



(51) International Patent Classification:

A45D 44/00 (2006.01) G06F 19/00 (2011.01)
A61K 8/00 (2006.01) G06Q 30/00 (2012.01)
A61Q 5/10 (2006.01)

(21) International Application Number:

PCT/US2017/014503

(22) International Filing Date:

23 January 2017 (23.01.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/281,346 21 January 2016 (21.01.2016) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: VIRTUAL HAIR CONSULTATION

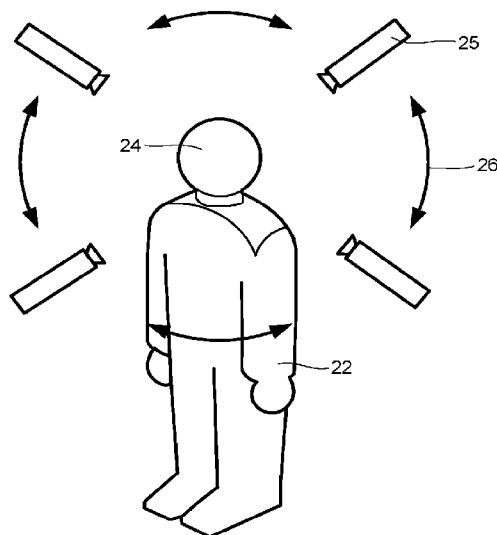


FIG. 1

(57) Abstract: Provided are a method and apparatus of generating a preview of a customizable hairstyle on an image of a client. The method includes receiving image data that is to be processed by a computer processor to generate the image of the client. An existing hairstyle of the client's is prepared as a virtual representation of the client's actual hair to appear in the image and render the virtual representation of the existing hairstyle customizable. Starting with the existing hairstyle appearing in the image of the client, a custom hairstyle is created to appear in the image of the client by modifying the existing hairstyle in the image.



Published:

— *with international search report (Art. 21(3))*

VIRTUAL HAIR CONSULTATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/281,346, filed January 21, 2016, which is incorporated in its entirety herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] This application relates generally to generating and modifying virtual renderings of body features and, more specifically, to a method and apparatus for generating an editable rendering of a client's existing hair to prepare a preview of an altered hair style in view of the client's facial features.

2. Description of Related Art

[0003] Various methods have been proposed for generating a preview of a hairstyle on a computer. In most instances, a digitized photograph of the client's head is displayed by a computer terminal and various hairstyle options selected from a menu are overlaid on top of the client's head. However, the available hairstyle options conventionally used to generate such previews are static images, with fixed properties that may not fully illustrate all traits of the desired hairstyle envisioned by the client.

[0004] More recently, attempts have been made to allow certain properties of a hairstyle selected from a menu to be altered in the preview. For example, the color of a selected hairstyle overlaid on the client's photograph can optionally be changed to a variety of colors in a color palette of available hair dyes. However, such customization is limited to the fill color of the otherwise static graphic of the overlaid hairstyle. Due to limitations of computer displays this displayed color will likely deviate from the actual hair color actually provided to, and observed by the client, making visualization of the previewed hair color relative to the client's skin tone, eye color, etc. difficult. Further, the static graphic of a hairstyle is overlaid on each client's photograph without regard for client-specific attributes such as each individual client's: face size and shape, head size and shape, hair texture, hair thickness, skin tone, and/or other features of the client and the client's existing hair (prior to

styling). As a result, computer displays have not been able to generate an accurate preview of a proposed hairstyle and hair color as it would appear on the client. Instead, conventional computer-generated previews have appeared much different than the actual hairstyle and hair color the client receives when viewed in relation to the client's face size and shape, head size and shape, hair texture, hair thickness, skin tone, and/or other features.

BRIEF SUMMARY OF THE INVENTION

[0005] Accordingly, there is a need in the art for a hairstyle preview method and apparatus that overcomes at least some of the limitations of conventional computer displays in previewing a hairstyle for each individual client. The present disclosure is directed toward such a method and apparatus that generates a preview of a hairstyle and hair color including a customizable rendering of the client's existing hair on a digitized photograph (3D Model) of the client. The computer-generated hairstyle is thus displayed relative to the client's own facial structure, skin tone, etc., for an improved representation of the actual hairstyle and hair color the client is to receive.

[0006] According to one aspect, the subject application involves a computer system that executes computer-executable instructions for rendering a captured likeness of a client in a virtual preview of aesthetic alterations to the client's actual hair, relative to one or a plurality of other attributes of the client that also appear in the preview. The preview can optionally allow full 360 degree rotation of the client's likeness and manipulation of the virtual representation of the client's actual hair (interchangeably referred to as the "virtual hair"), taking into consideration various other attributes captured by an image capture device, manually input into the computer system, or a combination thereof. Previewing alterations of the virtual representation of the client's actual hair, on the virtual likeness of the client exhibiting the client's visible attributes, greatly improves the ability of the computer system to accurately display hairstyling alterations based on the qualities of the user's actual hair, with the client's own likeness as a frame of reference.

[0007] For example, the computer system can support hair grouping, section selection, or both. Utilizing the virtual hair, the present technology will group the virtual hair matching the hair style and flow. The sensitivity or orientation of this grouping can be altered to allow for finer detail or more general hair groupings. From the hair groupings, a user can then select several hair groups in the preview to create a selected section for

alteration, and/or alter individual hair groupings. A section of hair can be moved throughout the 3D space within the physical confines of the hair length (i.e., the virtual representation of the hair can optionally be prevented from being extended beyond the then current length of the client's hair). However, alternate embodiments can allow the virtual hair to be lengthened to preview hairstyles that would be possible if the client let his/her hair grow. Then it can be pinned/held statically to simulate a new hairstyle, or the stylist can manually hold the virtual hair in a static position as they would normally, during physical hairstyling of the client's actual hair. The latter will allow for easier application of features detailed later in this document. Once the stylist is done holding the virtual hair section, they can release the section allowing the accelerative force of gravity simulated by the computer system to be reapplied to the hair in the preview. This will cause the virtual hair section that was being held to fall naturally into place, later to be styled with virtual styling tools to achieve the client's desired look or style.

[0008] Globally or confined to hair sections, the user can apply colorings to the virtual hair, starting from the client's hair color appearing in the captured images used to generate the preview. The user can also cut the virtual representation of the hair in the preview by mapping a nonintersecting line from one vertical start point to a vertical end point. This allows the user to freely cut the virtual representation of the hair in a straight line, jaggedly, in smooth curves, etc. Once the mapping is done, the virtual representation of the hair will truncate the affected strands of the virtual hair up to the drawn line. The remaining virtual hair trimmings will be discarded or otherwise hidden from view.

[0009] At any point during the alterations, the current state of the virtual hairstyle can be saved as a snapshot. This allows several styles to be previewed during one session. The user can also undo an alteration that has been previously completed, or even revert the virtual hair to its original state.

[0010] To achieve at least some of the foregoing aspects, a pre-rendering survey is presented to serve as analytics and aid for the stylist. Portions of these surveys can be utilized to add in the rendering of the virtual hair and virtual face appearing in the preview. Length, thickness, and texture can determine the extent and type of curliness, weight, and flow of the hair, for example.

[0011] The virtual hair flow, style, length, and texture determined by the computer system can optionally be overridden and superimposed on to the virtual likeness of the client

appearing in the preview. In some cases when the stylist wants to start from a particular state, the stylist can “grow” (lengthen) the virtual hair from its starting length to a length of their liking. The stylist can create a virtual hair type with attributes of color, thickness, texture, and flow tendencies. The stylist can select and edit a root layout style. From this layout style, they can then grow the virtual hair length from the roots to the desired length using a preconfigured or custom hair type. Growing the virtual hair will be done by extruding polygons that subdivide the scalp with regard to the root layout style. The definition and density is also configurable. This will allow an optimized styling flow for the virtual styling to appear in the preview generated by the computer system.

