Detect Nail Peculiarity Using Image Segmentation

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Abstract: **Medical Image Processing plays a vital role in diagnosing various diseases like skin cancer, brain tumor, breast cancer and diseases related to lungs and heart. Human nail acts as a window of the human body for diagnosing the diseases. The segmentation techniques to extract the infected nail regions and their shape attributes are calculated and analyzed. Initially the nail image is segmented using Watershed, Thresholding and K-means segmentation Techniques. Then, the Shape features of the segmented nail region are extracted which can be further used in the diagnosis of nail diseases. The results of the three segmentation techniques are compared and analyzed based on these features.**

Keywords: **Medical Image Processing, Finger Nail, Nail Disease, Watershed, Thresholding and K-means segmentation, Nail Peculiarity.**

I. INTRODUCTION

Medical science has invented many ways and has developed various methods for diagnosis of diseases in human body. There are various parameters which can be analyzed for identifying the diverse effect in human body. One of the ways that to spot unwellness is through nails of the human. There are various features of nail on which human health condition can be analyzed. Nail is defined as the envelope like structure which covers the tip of the fingers. Nails are farthest from the heart, they are last to receive oxygen. Therefore, in healthcare domain, Nails are the first who shows the symptoms of disease in human body. In healthcare domain many diseases can be predicted by observing color and texture of human nails [1].

Nail diseases are the deformities of the nails that have a distinct classification. Each has its own signs and symptoms related to the medical conditions. Some nail conditions show the signs of infection or inflammation and may require medical assistance [2].

One of the ways to identify or ensure the existence of disease is the analysis of the color and texture of the nails. Different colors of nails will indicate different diseases, for example: Usually, pink nails are the sign of good health. A faded pink color of the nails can be a sign of anemia, heart failure, malnutrition, and liver disease. Conditions of white nail with dark edges can be a sign of serious harms with the liver, such as hepatitis. The yellow color indicates a fungus infection. If the bug is worse, the nail becomes thicker and brittle. Sometimes, yellow nails point to a serious condition such as thyroid disease, lung, diabetes, or psoriasis. Lack of oxygen can cause the nails to turn blue. However, infection of the lungs such as pneumonia or heart abnormality may also be the cause. Corrugated nail surface is the early signs of psoriasis or arthritis. Nail conditions that change the color to red brown are also commonly encountered. If longitudinal black stripe is found in the central point then it will be the symptom of melanoma, the most rigorous type of skin cancer [3].

Structure of a Finger Nail

The structure of the finger nail is shown in fig 1. The Nail plate is hard and lucid portion of the nail. Nail fold is the eponychium. Lunula is a visible part of the root of the nail. Cuticle is that the semi-circular layer of non-living, almost invisible dead skin cells. Nail matrix is that the formative layer of cells at the bottom of the nail. Hyponychium is the thickened portion.

Fig.1 Structure of a Finger Nail

In this 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 paper is organized as follows. Section II provides the summary of various existing image segmentation techniques and feature extraction methods. The segmentation techniques to extract the infected nail regions are proposed in Section III. Section IV discusses the shape features of a nail region. Experimental results and analysis is carried out in Section V. Conclusion and the future direction of the work is given in Section VI.

II LITERATURE SURVEY

A survey on various research works based on the segmentation methods and feature extraction is given below.

Sujatha (2016) et al., identified the leaf diseases using k-means clustering and SVM [4].

Ruby Peter (2016) et al., presented three different approaches such as Histogram comparison, Color co-occurrence Matrix and K-means clustering methods to detect Citrus Cancer Disease. The results were more accurate for Color co-occurrence Matrix and K-means clustering [5].

Rupali Patil (2016) et al., proposed a method comprising of segmentation and classification. Segmentation is performed using k-means clustering. From segmented image, the required area is extracted and the features of the image such as color, shape are identified. Color feature is employed to change the thing extraction and identification. The proposed system is fast, flexible and easy to implement [6].

