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GENERATING DYNAMIC EMOTIVE ANIMATIONS FOR AUGMENTED REALITY

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TECHNICAL FIELD

This description generally relates to methods and devices for generating dynamic emotive reaction animations in an augmented reality (AR) environment based on data associated with users.

BACKGROUND

Online shopping applications can provide interactive services that allow a consumer to utilize an electronic device to search for and purchase products. The interactive services may respond to any number of searches and selections performed by the consumer on the electronic device. A shopping interaction that accesses the interactive services may result in a transactional purchase in which the consumer may add one or more selected products and enter payment information to trigger a retailer to package and send the purchased products to the consumer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a third person view of an example physical (real-world) environment, in which a user is experiencing an augmented reality (AR) shopping environment through a display device.

FIG. 2A illustrates an example of a user accessing content in a user interface on an electronic device.

FIG. 2B, 2C, 2D, 2E, 2F and 2G are diagrams illustrating user interfaces of a user accessing shopping items on an electronic device, according to example implementations.

FIG. 3 is a block diagram illustrating an example system for generating and displaying dynamic emotive content in an augmented reality (AR) space or in an electronic device.

FIG. 4 is a flow chart diagramming one implementation of a process to generate and display dynamic emotive content.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

In general, this document describes example approaches for generating and displaying dynamic emotive content associated with a three-dimensional virtual fitting of one or more shopping items. Such shopping items may be selected in an electronic shopping environment in augmented reality (AR) or other electronic environment. The generated emotive content can provide, to the user, a dimension of intelligence that the user may use to make informed determinations about shopping purchases. For example, the emotive content may be generated by the systems described throughout this disclosure and may be displayed to a user to provide an additional emotive meaning in parallel with displayed views of shopping items such that the emotive meaning can be communicated without physical proximity to the shopping items.

The approaches described herein may represent user body dimensions while providing a realistic and informative shopping experience in a virtual fitting associated with one or more purchasable garments of the electronic shopping environment. Such approaches may provide the advantage of an informed shopping experience by generating and displaying emotive content to represent user wear-based comfort or discomfort with the one or more purchasable garments.

The systems and methods described herein may provide a user-personalized virtual fitting

of one or more purchasable shopping items (e.g., garments, accessories, etc.) that are available in an electronic shopping environment (e.g., application). The virtual fitting may utilize determined or retrieved user data, garment data (e.g., textile data), and/or emotions analytics to generate and display virtual content that depicts an avatar performing gestures and/or exuding system-generated emotive content (e.g., reactions) with respect to a particular garment. The gestures and/or emotive content may provide information to the user accessing the electronic shopping environment. For example, the gestures and/or generated emotive content may provide information about the fit and feel of a particular shopping item.

The approaches described herein can be implemented using an electronic device, such as a smartphone, a tablet computer, augmented reality (AR) glasses, a laptop computer, a netbook computer, and the like. For example, a user interface can be provided on an electronic device (e.g., as part of an electronic shopping environment), where the user interface can be configured to display a visual scene in which various versions of shopping items are presented on avatars representing aspects of the user accessing the electronic shopping environment.

The gestures and/or emotive content may provide a way for the user to determine whether or not a selected garment would fit correctly and/or fit according to known or retrieved preferences for the user. For example, the gesture and/or emotive aspects may enable a user to view particular fit or comfort for the garment by viewing one or more avatars representing a likeness of the user and wearing the garment. For example, the user may view the one or more avatars in various sizes, colors, styles, lengths, or other viewable option associated with the garment.

The systems described herein may generate dynamic emotive content that represent a system-generated user response to the fit or comfort of the garment. The generated emotive content (e.g., generated user reactions) may be applied to the one or more avatars for viewing by the user. The generated emotive content may be based at least in part on the determined or retrieved user data, the garment data, and/or the emotions analytics. The generated emotive content may represent a way in which the user might respond (in the physical environment) to aspects associated with a particular garment.

For example, the systems described herein may generate or have access to any or all of a physiological model of human muscle movement (e.g., body animation input), a database of garment information (e.g., garment data), and user data pertaining to sizes and shopping preferences. The systems may generate a virtual fitting for avatars using any or all of the above data. The virtual fitting may include generation and display of emotive content including portraying how the user may emote about a particular fit, function, or look of a garment shown on an avatar in the virtual fitting. The emotive content can pertain to facial expressions and body language determined to be generated and displayed on one or more avatars based on the generated emotive content based on the above data.

In general, the emotive content described herein may be based on retrieved or determined user data including, but not limited to particular stored or retrieved user measurements, preferences, facial expressions, body movements, and/or gestures. User data may include user provided or user-approved determination of body measurements, body scans, garment preferences, purchase history, user-provided demographics, web browsing history, etc. As described throughout this disclosure, the emotive content may be generated based on particular emotions analytics derived or retrieved by the systems

described herein.

As used herein, emotions analytics may pertain to software that collects data on how a user may communicate verbally and nonverbally to understand a feeling, mood, attitude, and/or context for the user. Such data may be used to provide users with improved consumer experiences via a shopping application, for example. Emotions analytics may be used to generate particular animations (e.g., facial expressions, body language, gestures, etc.) on an avatar for the purposes of communicating a feeling, mood, attitude, and/or context for a user browsing shopping items in the electronic shopping application. Emotions analytics may be retrieved by the systems described herein from any number of databases. Emotions analytics can be generated, using machine learning algorithms, for example, that may learn to recognize particular characteristics (e.g., expressions) that relate to particular emotions. In some implementations, emotions analytics may be combined with garment data to produce emotive content on an avatar. Example emotions that the systems described herein may depict on an avatar include, but are not limited to happiness, sadness, joy, disgust, surprise, contempt, anger, etc.

As used herein, garment data for each particular garment may include any and all information defining textile materials in the garment, movement of the textile, manufacturing of the garment, simulated movement models for the garment, stitching details, angles, lines, and/or shapes of the garments, etc. In addition, garment data may pertain to pricing, availability, garment description, etc. The garment data may be used to animate the garment on an avatar. The garment data may also be used to generate particular emotive content in body language and/or facial expressions, for example.

The systems described herein may identify particular items of interest to a user, both

within a virtual shopping environment and/or within the surrounding physical environment. For example, a user may be operating an electronic device that houses a camera device. The camera device may capture information about items within the physical environment of the user operating the electronic device. Similarly, the same electronic device may instead determine information about items within a shopping environment being accessed on the electronic device.

The electronic device may identify items within a visual device display (or within a surrounding physical environment) that are of interest to the user. The approaches described herein can visually indicate (on a display of the electronic device) specific elements or content associated with the items of interest, such as by highlighting items, applying icons or notes to items, modifying avatars associated with wearing the items, etc. In some implementations, an electronic device implementing such approaches can operate in conjunction with one or more other devices, such as one or more server computers (e.g., Internet servers, database servers, machine learning servers, augmented reality systems and peripherals, etc.), or other appropriate devices, such as those described below with respect to FIG. 5.

In the example implementations described herein, computer vision and/or machine learning can be used to identify (find, locate, etc.) and recognize individual elements associated with a particular shopping item and/or visual scene that is provided to (received by, accessible to, etc.) an electronic device. In some implementations, such items or scenes can be captured (e.g., multi-frame, real-time visual content) by a camera of the electronic device. In some implementations, items or scenes can be in the form of a single-frame image (e.g., a photograph) that is stored on, or provided to the electronic

device. Identifying such items or scenes can include performing text recognition and/or image recognition on the items and/or scenes.

FIG. 1 is a third person view of an example physical environment 100, in which a user is experiencing an augmented reality (AR) shopping environment 102 through a display device. The AR environment 102 can be generated by an AR application 106 (using one or more modules 108) and displayed to the user through an HMD device 104, or other device, as shown in FIG. 2 for example.

The AR environment 102 can be a mixed reality environment including a mixture of virtual objects and physical objects (e.g., virtual objects within a physical environment 100). The AR environment 102 can be an environment in which the user can place and interact (e.g., manipulate, elevate, move, interact with, etc.) with virtual objects in a physical environment 100 within the displayed AR environment 102. In some implementations, such virtual objects can include stickers, characters, sprites, animations, 3D renderings, and so forth.

When the user moves within the physical environment 100, the AR environment 102, and the virtual objects therein, move in a corresponding fashion. In other words, the AR objects 110A-110D and the corresponding avatars are moved within the AR environment 102 based on the movement of the user in the physical environment 100. The AR objects 110A-110D and the corresponding avatars can be moved and placed within the AR environment 102 based on the depth information associated with each respective object. For example, if the user moves away from a chair 114 in the physical environment 100, the AR objects 110A-110D can have an appearance with the AR environment 102 shown in the display (e.g., within the screen of the HMD device 104) that is further away. This

rendering can be based on the depth information associated with the AR objects.

The AR environment 102 includes AR objects such as UI elements 110A, 110B, 110C, 110D next to each avatar. Each AR object 110A-110D represents selectable information about shopping items x1, x2, x3, and x4 (on avatars 112A, 112B, 112C, and 112D, respectively) displayed over an image of the physical environment 100. The shopping items x1-x4 may also be represented as AR objects. In this example, the AR objects 110A-110D may represent an affordance dot (e.g., UI element) for providing additional information about each shopping item associated with each respective UI element.

In general, an affordance (e.g., UI element 110A) may be selectable to provide any number of UI content items related to a particular shopping item (or other object represented in the AR environment or shown in the physical environment). Once the UI element is presented in the AR environment 102, the user may select the UI element (e.g., 110A) to be provided particular UI content items. In operation, the UI content items may be generated at a second AR object which may replace the UI element provided as the AR object. In some implementations, rules, relationships, and content indicated for particular UI elements may be used to determine and provide a user-relevant layout of the content in the AR environment.

In the examples described herein, facial expressions, physical expressions, body language, or other emotive response may be depicted on an avatar based on information associated with a particular UI element. For example, the user may access a shopping environment (in AR space or in a shopping environment in an electronic device) and may search for and select a shopping item. The systems described herein may invite the user to try the shopping item on (e.g., virtually in the electronic device or AR headset). The

user may confirm to execute a virtual fitting of the shopping item and may select a location using a camera associated with the electronic device or AR headset to choose a location in the physical environment.

In the example shown in FIG. 1, the user selected to view the virtual fitting using the floor of the living room. In addition, the user may have previously selected a shirt item (x1-x4) to view in the virtual fitting. The systems described herein provide avatars that resemble the user based on determined, retrieved, or entered user measurements. In addition, the systems may access information from any number of sources for use in depicting the avatars. The user may be provided images of herself (e.g., mannequins/avatars generated from user measurements, full body scans, captured user images, user-entered data, etc.).

