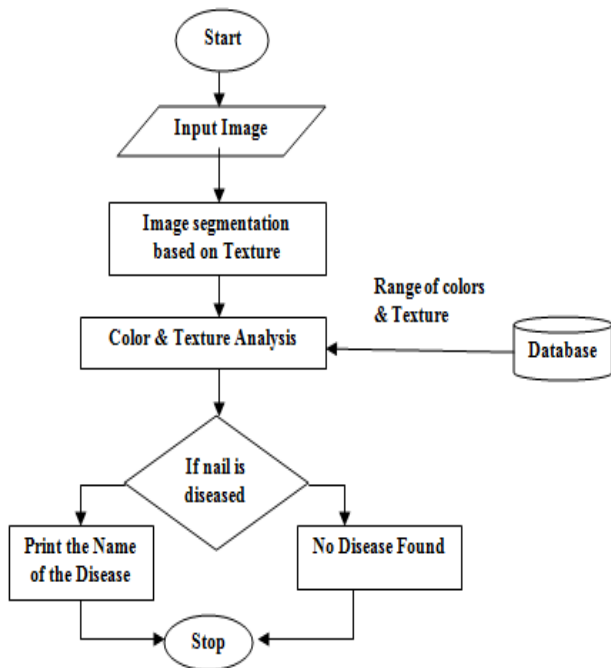
Input to model: image of finger nail

↓

Extract the nail region by applying Image segmentation:

↓

Analysis of the Nail region: Color and Texture.

↓

Comparing the color and texture value with the pre- defined value using knowledge base.

↓

After analysis the output reveals whether nail is healthy or not.

Process	Method Name	Description
Image Segmentation	imsegfmm(W, seedpointC, seedpointR, thresh)	BW =imsegfmm(W,C,R,thresh) returns a segmented image, with seed locations specified by the vectors C) and R, which contain column and row indices. C and R must contain values which are valid pixel indices in W.
Return Pixel values	Impixel(I)	Impixel(I) returns the value of pixels in the specified image I, where I can be a grayscale, binary, or RGB image. impixel displays the image specified and waits for you to select the pixels in the image using the mouse. If you omit the input arguments, impixel operates on the image in the current axes.
Region of Interest	roicolor	Select region of interest (ROI) based on color.
Create mask within Image	createMask(h) *parameter : getColor — Get color used to draw ROI object.* *color = getColor(h)*	Returns a mask, or binary image, that is the same size as the input image with 1s inside the ROI object h and 0s everywhere else. The input image must be contained within the same axes as the ROI. Gets the color used to draw the ROI object h. The three-element vector color specifies an RGB triplet.
Texture Analysis	BW2 = bwareaopen(BW, P)	Removes from a binary image all connected components (objects) that have fewer than P pixels, producing another binary image, BW2. This operation is known as an area opening. The default connectivity is 8 for two dimensions, 26 for three dimensions, and conndef(ndims(BW), 'maximal') for higher dimensions.
	IM2 = imclose(IM,NHOOD)	Performs closing with the structuring element strel(NHOOD), where NHOOD is an array of 0's and 1's that specifies the structuring element neighborhood.
	BW2 = imfill(BW,'holes')	Fills holes in the binary image BW. A hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image.
	BW2 = bwperim(BW1)	Returns a binary image containing only the perimeter pixels of objects in the input image BW1. A pixel is part of the perimeter if it is nonzero and it is connected to at least one zero-valued pixel. The default connectivity is 4 for two dimensions, 6 for three dimensions, and conndef(ndims(BW), 'minimal') for higher dimensions.
Specific Problem: For Nail Pitting.	bwpropfilt(BW,attrib,range)	BW2 =bwpropfilt(BW,attrib,range) extracts all connected components (objects) from a binary image BW that meet the criteria specified by attrib and range. attrib is a text string that identifies a particular property of the objects, such as their area. range is a 2-by-1 vector that specifies the range of values (low and high) of the property. bwpropfilt returns a binary imageBW2 containing only those objects that meet the criteria.

Algorithm   Pseudo code for the Proposed System
1. Input the hand image of the patient.
2. Perform Texture based segmentation which results in bifurcation of the Nail region from the entire Hand.
3. Segmentation the result by marking boundary.
4. Perform Color Analysis by comparing range values of the color stored in the database.
5. Texture identification and extracting features within the nail.

6. If color_of_nail= "Yellow"
    then "Diseased Nail"
    Else If color_of_nail== "Brown"|"Purple"
    then "Trauma Nail"
    Else "Healthy Nail"
    End.