[0012] According to another aspect, the subject application involves a method of generating a preview of a customizable hairstyle on an image of a client. The method includes receiving image data that is to be processed by a computer processor to generate the image of the client. An existing hairstyle of the client’s is prepared as a virtual representation of the client’s actual hair to appear in the image and render the virtual representation of the existing hairstyle customizable. Starting with the existing hairstyle appearing in the image of the client, a custom hairstyle is created to appear in the image of the client by modifying the existing hairstyle in the image.

[0013] The above summary presents a simplified summary in order to provide a basic understanding of some aspects of the systems and/or methods discussed herein. This summary is not an extensive overview of the systems and/or methods discussed herein. It is not intended to identify key/critical elements or to delineate the scope of such systems and/or methods. Its sole purpose is to present some concepts in a simplified form as a prelude to the more detailed description that is presented later.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWING

[0014] The invention may take physical form in certain parts and arrangement of parts, embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

[0015] FIG. 1 is a perspective view of the creation of an illustrative imaging system that captures a virtual representation of a client’s existing hair;

[0016] FIG. 2 is a block diagram schematically depicting various components of an illustrative computer system for generating a preview of a customizable hairstyle on an image of a client;

[0017] FIG. 3 shows an illustrative embodiment of an alignment interface displayed by a display device for positioning a virtual representation of a client's head and hair;

[0018] FIG. 4 shows an illustrative embodiment of a menu of manually-selectable options that allow a user to input characteristics of the client's hair, face and possibly other attributes;

[0019] FIG. 5 is an illustrative front view of the virtual representation of the client's face and existing hair captured by an image capture device such as a camera and displayed by a display device, with facial dimension lines shown for illustrative purposes, however the facial dimension lines can optionally be displayed in the computer generated preview and optionally be made manually adjustable to fine tune the facial shape recognition;

[0020] FIG. 6 is an illustrative front view of the virtual representation of the client's face and existing hair captured by an image capture device such as a camera and displayed by a display device, with pattern lines overlaid on the client's existing hair for illustrative purposes, however the pattern lines can optionally be displayed in the computer generated preview and optionally be made manually adjustable to fine tune how accurately the pattern lines represent the flow of the client's existing hair;

[0021] FIG. 7 shows a sub-section of the virtual representation of the client's existing hair in FIG. 6 selected in a user interface for performance of a hairstyling operation on that selected sub-section;

[0022] FIG. 8 shows the sub-section of the virtual representation of the client's existing hair in FIG. 7 repositioned for performance of a hairstyling operation on that selected sub-section;

[0023] FIG. 9 shows the repositioned sub-section of the virtual representation of the client's existing hair in FIG. 8 with a cut line indicating a pattern to be cut using a cutting implement selected from a plurality of virtual hairstyling tools;

[0024] FIG. 10 shows the result of the virtual hairstyling operation performed in the view of FIG. 9 on the virtual representation of the client's actual hair;

[0025] FIG. 11 is an illustrative front view of the virtual representation of the client's face and existing hair, with a bulk coloring operation performed on the client's existing hair;

[0026] FIG. 12 is an illustrative front view of the virtual representation of the client's face and now colored hair, with a freehand coloring operation performed on a portion, but less than the entirety of the client's existing hair; and

[0027] FIG. 13 is an illustrative front view of the virtual representation of the client's face and existing hair at an original length captured by an image capture device such as a camera and displayed by a computer display device, prior to the client's existing hair being trimmed to the length appearing in FIGs. 5-12.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Certain terminology is used herein for convenience only and is not to be taken as a limitation on the present invention. Relative language used herein is best understood with reference to the drawings, in which like numerals are used to identify like or similar items. Further, in the drawings, certain features may be shown in somewhat schematic form.

[0029] It is also to be noted that the phrase “at least one of”, if used herein, followed by a plurality of members herein means one of the members, or a combination of more than one of the members. For example, the phrase “at least one of a first widget and a second widget” means in the present application: the first widget, the second widget, or the first widget and the second widget. Likewise, “at least one of a first widget, a second widget and a third widget” means in the present application: the first widget, the second widget, the third widget, the first widget and the second widget, the first widget and the third widget, the second widget and the third widget, or the first widget and the second widget and the third widget.

[0030] FIG. 2 shows an illustrative embodiment of a computer system 10 that includes a computer 11 comprising a computer processor 12 that executes computer-executable instructions stored in a non-transitory computer-readable memory 14, such as solid-state or magnetic-disc hard disk drives, for example. When executed, the computer-executable instructions cause the computer 11 to render a captured likeness of a client in a virtual preview of aesthetic alterations to the client’s actual hair, as captured by an image capture device 16, which can include one or more digital cameras for example. The aesthetic alterations appearing in the virtual preview can be based on the attributes of the client’s existing hair, and optionally displayed by a display device 18 operatively connected to the computer 11 relative to one or a plurality of other attributes of the client that were captured by the image capture device 16 in the preview. The preview can optionally allow full 360 degree rotation of the client’s likeness to show the hairstyle from a plurality of different vantage points, and manipulation of the virtual representation of the client’s actual hair (interchangeably referred to as the “virtual hair”), taking into consideration various other attributes captured by an image capture device, manually input into the computer system 10, or a combination thereof. Previewing alterations of the virtual hair, on the virtual likeness of the client exhibiting the client’s visible attributes, greatly improves the ability of the computer system 10 to accurately display hairstyling alterations based on the qualities of the

user's actual hair, as they will appear on the client once actual, physical hairstyling is complete. The previewed hairstyle performed on the virtual hair can optionally be defined by data transmitted by the computer 11 to an automated hairstyling device 20 with mechanized hair cutting, coloring, drying, curling, etc. devices that can automatically reproduce the previewed hairstyle on the client, without stylist intervention, under the control of the computer 11.

[0031] The method of generating the virtual representation of the client's actual hair, and subsequent hairstyling applied to that virtual hair to be displayed by a display device 18 (e.g., computer monitor, plasma and LCD television, holographic display, etc.) can begin with capturing the client's likeness, as illustrated schematically in FIG. 1. As shown, the client 22 can stand or be seated in a stationary position, and one or more digital cameras 25, video cameras, or other suitable image capture device 16 can be repositioned at a plurality of locations about the client's head region 24. According to alternate embodiments, the client 22 can rotate to provide a stationary camera 25 with each of the vantage points that would be achieved by rotating the camera(s) 25 about the client 22.

[0032] At least one, and optionally a plurality of images are captured of the head region 24 at each of the plurality of locations to capture image data that can be used to reproduce a full 360 degree image of the head region 24 as indicated by arrows 26. A suitable number of images can be taken about the head region 24 to allow those images to be stitched together by the computer 11 to assemble a three-dimensional virtual representation of the client's head region 24. This virtual representation of the client's head region 24 can then be rotated 360 degrees within the preview displayed by the display device 18 to provide a complete view of the proposed hairstyle being previewed.

[0033] At least one of the captured images received by the computer 11 can be arranged within the interface 28 displayed by the display device 18 as shown in FIG. 3, to provide a reference point for the analysis of the virtual representation of the client's likeness. Aligning the client's face within the interface 28 provides the computer system 10 with basic information about the general vicinity in which certain landmarks are likely to appear in the image(s) being analyzed. For instance, centering the image of the client within the outline 30 in FIG. 3 suggests that the client's nose will appear within a central region of the outline 30. Likewise, the client's chin will appear towards the bottom of the outline 30, and the client's hair will be positioned towards the top of the outline 30. By centering the client's face within the outline 30, the algorithms used for recognizing certain features of the client's face and

hair can be derived specifically to detect attributes of those features within the regions where they are most likely to appear, thus improving the attributes that can be recognized by the computer 11 in preparing the virtual representation of the client's hair.

