Technische Hochschule Augsburg

An Interactive Makeup Learning Tool

Interaction Engineering | Prof. Dr. Michael Kipp

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Content

Abstract

The Makeup Artist is an interactive web application enabling users to apply various makeup products onto a digital character using hand gestures.

As the primary input modality, different intuitive hand gestures correspond to applying specific makeup products. Additionally, users have control over the density of the product colors in the following way. Continuous hand gesture interactions gradually intensify color brightness and density, whereas brief interactions lead to a lighter application of makeup colors.

In this project, we employed hand landmarks and gesture recognition mechanisms to activate specific layers of makeup on the character. These gestures were designed to replicate either the procedural motions involved in the real-life application of a makeup product or the physical representation of the product itself. Our application contributes insights to the exploration of innovative human-computer interaction approaches in the field of digital aesthetics.

Motivation

Current digital makeup platforms lack hand gestures as the primary interaction method, and even when gestures are implemented, they are limited to basic functions like selecting products, adjusting colors, or switching pages (related works are listed below). Such interaction methods are not engaging for users.

Additionally, we have observed that, for makeup beginners, the complex variety of makeup products and the steep learning curve in makeup techniques pose significant barriers. Therefore, we aim to explore a new approach to virtual makeup application—using gestures similar to those in real makeup scenarios to apply makeup. This aims to reduce the learning curve, add an element of fun, and enhance user accessibility.

To achieve this, we decided to investigate the comparative user engagement between gestures and traditional computer mouse interactions in the makeup context. We also aim to explore the feasibility of customizing specific gestures for simplicity and a natural resemblance to traditional makeup applications, catering to individuals with varying levels of expertise in makeup techniques.

Related works

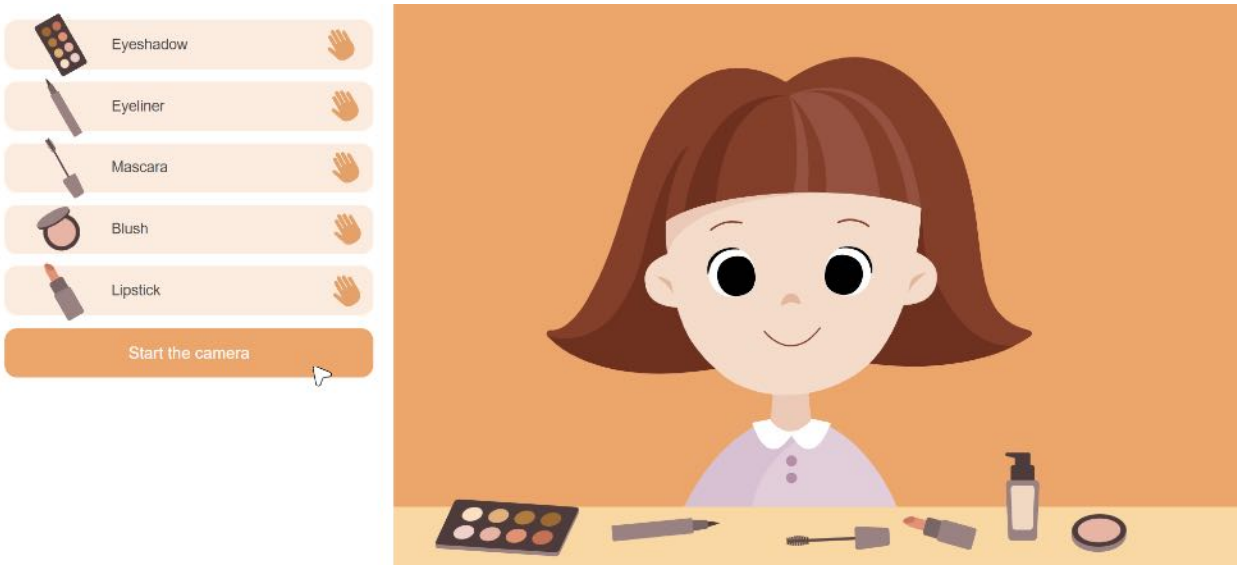
Interactive Pixel-unit AR Lip Makeup System Using RGB Camera (Hyeongil Nam, Jeongeun Lee, and Jong-Il Park) [1]
This study focuses on an interactive pixel-unit Augmented Reality (AR) lips makeup application. Leveraging augmented reality based on an RGB camera, the researchers implemented hand gestures interaction for precise lipstick application. The analysis at a pixel-unit level contributed to the accurate mapping of the users' lips. Notably, the application's scope was dedicated exclusively to lip makeup.

YouCam Makeup Tool (Mobile application)
This mobile application incorporates gesture controls for product and color selection, enabling users to navigate through various options such as previous and next colors. Users can visualize the makeup effect directly on their own faces. However, it lacks control over color density, representing a notable distinction from our project's objectives.

