Checking Appearance of The Human Face Virtually by Applying Cosmetic Products

Rachitha[1], Priya Rama Naik[2], Erin Sheryl Pereira[3], Mayola Angela Dsouza[4], Kishore Kumar [5]

[1] UG Student, Department of CSE, Sahyadri College of Engineering and Management, Mangaluru

[5] Assistant Professor, Department of CSE, Sahyadri College of Engineering and Management , Mangaluru

Abstract: There has been a significant rise in demand for virtual try-on application development over the past few years. Artificial Intelligence and Machine Learning have become more prevalent as a result of the advancement of technology in a variety of fields, including online retail sites. A virtual cosmetics application system thus gives the experimental process various benefits by enabling the user to rapidly and remotely visualize the results. This project applies cosmetics to a virtual face in order to study the makeup combination. This website enables users to realistically apply several cosmetic product shades to the desired facial region. Before purchasing makeup, users can try out a virtual version of the product first. In order to accomplish this, we've used image processing methods for landmark detection and applying makeup to face images, together with machine learning techniques and libraries. These programmes might promote internet shopping, giving businesses new avenues for making money.

Keywords: Virtual try-on, landmark detection, cosmetic products, shades, facial feature.

I. INTRODUCTION

The most diverse communities have utilized makeup for ages, and it is now a common thing in many people's daily life. Facial makeup can be used for a variety of reasons, including to make people appear more attractive, to develop the personality of an artistic or a model, for medical reasons, or just for fun. It alters the optical qualities and texture of the skin. Real facial makeup experimentation, however, necessitates the use and waste of numerous goods, including the makeup itself, cleaning solutions, applicators, etc. As a result, a virtual cosmetics application system enables consumers to test out makeup virtually, saving time and money on product waste. While some virtual makeup applications only display the finished product on the user's face, others let the user interact with the makeup as it is being applied on a photograph.

In this research, we suggest a machine learning-based computer vision technique and library that would enable a virtual makeup try-on. Through the use of a web application designed for desktops, the user communicates with the system. It uses a single frontal face image to operate as a virtual try-on application. The application needs the user's aid in a number of ways: The user first selects the face's structure or skin tone, and then the application of cosmetics is done using landmark detection of the face. The user can then adjust the desired makeup mix. Only frontal face portraits can be used in this application, and only the front portion of various face images can be reproduced over the input image.

With the help of this application, users may test out cosmetics and get individualized product recommendations based on facial image recognition. Numerous applications let customers try out new goods and change how they look virtually. These applications might promote internet purchases, providing new business prospects for organizations.

II. LITERATURE SURVEY

There are many literature contributions to Suspicious human activity detection using machine learning techniques. A facial makeup detection method using CMYK and neural networks is presented in this work [1]. The primary objective is to identify facial makeup using the CMYK color model, and to evaluate the results by contrasting them with those obtained using the widely accepted HSV color model. The overall objective of this research is to successfully use convolutional neural networks and the CMYK color model to detect facial makeup on an image with frontal face and eye regions. In this project, neural networks will be used to produce more definitive results in images with unfavourable conditions. Convolutional Neural Networks were chosen and used for this reason.

In order to extract features from each of the blocks of an image, the technique for digital image authentication presented in this research [2] combines the study of local texture patterns with the discrete wavelet transform and the discrete cosine transform. A model that enables the verification of the image's authenticity is then made using a vector support machine. In order to test the effectiveness of the suggested approach, experiments were conducted using fictitious images from widely used public databases. Digital photo tampering has been minimized by image editing software. These tools enable manipulating the image's content while leaving no obvious signs of the changes. Additionally, the ease of disseminating information via the Internet has led society to accept everything as factual without scrutinizing the veracity of it.

A virtual mirror-like experience is created by the proposed augmented reality system [3], which enables users to physically apply virtual makeup to their faces. Users of virtual makeup systems can test out different looks without wasting materials or having to clean up afterwards. Some virtual makeup applications only display the finished look on the user's face, while other programmers let the user interact with the makeup as it is being applied on a photograph. This study introduces an augmented reality system that enables users to physically apply virtual cosmetics to their faces with an applicator, emulating the usage of a virtual mirror. A normalized 2D face mesh made up of 124 triangles is used to map facial traits that are recognized and tracked using an RGBD camera. Additionally, the RGBD video stream detects finger touches on the face, which are then used to save the representation of the texture of the cosmetics on the matching 2D facial triangle. The virtual makeup is applied to the face by back-projecting it onto the camera-captured image of the facial mesh. Our early prototype shows the viability of our method, which detects touches quite accurately (about 2.2 mm) and delivers real-time interactive performance (about 15 fps) when tracking and rendering makeup using a standard PC and an Intel Real Sense RGBD camera.

