HBRP PUBLICATION

Recent Trends in Analog Design and Digital Devices
Volume 2 Issue 3
DOI: [To be assigned]

A Review on Nail Image Processing for Disease Detection

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ABSTRACT
There are various parts of human body analyzed for identifying the different effect in human body. Human finger nail analysis is one of the ways to identify disease in human body. Nails are the body part which are farthest from the heart and therefore fare last to receive oxygen. As a result the nails are the first who shows the symptoms of disease in the human body. Finger nails can be easily captured for diagnosis and there are no heavy equipment's or conditions require for using nail image for disease diagnosis like in other tests and scanning process. Nail is one of the physical investigative tools which are normally practiced in Ayurveda where nail can be a strong indicator of likely complaints happening in the human body. Human nails deliver beneficial information about complaints or any nutritive imbalances dependent upon their shape, texture and color. In a human being, numerous systemic and skin diseases can be easily make a diagnosis through careful examination of nails of both limbs. A lot of nail illnesses have been found to be primary signs of numerous underlying systemic illnesses. The color, texture or shape changes in nails are signs of many diseases mainly affecting nails. And if we are able to use digital image processing methods for identifying such changes in the human nail, then we would be able to get more precise results and predict numerous diseases effortlessly.

Keywords: *Nail image processing, early detection, nail analysis*

INTRODUCTION

In healthcare domain various diseases can be detected by analysing color of human nails. A white spot here, a rosy stain there, or some winkle or projection may be an indication of disease in the body. Problems in the liver, lungs, and heart can show up in your nails. Doctors observe nails of patient to get assistance in disease identification. Usually pink nails indicate healthy human. Healthy nails are smooth and consistent in color. Anything else affecting the growth and appearance of the fingernails or toenails may indicate an abnormality. A person's nails can say a lot about their health condition. The need of system is to analyze nails for disease prediction is because human eye is having subjectivity about colors, having limitation of resolution and small amount of color change in few pixels on nail not be highlighted to human eyes which may lead to wrong result, whereas computer recognizes small color changes on nail. The system will extract color feature of human nail image for disease prediction. The system is concentrating on image recognition on the basis of human nail color analysis. Many diseases could be detected by analyzing nails of human hands. In this system human nail image is captured by camera. Captured image is given to our system and region of interest from nail area is selected from uploaded image manually. The selected area is then processed for extracting features of nail such as color of nail. Then this color feature of nail is matched using simple matcher algorithm for disease prediction. In this way the system is useful in

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detection of diseases in their early stages. In literature study here mentioned some of the diseases with its related color change in nails.

PARTS OF A NAIL

The matrix claw, keratogenous membrane, nail matrix, the tissue upon which the nail lie, the part of the nail bed that extends beneath the nail root and it contains nerves, lymph and blood vessels. The matrix is responsible for production of the cells that become the nail plate. The width and thickness of the nail plate is determined by size, length, and thickness of the matrix, while the shape of the fingertip determines if the nail plate is flat, arched, or hooked. The matrix will endure on grow as long as it gets nutrition and remains in a healthy condition. As new nail plate cells are incubated, they emerge from the matrix round and white will to push older nail plate cells forward; and this way yet older cells become crimed, flat, and translucent, making the pink color of the capillaries in the nail bed below visible.

The lunula is the observable part of the matrix, the whitish crescent-shaped base of the visible nail. The lunula is largest in the thumb and often absent in the little finger.

The nail bed is the skin, which under the nail plate. Like all skin, it is consist of two types of tissues: the deeper dermis, the living tissue fixed to the bone which contains capillaries and glands, and the superficial epidermis, the 2 layer just beneath the nail plate which moves forward with the plate. The epidermis is attached to dermis by a small longitudinal "grooves" known as the matrix crests or crests of nail matrix (cristae matric is unguis).As we age, the plate grows thinner and these ridges become obvious in the plate itself.

The nail plate or body of nail is the actual nail, and similar to hair and skin, made up of translucent keratin protein made of amino acids. In the nail it forms a strong flexile material made of several layers of dead, flattened cells, the plate visible pink because of the underlying capillaries. Its (transversal) shape is determined by the form of the underlying bone.

The free edge or distal edge is the anterior edge of the nail plate corresponding to the abrasive or cutting edge of the nail. The hyponychium is the epithelium located under the nail plate at the junction between the free margin and the skin of the tip of the finger. It forms a secure nail bed. The onychodermal band is the seal between the nail plate and the hyponychium. It is found just beneath the free margin, in that portion of the nail where the nail bed ends and can be recognized by its glassy, greyish colour (in fair-skinned people). It is not perceptible in some individuals while it is highly prominent on others. The nail sinus is the deep crease into which the nail root is inserted.