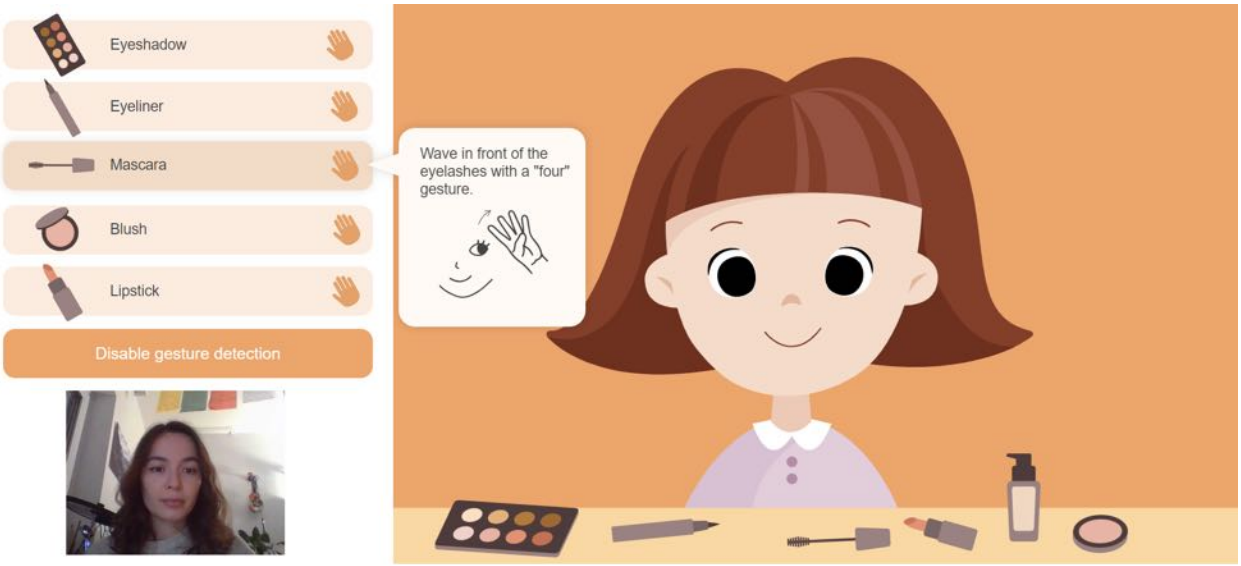
Concept

Our concept consists of three different scenarios: one-handed gesture interaction, two-handed interaction, and mouse interaction. Below we will review the gesture interaction as the main focus of the study.

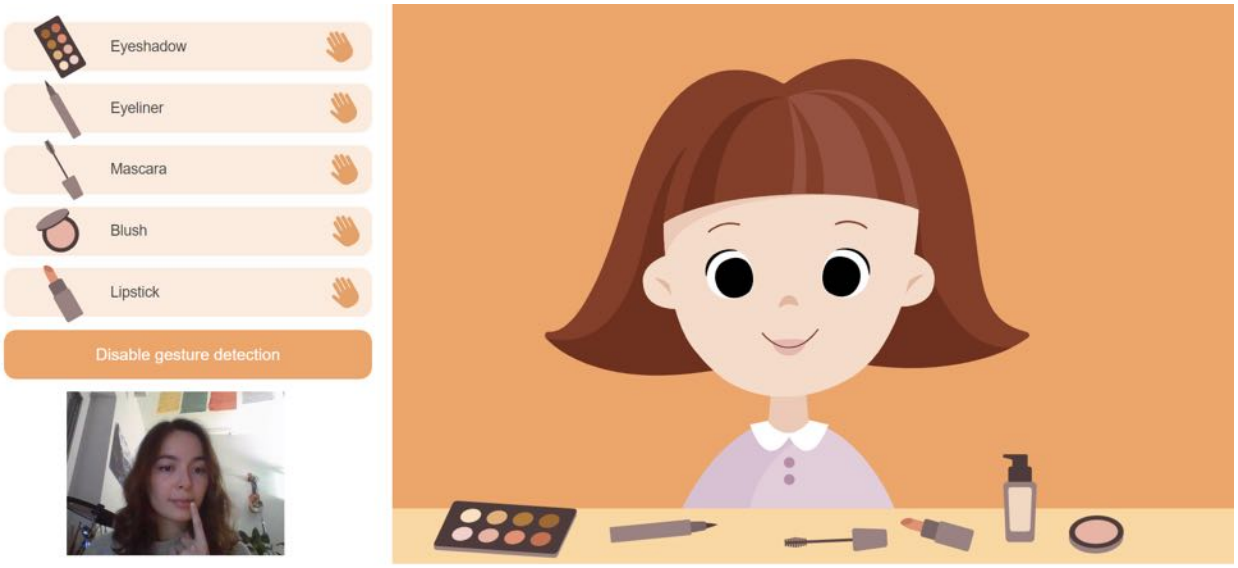
To begin, the user initiates the webcam by clicking on the start button.