The suggested face detection algorithm[4] for color photos when different lighting conditions and intricate backdrops are present. Based on an innovative lighting compensation technique and a non linear color transformation, it recognizes skin regions throughout the entire image and produces face candidates based on the spatial configurations of these skin patches. Face detection techniques can be divided into different categories depending on the type of representation that is used, with holistic representations having the advantage of finding small faces or faces in low-quality images, while geometrical facial features are a good choice for detecting faces in various poses. Without facial characteristics like eyes, a mouth, or a face border, the facial feature identification module rejects the face candidate region. The quality of the lighting affects how skin tone color appears. It is now possible to distinguish between skin tones with low and high luminosities. The purpose of this project is to create a system that can identify faces and facial features that can be used as indices for identification and retrieval from image and video databases.

This article presents a conceptual classification of beautification [5], discusses pertinent face recognition scenarios, and revisits related literature. Along with outstanding problems and difficulties in the field, the technical considerations and trade-offs of the methodologies surveyed are also summarized. Deep face recognition systems make use of very large face image collections to learn detailed and condensed representations of faces. Heavy makeup considerably reduces a person's capacity to be recognized, whereas light makeup somewhat boosts it. The accuracy of various sex-prediction algorithms and age assessment techniques is greatly reduced by changes brought on by facial cosmetics. Accordingly, a crucial pre-processing step for effective facial soft biometric estimators is reliable makeup detection. This study aims to give a thorough point of reference for biometric researchers and practitioners working in the field of face recognition who wish to address issues brought on by facial beautification. Despite the fact that a number of techniques for beautification detection have been put forth, the difficulty of successfully integrating newly provided detection modules into the face recognition system's processing chain still exists. A common omission in facial recognition systems performance studies is the application of beautification detection during authentication.

Facial cosmetics have a negative effect on the matching precision of automated face recognition systems [6]. The impact of cosmetics on algorithms that automatically estimate a person's gender and age is examined in this research. Such cosmetic applications have the potential to mislead automatic face-based gender categorization algorithms that normally use the texture and structure of the face image to differentiate between males and girls. They crop the photographs to highlight the facial region solely, label the subjects' eyes, and use three cutting-edge gender categorization algorithms to assess the efficacy of makeup-induced gender spoofing. Gender spoofing caused by makeup affects computerized gender classification. Algorithms for automatically estimating age may be affected by cosmetics use. In the context of face identification, it was demonstrated that whenever makeup is identified, an image preparation approach can be utilized to lessen its impact. According to this study, it is necessary to take into consideration the makeup issue. It is not possible for a subject to apply makeup to purposefully trick the system, but it is not difficult to imagine situations in which a malicious user may utilize widely available makeup to trick the system. Algorithms that are resistant to the changes brought on by facial makeup will be developed in the future.

The novel technique for applying makeup to the eyes, face, and lips is suggested in this paper based on several cosmetics examples [7]. In this study, a method for naturally transferring makeup techniques from two separate cosmetics sample photos to a target image is provided. One sample image can be used to extract the lip makeup, while another can be used to remove the eye and skin makeup. Both can then be applied to the target facial image. To get outcomes of natural blending, they applied a Gaussian weight map. This involved removing the lip and eye makeup from one sample image, the skin makeup from the other, and applying them to the target image. To simulate the appearance of real skin makeup, researchers generated two Gaussian weight maps. Our makeup results are natural because of the use of a Gaussian weight map throughout the mixing procedure. By simply choosing sample photos, the suggested method enables users to see the results of makeup application.

In this research [8], products will be virtually tried on. For a lipstick trial, an application was created. The user can view herself applying lipstick to a monitor. For better results, we combine face segmentation with color segmentation and color space transformation to identify the lips' approximate locations. The application functions realistically despite minor system lags. It makes use of image processing techniques. Users can simultaneously view the original and final images on the monitor as the system operates in real time. Face segmentation is employed to identify the lips' location, color segmentation to cut the lips, and color space transformation to improve outcomes. The system operates realistically, however occasionally there may be temporal delays. The system has the benefit of being inexpensive. To use the system, just a camera and a computer are required. Personal color, commonly referred to as skin tone color matching, is the practice of selecting apparel and cosmetics that complement a person's skin tone, eye color, and hair color.

