
Hair Multinet: A multi scale feature fusion method using deep learning approach with web Interface

Submitted By

Ahsan Mahbub	(20211203009)
Nizamul Haque Sohan	(20211203011)
Lipi Akter	(20211203035)
Nazmul Hassan	(20211203036)
Tohsin Taslim	(19202203082)

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Department of Computer Science and Engineering
Bangladesh University of Business and Technology

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Declaration

We hereby declare that the project entitled “Hair Multinet: A multi scale feature fusion method using deep learning approach with web Interface” submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering in the Faculty of Computer Science Engineering of Bangladesh University of Business and Technology (BUBT) is our own work and that it contains no material which has been accepted for the award to the candidate(s) of any other degree, except where due reference is made in the text of the project. To the best of our knowledge, it contains no materials previously published or written by any other person except where due reference is made to the project.

Ahsan Mahbub, Id: 20211203009

Nizamul Haque Sohan, Id: 20211203011

Lipi Akter, Id: 20211203035

Nazmul Hassan, Id: 20211203036

Tahsin Toslim, Id: 19202203082

Approval

This report “Hair Multinet: A multi scale feature fusion method using deep learning approach with web Interface” submitted by Ahsan Mahbub, Nizamul Haque Sohan, Lipi Akter, Nazmul Hassan, Tohsin Taslim, ID NO: 20211203009, 20211203011, 20211203035, 20211203036 and 19202203082 Department of Computer Science and Engineering (CSE), Bangladesh University of Business and Technology (BUBT) under the supervision of Md. Mahbubur Rahman, Assistant Professor, Department of Computer Science and Engineering (CSE) has been accepted as appeasement for the partial fruition of the requirement for the degree of Bachelor of Science (B.Sc.) in Computer Science and Engineering and endorsed as to its contents.

Supervisor

Md. Mahbubur Rahman (Assistant Professor)

Department of Computer Science Engineering

Bangladesh University of Business and Technology

Chairman

Md. Saifur Rahman (Assistant Professor)

Department of Computer Science Engineering

Bangladesh University of Business and Technology

Dedication

We would like to dedicate this project to our loving parents . . .

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Abstract

Approximately 50% of men experience some degree of hair loss by the age of 50, and male pattern baldness (androgenetic alopecia) affects around 30% of men by the age of 30 and approximately 40% of women experience some degree of hair loss by the age of 40. Almost 50 million men and 30 million women in the United States alone are affected by hair loss due to aging, stress, medication, or genetic makeup. Hair and scalp-related diseases often go unnoticed in the beginning. Sometimes, a patient cannot differentiate between hair loss and regular hair fall. Diagnosing hair-related diseases is time-consuming as it requires professional dermatologists to perform visual and medical tests. Because of that, the overall diagnosis gets delayed, which worsens the severity of the illness. Due to the image-processing ability, neural network-based applications are used in various sectors, especially healthcare and health informatics, to predict deadly diseases like cancers and tumors. These applications assist clinicians and patients and provide an initial insight into early-stage symptoms. In this study, we used a deep learning approach that successfully predicts three main types of hair loss and scalp-related diseases. However, limited study in this area, unavailability of a proper dataset, and degree of variety among the images scattered over the internet made the task challenging. 1500 images were obtained from various sources and then preprocessed by denoising, image equalization, enhancement, and data balancing, thereby minimizing the error rate. After feeding the processed data into the ResNet-50 model, we obtained overall training accuracy of 100%, with a validation accuracy of 70.1%. We also created

a dataset of the scalp images for future prospective researchers.

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Chapter 1

1 Introduction

Introduction

Hair fall, also referred to as hair loss or alopecia, is a prevalent condition characterized by the excessive shedding of hair from the scalp or other areas of the body where hair grows. This phenomenon can manifest gradually over time or occur suddenly, impacting individuals of all ages and genders. The complex nature of hair fall involves a myriad of contributing factors, necessitating a comprehensive understanding to identify the root causes and tailor appropriate treatments. These causes encompass genetic predispositions, hormonal changes, medical conditions like infections and autoimmune disorders, side effects of medications, nutritional deficiencies, and the influence of physical or emotional stress. Recognizing the specific factors at play is crucial for formulating effective prevention and treatment strategies.

