SYSTEM AND METHOD FOR ROBOTIC ASSISTED WIG CONSTRUCTION

by

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REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional application number 60/621,586, filed October 22, 2004.

BACKGROUND OF THE INVENTION

A wig is a manufactured head covering that is worn to alter ones appearance. Wigs are worn by men and women alike and are employed in a number of different applications. From a historical context, aristocrats, royalty, and high-ranking officials have traditionally worn wigs to symbolize status in society. Today, wigs are more often worn to disguise the thinning or loss of hair. For example, cancer patients often employ wigs to cover hair loss resulting from chemotherapy treatment. Wigs also find use in an entertainment context to alter the appearance of actors and performers. In general, the uses and applications of wigs are as varied as the different styles and configurations available.

Wig construction generally begins with a foundation or cap to which real or synthetic hair is attached. Hereafter, the term cap, wig cap, and foundation may be used interchangeably to generally refer to the base or support structure for a wig. The characteristics of the cap, such as size, shape, composition, etc. may vary depending upon the particular application. For example, wig caps may be hand or machine made and comprised of a fine mesh net or monofilament material. In one embodiment, the cap is comprised of a translucent monofilament material that, when worn, allows the natural skin color of the scalp to show through. In addition, other materials, such as Dermafix may be added to the cap, which when heated by body temperature helps adhere the cap to the scalp.

In simple terms, wigs are constructed by attaching hair to the cap. The hair may be selectively attached to the cap to match the needs of the end user, e.g., cover thinning or balding areas, deliver desired entertainment effect, etc. Hair characteristics, such as texture, quality, color, length, etc. may vary depending upon the particular application or construction technique of the wig. Moreover, the hair may be comprised of human hair, synthetic fibers, or animal hair.

There are generally three types of wigs that are available, stock, semi-custom, and custom made wigs. Stock wigs are usually machine made and are not necessarily designed for a specific person or application. As such, stock wigs are usually cheaper in cost, which unfortunately usually comes at a substantial sacrifice in the appearance and quality of the wig. Moreover, because stock wigs are made with little or no input from the ultimate user, these wigs are often recognizable when worn. In one example, stock wigs are constructed using a sewing machine to attach hair to a "weft", which is a long string. Once the hair is sewn to the weft, it is then wrapped around and attached to the cap.

Semi-custom and custom wigs are capable of providing a more natural look when worn. Hereafter, reference to semi-custom and custom wigs may be used interchangeably to refer to wigs that are constructed with a particular application, user group, or person in mind. With custom wigs, the cap and various characteristics of the hair used to construct the wig, such as placement, color, texture, length, etc. may be customized to match a particular application or person.

Unfortunately, wig construction is a tedious, time consuming, laborious, and consequently expensive process. This is especially true for custom wig construction. For example, when constructing a custom wig, the cap is usually custom fit to a particular individual's scalp. This frequently involves measuring the individual's scalp and head and matching the ends of the cap

to the individual's hairline. Consideration is also given to the desired coverage the wig is intended to provide. For example, in the case of partial baldness, the cap may be constructed only to cover balding portions of an individual's scalp. In the case of complete baldness or if desired from a cosmetic standpoint, the cap may be configured to cover the individual's entire scalp.

Once the specifications of the cap are placed in a state of acceptance, the wig is constructed by attaching hair to desired locations on the cap. Hair is attached to the cap using a manual labor-intensive one-by-one process. Wig makers refer to this process as ventilating a wig. Using a needle, each individual hair is fed through the cap, wrapped around itself, and fed back through the cap in a knot tying fashion. The process employed is similar to the 'latch hook' technique used for tying a rug. A typical wig may require the process repeated between 30,000 and 40,000 times. Moreover, the manual process used for tying a wig generally takes between 40 and 60 hours to complete.

What is needed therefore, is a system and method for reducing the repetitive manual steps used during wig construction. The present invention is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth above.

SUMMARY OF THE INVENTION

The invention of the present disclosure includes methods for constructing wigs wherein an at least one effector attached to a robotic arm of a robot is positioned proximate to a wig cap; and the effector is then operated to fixedly attach an at least one hair to the wig cap.

