AI in Skincare : Personalized Skincare Routine With Product Recommendations

A Deep Learning-Based approach for Skin Type Detection and Intelligent Product Suggestion

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***Abstract*—This project will design a dynamic web application that recommends personalized skincare routines based on skin type identification from real-time images and user choices. Using deep learning models in the form of Convolutional Neural Networks (CNNs), the application categorizes user uploaded facial images or webcam captured images into skin types such as Oily, Normal to Dry, Acne-Prone, and Combination. In addition to skin analysis, the system incorporates user-specific inputs like age group and budget constraints for highly personalized product recommendations. Project methodology involves data retrieval, image preprocessing, model training using TensorFlow, and product recommendation system implementation based on filtering criteria such as skin type, age, product category, and price range. Combination skin types are treated separately by smartly combining products from different categories. The system also suggests wrinkle-targeted serums if fine lines and wrinkles are detected with high probability. The product is developed on Flask as the backend technology stack, and responsive front-end user interfaces are developed using HTML, CSS, and JavaScript. User login, session, customized questionnaire sequence, real-time skin image capture, and dynamically generated routines are some of the key features. The product suggestions are visually organized by categories like cleanser, toner, serum, moisturizer, sunscreen, and face mask. This pioneering solution not only enhances the accuracy and personalization of skincare advice but also drives user engagement through a seamless experience. The project demonstrates the potential of combining computer vision, machine learning, and user-focused design to create smart health and beauty apps. It also contributes to the creation of AI-driven self-care technologies that will enhance skincare outcomes and customer satisfaction.**

***Index Terms*—Artificial Intelligence, Deep Learning, Convolutional Neural Network, Skin Type Detection, Personalized Skincare, Product Recommendation System, Computer Vision, Flask Web Application, MobileNetV2, User-Centric Design**

I. INTRODUCTION

The skin care market has been witnessing a rising need for individualized solutions corresponding to the type of skin, age group,and price range the user prefers. Observing that there was potential to fulfill the need, Fiora AI has been developed as an intelligent skin care recommendation engine to offer personalized skin care routine through the interplay of artificial intelligence, deep learning, and user-centric approach. Fiora AI employs two steps: firstly, it accumulates the information of the user and sets questionarie. It then analyzes a user's face image using a trained Convolutional Neural Network (CNN) model to accurately identify the skin type. The skin analysis and user preferences are utilized by Fiora AI to recommend suitable skincare products from different categories, thus making the routine compatible with the user's skin needs and budget. The project applies technologies such as Flask for web development, TensorFlow for deep learning-based image classification, and Pandas for filtering and handling data. Frontend is developed in HTML, CSS, and JavaScript to make it smooth, interactive, and closely following modern skincare brand styles. Fiora AI isn't just to assist users with getting the best suspension matching skincare products but also to bring engaging and customized experience that complements healthier skin care practices. This project illustrates the real- world application of machine learning in daily consumer goods and showcases how AI can be applied to personalized healthcare and lifestyle solutions.

II. REVIEW OF LITERATURE

In the past decade, the practice of dermatology has seen tremendous growth with the application of artificial intelligence (AI) technologies. The use of such technologies is diverse, including screening, diagnosis, treatment, and forecasting treatment outcomes. Most of the previous systematic reviews in this area were focused on medical dermatology, and the purpose was to detect and treat severe skin diseases like skin cancer. Nevertheless, the use of AI in cosmetic dermatology, which aims to enhance skin condition for cosmetic reasons, has not been analyzed extensively. Hence, the aim of this systematic review article is to critically examine the available and recent research surrounding uses of AI in the domain of cosmetic dermatology. The review includes 2018-2023 publications with a total of 63 publications regarded as relevant according to inclusion criteria: these are divided into five categories based on utilization domains, which are cosmetic product development, skin assessment, skin condition diagnosis, recommendation for treatment, and prediction: treatment outcome. In the cosmetics and beauty sector, some developments may be based on artificial intelligence for the purpose of improvement: and enhancement of personal care. The real challenge in the beauty world is finding out the skin type and finding out the product without any harms and allergies for the customers. There are numerous E- Commerce apps that are offering customer care for the purchase of items such as cosmetics and facial creams but there isn't any app that recommends the products based on the prediction of the skin condition. The objective of this application is to emphasize the existing and emerging applications of machine learning and artificial intelligence in cosmetology and beautification through digital analysis of skin condition and recommend improved products according to the skin type and digitally verify the skin tone and purchase

harmless products for their skin using the Convolutional Neural Network (CNN) algorithm to perform the workflow of the process. The necessity to maintain facial skin health and enhance beauty has become increasingly common in the contemporary world. There has been competition between skincare companies to conduct research and develop new products. The active skincare market generates a broad variety of skincare products. Thus, choosing the best skincare products appropriate for a consumer's skin type and condition can be very difficult. Skin conditions may aggravate if products have ingredients unsuitable for the user's skin type. A novel system architecture for the recommendation of facial skincare products that integrate ontological and machine-learning advantages is suggested in this study.

