IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 7 Issue 10, October 2020
ISSN (Online) 2348 – 7968 | Impact Factor (2020) – 6.72
www.ijiset.com

Hair Follicle Analysis Using Image Processing Techniques

Swapnil M. Wanjare[1], Dr. Vishwas T. Gaikwad[2]

[1] Master of Engineering, Student, Department of Electronics and Telecommunications Engineering,
Sipna College of Engineering and Technology, Amravati. Email: swwapnilw@gmail.com

[2] Professor, Department of Electronics and Telecommunications Engineering,
Sipna College of Engineering and Technology, Amravati.

Abstract

Nowadays, the problem is over heading of hair loss, premature hair thinning so people are tending towards the hair transplants which has good success rate and secure to do. Hair Follicles are tiny to naked eyes we cannot determined its dimensions and for transplants various types of follicular units are used. Another aspect of hair follicle inspection in Forensic Examinations in which till date tasks are operated over human observations so, human interference required in the results so that reduction of human efforts so to make it possible proposing a technique. To analyze the hair roots, we can use the techniques of Image Processing by training machine is targeted in this project.

Keywords: Hair Follicle, Image Processing, Forensic, Machine Learning, Artificial Intelligence.

1. Introduction

The hair roots carry some characteristic and physical information in its hair follicle. In this work the emphasis is on the physical information that decides it's physical aspects so as it contributes the significance in the medical as well as forensic science. [1] Biologically hairs are the waste proteins from the body but it has significance in human activities in chemical aspects. [2] It is possible now that we can determine the density of hair without cutting them so as to taking this inspiration while hair implantation or in forensic science there's a need to extract the length of hair follicle.[3]Unsupervised Hair segmentation is used here to extract the physical quantities of the hair follicle, this paper is concentrated on development of medical software also the entire work can be embedded on such system. [4] Average error accured in the allocation of pixels to two or more groups so that exacts detection of image edges and dimensions.[5], I have employed K–Mean at K=2 an unsupervised algorithm to cluster the pixels so further operation has to perform on it. Adaptive Thresholding is the tool used for corner detection and tracking of gradients. [6], Performing operations on images of framed picture of specific dimensions with reference object gives the physical dimension of image.

This paper is structured as follows. The K-Mean Clustering on image is discussed in Section 2. Section 3 is on Binary to Grey.Adding reference image to input image in Section 4. Section 5 is for operation of Gaussian Blur. The closed gaps between then objects in Section 6. Section 7 is the finding contours in the edge gap. The pixels per metric calibration is in the Section 8. Finding midpoints and Euclidean Distance between midpoints is discussed in the Section 9. Section 10 shows the block diagram and Section 11 demonstrates the methodology. Flow of program is in Section 12. The exploratory results are exposed in section 13. Conclusion is in Section 14.

2. K-MEAN Clustering

A sRGB image of 768*576 dimension having 72 pixels/inch of 8 bit .jpg format is taken as input basically a we have to perform the operation based on K-Mean. Image segmentation is the classification of an image and its pixels into different groups. Different researchs have been done in the area of image segmentation using clustering. K-Mean clustering algorithm to read an image and cluster different regions of the image. Application of median blue of value 5 and then thresholding the image with 25 and 75 with function named as cv2.threshlod. Reshaping of the image with specified criteria to satisfy the algorithm iteration.

3. BGR to Gray

Differentiating out regions of an image corresponding to objects which we want to analyze. This differentiation is based on the variation of intensity between the pixels of object and the background pixels

dest(x,y)={maxV if src(x,y) > thresh }
{0 otherwise}

4. Add reference Image

We have to perform an image addition with is reference, and add to input image. It gives a feeling of blending also different weights are given to images, Reference Image is added as per the equation below:

$$g(x) = (1-\alpha)\, f_0(x) + \alpha\, f_1(x)$$

By varying α from 0 tends to 1, we can perform a transition between one image onto another. Here I took one images to blend on other which is input image.

$$dst = \alpha \,.\, img1 + \beta \,.img2 + \gamma$$

5. Gaussian Blur

Gaussian Blur is carried with the function, cv2.GaussianBlur(). We need to specify the width and height of the kernel should be positive and odd. We have to specify the standard deviation in the X and Y directions, Sigma_X and Sigma_Y respectively. If and only Sigma_X is specified, Sigma_Y is taken as the same as Sigma_X. If both are given as null, they are calculated from the kernel size. Gaussian blurring is highly effective in bypassing and elimination of Gaussian noise from an image.