Once the system has triggered display of one or more avatars that resemble the user wearing the clothing item, the system may trigger body animations, such as facial movements, gestures, walking movements, sitting movements, standing movements, squatting movements, running movements, turning movements, stretching movements, kicking movements, and the like. The triggered body animations may enable the avatars 112A-112D to display, to the user, a level of comfort based on the fit, feel, or look of the shirt. For example, the system may use garment movement physics and physical anatomy movement rules (e.g., muscle, bone, and skin anatomy) to show comfort or discomfort of the augmented body wearing the shirt. The system may generate a matched facial expression to indicate the comfort for a well-fitted garment. Similarly, the system may generate a matched facial expression to indicate the discomfort of an ill-fitted garment.

For example, the user may have provided sizing information before or during access of the shopping application. In this example, the user may have provided waist measurements, length measurements, and a general size measurement (e.g., 30 or Medium). The user may have also searched and selected a particular shirt for review in the shopping application. In response, the system may generate a virtual fitting with any number of avatars donning options of the selected shirt.

As shown in FIG. 1, a shirt x1 is depicted on an avatar 112A representing the user. The shirt x1 is an extra large cotton blend shirt. Since the user indicated that he is a medium size, the system generated, for the extra large shirt x1, a fit on the avatar with sagging and gaping at the arms and waist of the avatar. In addition, the system generated emotive content including the avatar pulling at the shirt (arrow 116) indicating discomfort wearing the shirt x1. In addition, additional emotive content including the body language of the avatar indicates discomfort or dislike. For example, the facial expressions 118 (e.g., additional emotive content) include downward cast eyes, forehead wrinkles, lip curling, etc. Such body language and/or facial expressions 118 may indicate an ill-fitted garment to a user viewing the avatar in the shopping environment. The user may use the information gleaned from the body language and/or facial expressions 118 to make a decision to purchase or not purchase the shirt x1 in the extra large size. In this example, the information indicates that the user may be uncomfortable in the shirt x1.

In the same (or a different) shopping session, the user may be provided a shirt x2 on an avatar 112B representing the user. The shirt x2 is an extra small cotton blend shirt similar to shirt x1, but smaller. Since the user indicated that he is a medium size, the system generated, for the extra small shirt x2, a tight fit on the avatar with a laterally

stretched star and sleeves that pull and a waistline that is short with respect to the avatar's torso. The avatar is shown bending left and right (arrow 120) indicating discomfort and showing the shirt x2 raised and ill-fitted. In addition, the body language (e.g., additional emotive content) of the avatar indicates discomfort or dislike. For example, the avatar has a hunched posture and facial expressions 122 (e.g., additional emotive content) that include a scrunched forehead, an open mouth indicating outward dislike of the fit or other aspect of shirt x2. Such body language and/or facial expressions depicted on the avatar may indicate an ill-fitted garment to a user viewing the avatar in the shopping environment. The user may use the information gleaned from the body language and/or facial expressions to make a decision to purchase or not purchase the shirt x2 in the extra small size. In this example, the information indicates that the user may be uncomfortable in the shirt x2.

In the same (or a different) shopping session, the user may be provided a shirt x3 on an avatar 112C representing the user. The shirt x3 is a medium cotton blend shirt similar to shirt x1 and x2, but in a different size. Since the user indicated that he is a medium size, the system generated, for the medium shirt x3, a fit on the avatar with sleeves, waist, and movement of the shirt that appear to fit the avatar. The avatar has facial expressions 124 that include smiling. The body language of the avatar indicates comfort for the fit of the shirt x3. Such body language (e.g., additional emotive content) and/or facial expressions 124 (e.g., additional emotive content) may indicate to a user viewing the avatar in the shopping environment, a well-fitted garment and a high comfort level. The user may use the information gleaned from the body language and/or facial expressions 124 to make a decision to purchase or not purchase the shirt x3 in the medium size. In this example, the

information indicates that the user may be comfortable in the shirt x3. The AR object 110C (e.g., a selectable UI element) may provide additional garment information for the user. Thus, in this example, the user has selected AR object 110C to continue research for his shopping expedition.

In the same (or a different) shopping session, the user may be provided a shirt x4 on an avatar 112D representing the user. The shirt x4 is a relaxed cut shirt in a medium. Here, the shirt x4 may be the same fabric as shirts x1, x2, x3, but may be a different style or cut (e.g., athletic, slim, relaxed, etc.). Since the user indicated that he is a medium size, the system generated, for the shirt x4, a looser fit on the avatar than the fit of the medium shirt x3 because the shirt x4 is a relaxed cut. In this example, the shirt x4 is loose and rippled on the avatar. In addition, the star is low on the shirt indicating the shirt is a different and larger fit on the avatar than the shirt x3. The avatar is also shown with facial expressions 126 (e.g., additional emotive content) that include downcast eyes and a frown. This may indicate to the user viewing the avatar in the shopping environment that shirt x4 may be an ill-fitted option. Such body language (e.g., additional emotive content) and/or facial expressions 126 (e.g., additional emotive content) may indicate an ill-fitted garment to the user viewing the avatar in the shopping environment. The user may use the information gleaned from the body language and/or facial expressions 124 to make a decision to purchase or not purchase the shirt x4 in the medium and relaxed fit size. In this example, the information indicates that the user may be uncomfortable in the shirt x4.

The systems described herein may generate emotive content for avatars based on human muscle and/or skin movements that may show particular facial expressions, body

language, and/or other emotions pertaining to a shopping experience. The systems utilize provided user data. The systems utilize human anatomical movement data (e.g., muscle movements, facial feature analysis, gesture data, etc.). The systems utilize emotive analytics about how the human body and/or face may depict emotion. The systems utilize garment movement data.

Other example information that the systems may access in order to depict the avatars may include information about the shopping item(s) including, but not limited to, a size, a color, online reviews about fit and comfort, reputation of such online reviews, and the like. Additional information that the systems may access in order to depict avatars may include user preferences, user sizing, purchase histories, retailer data, weather information, trend information, web browsing history, and/or suggestion generators based on any of the determined, retrieved, or other user-based data.

Any combination of the above data may be used by the system to provide a shopping user a way to determine, by viewing the system-generated body animations and/or facial expressions, whether the body looks comfortable or uncomfortable moving in the clothing item. The determination may influence a purchase of a shopping item.

As shown in FIG. 1, the user may be viewing AR content with respect to a selected shopping item, such as shirts shown by shopping items x1, x2, x3, and x4. Here, the shopping items x1, x2, x3, and x4 are shown on avatars representing aspects of the user. The systems described herein may take into account aspects of each shopping item x1-x4 to generate a fit for each avatar. The systems described herein may also take into account user sizing details, material of the shopping items, and/or other system or user preferences to generate the fit.

To communicate additional information about the shopping items x1-x4, the systems described herein may utilize emotions analytics and user data to generate emotive content that may be used to portray an opinion (e.g., judgement) for how the shopping item will appear and/or feel if the user were to wear the shopping item in the physical world. For example, facial expressions and/or body movements may be provided as animations on the avatars 112A-112D to represent a fit of a particular shopping item (e.g., t-shirts worn by the avatars). The user shopping for the shopping item may view such facial expressions and/or body movements to make a determination for whether or not to pursue a purchase in the shopping experience.

The various versions of the shopping item may be associated with different sizes, colors, styles, lengths, or other viewable options available in the electronic shopping environment. For example, a visual scene may include a number of avatars representing the shape and/or size of the user. Such a visual scene may depict each avatar wearing a different size of the shopping item. Each avatar may depict different emotive content responsive to a determined fit of the shopping item for the avatar. The fit may include an actual size fit as compared to body measurements for the user. The fit may include a comfort level with respect to the fabric type associated with the shopping item as compared to user purchase history and/or known user preferences.

Referring again to FIG. 1, the modules 108 may function with AR application (or a shopping environment) to determine and provide locations and layouts with which to insert AR content, such as an AR object (a sticker, a character, an avatar, an animation, etc.). For example, the modules 108 may prompt a user to identify a location for inserting the content and may then receive a user input indicating a location on the screen

for the content. The user may indicate a location for placing AR content (or shopping content) without being prompted.

Although the examples described herein include references to shirts, any garment, accessory, or other user-wearable item may be substituted and the systems described herein may provide emotive content for avatars to provide users with shopping information for a shopping experience.

FIG. 2A illustrates an example of a user accessing content in a user interface on an electronic device 202. The user may be searching for a shopping item. For example, the user may wish to purchase a t-shirt with a logo on the front. The user may select one or more shirts (e.g., shirt 204) and may be prompted 206 to try on the shirt in augmented reality.

FIG. 2B illustrates an example user interface 210 that includes a searchable shopping environment. The user may be provided the prompt 206 on electronic device 202 in response to entering a query in box 208, for example. In response, the system may search for shopping items and provide user interface 210. The user may select shirt 205 and then may select prompt 206 (e.g., Try it Now button) to experience a virtual fitting of the shirt in the screen of the mobile/electronic device 202. The user may select any number of garments and/or accessories from user interface 210 to view a virtual and/or augmented reality experience of the virtual fitting.

The user may use the electronic device (or other controller) to select a location in the physical environment in which to experience the virtual fitting. For example, the user may point the camera of device 202 at a floor, table, wall, or other location to select that location as a background for viewing the virtual fitting for the selected one or more

shopping items (e.g., shirts).

In response to selecting prompt 206, the user may be provided with a view of one or more avatars representing a likeness to the user. For example, upon selecting prompt 206, the user may provide the avatar 212A, shown in FIG. 2C wearing the shirt 205. The avatar 212A is wearing the selected garment 205. In this view of the avatar 212A, the system 300, for example, provided a virtual fitting of the selected garment 205, but has yet to provide emotive content based on the fit of the garment 205. The measurements and shape of avatar 212A are provided to match measurements associated with the user viewing the virtual fitting.

FIG. 2D illustrates an example avatar depicting generated and applied emotive content. For example, the garment 205 is a shirt that may be small for a user based on known user size and known garment size. The system can depict the smallness of the garment 205 to provide information to the user that the garment is likely too small for the user and that such a purchase would not provide a positive purchasing experience.

In addition to depicting the garment 205 as tight (214) and short on the torso (214), the system may depict how the user may emote (or feel) about wearing such a garment. In this example, the system determined to provide angry or disgusted facial expressions 216 (e.g., scowl, narrowed eyes, and a frown). In this example, the system may determine to show angry emotive content based on previous complaints of purchased items being too small (by the user or other users reviewing the garment). The system may determine to show emotive content based on the fit of the garment responsive to movements of the avatar. For example, the system may not show particular emotive content on the avatar until the avatar begins to move or gesture. In the depicted example, the system had the

avatar 212B raise both arms 218. Raising both arms cause the garment to rise at the torso (214) indicating that the shirt may be too small for the avatar (and by proxy, the represented user). At this point, the system may modify the facial expressions to indicate displeasure or unhappiness with the garment based on the raised hands and subsequent exposed torso.