The nail root is the part of nail located in the nail sinus, *i.e.* the base of the nail attached under the skin. It originates from growing tissue below, the matrix.

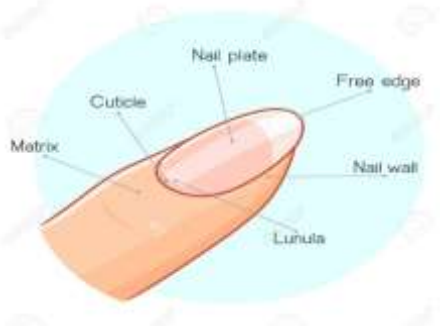

Fig. 1: *Parts of Nail.*

The eponychium considered the small band of epithelium which extends from the posterior nail wall onto the base of the nail. Often with erroneously called the "proximal fold" or "cuticle", the eponychium is the end of the proximal fold

which folds back by itself to shed an epidermal layer of skin onto the freshly formed nail plate. This layer is non-living, almost unseen part of skin is the cuticle that "rides out" on the upper part of the nail plate. Together, the eponychium and the cuticle form a secure cover. The cuticle on the nail plate is non-living cells and is often eliminated during manicure, but the eponychium is living cells and should not be touched. The perionyx is the projecting edge of eponychium covering the proximal strip of the lunula.

The nail wall is the cutaneous fold overlapped the sides and proximal end of the nail. The lateral edge (margo lateral is) is lying under the nail wall on the sides of the nail and the nail groove or fold are the cutaneous slits into the lateral margins are enclosed.

HUMAN HEALTH AND FINGER NAIL

Each finger represent group of organs which are summarized below:

Table 1: *Finger Relation with Body Parts.*

Finger name	Organ
The thumb	Brain,excretory system and reproductive system
Index finger	Liver,gall bladder or nervous system
Middle finger	Heart and circulatory system
Ring finger	Reproductive and the hormonal system
Little finger	Digestive system

Generally smooth, pink color and shining nails indicate healthy human. The analysis of nails and its related disease symptoms are:

Table 2: *Nail Disorders and Related Disease.*

Nail Disorder	Diseases
Congentital	Anonychia,pail patella syndrome,pachyonychia congentital
Traumatic	Onychophagia,hang nails,onychong-ryphosis,onchrocryptosis
Infatious	Paronychia,pseudonraonas
Tumors	Glomus tumor,melanocytic nevi

Table 3: *Nail Abnormalities.*

Category	Nail Abnormality
Dematosis	Onycholysis, splinter haemorrhage, Darier's disease ,alopecia
Change in shape	Clubbing , koilonychia
Change in surface	Bau's lines, meruhrcke's line, leuonychia
Change in color	Terry's nails, linday's nails, red lunula ,splinter haemorrhage ,yellow nail syndrome

LITERATURE SURVEY

A review on various research works on nail image analysis for disease detection and similar technique which used in leaf disease detection is given below, Indi Trupti proposed early stage detection of disease, based on nail image processing; here nail plate is used in ESDD system. The performance of ESDDS system is calculated in terms of GAR and FAR. The GAR is genuine acceptance rate which the ratio of matching samples and total number of tests. The FAR is false acceptance rate is the ratio between the number of non-matching samples matched by the system and total number of tests used. Input images taken from patients are trained by Weka tool. In this they used J48 classifier (C4.5 algorithm) to classify and train data got from patients. An algorithm C4.5 is used to construct decision trees. The decision trees generated by C4.5 can be used for classification, and for this reason, C4.5 is can referred to as a statistical classifier. In this system, system analyzes the human nail and gives

probable disease for person including healthy case. Here, for disease prediction nail color (average RGB) value used as a nail feature extraction. This model gives more accurate results than human vision, because it overcomes the limitations of human eye like subjectivity and resolution power.[1]

Sneha Gandhat was proposed an algorithm which automatically extract nail area and scrutinize this nail part for disease detection based on color of nail, proposed system requires only the image of patients' hand that can be obtained easily and it's not difficult to perform. Image of the nail must be taken. Extract the area to be examined. Examine the nail color. Compare the nail with the pre-defined range.. This paper describes DDS as an application of digital image processing and analysis technique. This can be used in healthcare domain to predict diseases like Diabetes & Jaundice from nails for human being. The images of human nail are the input to the system. Then, system uses digital image processing techniques on input images to extract certain features in the image using MATLAB software. By using knowledge base of medical palmistry it analyzes the features in image and predicts related disease.[2]