6. Closed Gaps between Objects

Changing the structure of a region in an image. We will look just at binary images, though the concepts elaborated here can be extended to gray-level images. The process of skeletonizing of image is reducing foreground area in a binary image to a skeletal remnant that largely preserves the extent and connectivity of the original region while throwing away most of the original foret is the difference between dilation and erosion of an image.

6.1 Erosion

The erosion of image is similar to soil erosion, it scratches away the boundaries of foreground object (Always keep foreground in white).Kernel slides through the image.Original image's pixels will be assumed 1 only if all the pixels under the kernel is 1, otherwise it is eroded.

Entire pixels near boundary will be eliminated depending upon the size of kernel. Dimension or size of the foreground object decreases or white region decreases in the image. Erosion is helpful in removing small white noises, detach two connected objects etc.

erosion = cv2.erode(img,kernel,iterations = 1)

$$\mathbf{X \ominus B = \{ Z \mid (B\hat{}) Z \in X \}}$$

6.2 Dilation

Dilation is opposite of erosion operation. A pixel element is 1 if minimum one pixel under the kernel is 1. It luminates the white region in the image or size of foreground object increases. In cases noise removal, erosion is done after dilation. Erosion eliminates white noises, but it reduce our object region. Therefore we dilate it. So noise is gone, they won't come back, but our object area increases.It is useful in joining disjoint parts of an object.

dilation = cv2.dilate(img,kernel,iterations = 1)

$$\mathbf{X \oplus B = \{ Z \mid [(B\hat{}) Z \cap X] \in X\}}$$

7. Counters of Edge Gaps

Image thresholding operation is to separate the boundary from the background.We say pixels with intensities above a certain value are the background and the rest are the foreground. Center image shows this thresholded image.In hard scenario even though the boundary has been nicely extracted, the interior of the coin has intensities similar to the background. Hence, the thresholding operation can't distinguish it from the background.

8. Pixels per Metric Calibration

Pixels per meter measure as a metric of image scruitiny quality. For while, we need around 130 pixels per meter to have ample details to accurately recognization.Calculation of pixel density (pixel per meter) we need the number of horizontal pixels of the image source and the width in meters of the scene.Therefore,

Pixel per Metric = ImageWidth (in pixels) / Field of View (in meters)

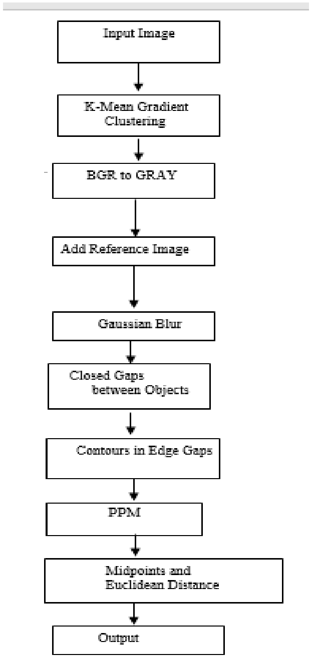
9. Midpoints and Euclidean Distance

This reference object/image should have crucial properties: We know the dimensions (in terms of inches, millimeters, etc.) of the object. It can be identified in our image.