Similar changes to the avatar and resulting emotive content can be made if the avatar is triggered to continue to move (e.g., walk, sit, squat, stand, run, turn, stretch, kick, etc.). The emotive content provided on the avatar can provide the user with information with which to ponder when purchasing garments in an electronic shopping environment. For example, the emotive content may system-generated and depicted on one or more avatars. The user can determine if the avatar (resembling the user and user size) looks comfortable during the animations. Using any number of physical models, emotive models, machine-learning, and/or other representational technology, the systems described throughout this disclosure can show comfort or discomfort to provide relevant fit information to a user accessing the electronic shopping environment. Thus, the user may make an informed judgement about purchasing and/or shopping decisions.

FIG. 2E illustrates a plurality of example avatars in a virtual fitting and showing generated and applied emotive content. Here, the avatar 212B is shown (from FIG. 2C). In addition, the system generated three additional avatars 212C, 212D, and 212E to depict the fit of similar shirts in different sizes. The different fit for each avatar accounts for the user measurements and preferences. In addition, each avatar is shown performing the same pose as the pose indicated by avatar 212B. Such information can indicate to the user which shirt may fit the user when stretched in a similar fashion to the garment 205

on avatar 212B.

For example, the avatar 212C is shown wearing a larger shirt 220 than avatar 212B. The shirt 220 does not rise about the torso of the avatar 212C. However, the shirt 220 still bags (arrow 221) under the arm of the avatar. Thus, the system may depict a facial expression with pursed lips indicating that the user may be unhappy with such a fit if the shirt 220 were to be purchased.

Similarly, a shirt 222 on avatar 212D appears to be too large (arrow 223) in the neckline for the avatar. Thus, the system may depict a facial expression with pursed lips, similar to avatar 212C, indicating that the user may be unhappy with such a fit if the shirt 222 were to be purchased.

In addition, a shirt 224 on avatar 212E appears to be a good fit. Thus, the system may depict a happy facial expression with a smile, for example. The user accessing the virtual fitting in the shopping environment may glean from the happy facial expression and the look of the shirt 224 on the avatar 212E that shirt 224 would be a good purchase according to user size and preferences.

The user may also decide to look at several different garments or accessories on any number of avatars. FIG. 2F illustrates a plurality of example avatars in a virtual fitting and showing generated and applied emotive content. In this example, each avatar is shown in a different shopping item (e.g., different shirts). The user may assess which shirt has a best fit, style, or look for the user's body. Other shopping items may of course be added and/or substituted.

The user may continue to experience additional shopping items, for example, by swiping on, selecting on, or moving the electronic device 202. For example, the user may move

the device 202 to the left (indicated by arrow 226) to view additional avatars wearing different sizes and/or styles of particular garments.

FIG. 2G illustrates a plurality of example avatars in a virtual fitting and showing generated and applied emotive content. The avatars may be shown upon the user moving the electronic device 202 to view content to the left of the content shown in FIG. 2F, as indicated by indicator 228. If the user were to move the electronic device 202 leftward again, additional avatars would be displayed. In this example, a number of avatars 212K, 212L, 212M, 212N, 212O are shown, each wearing a different shirt size and/or style.

The user may speak into a microphone of the electronic device 202 to request that the avatar perform an animation. For example, if the user were reviewing denim 230 in the virtual fitting, the user may ask the avatar to sit in the denim to determine how the denim may move or fit while a user is seated. If the user has selected denim that is 3 sizes too small for the actual size of the user, the system may show the denim on the avatar 212L, but may refuse to sit based on the known physical impossibility or discomfort that would occur if the user were wearing the denim in three sizes too small and attempted to sit. The system may refuse to sit. The system may provide the information that sitting would be uncomfortable. The system may instead provide facial expressions to indicate discomfort. The system may show an animation of a button opening or flying off the denim when the avatar sits.

In some implementations, the user may view the avatars by walking around the avatars (in an AR environment). Similarly, the user may utilize the electronic device to zoom in or out to view particular details of the garments and the avatars. The avatars may interact with one another such that if the user makes a selection and adds a particular garment

from a first avatar to a shopping cart, the remaining avatars can agree with the selection. Similarly, the system may cause the remaining avatars may emote particular approvals for the selection. The remaining avatars may disappear once the user adds a garment to the shopping cart. Other interactions and portrayals are of course possible.

FIG. 3 is a block diagram illustrating an example system 300 for generating and displaying dynamic emotive content in an augmented reality (AR) space or in an electronic device. The system 300 can be configured to generate an augmented reality (AR) environment for a user of the system 300. The system 300 includes a computing device 302, a head-mounted display device (HMD) 304 or other display device (such as a display of the computing device 302), and a content source 306. Also shown is a network 308 over which the computing device 302 may communicate with the content source 306. A display device such as a mobile phone can be used instead of the HMD 304.

The computing device 302 may include a memory 310, a processor assembly 312, a communication module 314, a sensor system 316, and a display device 318. The memory 310 may include an AR application 320, AR content 322, modules 324, and a framework 326 capable of generating dynamic emotive content in an AR or other electronic environment. The framework 326 includes a garment animator 328, an emotion animator 330, UI element generator 332, a shopping application 334, a body animator 336, and user data 338. The memory 310 also includes or has access to operating system 340, device characteristics 342, garment data 344, and emotions analytics 345.

User data 338 may include, but is not limited to particular stored or retrieved user measurements, preferences, facial expressions, body movements, and/or gestures. User

data may include user provided or user-approved determination of body measurements, body scans, garment preferences, purchase history, user-provided demographics, web browsing history, etc. As described throughout this disclosure, the emotive content may be generated based on particular emotions analytics derived or retrieved by the systems described herein.

Garment data 344 may include any and all information defining textile materials in a garment, manufacturing of the garment, simulated movement models for the garment, etc. In addition, garment data may pertain to pricing, availability, garment description, etc. The garment data may be used to animate the garment on an avatar, for example.

The emotions analytics 345 may pertain to collected data on how a user may communicate verbally and nonverbally. The analytics 345 may be collected to understand a feeling, mood, attitude, and/or context for the user. Such data may be used to provide users with improved consumer experiences via a shopping application, for example. Emotions analytics may be used to generate particular animations (e.g., facial expressions, body language, gestures, etc.) on an avatar for the purposes of communicating a feeling, mood, attitude, and/or context for a user browsing shopping items in the shopping application.

Emotions analytics may be retrieved by the system 300. Emotions analytics can be generated, using machine learning algorithms, for example, that may learn to recognize particular characteristics (e.g., expressions) that relate to particular emotions. In some implementations, emotions analytics may be combined with garment data to produce emotive content 350 on an avatar. Example emotions that may be depicted as emotive content 350 include, but are not limited to happiness, sadness, joy, disgust, surprise,

contempt, anger, etc.

In general, the framework 326 can enable users to view information about shopping items by providing emotive content 350 (and cues) on avatars. For example, within the shopping application 334, users may access shopping items for view within system 300. Various versions of the shopping items may be placed on one or more avatars. The user may view the avatars to make an informed purchasing decision based on information gleaned from viewing the avatars wearing the shopping item(s).

The information may include emotive content depicted as facial expressions or body language exhibited by a particular avatar. The system 300 may utilize a garment animator 328 and the body animator 336 to depict fit and movement for a particular garment.

The system 300 may also utilize the emotion animator 330 to generate and display emotive content on one or more avatars. The emotion animator 330 may take into account known emotions analytics combined with user sizing and preferences to generate particular emotive content that applies to a particular fit (with respect to known user data) for each avatar wearing the shopping item (e.g., garment). For example, a garment that is determined to be tight fitting according to user size may prompt the system 300 to generate unhappy or sad emotive content when providing facial expressions for the particular avatar wearing the tight fitting garment. The garment animator 328 may function with the body animator 336 to properly move the body and face of a particular avatar according to the determined fit of the garment and the emotive content. For example, the system 300 may use garment movement physics and physical anatomy movement rules (e.g., muscle, bone, and skin anatomy) to show comfort or discomfort of

the augmented body (e.g., avatar) wearing the garment. The system may generate a matched facial expression to indicate the comfort for a well-fitted garment. Similarly, the system may generate a matched facial expression to indicate the discomfort of an ill-fitted garment.

The UI element generator 332 may be accessed by system 300 to provide additional details (e.g., affordances with additional UI content for display). Further, the UI element generator 332 may provide updates and movements based on additional user selections with respect to a particular shopping item.

The computing device 302 may also include various user input components (not shown) such as a controller that communicates with the computing device 302 using a wireless communications protocol. The computing device 302 is a mobile device (e.g., a smart phone) which may be configured to provide or output AR content or other content to a user via the HMD 304 and/or the display device 318. For example, the computing device 302 and the HMD 304 (or other display device) may communicate via a wired connection (e.g., a Universal Serial Bus (USB) cable) or via a wireless communication protocol (e.g., any Wi-Fi protocol, any Bluetooth protocol, ZigBee, etc.). The computing device 302 can be a component of the HMD 304 and may be contained within a housing of the HMD 304. The HMD 304 is not utilized and content may instead be provided at the display device 318 of the computing device 302.

The AR application 320 may use the sensor system 316 to determine a location and orientation of a user within a physical environment and/or to recognize features or objects within the physical environment.

The AR application 320 may present or provide the AR content to a user via the HMD

and/or one or more output devices of the computing device 302 such as the display device 318, speakers, and/or other output devices. The AR application 320 includes instructions stored in a memory 310 that, when executed by a processor assembly 312, cause the processor assembly 312 to perform the operations described herein. For example, the AR application 320 may generate and present an AR environment (or in computing device 302) to the user based on, for example, online content, AR content (e.g., AR objects), such as the AR content 322 and/or content received from the content source 306, and/or content received from modules 324. The AR content 322 and modules 324 may include UI content such as images or videos that may be displayed on a portion of the user's field of view in the HMD 304 or within device 302. The UI content includes content provided by a browser, a shopping application, and/or camera assembly 346, etc.

The AR environment may also include at least a portion of the physical (real-world) environment and physical (real-world) entities. For example, shadows may be generated so that the content is realistically provided within the physical environment in which the user is located. The content may include objects that overlay various portions of the physical environment. The content may be rendered as flat images or as three-dimensional (3D) objects. The 3D objects may include one or more objects represented as polygonal meshes. The polygonal meshes may be associated with various surface textures, such as colors and images.

