Robotic Cosmetic Application Device with Machine Learning and User Preference Integration

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Abstract

A robotic cosmetic application device, and techniques for controlling the device, are provided. The device may include sensors that capture real-time data associated with a user's face and robotic arms equipped with makeup applicator tools. The device may receive an indication of a makeup look selected by the user; analyze the real-time data associated with the user's face in order to generate a three-dimensional map associated with the face of the user, identify facial features of the user's face on the three-dimensional map; and control the robotic arms to automatically adjust the makeup applicator tools with respect to the user's face, to apply one or more cosmetic products to the user's facial features in order to achieve the makeup look selected by the user.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of cosmetics and, more specifically, to a robotic cosmetic application device capable of precise and controlled movements for applying makeup, utilizing machine learning, artificial intelligence, augmented reality, and other technologies.

BACKGROUND

[0002] The background description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly nor impliedly admitted as prior art against the present disclosure.

[0003] While there are devices that allow for the application of makeup, these makeup applicators are typically manually operated and do not provide precision, customization, and versatility beyond the user's baseline makeup knowledge and skills. Moreover, these makeup applicators may be difficult to use for users with certain disabilities.

SUMMARY

[0004] In one aspect, a robotic cosmetic application device is provided, comprising: one or more sensors configured to capture real-time data associated with a face of a user; one or more robotic arms equipped with one or more respective makeup applicator tools; a controller, comprising: one or more processors; and one or more memories storing non-transitory computer-readable instructions that, when executed by the one or more processors, cause the one or more processors to: receive, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyze the real-time data associated with the face of the user in order to generate a three-dimensional map associated with the face of the user; identify one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and control the one or more robotic arms to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user. The robotic cosmetic application device may include additional, fewer, or alternate elements, including those discussed elsewhere herein.

[0005] In another aspect, a computer-implemented method for controlling a robotic cosmetic application device via one or more processors is provided. The method may include receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user; identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user. The method may include additional, fewer, or alternate actions, including those discussed elsewhere herein.

[0006] In still another aspect, a non-transitory computer-readable storage medium storing instructions for controlling a robotic cosmetic application device is provided. The computer-readable instructions, when executed by one or more processors, may cause the one or more processors to perform a method. The method may include receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user;

identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user. The instructions may direct additional, fewer, or alternative functionality, including that discussed elsewhere herein.

[0007] Advantages will become more apparent to those of ordinary skill in the art from the following description of the preferred embodiments which have been shown and described by way of illustration. As will be realized, the present embodiments may be capable of other and different embodiments, and their details are capable of modification in various respects. Accordingly, the drawings and description are to be regarded as illustrative in nature and not as restrictive.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The figures described below depict various aspects of the system and methods disclosed herein. It should be understood that each figure depicts an embodiment of a particular aspect of the disclosed system and methods, and that each of the figures is intended to accord with a possible embodiment thereof.

[0009] There are shown in the drawings arrangements which are presently discussed, it being understood, however, that the present embodiments are not limited to the precise arrangements and instrumentalities shown, wherein:

[0010] FIG. **1**A-**1**G depict actions of an exemplary robotic cosmetic application device as the robotic cosmetic application device applies a cosmetic product to an individual, according to some embodiments;

[0011] FIG. **2** depicts an exemplary computer system associated with a robotic cosmetic application device, according to some embodiments;

[0012] FIGS. **3**A-**3**C depict examples of displays as may be provided by a user interface associated with a robotic cosmetic application device, according to some embodiments; and

[0013] FIG. **4** depicts a flow diagram of an exemplary computer-implemented method for controlling a robotic cosmetic application device, according to some embodiments.

[0014] While the systems and methods disclosed herein are susceptible of being embodied in many different forms, it is shown in the drawings and will be described herein in detail specific exemplary embodiments thereof, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the systems and methods disclosed herein and is not intended to limit the systems and methods disclosed herein to the specific embodiments illustrated. In this respect, before explaining at least one embodiment consistent with the present systems and methods disclosed herein in detail, it is to be understood that the systems and methods disclosed herein is not limited in its application to the details of construction and to the arrangements of components set forth above and below, illustrated in the drawings, or as described in the examples.

[0015] Methods and apparatuses consistent with the systems and methods disclosed herein are capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract included below, are for the purposes of description and should not be regarded as limiting.

DETAILED DESCRIPTION

Overview

[0016] The present disclosure provides a robotic cosmetic application device (also referred to as an

"intelligent robotic cosmetic application device" or a "smart robotic cosmetic application device" herein) that utilizes smart technologies to deliver a personalized and precise makeup application experience. The robotic cosmetic application device uses an auto-adjusting system, machine learning (ML), artificial intelligence (AI), augmented reality (AR), and other technologies to accurately apply makeup according to the user's preferences, including re-creating looks selected by the user. The robotic cosmetic application device also offers integration with smart devices and smart packaging, which allows the robotic cosmetic application device to create a wide variety of makeup looks and styles. As provided herein, the smart auto-adjusting makeup applicator device streamlines the cosmetic application process, providing users with a personalized, efficient, and precise makeup experience.

[0017] The robotic cosmetic application device provided herein embodies a unique blend of technology and usability to enhance the user's makeup application experience. Advantageously, the robotic cosmetic application device provided herein incorporates features such as auto-adjustment based on facial contours, hyper-personalization considering factors like skin type and weather conditions, compatibility with smart devices and smart packaging, and the ability to save, recreate, and subscribe to different looks, in various embodiments. The integration of AR for detailed facial mapping and makeup preview further distinguishes this device, providing users an immersive and interactive makeup experience. Beneficially, the robotic cosmetic application device may continue to learn and adapt based on user preferences, software updates, and updated makeup looks to capture the latest trends.

[0018] The robotic cosmetic application device utilizes sensors to detect the contours and features of the user's face, auto-adjusting the arms' and/or the applicators' angle, pressure, and movement to ensure a precise and controlled application. The robotic cosmetic application device uses machine learning algorithms and artificial intelligence to learn the user's facial features, skin type, and personal preferences over time. It adjusts its operation accordingly to improve the makeup application process, ensuring optimal results each time. Using AR technology, the robotic cosmetic application device creates a detailed 3D map of the user's face. The robotic cosmetic application device uses this map to accurately apply makeup to the desired areas. The AR interface also allows the user to preview different looks before application. The robotic cosmetic application device can be paired with smartphones, tablets, or computers. The user can then select or design makeup looks on the paired device, which the applicator device will then replicate. The robotic cosmetic application device is compatible with smart packaging, which contains information about the makeup (such as color, texture, and type). When the robotic cosmetic application device comes into the vicinity with the smart packaging, it reads this information and adjusts its application method accordingly. The robotic cosmetic application device can save looks the user has created or applied in the past. The user can also subscribe to looks created by others, allowing the user to experiment with and apply a wide variety of makeup styles. The robotic cosmetic application device takes into account factors such as the user's skin type, preferred style, and even the current weather conditions to adjust its application method, ensuring a personalized makeup experience.

[0019] The robotic cosmetic application device provides users with a personalized, efficient, and precise makeup experience, eliminating the need for manual application and reducing the likelihood of uneven or inaccurate cosmetic application. The robotic cosmetic application device has the potential to revolutionize the makeup application process by providing users with a personalized, efficient, and precise makeup experience. The robotic cosmetic application device's innovative use of AI, ML, and computer vision technologies enables it to adapt to each user's unique facial features and preferences, ensuring flawless cosmetic application and reducing the likelihood of uneven or inaccurate makeup application. With the addition of the features mentioned above, the robotic cosmetic application device can provide even greater convenience and functionality for users, making it a valuable addition to any makeup routine.

[0020] By incorporating these advanced features and enhancements, the robotic cosmetic

application device can further revolutionize the makeup application process and expand its applications. The robotic cosmetic application device can become an indispensable tool for users looking for a personalized, efficient, and precise makeup experience, making it an attractive option for both personal and professional use.

[0021] Overall, the robotic cosmetic application device represents a significant advancement in the field of cosmetic application devices. By leveraging AI, ML, and computer vision technologies, the robotic cosmetic application device provides users with a personalized, efficient, and precise makeup experience that adapts to each user's unique facial features and preferences. The robotic cosmetic application device streamlines the makeup application process, ensuring flawless results with minimal effort. The integration of additional features such as VR and AR technologies, environment and lighting adaptation, subscription-based makeup refills, adaptive makeup tutorials, biometric authentication, multi-user support, and skin health monitoring further enhances the user experience and expands the robotic cosmetic application device's applications. The robotic cosmetic application device has the potential to revolutionize the makeup application process for users across different skill levels, from beginners to professional makeup artists. By making it easier to achieve perfect cosmetic application, the robotic cosmetic application device can not only save users time and effort but also boost their confidence and self-esteem. As the robotic cosmetic application device continues to evolve and incorporate advanced features, it has the potential to become an indispensable tool in the world of cosmetics, revolutionizing the way people apply makeup and care for their skin.