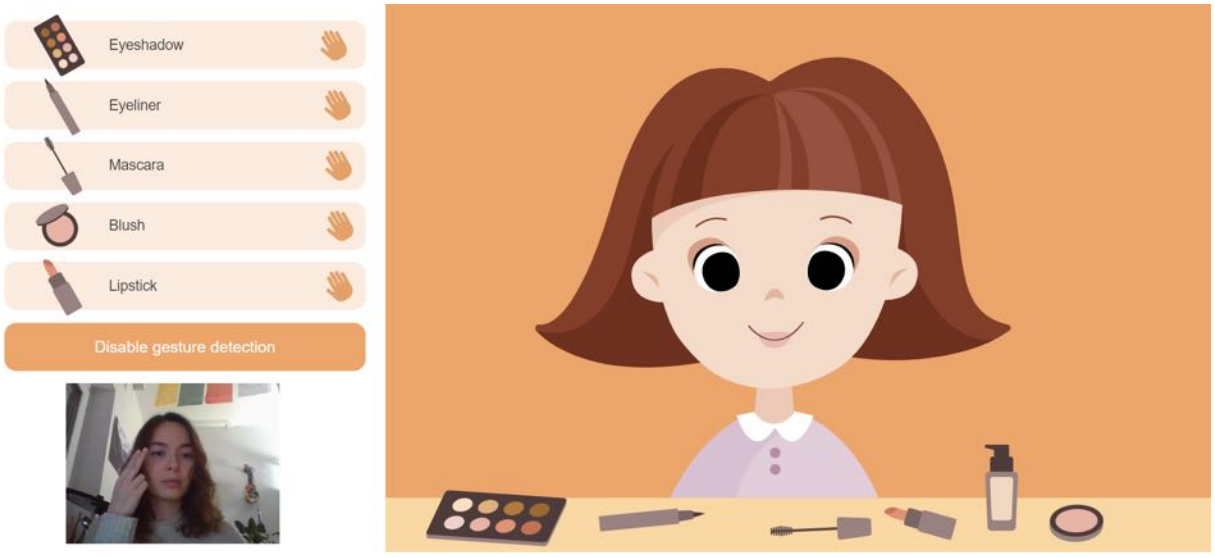
The user familiarizes themselves with the gesture instructions for various products such as eyeshadow, eyeliner, mascara, blush, and lipstick.



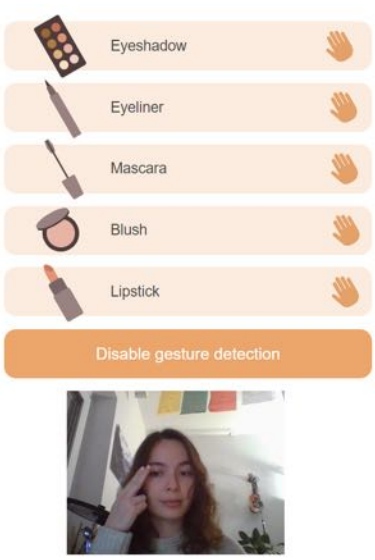
The user performs the gestures.

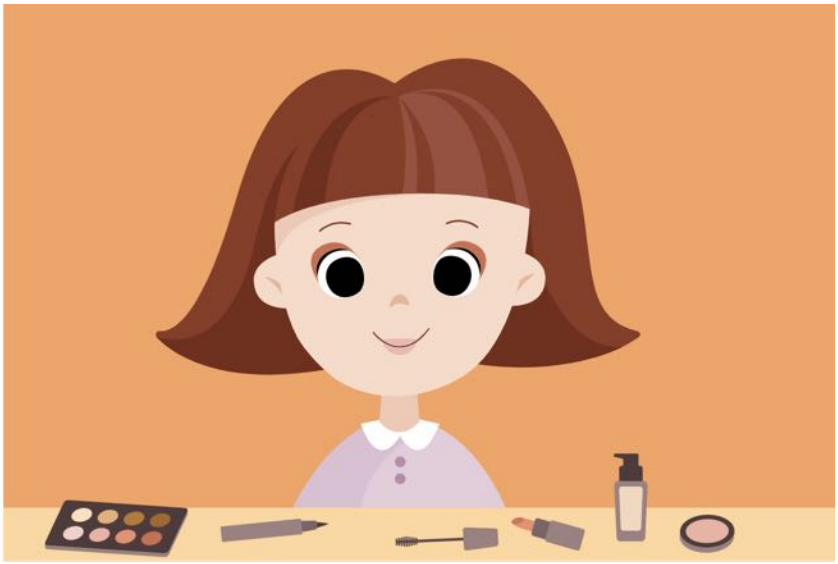


A shorter duration of the gesture application results in a lighter color.



While a prolonged gesture duration leads to a brighter and denser color outcome.