Euclidean Distance

$$\|X\text{-}Y\| = \sum_{i=1}^{d}(Xi - Yi)^2$$

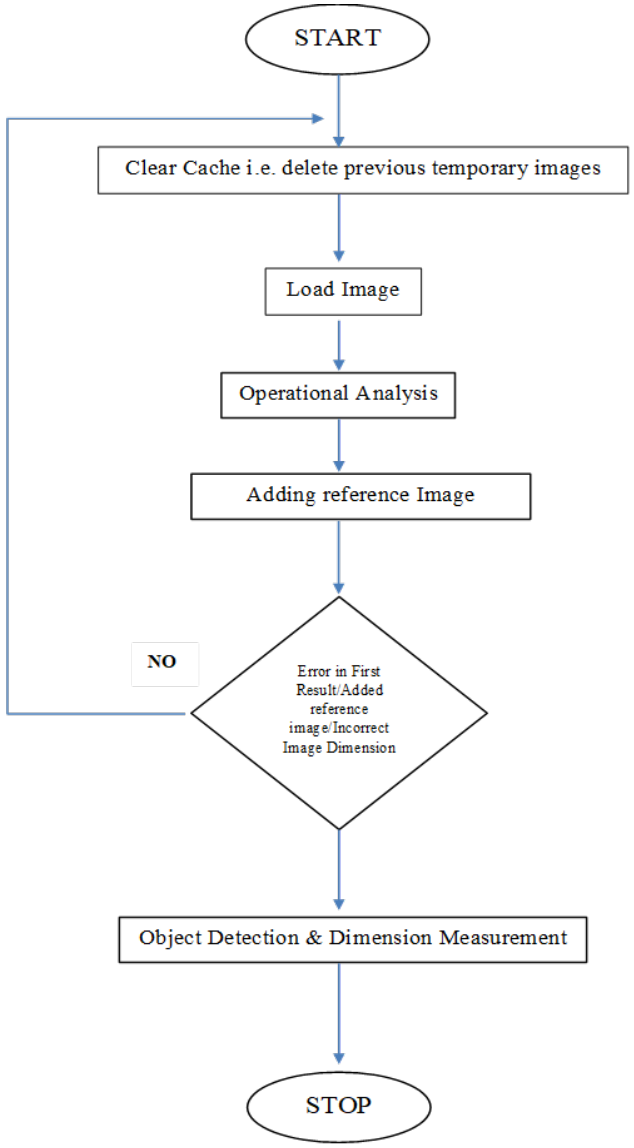
10. Block Diagram



11. Methodology

Input: Standard benchmark images in sRGB Format.
Step 1: Adding Reference Image to Input Image
Step 2: K-Mean Gradient Clustering.
Step 3: BGR to Gray Operation
Step 4: Gaussian Blur
Step 5: Closed Gaps between Objects
Step 6: Contours in Edge Gaps
Step 7: Pixel Per Metric
Step 8: Midpoints and Euclidean Distance
Step 9: Output
Output: Dimensions of the Hair Follicle

12. Flowchart



K-Mean Gradient

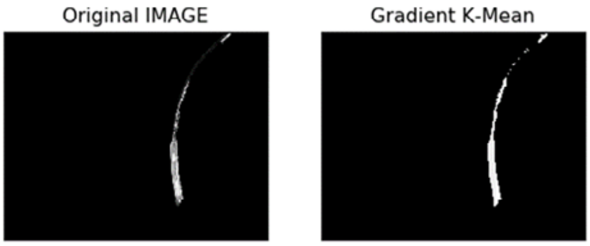
BGR to Gray

Added Reference Image

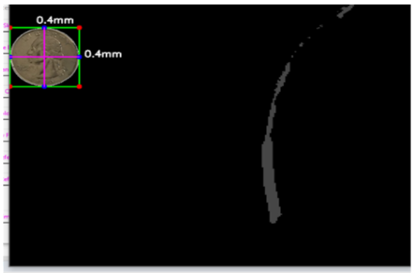
Dimensions of Image

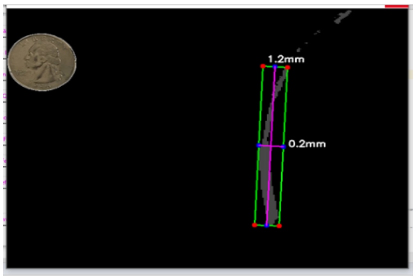
```
Length(cm)= 0.7162406015037595
Width(cm)= 0.1269699248120301
Area(cm^2)= 0.31102300154912155
Volume(cm^3)= 0.009068814996587531
Base_Area(cm^2)= 0.01266168795450495
Lateral_Surface(cm^2)= 0.28569962564011164
```

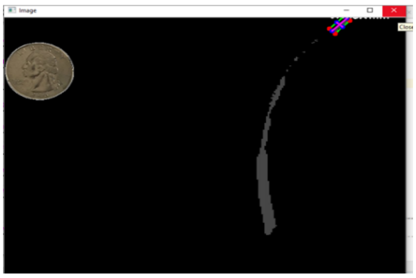
The result has been extracted from the image so all related dimensions also given by this algorithm.