Example Robotic Cosmetic Application Device

[0022] FIG. **1**A-**1**G depict actions of an exemplary robotic cosmetic application device **100** as the robotic cosmetic application device **100** applies a cosmetic product to an individual, according to some embodiments. As shown in FIG. **1**A, the robotic cosmetic application device **100** includes a housing **102** and one or more arms **104**. The one or more arms **104** may be attached to the housing and may each be configured to move with one or more degrees of freedom. As discussed in greater detail below with respect to FIG. **2**, the robotic cosmetic application device **100** may include sensors configured to capture data associated with a user's face, as well as motors and/or actuators that may be automatically controlled to move and/or adjust the arms **104** and/or applicator tools **106** in real-time to select various cosmetic products and apply them to the user's face. For instance, the motors and/or actuators may be automatically controlled to move and/or adjust the arms **104** and/or applicator tools **106** in real-time as the robotic cosmetic application device **100** applies a cosmetic product to the user's face, e.g., in order to adjust an angle, a pressure, a movement, a spin, etc., of the arms **104** and/or applicator tools **106**, in order to apply a cosmetic product to the face of the user. For example, the motors and/or actuators may be automatically controlled to move and/or adjust the arms **104** and/or applicator tools **106** laterally, vertically, and/or at various angles and pressures, and may be adjusted to spin at various speeds, as the robotic cosmetic application device **100** moves the arms **104** and/or applicator tools **106** to the user's face, in order to apply a cosmetic product to the face of the user.

[0023] For instance, as shown in FIG. **1**B and **1**C, the robotic cosmetic application device **100** may utilize an arm **104** to pick up, grab, or otherwise attach an applicator tool **106** (in this case, a lip product applicator tool). In other examples, the robotic cosmetic application device **100** may include one or more applicator tools **106** permanently or interchangeably attached to one or more arms **104**. That is, for example, the housing **102** may be configured such that one or more applicator tools **106** may be attached to the housing **102**, and may be subsequently removed from the housing **102** by a user (or by the robotic cosmetic application device **100**) and replaced with another of the one or more applicator tools **106**.

[0024] As shown in FIG. **1**D, the robotic cosmetic application device **100** may utilize an arm **104** to dip an applicator tool **106** into a dispenser or container containing a particular cosmetic product (in this case, a lip product such as a lipstick, lip gloss, lip balm, etc.), and dab off excess cosmetic

product from the applicator tool **106** as needed. As shown in FIG. **1**E, the robotic cosmetic application device **100** may utilize an arm **104** to move the applicator tool **106** to the user's face in order to apply the cosmetic product to a particular area of the user's face (in this case, the user's lips).

[0025] In a similar manner as shown with respect to FIGS. **1**B-**1**D for the lip product applicator tool **106**, the robotic cosmetic application device **100** may utilize the same arm **104**, or other arms **104** to pick up, grab, or otherwise attach other types of applicator tools **106**, and apply respective cosmetic products to the other types of applicator tools **106** (and dab off excess product if needed). For instance, an applicator tool **106** may include a brush for applying blush or other powder or cream based cosmetic products. As another example, an applicator tool **106** may include a wand or spoolie brush for applying mascara, eyebrow tint, eyebrow gel, or other cosmetic products. As still another example, an applicator tool **106** may include a lipstick tube, crayon, or pencil for applying lipstick, lip gloss, lip tint, eyeshadow, eyeliner, or other cosmetic products. In various embodiments, the applicator tools **106** may include a sponge applicator tool, a puff applicator tool, a pencil applicator tool, a felt tip applicator tool, a marker applicator tool, a crayon applicator tool, a lip stick applicator tool, a lip gloss applicator tool, a roller applicator tool, etc., or any other suitable applicator tool for applying a cosmetic product.

[0026] For example, as shown in FIG. **1**F, the robotic cosmetic application device **100** may utilize an arm **104** to move an eyeshadow applicator tool **106** to the user's face in order to apply an eyeshadow product to the user's eyelids. As another example, as shown in FIG. **1**G, the robotic cosmetic application device **100** may utilize an arm **104** to move an eyeliner applicator tool **106** to the user's face in order to apply an eyeliner product to the user's eyelids. In other examples, the robotic cosmetic application device **100** may utilize an arm **104** to move various applicator tools **106** to the user's face in order to apply respective cosmetic products to the various areas of the user's face.

[0027] In some examples, the robotic cosmetic application device **100** may be a standalone device, such as a portable device, or a device integrated with a desk or vanity. Moreover, in some examples, the housing **102** of the robotic cosmetic application device **100** may be permanently or removably integrated with a prosthetic body part, such as a prosthetic arm, prosthetic hand, etc. of a user.

Example System

[0028] FIG. **2** depicts an exemplary computer system **200** for controlling a robotic cosmetic application device **100**, according to one embodiment. The high-level architecture illustrated in FIG. **2** may include both hardware and software applications, as well as various data communications channels for communicating data between the various hardware and software components, as is described below.

[0029] The system **200** may include a robotic cosmetic application device **100** as well as, in some cases, one or more user computing devices **202** (which may include, e.g., smart phones, smart watches or fitness tracker devices, tablets, laptops, virtual reality toolsets, smart or augmented reality glasses, wearables, heads up display (HUD) devices, or any suitable mobile devices, etc.), and/or one or more server(s) **204**. The robotic cosmetic application device **100**, user device(s) **202**, and/or server(s) **204** may be configured to communicate with one another via a wired or wireless computer network **206**, and/or via short range signals, such as BLUETOOTH signals.

[0030] Although one robotic cosmetic application device **100**, one user device **202**, one server **204**, and one network **206** are shown in FIG. **2**, any number of such robotic cosmetic application devices **100**, user devices **202**, servers **204**, and networks **206** may be included in various embodiments. To facilitate such communications, the robotic cosmetic application device **100**, user devices **202**, and/or servers **204** may each respectively comprise a wireless transceiver to receive and transmit wireless communications.

[0031] The robotic cosmetic application device **100** may include one or more sensors **208**, one or

more actuators **210**, one or more motors **212**, one or more components **214**, and/or one or more light sources **216** configured to provide light to the face of the user. Additionally, the robotic cosmetic application device **100** may include a controller **218**, including one or more processor(s) **220**, as well as one or more computer memories **222**.

[0032] Generally speaking, the sensors **208** may be configured to capture real-time data associated with the face of a user as the robotic cosmetic application device **100** applies a cosmetic product. The sensors **208** may include, for instance, a camera and/or a depth sensor configured to capture data associated with the user's face, distances from various features of the user's face to the robotic cosmetic application device **100**, data associated with various cosmetic products to be applied to the user's face and/or their packaging, etc. Moreover, the sensors **208** may include sensors (e.g., the camera and/or the depth sensor, or additional or alternative sensors) configured to capture biometric data associated with the user, such as facial recognition data, fingerprint recognition data, iris recognition data, etc.

[0033] The one or more actuators **210** may be configured to, in conjunction with the one or more motors **212**, automatically move and/or adjust the one or more components **214**, such as the arms and/or the (in some cases, interchangeable) applicator tools **106** discussed with respect to FIG. **1**A-**1**G, based on commands/instructions provided by the controller **218**. That is, the one or more actuators **210** and/or the one or more motors **212** may automatically move and/or adjust the or more components **214** in real-time as the robotic cosmetic application device **100** applies a cosmetic product to the user's face. For instance, the one or more actuators **210** and/or the one or more motors **212** may automatically spin and/or twist the or more components **214**, and/or may move the one or more components **214** laterally, vertically, or in other directions with respect to the user's face to apply the cosmetic product in a particular pattern or shape, and/or to increase or decrease pressure as the cosmetic product is applied.

[0034] As discussed above, the one or more components **214** may include the applicator tools **106**.

[0035] Furthermore, the one or more components **214** may include, for instance, a user interface component configured to receive inputs and selections from the user of the robotic cosmetic application device **100**, and/or to provide audible or visual feedback to the user of the robotic cosmetic application device **100**.

[0036] For instance, the user interface component **214** may provide interactive displays via which users may select a desired makeup look to be applied via the robotic cosmetic application device **100**. The user may select a pre-existing look associated with pre-existing specifications for the robotic cosmetic application device **100** to follow when applying the look, or may customize specifications for the robotic cosmetic application device **100** to follow when applying the look. Additionally, the user may provide an image or a social media link which may be analyzed to determine the specifications for the robotic cosmetic application device **100** to follow when applying the look. For instance, these specifications may include types of makeup applied to each area of the face, heaviness of makeup applied to each area of the face, particular patterns, shapes, or borders of makeup applied to each area of the face, layers of makeup applied to each area of the face, etc. Examples of such displays are shown at FIGS. **3**A-**3**C below. In some examples, the user interface component may further include an augmented reality (AR) component configured to generate and display an AR rendering of three-dimensional map of the user's face, and/or a selected makeup look as applied to the user's face. For example, in some cases, the AR rendering may be overlaid upon an image or video of the user's face as captured in real-time by the sensors **208** or **232**, to illustrate the appearance of the selected makeup look as applied to the user's face.

[0037] Moreover, in some examples, the user interface component **214** may be configured to receive feedback from a user associated with a selected makeup look after the selected makeup look is applied via the robotic cosmetic application device **100**. Furthermore, the user interface component **214** may provide additional alerts, notifications, communications, etc., as discussed elsewhere herein.

[0038] Additionally, the one or more components **214** may include, for instance, one or more dispensers for cosmetic products, configured to dispense various cosmetic products, based on commands/instructions provided by the controller **218**. For example, the dispensers may dispense particular cosmetic products to particular applicator tools associated with such products (e.g. a mascara dispenser may dispense mascara to a mascara brush applicator tool, a blush dispenser may dispense blush powder to a brush applicator tool, etc.). Furthermore, the one or more components **214** may include, for example, one or more temperature control components configured to maintain temperature associated with the various cosmetic products stored in the various dispensers.

[0039] Moreover, the one or more components **214** may include, for instance, one or more cleaning components configured to clean and/or disinfect other of the components **214** (such as, e.g., the arms **104**, the (in some cases, interchangeable) applicator tools **106**, the dispensers, the user interface, etc.), and/or the housing **102**, of the robotic cosmetic application device **100**, based on commands/instructions provided by the controller **218**.