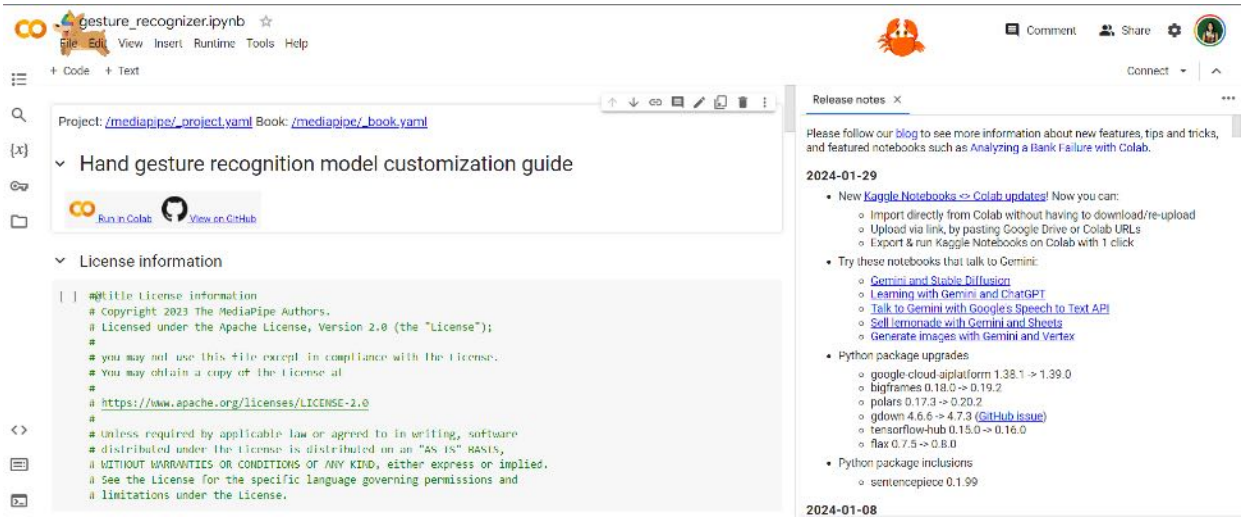




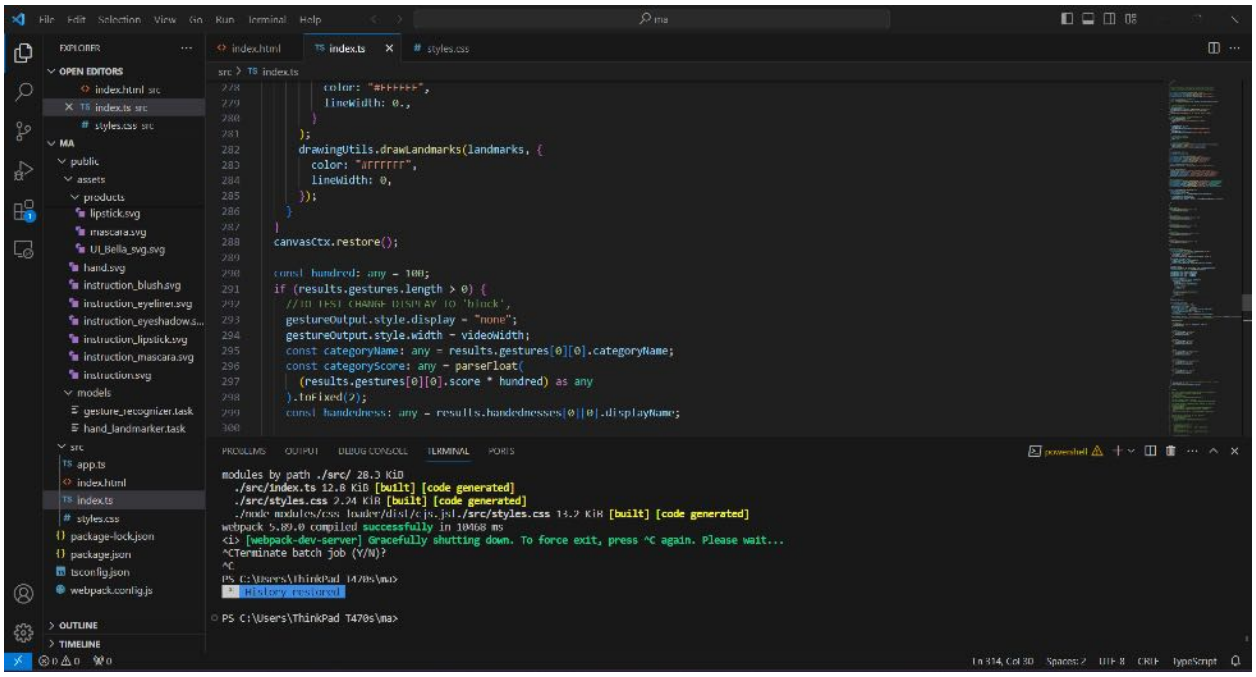
All hand gestures and related products.