Overlays, content layout, and other UI displays may be provided by the modules 324 accessed by operating system 340, for example, rather than provided by the AR application 320. The sensor system 316 may utilize camera assembly 346, shopping

application 334, emotion animator 330, body animator 336, garment animator 328, and UI element generator 332 to provide such content via the modules 324.

The AR application 320 may use the image analyzer 336 and an image buffer (not shown) to generate images for display via the HMD 304 based on the AR content 322. For example, one or more images captured by the camera assembly 346 may be stored in the image buffer. The image buffer is a region of the memory 310 that is configured to store one or more images. The computing device 302 stores images captured by the camera assembly 346 as a texture within the image buffer. Alternatively or additionally, the image buffer may also include a memory location that is integral with the processor assembly 312, such as dedicated random access memory (RAM) on a graphics processor unit (GPU).

The image analyzer 336 may determine various properties of the image, such as the location of objects and UI surfaces upon which the content (e.g., avatars, shopping items, etc. may be positioned. The image analyzer 336 may analyze an image captured by camera assembly 346 as a basis for searching and obtaining additional related information to data represented by the captured image. Such related information can be utilized by system 300 to provide relevant facts, media, and other UI content associated with particular objects presented in the AR environment.

The modules 324 may function with UI element generator 332, and user data 338 to determine and provide locations and layouts with which to insert AR content, such as an AR object (an avatar, an animation, a shopping item, etc.). For example, the modules 324 may prompt a user to identify a location for inserting the content and may then receive a user input indicating a location on the screen for the content. The user may

indicate a location for placing AR content without being prompted. The device 302 can generate a UI layout that includes one or more UI content items arranged according to a spatial relationship described by a particular pattern according to the shopping application 334 that may dictate rules and relationships to follow when providing UI content for a particular user accessing a particular AR environment.

The AR application 320 and/or modules 324 may update the AR environment based on input received from the camera assembly 346, the IMU 348, and/or other components of the sensor system 316. For example, the IMU 348 may detect motion, movement, and/or acceleration of the computing device 302 and/or the HMD 304. The IMU 348 may include various different types of sensors such as, for example, an accelerometer, a gyroscope, a magnetometer, and other such sensors. A position and orientation of the HMD 304 may be detected and tracked based on data provided by the sensors included in the IMU 348. The detected position and orientation of the HMD 304 may allow the system to detect and track the user's position and orientation within a physical environment. Based on the detected position and orientation, the AR application 320 and/or modules 324 may update the AR environment to reflect a changed orientation and/or position of the user (or avatars or shopping items) within the environment.

Although the computing device 302 and the HMD 304 are shown as separate devices in FIG. 3, The computing device 302 may include the HMD 304 (or other display device such as a mobile phone). The computing device 302 communicates with the HMD 304 via a cable, as shown in FIG. 3. For example, the computing device 302 may transmit video signals and/or audio signals to the HMD 304 for display for the user, and the HMD 304 may transmit motion, position, and/or orientation information to the computing

device 302. The computing device 302 communicates with the HMD 304 via a wireless connection.

The content source 306 may generate and output AR content 322 or other content, which may be distributed or sent to one or more computing devices, such as the computing device 302, via the network 308. In an example implementation, the AR content includes three-dimensional scenes, facts, avatar data, emotive data, executable content, and/or images. Additionally, the AR content may include audio/video signals that are streamed or distributed to one or more computing devices. The AR content may also include the AR application 320 and/or modules 324 that run (execute) on the computing device 302 to generate 3D scenes, audio signals, and/or video signals.

The memory 310 can include one or more non-transitory computer-readable storage media. The memory 310 may store instructions and data that are usable to generate an AR environment for a user.

The processor assembly 312 includes one or more devices that are capable of executing instructions, such as instructions stored by the memory 310, to perform various tasks associated with generating an AR environment. For example, the processor assembly 312 may include a central processing unit (CPU) and/or a graphics processor unit (GPU). For example, if a GPU is present, some image/video rendering tasks, such as displaying AR objects, displaying aspects of AR objects (such as displaying tether lines), generating shadows or shading polygons representing shadows of AR objects, etc., may be offloaded from the CPU to the GPU.

The communication module 314 includes one or more devices for communicating with other computing devices, such as the content source 306. The communication module

314 may communicate via wireless or wired networks, such as the network 308.

The sensor system 316 may include various sensors, such as a camera assembly 346. Implementations of the sensor system 316 may also include other sensors, including, for example, an inertial motion unit (IMU) 348, a microphone 349, a light sensor, an audio sensor, an image sensor, a distance and/or proximity sensor, a contact sensor such as a capacitive sensor, a timer, and/or other sensors and/or different combination(s) of sensors.

The IMU 348 detects motion, movement, and/or acceleration of the computing device 302 and/or the HMD 304. The IMU 348 may include various different types of sensors such as, for example, an accelerometer, a gyroscope, a magnetometer, and other such sensors. A position and orientation of the HMD 304 may be detected and tracked based on data provided by the sensors included in the IMU 348. The detected position and orientation of the HMD 304 may allow the system to detect and track the user's gaze direction and head movement, or movement of the computing device 302.

The camera assembly 346 captures images and/or videos of the physical environment around the computing device 302. The camera assembly 346 may include one or more cameras. The camera assembly 346 may also include an infrared camera.

The microphone 349 may be used by a user of device 302 to enter data, provide audio input for search queries, and/or otherwise communicate within AR environment with device 302 and/or other users accessing the AR environment.

The network 308 may be the Internet, a local area network (LAN), a wireless local area network (WLAN), and/or any other network. The computing device 302, for example, may receive the audio/video signals, which may be provided as part of AR content in an

illustrative example implementation, via the network 308.

The system 300 may provide an architecture in which each unit of computing experience is divided from application based execution into module- based execution in which each module 324 can be flexibly combined with other modules to provide a coherent UI content experience for a user accessing the AR environment.

In general, the system 300 may present experiences in the AR environment that organize modules of functionality (e.g., modules 324). A number of layers of structure may be used to generate such modules 324. The modules 324 may be used to provide a presentation (e.g., layout) of UI content and a navigation model with which to drill into the UI content. The layers of structure may include shells in a UI stack that function to provide the UI content and navigation model. In some implementations, any number of shells can be replaced in the UI stack to customize a particular user experience. For purposes of simplifying the drawing, the shells are not depicted in the system of FIG. 3.

The framework 326 may take into account data from the operating system 340, the device characteristics 342, the garment data 344, the emotions analytics 345 and any user data 338 associated with characteristics and/or the user. Such data may be used to operate within the shells of the UI stack to provide the UI content. In general, an experience shell may encompass all other shells that provide the user experience with the UI content in the AR environment.

In some implementations, a device shell may represent a lowest layer in the UI stack. The device shell may allow users to perform actions such as logging in and/or authenticating use of the AR environment and/or affordances (e.g., UI elements) associated with such an environment. A user shell may represent a main UI layer. The

user shell represents what a user views once logged in. The user shell provides system UI settings, search areas, start and stop experience controls, and navigation controls.

Modules 324 may execute in the experience shell and may use UI element generator 332 to generate UI elements on surfaces of AR objects. Modules 324 may be a smallest unit of computation utilizing the UI stack. The layout of the surfaces may be generated by the experience shell. Each experience in a user shell delegates space to the experience shell in order to allow the experience shell to arrange surfaces.

The system 300 may take into account privacy. For example, modules may provide sandboxing of information to increase privacy. The software performing object recognition can be granted privileged access to a camera scene to create semantic annotations (e.g., labelling features or mesh regions with standardized schema labels), but such software may not have a need to utilize visibility on what the system or the user does with those labels.

In such an example, a (trusted) operating system can then suggest modules that may act upon these entities. The modules can start and express a desired semantic relationship to this content (e.g. overlay) and provide UI content to the (trusted) AR experience shell. The AR experience shell can then arrange the UI content at the correct coordinates in the scene without having to provide the modules access to scene information. The AR experience shell needs no access to the UI contents of the module because layout (e.g., arrangement) of the UI content is performed using metadata.

FIG. 4 is a flow chart diagramming one implementation of a process 400 to indicate, generate and/or display dynamic emotive content. The dynamic emotive content is depicted in the AR environment. The dynamic emotive content is depicted in an

application (e.g., a shopping application depicted in a display of an electronic device). The process 400 is described with respect to the system 300, but other elements and systems may also carry out the steps of the process 400.

The system 300 may generate an augmented reality or virtual reality environment including a number of three-dimensional virtual objects within a user interface provided in a head mounted display device. The augmented reality environment is an electronic shopping application. The system 300 may generate representations of users, objects, shopping items, and can track such things for translation into the augmented reality environment based on movements and gestures carried out in the physical world.

In short, the process 400 may utilize system 300 to enable users to view information about shopping items by providing emotive content 350 (and cues) on avatars. For example, within the shopping application 334, users may access shopping items for view within system 300. Various versions of the shopping items may be placed on one or more avatars. The user may view the avatars to make an informed purchasing decision based on information gleaned from viewing the avatars wearing the shopping item(s).

At block 402, the process 400 includes receiving, within a user interface generated for a display device, an indication to access an augmented reality fitting environment associated with at least one shopping item. For example, the framework 326 of device 302 may generate an AR environment (or other electronic environment) in which the user accesses to perform shopping tasks (e.g., shopping application 334). A user may access such an environment and may select a shopping item and may wish to virtually try the item on. The user may select a presented prompt from the shopping application 334, for example, to instigate the augmented reality fitting environment.

At block 404, the process 400 includes receiving a selected image of a location in which to display the AR fitting environment. For example, the user may confirm to execute a virtual fitting of a particular shopping item and may select a location using a camera assembly 346 associated with the electronic device or the AR headset to choose a location in the physical environment in which to be provided the virtual fitting and details associated with the AR fitting environment. The image may be a still image, a video image, or any selectable scene in which AR content may be placed.

At block 406, the process 400 includes obtaining user measurement data, shopping item data, and emotions analytics data associated with the AR fitting environment. for example, the system 300 may obtain user measurement data from the user. User measurement data can include, but is not limited to neck measurements, shoulder measurements, bust measurements, waist measurements, arm/leg length measurements, and/or a general size measurement (e.g., 30 or Medium).

The shopping item data may include garment data 344, which may include any and all information defining textile materials in a garment, manufacturing of the garment, simulated movement models for the garment, etc. In addition, shopping item data may include item pricing, availability, and/or descriptions, etc.

The emotions analytics data 345 may pertain to collected data on how a user may communicate verbally and nonverbally. The analytics 345 may be collected to understand a feeling, mood, attitude, and/or context for the user. Such data may be used to provide users with improved consumer experiences via a shopping application, for example, as described in detail below.