Jimita Baghel (2016) et al., proposed two clustering algorithms k-means and fuzzy-c means algorithm to extract the diseased portions. The clustering algorithms use intensity based values and statistical feature based values. Finally the results are compared [7].

Vipra Sharma (2016) et al., proposed the color and texture features of nail to detect the disease by comparing the values with the predefined values of a healthy nail. The nail color and texture is extracted by applying image segmentation and the analysis is carried out in the segmented area to detect whether the body is the healthy one or not [8].

From the survey it has been identified that the clustering algorithms can effectively extract the affected regions.

III PROPOSED METHOD

In this paper, the infected regions from the nail images are extracted by Watershed Segmentation, Thresholding and K-means Segmentation techniques and their shape features are extracted for further processing. The flow diagram of the proposed work is shown in Fig.2.

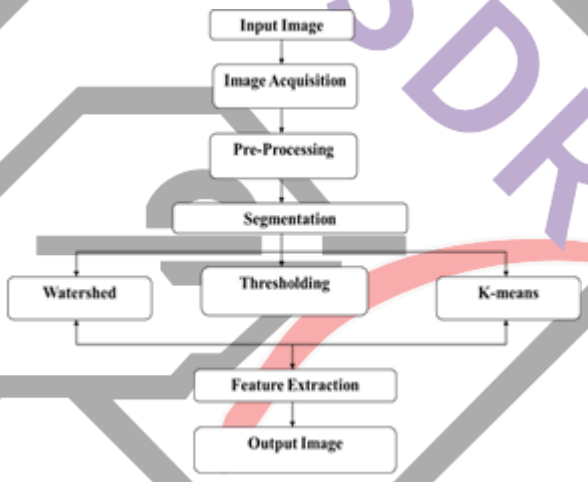


Fig.2 Flow diagram for Proposed System

A. Image Acquisition

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. The sample infected nail image is shown in Fig.3.

B. Image Pre-Processing

Image Pre-processing refers to working on images in order to convert it into an appropriate form. To increase the accuracy and clarity of the image, the input image is preprocessed 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. The pre-processed noise free image is shown in Fig.4.

Fig.4 Pre-Processed Image

C. Segmentation Techniques

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.

A. Watershed Segmentation

The Watershed segmentation technique is used to segment the images by simulating the flooding on a surface. The watershed segmentation procedure is given below:

Step 1: Read preprocessed nail image.

Fig.5 Infected Nail Image

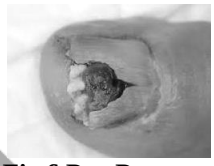


Fig.6 Pre-Processed Image

Step 2: Apply sobel area detector to extract the boundary of the image.

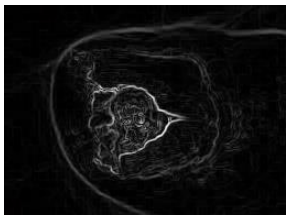


Fig.7 Edge Detection Image

Step 3: Reconstruct the foreground objects by applying Morphological opening and closing operations.

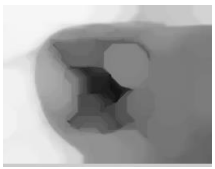


Fig.8 Opening Image

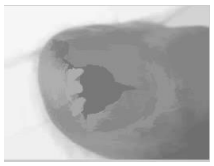


Fig.9 Reconstruction by Opening

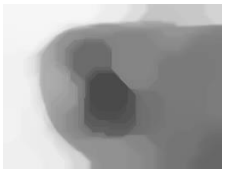


Fig.10 Opening -Closing

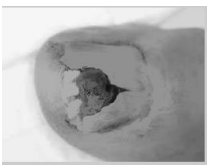


Fig.11 Reconstruction by Opening-Closing

Step 4: Covert the reconstructed image into a binary image by thresholding technique.