Various types of hair loss, such as androgenetic alopecia, telogen effluvium, and alopecia areata, further underline the diverse nature of this condition. From lifestyle adjustments and topical medications to surgical interventions like hair transplantation, a range of treatment options exists. Seeking professional advice from dermatologists or trichologists is paramount for accurate diagnosis and the development of personalized plans to address individual circumstances. Adopting a holistic approach to health, including a balanced diet, proper hair care practices, and stress management, contributes significantly to mitigating hair

fall and promoting overall well-being.

This chapter provides a quick overview of hair fall using dermoscopy images. This chapter also discusses the approaches examined and, eventually, how they lead to the ultimate aim.

1.1 Problem Statement

Hair fall stands as a pervasive issue affecting people worldwide, not only impacting their physical appearance but also taking a toll on self-esteem and overall well-being. The lack of an efficient and accessible method for early detection compounds the challenge, frequently resulting in delayed intervention and a worsening of the condition. Present solutions for hair fall detection are often constrained, relying on subjective assessments or sophisticated diagnostic tools primarily found in clinical settings. Consequently, individuals face difficulties in monitoring and comprehending the progression of their hair loss, impeding timely intervention and personalized treatment. This pressing issue underscores the need for an innovative and user-friendly solution that can empower individuals to proactively address hair fall concerns, fostering early detection, and providing personalized insights for effective management.

1.2 Problem Background

The problem of hair fall is a prevalent and multifaceted issue that has garnered widespread attention due to its impact on individuals' physical appearance, psychological well-being, and overall quality of life. Hair loss can result from a myriad of factors, encompassing genetic predispositions, hormonal imbal-

ances, medical conditions, lifestyle choices, and environmental influences. Understanding the underlying causes and patterns of hair fall is crucial for devising effective preventive measures and treatment strategies.

One significant aspect of the problem lies in the limited accessibility to efficient and early detection methods. Many existing solutions rely on subjective assessments or require access to advanced diagnostic tools found predominantly in clinical settings. This lack of accessible tools for early detection can lead to delayed intervention, allowing the condition to progress to more advanced stages, making it challenging to implement effective interventions.

Moreover, the subjective nature of assessing hair fall often complicates the issue. Individuals may find it challenging to accurately monitor the progression of their hair loss, leading to uncertainties about the severity of the problem and hindering their ability to seek timely and personalized treatment. This knowledge gap further emphasizes the need for a comprehensive and user-friendly approach to hair fall detection.

The social and psychological ramifications of hair fall should not be overlooked. Beyond the physical aspects, individuals often experience a decline in self-esteem and confidence, impacting their social interactions and overall mental health. The problem extends beyond a cosmetic concern, highlighting the necessity for holistic solutions that address both the physical and psychological dimensions of hair fall.

In light of these challenges, there is a compelling need for research and innovation in the field of hair fall detection and management. Developing accessible, reliable, and user-friendly tools for early detection, along with educational

resources and personalized treatment recommendations, can significantly contribute to mitigating the impact of hair fall on individuals' lives. This sets the stage for a comprehensive exploration of the problem, emphasizing the importance of interdisciplinary approaches in understanding and addressing the multifaceted nature of hair fall.

1.3 Problem Motivation

The motivation behind embarking on this comprehensive exploration of innovative hair loss detection and prevention strategies stems from the widespread and impactful nature of hair loss as a global concern. Hair health is intricately linked to one's self-esteem, social confidence, and overall well-being. The emotional and psychological effects of hair loss extend beyond cosmetic considerations, making it a significant aspect of personal identity and quality of life.

Current approaches to addressing hair loss often lack precision and fail to provide timely interventions. This research is driven by a fervent desire to revolutionise the landscape of hair health by harnessing the power of advanced technologies, including artificial intelligence and machine learning, to create a reliable and accessible detection system.