At block 408, the process 400 includes generating, based on the obtained user

measurement data, a plurality of three-dimensional avatars representing a user accessing the augmented reality fitting environment on the electronic device. For example, the system 300 may generate avatars to show how particular shopping items may look and/or feel to a user interested in purchasing such items. The avatars may be based on the user's actual measurements and looks. The avatars may each show a different size or fit for a particular shopping item.

At block 410, the process 400 includes, for each avatar, generating, using the shopping item data and the user measurement data, a unique three-dimensional representation of the at least one shopping item. For example, the system 300 may utilize garment data 344 and user data 338 to generate avatar details that provide accurate depictions of the user wearing the shopping item.

The process 400 also includes, for each avatar, generating emotive content based at least in part on the emotions analytics data and on the respective generated representation of the at least one shopping item. For example, the system 300 may use emotions analytics 345 to generate particular animations (e.g., facial expressions, body language, gestures, etc.) on an avatar for the purposes of communicating a feeling, a mood, an attitude, and/or context for a user browsing shopping items in the AR fitting environment. In some implementations, each respective generated representation of the at least one shopping item includes a different size, a different color, a different fit, or a different brand of the at least one shopping item.

In addition, emotive content may include body language applied to the avatar to indicate comfort, discomfort, like, and/or dislike, among other things. Facial expressions may also be provided on the avatars to indicate such feelings. For example, downward cast

eyes, forehead wrinkles, lip curling, etc. may indicate an ill-fitted garment to a user viewing the avatar in the shopping environment. The user may use the information gleaned from the body language and/or facial expressions to make a decision to purchase or not purchase the particular shopping item.

At block 412, the process 400 includes triggering, in the user interface, display of the plurality of three-dimensional avatars in the augmented reality fitting environment and within the selected image of the location. For example, the plurality of avatars (e.g., as shown in FIG. 2E) may be displayed within the room selected by the user (shown in FIG. 1). Each avatar may also be depicted with the respective generated emotive content and wearing the respective generated representation of the at least one shopping item. For example, the system 300 may trigger display of one or more avatars that resemble the user wearing a clothing item. The plurality of avatars depict body language or physical reactions associated with the generated emotive content based at least in part on a size-based fit associated with the respective generated representation of the at least one shopping item.

The system 300 may also trigger body animations, such as facial movements, gestures, walking movements, sitting movements, standing movements, squatting movements, running movements, turning movements, stretching movements, kicking movements, and the like. The emotive content is an animation depicting comfort or discomfort associated with a respective generated representation of the at least one shopping item. For example, the triggered body animations may enable the avatars to display, to the user, a level of comfort based on the fit, feel, or look of the shirt. For example, the system 300 may use garment movement physics and physical anatomy movement rules (e.g., muscle,

bone, and skin anatomy) to show comfort or discomfort of the augmented body wearing the shirt. The system 300 may generate a matched facial expression to indicate the comfort for a well-fitted garment. Similarly, the system may generate a matched facial expression to indicate the discomfort of an ill-fitted garment.

ABSTRACT

The method may include receiving, at a user interface generated for the electronic device, an indication to access an augmented reality fitting environment associated with at least one shopping item; receiving a selected image of a location in which to display the augmented reality fitting environment; obtaining user measurement data, shopping item data, and emotions analytics data associated with the augmented reality fitting environment; and generating, based on the obtained user measurement data, a plurality of three-dimensional avatars representing a user accessing the augmented reality fitting environment on the electronic device. For each avatar, the method may include generating, using the shopping item data and the user measurement data, a unique three-dimensional representation of the at least one shopping item, generating emotive content based at least in part on the emotions analytics data and on the respective generated representation of the at least one shopping item, and triggering, in the user interface, display of the plurality of three-dimensional avatars in the augmented reality fitting environment and within the selected image of the location, each avatar being depicted with the respective generated emotive content and wearing the respective generated representation of the at least one shopping item.

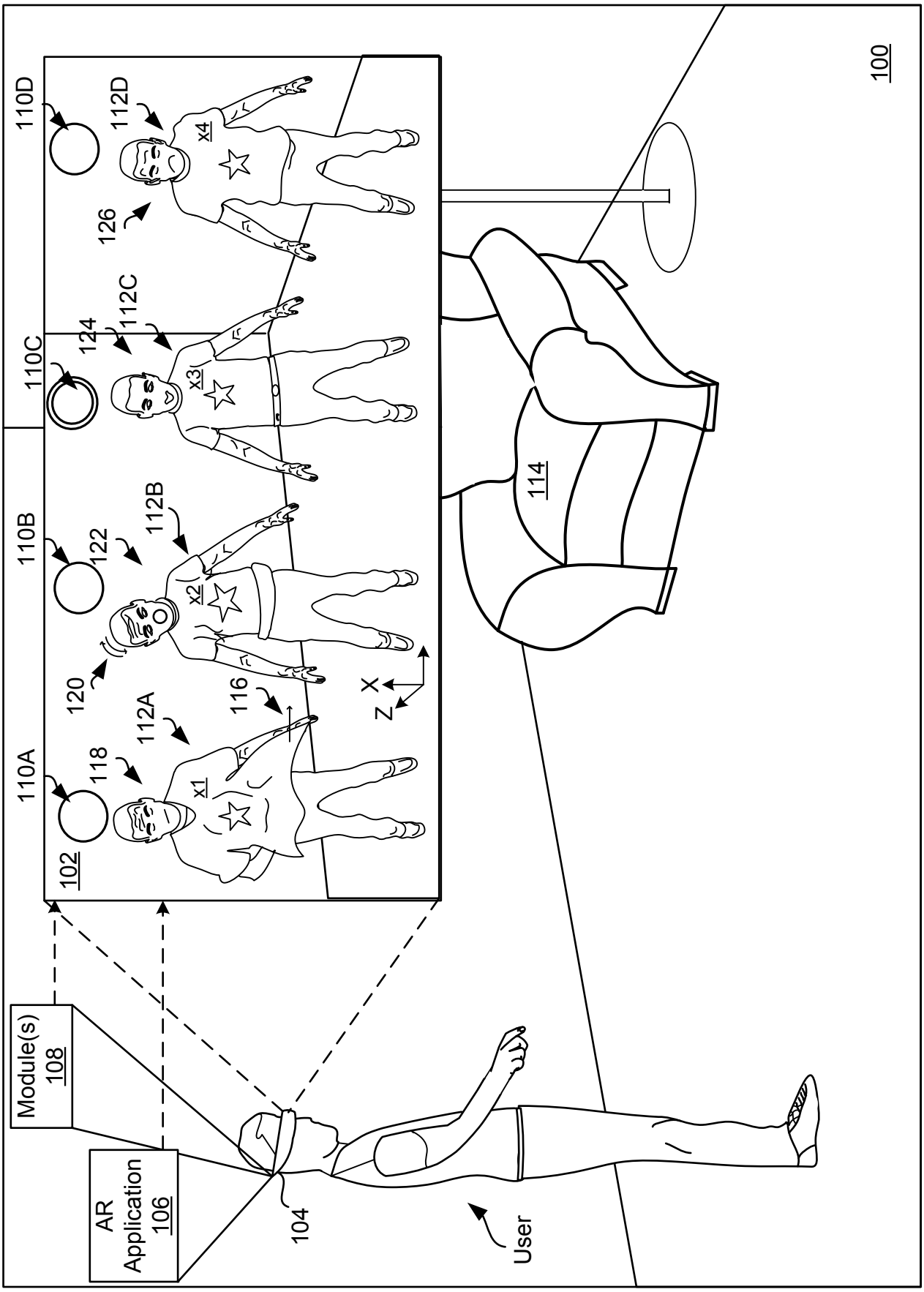
100
102
110A
110B
110C
110D
112A
112B
112C
112D
114
116
118
120
122
124
126
x1
x2
x3
x4
X
Z
Module(s) 108
AR Application 106
104
User

