AI-Enhanced Smart Beauty Companion with Customized Recommendations

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***Abstract*—Introducing AI-powered personalized makeup rec- ommendation system, the paper focuses on delivering personal- ized recommendations by analyzing users' facial features, user preferences, and skin tone analysis. The system employs face detection, facial landmark detection, and skin tone detection to determine the most suitable looks for the user. It suggests customized makeup styles for various occasions such as office look, casual look, and party look settings based on the user preferences. Users can also input the makeup products they own, and the system provides detailed instructions on creating a look using those products The model delivers instruction for applying makeup according to user recommendations, making it more interactive and gives personalized experience. This system demonstrates how AI can revolutionize the beauty industry by making makeup advice more accessible and tailored, with potential for further advancements in personalized beauty and skincare solutions.**

***Index Terms*—Keywords - Facial Features, Skin Tone, Recom- mendation, Makeup**

I. INTRODUCTION

In this era of technology and automation, the personal care sector is also experiencing a remarkable shift with the help of the integration of Artificial intelligence (AI) and machine learning. This system uses algorithms to analyze facial features and skin tones, further it gives makeup suggestions that enhance the user's appearance. The principal objective behind this system is to provide users with a personalized experience by taking inputs such as desired looks for any occasions etc. With the help of facial landmark detection and skin tone analysis the system can predict the appropriate makeup look. The system aims to redefine the concept of beauty personification. The system not only extracts facial features, skin tones, recommends the makeup but also emphasizes on user involvement by giving guidelines or by giving step by step instructions to the user for makeup application. By incorporating user feedback, the system can adapt and refine its recommendations, creating a continuous loop of improvement with evolving choices and trends.

II. PROBLEM DEFINITION

This System tends to solve the lack of personalized care for makeup recommendations that intend to differ for individual's differences in skin tone, facial features, and personal pref- erences. Traditional makeup advice is often generalized and doesn't consider the uncommon needs of each user, making it more difficult for users to find the products and the application techniques that are best suited for them. This system tracks this issue by using AI to study user's facial characteristics and
existing products, providing customized recommendations for beauty products and shades. It offers step by step application instructions making the makeup process easier and more exclusive.

III. PROPOSED DESIGN

The proposed AI personalized makeup recommendations system aims to advise users in choosing makeup looks that complement their facial features, skin tone and user prefer- ences. This system produces customized recommendations for different occasions such as office, casual or parties making makeup advice more accessible. The presumed system design explains the flow of the system from user input to instruction generation and feedback to improve the system.
The system's core process integrates user preferences, facial detection and landmark analysis, skin tone

detection, and recommendation generation. Techniques for detecting facial features and landmarks play a key role in analyzing the user's skin tone [14]. User preferences, including desired makeup styles, specific occasions, and available beauty products, are essential in tailoring personalized and precise recommenda- tions
The system is composed of several interconnected modules:

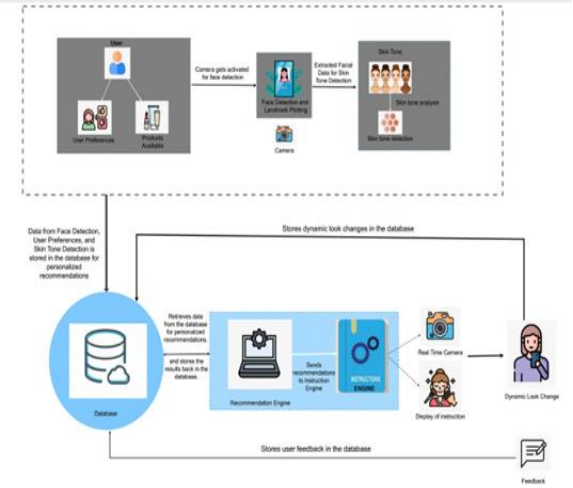

Fig. 1. System Architecture

1) User Input Processing Module: In this module the user provides preferences like makeup styles (party, office, casual) and the system stores data about products they
own for personalized instructions.

2) Face Detection and Landmark Detection Module: This module uses advanced algorithms such as MTCNN, YOLO[13], Mediapipe : Utilizes deep neural networks for detecting face regions and provides a 3D mesh representation with 468 points, Dlib:Uses Histograms of Oriented Gradients for face detection and regression trees for landmark estimation.[2]

3) Skin Tone Detection Module: A deep learning-based model like ResNet 50, MobileNet,etc to analyze skin tone and adjust the makeup recommendation accordingly.