Implementation

In our technical implementation, the foundation of hand gesture recognition is built upon Google MediaPipe's hand landmarks task. This base component is complemented by the integration of an open-source HAnd Gesture Recognition Image Dataset (HaGRID) dataset [2]. Using Google Colab and Python-3, we trained a machine-learning model with tailored hand gestures with an accuracy of 90%.



The user interface and interactive functionalities of our application are developed using a combination of HTML5, CSS3, and TypeScript in Visual Studio Code software.



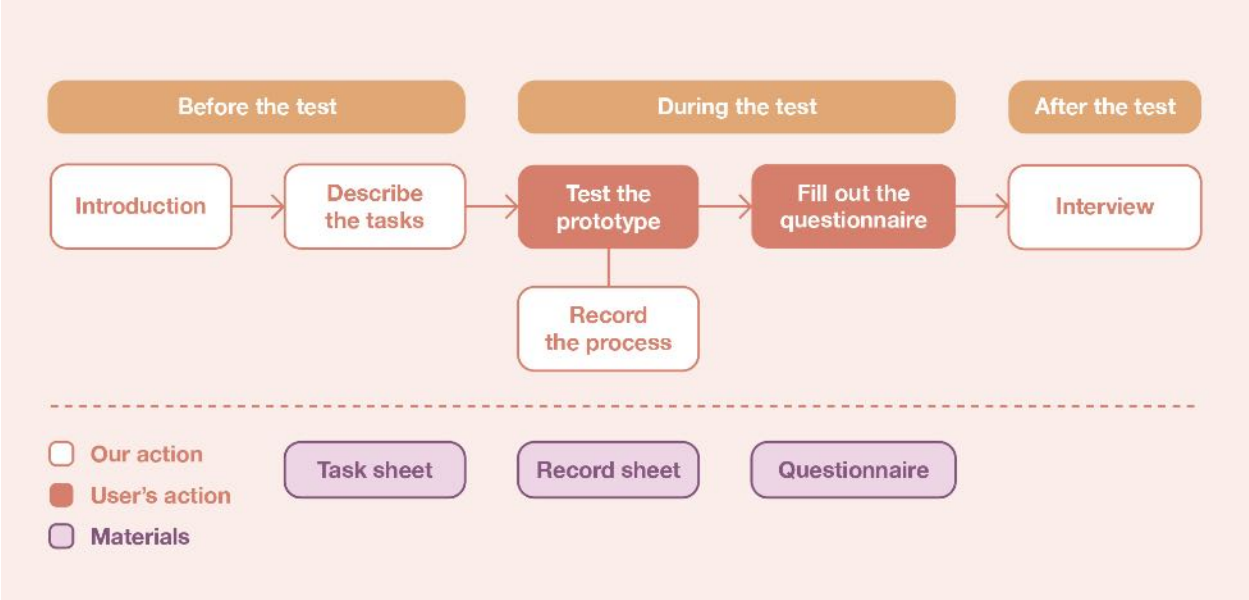
Evaluation

1. Participants

To assess the formulated gesture interaction method and product usability, we conducted a User Test with 11 participants, including five males and six females. Among them, five had no prior experience with gesture interaction, and six had no experience with makeup. Their professions varied, including students, lawyers, software engineers, and doctors.

2. Procedure

We started by introducing our project, explained the test content and procedure, and then assigned tasks to the participants. After completing the tasks, participants filled out questionnaires and underwent interviews based on their experiences. Throughout the testing process, we recorded efficiency (time taken), effectiveness (error count), and satisfaction (facial expression) on a recording sheet.



User test steps

User Test for the Interaction Engineering Project

As a makeup novice, you're looking to understand the basic usage and application effects of makeup products through this product.

Scenario 1

- Apply every makeup following the instructions when you hover the hand icon on each button.
- Try to make the color as denser as you can.

Task 1

Apply **eyeshadow, eyeliner, mascara, and blush** by using one- and two-handed gestures.

Task 2

Apply **lipstick** by using the following gestures.

Gesture A

Gesture B

Scenario 2

- Apply every makeup by clicking the buttons.
- Try to make the color as denser as you can.

Task sheet

Recording Sheet M / F Experienced / Inexperienced

Action	Applying eyeshadow		Applying eyeliner		Applying mascara	
	One-handed	Two-handed	One-handed	Two-handed	One-handed	Two-handed
Efficiency	Error num: ____	Error num: ____	Error num: ____	Error num: ____	Error num: ____	Error num: ____
Effective-ness	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted
Spending Time	____ seconds	____ seconds	____ seconds	____ seconds	____ seconds	____ seconds
Facial expression	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍
Note						

Action	Applying blush		Applying lipstick		Applying by clicking the buttons
	One-handed	Two-handed	Gesture A	Gesture B	
Efficiency	Error num: ____	Error num: ____	Error num: ____	Error num: ____	Error numbers: ____
Effective-ness	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted	☐ Completed ☐ Incompleted
Spending Time	____ seconds	____ seconds	____ seconds	____ seconds	User used ____ seconds
Facial expression	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍	😫 😕 😐 🙂 😍
Note					

Recording sheet

3. Questionnaire

The questionnaire, using Likert scales and direct comparison in a within-subject study, consisted of two parts with seven questions:

Part 1 - Gestures or clicking buttons
1. Rate your experience with applying makeup with gestures.
2. Rate your experience with applying makeup by clicking buttons.