FIG. 1

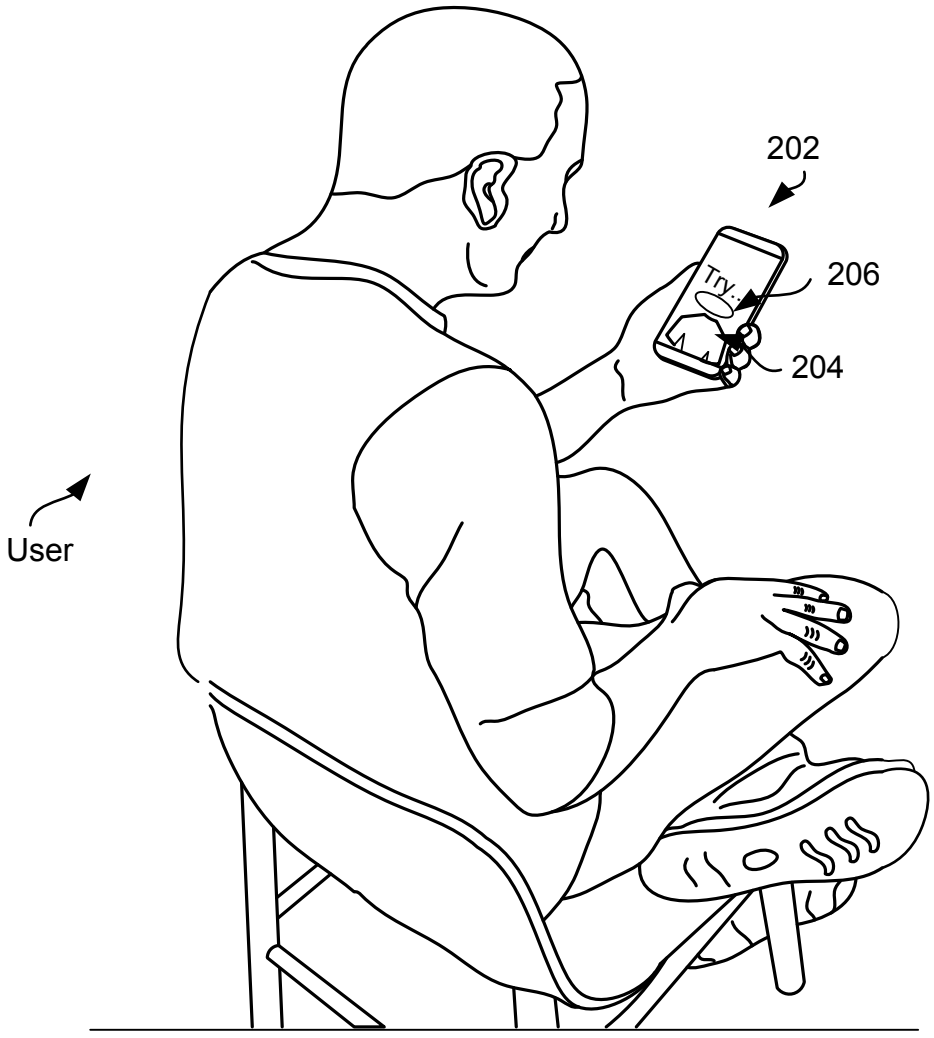

FIG. 2A

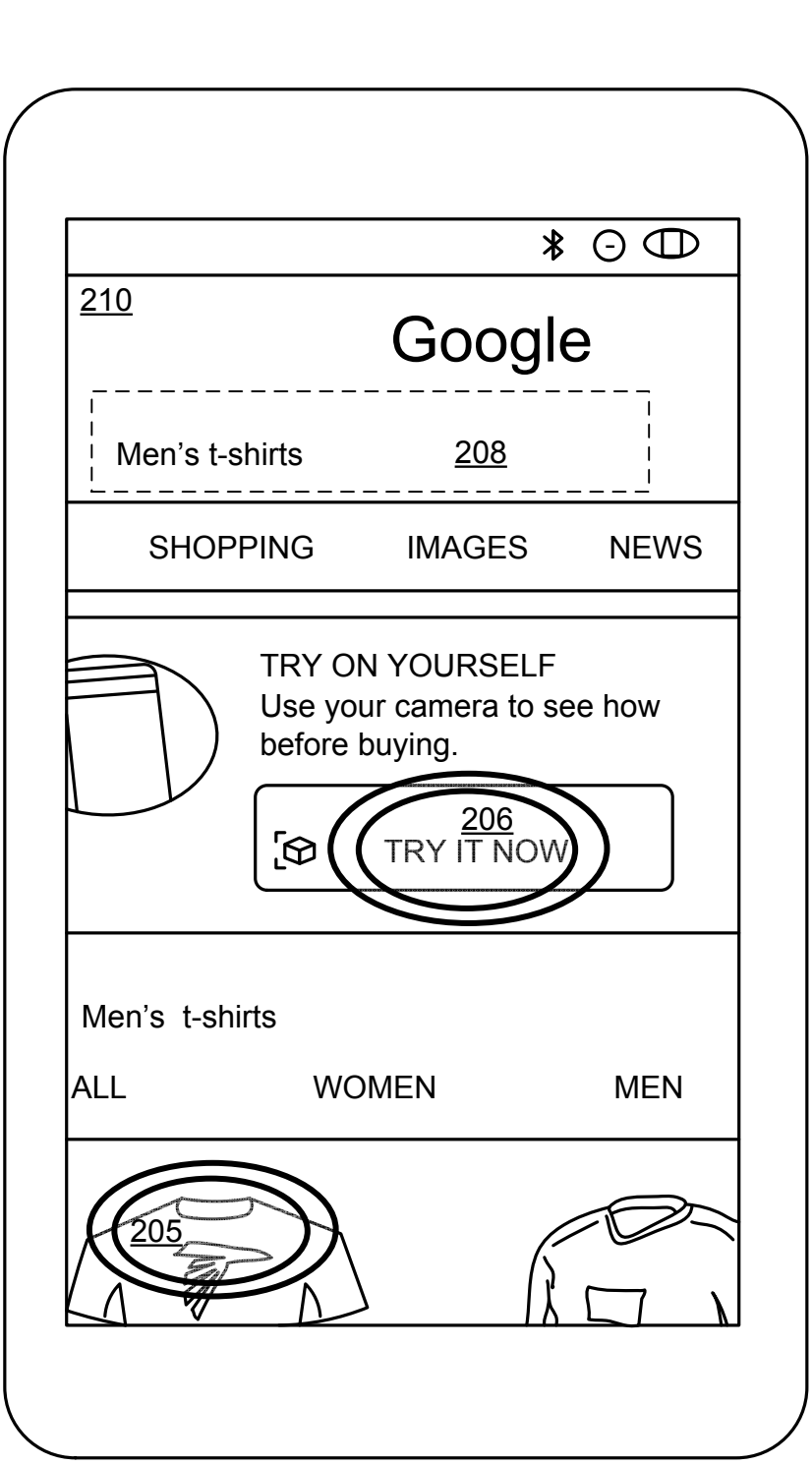
202
210
Google
Men's t-shirts
208
SHOPPING
IMAGES
NEWS
TRY ON YOURSELF
Use your camera to see how before buying.
206
TRY IT NOW
Men's t-shirts
ALL
WOMEN
MEN
205

