

Skin Condition Based Smart Cosmetics Suggestion System Using Artificial Intelligence

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ABSTRACT

Globally, the demand for cosmetics has increased recently, especially in the skin care sector. With so many choices available online, many consumers find it difficult to choose a product that complements their skin tone. Every person has unique skin, so it can be difficult to choose cosmetics that work well for them. It is important to identify cosmetics that do not cause allergies or other adverse reactions in clients. The perfect solution to this problem is to use AI (Artificial Intelligence) algorithms. This paper presents Skin Condition Based Smart Cosmetics Suggestion System using Artificial Intelligence. The described model of Skin Condition-Based Smart Cosmetics Suggestion System uses a Convolutional Neural Network (CNN) classification technique. This recommendation system helps users identify their skin type and suggests cosmetics. The AI-based Cosmetics Suggestion System outperforms the traditional Cosmetics Suggestion System in terms of Accuracy and Precision.

Keywords: *Skin Condition, cosmetics, Artificial Intelligence, Kaggle website, Convolutional Neural Network, Cosmetics Suggestion System.*

I. Introduction

As the beauty industry becomes larger over time, so do the products it offers and the number of its customers [1]. Products used to improve users' appearance are called cosmetic products. It includes various types of cosmetics- face wash, body lotion, foundation, compact, kajal, eye shadow, lipsticks, mascara, eyeliner, etc. [2]. There are several procedures and tasks involved in making a cosmetic product, all aimed at achieving harmony among its components.

With the increasing number of products and consumers, choosing the right cosmetic product is very important [3]. This solution is very useful for them because not everyone is good at choosing the best for themselves. Furthermore, a person can choose a cosmetic product based on personal factors [4]. Many modern marketing and sales techniques for beauty products cannot offer such a personal advisor, but beauty consultants are often very helpful in providing product suggestions [5]. For example, discount stores, online purchasing arrangements, telephone ordering, and mail-in product purchases often lack the communication exchanges necessary to complete a product sale. Therefore, the items must be automatically recommended [6].

Since cosmetics can affect one's appearance, it's important to choose the right product for the user's skin type, whether it's normal, oily, combination, or dry. Since every person has a different skin texture, it can be difficult to find the right cosmetics for their skin type [7]. Even if

we identify a product for the customer, skin problems are complex. We can use a deep learning, machine learning framework to solve this problem in the beauty industry because it works well with unstructured and large amounts of data, and it gives promising results [8].

Many factors can be used to establish one's skin type, including age, gender, sleep patterns, and skin condition. There are four types of skin: normal, oily, dry and mixed. There is an eerie similarity between dry, rough, and scaly skin. A condition known as oiliness is characterised by shiny, oily, or enlarged pores. It has middle qualities [9]. Unlike normal skin, combination skin is sometimes dry and sometimes oily in different places. A skin care routine is a set of several steps to maintain the health of each individual's skin. Every skin type has a different routine and procedure.

There are several procedures in a person's skin care regimen. For different skin types, there are certain methods and rules to follow. Skilled cosmeticians frequently discuss the choice. Since sensitive skin is more prone to allergies and skin problems, it is not included when considering other medical issues such as food, family history, dust and chemicals [10]. responses, symptoms and illnesses all affect skin type. However, skin type is also influenced by factors such as environment, sleep habits, and exercise.

Research in natural language processing, machine translation, computer vision, chatbots and many other areas has been made possible by deep learning in recent years. Without the ability to learn a feature representation from scratch, they provide stable performance [11]. This effect applies to the recommendations area, where deep learning methods outperform traditional methods with significant results. The process of deciding which cosmetic product is suitable for specific skin types is called cosmetic item composition.

The problem of cosmetic product composition arises because not everyone has the time or expertise to make informed decisions about what to choose. Deep learning techniques provide an answer to this problem, offering greater accuracy. Deep Neural Networks (DNNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Deep Belief Networks (DBNs) are deep learning techniques. When it comes to recommendations, deep learning methods produce better results than traditional methods. Better solutions to new problems can be achieved by using deep learning.

This paper aims to develop a model that accurately identifies various features on the skin and provides personalized recommendations for suitable skincare products based on an individual's unique needs. To achieve this goal, Skin Condition Based Smart Cosmetics Suggestion System uses Convolutional Neural Network (CNN) classification technique, ensuring the accuracy and effectiveness of the products recommended to consumers.

The remaining paper is organised as follows: Section II presents a literature survey; Section III explains the described methodology. Results and discussion are presented in Section IV, and the paper concludes with Section V.