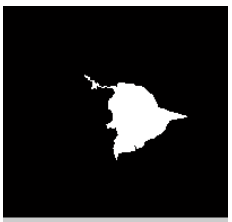


Fig.12 Thresholded Image

Step 5: Apply Watershed Transform. The final segmented image is shown in fig 13.

Fig.13 Segmented Image

B. Thresholding Segmentation

Thresholding is the simplest segmentation method in which the pixels are partitioned into foreground and background objects based on the intensity values. The threshold value is selected by Otsu's threshold method and the resultant image is shown in fig 15. The Threshold image may have some misclassification i.e., sometimes the objects can be identified as a background or the background can be identified as an object. So to avoid this, the image is enhanced using morphological operation and the complement of the image is taken as an output.

Step 1: Read the preprocessed nail image.

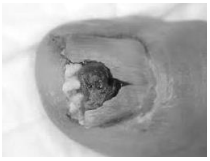


Fig.14 Pre-Processed Image

Step 2: Apply Thresholding value.

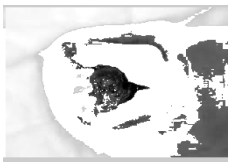


Fig.15 Threshold Image

Step 3: Enhance the Contrast of the image and complement the image.

Fig.16 Contrast Enhancement

Fig.17 Segmented Image

C. K-means Segmentation

Clustering technique will initially classify the pixels with same characteristics into one cluster then into different clusters based on the center points selected. It is used to segment the region of interest from the background based on same characteristics. The K-means segmentation procedure is given below:

1. Read input image of nail.

Fig.18 Infected Nail Image

2. Convert RGB color area to L* a* b* color area.

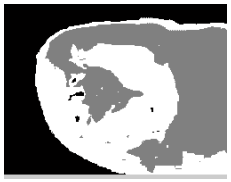


Fig.19 Cluster Index Image

3. Classify the colors in a* b* space using k-means cluster.

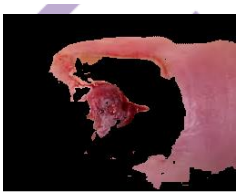


Fig.20 First Cluster Image

4. Label each pixel in the image using the results from k-means cluster.

Fig.21 Second Cluster Image

5. Create an image that segmenst the original image by color. When segmentation is completed, one cluster will be the infected region.

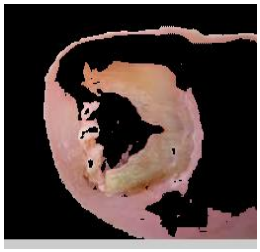


Fig. 22 Final Cluster Image

The final cluster image is a color image. It is converted into a binary image for further process. The binary image is shown in Fig.23

Fig.23 Binary Image

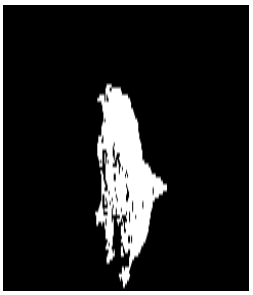


Fig.24 Segmented Image

The unwanted portion is removed using morphological area opening. Finally, the infected portion alone is segmented. The segmentation result is shown in Fig.24.

IV FEATURE EXTRACTION

Extraction of options of a picture could be a property in image process. The aim of this phase is to find and extract the features that can be used to determine the meaning of a given sample. In this paper, the Shape Attributes (Area, Perimeter, and Diameter) are calculated and the segmentation results are compared.

Area:

The value of area is calculated by counting the number of infected skin region pixels.

Area = AD * pixel width ---------- 1

where AD- no of infected pixels.