[0034] One example of a suitable technique for detecting the client's face, and possibly other attributes is the Circle Hough Transform (CHT) technique. The CHT technique utilizes the Hough Transform, optionally modified to focus on oblong shapes common to human faces, as a feature extraction technique for detecting circular boundaries. The CHT technique is well adapted to identifying circular shapes in imperfect image inputs by ranking candidates in the Hough parameter space and then selecting the local maxima in a so-called accumulator matrix. Based on such an analysis, the boundary of the client's face can be roughly identified by the computer 11. Such an analysis and the accompanying drawings are not the only type of recognition application that can be utilized to recognize objects such as the client's face and other facial features, but are described herein as merely examples of the types of analysis that can be performed.

[0035] With the client's face properly positioned and the boundary of the client's face identified by the computer 11, the method can further involve a determination of the client's facial structure based on certain landmarks. For example, the client's facial shape can be determined by measuring a distance separating certain facial features at a plurality of different locations on the client's face. As shown in the preview 44 of FIG. 5, a plurality of distances D1, D2, D3 can be measured to determine the client's facial shape. For instance, the distance D1 between a hairline of the client and an eyebrow of the client can be measured; the distance D2 between the eyebrow and a distal end of the client's nose can be measured; and the distance D3 between the end of the nose and a bottom of the client's chin can be measured. Color gradients occurring in certain regions of the client's face where the computer 11 expects the nose, chin, eyebrow, etc. to be located based on the proper positioning of the face as noted above can be used to identify the location of each facial feature used in measuring the distances D1, D2, D3. Based on the lengths of these distances D1, D2, D3, and optionally the width of the client's face at one or more locations along the height of the client's face. Previewed hairstyles generated for the client's likeness in the preview by the computer 11 can be customized according to the client's specific facial shape.

[0036] In addition to positioning the image of the client's face for digital image analysis, the operator can optionally be prompted by a user interface 32 shown in FIG. 4 to manually input additional information about the client's attributes. The user interface 32 can

include at least one color selection tool, and optionally a plurality of subjective ranking tools 38 that allow the operator to fine tune the attributes recognized by the computer 11 on a relative scale. For the illustrative embodiment shown in FIG. 4, a natural color menu 34 can be selected to display a full, or at least common pallet of colors from which the operator can pick the natural hair color of the client's hair, as specified by the client 22. A current color menu 36 can also be provided, allowing the client's current hair color to be manually entered into the computer system 10 if different than the natural hair color entered via the natural color menu 34 or recognized by the computer 11 from the captured images. For instance, if the client has previously colored his/her actual hair using a known hair coloring application, that known hair color can be entered via the current color pallet 36, if different than the client's natural hair color. The natural hair color selected via the natural color menu 34, the current hair color selected from the current color pallet 36, or the hair color in the captured images can appear in the preview 44 as part of the starting hairstyle to be modified.

[0037] For the embodiment shown in FIG. 4, each of the ranking tools 38 includes five fillable "bubbles" corresponding to five increments of a scale corresponding to each attribute. For the example shown in FIG. 4, the ranking tools 38 include a category to specify the length 40 of the client's hair appearing in the captured images. The five fillable bubbles 42 range from a "short" option on the far left to a "long" option on the far right. In the illustrated embodiment, the second shortest option has been selected as denoted by the filled bubble, serving to refine or confirm the recognized attributes of the client's hair from the captured images. In addition to the length category 40, the other attributes included in the interface 32 include: hair thickness (ranked from bald to full), hair texture (ranked from very fine to extremely coarse), hair damage (ranked from virgin to severely damage), client lifestyle (ranked from sedentary to very active), and face shape (selected from among a plurality, such as the seven basic face shapes including oval, round, square, diamond, heart, pear and oblong, for example). According to alternate embodiments, other attributes can be included in the interface 32 to input whether the client's hair appearing in the captured images has been chemically treated, whether the client's hair appearing in the images includes artificial hair extensions, and/or whether the client's existing hair differs in appearance from the client's hair appearing in the captured images, which may have been captured during a previous visit. The present system and method can utilize none, one or a plurality of the ranking tools 38 to improve the accuracy of the client's likeness to appear in the preview. Although the ranking tools 38 are shown and described as fillable bubbles for

the sake of brevity to clearly explain the present technology, any suitable user interface (e.g., sliding bar scale, numerical ranking, etc.) that allows the user to input an indication of degree, ranking or other selection is within the scope of the present disclosure.

[0038] The virtual likeness 46 of the client along with the virtual hair 48 is generated by the computer 11 based on the captured images and the attributes gleaned therefrom, and optionally the manually-input data via the interface 32 of FIG. 4, to appear in the preview 44 shown in FIGs. 5-13. Rather than a static image, however, at least the virtual hair 48 is an active representation of the client's actual hair to be used as the starting point to be modified for creating the hairstyle to be presented to the client as part of the preview 44. The term "virtual hair" refers to a three-dimensional 360 degree, virtual reality version of the client's hair. In other words, "virtual hair" can be considered a virtual representation of the client's actual hair within the preview 44, with an appearance matching the client's actual, existing hair as close as practically possible in relation to the other facial attributes of the client 22 also appearing in the image, but rendered capable of modification by traditional hairstyling techniques simulated by the computer 11 in the preview 44. Thus, the virtual hair 48 of the present disclosure differs from typical graphic rendering techniques that simply fill or overlay a computer-generated graphic with a selected hair color and/or hairstyle, regardless of the attributes of the real-world object represented by that computer-generated graphic for example. According to the present example, a desired hair color may appear darker on a client having a very dark natural hair color than it would appear on a client having a blonde natural hair color. Conventional display techniques are limited to simply filling a graphic overlaid onto a photograph of a client with the desired hair color and/or hairstyle, independent of the client's actual hair color and hair characteristics. As a result, the client may be unpleasantly surprised upon having his/her hair dyed that color or cut that style only to discover that the computer display did not accurately portray how the desired hair color and/or hairstyle would appear in practice, with their natural hair color and hair characteristics as a starting point.

[0039] With the virtual hair 48 generated and appearing in the preview 44, the stylist or any other operator can now simulate various hairstyling techniques on the virtual hair 48 to obtain a virtual simulation of how those techniques will translate to the client's actual hair in practice. The computer system 10 receives modifications to the virtual hair 48 through manipulation of a plurality of different hairstyling tools shown in FIGs. 5-13. For example, in FIG. 6, the operator has elected to perform a combing operation on the virtual

hair 48 by selecting a sectioning tool 50 by clicking on the corresponding icon in the preview 44. In response to selecting the sectioning tool 50, the computer 11 can use color gradients, patterns, other hair attributes, or any combination thereof to generate a preliminary set of pattern lines 52 representing the hair pattern of the virtual hair 48, and/or optionally indicating a generalized, bulk direction in which hair strands extend in each of the different regions. The operator can manually select available types of lines that can be used to perform the desired direction of the cut done on the virtual hair. In FIG. 6, the available types of pattern lines 52 include diagonal lines, vertical lines, horizontal lines and pie sections that can be used to group regions of the virtual hair 48. The pattern lines can then be selected by the operator for the performance of certain hairstyling operations that are to be limited to the regions defined by the selected pattern lines, leaving the other, unselected regions unchanged. As another example, the overall length of the client's virtual hair 48 can be truncated. In FIG. 13, the original length of the virtual hair 48 is shortened from the longer-than-shoulder length to the less-than-shoulder length appearing in FIGs. 5-12 using the cutting tool 60. Following the performance of a styling operation, the pattern lines 52 for the affected region can be changed to reflect the result of the hairstyling operation. The pattern lines 52 generated by the computer based on digital image analysis of the captured images of the client can be updated through manual input by the operator using a stylus, mouse, finger on a touch screen display, or other computer pointing device to move or otherwise edit any pattern lines 52.