Part 2 - Different gestures for the same product
3. Which do you prefer when applying eyeshadow, using one-handed or two-handed gestures?
4. Which do you prefer when applying eyeliner, using one-handed or two-handed gestures?
5. Which do you prefer when applying mascara, using one-handed or two-handed gestures?
6. Which do you prefer when applying blush, using one-handed or two-handed gestures?
7. Which do you prefer when applying lipstick, using gesture 1 or gesture 2?

4. Results

In part 1, most participants rated gesture interaction as "Interesting" and "Very Interesting," with an average score of 4.9 out of 5. In part 2, single-handed gestures received positive feedback due to their adaptability with most products, resembling real-world interactions with actual makeup items. Additionally, simulating product shapes using gestures was considered a simple and natural approach.

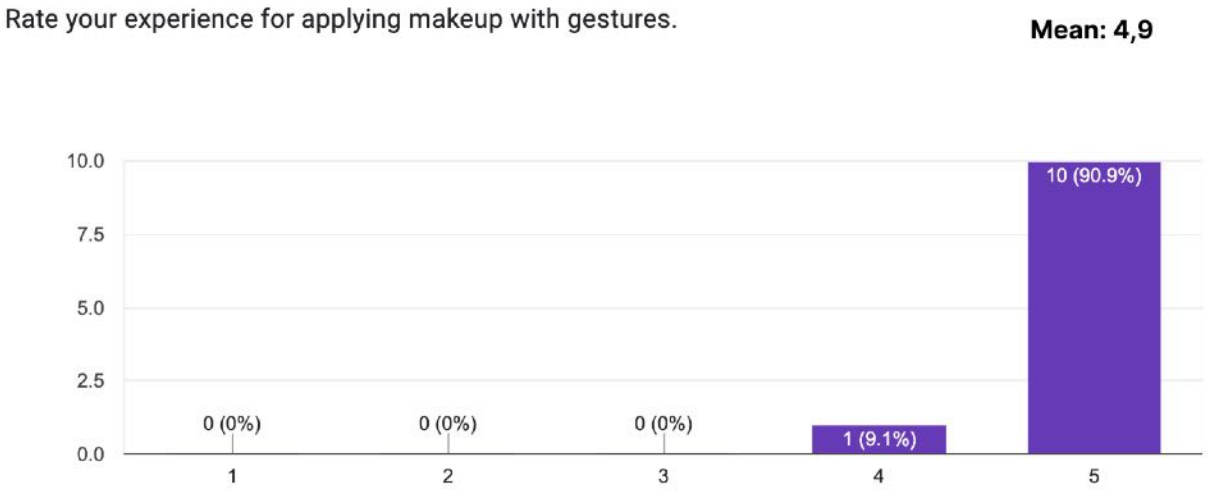


Figure: Rate your experience for applying makeup with gestures

Rate your experience for applying makeup with clicking buttons. **Mean: 2,7**

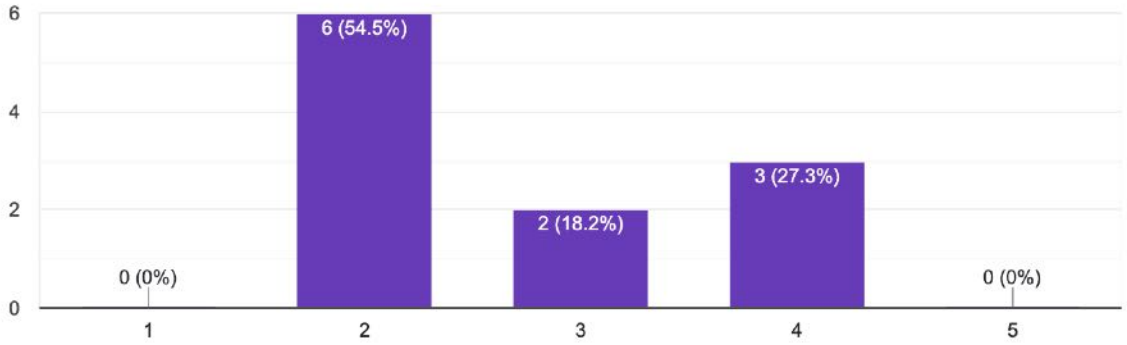


Figure: Rate your experience for applying makeup with clicking buttons

Which do you prefer when applying eyeshadow, using one-handed or two-handed gestures? **Mean: 2,6**