Certain other embodiments of the present invention include a method for constructing a wig wherein the three-dimensional position of a wig cap with respect to an at least one effector attached to a robotic arm of a robot is localized and registered with the controller of the robot

followed by the controller operating the effector to retrieve the at least one hair from a hair staging area and then fixedly attaching the at least one hair retrieved from the hair staging area to a location on the wig cap specified by a controller of the robot.

Still another embodiment of the present invention is a method for constructing a wig that includes: registering the three-dimensional position of a wig cap with respect to an at least one effector attached to a robotic arm of a robot with a controller of the robot; co-localizing at least one fiduciary marker affixed to a model with positions on the wig cap; operating the effector to retrieve at least one hair from a hair staging area; and operating the effector to fixedly attach the at least one hair retrieved from the hair staging area to a location on the wig cap in a position specified by its proximity to the co-localized position of the at least one fiduciary marker.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 represents a visual depiction of one embodiment of wig construction methods of the present application.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Robots are currently used in a number of different industries to automate various processes. A number of different suppliers, such as ABB Inc., KUKA Robot Group, CTA Automation Technology, Fanuc Robotics, etc., offer a wide range of robots and accompanying control technology. Often, robots are integrated with manufacturing processes to remove or eliminate the need for human intervention. In such an environment, robots ordinarily increase the speed of the manufacturing process and reduce the manufacturing costs (e.g., labor costs) of a finished product. With the present invention, a robot may be configured and employed to reduce or eliminate the repetitive manual processes typically associated with wig construction.

Robots are provided in a number of different configurations. For example, robots may be provided with one or more robotic arms, mechanical attachments, and/or other types of peripherals. In most applications, a robot uses at least one robotic arm that is configured with an effector attached at or near a distal end of the robotic arm to perform a desired task or function. For example, printed circuit board manufacturers use robots having robotic arms with effectors for picking and placing semiconductor chips on printed circuit boards. In this case, the effector is usually a suction mechanism that is capable of grasping and releasing a chip.

The present invention is not limited to any particular robot or configuration. Rather, a variety of different robots are configurable with an appropriate amount of intelligence and arm control capability to reduce or eliminate the repetitive manual processes associated with wig construction. One such robot configuration is taught, for example, in U.S. Patent No. 6,585,746 the contents of which are hereby incorporated by reference as if set forth in its entirety.

With the present invention, a robot 1, as shown in Figure 1, is configured so that it may interact with a wig cap 2 in a controlled manner to selectively and precisely place hair in desired locations. In one illustrative embodiment, a cap 2 is placed in known three-dimensional space with respect to a robot 1. Those skilled in the art will appreciate that a number of different video or other registration techniques may be used to orient the robot and/or one or more robotic arms with respect to the cap. For example, a cap holder 3, such as a stand or other suitable structure, may be positioned and configured in known three-dimensional space with respect to the robot 1. By placing the cap 2 upon the cap holder 3, the cap 2 becomes oriented in space with respect to the robot 1.

Depending upon the particular application, a universal connector 4 or similar device may be configured to be cooperatively operable with the robot 1. The universal connector 4 simplifies

orienting a plurality of different cap holders 3 in three-dimensional space with respect to the robot 1. For example, each of the plurality of cap holders 3 may be attached to the universal connector 4 and pre-oriented in three-dimensional space with respect to the robot 1. In this example, the plurality of cap holders 3 may vary in size, shape, etc., and a cap holder 3 that best matches the size and shape of a particular cap 2 may be selected. If pre-oriented, a particular cap holder 3 may be selected, attached to the universal connector 4, and its stored orientation configuration recalled using the robot's control system. Generally speaking, the universal connector 4 may be any device, holder, software or wireless program attachment that assists the repeated placement of the cap holders 3 in substantially the same position with respect to the robot 1.