[0040] At least a portion of the hairstyling tools used to modify the virtual hair 48 in the preview 44 require the grouping to be modified to be separated or isolated from other groupings of the virtual hair 48, as identified by the pattern lines 52. For instance, to trim one grouping of virtual hair 48 but not a neighboring grouping to create the appearance of layers, the grouping 54 has been selected using the “hold” tool 56 in FIG. 7. To identify which grouping has been selected, the selected grouping 54 is shaded a different color than the non-selected groupings in FIG. 7, but other indicators such as unique pattern lines 52, etc., can be utilized to identify the selected group without departing from the scope of the present disclosure.

[0041] The operator can then move the selected groupings 54 throughout the 3D space within the preview 44, optionally within the physical confines established by the hair length (i.e., the virtual representation of the hair can optionally be prevented from being extended beyond the then current length of the client's hair). However, alternate

embodiments can allow the selected groupings 54 to be lengthened to preview hairstyles that would be possible if the client 22 let his/her hair grow. The effect can optionally be achieved using extensions, for example, instead of waiting for the client's own hair to grow. The moved grouping 54 can optionally be designated to be pinned/held statically within the preview 44 as shown in FIG. 8 to simulate a new hairstyle, or the stylist can manually hold the virtual hair in a static position as they would normally do during physical hairstyling of the client's actual hair. Isolating the selected grouping 54 from other, unselected groupings will help the operator limit application of a hairstyling operation to the selected grouping 54. For example, as shown in FIG. 9, the cutting tool 60 is selected to allow the operator to draw a cut line 62 marking the desired length of the selected grouping 54. The cut line 62 can be drawn straight, or include one or more waves, for example. Upon receiving confirmation of the desired cut, the computer 11 shall shorten the length of hair appearing in the selected group 54 and alter the length of pattern lines 52 for that group accordingly. Once the operator is done holding the selected grouping 54 of the virtual hair 48, the selected grouping 54 is released from the held/pinned position in the preview 44 and the accelerative force of gravity simulated by the computer system 10 causes the selected grouping 54, with the hair therein at the new length, to fall naturally into place as shown in FIG. 10. Any portions of the client's face or other attributes of the client in the preview that were previously concealed from view by the now cutaway hair can be filled in by the computer 11 using extrapolation techniques based on the shape of the client's face as determined above.

[0042] Although the preceding example was described using a cutting tool 60, the present method and apparatus offers a variety of different tools available for styling the virtual hair 48. For example, the illustrative embodiment shown in FIGs. 11 and 12 provides the operator with several color tools 70 available for modifying the color at least a portion of, and optionally all of the client's virtual hair 48. In FIG. 11, the bulk color tool 72 is selected, allowing the operator to change the bulk color of substantially all of the virtual hair 48 to a selected color 74. The virtual hair 48, optionally with the new bulk hair color, can also have portions thereof, but less than all of the virtual hair 48, be edited to include a second color 76 such as highlights, as shown in FIG. 12. For the present embodiment, the freehand tool 78 is selected to allow the operator to apply the second color 76 to only selected groupings of the virtual hair 48 to create highlights or other hair coloring effects.

[0043] Although the hairstyling tools described above relate to cutting and coloring the virtual hair 48, the embodiment shown in FIG. 12 also includes a styling

category 80 of tools available to the operator to achieve other desired styling and finishing effects. For example, the styling tools can include at least one, and optionally a plurality of a hair curling implement, a hair crimping implement, a hair brushing implement, and a blow dryer, for example. Any other hairstyling tools available to a hairstylist in practice are also contemplated within the scope of the present disclosure.

[0044] The embodiments discussed above pertain to alterations performed on the virtual hair 48. However, alternate embodiments of the present method and apparatus allow the operator to select a proposed hairstyle saved in a database stored in the memory 14 of the computer 11 to be “tried on” by the client within the preview 44. Instead of, or in addition to retrieving a proposed hairstyle from such a database, a photograph of a desired hairstyle can be captured by a digital camera or other image capture device to be “tried on” by the client within the preview 44. Regardless of whether the proposed hairstyle is obtained from a database or captured using a digital camera, the proposed hairstyle can be adjusted from the condition in which it was retrieved to be specific to the client 22 appearing in the preview 44. For example, if the desired hairstyle was captured from a person having a round face, but the client has a square face, the computer 11 can modify the desired hairstyle to conform to the square face of the client. As another example, if the desired hairstyle to be shown on the client’s likeness in the preview 44 has red hair and the client’s natural hair color is very dark, the tint of the red color in the desired hairstyle can be adjusted to reflect how it would appear on the client. Similarly, the desired hairstyle can be adjusted in the preview 44 based on the thickness of the client’s virtual hair 48, which may be thicker or thinner than the model from which the desired hairstyle was captured, to reflect how the desired hairstyle would look with the client’s different hair thickness. This customization of the desired hairstyle to provide a realistic simulation of how that desired hairstyle would look on the client’s head is also performed for any other hair characteristics that may differ from the desired image to the client’s hair. For example, if the desired hairstyle is blond in color and the client’s actual hair is very dark, the hue of that blond hair may be darkened slightly from its appearance in the desired image when shown on the client in the preview 44 to reflect dyeing the client’s dark hair blond.

[0045] Although the examples provided above describe customizing the virtual hair 48 on top of the client’s likeness in the preview 44, and the client is female in the illustrative embodiments of the preview 44 in the drawings, the present disclosure is not so limited. Rather, the client can be male, and the virtual hair to be styled in the preview 44 can

be facial hair instead of, or in combination with the hair on top of the client's head without departing the scope of the present application.

[0046] Illustrative embodiments have been described, hereinabove. It will be apparent to those skilled in the art that the above devices and methods may incorporate changes and modifications without departing from the general scope of this invention. It is intended to include all such modifications and alterations within the scope of the present invention. Furthermore, to the extent that the term "includes" is used in either the detailed description or the claims, such term is intended to be inclusive in a manner similar to the term "comprising" as "comprising" is interpreted when employed as a transitional word in a claim.

CLAIM(S)

What is claimed is:

1. A method of generating a preview of a customizable hairstyle on an image of a client, the method comprising:

receiving image data that is to be processed by a computer processor to generate the image of the client;

preparing an existing hairstyle as a virtual representation of the client's actual hair to appear in the image and render the existing hairstyle customizable; and

starting with the existing hairstyle appearing in the image of the client, creating a custom hairstyle to appear in the image of the client by modifying the existing hairstyle in the image.

2. The method of claim 1, wherein said receiving the image data comprises receiving a plurality of views of the client, and the image of the client comprises a three-dimensional image of the client that is adjustable in the preview to show the existing hairstyle and the custom hairstyle from a plurality of different vantage points.

3. The method of claim 1 further comprising:

determining a facial shape of the client by measuring a distance separating facial features at a plurality of different locations on the client's face.

4. The method of claim 3, wherein the distance separating the facial features is measured:

between a hairline of the client and an eyebrow of the client;

between the eyebrow and a distal end of a nose; and

between the end of the nose and a bottom of a chin.

5. The method of claim 3 further comprising:

receiving proposed hairstyle data representing a first hairstyle to be presented in the image appearing in the preview; and

adjusting the proposed hairstyle based, at least in part, on the facial shape of the client for displaying the proposed hairstyle appropriately in the preview for the client having the facial shape.