[0040] The memories **222** may include one or more forms of volatile and/or non-volatile, fixed and/or removable memory, such as read-only memory (ROM), electronic programmable read-only memory (EPROM), random access memory (RAM), erasable electronic programmable read-only memory (EEPROM), and/or other hard drives, flash memory, MicroSD cards, and others. Memorie(s) **222** may store an operating system (OS) (e.g., iOS, Microsoft Windows, Linux, UNIX, etc.) capable of facilitating the functionalities, apps, methods, or other software as discussed herein.

[0041] Generally speaking, the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the processors **220** to receive an indication of a makeup look selected by a user (e.g., from a user interface component **214** of the robotic cosmetic application device **100**, or from a user interface **230** of an associated user device **202**), and instructions that, when executed by the controller **218**, cause the robotic cosmetic application device **100** to apply a cosmetic product based on the selected makeup look.

[0042] For instance, the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the processor(s) **220** to detect whether a particular applicator tool **106** is attached to the housing **102** (and, in some cases, to provide a prompt via a user interface component of the robotic cosmetic application device **100**, or via the user interface **230** of the user device **202**, for the user to attach a particular applicator tool **106** associated with the selected makeup look).

[0043] Furthermore, the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the processor(s) **220** to analyze images associated with cosmetic products to identify particular cosmetic products or characteristics thereof. For instance, the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the processor(s) **220** to capture image data (e.g., via the sensors **208** and/or sensors **232**) associated with packaging of various cosmetic products (i.e., cosmetic products to be added to integrated dispensers of the robotic cosmetic application device **100**, and/or cosmetic products stored separately from the robotic cosmetic application device **100**), and analyze the image data associated with the packaging of the various cosmetic products to identify respective cosmetic products based on their packaging. For instance, in some examples, this analysis may include using object recognition techniques to identify a likely type of cosmetic product and/or likely properties associated with the cosmetic product based on the image. Moreover, in some examples, this analysis may include analyzing an image of the cosmetic product packaging using optical character recognition techniques to identify one or more letters, numbers, words, codes, etc., on the cosmetic product packaging, and accessing a database associated with cosmetic products to match any identified letters, numbers, words, codes, etc., on the cosmetic product packaging with particular cosmetic products and/or particular properties associated therewith. As another example, this analysis may include analyzing an image of the cosmetic product packaging to identify and/or decode a barcode, QR code, etc. For instance, the payload of the barcode, QR code, etc., may include an identification or indication of the

cosmetic product and/or properties associated therewith.

[0044] The memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the processor(s) **220** to identify an available cosmetic product that is appropriate for a particular element of the selected look and/or the current applicator tool component **214**, and the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the controller **218** to control one or more dispenser components **214** to dispense a particular cosmetic product to a particular attached applicator tool component **214**, and/or instructions that, when executed by the processor(s) **220**, cause the controller **218** to control one or more applicator tool components **214** to dip into the dispenser components **214**, or into separately packaged cosmetic containers or dispensers, such that an appropriate cosmetic product is applied to a particular attached applicator tool component **214**.

[0045] Furthermore, the memorie(s) **222** may store instructions that, when executed by the processor(s) **220**, cause the controller **218** to control the actuators **210** and/or motors **212** to automatically adjust an arm **104** and/or an applicator tool **106** of the robotic cosmetic application device **100** in real-time, to apply the cosmetic product to the user's face based on the selected makeup look.

[0046] In particular, the instructions stored on the memorie(s) **222** may cause the processors **220** to analyze real-time sensor data captured by the sensors **208** (and/or external sensors, such as sensors **232** of a user device **202**) in order to generate a three-dimensional map associated with the user's face and identify the locations of one or more facial features (e.g., eyes, eyelids, eyebrows, eyelashes, cheeks, cheekbones, nose, lips, chin, etc.) of the user's face on the three-dimensional map. The instructions stored on the memorie(s) **222** may cause the processors **220** to analyze real-time sensor data captured by the sensors **208** (and/or external sensors, such as sensors **232** of a user device **202**) in order to determine the location of the robotic cosmetic application device **100** (and/or one or more arms **104**, applicator tools **106**, etc., thereof) with respect to the facial features of the user's face, and may cause the controller **218** to control the actuators **210** and/or motors **212** to automatically adjust an arm **104** and/or applicator tool **106** of the robotic cosmetic application device **100** to apply a cosmetic product based on the selected makeup look, based on the determined location of the robotic cosmetic application device.

[0047] For instance, when a lipstick applicator tool of the robotic cosmetic application device **100** is close to or touching the lips of the user's face, the instructions stored on the memorie(s) **222** may cause the controller **218** to control the arm **104** and/or the lipstick applicator tool **106** to apply pressure in real-time as the robotic cosmetic application device **100** moves the applicator tool **106** across the user's lips, in order to apply lipstick in accordance with a selected makeup look that includes lipstick, in some cases including lipstick within the edges of the lips for some lipstick looks, or in some cases extending outside of the edges of the lips for an over-lined lipstick look. As another example, when a mascara wand applicator tool **106** of the robotic cosmetic application device **100** is close to or touching the eyelashes of the user's face, the instructions stored on the memorie(s) **222** may cause the controller **218** to control the arm **104** and/or the mascara wand applicator tool **106** to slowly spin or stroke in a vertical direction in real-time as the robotic cosmetic application device **100** moves the applicator tool **106** over the user's eyelashes, in order to apply mascara in accordance with a selected makeup look that includes mascara, in some cases including multiple coats of mascara for a selected makeup look including heavier mascara. As still another example, when an eyeliner applicator tool of the robotic cosmetic application device **100** is close to or touching the edge of the eyelid of the user's face, the instructions stored on the memorie(s) **222** may cause the controller **218** to control the arm and/or the eyeliner applicator tool to adjust the eyeliner applicator tool vertically or laterally in real-time as the robotic cosmetic application device **100** moves the applicator tool **106** over the user's eyelid, in order to apply eyeliner in accordance with a selected makeup look that includes eyeliner (e.g., in a straight line with a pointed tip extending from the eye for a winged or cat-eye look, in a smudged line near the

eyelid for a smoky-eye look, etc.).

[0048] The instructions stored on the memorie(s) **222** may cause a user interface component **214** to provide audible or visible feedback, guidance, or tutorials to the user in real-time as the robotic cosmetic application device **100** applies the makeup look, or may send such feedback, guidance, or tutorials to another device (such as the user device **202**) for display via the user interface of that device (e.g., the user interface **230**).

[0049] Moreover, the instructions stored on the memorie(s) **222** may cause the controller **218** to adjust the movement of the arm and/or applicator tool components **214** based on conditions associated with the user's skin as detected in real-time, e.g., based on data captured by the sensors **208** or sensors **232**. For instance, the instructions stored on the memorie(s) **222** may cause the processor(s) **220** to analyze image data captured by the sensors **208** or sensors **232** to detect blemishes of the user's skin, and may, for instance, cause the controller **218** to adjust the movement of the arm and/or applicator tool components **214**, such that additional cosmetic products or additional coats of cosmetic products, special cosmetic products specifically designed for blemishes, are applied to the affected area. Furthermore, in some examples, the instructions stored on the memorie(s) **222** may cause the processor(s) **220** to analyze image data captured by the sensors **208** or sensors **232** to detect skin health conditions, injuries, reactions, etc., of the user's skin, and may, in some cases, cause the controller **218** to adjust or cease the movement of the arm and/or applicator tool components **214** to avoid further irritating or injuring any detected skin health conditions, injuries, reactions etc. Furthermore, in some examples, the instructions stored on the memorie(s) **222** may cause the processor(s) **220** to generate an alert based on the detected skin health condition, injury, reaction, etc., and provide the alert, e.g., via a user interface component **214** and/or via the user interface **230**.

[0050] Furthermore, in some examples, the instructions stored on the memorie(s) **222** may cause the processor(s) **220** and/or the controller **218** to perform any or all of the steps of the method **400** discussed below with respect to FIG. **4**.

[0051] The user device **202** may include, or may be configured to communicate with, a user interface **230**, which may receive input from users and may provide audible or visible output to users in a similar manner as discussed above with respect to the user interface component **214** of the robotic cosmetic application device **100**. Furthermore, the user device **202** may include, or may be configured to communicate with, one or more respective sensors **232**, which may include similar sensors and/or sensor functionality as discussed above with respect to the sensors **208** of the robotic cosmetic application device **100**. Additionally, the user device **202** may include, or may be configured to communicate with one or more light sources **234** configured to provide light to the face of the user of the robotic cosmetic application device **100**.