7. If texture_of_nail== "Pitted"
    then "Nail Pitting Found"
    Else If texture_of_nail== "Beau"
    then "Nail is a Beau Nail"
    End.

8. Print the result in proper format.

FLOW CHART

IV. PRE-CONDITIONS /ASSUMPTIONS FOR THE DATASET

Assumption(s)	Description
1.Distal Edge	Distal edge (free edges) of nails can affect the result of analysis, the color and texture of the nail part which is attached with the skin can give the symptoms of disease, therefore the nail's image is to be given as an input must be trimmed.
2.Nail Biting	The case of oral compulsive habit of nail biting will not be taken under consideration; these images cannot be used for the data present as they can produce erroneous results. Pitted nail and bitted nail cannot be differentiated properly even by human eye. Therefore the proposed system will not cater to this problem.
3. Nail Polish	Polished nail/dyed nail (using some kind of Ink generally the case of voting) will not be considered for the analysis, so before performing the analysis the nail must be cleaned properly such that nail must be translucent in appearance.
4. Hands Only	We will not consider the image of toe-nail for analysis purpose because toe-nail is not exposed to air so its color is not too natural when compared with finger-nail; also toe-nail is harder in comparison to the finger nail, so it is easier to detect the disease if present in human body through finger nail.
5.Illumination	The illumination in room must be proper or focus of the light on the nail must be adequate before taking an image.
6.Weather Conditions	The nail image must be taken in normal room temperature as color of nail can be affected in extreme cold temperature.

V. FUTURE WORK

Future scopes for the model are:

- Nail detection can be used for the purpose of personnel identification and verification. The system used for this purpose known as Biometric system [4].
- Biometric system may cause lack of security in some manner as it uses the constant attributes like iris, retina, finger print, face recognition these attributes do not changes with the period of time, whereas transient attribute like finger nail usually changes within 2 months hence it proves to be more secure [1].
- CFCE (Certified Forensic Computer Examiner) scrutinize the digital data using forensic tools like Helix [2].

VI. CONCLUSION

Today life became better and easier with the generation of machines. The problem are now being solved beyond the capacity of human being and even it is clear from the proposed methodology the nails can be detected and diagnose the disease. The model is being developed by using MATLAB tool; basically this proposed work belongs to the

area of Image Processing. The method proceeds with the input image segmentation and then performing analysis on the segmented nail area. Although some considerations are to be follow and kept in mind during the procedure. The pre-assumption must be followed during execution. The result generated by this model will be very useful for medical domain and Biometrics domain. This model provides ease to compute, security, and cost efficient.

REFERENCES

[1] Barbosa I.B. et. al., "Transient Biometrics using Fingernails", Biometrics: Theory, Applications and Systems (BTAS), 2013 IEEE, Pages: 1-6, 2013.Accessed from : http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6712730&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6712730 , 2001, Accessed on: [15/12/2015].

[2] Flaim C.V., "Developing a Computer Forensics Team", SANS Institute InfoSec Reading Room, Accessed from: http://www.sans.org/readingroom/whitepapers/incident/developing-computer-forensics-team-628, Accessed on: [03/01/2015].

[3] Fujishima N. & Hoshino K., "Fingernail Detection Method from Hand Image including Palm", APR International Conference on Machine Vision Applications, Pages-117-120, 2013, Accessed from: http://www.mvaorg.jp/Proceedings/2013USB/papers/04-21.pdf, Accessed on: [21/ 02/2015]

[4] Garg S., Kumar A. & Hanmandlu M., "Biometric Authentication Using Fingernail Surface", 12th International Conference on Intelligent Systems Design and Application, IEEE, Pages: 497-502, 2012.Accessed from:http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6416588&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6416588 , Accessed on: [04/02/2015].

[5] Gonzalez R. & Woods R. "Digital Image Processing", 2nd edition, Pearson Education, 2004.

[6] Math Works, www.mathworks.com , 2015.

[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[8] My Practical Skill, Accessed from: http://www.mypracticalskills.com/store/rgb-color-swatches/, Accessed on: [04/02/2015].

[9] Sitapa Rujikietgumjorn "Segmentation Methods for Multiple body parts", Accessed from: http://imaging.utk.edu/publications/papers/dissertation/2008-aug-sitapi-pilot.pdf , Accessed on: [04/02/2015].

[10] Williams M. E."Examining Finger Nails: When evaluating presenting symptoms in elderly Patients", 2009, Accessed From: www.medscape.com, Accessed on: [22/12/2014].