6. The method of claim 5, wherein said receiving the proposed hairstyle comprises receiving model hair data captured by an imaging device from a photograph of the proposed hairstyle.

7. The method of claim 1, wherein said generating the existing hairstyle comprises:

organizing the existing hairstyle into a plurality of different regions; and

establishing, for each of the plurality of different regions, pattern lines indicative of a generalized direction in which hair strands extend in each of the different regions.

8. The method of claim 7, wherein the pattern lines are established to further indicate a hair pattern.

9. The method of claim 7 further comprising:

presenting a user interface including a plurality of virtual hairstyling tools that are selectable by a user to perform hairstyling techniques as part of said modifying the existing hairstyle.

10. The method of claim 9, wherein said modifying the existing hairstyle using at least one of the plurality of virtual hairstyling tools modifies the existing hairstyle and alters at least one of the pattern lines in the image.

11. The method of claim 10, wherein the plurality of virtual hairstyling tools comprises at least one of:

- a hair cutting implement;
- a hair curling implement;
- a hair crimping implement;
- a hair brushing implement;
- a razor; and
- a blow dryer.

12. The method of claim 1 further comprising:

receiving manually-input preliminary hairstyle information indicative of a un-dyed natural hair color, current hair color, thickness, density of the client's hair, wherein the existing hairstyle is to appear in the image in the natural color as part of the preview.

13. The method of claim 1, wherein the image data constitutes a photograph captured by a digital imaging device, and said method further comprises:

receiving preliminary hairstyle information indicating that the client's hair appearing in the photograph has been chemically treated, and the existing hair appearing in the preview is altered from an appearance of the client's hair appearing in the photograph.

14. The method of claim 1, wherein the image data constitutes a photograph captured by a digital imaging device, and said method further comprises:

receiving preliminary hairstyle information indicating that the client's hair appearing in the photograph includes an artificial hair extension, and the existing hair appearing in the preview is altered from an appearance of the client's hair appearing in the photograph.

15. The method of claim 1 further comprising:

transmitting data indicative of the custom hairstyle to an automated hairstyling device to control operation of the automated hairstyling device to give the client the custom hairstyle.

16. The method of claim 1, wherein said receiving the image data comprises receiving a plurality of views of the client to be assembled to establish a full 360° virtual representation of a head region of the client, and the image of the client comprises a rotatable image that can be rotated to display a full 360° of the head region in the preview to show the existing hairstyle and the custom hairstyle from a plurality of different vantage points.

17. The method of claim 1 further comprising:

determining a thickness of the client's actual hair by receiving a manually-input indication of perceived hair thickness;

receiving proposed hairstyle data representing a first hairstyle to be presented in the image appearing in the preview; and

adjusting the proposed hairstyle based, at least in part, on the thickness of the client's actual hair for displaying the proposed hairstyle appropriately in the preview for the client having the thickness input.