[0052] Moreover, the user device **202** may include one or more processor(s) **236**, as well as one or more computer memories **238**. Memories **238** may include one or more forms of volatile and/or non-volatile, fixed and/or removable memory, such as read-only memory (ROM), electronic programmable read-only memory (EPROM), random access memory (RAM), erasable electronic programmable read-only memory (EEPROM), and/or other hard drives, flash memory, MicroSD cards, and others. Memorie(s) **238** may store an operating system (OS) (e.g., iOS, Microsoft Windows, Linux, UNIX, etc.) capable of facilitating the functionalities, apps, methods, or other software as discussed herein. The memorie(s) **238** may store instructions that, when executed by the processor(s) **236**, cause the processor(s) **236** to receive input from a user as provided via the user interface **230** (e.g., via interactive user interface display screens discussed below with respect to FIGS. **3**A-**3**C), and send the received user input to the robotic cosmetic application device **100** (e.g., via the network **206**), in some cases responsive to a request for such user input from the robotic cosmetic application device **100**. Furthermore, in some examples, the memorie(s) **238** may store instructions that, when executed by the processor(s) **236**, cause the processor(s) **236** to capture sensor data via one or more sensors **232**, in some cases responsive to a request for

particular sensor data from the robotic cosmetic application device **100**, and may send the captured sensor data to the robotic cosmetic application device **100**. Moreover, in some examples, the memorie(s) **238** may store instructions that, when executed by the processor(s) **236**, cause the processor(s) **236** to provide light to the face of the user via a light source **234**, in some cases responsive to a request from the robotic cosmetic application device **100** to provide light to the face of the user. In some examples, the request may include a request for a particular lighting parameters, such as a particular level/intensity of light, or a particular warmth or color of light, and the processor(s) **236** may in turn cause the light source **234** to provide the requested level/intensity, color, warmth, etc. of light to the face of the user.

[0053] Furthermore, in some examples, the instructions stored on the memorie(s) **238** may cause the processor(s) **236** to perform any or all of the steps of the method **400** discussed below with respect to FIG. **4**.

[0054] In some embodiments the server **204** may comprise one or more servers, which may comprise multiple, redundant, or replicated servers as part of a server farm. In still further aspects, such server(s) **204** may be implemented as cloud-based servers, such as a cloud-based computing platform. For example, such server(s) **204** may be any one or more cloud-based platform(s) such as MICROSOFT AZURE, AMAZON AWS, or the like. Such server(s) **204** may include one or more processor(s) **250** (e.g., CPUs) as well as one or more computer memories **252**.

[0055] The memories **252** may include one or more forms of volatile and/or non-volatile, fixed and/or removable memory, such as read-only memory (ROM), electronic programmable read-only memory (EPROM), random access memory (RAM), erasable electronic programmable read-only memory (EEPROM), and/or other hard drives, flash memory, MicroSD cards, and others. Memorie(s) **252** may store an operating system (OS) (e.g., Microsoft Windows, Linux, UNIX, etc.) capable of facilitating the functionalities, apps, methods, or other software as discussed herein. The memorie(s) **252** may store one or more machine learning models **258**, and/or one or more respective machine learning model training applications **260**. These machine learning models **258** may include, for instance, a machine learning model trained to analyze data associated with a user's face and/or a three-dimensional map associated with the user's face to identify facial features thereon, a machine learning model trained to analyze images associated with makeup looks to identify cosmetic products and/or techniques used to create the makeup looks, a machine learning model trained to analyze data associated with the user's skin to identify a skin type or a skin health condition associated with the user, a machine learning model trained to analyze data associated with previous makeup looks selected by a user to predict additional makeup looks for the user, etc.

[0056] Additionally, or alternatively, the memorie(s) **252** may store makeup look data, and/or user data. The makeup look data may include, for instance, specifications associated with various makeup looks, and may also be stored in a look database **254** (or in multiple such databases), which may be accessible or otherwise communicatively coupled to the server **204**. The user data may include previous makeup looks worn by the user, user preferences, and various other data associated with the user, and may also be stored in a user database **256** (or in multiple such databases), which may be accessible or otherwise communicatively coupled to the server **204**. Furthermore, in some examples, the makeup look data and the user data may be stored in the same database, which may be accessible or otherwise communicatively coupled to the server **204**.

[0057] Furthermore, the memorie(s) **252** may store instructions that, when executed by the processors **250**, cause the processors **250** to receive data from various databases such as the databases **254** and **256**, and/or data from the robotic cosmetic application device **100** and/or the user device **202** (e.g., via the network **206**). The data from the robotic cosmetic application device **100** and/or the user device **202** may include, for instance, data captured by the sensors **208** of the robotic cosmetic application device **100** and/or data captured by the sensors **232** of the user device **202**, data input by a user via a user interface component **214** of the robotic cosmetic application device and/or data input by a user via the user interface **230** of the user device **202**, etc. The

instructions stored on the memorie(s) **252**, when executed by the processors **250**, may cause the processors **250** to analyze data received from the database, and/or the robotic cosmetic application device **100** and/or the user device **202** in order to make an identification or a prediction based on the received data, and subsequently send the identification and/or prediction to the robotic cosmetic application device **100** and/or the user device **202**. For instance, this analysis and identification and/or prediction may be based upon applying a trained machine learning model **258** to the data received from the databases and/or the robotic cosmetic application device **100** and/or the user device **202**.

[0058] In some examples, one or more machine learning model(s) **258** may be executed on the server **204**, while in other examples one or more machine learning model(s) **258** may be executed on another computing system, separate from the server **204**. For instance, the server **204** may send data to another computing system, where a trained machine learning model **258** is applied to the data, and the other computing system may send a prediction or identification, based upon applying the trained machine learning model **258** to the data, to the server **204**. Moreover, in some examples, one or more machine learning model **258** (s) may be trained by respective machine learning model training application(s) **260** executing on the server **204**, while in other examples, one or more machine learning model(s) **258** may be trained by respective machine learning model training application(s) executing on another computing system, separate from the server **204**.

[0059] Whether the machine learning model(s) **258** are trained on the server **204** or elsewhere, the machine learning model(s) **258** may be trained by respective machine learning model training application(s) **260** using training data (including historical data in some cases), and the trained machine learning model(s) **258** may then be applied to new/current data that is separate from the training data in order to determine, e.g., predictions and/or identifications related to the new/current data.

[0060] For example, a machine learning model **258** trained to analyze data associated with a user's face and/or a three-dimensional map associated with the user's face to identify facial features thereon may be trained by a machine learning model training application **260** using training data including images of various faces and/or three-dimensional maps associated with the various faces, and indications of locations of facial features in the images and/or three-dimensional maps. For instance, each image and/or three-dimensional map may be labeled to indicate locations of facial features such as the eyes, eyelids, eyebrows, eyelashes, cheeks, cheekbones, nose, lips, chin, etc. on the face, and these labeled images and/or three-dimensional maps may be used as training data. Once sufficiently trained using this training data, such a machine learning model **258** may be applied to a new image, video, and/or three-dimensional map associated with a user's face (e.g., an image or video captured by the sensors **208**, **232**, etc., in real-time), and may identify likely locations of various facial features of the user's face.

[0061] As another example, a machine learning model **258** trained to analyze images associated with makeup looks to identify cosmetic products and/or techniques used to create the makeup looks may be trained by a machine learning model training application **260** using training data including images of individuals with various makeup looks applied, and indications of cosmetic products and/or techniques that were used to create the looks shown in the images. For instance, an image of an individual wearing a particular makeup look may be labeled with a particular color or brand of mascara, blush, lipstick, foundation, etc., used to create the look, as well as types of applicators used to create the look, number of coats/layers of each cosmetic product, techniques such as motions, patterns, shapes, or lines used to create the look, etc., and these labeled images may be used as training data. Once sufficiently trained using this training data, such a machine learning model **258** may be applied to a new image, such as an image provided by a user via a user interface component **214** and/or a user interface **230**, or an image from a social media link provided by the user via the user interface component **214** and/or a user interface **230**, and may identify/predict cosmetic products and/or techniques that may be used to replicate the makeup look shown in the

image. In some examples, the machine learning model **258** may further generate specifications to be used by the robotic cosmetic application device **100** when replicating the makeup look shown in the image.

[0062] Moreover, as another example, a machine learning model **258** trained to analyze data associated with the user's skin to identify a skin type or a skin health condition associated with the user may be trained by a machine learning model training application **260** using training data including images or other sensor data associated with various individuals' skin, and indications of skin types, skin health conditions, or other skin characteristics associated with the various individuals' skin. For instance, images of individuals having various skin types may be labeled with the respective skin types shown in each image. Similarly, images of individuals having various skin health conditions may be labeled with an indication of the health condition, the location of visual indicators associated with the health condition shown in the image, etc. Furthermore, images of individuals having various skin characteristics may be labeled with the respective skin characteristics. These labeled images may be used as training data, and once sufficiently trained using this training data, such a machine learning model **258** may be applied to a new image, video, and/or three-dimensional map associated with a user's face (e.g., an image or video captured by the sensors **208**, **232**, etc., in real-time), and may identify/predict a skin type, skin health condition, and/or other skin characteristic associated with the user's face.

[0063] Additionally, as another example, a machine learning model **258** trained to analyze data associated with previous makeup looks selected by a user to predict additional makeup looks for the user may be trained by a machine learning application **260** using training data including makeup looks selected by previous users, characteristics of the previous users, input/feedback from the previous users about the makeup looks, once applied by a robotic cosmetic application device **100**, etc. For instance, various makeup looks may be labeled with indications of characteristics of users who gave positive feedback regarding the makeup looks, indications of other looks receiving positive feedback from the same users, etc. Once sufficiently trained using this training data, such a machine learning model **258** may be applied to a user, the user's characteristics, and previous makeup looks selected/liked by the user, and may predict/suggest other makeup looks that the user may enjoy.

[0064] In various aspects, the machine learning model(s) **258** may comprise machine learning programs or algorithms that may be trained by and/or employ neural networks, which may include deep learning neural networks, or combined learning modules or programs that learn in one or more features or feature datasets in particular area(s) of interest. The machine learning programs or algorithms may also include natural language processing, semantic analysis, automatic reasoning, regression analysis, support vector machine (SVM) analysis, decision tree analysis, random forest analysis, K-Nearest neighbor analysis, naïve Bayes analysis, clustering, reinforcement learning, and/or other machine learning algorithms and/or techniques.