This study proposes a method for automatically creating virtual cosmetics based on individual color[9]. Utilizing a person's personal color would be one approach that could be taken to accomplish this objectively and methodically. Personal color, commonly referred to as skin tone color matching, is the practice of selecting apparel and cosmetics that complement a person's skin tone, eye color, and hair color. In this study, we suggest a method for creating virtual makeup on the basis of individual color. To achieve that, first determine the user's personal color from the image by examining the color of the skin, hair, and eyes. Then choose a cosmetic technique and color scheme. To finish, we create a virtual makeup on the user's face image by consulting the specified cosmetics database for foundation, blush, lipstick, eyeliner, and eye shadow. We proposed a method for virtual cosmetics in this paper that is based on individual color analysis. Using Dlib's pre-trained face detector, we first retrieved the facial landmarks, such as the iris, hair, and skin region, to achieve this. The color of the retrieved regions was then examined, and the personal color was determined by taking user data and landmark attributes into account. Last but not least, we applied virtual makeup by consulting the predefined makeup database, which contains cosmetic techniques and colors based on the user's scenario and personal color. Through two experiments, we assessed our plan. In general, user satisfaction for virtual cosmetics is satisfactory according to the trial results, which demonstrate that the precision of hair, skin, and iris region extraction is fairly good.

An off-line created database that stores canonical patterns of facial components, or "golden samples," is part of a virtual cosmetics system[10]. Customers using virtual makeup should get similar sensations to what they would get from real trials. We provide an alternative to current techniques: a virtual cosmetics system with an offline created database including canonical patterns of facial components, or "golden examples." In order to determine the best-matching pattern, users online submit a face image to extract the facial landmarks. Representative aspects of the facial components are then calculated and searched in the database. Following that, the user-selected colors are applied to the best-matching pattern, and it is stitched to the input image. The experimental findings show that the virtual makeup technique we've suggested produces good visual outcomes.

III. METHODOLOGY

Cosmetics have a vast variety of products and color palettes, and because manual application is time-consuming and expensive, there is no way for beauty firms to offer a customized cosmetic shade experience.

This website focuses on applying cosmetics to a virtual face. In this application, the user chooses the desired cosmetic product together with an appropriate face image with the right skin tone, and after that, makeup is applied to the image of the face.
To do this, we employed image processing, machine learning algorithms, and libraries, and the front end of the web application was created using the Django framework. In order to apply makeup to the virtual face, color segmentation or clustering are employed along with the landmark approach in face segmentation.
Figure 1 describes the architectural view of the proposed project design.

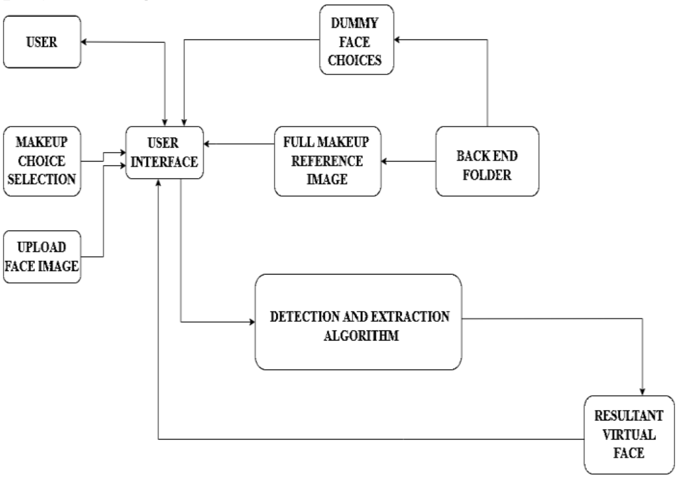


Figure 1: System Architecture for applying cosmetic product on human face virtually.

A. System Architecture

The user interface, face segmentation, landmark detection, and coordination identification are all included in the system architecture of this web application. The chosen shade of the cosmetic product will be applied to the facial image to analyse the outcome using ML libraries and image processing techniques.

B. User Interface:

People would always like to try makeup on before purchasing it, and this is a constancy in the world of cosmetics. The goal of this user interface is to give people a complete experience with makeup. It has the following options:

a. **Dummy Face And Choice Selection:**
The users of this programme can select from among the available facial images on the interface. Users are able to access face photos with various skin tones. The moment the user selects a face image, facial information for that image is collected. The user will choose the colour of the cosmetic product and the area of the face they wish to apply it on. The final image will be presented on the screen based on this.

b. **Full reference makeup:**
The user can customise the makeup on the uploaded face image by using the Reference makeup functionality. This characteristic demonstrates how the suggested system is different from the ones currently in use.

c. **Upload Image:**
In order to apply makeup, users have the option of uploading a picture of their face. Model images aren't used using this technique. Instead of using an dummy face image, users can upload their own face image in order to see how different cosmetic product shades appear on their face. Only a limited number of shade selection options are provided for this feature. To acquire the virtual visual effect on the user's face image, images can be submitted both in dummy face and choice selection as well as full reference makeup.