II. Literature Survey

In [12], segmentation of skin microstructure and analysis using CNN models. First, propose to extract the skin's microstructure using the Fusion U-Net (U-shaped Network) model. Then evaluate and compare the segmentation performance using deep learning models and image processing techniques. The skin microstructure is then used to categorise skin ageing. MobileNetV3 (Version 3)-Small achieves the best accuracy of 94% in microstructure-based classification of skin ageing. In [13], Bidirectional imaging, a skin-imaging method described, captures significantly more properties than standard imaging. Incident illumination angle and viewing angle have a significant effect on the structure of the observed skin surface. The modelling and measurement methods are shown to be effective in the classification experiments.

In [14], to adaptively initialise individual ad hoc skin classifiers, a skin classification technique is proposed that leverages automatically detected faces and bodies in an image. The described model outperforms state-of-the-art methods, and the difference is statistically significant based on experimental results on a heterogeneous dataset of labelled images. In [15], developing a reliable evaluation method for psoriasis requires a segmentation-scaling algorithm for 2D digital images. A Markov Random Field (MRF) is used by a Support Vector Machine (SVM) to enable pixel-wise classification in a feature space derived from image colour and texture scaling. Evaluation using photos under different lighting conditions, with different skin types, and with different psoriasis types shows that the system produces reliable segmentation results.

In [16], deep learning-based methods for detecting dermatological disorders from dermoscopic images are reviewed in this study, which also covers the most available datasets for computer-aided identification of dermatological conditions. In addition to providing dermatologists with the latest information on technological developments in the area. This paper discusses the latest developments in deep learning-based methods for identifying dermatological conditions for researchers. In [17], a knowledge base was developed to model the relationships between facial style characteristics and makeup style characteristics. This knowledge base takes into account context, such as everyday makeup or heavy makeup, in line with current trends. A semantic explanation of the reasoning behind the recommended style is also included. The results show the efficiency and suitability of the proposed fully automated framework. In [18], using content-based filtering offers a novel method for developing a machine learning-based skincare product recommendation system. The system provides customized recommendations by examining the chemical makeup of products and taking individual skin types into account. The system's ability to provide tailored recommendations is demonstrated by empirical evidence, and it holds great promise for transforming consumer experiences in the cosmetics industry.

In [19], a virtual cosmetics recommendation system is presented that uses user photos to provide customised beauty recommendations. The objective of the proposed solution is to improve decision-making and provide an interactive user interface for cosmetic brand classification. The system's ability to generate accurate cosmetic recommendations is demonstrated by experimental results.

In [20], a simple cosmetic recommendation system is proposed. This model extracted an ingredient-based recommender system after identifying the best cosmetic ingredients for each user characteristic. Scraped Sephora's page to find information on chemicals and ingredients for cosmetics. A Document Term Matrix (DTM) is made by applying NLP (Natural Language Processing) concepts to chemicals. Finally, a plot is developed. Plotly is used to create a scatter plot and a hover tool is added to show that information.

In [21], an Android app named SkinProf has been suggested to educate knowledge consumers about skin care and beauty products. Skin Prof makes it easy for cosmetic users to assess which ingredients to avoid and the safety level of each. They can choose the best product by using Skin Prof to compare the ingredients of several products. In [22], discuss an opinion on the use of AI in cosmetics. Even in the cosmetics industry, AI is gradually being applied. For example, use a smartphone to take a picture of your skin tone, then customise the foundation to match it.

III. Smart Cosmetics Suggestion System

The workflow of Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is represented in Figure 1 below.