A custom cap holder 3 may also be used with the present invention. In one illustrative embodiment, a custom cap holder 3 may be produced from a scan of the end user's head and/or scalp. The data collected during the scan may be used to customize the dimensions, shape, and other characteristics of a cap holder 3. It should be appreciated that a number of different scan techniques may be used to collect this data. One such technique is described, for example, in U.S. Patent No. 6,585,746. In this example, a video system is used with one or more cameras to map locations of interest. A range finder may also be employed for measuring distance. The data collected during the scan may include the shape and dimensions of the end users head and scalp, locations of thinning hair, hairline details, hair color, density, coarseness, or stereovision may be used to reconstruct the shape and dimensions of the head in virtual space. This data may then be processed and used to fabricate a custom cap holder 3. Moreover, as will be described below, this data may also be used to customize the wig construction process.

The robot 1 may be operated and controlled using any number of different control systems. In one illustrative embodiment, the robot 1 operates using a computerized control

system that is cooperatively operable with one or more cameras focused on an area of interest that includes, for example, an effector 5 attached to a robotic arm 7 of the robot 1. As will be described below, the effector 5 may include at least one of a hook 6, needle, or any other mechanical device useful for grasping individual or groups of hair and robotically attaching the hair to the cap 2. Moreover, the effector 5 may include an array of mechanical devices that are automatically interchangeable and cooperatively operable for robotically attaching hair to the cap 2.

Using a multi-camera stereo, orthogonal, or other configuration, the control system is capable of determining the position of an effector 5 in three-dimensional space with respect to a specific point of interest on a wig cap 2. For example, in one illustrative embodiment, two cameras may be attached near the distal end of a robotic arm of the robot 7, and the views of the two cameras configured to overlap with the effector 5. If the locations of the two cameras are known with respect to the position of the effector 5, the control system is configurable using conventional localization techniques, such as triangulation, to calculate the spatial orientation of the effector 5 in three-dimensional space.

In another embodiment, a range finder 8 and a camera 9 may be attached near the distal end of a robotic arm of the robot 7, and the view of the camera 9 configured to overlap with the effector 5. As described above, if the locations of the range finder 8 and the camera 9 are known with respect to the position of the effector 5, the control system is configurable using conventional localization techniques to calculate the spatial orientation of the effector 5 in three-dimensional space. As is known in the art, a range finder 8 is operable for communicating with the control system the distance to a specific area of interest. With this configuration, the control system may be cooperatively operable with the camera 9 and the range finder 8 to determine the

position of the effector 5 in three-dimensional space with respect to a specific point of interest on a wig cap 2.

The control system may include a display system 10, such as a screen or monitor 11, to facilitate visual interaction with a robot operator. For example, prior to wig construction a real-time image 12 of the cap 2 may be displayed and presented to the robot operator. To capture the real-time image 12 of the cap 2, any number of cameras may be focused on the cap 2. These cameras may include additional cameras and/or the previously described cameras attached to a distal end of the at least one robotic arm of the robot 7. A variety of different techniques may be employed using the captured real-time video image 12 to control and customize the wig construction process. Data may be visualized by the operator or used directly by the robot 1 to direct the process.

In one illustrative embodiment, the real-time video image 12 being displayed may be visually overlapped with data previously used to orient the cap 2 and/or the cap holder 3 in three-dimensional space. For example, once properly oriented, an image of the cap holder 3 may be electronically stored in the computerized control system. The image of the cap holder 3 may be recalled and overlapped with the real-time video image 12 of the cap 2. For example, the image may be either wire-frame or surface rendered. In one embodiment, to make the two images more distinguishable, the image of the cap holder 3 is electronically formatted into a three-dimensional wire-frame image that is superimposed onto the real-time video image 12 of the cap 2.

In an alternative and more sophisticated embodiment, the control system may be configured to accept several identified points of interest on the real-time video image 12. This data may be entered interactively by the robot operator or captured automatically by the control system. In one illustrative embodiment, fiducial markers 13 may be placed at selected locations around the cap 2. These points of interest may be matched with previously stored data used to

orient the cap 2 in three-dimensional space with respect to the robot 1. Using real-time mapping algorithms and/or other data manipulation techniques known in the art, the real-time image 12 of the cap 2 may be resolved into the three-dimensional space known to the robot 1.