Adding Reference Image







```
Length(cm)=  0.56
Width(cm)=  0.20
Area(cm^2)= 0.41469023027385277
Volume(cm^3)= 0.017592918860102846
Base_Area(cm^2)= 0.031415926535897934
Lateral_Surface(cm^2)= 0.35185837720205687
```

Samples Sr.No.	Format	Size (in Pixels)	Resolution (ppi)	Type (Encoding)	Mode	Layer	Channel
1	jpg	768x576	72	sRGB	RGB Color	Black	RED
2	jpg	768x576	72	sRGB	RGB Color	Black	RED

Specification of Sample Images

Sr. No.	Operation Performed	GRAYSCALE Conversion	Type of Operation	Valid Canvas Dimensions	Dimensions On Console
1	YES	YES	Automatic	YES	YES
2	YES	YES	Manual	YES	YES

Operational Specifications

Sr.No.	Length(mm)	Width(mm)	Radius(mm)	Area(mm^2)	Volume (m^3)	Base Area	Lateral Surface
1	0.7162	0.1269	0.0611	0.311	0.0009	0.012	0.2856
2	0.56	0.2	0.1	0.414	0.017	0.0314	0.3518

Physical Dimensions

14. Conclusion

In this work image processing is embedded with artificial intelligence that conclusively we are training our system with specific algorithm and parameters. Many of image processing techniques are used here in various stage that worked and advantageous in forensic as well as medical aspects for analyzing the hair follicle examination and its analysis. For specific format of images this project is designed so, it is necessary to follow that restrictions of images formatting.

References

[1] Buffoli B, Rinaldi F, Labanca M Et Al. The Human Hair: From Anatomy to Physiology. Int J Dermatol 2014;53: 331–341.

[2] Paus R, Cotsarelis G. The Biology of Hair Follicle. N Engl J Med 1999;341:491–497.

[3] Shun Negishi And Masanobu Takahashi- Image Analysis of Hair - Hair roots extraction - Proceedings of the SICE annual conference 2017 September 19-22, 2017, Kanazawa University, Kanazawa, Japan

[4] Chia Shih-An Unsupervised Hair Segmentation and Counting System in Microscopy Images-Huang IEEE Sensors Journal, Vol. 15, No. 6, June 2015

[5] Md. Abu Bakr Siddique1*, Rezoana Bente Arif1@, Mohammad Mahmudur Rahman Khan2#-Digital Image Segmentation in MATLAB: A brief study on OTSU'S Image Thresholding-International Conference on Innovation in Engineering and Technology (ICIET) 27-28 December, 2018

[6] Xiaolian Deng, Yuehua Huang, Shengqin Feng - Adaptive Threshold Discriminating Algorithm for Remote Sensing Image Corner 010 3rd International Congress on Image and Signal Processing (CISP 2010)

[7] M. F. Nurul Wahidah M. Y. Mashor N. Mustafa S. S. M. Noor- Comparison of Color Thresholding and Global Thresholding for Ziehl-Neelsen TB Bacilli Slide Images in Sputum Samples 2015 2nd International Conference on Biomedical Engineering (ICOBE), 30-31 March

2015, Penang
[8] Huang-Chia Shih and Bo-Syun Lin-Hair Segmentation and Counting Algorithms in Microscopy Image-2015 IEEE International Conference on Consumer Electronics (ICCE)

Biography

Swapnil M. Wanjare received Bachelor of Engineering, degree in Electronics and Telecommunication in 2017 from Sant. Gadge Baba Amravati University, Amravati. He is perusing Master of Engineering in Digital Electronics Engineering, in Sipna College of Engineering and Technology, Amravati. He is doing project on Hair Follicle Analysis using Image Processing also worked on project of Internet of Things in his graduation.

Dr. Vishwas T. Gaikwad is Professor in Department of Electronics and Telecommunications at Sipna College of Engineering and Technology, Amravati.