FIG. 2B

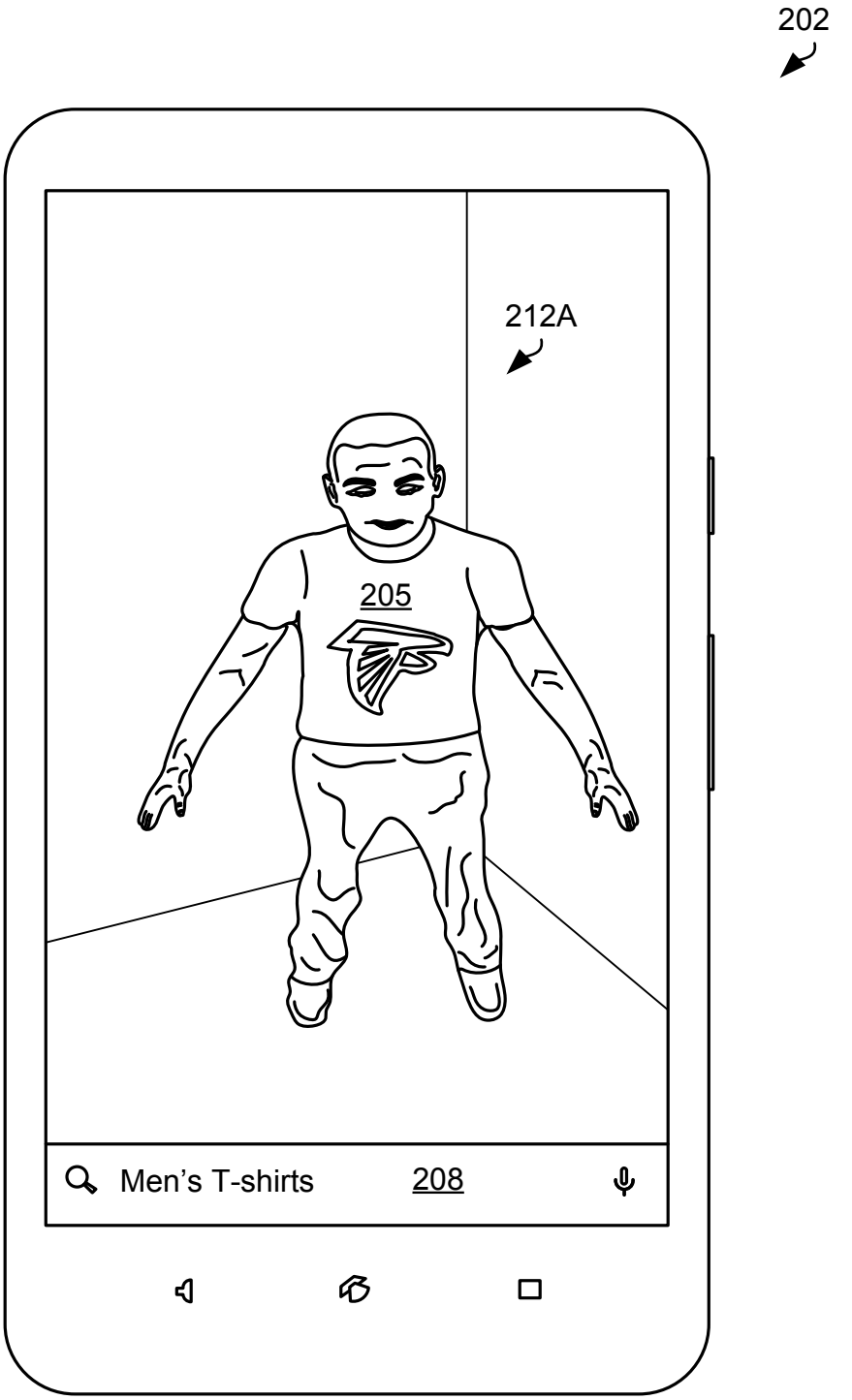

FIG. 2C

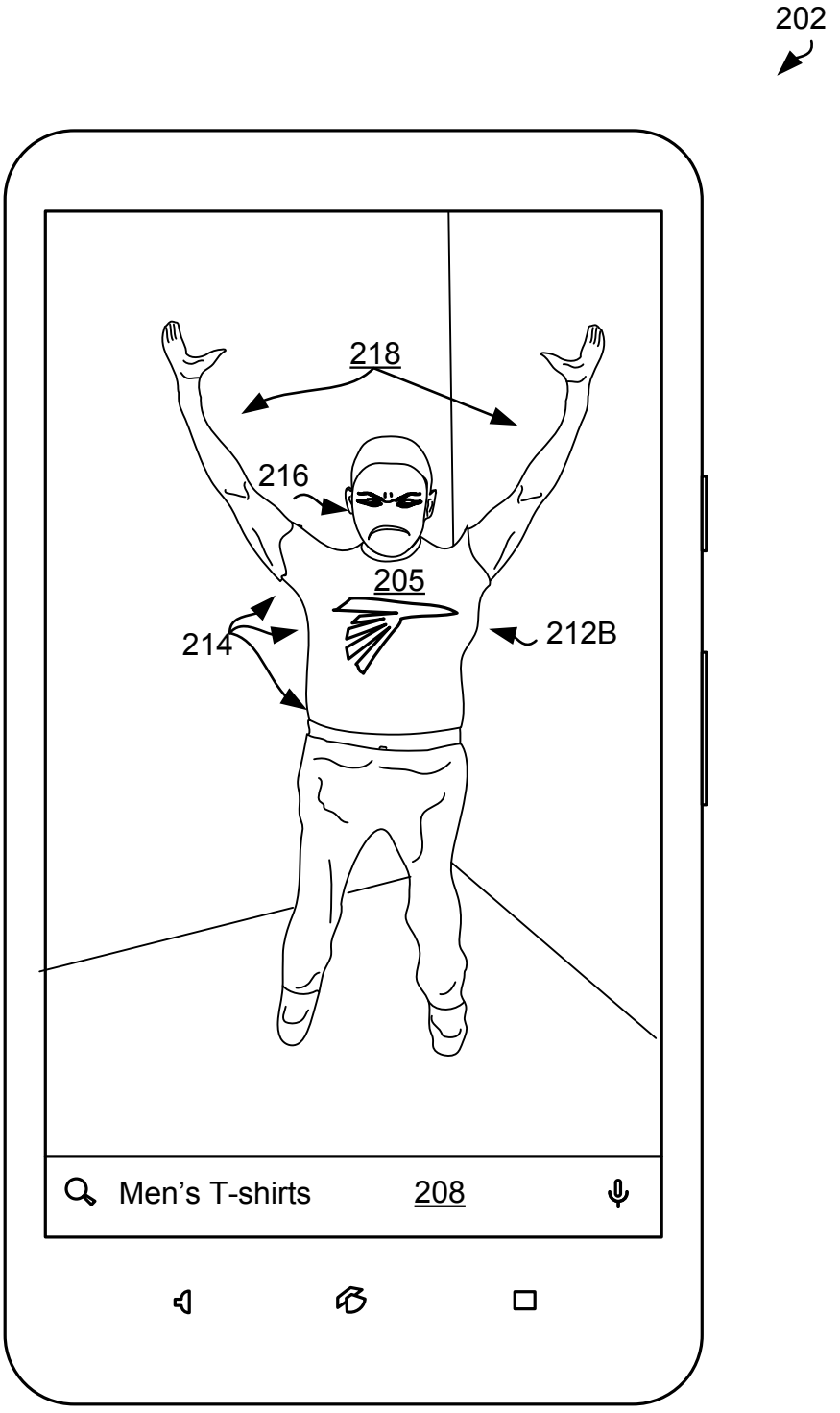

FIG. 2D

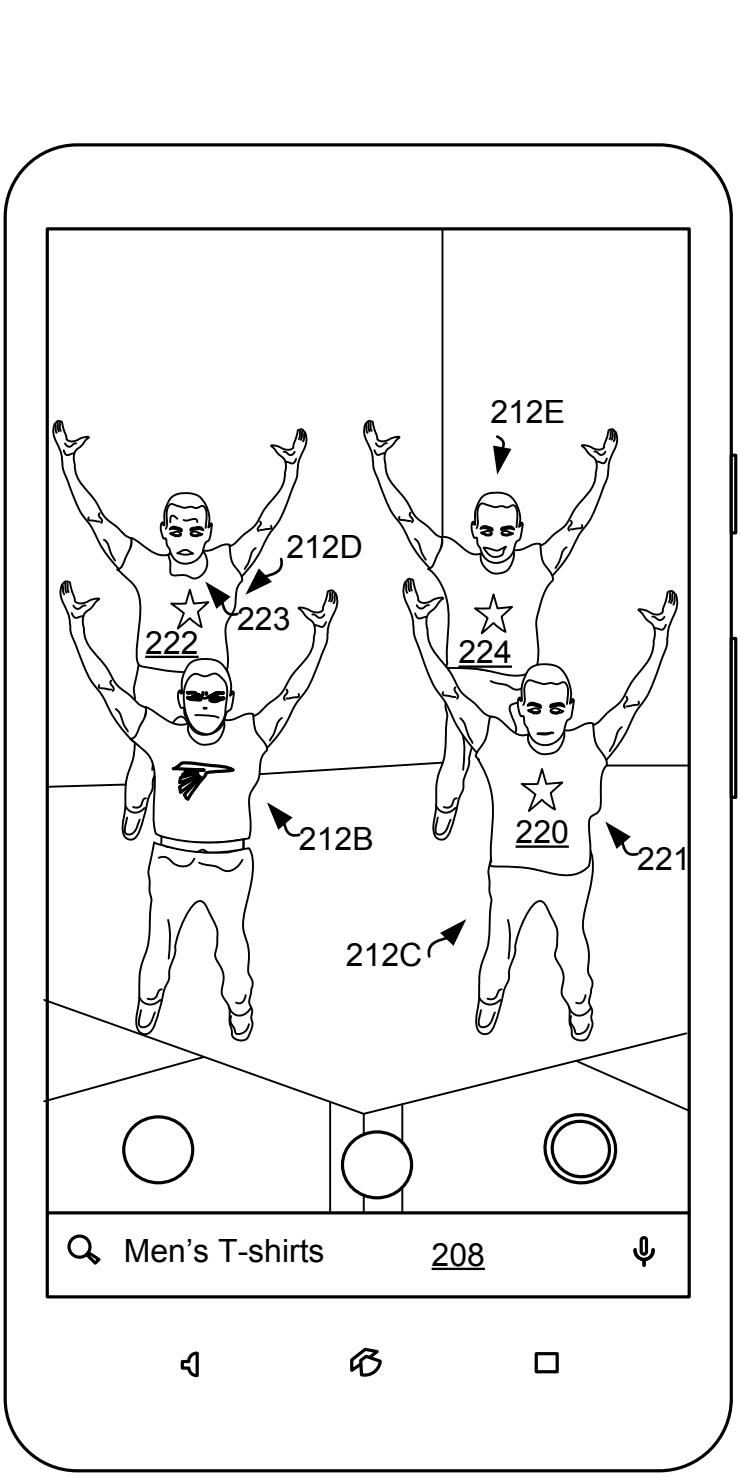

FIG. 2E

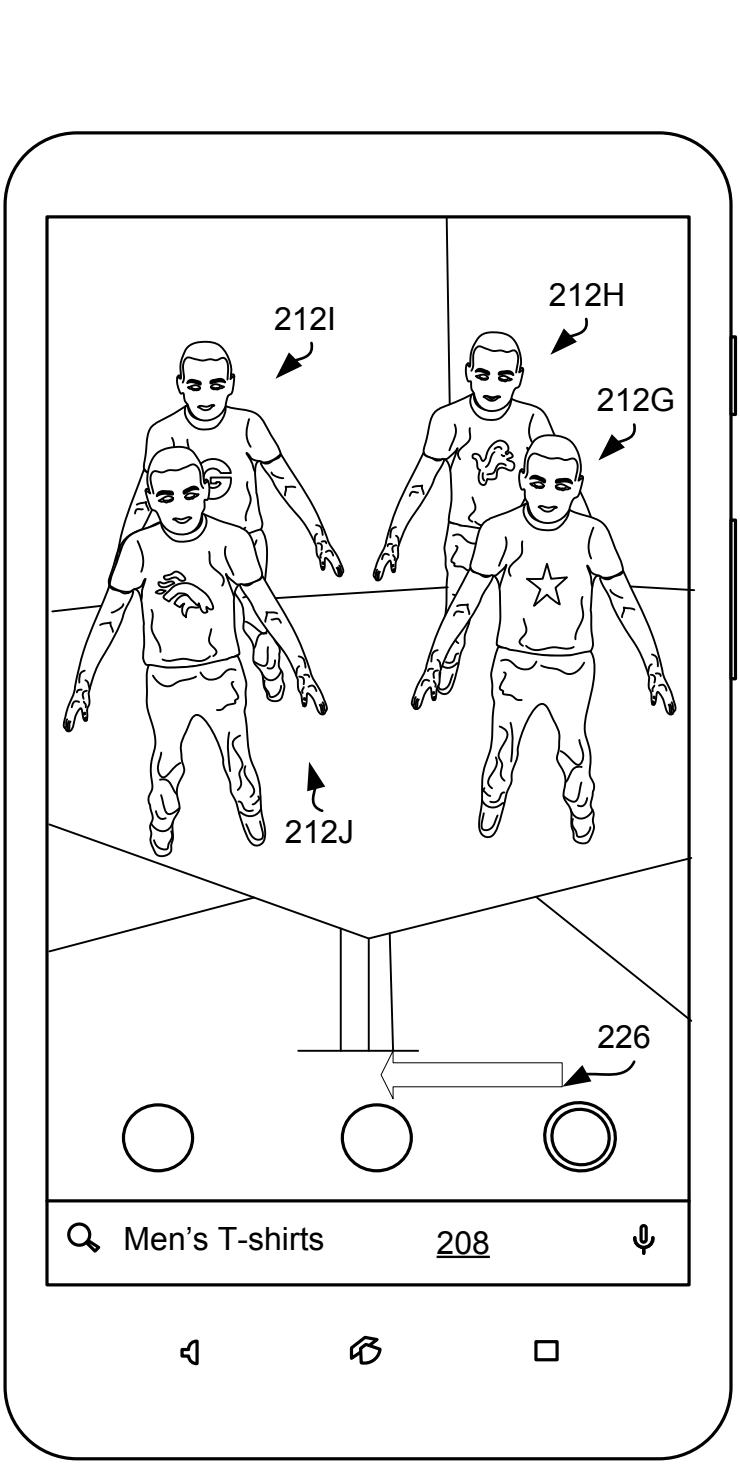

FIG. 2F

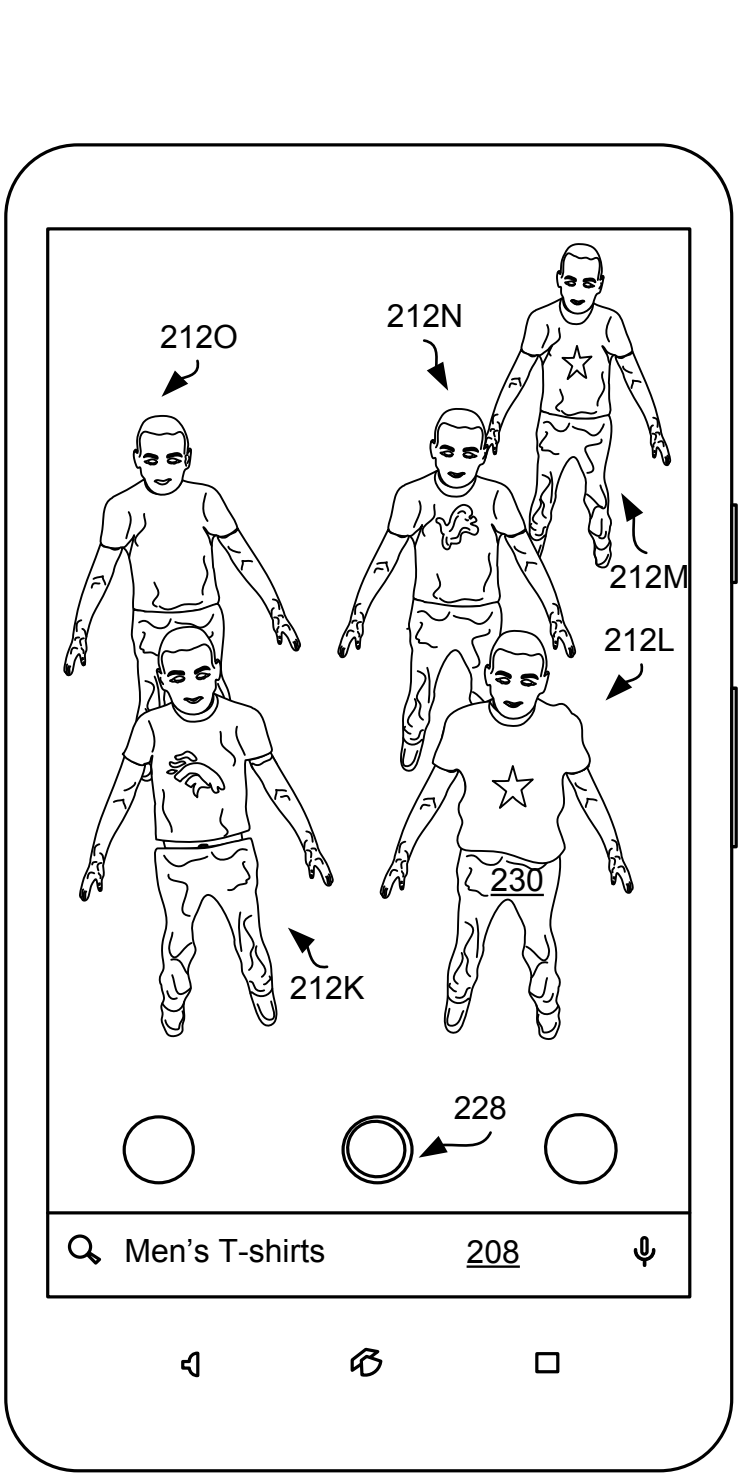

FIG. 2G

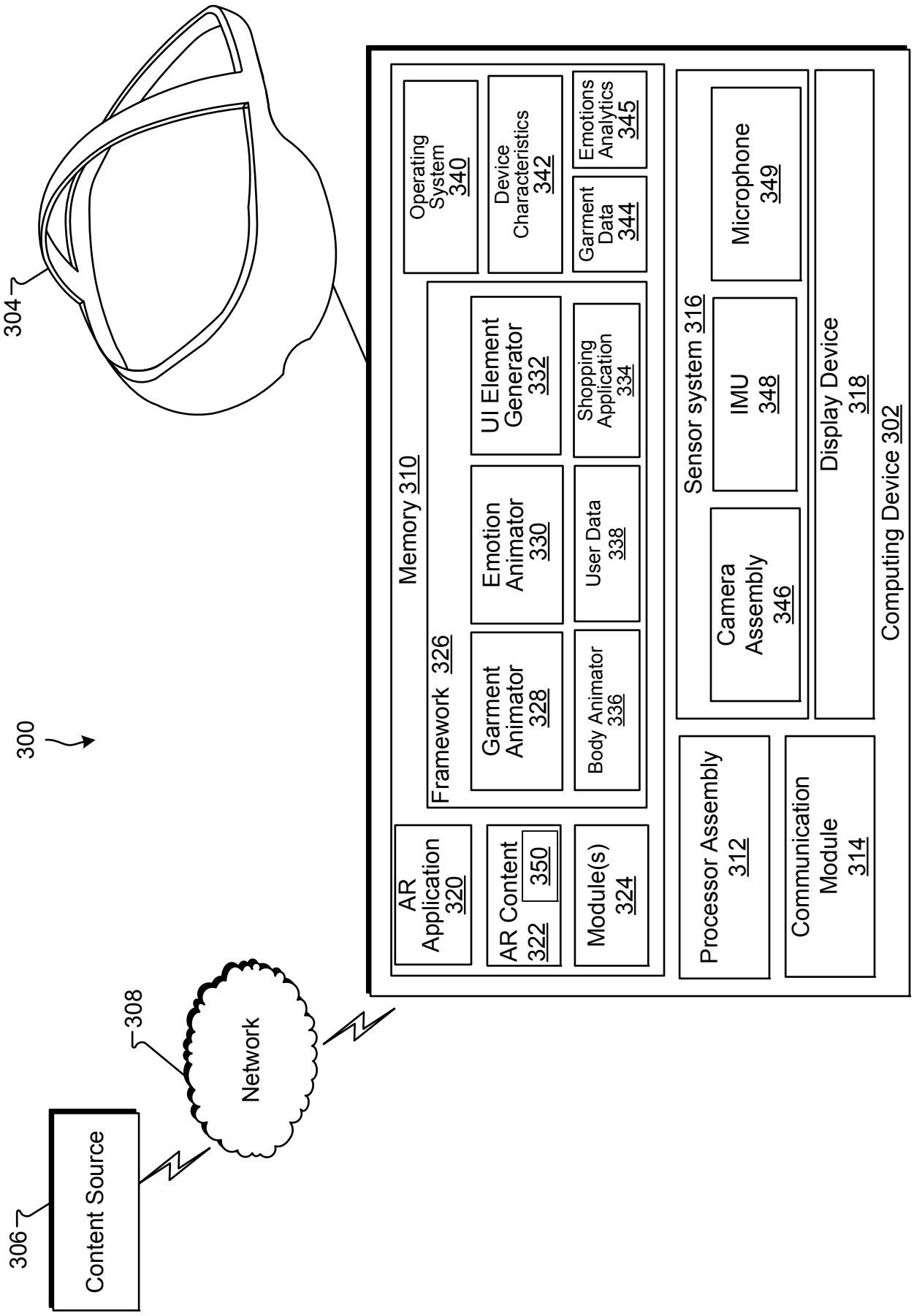
300
304
306
Content Source
308
Network
Computing Device 302
Memory 310
Framework 326
AR Application 320
AR Content 322
350
Module(s) 324
Garment Animator 328
Emotion Animator 330
UI Element Generator 332
Shopping Application 334
Body Animator 336
User Data 338
Operating System 340
Device Characteristics 342
Garment Data 344
Emotions Analytics 345
Processor Assembly 312
Communication Module 314
Sensor system 316
Camera Assembly 346
IMU 348
Microphone 349
Display Device 318

FIG. 3

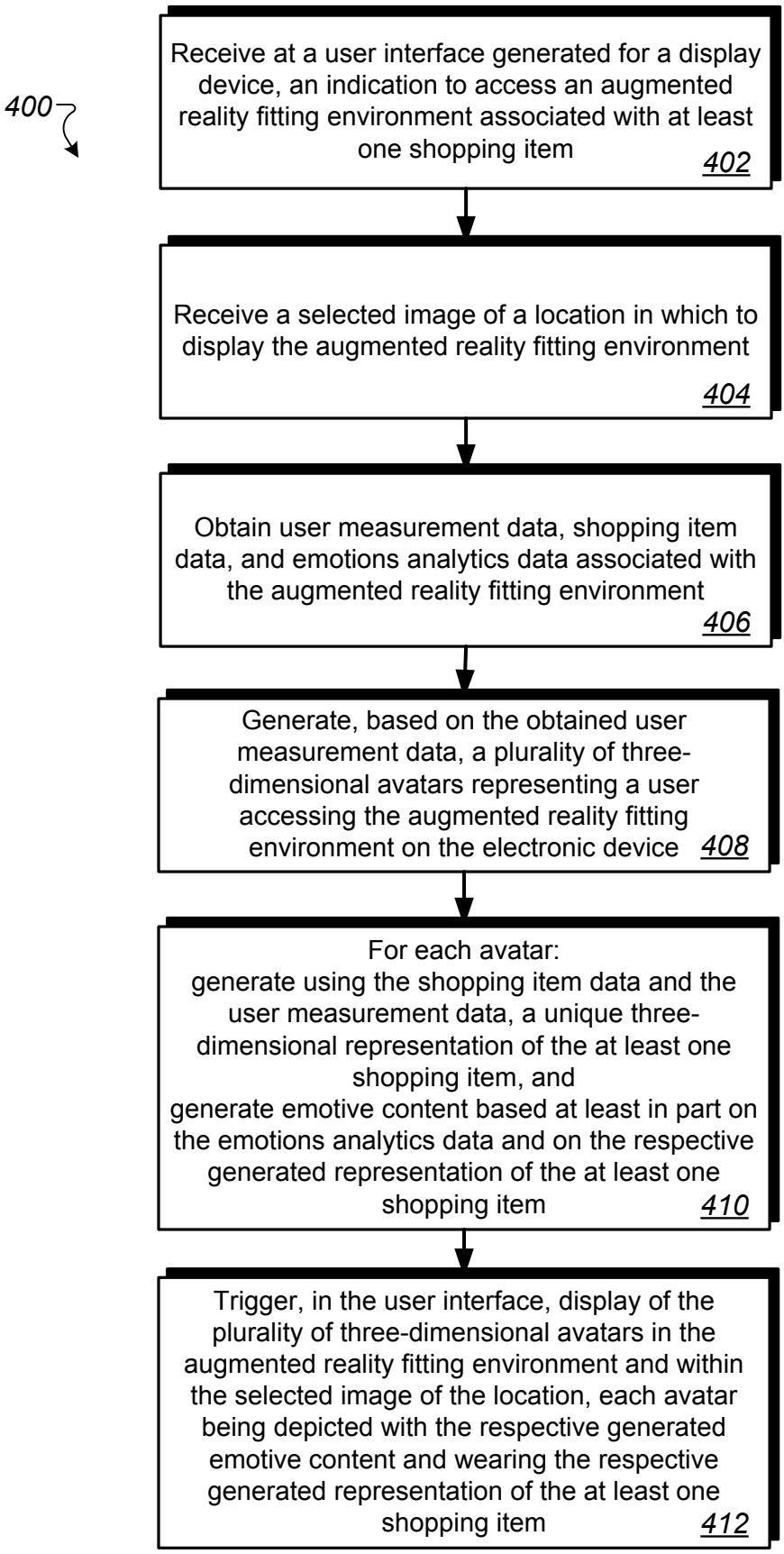
400
Receive at a user interface generated for a display device, an indication to access an augmented reality fitting environment associated with at least one shopping item
402
Receive a selected image of a location in which to display the augmented reality fitting environment
404
Obtain user measurement data, shopping item data, and emotions analytics data associated with the augmented reality fitting environment
406
Generate, based on the obtained user measurement data, a plurality of three-dimensional avatars representing a user accessing the augmented reality fitting environment on the electronic device
408
For each avatar:
generate using the shopping item data and the user measurement data, a unique three-dimensional representation of the at least one shopping item, and
generate emotive content based at least in part on the emotions analytics data and on the respective generated representation of the at least one shopping item
410
Trigger, in the user interface, display of the plurality of three-dimensional avatars in the augmented reality fitting environment and within the selected image of the location, each avatar being depicted with the respective generated emotive content and wearing the respective generated representation of the at least one shopping item
412

FIG. 4