By visually interacting with the control system, the robot operator may customize the wig construction process to produce a wig having desired characteristics. For example, once the cap 2 is positioned for construction, e.g., positioned on a cap holder 3, an image of the cap 2 may be displayed on the display system 10. As described, the previously stored orientation image may be recalled and overlapped with the real-time image 12, or the real-time image 12 may be mapped with the orientation data allowing direct interaction with the real-time image 12. As additional input, the operator may recall a previously stored image of the end users scalp and/or head. As previously described, scanning the end user's scalp and/or head may create this image. The operator to help facilitate the custom wig construction process may recall this data.

The robot operator may interact with the display system 10 to control and customize the wig construction process. For example, the robot operator may interact with control system using a light pen or other data entry device and select a variety of different variable characteristics of the wig to be produced. For example, the operator may select desired hair location, i.e., coverage, hair color, density, texture, direction, coarseness, etc. The operator may select to blend certain colors, fade certain areas with respect to hair density, color, hair direction, etc. As a practical matter, it should be appreciated that the control system and its software may be configured so that virtually any variable considered during traditional wig construction may be varied and robotically carried out.

In another embodiment, the robot operator may control and customize the wig construction process by physically interacting with the cap 2. That is, the robot operator may enter data into the robot control system by physically interacting with the cap 2. For example,

using a data entry device 14, such as a wand, light pen, marker, etc., that has been oriented in three-dimensional space with respect to the robot 1, the robot operator may interact with the cap 2 to mark areas of interest or perform other data entry functions. The data entry device may be wireless or wired, depending upon the particular application. This approach allows the robot operator a more hands-on approach to wig customization and may also be a more familiar and comfortable process to the operator.

In yet another illustrative embodiment, the operator may interact with a model, such as a head model, that is cooperatively operable with the control system to customize and control the wig construction process. The model may be configured and oriented in three-dimensional space with respect to the robot 1 in a fashion that is similar to the cap holder 3. Moreover, the model may be arranged such that identified points on the model correspond with identified points on the cap holder 3 or wig cap 2. Using a data entry device 14, such as a light pen, pointer, etc., the operator may interact with the model to customize the wig construction process. The model may be a universal head model capable of being repeatedly used for multiple wig construction processes. Alternatively, a custom model may be created to match a particular end user or application.

Once the control system is configured for a particular wig, the robot 1 may be activated to begin robotically constructing the wig. During this process, the robot retrieves hair 16 from a hair staging area 15 and attaches, i.e., implants, the hair 16 to an identified location on the cap 2.

The hair staging area 15 may be arranged and configured in any number of different ways. In one illustrative embodiment, the hair staging area 15 is configured in an n x n array organized, for example, by color and length. In this illustrative example, the rows of the array are organized by color, while the columns are organized by length. It should be appreciated,

however, that other hair characteristics, such as human, synthetic, animal, coarseness, etc. might be included in the organization scheme. Any number of modifications may be made to the hair staging area 15 to accommodate additional criteria. Moreover, it should be appreciated that any type of hair used with conventional wig construction may also be used with the present invention.

The placement and arrangement of the hair 16 in the array is ordinarily pre-programmed into the robot's control system. This information will vary depending upon the configuration of the hair staging area 15. For example, in one illustrative embodiment, the control system is programmed to anticipate the hair 16 to be stored in a direction parallel to its direction of retrieval. Using this information, the robot 1 may automatically retrieve the hair 16 necessary for completing the wig configuration input by the robot operator.

As described above, for example, the robot 1 may be equipped with two cameras attached to the distal end of at least one robotic arm 7. The camera views are provided to the control system, and the control system is operable to use this information to identify individual hairs stored in the hair staging area 15. Once an individual hair 16 of interest is identified, the control system directs the effector 5 attached to the robotic arm 7 to retrieve the hair 16.