[0065] In some embodiments, the artificial intelligence and/or machine learning based algorithms used to train the machine learning model(s) **258** may comprise a library or package executed on the server **204** (or other computing devices not shown in FIG. **2**). For example, such libraries may include the TENSORFLOW based library, the PYTORCH library, and/or the SCIKIT-LEARN Python library.

[0066] Machine learning may involve identifying and recognizing patterns in existing data (such as training a model based upon historical data) in order to facilitate making predictions or identification for subsequent data (such as using the machine learning model on new/current data order to determine a prediction or identification related to the new/current data).

[0067] Machine learning model(s) may be created and trained based upon example data (e.g., "training data") inputs or data (which may be termed "features" and "labels") in order to make valid and reliable predictions for new inputs, such as testing level or production level data or inputs. In supervised machine learning, a machine learning program operating on a server,

computing device, or otherwise processor(s), may be provided with example inputs (e.g., "features") and their associated, or observed, outputs (e.g., "labels") in order for the machine learning program or algorithm to determine or discover rules, relationships, patterns, or otherwise machine learning "models" that map such inputs (e.g., "features") to the outputs (e.g., labels), for example, by determining and/or assigning weights or other metrics to the model across its various feature categories. Such rules, relationships, or otherwise models may then be provided subsequent inputs in order for the model, executing on the server, computing device, or otherwise processor(s), to predict, based upon the discovered rules, relationships, or model, an expected output.

[0068] In unsupervised machine learning, the server, computing device, or otherwise processor(s), may be required to find its own structure in unlabeled example inputs, where, for example multiple training iterations are executed by the server, computing device, or otherwise processor(s) to train multiple generations of models until a satisfactory model, e.g., a model that provides sufficient prediction accuracy when given test level or production level data or inputs, is generated. The disclosures herein may use one or both of such supervised or unsupervised machine learning techniques.

[0069] In addition, memories **252** may also store additional machine readable instructions, including any of one or more application(s), one or more software component(s), and/or one or more application programming interfaces (APIs), which may be implemented to facilitate or perform the features, functions, or other disclosure described herein, such as any methods, processes, elements or limitations, as illustrated, depicted, or described for the various flowcharts, illustrations, diagrams, figures, and/or other disclosure herein. For instance, in some examples, the computer-readable instructions stored on the memory **252** may include instructions for carrying out any of the steps of the method **400** via an algorithm executing on the processors **250**, which is described in greater detail below with respect to FIG. **4**. It should be appreciated that one or more other applications may be envisioned and that are executed by the processor(s) **252**. It should be appreciated that given the state of advancements of mobile computing devices, any or all of the processes functions and steps described herein may be present together on a mobile computing device, such as the user device **202**, or the robotic cosmetic application device **100**.

Example User Interface Displays

[0070] FIGS. **3**A-**3**C depict exemplary user interface displays as may be provided by a user interface of the robotic cosmetic application device (e.g., a component **214** of the robotic cosmetic application device **100**) and/or of an associated user device (e.g., user device **202**). For instance, FIG. **3**A illustrates an example user interface display via which a user may select a makeup look, and FIG. **3**B illustrates an example user interface display via which a user has already selected a makeup look. For instance, the user may select between pre-set options such as "smoky eye," "cat eye," "contour," "day look," "night look," "party look," "work look," "celebrity look," etc. In some examples, the pre-set options may differ based on, for instance, whether a user is subscribed to a makeup look subscription service, or whether the user is operating the robotic cosmetic application device **100** in a "professional" mode compared to an "amateur" mode. Some of these options may include still-further options (not shown)-for instance, a user may select a specific celebrity for a "celebrity look," or may select options for each facial feature to create a custom look. These options may include, for instance, types of products applied, how heavily each of the products are applied to each facial area, etc. Furthermore, in some examples, the user may be prompted to upload an image of a desired look, or a link to a social media post including a desired look, which may be analyzed to generate specifications associated with the desired look for use by the robotic cosmetic application device **100**.

[0071] FIG. **3**C illustrates an example preview of the look selected by the user at FIG. **3**B. In some examples, the preview may be a generalized preview, e.g., illustrating examples of other individuals to whom the look has been applied, or illustrating examples of a three-dimensional rendering of the look as applied to a three-dimensional model of a face. As shown in FIG. **3**C, the

preview includes a rendering of the user's current look and a rendering of a predicted look including the selected makeup look. Furthermore, as shown in FIG. **3**C, the preview includes an option to confirm the selected look. Upon confirming the selected look, the specifications associated with the selected look may be sent to the robotic cosmetic application device **100** to be applied to the face of the user.

Example Method

[0072] FIG. **4** depicts a flow diagram of an exemplary computer-implemented method for controlling a robotic cosmetic application device, according to one embodiment. One or more steps of the method **400** may be implemented as a set of instructions stored on a computer-readable memory (e.g., memory **222**, memory **238**, memory **252**, etc.) and executable on one or more processors (e.g., processor **220**, processor **236**, processor **250**, etc.).

[0073] The method **400** may include receiving (block **402**), from a user interface (e.g., user interface **230** discussed with respect to FIG. **2**) associated with the robotic cosmetic application device, an indication of a makeup look selected by the user. In some examples, the user interface may be integrated into the robotic cosmetic application device, while in other examples, the user interface may be part of a separate device, such as a user device (e.g., the user device **202**, as discussed with respect to FIG. **2**), and/or another separate device. In embodiments in which the user interface is part of a separate device, receiving the indication of the makeup look selected by the user may include the robotic cosmetic application device receiving the indication of the makeup look selected by the user at a communication interface of the robotic cosmetic application device, e.g., via a network (e.g., network **206**), via a short range signal between the separate device and the robotic cosmetic application device, and/or via a wired connection between the separate device and the robotic cosmetic application device.

[0074] For instance, the user interface may provide a listing of possible makeup looks from which the user may select a makeup look. In some examples, the listing of possible makeup looks may include an indication of which makeup looks have previously been selected by the user. Moreover, in some examples, the listing of possible makeup looks may be modified (to include more looks, fewer looks, or otherwise different looks) based on whether the user is subscribed to a makeup look subscription service. Additionally, in some examples, the listing of possible makeup looks may include an indication of one or more suggested makeup looks for the user. For example, the method **400** may include providing suggested makeup looks for the user based on previous looks selected by the user, based on current trends associated with one or more makeup looks, based on a mood of the user, based on preferences indicated by the user, based on an indication, from the user, of an event or setting at which the user will be wearing the makeup look, based on a time of day or year, etc.

[0075] In some examples, providing suggested makeup looks for the user based on previous looks selected by the user may include applying a trained machine learning model to previously selected looks in order to identify a suggested look for the user. For instance, the method **400** may include training a machine learning model using historical data associated with makeup looks selected by other users, and feedback associated therewith. Once trained, the machine learning model may be capable of predicting a makeup look for a user based on previous makeup looks selected by the user.

[0076] In some examples, prior to proceeding to the further steps of the method **400**, the method **400** may include analyzing biometric data associated with the user (e.g., as captured by one or more integrated sensors, or sensors of a separate device) in order to determine whether the user is an authorized user of the robotic cosmetic application device. If the user is an authorized user of the robotic cosmetic application device, the method **400** may proceed, but if the user is not an authorized user of the robotic cosmetic application device, the method **400** may not proceed further, i.e., such that the operation of the robotic cosmetic application device is restricted to only authorized users.

[0077] Furthermore, the method **400** may include analyzing (block **404**) real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user. For instance, the sensors may include integrated sensors of the robotic cosmetic application device (e.g., sensors **208**, as discussed with respect to FIG. **2**). Additionally, the sensors may include sensors of a separate device, such as a user device (e.g., sensors **232** of the user device **202**, as discussed with respect to FIG. **2**), and/or another separate device. The sensors may include, for instance, cameras or depth sensors, or other suitable sensors.

[0078] In embodiments in which the sensors include sensors that are part of a separate device, the robotic cosmetic application device may request sensor data from, and/or receive sensor data captured by, the sensors of the separate device via a communication interface of the robotic cosmetic application device, e.g., via a network (e.g., network **206**), via a short range signal between the separate device and the robotic cosmetic application device, and/or via a wired connection between the separate device and the robotic cosmetic application device.

[0079] Additionally, in some examples, the robotic cosmetic application device, and/or a separate device, may include one or more light sources. In such examples, the method **400** may include controlling light sources integrated into the robotic cosmetic application device to provide light to the face of the user as the sensor data is being captured, or sending a request to the separate device to cause the separate device to activate a light source to provide light to the face of the user as the sensor data is being captured, e.g., via a network (e.g., network **206**), via a short range signal between the separate device and the robotic cosmetic application device, and/or via a wired connection between the separate device and the robotic cosmetic application device. For instance, in some examples, the method **400** may include determining optimized lighting parameters, such as an optimized level, warmth, and/or direction of light to be provided based on the selected makeup look, based on a particular cosmetic product being used, based on a particular step within the process of the selected makeup look being applied, and/or based on ambient lighting conditions in an area where the robotic cosmetic application device is being used, and may control an integrated light source to provide the optimized light level, warmth, and/or direction of light, or send a request to the separate device to provide the optimized light level, warmth, and/or direction of light.