18. The method of claim 1, wherein the existing hairstyle is a virtual representation of the client's facial hair.

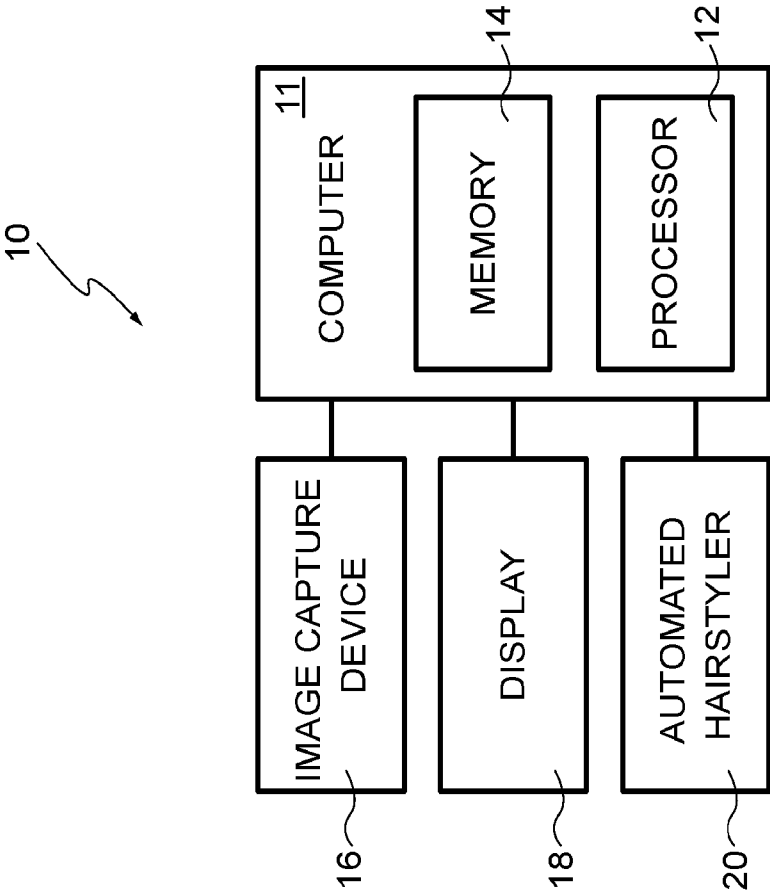


FIG. 2

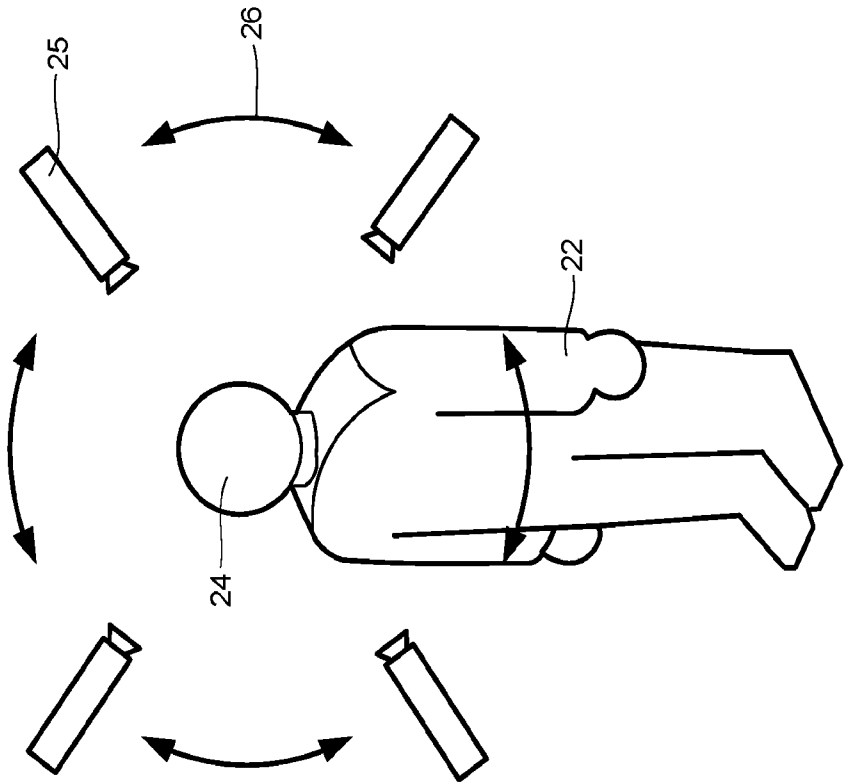


FIG. 1

32

Tell us about your clients hair characteristics

34 ~ Natural Color

36 ~ Current Color

Length