C. Detection And Extraction Algorithm:

Steps:

1. Upload/Select an image
2. Pre-process the image by resizing 256*256
3. Fetch the facial landmark using OpenCV
4. Select the facial part landmark
5. Extract the shade color from the reference image.
6. Apply the color to text image.

Figure 2 shows the sequence of steps for detection and extraction algorithm

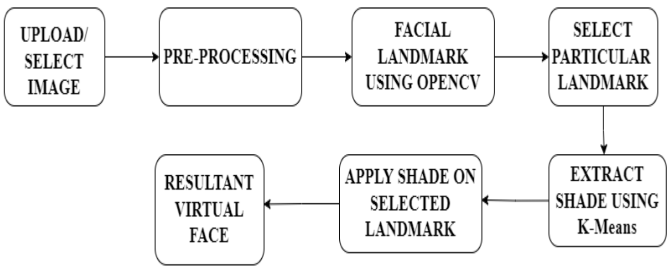


Figure 2: Steps for Detection and Extraction algorithm

Landmark Detection:

Input: Face Image

Output: Coordinated Facial Landmark of the image in binary format.

In general, the OpenCV library and ASM are used for landmark detection. Using test photos, Tensorflow is utilised to train the model. A model-based technique called Active Shape Model (ASM) normally aims to locate the greatest match position between the model and the data in a fresh image by using an earlier model of what is anticipated in the image. OpenCV is a fantastic tool for image processing and carrying out computer vision tasks. It is an open-source library that may be used to carry out operations like face detection, objection tracking, landmark detection, and much more. No matter what language you use, TensorFlow offers a variety of workflows to construct and train models using Python or JavaScript, and to simply deploy in the cloud, on-prem, in the browser, or on-device.

Extraction Algorithm (KMeans):

Input: Reference image with identified coordinates

Output: Color extracted

Step 1	Take random kk points (called centroids) from XX.
Step 2	Assign every point to the closest centroid. The newly formed bunch of points is called cluster.
Step 3	For each cluster, find new centroid by calculating a new center from the points
Step 4	Repeat steps 2-3 until centroids stop changing

IV. RESULT AND ANALYSIS

In this paper, we developed a web application for virtually testing on cosmetics. The main components that support the try-on experience were described, along with the process of a generic virtual try-on system. This was achieved after a review of current virtual try-on systems was undertaken to determine their shortcomings. The limitations of the present makeup apps are that they can only apply one cosmetics shade on a target image.

In this technique, we suggested the application of reference makeup as well as customized single facial features. Customized single facial features apply cosmetic shade virtually to a specific facial part, whereas reference makeup applications extract the shade color from the sample image and apply it to the target facial image. It contains cosmetics shades for the lips, eyes, and skin. users of this suggested methodology can assess the results of makeup application by simply selecting a face image or uploading an image.

Figure 3(a) is the chosen input image for lipstick shade application and figure 3(b) is the resulted lipstick shade applied image.

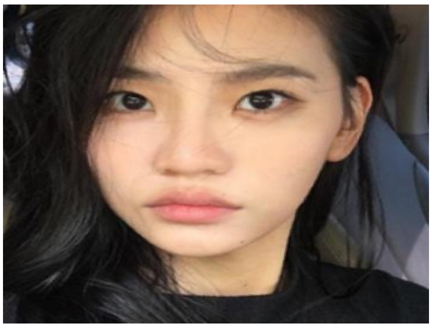
Figure 3(c) is the input image selected for eyeshadow application and figure 3(d) is the resulted eyeshadow applied image.

Figure 3(e) the sample image which is selected as reference make-up image.

Figure 3(f) is the uploaded image by the user for reference make-up application and figure 3(g) illustrates the application of over-all makeup from the sample image.


(a)


(b)


(c)


(d)


(e)

(f)

(g)

Figure 3: Input image and resultant cosmetic shade applied image

V. CONCLUSION:

We have implemented a system that can be used to determine personal makeup virtually. System works based on the facial landmarks and a reference image. System detects the lips, cheek and eye from the input image and compare it with the reference image. Current system works good with existing image samples with good accuracy. System uses OpenCV to collect facial landmark and TensorFlow APIs to pre-process, to create sessions and to compare input and reference images. Current system can be improved by using Mediapipe which is a Google tool for implementing ML-based computer vision solutions to improve the accuracy for live and random images. Similarly, an Android application or Hybrid application can be designed to reach maximum end user.

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