By delving into the development of a sophisticated detection system, our aim is to empower individuals with early insights into potential hair loss, allowing for proactive measures to be taken. Moreover, the project seeks to contribute to the body of knowledge surrounding the various factors influencing hair loss, providing a foundation for personalised preventive strategies.

The motivation is not solely rooted in scientific curiosity; it extends to a genuine commitment to enhancing the lives of those affected by hair loss. We aspire to foster a sense of empowerment and self-care by delivering practical, evidence-based solutions that individuals can incorporate into their daily lives. Ultimately, the motivation for this topic lies in the potential to make a tangible, positive impact on the lives of individuals grappling with the multifaceted challenges posed by hair loss.

1.4 Research Objective

- **Develop an Efficient Detection System:** Design and implement a user-friendly and accessible detection system for hair fall using computer vision and machine learning algorithms. The goal is to provide individuals with a reliable tool for early detection and monitoring of hair loss patterns. For user experience enhance we will display the output of the model through to a website.
- **Enhance Personalized Treatment Approaches:** Develop personalized treatment approaches based on individual characteristics, including genetic predispositions, hormonal profiles, and lifestyle factors. This includes exploring targeted therapies and interventions tailored to specific causes of hair fall.
- **Validate Diagnostic Tools:** Validate the accuracy and reliability of the developed diagnostic tools through rigorous testing and comparison with existing clinical assessments. Ensure that the detection system provides

consistent and trustworthy results across diverse populations.

- **Create Educational Resources:** Develop informative and accessible educational resources on effective hair care practices, nutritional guidelines, and stress management techniques. Empower individuals with knowledge to prevent and manage hair fall through lifestyle modifications.

1.5 Significance of Resource

- **Comprehensive Hair Analysis:** The resource provides a significant contribution to the field by offering a comprehensive approach to hair analysis. The multi-scale feature fusion method, coupled with deep learning, allows for a nuanced understanding of various aspects of hair characteristics.
- **Innovative Methodology:** The methodology employed in "Hair Multinet" is innovative, incorporating machine learning techniques and a multi-scale feature fusion method. This innovation contributes to the development of more accurate and efficient tools for analyzing hair-related data.
- **Health and Well-being Impact:** Research on hair fall holds significant implications for individuals' overall health and well-being. Understanding the underlying causes and developing effective prevention and treatment strategies can contribute to improved physical health, psychological well-being, and enhanced quality of life.
- **Preventive Health Measures:** Research findings can contribute to the development of preventive health measures that individuals can incorporate

into their daily lives. This includes guidance on nutrition, stress management, and lifestyle modifications aimed at reducing the risk of hair fall and promoting overall health.

- **Global Impact:** Given the widespread concern of hair fall across diverse populations, research in this field can have a global impact. Solutions and insights developed from such research can be applicable and beneficial to people of various ethnicities, cultural backgrounds, and geographical locations.
- **Technological Advancements:** Research on hair fall often involves leveraging advanced technologies such as computer vision, machine learning, and diagnostic tools. The development and refinement of these technologies not only contribute to addressing hair fall but also advance the broader field of health technology and diagnostics.

1.6 Key Contribution

Innovating in the model or domain of hair fall research, this study proposes a hybrid model that leverages the strengths of convolutional neural network (CNN) model architectures, including ResNet 50 model and MobileNetV2 model and DenseNet 201 model. The integration of these models aims to harness their unique capabilities in feature extraction and representation learning. The ResNet 50 model, known for its deep architecture with residual connections, contributes to capturing intricate patterns and hierarchical features in the data. Simultaneously, the MobileNetV2 model, optimized for efficiency, enhances the

computational speed and allows for real-time applications. DenseNet 201 model excels in feature reuse, promoting dense connections between layers. By combining these models into a hybrid architecture, this research endeavors to exploit the complementary advantages of both depth and efficiency, ultimately improving the accuracy and efficiency of hair fall detection and analysis. This innovative hybrid model has the potential to significantly advance the capabilities of computer vision applications in the context of hair fall research and may serve as a template for optimizing the performance of similar image-based analyses in the medical and healthcare domains.