4) Database: The database here stores user preferences, product user own, image of user, landmark coordinates, skin tone, recommended styles and instructions.

5) Datasets: The prepared dataset undergoes, 5-fold cross validation test is conducted for evaluating using the proposed model's performance. Data from various states and union territories are analysed and visualized highlighting diverse attributes across different regions.[17].

6) The technique for evaluating predictive models involves the spliting the original data set in two separate parts: one subset, called the model training set, is used to build and train the model, while the other subset, known as the test set, is reserved for assessing the model's performance. By training on one portion of the data and testing on another, this approach of the data and testing on another, this approach helps ensure that the model's accuracy and effectiveness can be evaluated independently from the data it learned from, giving a more reliable measure of its predictive power on unseen data.

7) Recommendation Engine: This AI-based engine processes all inputs and suggests specific makeup products, application techniques, and looks suitable for the user's facial structure, preferences and skin tone.

8) Dynamic Look Change and Feedback: This will be like a chat to the user, where the user can give instructions to the engine to update the style or product and get dynamic output and easier interface to communicate with the system. Also, the system gets updated based on the user feedback for refining future recommendations.

IV. FEATURES

1) Real Time: The main feature of the system is real-time facial instruction that allows for easier use of makeup and gives customized recommendations from face and landmark detection.
2) Personalization: Users can receive personalized styles for makeup to suit their wishes and facial features for parties or any sort of social events.
3) User Interface: User friendly interface which consists of simplistic color theme and has easy

navigation throughout the process.

4) Efficient: The model works efficiently and provides high accuracy with the help of some machine learning algorithms.

V. IMPLEMENTATION

1) Skin Tone Detection: MTCNN detects faces and ex- tracts key landmarks. These landmarks help crop and align the face for better skin tone analysis. MobileNetV2 processes the extracted facial region to classify the skin tone based on the dataset.

Fig. 2. Skin Tone Detection

2) Recommendation Model: There is a huge variety of makeup products such as foundation, concealer, blush, lipstick, and eyeshadow. Each product requires an indi- vidual recommendation system. The following image is the output for one such product, the eyeshadow. Similar systems are built for the rest.

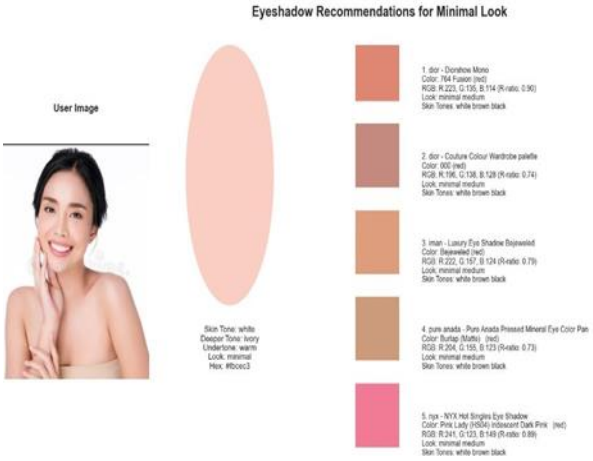

Fig. 3. Eyeshadow Recommendation Model

VI. RESULT ANALYSIS

The image given below is a line graph (or a plot with two overlaid line graphs) that depicts the relationship between Pre- cision and Recall as a function of the Match Score Threshold.

1) X-axis (Match Score Threshold): Represents the threshold value for classifying a match. A lower threshold means more lenient matching, while a higher threshold makes matching stricter.

2) Y-axis (Value): Represents the values of precision and recall, ranging from 0 to 1.

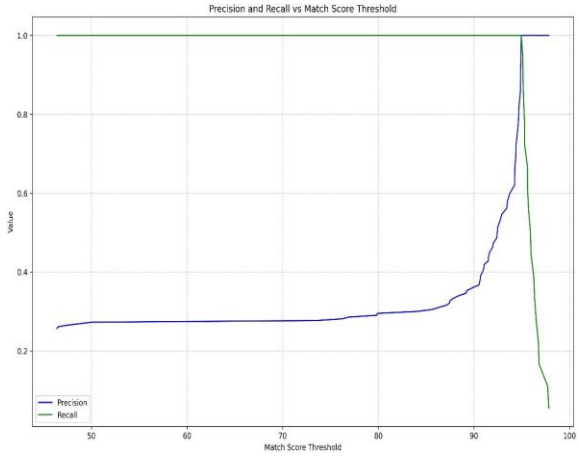

Fig. 4. Line Graph

VII. LITERATURE SURVEY

1) Graph Convolutional Neural Networks for Micro-Expression Recognition—Fusion of Facial Action Units for Optical Flow Extraction Publication Year: 2024 Authors: Xuliang Yangi, Yong Fang, C. Raga