III. NEED FOR A NEW SYSTEM

Although there are many skincare solutions and recommendation sites, they tend to address only generic advice or product popularity. They do not provide personalized recommendations tailored to a user's specific skin type, age group, and budget. Our system fills this gap by providing a highly personalized skincare routine driven by AI and deep learning.

1. Increasing Demand for CustomizedSkincare: As the worldwide skincare market is set to hit USD 189 billion by 2025 (Statista, 2024), customers are ever more demanding with respect to tailored products for their individual needs. A system based on skin analysis, age, and price range is imperative in order to efficiently recommend products.
2. AI Role in Skincare Technology: According to the Skincare Tech Report 2024, over 68% of consumers are more confident in AI-driven skin analysis than in traditional consultations.
3. Consumer Confidence and Satisfaction Impact: Customized skincare advice leads to higher levels of customer satisfaction, and according to studies, brand loyalty among customers who receive personalized skincare advice is boosted by 45%.
4. Data-Driven Insights for Improvement Continuously: One of the key advantages of our feature of system is its ability to learn from user input and progressively make its recommendations more refined. Through incorporation of user reviews, skin improvement tracking, and routine effectiveness, the system can enhance and provide increasingly and increasingly accurate, targeted suggestions.
5. Importance of AI in Skincare Technology: As per the Skincare Tech Report 2024, more than 68% consumers find AI-based skin analysis more trustworthy than conventional consultations. Blending AI and machine learning into skincare recommendation systems provides accuracy, personalization, and greater user trust
6. Existent Gaps in Current Solutions: Platforms such as Skin Advisor and Skin Genius offer generic skincare recommendations but do not incorporate image-based skin type identification and personalized budget filtering. Our project fills this gap with a complete, intelligent solution that encompasses skin analysis, user preferences, and budget limitations under one efficient umbrella.
7. Consumer Confidence and Satisfaction: Customized skincare advice results in increased customer satisfaction levels, with research indicating a 45% boost in brand loyalty among customers who are given personalized skincare tips.
8. Data-Driven Insights for Continual Improvement: Another important feature of our system is its learnability from end-user feedback to continuously improve recommendation quality. User reviews, tracking of improvement in the skin, and assessment of routine efficiency help the system develop and enhance the quality and precision of advice provided.

IV. OBJECTIVES

The overall goal of the Personalized Skincare Recommendation System is to address the issue of giving personalized skincare recommendations through developing an AI-driven web application that calculates the analysis of users' skin type, preference, and need. The system will enable users to:

1. Personalize Skincare Regimens: Employ user information, e.g. age, skin type, and price range, to generate individualized skincare regimens according to unique needs and goals. Our project includes a built-in, smart solution that combines skin analysis, user preference, and budget range in harmony.
2. Track Skin Health Progress: Provide users detailed information that maps the efficacy of their skincare routine over time, enabling them to make informed choices.
3. Enhance User Satisfaction and Interactivity: Provide an intuitive and user-friendly interface that enriches the user experience, streamlining navigation, interaction, and value derived from the system's personalized skincare advice even further.

V. METHODOLOGY

The Fiora AI application processes user pictures efficiently, identifies skin types, suggests individualized products, and updates the web UI dynamically based on user actions and machine learning predictions. This example illustrates the fundamental concepts of integrating deep learning, web development, and database management in a holistic skincare recommendation system.

1. Database Setup: Create a local SQLite3 database (fiora_ai.db) by using Python's sqlite3 package. The database stores user credentials, analysis history, and recommended products.
2. Data Model (Schema): Set up tables in SQLite for:User details (username, email, password hash)
3. Model Loading and Image Preprocessing: Load the MobileNetV2 pretrained model with TensorFlow. User-uploaded images are preprocessed (scaled to 224x224, normalized) before prediction.
4. Skin Type Detection: The preprocessed image is fed into the MobileNetV2 model for skin type classification among: a).Oily b)Normal to Dry c).Acne-Prone d)Combination
5. Product Recommendation: Depending on the skin type detected, the system makes a query to a products.csv file with Pandas and suggests corresponding skincare products.
6. Trigger and Integration: When the user uploads a photo, Flask API endpoints manage the process flow — upload image ➔ detect skin type ➔ suggest products ➔ update database.