[0080] In some examples, the method **400** may include generating an augmented reality (AR) version of the three-dimensional map of the face of the user, and displaying the AR version of the three-dimensional map of the face of the user via a user interface associated with the robotic cosmetic application device. As discussed above, in some examples, the user interface may be integrated into the robotic cosmetic application device, and the AR version of the three-dimensional map of the face of the user may be displayed via the user interface of the robotic cosmetic application device. In embodiments in which the user interface is part of a separate device, displaying the AR version of the three-dimensional map of the face of the user may include sending the AR version of the three-dimensional map of the face of the user to the separate device to be displayed by the user interface of the separate device, e.g., via a network (e.g., network **206**), via a short range signal between the separate device and the robotic cosmetic application device, and/or via a wired connection between the separate device and the robotic cosmetic application device.

[0081] Additionally, the method **400** may include identifying (block **406**) one or more facial features of the face of the user on the three-dimensional map associated with the face of the user. In some examples, this analysis may include applying a trained machine learning model to the three-dimensional map associated with the face of the user to identify the facial features. For instance, the method **400** may include training a machine learning model using historical three-dimensional maps associated with other faces, and corresponding portions of the three-dimensional maps associated with facial features of the other faces, and, once trained, the machine learning model may be capable of identifying such facial features on three-dimensional maps associated with new faces. That is, the trained machine learning model may be configured to recognize facial geometry associated with particular facial features on the three-dimensional map associated with a face.

Certain facial geometry on a particular location of the face may correspond to the eyes of the face, while other facial geometry at another location of the face may correspond to the lips of the face, etc.

[0082] Moreover, in some examples, the method **400** may include generating a preview of the makeup look selected by the user as applied to facial features of the face of the user on the three-dimensional map associated with the face of the user. For instance, the method **400** may include generating an AR preview of the makeup look selected by the user as applied to facial features of the face of the user on the three-dimensional map associated with the face of the user. Furthermore, the method **400** may include generating an AR preview of the steps of the application process of the makeup look selected by the user to the facial features of the face of the user. For instance, the AR preview of the steps of the application process may include images associated with each step of the application process, and/or videos associated with each step of the application process. The method **400** may further include displaying the AR preview of the selected makeup look, and/or the AR preview of the steps of the application process for the selected makeup look, via an integrated user interface of the robotic cosmetic application device **100**. In embodiments in which the user interface is part of a separate device, the method **400** may include sending the AR preview to the separate device to be displayed by the user interface of the separate device, e.g., via a network (e.g., network **206**), via a short range signal between the separate device and the robotic cosmetic application device, and/or via a wired connection between the separate device and the robotic cosmetic application device.

[0083] Furthermore, the method **400** may include controlling (block **408**) one or more robotic arm(s) of the robotic cosmetic application device (e.g., controlling the arm(s) **104**, via the actuators **210** of the robotic cosmetic application device **100**, discussed with respect to FIG. **2**) to automatically adjust one or more applicator tools (e.g., the applicator tools **106**, discussed with respect to FIG. **1**A-**1**G) associated with respective cosmetic products in real-time as the robotic cosmetic application device applies the cosmetic products to face of the user, based on the locations of the arm(s) or applicator tool(s) with respect to the one or more facial features of the face of the user, to apply one or more cosmetic products to the face of the user in order to achieve the makeup look selected by the user, i.e., by applying particular cosmetic products to particular areas of the identified facial features of the face of the user.

[0084] The interchangeable applicator tools may include, for instance, a brush applicator tool, a sponge applicator tool, a puff applicator tool, a pencil applicator tool, a felt tip applicator tool, a marker applicator tool, a crayon applicator tool, a lip stick applicator tool, a lip gloss applicator tool, a roller applicator tool, a mascara wand applicator tool, and/or any other suitable applicator tools for applying cosmetic products to the face of the user. The method **400** may include automatically adjusting an angle, a pressure, a movement, a spin, etc., of the one or more arms and/or applicator tools of the robotic cosmetic application device based on one or more of: the cosmetic product being applied, the type of applicator tool, the particular makeup look selected, and/or a particular step in the application of the selected makeup look, to apply one or more cosmetic products to the face of the user.

[0085] For instance, the method **400** may further include analyzing the sensor data in real-time to identify properties of the skin of the user, properties of the environment of the user, and/or properties of the one or more cosmetic products being applied, and automatically adjusting the angle, pressure, movement, spin, etc., of the arms and/or the applicator tools based on one or more of: a skin type associated with the user, a skin health condition associated with the user, a hydration level of the skin of the user, a skin tone associated with the user, current temperature conditions, current humidity conditions, current precipitation conditions, current lighting conditions, a current time of day, and/or one or more properties associated with the one or more cosmetic products being applied. In some examples, this analysis may include applying a trained machine learning model to the sensor data to identify the properties of the skin of the user, the properties of the environment of

the user, and/or the properties of the one or more cosmetic products being applied. For instance, the method **400** may include training a machine learning model using historical sensor data associated with skin properties, environmental properties, cosmetic product properties, etc., and, once trained, the machine learning model may be capable of identifying such properties based on new sensor data.

[0086] In some examples, the method **400** may include providing user instructions, guidance, support, tutorials, etc., associated with the operation of the robotic cosmetic application device (in general, and/or to apply the selected makeup look), e.g., via an integrated user interface, or by sending the user instructions, guidance, support, tutorials, etc. to a separate device to be presented via a user interface of the separate device.

[0087] Moreover, in some examples, the method **400** may further include analyzing the sensor data in real-time to identify blemishes of the skin of the user, and automatically adjusting the arms and/or the applicator tools, based on identified blemishes, i.e., beyond the initial parameters of the selected makeup look. For instance, the method **400** may include adjusting an amount of particular cosmetic product, e.g., to add more foundation or concealer, to an area of the user's face including a blemish, in order to cover the blemish with the cosmetic product. Furthermore, in some examples, the method **400** may include analyzing the sensor data in real-time to determine whether the blemish is sufficiently covered based on an initial application of the cosmetic product, and may include automatically adjusting the arms and/or applicator tools to add additional cosmetic product as needed until the blemish is sufficiently covered.

[0088] Additionally, in some examples, the method **400** may further include analyzing the sensor data in real-time to identify skin reactions of the skin of the user, and automatically generating alerts or notifications based on any identified skin reactions. For instance, the method **400** may include presenting such generated alerts via an integrated user interface, and/or sending such generated alerts to a separate device to be displayed via a user interface of the separate device.

[0089] In some examples, the robotic cosmetic application device may include integrated dispensers for various cosmetic products, and the method **400** may include controlling the dispensers to dispense the various cosmetic products as needed during the application of the makeup look to the face of the user. Furthermore, the robotic cosmetic application device may include temperature control components (e.g., heating elements, cooling elements, fans, etc.) for the dispensers for the various cosmetic products, and the method **400** may include controlling the temperature control components for each dispenser based on a particular range of temperatures associated with the cosmetic product with each dispenser. Additionally, the method **400** may include tracking the dispensing of the cosmetic products via the integrated dispensers, and determining, based on the tracking, when refills of one or more of the cosmetic products are required. For instance, the method **400** may include generating a notification indicating that a refill is required for one of the cosmetic products. For example, the method **400** may include providing the notification via an integrated user interface, or sending the notification to a separate device to be provided via a user interface of the separate device.

[0090] Furthermore, in some examples, the method **400** may include capturing data associated with packaging of various cosmetic products (i.e., cosmetic products to be added to integrated dispensers of the robotic cosmetic application device **100**, and/or cosmetic products stored separately from the robotic cosmetic application device **100**), and analyzing the data associated with he packaging of the various cosmetic products to identify respective cosmetic products based on their packaging. For instance, in some examples, this analysis may include capturing an image of a cosmetic product package and using object recognition techniques to identify a likely type of cosmetic product and/or likely properties associated with the cosmetic product based on the image. Moreover, in some examples, this analysis may include analyzing an image of the cosmetic product packaging using optical character recognition techniques to identify one or more letters, numbers, words, codes, etc., on the cosmetic product packaging, and accessing a database associated with

cosmetic products to match any identified letters, numbers, words, codes, etc., on the cosmetic product packaging with particular cosmetic products and/or particular properties associated therewith. As another example, this analysis may include analyzing an image of the cosmetic product packaging to identify and/or decode a barcode, QR code, etc. For instance, the payload of the barcode, QR code, etc., may include an identification or indication of the cosmetic product and/or properties associated therewith. Moreover, in some examples, the method **400** may include identifying a cosmetic product and/or properties associated therewith based on input provided by a user (e.g., input provided via an integrated user interface of the robotic cosmetic application device, and/or via a user interface of a separate device that is sent to the robotic cosmetic application device). The method **400** may further include adjusting movements of the arms and/or applicator tools based on particular cosmetic products being applied using the applicator tools, and/or properties associated therewith.

[0091] Additionally, in some examples, the robotic cosmetic application device may include a cleaning component configured to clean and/or disinfect one or more components of the robotic cosmetic application device (such as, e.g., the applicator tools, the dispensers, the exterior of the robotic cosmetic application device, etc.), and the method **400** may include controlling the cleaning component to clean and/or disinfect the one or more components of the robotic cosmetic application device (e.g., at regular intervals, at the request of the user, etc.).

[0092] In some examples, the method **400** may further include receiving feedback associated with the makeup look from the user (e.g., via a user interface) subsequent to the application of the one or more cosmetic products to the face of the user, and storing the feedback associated with the makeup look. For instance, the method **400** may update one or more aspects of the makeup look in future applications based on feedback provided by the user.

Additional Considerations

[0093] The following additional considerations apply to the foregoing discussion. Throughout this specification, plural instances may implement operations or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

[0094] Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "presenting," "displaying," or the like may refer to actions or processes of a machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, or optical) quantities within one or more memories (e.g., volatile memory, non-volatile memory, or a combination thereof), registers, or other machine components that receive, store, transmit, or display information.