Organization

Our proposed method for the development of Hair Multinet using machine learning based systems. In chapter 1 here we discussed our project problem statement, project motivation, project problem background, research objective, and declare contribution. In chapter 2 described previous study and previous problem analysis. In chapter 3 here discussed our proposed method and highlights which things we are now offering in our project.

Chapter 2

2 Literature Review

Introduction

In recent years, the integration of machine learning (ML) techniques in the field of dermatology has shown promising results for the diagnosis of hair-related disorders. This literature review synthesizes and critically analyzes recent studies that leverage ML, particularly deep learning algorithms, for the identification and diagnosis of alopecia areata (AA) and other hair loss conditions.

2.1 Previous Study

Here is an approach to identify alopecia areata by analyzing hair photos rather than conventional scalp and skin images. Employing techniques such as histogram equalization and data augmentation for image enhancement, the research successfully applies the VGG-16 deep learning algorithm for feature extraction. The key contribution lies in providing a straightforward method to predict and diagnose AA through the analysis of hair pictures, demonstrating the potential of intelligent neural networks for hair loss prediction.

Here for recognizes the algorithm's effectiveness while suggesting the need for further analysis with more samples and exploration of other intelligent methods to enhance prediction accuracy. This underscores the ongoing quest for refining ML models to improve their diagnostic capabilities in the realm of hair loss

This research explores the feasibility of automating Hair Density Measure-

ment (HDM) through deep-learning-based object detection technology. Evaluating three models, YOLOv4 emerges with superior performance. The study demonstrates the potential of cutting-edge deep learning in automating hair-related measurements, paving the way for more efficient and accurate assessments in clinical settings

Several studies highlight the importance of ethical considerations and data privacy in the development of ML models for hair loss diagnosis. Additionally, they acknowledge the need for further exploration into treatment response variability and dynamic environmental factors to enhance the model's comprehensiveness..

The review concludes with discussions on proposed CNN frameworks for hair disease detection. While 97% accuracy rates are achieved, challenges such as the lack of proper datasets and the necessity for diverse preprocessing methods are acknowledged. The need for ongoing research to address these limitations is emphasized.

The proposed framework leverages deep learning to automatically recognize male patterned baldness from frontal facial images, with potential applications in medical and security fields. However, limitations arise in detecting hair loss levels for women. Further research is required to mitigate dataset biases. Additionally, the framework introduces a CNN model for hair disease detection with high accuracy, yet faces challenges due to the absence of a proper dataset and the complexities of preprocessing for non-localized diseases. The ScalpEye system excels in AI-based recognition of four common scalp hair symptoms but is constrained by its limited support for symptoms, reliance on specialized equipment,

and high computational resource requirements. Further research is essential to expand its capabilities and address these limitations. The research identifies areas for future work, acknowledging that certain aspects, such as treatment response variability and the dynamic environmental factors, may require further exploration to enhance the model’s comprehensiveness. It prioritizes ethical considerations, emphasizing data privacy and security measures to ensure the responsible use of personal health information.

2.2 Problem Analysis

Future work focuses on increasing the accuracy of the model to provide more useful predictions. Future models will need to improve their ability to incorporate a wide range of lifestyle and environmental factors that affect hair health. Future projects will require refining the results by focusing on accessing many hair images. Since the dataset is collected from only Asian men with black hair, the generalizability of the dataset is limited to this specific population. Thus, some external factors which were not included in the dataset, such as different hair types, colors, or skin tones, which should be further tested using the proposed algorithm to address its general applicability. Since the dataset is collected from only, the generalizability of the dataset is limited to this specific population. Its exact mechanism along with other growth factors found in prepared PRP and the interactions between them and the relation of its concentration to the efficacy of used PRP still need further studies. Methodological obstacles in the related works section, including the lack of research on patterned baldness analysis using vision-based methods, difficulty in detecting hair loss levels from