Vipra Sharma proposed a system using an algorithm in such a way that it will take the back side palm image, performs segmentation process and extract the nail region from rest of the image then perform the color and texture detection method on the segmented nail portion which gives the output whether the nail is healthy or not. The output is produced on the basis of analysis and the disease would be predicted if it is present. This model is being using MATLAB tool; basically this proposed work belongs to the area of Image Processing. The method proceeds with an input image segmentation method and then performs analysis on the segmented nail area. In this they only process BMP, GIF, JPEG, PNG, TIFF image format. It can detect 2 or 3 diseases only.[3]

Kumuda N S presented a method for segmentation of fingernails and differentiate them as distinct nail parts; fingernail plate with lunula and distal free edge of nail plate. In the research work, concentrated on fixed area of the fingernail plate plus lunula, as it remains unchanged in structure, where as the distal nail edge extends and changes in structure over a period of time. Proposed method is of two stages. In first stage, color image is converted to gray scale and contrast enhancement is applied using adaptive histogram equalization. In second stage, perform segmentation using watershed method that exercises maxima and minima properties of marker controlled watershed principles. In order to verify the results of the algorithm, constructed a confusion matrix where evaluation has been done with ground truth. Additionally, the segmented object's from both the methods was considered for quality metrics assessmenting. Similarity and accuracy between the ground truth and watershed result is 84.0% correctness for fingernail plate. Initial fingernail segmentation results are promising, supporting its use for biometric application.[4]

Indrakumar S.S. tried mainly line detection and curve detection. First apply Sobel filter to remove the noise in the image and then apply Canny Algorithm to detect Edges to detect edges accurately. With the help of Canny Edge detection extract outlines of hand and lines on palm from the given image shows of the proposed method for palm eye trouble. The method consists of five main stages: Image Acquisition, Selecting ROI (Region of Interest) for detection, Applying Sobel Filter for noise reduction, Canny Algorithm to detect edges and Lines, if

there is circle on the mount of Sun on the then that sample will have eye problems.[5]

V. Saranya proposed a paper, various image processing techniques to automatically locate the nail area and to extract the abnormal region are proposed. Then the shape features like Area, Perimeter, and Diameter are calculated to identify how far the nail region is affected and the results are compared. . The input RGB nail images are acquired from digital camera and stored in JPEG format. Since the main aim of this research work is to extract the affected regions of the nail, the input image should be the infected nail chosen with different background. To increase the accuracy and clarity of the image, the input image is pre-processed by using the combination of median and average filters. After removing the noise particles, the image is converted into a gray scale image for computational efficiency. To extract the abnormal region of the nail three different segmentation techniques: Watershed segmentation, Thresholding and K-means clustering techniques are proposed in this paper.[6]

Hardik Pandit, proposed a model, which scans the palm through scanner, and then digital image processing and analysis techniques are applied to get color information. While doing this, first the portion of the palm should be fetched from the scanned image and then, palm color is to be identified, which may vary in different regions of palm. The model is implemented using ASP.Net with C#. A Forge.Net was used to get additional image processing filters. Each palm is scanned from both the sides, i.e. front side and back side. Front sides of both palms would help us to get color of palms and back. The model accurately extracts the palm portion and gives average color of human palm. These values would be used to predict diseases on the basis of medical palmistry. The model is working successfully for different skin tones of human palms. If the borders of palm are darker than palm color. So, may not get exact boundary of palm. This can make an effect in the calculation of average color of palm. Image enhancement methods can be used to overcome this problem. Moreover, if the surface of scanner is spoiled with stains, then also results may vary.[7]

Noriaki Fujishima proposed a two stage search method for hand images including palm side using color information and distribution density of strong nail-color pixels. This method could detect only fingernails with at least 80% probability from -90 to -40 degrees and from 40 to 90 degrees; however, the previous fingernail detection method was not good at removing some skin areas which have nail-color and gloss like finger side area. Therefore, should use additional information to remove these areas. Color continuity information is available for getting it. In this paper, therefore, we propose a new fingernail detection method using not only distribution density of strong nail-color pixels but also color continuity and improved detection accuracy. In this study, we talked about new information ”color continuity” and proposed a new fingernail detection method using color continuity and distribution density of strong nail-color pixels. In this experiments, investigated the relationship between wrist rotation angles and percentages of correct detection for three users. As a result, we confirmed that our proposed system could detect only fingernails with at least 85 % probability from -90 to -40 degrees and from 40 to 90 degrees and was superior to the previous method. [8]