[0095] As used herein any reference to "one embodiment" or "an embodiment" or "some embodiments" means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of the phrase "in one embodiment" or "in some embodiments" in various places in the specification are not necessarily all referring to the same embodiment.

[0096] As used herein, the terms "comprises," "comprising," "includes," "including," "has," "having" or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a process, method, article, or apparatus that comprises a list of elements is not necessarily limited to only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. Further, unless expressly stated to the contrary, "or" refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0097] In addition, use of "a" or "an" is employed to describe elements and components of the embodiments herein. This is done merely for convenience and to give a general sense of the invention. This description should be read to include one or at least one and the singular also includes the plural unless it is obvious that it is meant otherwise.

[0098] Upon reading this disclosure, those of skill in the art will appreciate still additional alternative structural and functional designs for a robotic cosmetic application device, and/or systems, methods, and/or techniques associated therewith. Thus, while particular embodiments and applications have been illustrated and described, it is to be understood that the disclosed embodiments are not limited to the precise construction and components disclosed herein. Various modifications, changes and variations, which will be apparent to those skilled in the art, may be made in the arrangement, operation and details of the method and apparatus disclosed herein without departing from the spirit and scope defined in the appended claims.

Aspects

[0099] 1. An intelligent robotic cosmetic application device, comprising: one or more sensors configured to capture real-time data associated with a face of a user; one or more robotic arms equipped with one or more respective makeup applicator tools; a controller, comprising: one or more processors; and one or more memories storing non-transitory computer-readable instructions that, when executed by the one or more processors, cause the one or more processors to: receive, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyze the real-time data associated with the face of the user in order to generate a three-dimensional map associated with the face of the user; identify one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and control the one or more robotic arms to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user. [0100] 2. The intelligent robotic cosmetic application device of aspect 1, wherein the one or more sensors include one or more of a camera or a depth sensor. [0101] 3. The intelligent robotic cosmetic application device of any one of aspects 1-2, wherein the one or more makeup applicator tools include one or more of: a brush applicator tool, a sponge applicator tool, a puff applicator tool, a pencil applicator tool, a felt tip applicator tool, a marker applicator tool, a crayon applicator tool, a lip stick applicator tool, a lip gloss applicator tool, a roller applicator tool, or a mascara wand applicator tool. [0102] 4. The intelligent robotic cosmetic application device of any one of aspects 1-3, further comprising a haptic feedback component, configured to provide guidance to the user as the intelligent robotic cosmetic application device applies the one or more cosmetic products to the facial features of the user. [0103] 5. The intelligent robotic cosmetic application device of any one of aspects 1-4, wherein the user interface is integrated into the intelligent robotic cosmetic application device. [0104] 6. The intelligent robotic cosmetic application device of any one of aspects 1-5, further comprising a communication interface configured to communicate with a mobile device, external to the intelligent robotic cosmetic application device. [0105] 7. The intelligent robotic cosmetic application device of aspect 6, wherein the communication interface is a wired communication interface. [0106] 8. The intelligent robotic cosmetic application device of aspect 6, wherein the communication interface is a wireless communication interface. [0107] 9. The intelligent robotic cosmetic application device of any one of aspects 6-8, wherein the user interface is integrated into the mobile device. [0108] 10. The intelligent robotic cosmetic application device of any one of aspects 6-9, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to request images of the face of the user as captured by a camera of the mobile device, wherein the images of the face of the user are used to generate a three-dimensional map associated with the face of the user. [0109] 11. The intelligent robotic cosmetic application device of any one of aspects 6-10, wherein the non-transitory computer-readable instructions, when

executed by the one or more processors, further cause the one or more processors to request that a light source of the mobile device modify one or more lighting parameters in order to provide light to the face of the user. [0110] 12. The intelligent robotic cosmetic application device of any one of aspects 1-11, further comprising an augmented reality (AR) component configured to generate and display an AR version of the three-dimensional map associated with the face of the user. [0111] 13. The intelligent robotic cosmetic application device of aspect 12, wherein the AR component is integrated into the user interface. [0112] 14. The intelligent robotic cosmetic application device of any one of aspects 12-13, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate a three-dimensional preview of the makeup look selected by the user as applied to the three-dimensional map associated with the face of the user, and wherein the AR component is further configured to generate and display an AR version of the three-dimensional preview of the makeup look selected by the user as applied to the three-dimensional map associated with the face of the user. [0113] 15. The intelligent robotic cosmetic application device of aspect 14, wherein the three-dimensional preview of the makeup look selected by the user includes a three-dimensional preview of the application process of the makeup look selected by the user. [0114] 16. The intelligent robotic cosmetic application device of any one of aspects 1-16, further comprising one or more dispensers for the one or more cosmetic products, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to control the dispensing of the one or more cosmetic products via the one or more dispensers. [0115] 17. The intelligent robotic cosmetic application device of aspect 16, further comprising one or more temperature control components configured to control temperatures associated with the one or more dispensers for the one or more cosmetic products within a particular range of temperatures. [0116] 18. The intelligent robotic cosmetic application device of any one of aspects 16-17, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: track the dispensing of the one or more cosmetic products via the one or more dispensers; determine, based on tracking the dispensing of the one or more cosmetic products via the one or more dispensers, that a refill of one or more of the cosmetic products is required; and provide a notification indicating that the refill of one or more of the cosmetic products is required, via the user interface. [0117] 19. The intelligent robotic cosmetic application device of any one of aspects 1-18, further comprising a cleaning component configured to one or more of: clean or disinfect one or more components of the intelligent robotic cosmetic application device. [0118] 20. The intelligent robotic cosmetic application device of any one of aspects 1-19, further comprising a light source configured to provide light to the face of the user. [0119] 21. The intelligent robotic cosmetic application device of aspect 20, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to control the light source to provide particular lighting conditions while the one or more cosmetic products are applied to the facial features of the user. [0120] 22. The intelligent robotic cosmetic application device of any one of aspects 1-21, wherein automatically adjusting the one or more makeup applicator tools of the intelligent robotic cosmetic application device includes automatically adjusting one or more of an angle, a pressure, or a movement of the one or more makeup applicator tools of the intelligent robotic cosmetic application device. [0121] 23. The intelligent robotic cosmetic application device of any one of aspects 1-22, wherein the instructions, when executed by the one or more processors, further cause the one or more processors to identify one or more blemishes of the face of the user on the three-dimensional map associated with the face of the user, and wherein controlling the one or more robotic arms to adjust the one or more makeup applicator tools of the intelligent robotic cosmetic application device in real-time, to apply one or more cosmetic products to the facial features of the user, is further based on the identified one or more blemishes of the face of the user. [0122] 24. The intelligent robotic cosmetic application device of

any one of aspects 1-23, wherein controlling the one or more robotic arms to adjust the one or more makeup applicator tools of the intelligent robotic cosmetic application device in real-time, to apply one or more cosmetic products to the facial features of the user, is further based on one or more of: a skin type associated with the user, a skin health condition associated with the user, a hydration level of the skin of the user, a skin tone associated with the user, current temperature conditions, current humidity conditions, current precipitation conditions, current lighting conditions, a current time of day, or one or more properties associated with the one or more cosmetic products. [0123] 25. The intelligent robotic cosmetic application device of any one of aspects 1-24, wherein controlling the one or more robotic arms to automatically adjust the one or more makeup applicator tools of the intelligent robotic cosmetic application device in real-time, to apply the one or more cosmetic products to the facial features of the user applying particular cosmetic products to particular areas of the facial features of the face of the user. [0124] 26. The intelligent robotic cosmetic application device of any one of aspects 1-25, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to operate in a manual mode based on an input provided by the user via the user interface, wherein, when operating in the manual mode, the one or more processors cease to control the one or more robotic arms to automatically adjust the one or more makeup applicator tools of the intelligent robotic cosmetic application device. [0125] 27. The intelligent robotic cosmetic application device of any one of aspects 1-27, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: analyze the real-time data associated with the face of a user to identify a skin reaction associated with the application of the one or more cosmetic products; and provide an alert, via the user interface, based on the identified skin reaction. [0126] 28. The intelligent robotic cosmetic application device of aspect 27, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: cease operating the one or more makeup applicator tools of the intelligent robotic cosmetic application device, based on the identified skin reaction. [0127] 29. The intelligent robotic cosmetic application device of any one of aspects 1-28, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to analyze one or more of: the real-time data associated with the face of the user captured by the one or more sensors, or previously-captured data associated with the face of the user captured by the one or more sensors, in order to determine one or more of a skin type or skin health condition associated with the user. [0128] 30. The intelligent robotic cosmetic application device of aspect 29, wherein analyzing one or more of: the real-time data associated with the face of the user captured by the one or more sensors, or previously-captured data associated with the face of the user captured by the one or more sensors, in order to determine one or more of the skin type or the skin health condition associated with the user, includes applying a trained machine learning model to one or more of the real-time data associated with the face of the user captured by the one or more sensors, or previously-captured data associated with the face of the user captured by the one or more sensors, to determine one or more of the skin type or the skin health condition associated with the user. [0129] 31. The intelligent robotic cosmetic application device of aspect 30, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: obtain training data including data associated with faces of individuals as captured by one or more sensors, and corresponding skin types and/or skin health conditions associated with the respective individuals; and train a machine learning model, using the training data, to identify one or more of a skin type or a skin health condition associated with a new individual based on data associated with the face of the new individual as captured by one or more sensors, resulting in the trained machine learning model. [0130] 32. The intelligent robotic cosmetic application device of any one of aspects 1-31, wherein identifying the one or more facial features of the face of the user on the three-dimensional map