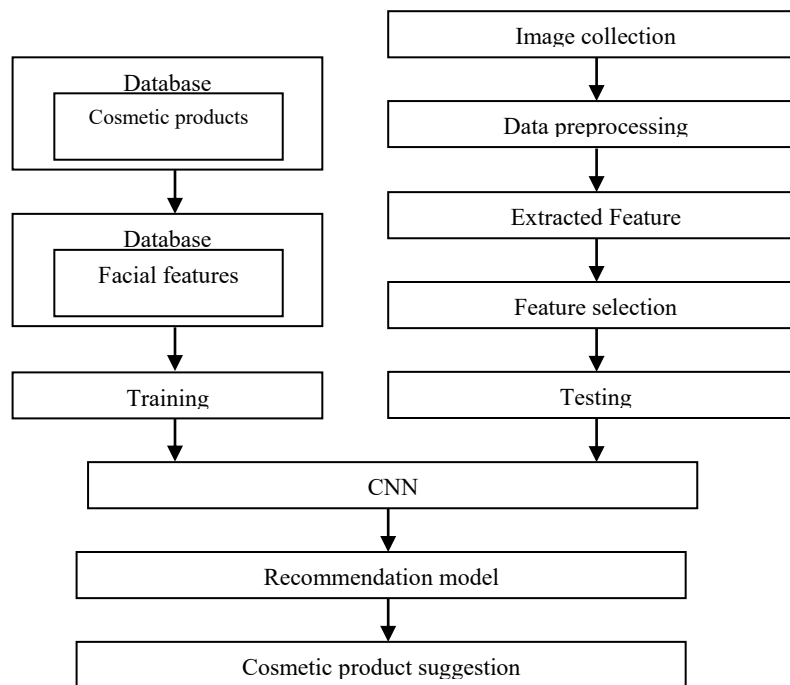


Figure 1: Work flow of Smart Cosmetics Suggestion System

This facial feature database is essential for the Cosmetics Suggestion process, which involves training the model to extract patterns and features from facial images. Users' skin types are mainly divided into four categories: oily, dry, normal, and combination. For this model evaluation, cosmetic data was collected from several websites, including @cosme and @Nykaa. The cosmetic products database contains information on 1472 products, including name, price, rank, brand, skin type and chemical ingredients. To focus on beauty products, only six were

selected from a wide range. These six categories include cleansers, face masks, eye treatments, moisturizers, sunscreen cream and facial treatments.

The Cosmetics Suggestion system provides personalized assistance to users who seek advice about their skin by offering recommendations for cosmetic products. At the initial stage, an image of an individual person or user is collected, and then it is further processed based on their facial features. The data preprocessing step is necessary to cleanse the data required by the given model. Preprocessing includes the process of resizing, patching and expanding. To start the preprocessing process, the input image size must be normalized. The first step is to tokenize the list of components in the component column. After tokenizing the words, create a binary collection of them. Then a dictionary is made using the parts. Duplicate data can be reduced by feature extraction. Data reduction and machine effort to generate combinations of variables (features) also speed up the learning and generalization stages of the machine learning process.

Labeled facial image contains information about the location and size of various facial features. From these features, the author selects some important and frequently used features, such as the mouth, eyes, and nose, for different skin types, including combination, normal, oily, and dry.

A special type of neural network used in deep learning to analyze data sets and extract knowledge from them is called a CNN. CNN can use images and other media to capture data. Essentially, CNN is made up of three elements: Local receptive fields, priority is given by shared weightings and biases, and finally bundling and activations. For a neural network to extract input information, it must first be trained on a large dataset. Following the input, an algorithm performs image preprocessing, feature extraction, data classification and output using the saved dataset.

The skin type is directly mapped to the recommendation system, while the components are taken from the topic. After receiving input, the algorithm performs image preprocessing, feature extraction, and data classification, and the output is evaluated using the saved dataset. This information can then be used to recommend products tailored to the user's specific facial features, such as makeup, skincare, or eyewear.

The performance of the described Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is evaluated by using the Accuracy and Precision parameters. Therefore, the Smart Cosmetics Suggestion System can suggest products tailored to the user's needs and address their unique skin concerns.

IV. Result Analysis

This section evaluates the performance of the described Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence. This study divided users' skin types into four basic groups: oily, dry, normal, and combination. This study collected thousands of photos under the above categories to create a pre-trained model. The Cosmetics Suggestion system provides personalized assistance to users who seek advice about their skin by offering recommendations for cosmetic products. The methodology first identifies the face from a user-uploaded image.

This image is preprocessed in the next stage. Then the features of the preprocessed image are extracted in the next step, which is used to reduce the duplicate data in the image. Later features are selected from the uploaded image. Identifying the condition of the skin and predicting the main features of the user's skin type: normal, oily, dry, or combination.

Skin Condition Based Smart Cosmetics Suggestion System uses Convolutional Neural Network (CNN) classification technique. A direct mapping of skin type to the recommendation system has been implemented. After that, details of the user's skin tone and features, along with details of cosmetics, are given to recommendation or suggestion systems. The performance or effectiveness of the described Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is evaluated by using the Accuracy and Precision parameters.

Accuracy: Proportion of correctly suggested instances, whether positive or negative. It is mathematically defined in below equation 1,

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} \quad (1)$$

Precision: Fraction of true positives among those suggested as positives. Precision has been expressed in (2).

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}} \quad (2)$$

Where TP denotes True Positive, TN denotes True Negative, FP denotes False Positive, and FN denotes False Negative.

Table 1 shows the comparative analysis of the described Skin Condition-based Smart Cosmetics Suggestion (SCSCS) System using AI and the Traditional Cosmetics Suggestion (TCS) System in terms of Accuracy and Precision parameters.

Table 1: Comparative analysis

Parameters	SCSCS System using AI	TCS System
Accuracy	97	85
Precision	97.5	84

Figure 2 represents the comparative accuracy analysis of the described SCSCS System using AI and the TCS system. In this graph, the X-axis denotes the models, and the Y-axis denotes the percentage value. From graph it is observed that, described model achieves highest accuracy compared to another model.

