Automated Counting of Hair Using an iPhone

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Abstract

Background: The loss of hair is common and its progression, as well as its response to treatment, is difficult to assess and monitor quantitatively. Manual hair counting facilitated by a dermatoscope is often employed by clinicians as reliable method to quantify hair, but is typically not a rapid technique. Devices exist that are capable of counting hair and therefore measuring hair density, but they are either too invasive, entail dyeing and/or trimming of the hair, or require too much time to operate. We have developed a wireless and portable system which employs the iPhone to automatically count hair and measure hair density in an expeditious and operator-friendly manner.

Objective: Our objective for this study is to determine the accuracy of the automated hair counting algorithm through comparison with manual hair counting.

Methods: Dermatoscopy images of hair (N=10) were acquired from different body sites of a volunteer with black hair. Our system is capable of acquiring dermatoscopy images of hair with magnification of 20X through the use of an iPhone and an accompanying mountable dermatoscopy lens. No pre-treatment of hairs, such as dyeing and trimming, is required. Dermatoscopy images are subsequently transmitted to a nearby laptop through a password-protected wireless network. Automated hair counting, which relies on the detection of hair endpoints, is performed by a customized algorithm in MATLAB software on the laptop and is presented to the user in a browser-based interface on the iPhone. Manual hair counting is also performed on the same dermatoscopy images for comparison.

Results: Our results indicate that, on average, our algorithm yields values that are within 7.8% of those acquired by manual counting. A TOST test (SAS 9.4 for Windows) showed that the two counting methods are equivalent within a 10% margin ($p = 0.0201$). Furthermore, not only is our algorithm able to detect hairs that are difficult to observe with the unaided eye, but the system also accurately counts and measures calibers of hairs of varying length which intersect multiple times and those with unusual and sharply curved trajectories.

Conclusions: We conclude from the results that our system can have clinical applications in hair density monitoring and in cosmetic and medical research.

Limitations: The current study only tests the algorithm on black hair and not on other colours, although the algorithm is capable of handling light and dark hair simultaneously. A larger user study is required to fully test the proposed system.