Rodolfo JR. Key Findings: This paper introduces a method that combines Graph Convolutional Networks (GCN) with facial action units (FAUs) and optical flow. This fusion improves the accuracy of micro-expression recognition by effectively capturing subtle facial move- ments, resulting in better performance for detecting brief, involuntary emotions. [1]

2) A Zero-Shot Image Enhancement Method Based on Human Skin Tone Reference Publication Year: 2023 Authors: Duilhio Oliveria, Alexandre Lopes, Victor Galassi Luquezi, Carlos Eduardo Nogueira, Dennis Liu, Helio Pedrini, Mauricio

Schiezaro Key Findings: This study presents a technique for enhancing images con- taining people by focusing on skin tone. The method is inspired by professional photo editing practices, partic- ularly the adjustment of RGB curves to improve overall color quality. [8]

3) Pixel-Level Image Quality Assessment for Explain- able Face Recognition Publication Year: 2023 Au- thors: Philip Terhost, Marco Huber, Naser Damer, Florian Kirchbuchner, Kiran Raja, Arjun Kuijper Key Findings: This paper introduces a training-free method to assess pixel-level face image quality (PLQ) for face recognition. It employs a quality regression model and back-propagation to enhance interpretability, improve image quality by inpainting occlusions, and detect low- quality areas caused by disturbances. The method is effective for ICAO compliance. [4]
4) Adv-Eye: A Transfer-Based Natural Eye Makeup Attack on Face Recognition Publication Year: 2023 Authors: Jiatian Pi, Junyi Zeng, Quan Lu, Ning Jiang, Haiying Wu, Zhiyou Wu, Linchengxi Zeng Key Find- ings: This paper introduces a subtle and effective method of using natural eye makeup to fool face recog- nition systems. The attack is transferable across differ- ent models, highlighting a widespread vulnerability. It achieves a high success rate without noticeable alter- ations, making it practical for real-world applications. [5]
5) A Fast Detection Network for Skin Color Model Publication Year: 2021 Authors: Yali Wang, Mingjie Li Key Findings: This model focuses on improving de- tection speed and accuracy while maintaining robustness under varying lighting conditions and backgrounds. The model is computationally efficient, making it suitable for real-time applications in facial recognition, security, and multimedia systems. [13]
6) Face Recognition Attendance System Based on Real- Time Video Processing Publication Year: 2020 Au- thors: Hao Yangi, Xiaofeng Han Key Findings: This system leverages face recognition technology to auto- mate attendance tracking. It captures real-time video, detects faces, and matches them with a pre-existing database to mark attendance. [19]

VIII. ACKNOWLEDGMENT

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IX. FUTURE WORK

Advanced possibilities in AI-powered makeup recommendation systems offer valuable opportunities to enhance user experience and personalization. Augmented Reality will facilitate integration and provide a better experience for the user, as they can apply makeup virtually, observing in real-time whether to illustrate the instructions or not. Further, the system can be extended to analyze skin conditions and useful products to help with the skin condition, such as acne, dryness, oily, etc., and give skincare advice along with makeup suggestions. With the help of voice- activation functionality, improvement in accessibility can be done, enabling users to request personalized looks and tips through natural language commands. Moreover, the system and user could benefit by integration with e-commerce and brands allowing users to seamlessly purchase recommended products, increasing engagement. Promoting multi-cultural inclusivity is another important aspect, where AI models are trained on diverse datasets to accommodate a wide range of skin tones, facial features, and cultural preferences. Finally, smart mirror integration offers real-time, interactive beauty advice, bridging the gap between virtual recommendations and real-world application, thus improving daily routines with live feedback on makeup techniques.

X. CONCLUSION

The Intelligent Makeup Guide represents a

groundbreaking step in making personalized beauty accessible to everyone. By combining AI with facial analysis, it provides tailored makeup recommendations based on individual skin tones and facial features, offering users a more personalized and professional experience. As the system evolves, expanding the product database, refining image processing, and incorporating user feedback will further enhance its capabilities. The upcoming integration of augmented reality with accessibility features is expected to provide a much more inclusive and interactive ex- perience to ensure that all individuals can enjoy individualized beauty guidance.

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