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# Hair Count Using Image Processing

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**Abstract -** Trichology is the study of the hair and scalp in detail[1]. Trichology is subdivided into two parts Trichogram and Trichoscopy, we in our study focus on Trichoscopy(this procedure doesn't involve hair trimming, while Trichogram involves hair trimming). The Trichoscopy procedure used in this study is to diagnose various scalp illnesses such as telogen-effluvium and alopecia by analyzing microscopic images of the hair and scalp. The analysis of the photos gives us informative metrics, including hair density, count, length, and thickness. Image processing is employed in the development of trichoscopy, which is specifically used to detect conditions on the scalp. We have built a system that assists in extracting these features and generates a report that shows the hair count. With a dermatoscope, the practitioner can use the technology to capture an image while on the go or upload one. Following the recording of the image, it is enhanced using a number of techniques including morphological modifications, gray scaling, sharpening, denoising, blurring, and resizing. Finally, a thorough report is sent to the expert following the study and is concurrently saved in the dataset. From the viewpoints of the doctor and the patient, hair count is the most important metric because it directly reflects how well the treatment works. The hair count obtained from this economical technology will help the practitioner identify the illness and conduct appropriate preventative and curative action.

***Key Words***: Trichoscopy, Trichogram, Medical Image Analysis, Image Processing

## 1.INTRODUCTION

The obstacles experienced by medical professionals have been greatly addressed by recent biotechnology breakthroughs. Integrating technology has resulted in accurate, economical, and time-saving solutions in many medical domains, such as trichology, which addresses problems pertaining to hair, scalp illnesses, and their diagnosis. Trichology is useful in detecting illnesses of the scalp and in understanding the reasons behind hair loss [2]. A variety of techniques, including invasive, semi-invasive, and non-invasive ones, are used to evaluate aspects in trichology. While semi-invasive and non-invasive approaches rely on Trichogram, Trichoscopy, Trichoscan, and related techniques, invasive methods involve scalp biopsy. [3]

Using handheld instruments like dermatoscopes and video-dermatoscopes, tiny pictures of the patient's hair and scalp are analyzed as part of the non-invasive trichoscopy procedure. The precise assessment of the hair count parameter is made possible by these excellent photographs. Trichoscopy is a technique that makes use of greatly magnified pictures of the scalp and hair to extract extra features including the perifollicular epidermis and hair follicle openings. These techniques help in diagnosing hair disorders and es-timating the likelihood of recovery. [4].

The process of extracting features from microscopic images requires image processing, or IP. This research suggests an IP-based system to obtain a precise hair count from the taken pictures. Systems that extract vital characteristics from medical hair and scalp photographs, such as hair count and anagen-telogen rate, are being developed by researchers worldwide. These technologies provide quantitative insights into the health of the hair and scalp, preprocess photos, and extract important elements. By offering objective measurements, they improve medical diagnostics, resulting in precise evaluations and more successful therapies.

## 2. Literature Survey

The study [5] by Danchen Hu et al. explores two primary methods for hair count data collection: quantitative trichoscopy analysis and pathologic examination. Quantitative trichoscopy analysis, a non-invasive and rapid technique, enables dermatologists to obtain magnified scalp images for analyzing hair density and shaft diameter. It is increasingly favored in diagnosing hair loss conditions due to its non-invasiveness and efficiency. Conversely, pathologic examination, involving horizontal sectioning of 4-mm punch biopsy specimens, offers potentially more precise insights into hair follicles but is hindered by physical discomfort and scarring risks, limiting its widespread application.

Hyungjoon Kim et al.'s approach [6] for identifying hair and scalp characteristics from microscope pictures was presented. The identification of scalp blotches, hair thickness, and hair count were the main research objectives. They evaluated their method using many images taken with a microscope camera that is easily attached to a smartphone in order to determine its accuracy. This method made it possible to thoroughly assess the system's functionality, particularly in terms of its capacity to precisely identify characteristics on the scalp and offer trustworthy assessments of the thickness and number of hairs. Pre-processing methods were used on the images before analysis to increase the system's accuracy and improve the output's caliber.

## 3. Proposed System

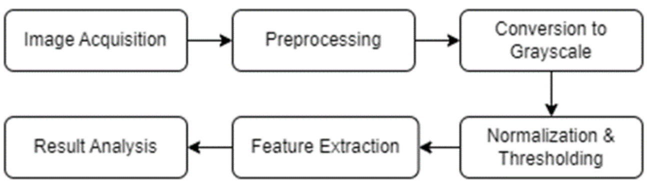


Figure 1. Proposed System Flow

**3.1 Image Acquisition:** The system begins by acquiring high-resolution images of the scalp or the region of interest using a digital camera or a dermatoscope. Proper lighting conditions are maintained to ensure consistent image quality, which is essential for accurate analysis.

**3.2 Preprocessing:** Before proceeding with hair counting, preprocessing techniques are applied to enhance the quality of the acquired images (Figure 2). This involves contrast stretching (Figure 3) to improve the dynamic range of pixel intensities, followed by denoising to reduce noise and improve image clarity (Figure 4).

**3.3 Conversion to Grayscale with Highest Energy Component:** The pre-processed image is then converted to grayscale while retaining the component with the highest energy. This step involves reshaping the image into a 2D array, computing the covariance matrix, and extracting the eigenvector corresponding to the highest eigenvalue. The resulting grayscale image emphasizes features with the most significant variance, which aids in subsequent hair detection.