40

42

38

Thickness

Texture

Damage

Lifestyle

Face Shape

Add Notes

SUBMIT TO CLIENT NOTES

FIG. 4

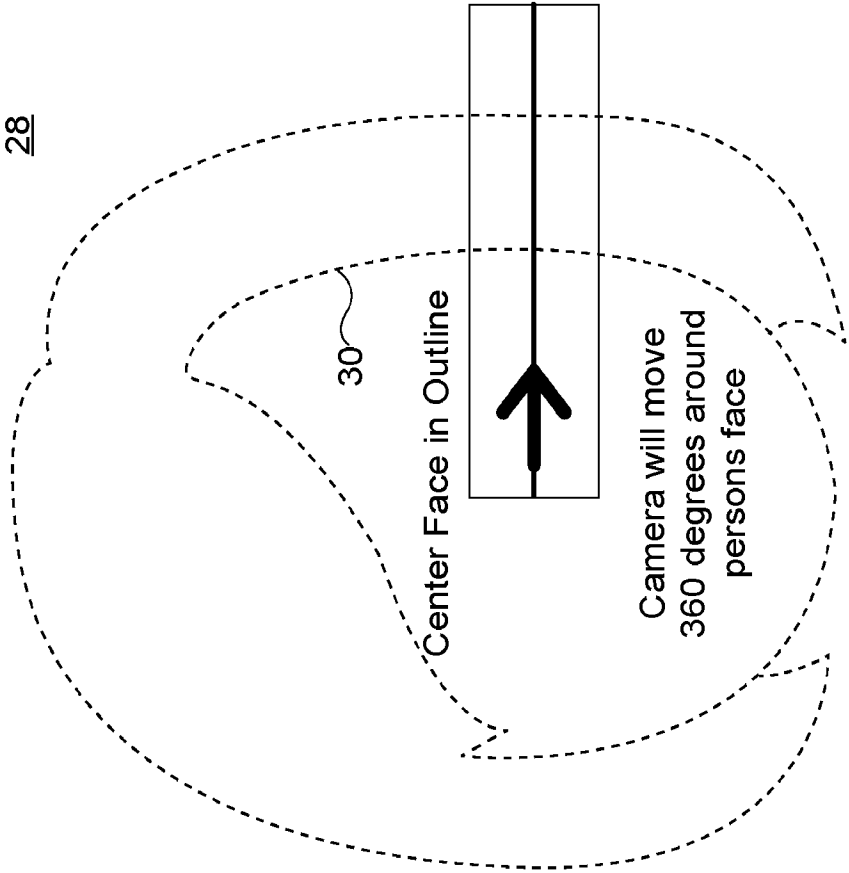


FIG. 3

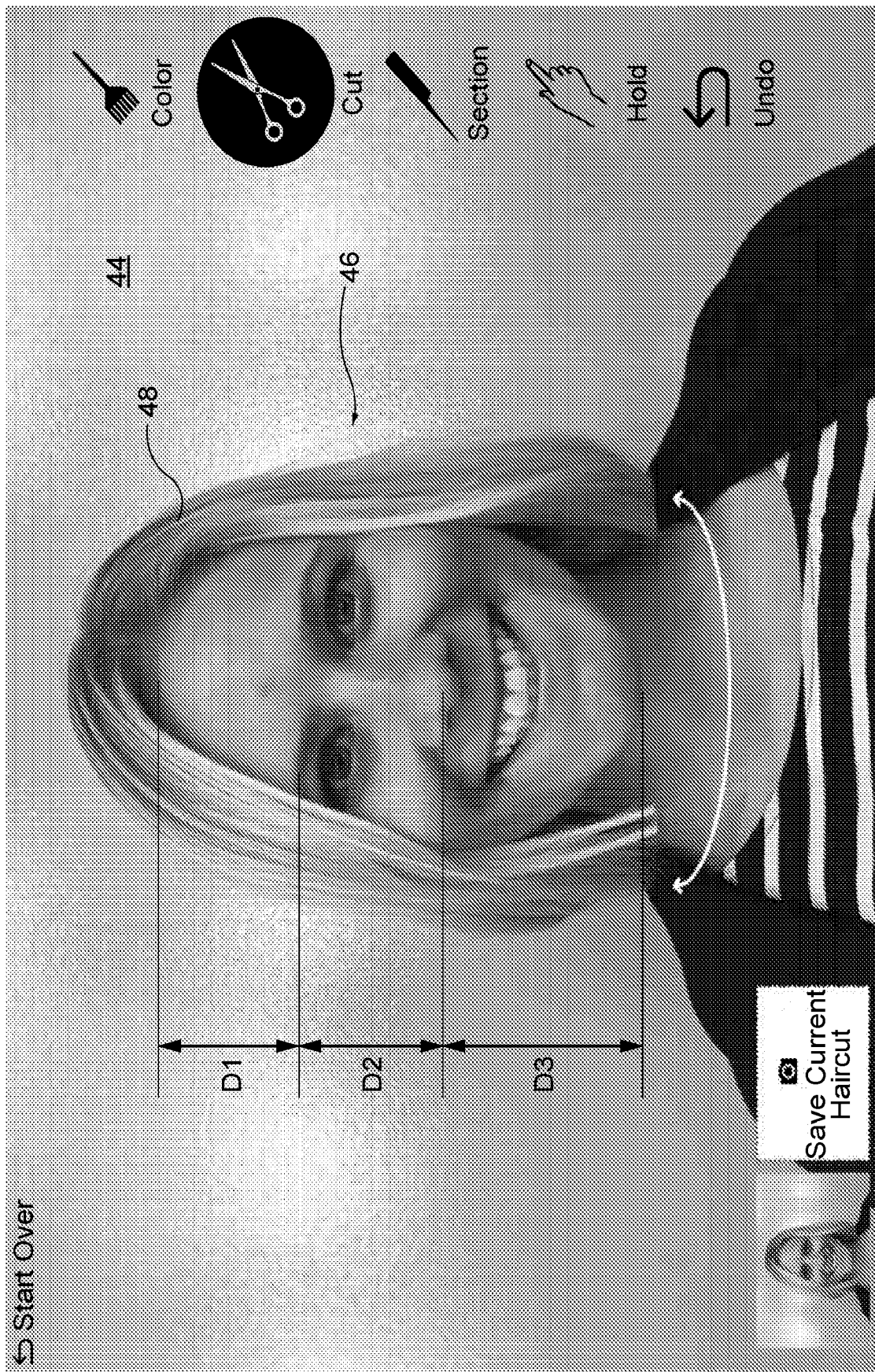


FIG. 5



FIG. 6

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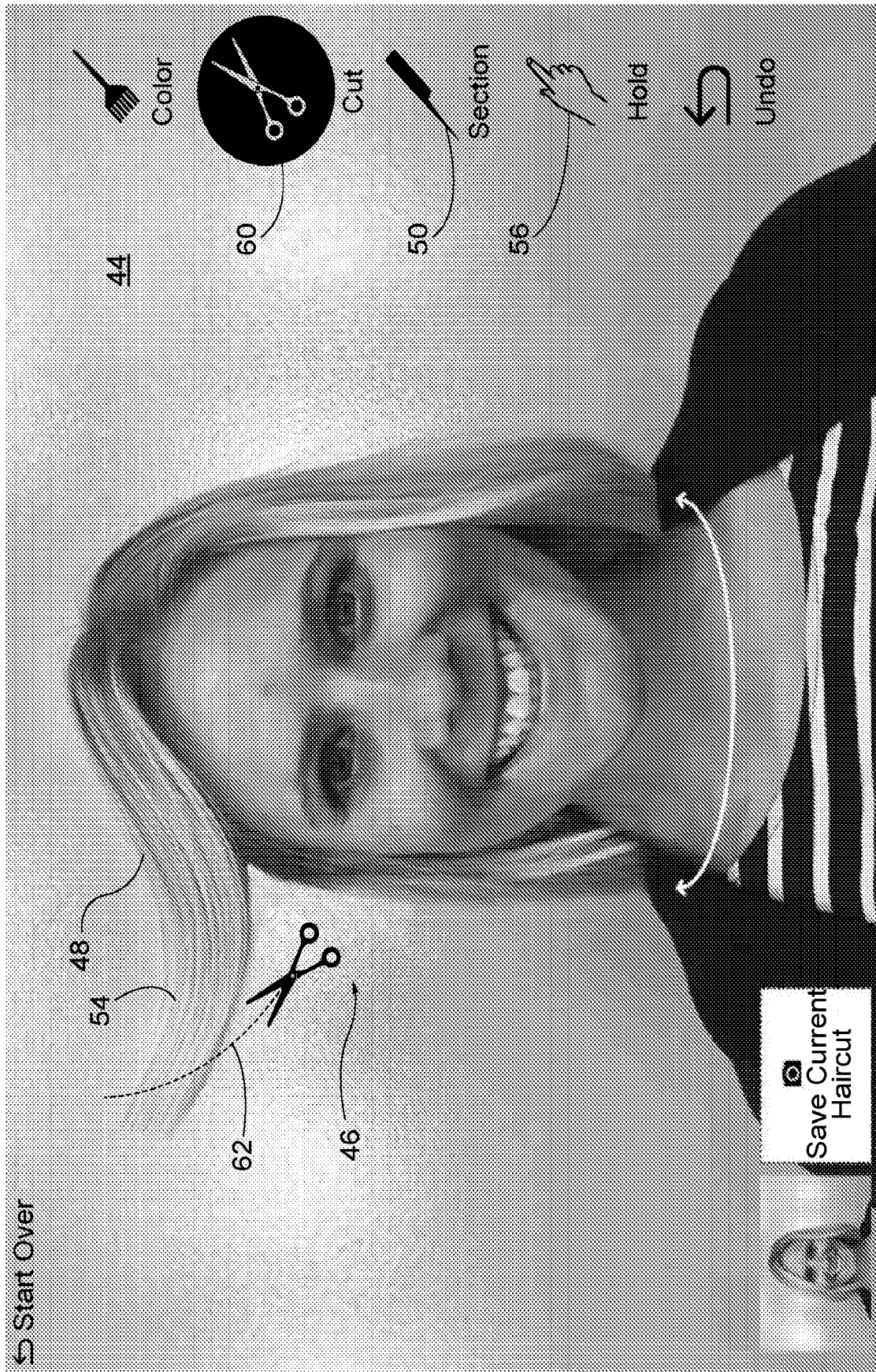
FIG. 7