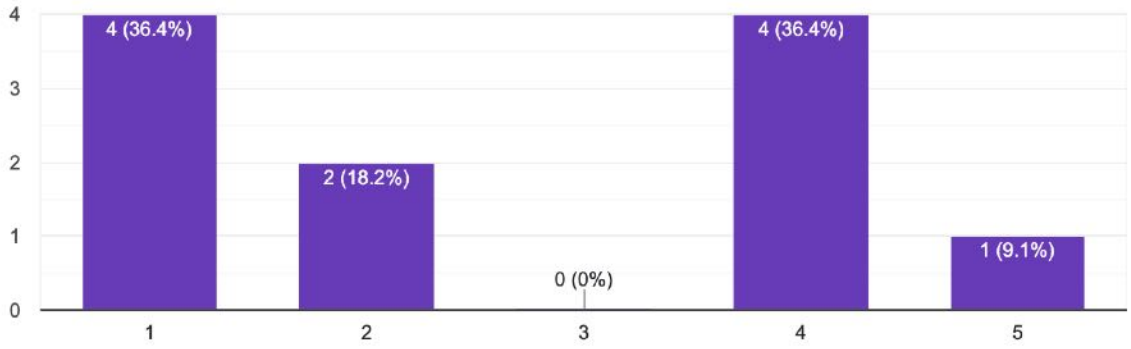


Figure: Which do you prefer when applying eyeshadow, using one-handed or two-handed gestures?

Which do you prefer when applying eyeliner, using one-handed or two-handed gestures?

Mean: 2,7

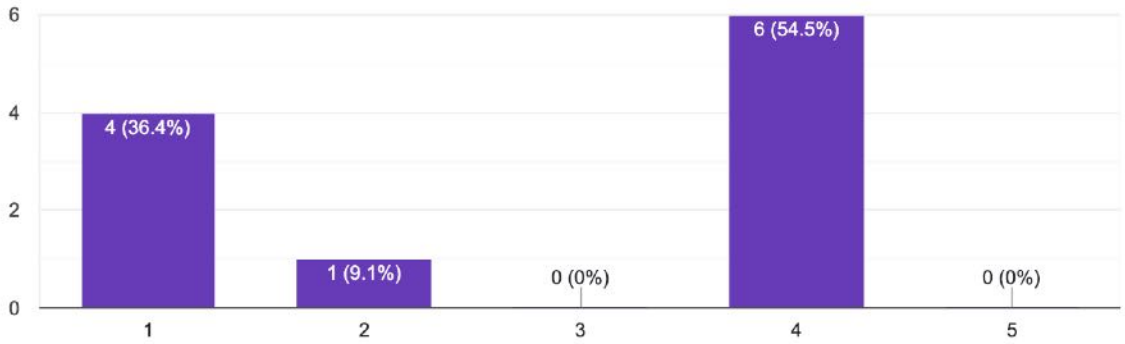


Figure: Which do you prefer when applying eyeliner, using one-handed or two-handed gestures?

Which do you prefer when applying mascara, using one-handed or two-handed gestures?

Mean: 2,2

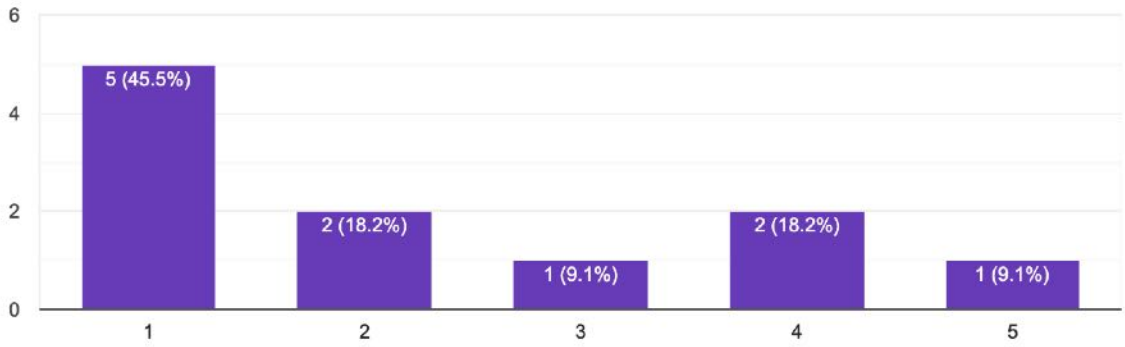


Figure: Which do you prefer when applying mascara, using one-handed or two-handed gestures?