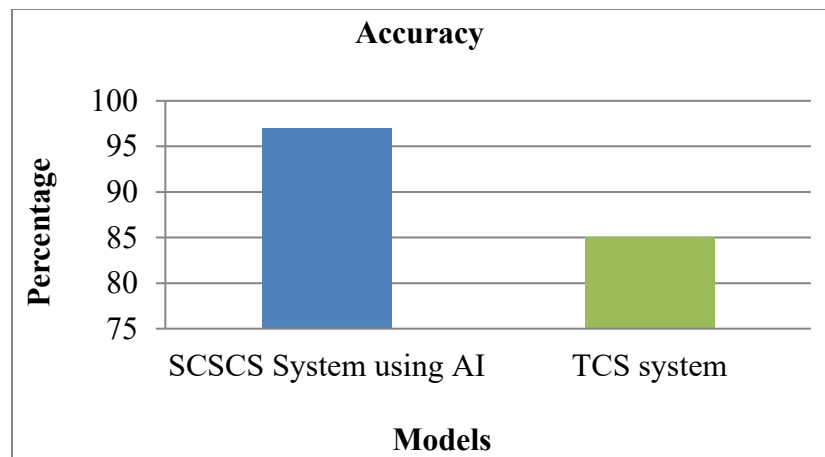


Figure 2: Comparative analysis in terms of the Accuracy parameter

A comparative analysis of precision parameters is shown in Figure 3 for the described SCSCS System using AI and the TCS system. The precision of the SCSCS System using AI is higher than that of the TCS system. The X-axis represents the models, and the Y-axis represents the percentage value.

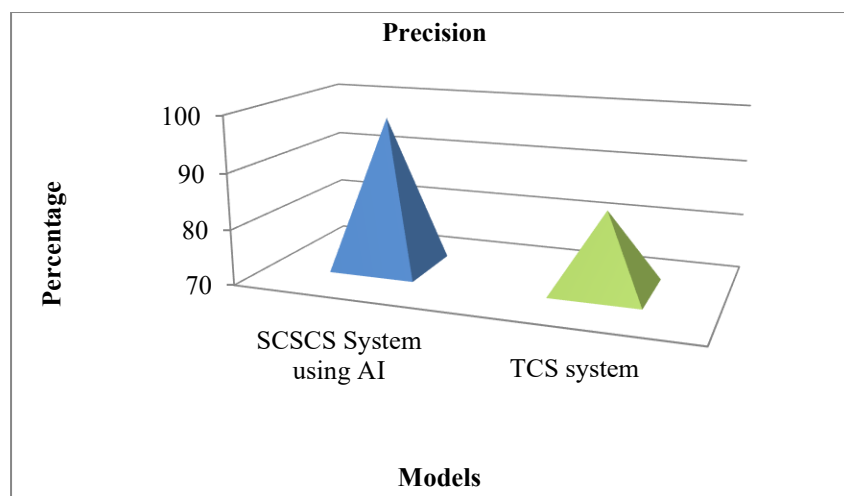


Figure 3: Comparative analysis in terms of the Precision parameter

From the overall results, it is observed that the described Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is more accurate and precise than the Traditional Cosmetics Suggestion (TCS) System. Cosmetic recommendations based on individual skin conditions identified through analysis. This innovative approach enhances the user experience by offering targeted solutions that meet their skin's specific requirements, ultimately contributing to a more effective and satisfying cosmetic routine.

V. Conclusion

In this paper, a Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is described. This innovative system improves the power of artificial intelligence to

analyze and understand various skin conditions, providing personalized recommendations for cosmetic products. This facial feature database is essential for the Cosmetics Suggestion process, which involves training the model to extract patterns and features from facial images. Users' skin types are mainly divided into four categories: oily, dry, normal, and combination. Cosmetic data from various websites, including @cosme and @Nykaa, were gathered for this model evaluation. The Cosmetics Suggestion system provides personalized assistance to users who seek advice about their skin by offering recommendations for cosmetic products. Skin Condition-Based Smart Cosmetics Suggestion System uses a Convolutional Neural Network (CNN) classification technique. The recommendation system was directly mapped to skin type. Then, recommendation or suggestion algorithms use data that includes cosmetic information, along with the user's skin tone and features. From the overall results, it is observed that the described Skin Condition-Based Smart Cosmetics Suggestion System using Artificial Intelligence is more accurate and precise than the Traditional Cosmetics Suggestion (TCS) System. The achieved accuracy value is 97% and the Precision parameter is 97.5%. A future development is to learn knowledge-based rules directly from labelled data and to extend the system to represent both men and women. This innovative approach enhances the user experience by offering targeted solutions tailored to each user's skin's specific requirements.

VI. References

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