Perimeter

Perimeter calculation formula is given in equation (2),

$$P = n_e + \sqrt{2n_0} \quad \text{---------- 2}$$

Diameter

Diameter calculation formula is given in equation (3),

$$D=\sqrt{4 * (\text{area})/\text{perimeter}} \quad \text{---------- 3}$$

V RESULT AND ANALYSIS

Nearly 20 sample nail disease images are taken and the infected portion is segmented using Watershed, Threshold and Clustering segmentation techniques. Out of 20 images, 3 images are taken for the discussion. For the extracted nail region the shape parameters are calculated and the results are compared and tabulated below. The proposed approach was tested on 20 images out of which 3 images are taken for this discussion.

Table1. Segmentation Results

Images	Thresholding	Watershed	K-means
Image 1	69.75	67.96	64.93
Image 2	88.92	86.26	78.36
Image 3	84.32	81.57	83.65

Table2. Area Calculation Value

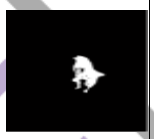
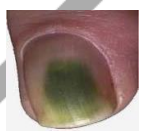
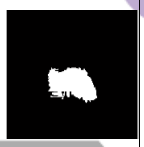
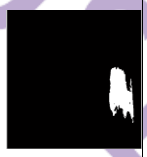
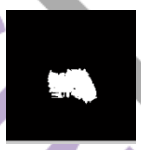
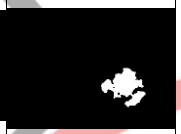
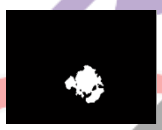
Original Image	Watershed	Thresholding	K-means
			
			
			

Fig.25 Mathematical Representation for Area Value

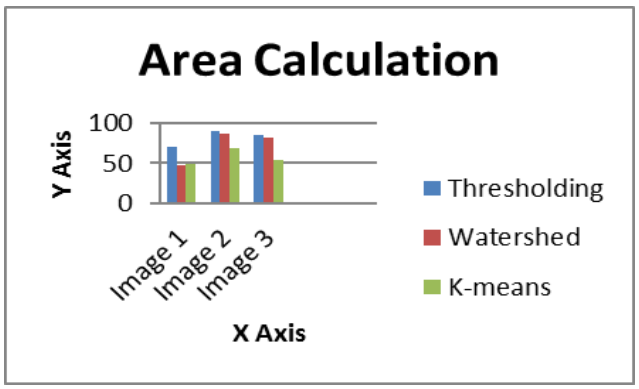


Table3. Perimeter Calculation Value

Images	Thresholding	Watershed	K-means
Image 1	8.79	8.71	8.92
Image 2	9.41	9.27	8.73
Image 3	9.76	9.54	6.82

Fig.26 Mathematical Representation for Perimeter Value

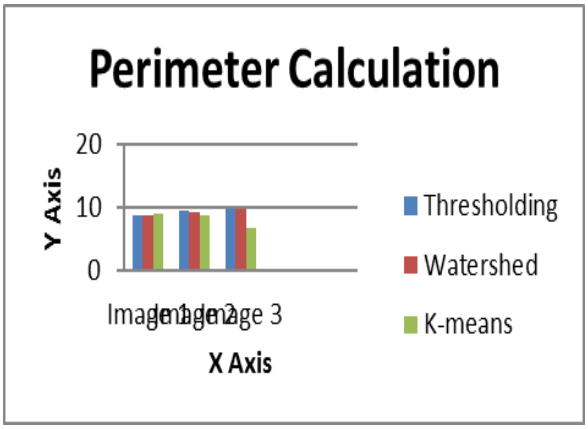
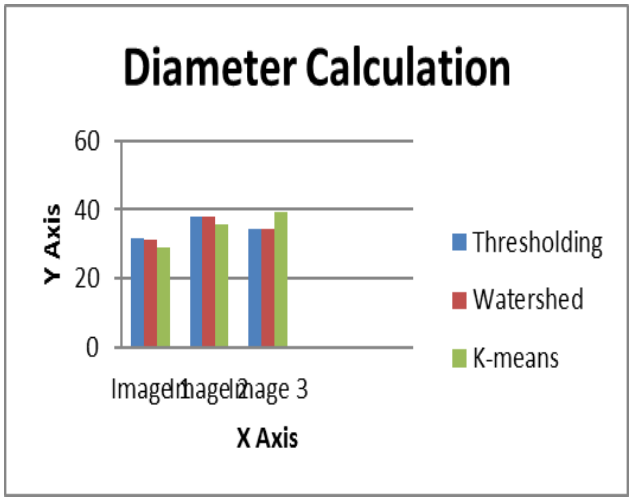