frontal face pictures, and the need for user intervention in some semi-automatic methods. These obstacles highlight the need for further research and development in the field of computer vision-based Detecting hair follicles in images can be challenging due to various factors such as variability in hair appearance, lighting conditions, and image quality. Resolution optimization involves finding a balance between image quality and computational efficiency by adjusting the resolution of images. An extension of a severity index equation usually involves refining or expanding the factors considered in the equation to provide a more accurate and comprehensive assessment of the severity of a particular condition or situation. The need for advanced algorithms arises from the increasing complexity and scale of problems across various domains. Advanced algorithms provide more sophisticated and efficient solutions to tackle challenges that traditional algorithms may struggle with. Data augmentation is a technique used in machine learning to artificially increase the size of a training dataset by applying various transformations to the existing data. This process helps improve the generalization and robustness of machine learning models. When combined with model training, data augmentation contributes to better model performance, especially in scenarios with limited labeled data. The exploration of different models is a crucial step in the machine learning and data science workflow. It involves trying out various algorithms or architectures to find the one that best suits the problem at hand. Mechanistic understanding refers to a comprehensive comprehension of the underlying processes, interactions, and principles that govern a system or phenomenon. The goal is to bridge the gap between laboratory research and real-world medical practice, ultimately improving patient

outcomes and healthcare.

Conclusion

In conclusion, recent advancements in machine learning applications for hair loss diagnosis present a diverse array of methodologies and technologies. These studies collectively contribute to the development of intelligent systems capable of predicting, diagnosing, and understanding various hair-related conditions. However, ongoing research is crucial to refining these models, addressing ethical considerations, expanding capabilities, and ensuring comprehensive and accurate diagnoses in clinical practice.

Chapter 3

3 Methodology

Introduction

Our proposed "Hair Multinet" system offers a multi-scale feature fusion method using a deep learning approach, coupled with a user-friendly web interface. This suggests efficiency, innovation, and accessibility, making it appealing for those interested in comprehensive and reliable hair analysis.

3.1 Design Diagram

3.2 Collection Dataset

Datasets is essential for training, validating, and testing machine learning models. Datasets are the building blocks that empower researchers, developers, and analysts to create effective algorithms, solve real-world problems, and contribute to advancements in artificial intelligence and data-driven technologies.

3.3 Training Model

3.3.1 Input Dataset

Input datasets is fundamental for training, evaluating, and improving machine learning models. Datasets are the foundation that empowers researchers, developers, and analysts to create effective algorithms and address real-world challenges.

3.3.2 Image Processing

Image processing is crucial for extracting valuable information, enhancing visual content, and enabling efficient analysis in various fields. It plays a vital role in medical imaging. Image processing improves image quality.

Region of Interest Extraction Region of Interest Extraction (ROI Extraction) involves identifying and isolating specific areas within an image that are of particular interest for further analysis. This technique is commonly used in computer vision, image processing, and machine learning to focus on relevant portions of an image, streamlining data analysis and enhancing the efficiency of algorithms.

RGB to Gray Converting images from RGB to grayscale is a common preprocessing step in machine learning. Grayscale images contain only intensity information, simplifying the data while retaining essential features. This conversion reduces computational complexity, enhances processing speed, and focuses on essential image details, making it particularly useful in various machine learning applications.

3.4 Test Image

Testing images in machine learning are essential for evaluating the performance and generalization of trained models. They provide a separate dataset that the model hasn't seen during training, helping assess how well the model can make accurate predictions on new, unseen data. Testing images enable

researchers and practitioners to validate the model’s effectiveness, identify potential issues like overfitting, and ensure reliable performance.

Conclusion

”Hair Multinet” system represents an innovative and effective solution for hair analysis. The multi-scale feature fusion method, combined with deep learning, enhances the accuracy and granularity of results. The web interface system adds a layer of accessibility, making the tool practical for a broad range of users.