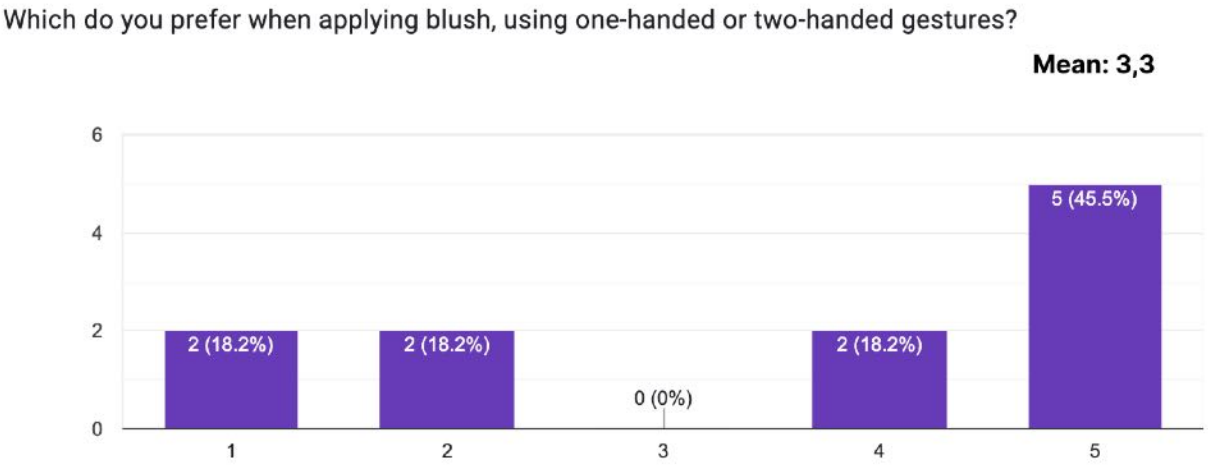


Figure: Which do you prefer when applying blush, using one-handed or two-handed gestures?

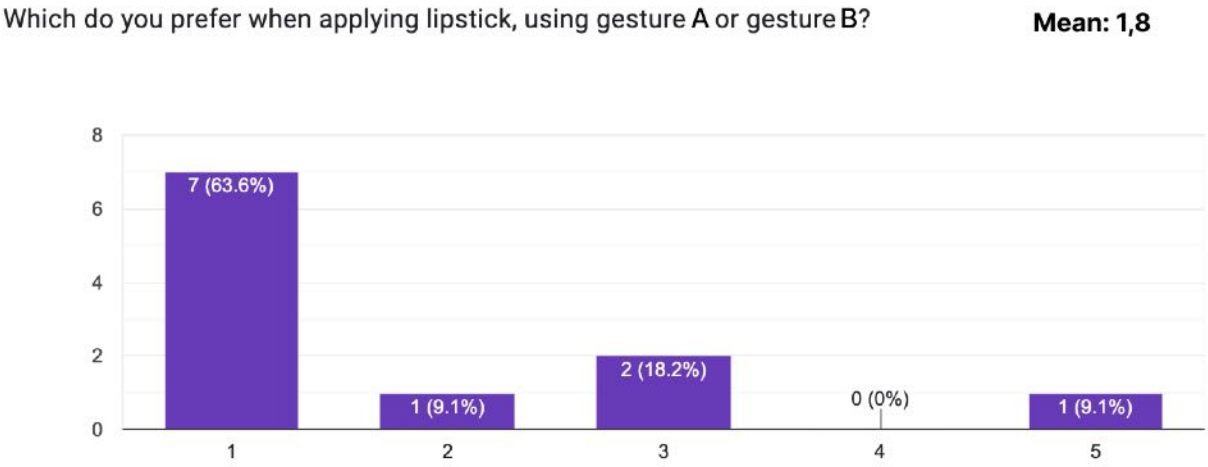


Figure: Which do you prefer when applying lipstick, using gesture A or gesture B?

Conclusion

In conclusion, our findings from user testing indicate a prevalent preference for single-handed gestures for the application of smaller cosmetic products, such as Mascara, Eyeliner, Lipstick, and Eyeshadow. Conversely, two-handed gestures gain prominence when users engage with larger facial regions, including the application of Blush, Foundation, or Powder.

As future improvements, we could incorporate facial recognition technology to restrict the activation of gestures solely on specific facial zones where users perform the gesture (e.g. applying blush to the cheek region or mascara to the eye area). Furthermore, enabling unilateral makeup application based on hand position may contribute to improved usability and visual clarity within our makeup application tool.

Overall, Makeup Artist offers new gesture interaction in the makeup field and is considered a success overall in terms of virtual makeup experience. With additional features, the project has the potential to offer diverse virtual makeup choices and novel try-on experiences.

References

[1] Hyeongil Nam, Jeongeun Lee, and Jong-Il Park, “Interactive Pixel-unit AR Lip Makeup System Using RGB Camera,” 2020.
Retrieved from http://www.kibme.org/resources/journal/20210112165849942.pdf

[2] Kapitanov Alexander, Kvanchiani Karina, Nagaev Alexander, “HaGRID – HAnd Gesture Recognition Image Dataset,” 2022.
Retrieved from https://arxiv.org/html/2206.08219v2