Table4. Diameter Calculation Value

Images	Thresholding	Watershed	K-means
Image 1	31.74	31.21	29.11
Image 2	37.79	37.79	35.10
Image 3	34.55	34.35	39.16

Fig.27 Mathematical Representation for Diameter Value



VI CONCLUSION

In this work, Different digital nail images have been analyzed based on unsupervised image acquisition, pre-processing, and the widely used segmentation techniques namely Watershed segmentation, Thresholding segmentation and K-means segmentation. Finally, the Feature extraction is applied on these segmented nail images to calculate the shape attributes (Area, Perimeter, and Diameter). Identification of nail disease from the extracted features may be the future direction of the research work.

REFERENCES

[1] Michael w.cashman "Nutrition and nail disease", clinics in dermatology.
[2] http://www.aafp.org/afp/anatomy of nail.
[3] Sujatha R, Y Sravan Kumar "Leaf disease detection using image processing". ISSN: 0974-2115 Journal of Chemical and Pharmaceutical Sciences. January - March 2017 670 JCPS Volume 10 Issue 1.

[4] Shoby Sunny And Ruby Peter" Detection Of Canker Disease On Citrus Leaves Using Image Processing". International Journal of Computer Engineering and Applications, Volume X, March 16, ISSN 2321-3469.
[5] Jimita Baghel, Prashant Jain" K-Means Segmentation Method for Automatic Leaf Disease Detection", ISSN: 2248-9622, Vol. 6, Issue 3, (Part -5) March 2016.
[6] Vipra Sharma, Aparajit Shrivastava "System for Disease detection by analyzing finger nails Color and Texture". International Journal of Advanced Engineering Research and Science (IJAERS) Vol-2, Issue-10, Oct- 2015].
[7] Hardik Pandit and D M Shah, "The Model for Extracting a Portion of a Given Image Using Color Processing", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 1 Issue 10, December- 2012.
[8] Darshana A, Dr. Jharna Majumdar, Shilpa Ankalaki "Segmentation Method for Automatic Leaf Disease Detection". International Journal of Innovative Research in Computer and Communication Engineering. (An ISO 3297: 2007 Certified Organization)Vol. 3, Issue 7, July 2015. DOI: 10.15680/ijircce.2015. 0307113.
[9] Sanjay B. Patil, Dr. Shrikant K. Bodhe "Leaf Disease Severity Measurement Using Image Processing". International Journal of Engineering and Technology Vol.3 (5), 2011, 297-301. ISSN: 0975-4024.
[10] Sanjay B. Patil, Dr. Shrikant K. Bodhe, "Betel Leaf Area Measurement Using Image Processing". International Journal on Computer Science and Engineering (IJCSE). ISSN: 0975-3397 Vol. 3 No. 7 July 2011.
[11] Ravi C.Shinde, Jibu Mathew C and Prof. C. Y. Patil,"Segmentation Technique for Soybean Leaves Disease Detection" International Journal of Advanced Research (2015), Volume 3, Issue 5, 522-528.
[12] C.B. Tatepamulwar, V.P. Pawar "Detection and Identification of Human Skin Diseases Using CIELab Values". International Journal of Advanced Research in Computer Science and Software Engineering". Volume 5, Issue 6, June 2015 ISSN: 2277.
[13] Jagadeesh D.Pujari, "Image Processing Based Detection of Fungal Diseases in Plants" International conference on information and communication technologies (ICICT 2014) 1802 – 1808.