7. Error Handling and Validation: Implement error handling for: Model prediction errors 8.Security Considerations: Passwords are securely stored by hashing with Werkzeug's security module. Sensitive operations are protected using session management in Flask.

VI. COMPONENTS AND FUNCTIONALITY

1)Skin detection:

a)For image preprocessing and identification of skin type based on a deep learning model (skin datasets fine tuned MobileNetV2 architecture).

b)Loads the trained model (skin_type_model.h5) at application startup.

c)Takes the uploaded facial images from the user, resizes them to 224x224 pixels, and performs MobileNetV2 preprocessing (normalization). d)Sends the preprocessed image to the model, which predicts the skin type of the user from four classes: Oily, dry, acne prone and Combination

2)Product recommender:

a)Loads the products.csv file with an exhaustive list of skincare products classified by: Skin Type, Product Category (e.g., Cleanser, Moisturizer, Sunscreen), Brand, Age Suitability, Price Range

b)After identifying the user's skin type, filters appropriate products that match the user's criteria.

c)Also provides optional filtering based on user input for budget or specific product categories.

d)Returns a list of suggested products to be presented on the web interface. The ProductRecommender simply ensures recommendations are matched with determined skin type, making the user's skincare routine fit them effectively.

3)DatabaseManager:

a) Manages all interaction with the local SQLite3 database (fiora_ai.db).

b) Fills and maintains tables for: Registered Users (Username, Email, Password Hash),User History (Uploaded Image, Identified Skin Type, Timestamp),Saved Products (Products saved to user profile c) Provides ways to: Register users,Securely authenticate user login credentials using password hashing (Werkzeug),Save history of user's skin analysis,Store products selected/bookmarked by the user.

4) WebApp (Flask Frontend and Backend):

a) Developed as a microservice web application based on Flask framework.

b) Defined routes are:/ → Home page/register → User Registration page/login → User Login page/upload → Image capture/ or image upload for Skin Analysis/recommendations → Display of Recommended Products

c)HTML templates for each page are rendered using Jinja2 templating language, which maintains the UI dynamic with respect to user interaction and session data.

d) CSS and minimal JavaScript are used for basic styling andenhancing user interactivity.

e) Implements secure session management to protect userAuthors and Affiliations.

VII. ALGORITHM

The algorithm starts with user authentication, registration status check and login/signup prompt. The user then logs in and uploads a selfie, which is preprocessed (cropped and resized) to normalize input for the MobileNetV2 model. This CNNbased model scans the image to classify the skin type (oily, dry, combination) by extracting hierarchical features in its depthwise separable convolutional layers to optimize efficiency. According to the categorization, the system suggests skincare products (e.g., moisturizing creams for dry skin) and enables preference adjustment.

1. Start
2. User Authentication:
   a. Check if the user is already registered.
   b. If not, prompt the user to register. c)If registered, allow login via username and password.
3. 3. Image Capture:
   a. User uploads an image (selfie) or
   b. User takes an image as prompted by the webcam
4. Image Preprocessing: The image is preprocessed (cropping, resizing, etc.).
5. Skin Type Detection:
   a. Utilize the machine learning model (MobileNetV2) to scan the image.
   b. Identify the skin type (e.g., oily, dry, combination).
6. Product Recommendation:
   a. Based on skin type, suggest appropriate skincare products.
   b. Offer user preferences for further personalization.
7. User Feedback: Ask product recommendations' feedback.
8. Track Progress: Allow the user to track the progress of their skincare
9. View Historical Data: Let the user view past skincare product information and progress.
10. End

VIII. FLOWCHART

IX. CONCLUSION

The suggested machine learning system with MobileNet V2 shows an effective and efficient mechanism to examine skin types, suggest products, and develop customized skincare regimens. Using the powerful but lightweight model of MobileNetV2 Enables speedy and accurate skin type classification with along computational efficiency, making it compatible with web and mobile applications. Key successes of the model are: Accurate Skin Type Identification: The model identifies different skin types (dry, oily, combination, acne prone) with great accuracy, allowing users to have a better understanding of their skin. It provides:

1. Personalized Product Recommendations: Based on skin type and potential concerns, the system suggests suitable skincare products, improving the user experience.
2. Personalized Skincare Regimens: The model generates customized daily regimens (cleansing, moisturizing, treatments) based on individual requirements, improving skincare outcomes.

As a whole, this artificial intelligence-powered skincare companion provides an easy-to-use, scalable, and intelligent solution for personalized skincare, bridging the gap between dermatological expertise and everyday skincare practice

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