**3.4 Normalization and Thresholding:** The grayscale image is normalized to the 0-255 range to facilitate further processing. Otsu's thresholding method is then applied to obtain a reliable binary image, effectively separating the foreground (hair) from the background (Figure 5). Additionally, the binary image is inverted to ensure that the hair regions are represented as white pixels and the hairs as black as shown in Figure 6.

**3.5 Feature Extraction:** Initially, the Contour Detection phase involves identifying contours within the inverted binary image created through thresholding. Using the contour detection function, the system identifies continuous boundaries outlining regions of hair follicles. Subsequently, Contour Filtering and Analysis meticulously evaluate the characteristics of identified contours, employing strict criteria to distinguish genuine hair follicles from irrelevant artifacts. By assessing contour area, perimeter, and aspect ratio, the system effectively removes noise, ensuring that only relevant contours contribute to the subsequent counting stage.

Following contour detection and filtering, Visualization and Hair Counting provide valuable insights into the distribution and quantity of hair follicles within the image. Simultaneously, the system counts the number of retained contours that exceed the threshold limit of contour area, identifying them as individual hair strands.

**3.6 Results Analysis:** The final step involves analyzing the results obtained from extracting features from the image. The system provides quantitative information such as the total number of hairs detected, which can be further analyzed for diagnostic or research purposes. The accuracy and efficiency of the proposed methodology are evaluated based on comparison with ground truth data or manual counts.

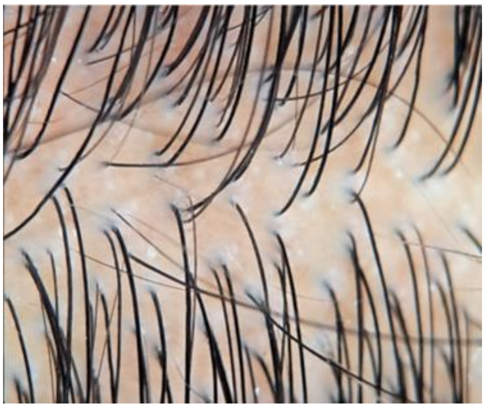

Figure 2. Resized Image

Figure 3. Contrast Stretching

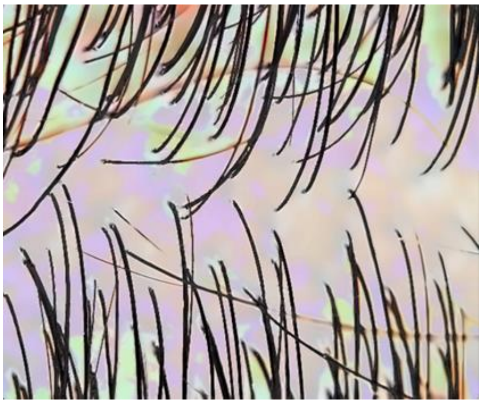

Figure 4. Denoising

Figure 5. Grayscaling and normalizing

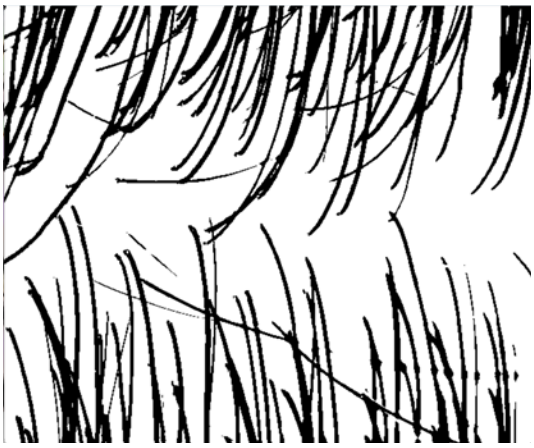

Figure 6. Inverting binary

## 4. Future Scope

Three significant improvements are planned for the suggested system in the future. Color analysis can be used to identify differences in hair color[7], such as gray or white hair, which can provide information about nutritional deficiencies and aging-related changes. Changes in the texture of hair, such as coarseness or brittleness, can be detected by texture analysis and act as markers for many hair problems. Modern deep learning algorithms are also integrated with the goal of automating disease detection based on diagnostic factors, improving the efficiency and accuracy of the system's diagnosis.

These algorithms will also be used to identify and classify hair types that can be linked to particular disorders, such as corkscrew, exclamation, and comma hair. These further elements will improve our capacity to provide customized hair inspections.

## 5. CONCLUSIONS

In summary, this study offers a novel technology that will transform the fields of dermatology and trichology by fusing trichoscopy with image processing techniques. Dermatologists and trichologists can now handle patient data more effectively, analyze hair and scalp diseases in detail, and make well-informed decisions about diagnosis and treatment thanks to the system's comprehensive solution. This system improves dermatoscopic data processing accuracy and accessibility with dynamic dashboards, IP capabilities, and an easy-to-use interface for patient management.

The system's inspection of dyed hair is dependent on it, especially for non-black hair, which may compromise the accuracy of results for such hair hues. Additionally, a photograph that has hair follicles overlapped may result in an inaccurate hair count. Notwithstanding these drawbacks, the study represents a noteworthy accomplishment in the field of healthcare technology-healthcare integration, offering enhanced early diagnosis and efficient treatment planning along with the possibility of future improvements and breakthroughs.

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