**LITERATURE SURVEY**

**[1] "Deep Learning based Detection of Hair Loss Levels from Face Pictures", 2019 Eighth International Conference on Image Processing Theory Tools and Applications, Halim Benhabiles, Karim Hammoudi, Ziheng Yang, Feryal Windal, Mahmoud Melkemi, Fadi Dornaika, and Ignacio Arganda-Carreras (IPTA)**

Hair loss is a phenomenon known to affect people's morale and self-confidence. Often, the awareness of the phenomenon and the possibilities of treatment is late. This paper investigates deep learning methods for detecting hairs loss levels by men from face images. In this context, a specific training dataset has been prepared with face images having varied levels of baldness. Moreover, in spite of the low visibility of hairs in such images, a matching method is proposed for automatically classifying facial images with respect to pattern classification tables of male baldness from the medical area. Experimental results show the potential and the efficiency for medical, security and commercial applications.

**[2]Survey-based Machine Learning approaches to diagnosis of hair fall disorder in Bangladeshi Community," 2022 13th International Conference on Computing Communication and Networking Technologies, Farhana Khatun, Moshfiqur Rahman Ajmain, Sharun Akter Khushbu, Nushrat Jahan Ria, and Sheak Rashed Haider Noori (ICCCNT)**

Hair symbolizes the beauty of women and men. All of us are jealous of our hair. We lose hair at a young age due to some mistakes or irregularities. Lots of men and women all over the world are suffering from hair falling and the number of females is suffering growing per year. Genetically, dandruff, allergy and stress are the major problems for falling hair. We are doing this research survey for helping people. This study is representing two things. First of all, we are findings how many reasons are involved in hair fall. Another thing is we train our dataset with machine learning algorithms to find out the accuracy. Machine learning technologies have rapidly evolved to analyze survey datasets. SVM, Logistic Regression, Naive Bayes, Decision Tree, Random Forest, K-nearest Neighbor and XGBoost algorithms for performance comparison. The experimental results indicated that XGBoost had the best performance, with an accuracy of 92.62%.

**[3]A Deep Learning-Based Scalp Hair Inspection and Diagnostic System for Scalp Health, IEEE Access**

Many people suffer from scalp hair problems such as dandruff, folliculitis, hair loss, and oily hair due to poor daily habits, imbalanced nutritional intake, high stress, and toxic substances in their environment. To treat these scalp problems, dedicated services such as scalp hair physiotherapy have emerged in recent years. This article proposes a deep learning-based intelligent scalp inspection and diagnosis system, named Scalp Eye, as an efficient inspection and diagnosis system for scalp hair physiotherapy as part of scalp healthcare. The proposed ScalpEye system consists of a portable scalp hair imaging microscope, a mobile device app, a cloud-based artificial intelligence (AI) training server, and a cloud-based management platform. The Scalp Eye system can detect and diagnose four common scalp hair symptoms (dandruff, folliculitis, hair loss, and oily hair). In this study, we tested several popular object detection models and adopted a Faster R-CNN with the Inception ResNet\_v2\_Atrous model in the ScalpEye system for image recognition when inspecting and diagnosing scalp hair symptoms. The experimental results show that the ScalpEye system can diagnose four common scalp hair symptoms with an average precision (AP) ranging from 97.41% to 99.09%.

**[**4**]** Kim, Jong-Hwan, Segi Kwon, Jirui Fu, and Joon-Hyuk Park. 2022. "Hair Follicle Classification and Hair Loss Severity Estimation Using Mask R-CNN" Journal of Imaging 8, no. 10: 283. https://doi.org/10.3390/jimaging8100283

Early and accurate detection of scalp hair loss is imperative to provide timely and effective treatment plans to halt further progression and save medical costs. Many techniques have been developed leveraging deep learning to automate the hair loss detection process. However, the accuracy and robustness of assessing hair loss severity still remain a challenge and barrier for transitioning such a technique into practice. The presented work proposes an efficient and accurate algorithm to classify hair follicles and estimate hair loss severity, which was implemented and validated using a multitask deep learning method via a Mask R-CNN framework. A microscopic image of the scalp was resized, augmented, then processed through pre-trained ResNet models for feature extraction. The key features considered in this study concerning hair loss severity include the number of hair follicles, the thickness of the hair, and the number of hairs in each hair follicle. Based on these key features, labeling of hair follicles (healthy, normal, and severe) were performed on the images collected from 10 men in varying stages of hair loss. More specifically, Mask R-CNN was applied for instance segmentation of the hair follicle region and to classify the hair follicle state into three categories, following the labeling convention (healthy, normal and severe). Based on the state of each hair follicle captured from a single image, an estimation of hair loss severity was determined for that particular region of the scalp, namely local hair loss severity index *(P)*, and by combining *P* of multiple images taken and processed from different parts of the scalp, we constructed the *hair* loss severity estimationand visualized in a heatmap to illustrate the overall hair loss type and condition. The proposed hair follicle classification and hair loss severity estimation using Mask R-CNN demonstrated a more efficient and accurate algorithm compared to other methods previously used, enhancing the classification accuracy by 4 to 15%. This performance supports its potential for use in clinical settings to enhance the accuracy and efficiency of current hair loss diagnosis and prognosis techniques.

**[5] Investigation of the international epidemiology of androgenetic alopecia in young Caucasian men using images from the Internet, Avital Y, Morvay M, Gaaland M, Kemny L. Indian Journal of Dermatology. 2015; 60(4):419.**

The epidemiological evaluation of androgenetic alopecia (AGA) is based mainly on direct observation and questionnaires. The international epidemiology and environmental risk factors of AGA in young Caucasian men remain unknown. To use photographs and data from the Internet to evaluate severe AGA and generate greater understanding of the international epidemiology of the disorder in young Caucasian men. A population-based cross-sectional study design was used. The sample included 26,340 Caucasian men aged 30 to 40 years who had uploaded profiles to two dating websites. Their photographs were evaluated for AGA and graded as follows: severe AGA (Norwood type VI-VII), non-severe AGA, and unknown. Epidemiological data were collected from the sites. Logistic regression was used to analyse the effect of risk factors on the prevalence of severe AGA. **T**he overall success rate for identifying severe AGA by indirect evaluation of Internet photographs was 94%. The prevalence of severe AGA was 15.33% overall and varied significantly by geographical region. The risk of having severe AGA was increased by 1.092 for every year of age between 30 and 40 years. Severe AGA was more prevalent in subjects with higher body mass index. Photographs from the Internet can be used to evaluate severe AGA in epidemiological studies. The prevalence of severe AGA in young Caucasian men increases with age and varies by geographical region. Body mass index is an environmental risk factor for severe AGA.