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FIG. 8

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FIG. 10

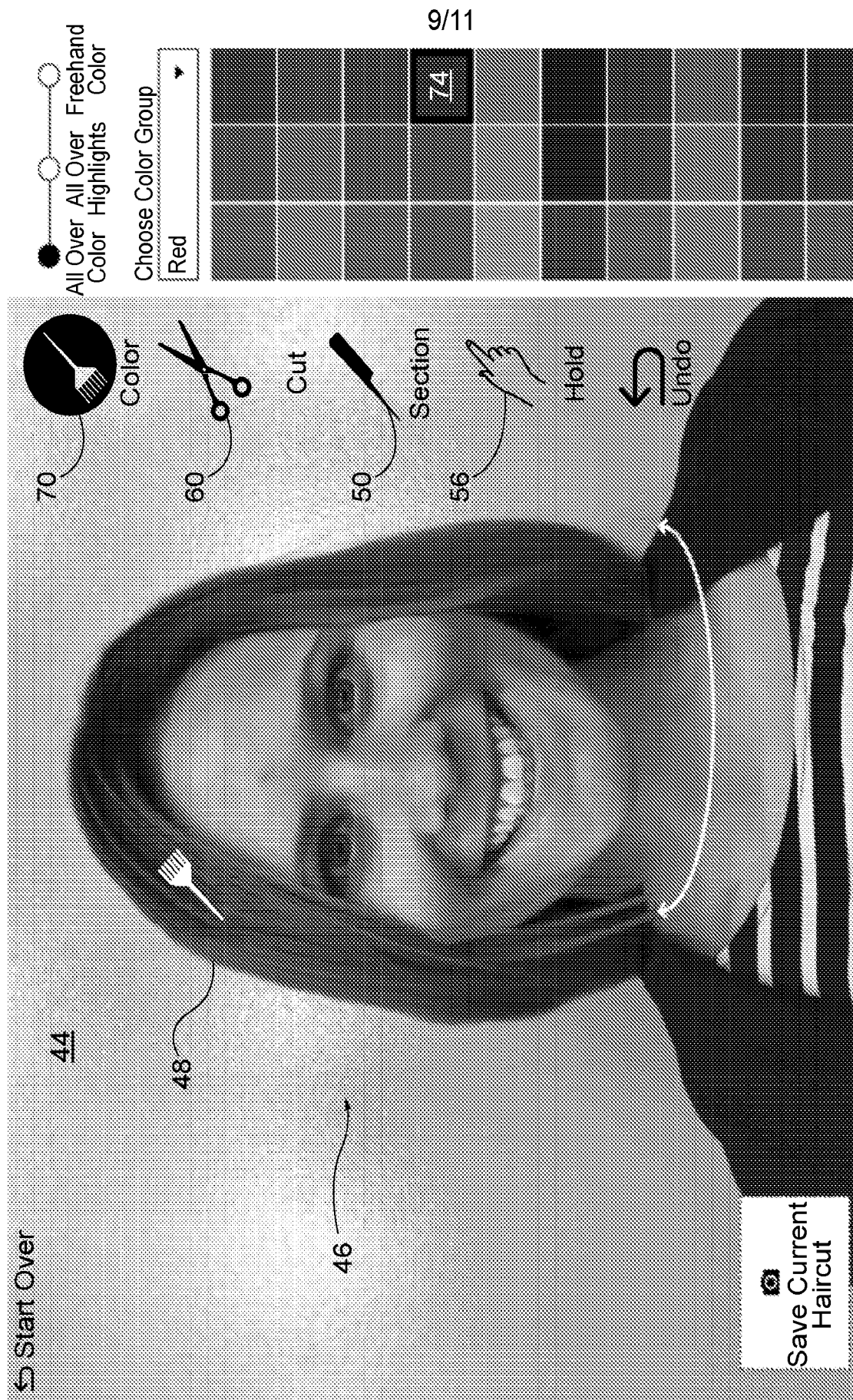


FIG. 11

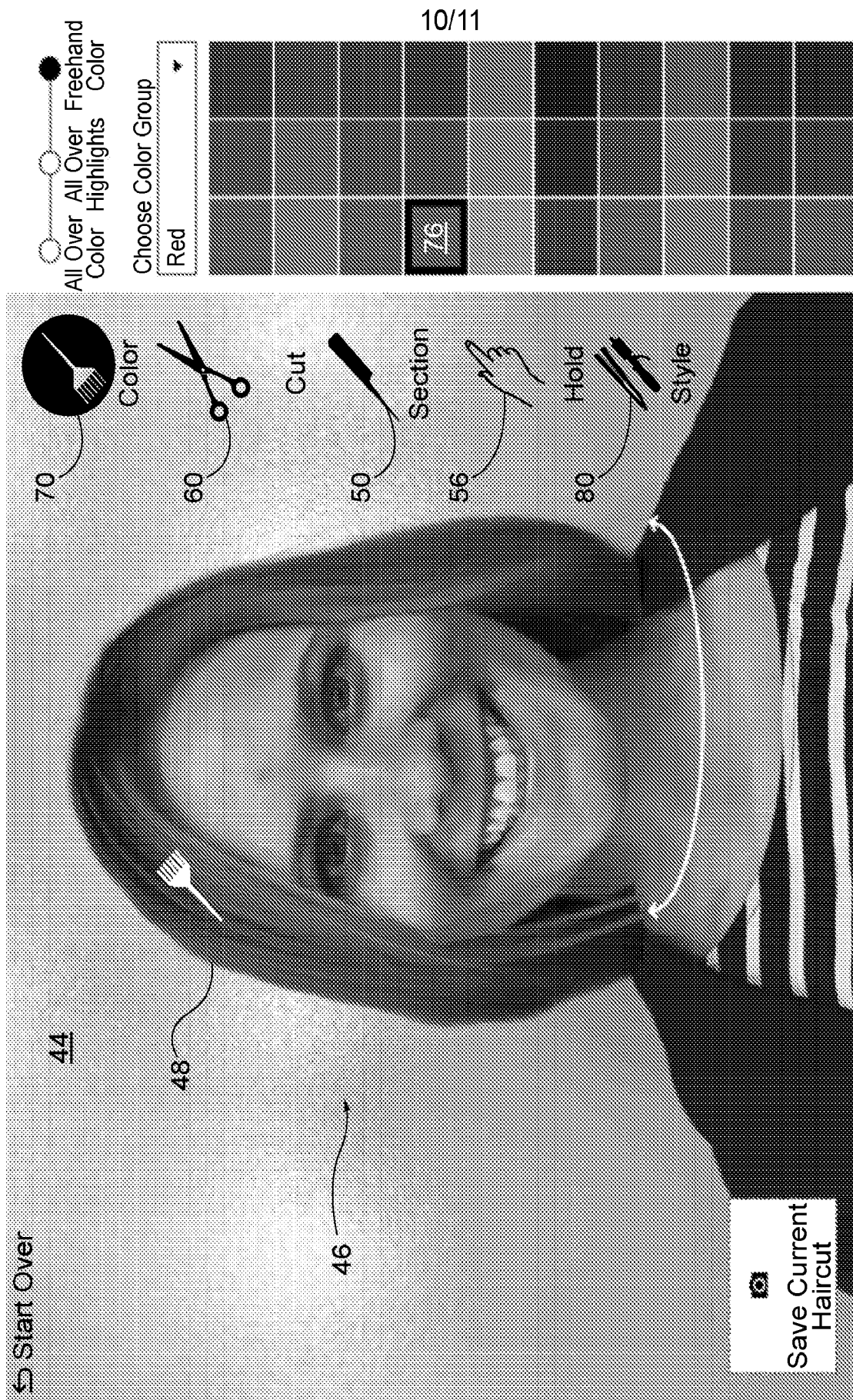


FIG. 12

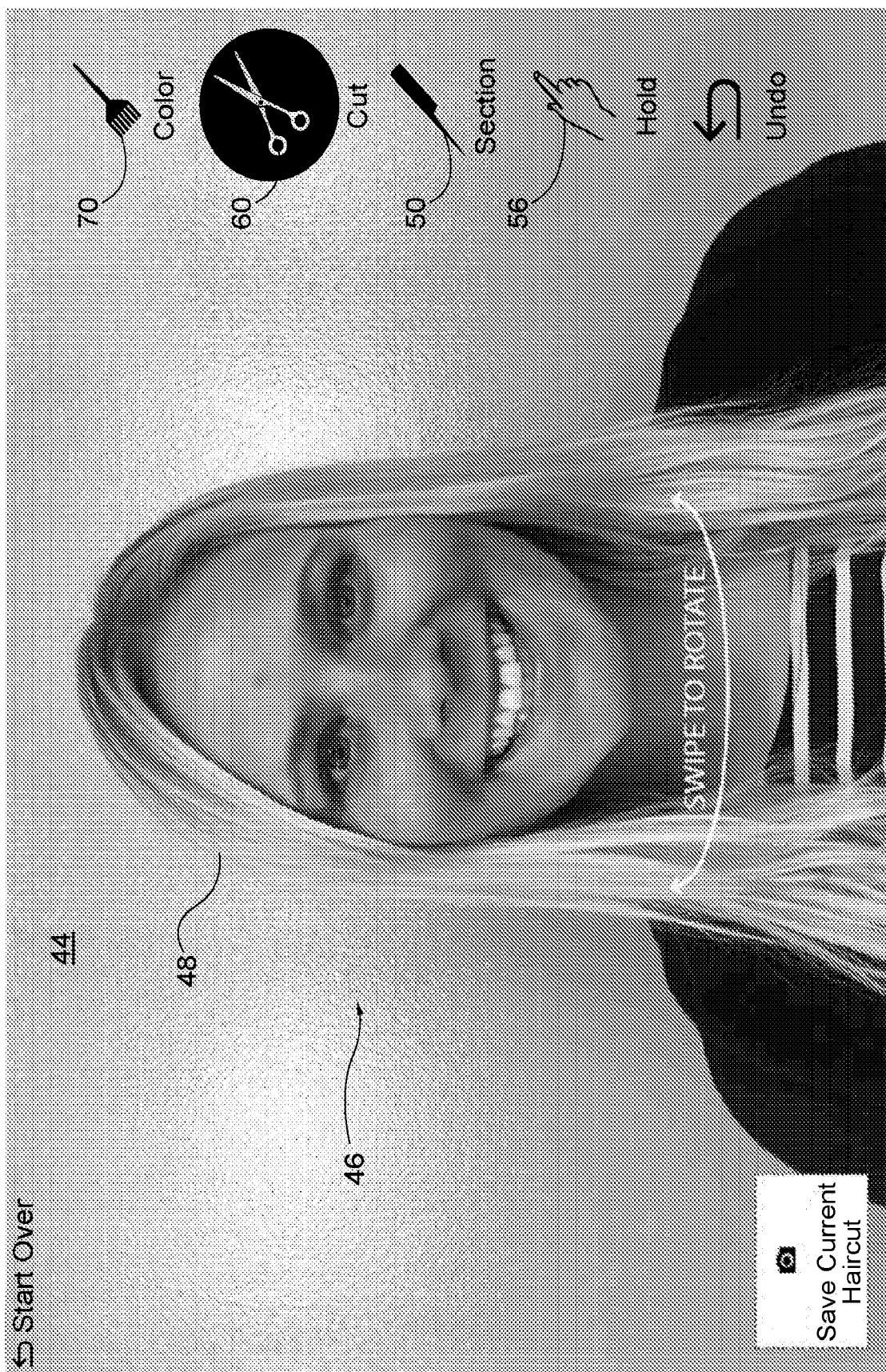


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2017/014503

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A45D44/00; A61K8/00; A61Q5/10; G06F19/00; G06Q30/00 (2017.01)

CPC - A45D44/005; A45D19/00; A61Q5/065; A45D2200/058; A45D2019/0066 (2017.02)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 345/419; 8/405; 434/94; 705/26 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8,977,389 B2 (COLORCULTURE NETWORK, LLC) 10 March 2015 (10.03.2015) entire document	1, 7-13, 17
Y		2-6, 14-16, 18
Y	US 2007/0265867 A1 (LIN) 15 November 2007 (15.11.2007) entire document	2, 6, 15, 16
Y	US 2011/0115786 A1 (MOCHIZUKI) 19 May 2011 (19.05.2011) entire document	3-6, 18
Y	US 2015/0052008 A1 (CAMPBELL) 19 February 2015 (19.02.2015) entire document	14
A	US 2007/0107744 A1 (DILBECK et al) 17 May 2007 (17.05.2007) entire document	1-18

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 March 2017

Date of mailing of the international search report

06 APR 2017

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