After the effector 5 secures a hair 16, the effector 5 is moved by the robotic arm 7 to a position proximate the cap 2. Using any number of techniques, the control system operates to automatically and robotically move the effector 5 to attach the hair 16 to the cap 2. As described above, the effector 5 may include at least one of a hook 6, needle, or any other mechanical device or tool for attaching the hair 16 to the cap 2. In one illustrative embodiment, the control system attaches the hair 16 by moving the effector 5 in a manner that mimics the manual 'latch hook' technique used in conventional wig construction, however, any attachment technique may be

utilized. Moreover, the effector 5 may be equipped with a magazine or array of tools that are capable of being automatically deployed when attaching the hair 16 to the cap 2.

The robotic process of hair retrieval and attachment may be repeatedly completed until the wig construction process has reached a state of acceptance. The robot operator may monitor the construction process using, for example, the aforementioned cameras and display system 10. Periodically, if desired, the operator may halt the process and inspect the cap 2 and wig to ensure the process is being completed as desired. If necessary, modifications may be made using the control system. For example, at any point during the wig construction process, the operator may halt the robot 1 and interact with the control system to make modifications to hair color, texture, placement, quality, and/or any other variable. Alternatively, the control system may permit on-the-fly modifications, while the robot 1 is working.

The particular embodiments disclosed above are illustrative only, as the invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention.

What is claimed:

1. A method for constructing a wig comprising:

(a) positioning an at least one effector attached to a robotic arm of a robot proximate to a wig cap; and

(b) operating the effector to fixedly attach an at least one hair to the wig cap;

wherein the three-dimensional position of the wig cap relative to the effector is registered with a controller of the robot, and

wherein the registration is obtained through at least two cameras via a triangulation technique.

2. A method for constructing a wig comprising:

(a) localizing the three-dimensional position of a wig cap with respect to an at least one effector attached to a robotic arm of a robot;

(b) operating the effector to retrieve the at least one hair from a hair staging area;

(c) operating the effector to fixedly attach the at least one hair retrieved from the hair staging area to a location on the wig cap specified by a controller of the robot.

3. The method of claim 2 wherein the at least one hair is attached to the wig cap through a latch hook technique.

4. The method of claim 2 wherein the three-dimensional position of the wig cap is localized through a video registration technique.

5. The method of claim 4 wherein the position of the wig cap after the video registration is displayed as an image on a monitor.

6. The method of claim 5 wherein the image is overlaid with a second image.

7. The method of claim 2 wherein the three-dimensional position of the wig cap is localized through the use of an at least one universal connecter that positions a wig cap holder in a predefined location.

8. The method of claim 2 wherein the effector further comprises more than one mechanical device.

9. The method of claim 8 wherein the more than one mechanical devices are automatically interchangeable and cooperatively operable for robotically attaching the at least one hair to the wig cap.

10. A method for constructing a wig comprising:

(a) registering the three-dimensional position of a wig cap with respect to an at least one effector attached to a robotic arm of a robot with a controller of the robot;

(b) co-localizing at least one fiduciary marker affixed to a model with positions on the wig cap;

(c) operating the effector to retrieve at least one hair from a hair staging area;

(d) operating the effector to fixedly attach the at least one hair retrieved from the hair staging area to a location on the wig cap in a position specified by its proximity to the co- localized position of the at least one fiduciary marker.

11. The method of claim 10 wherein the at least one hair is attached to the wig cap through a latch hook technique.

12. The method of claim 10 wherein the model is the individual for which the wig is being constructed.

13. The method of claim 10 wherein the effector further comprises more than one mechanical device.

14. The method of claim 13 wherein the more than one mechanical devices are automatically interchangeable and cooperatively operable for robotically attaching hair to the wig cap.

15. The method of claim 10 wherein the three-dimensional position of the wig cap is registered through a video registration technique.

16. The method of claim 15 wherein the position of the wig cap after video registration is displayed as a real-time image on a monitor.

17. The method of claim 16 wherein the image is overlaid with a second image which represents the end user of the wig.

18. The method of claim 17 wherein the overlaid second image is used to preplan or direct the construction of the wig.