associated with the face of the user includes applying a trained machine learning model to the three-dimensional map associated with the face of the user to identify the one or more facial features of the face of the user. [0131] 33. The intelligent robotic cosmetic application device of aspect 32, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: obtain training data including three-dimensional maps associated with faces of individuals and corresponding facial features of the faces of the respective individuals; and train a machine learning model, using the training data, to identify one or more facial features of a face of a new individual based on a three-dimensional map associated with the face of the new individual, resulting in the trained machine learning model. [0132] 34. The intelligent robotic cosmetic application device of any one of aspects 1-33, wherein the one or more sensors are further configured to capture data associated with packaging of the one or more cosmetic products, and wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to analyze the data associated with the packaging of the one or more cosmetic products to identify the one or more cosmetic products. [0133] 35. The intelligent robotic cosmetic application device of aspect 34, wherein identifying the one or more cosmetic products includes determining one or more properties associated with the one or more cosmetic products. [0134] 36. The intelligent robotic cosmetic application device of any one of aspects 1-35, wherein the one or more memories are further configured to store one or more makeup looks previously selected by the user. [0135] 37. The intelligent robotic cosmetic application device of any one of aspects 1-36, wherein receiving an indication of a makeup look selected by the user includes receiving an indication of a makeup look selected by the user from a plurality of makeup looks provided by a subscription service. [0136] 38. The intelligent robotic cosmetic application device of any one of aspects 1-37, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate one or more suggested makeup looks for the user based on current trends associated with one or more makeup looks.

[0137] 39. The intelligent robotic cosmetic application device of any one of aspects 1-38, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate one or more suggested makeup looks for the user based on a mood and/or setting of the user. [0138] 40. The intelligent robotic cosmetic application device of aspect 39, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to determine the mood of the user based on data associated with one or more of facial expressions, voice tone, or other behavioral cues, of the user, captured by the one or more sensors. [0139] 41. The intelligent robotic cosmetic application device of any one of aspects 1-40, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate one or more suggested makeup looks for the user based on one or more makeup looks previously selected by the user. [0140] 42. The intelligent robotic cosmetic application device of any one of aspects 1-41, wherein generate one or more suggested makeup looks for the user based on one or more makeup looks previously selected by the user includes applying a trained machine learning model to the one or more makeup looks previously selected by the user to generate one or more suggested makeup looks for the user.

[0141] 43. The intelligent robotic cosmetic application device of aspect 41, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: obtain training data including data associated with makeup looks previously selected by individuals, and corresponding subsequent makeup looks selected by respective individuals; and train a machine learning model, using the training data, to identify a suggested makeup look for a new individual based on data associated with makeup looks previously selected by the individual, resulting in the trained machine learning model. [0142] 44. The intelligent robotic cosmetic application device of aspect 42, wherein the non-transitory

computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: receive feedback associated with the makeup look, subsequent to the application of the one or more cosmetics products to the facial features of the user, from the user, via the user interface, wherein feedback associated with a makeup look is included in data associated with the makeup look. [0143] 45. The intelligent robotic cosmetic application device of any one of aspects 1-44, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate reminders associated with one or more of cleaning or maintenance of the intelligent robotic cosmetic application device, and to provide the reminders via the user interface. [0144] 46. The intelligent robotic cosmetic application device of any one of aspects 1-45, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: analyze biometric data associated with the user captured by the one or more sensors in order to determine whether the user is an authorized user; and restrict operation of the intelligent robotic cosmetic application device to authorized users only. [0145] 47. The intelligent robotic cosmetic application device of any one of aspects 1-46, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to provide one or more user instructions, guidance, support, or tutorials associated with the operation of the intelligent robotic cosmetic application device, via the user interface. [0146] 48. The intelligent robotic cosmetic application device of any one of aspects 1-47, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: generate real-time feedback to the user as the one or more cosmetic products are applied to the facial features of the user, the real-time feedback including one or more improvements or corrections associated with the application of the one or more cosmetics products to the facial features of the user. The intelligent robotic cosmetic application device of claim 1, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to operate in one or more modes associated with respective users or types of users. [0147] 49. The intelligent robotic cosmetic application of any one of aspects 1-48, wherein the intelligent robotic cosmetic application device is integrated with a prosthetic limb of the user. [0148] 50. The intelligent robotic cosmetic application of any one of aspects 1-49, wherein the mobile device is a heads up display (HUD) device. [0149] 51. A computer-implemented method for controlling an intelligent robotic cosmetic application device via one or more processors, comprising: receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user; identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user. [0150] 52. A non-transitory computer-readable medium storing instructions for controlling an intelligent robotic cosmetic application device that, when executed by one or more processors, cause the one or more processors to perform a method comprising: receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing the real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user; identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the

one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user.

Claims

1. An intelligent robotic cosmetic application device, comprising: one or more sensors configured to capture real-time data associated with a face of a user; one or more robotic arms equipped with one or more respective makeup applicator tools; a controller, comprising: one or more processors; and one or more memories storing non-transitory computer-readable instructions that, when executed by the one or more processors, cause the one or more processors to: receive, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyze the real-time data associated with the face of the user in order to generate a three-dimensional map associated with the face of the user; identify one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and control the one or more robotic arms to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user.

2. The intelligent robotic cosmetic application device of claim 1, wherein the one or more sensors include one or more of a camera or a depth sensor.

3. The intelligent robotic cosmetic application device of claim 1, wherein the one or more makeup applicator tools include one or more of: a brush applicator tool, a sponge applicator tool, a puff applicator tool, a pencil applicator tool, a felt tip applicator tool, a marker applicator tool, a crayon applicator tool, a lip stick applicator tool, a lip gloss applicator tool, a roller applicator tool, or a mascara wand applicator tool.

4. The intelligent robotic cosmetic application device of claim 1, further comprising a haptic feedback component, configured to provide guidance to the user as the intelligent robotic cosmetic application device applies the one or more cosmetic products to the facial features of the user.

5. The intelligent robotic cosmetic application device of claim 1, wherein the user interface is integrated into the intelligent robotic cosmetic application device.

6. The intelligent robotic cosmetic application device of claim 1, further comprising a communication interface configured to communicate with a mobile device, external to the intelligent robotic cosmetic application device.

7. The intelligent robotic cosmetic application device of claim 6, wherein the communication interface is a wired communication interface.

8. The intelligent robotic cosmetic application device of claim 6, wherein the communication interface is a wireless communication interface.

9. The intelligent robotic cosmetic application device of claim 6, wherein the user interface is integrated into the mobile device.

10. The intelligent robotic cosmetic application device of claim 6, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to request images of the face of the user as captured by a camera of the mobile device, wherein the images of the face of the user are used to generate a three-dimensional map associated with the face of the user.

11. The intelligent robotic cosmetic application device of claim 6, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to request that a light source of the mobile device modify one or more lighting parameters in order to provide light to the face of the user.

12. The intelligent robotic cosmetic application device of claim 1, further comprising an augmented reality (AR) component configured to generate and display an AR version of the three-dimensional

map associated with the face of the user.

13. The intelligent robotic cosmetic application device of claim 12, wherein the AR component is integrated into the user interface.

14. The intelligent robotic cosmetic application device of claim 12, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to generate a three-dimensional preview of the makeup look selected by the user as applied to the three-dimensional map associated with the face of the user, and wherein the AR component is further configured to generate and display an AR version of the three-dimensional preview of the makeup look selected by the user as applied to the three-dimensional map associated with the face of the user.

15. The intelligent robotic cosmetic application device of claim 14, wherein the three-dimensional preview of the makeup look selected by the user includes a three-dimensional preview of the application process of the makeup look selected by the user.

16. The intelligent robotic cosmetic application device of claim 1, further comprising one or more dispensers for the one or more cosmetic products, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to control the dispensing of the one or more cosmetic products via the one or more dispensers.

17. The intelligent robotic cosmetic application device of claim 16, further comprising one or more temperature control components configured to control temperatures associated with the one or more dispensers for the one or more cosmetic products within a particular range of temperatures.

18. The intelligent robotic cosmetic application device of claim 16, wherein the non-transitory computer-readable instructions, when executed by the one or more processors, further cause the one or more processors to: track the dispensing of the one or more cosmetic products via the one or more dispensers; determine, based on tracking the dispensing of the one or more cosmetic products via the one or more dispensers, that a refill of one or more of the cosmetic products is required; and provide a notification indicating that the refill of one or more of the cosmetic products is required, via the user interface.

19-**51**. (canceled)

52. A computer-implemented method for controlling an intelligent robotic cosmetic application device via one or more processors, comprising: receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user; identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the one or more respective makeup applicator tools with respect to the face of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user.

53. A non-transitory computer-readable medium storing instructions for controlling an intelligent robotic cosmetic application device that, when executed by one or more processors, cause the one or more processors to perform a method comprising: receiving, from a user interface associated with the intelligent robotic cosmetic application device, an indication of a makeup look selected by the user; analyzing the real-time data associated with the face of the user captured by one or more sensors in order to generate a three-dimensional map associated with the face of the user; identifying one or more facial features of the face of the user on the three-dimensional map associated with the face of the user; and controlling one or more robotic arms of the intelligent robotic cosmetic application device, equipped with one or more respective makeup applicator tools, to automatically adjust the one or more respective makeup applicator tools with respect to the face

of the user, to apply one or more cosmetic products to the facial features of the user in order to achieve the makeup look selected by the user.