Priya Maniyan proposed a system, the input system NIPS-McS is the backside of the palm on a white background. Then from the palm image using Canny’s edge

detection method and segmentation process, the Region of Interest (ROI), the nail region is extracted. Then the nail color, shape and texture are extracted and combined together to form a feature vector which is then compared with the existing database of diseased and normal nail. The proposed system uses Multiclass SVM Classification Method for classification and prediction of diseases. The capability to identify several diseases in their initial phases is a very beneficial work for the society. The proposed system NIPS- McS is based on Digital Image Processing, Combining features of Nail color, shape, texture for forming a feature vector and then doing the nail analysis and prediction using a classifier – Multiclass SVM. In the proposed system, the one-versus-rest(1VR) method for Multiclass SVM is used, but its training time is longer compared to one-versus one(1V1) method, but 1VR's performance is better than 1V1. This model gives more accurate results than human vision, because it overcomes the limitations of human eye like subjectivity and resolution power.[9]

V. Ramya proposed a system, that timely and accurate detection and classification of plant diseases are the crucial factors in plant production and the reduction of losses in crop yield. Spreading of color is similar for unaffected leaves, but for the affected leaves the spreading of color is not even. This is because of the values of the pixels of affected leaves were totally different form the pixel values from the normal leaves. The image quality is improved by applying the mean filter after that Segmentation of the image is performed by Otsu's threshold algorithm. After extracting the features from the given leaf image, a recognizer is needed to recognize the disease in the leaf image from the stored database. This paper proposes a recognition method, which uses Back Propagation Network (BPN). Back propagation can train multilayer feed-forward networks which consist of a forward pass and a backward pass .In the forward pass outputs are calculated and compared with preferred outputs. Errors from preferred and actual output are calculated. In the backward pass this error is used to alter the weights in the network in order to reduce the dimension of the error. Forward and backward pass are repeated until the error is low, users usually set the value of accepted error. When training NN, are feeding network with set of examples that have inputs and desired outputs. Choose the learning rate and momentum will help with weight adjustment. The output layer contains one neuron. Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for classification. [10]

CONCLUSION

Now days, non-invasive procedure for disease diagnosis is an important aspect in healthcare domain. The various features of human body and mechanism which can be used for non-invasive procedure for disease diagnosis such as nail image, eye, breath etc. Human nail image analysis is one of the non-invasive procedure in which different image processing techniques such as image capturing, image pre-processing, image segmentation, feature extraction are used for nail image analysis. This survey paper presents various techniques in nail image processing for different disease diagnosis. Different classification techniques such as SVM classifier, KNN classifier, ANN classification.

Various diseases can be diagnosed by non-invasive approach, nail image analysis. The different nail features like nail color, nail shape and nail texture used to analyze nail image. The nail features are extracted and measured by deriving these features in certain terms of area of nail shape, perimeter of nail shape etc. and nail texture extracted in terms of entropy, energy,

compactness etc. The cutting edge classification technologies used in the nail image processing systems are deep neural network, artificial neural network classifier and SVM classifier.

REFERENCES

1. Indi T.S. *Early Stage Disease Diagnosis System Using Human Nail Image Processing*. I.J. Information Technology and Computer Science, 2016, 7, 30-35p.
2. Gandhat S., Thakare A.D., Avhad S., *et al. Study and Analysis of Nail Images of Patients*. International Journal of Computer Applications (0975–8887), 143(13), June 2016
3. Sharma V., Shrivastava A. *System for Disease detection by analyzing finger nails Color and Texture*. International Journal of Advanced Engineering Research and Science (IJAERS), Oct 2015, 2(10), ISSN: 2349-6495.
4. Kumuda S. *An Image Pre-processing Method for Fingernail Segmentation*. 2017 IEEE 2nd International Conference on Signal and Image Processing, 978-1-5386-0969-9/17/$31.00 ©2017 IEEE
5. Indrakumar S., Shashidhara M.S. *Study on eye troubles using palm print and image processing technique*. International Journal of Recent Trends in Engineering & Research (IJRTER), May 2016, 2(5) [ISSN: 2455-1457].
6. Saranya V., Ranichitra A. *Image segmentation techniques to detect nail abnormalities*" International Journal of Computer Technology & Applications, 8(4), 522-527p.
7. Pandit H., Shah D.M. *The Model For Extracting A Portion of A Given Image Using Color Processing*. International Journal of Engineering Research & Technology (IJERT), December 2012, 1(10), ISSN: 2278-0181.
8. Fujishima. *Fingernail Detection Method from Hand Images including Palm*. MVA2013 IAPR International Conference on Machine Vision Applications, May 20-23, 2013, Kyoto, JAPAN.
9. Maniyan P. *Detection of Diseases using Nail Image Processing Based on Multiclass SVM Classifier Method*. International Journal of Engineering Science and Computing, May 2018
10. Ramya V., Lydia M.A. *Leaf Disease Detection and Classification using Neural Networks*. International Journal of Advanced Research in Computer and Communication Engineering, November 2016, ISO 3297:2007 Certified.