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METHODS AND APPARATUS TO SCALE ANNOTATIONS FOR DESIRABLE VIEWING IN AUGMENTED REALITY ENVIRONMENTS

Alexander James Faaborg

Shengzhi Wu

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FIELD OF THE DISCLOSURE

This disclosure relates generally to augmented reality (AR) environments, and, more particularly, to methods and apparatus to scale annotations for visual appearance in AR environments.

BACKGROUND

Augmented reality (AR) presents the display of information associated with real world objects and places. One example of AR is an annotation of images of real world objects with textual information. Annotation in AR is convenient to annotate the physical world around us.

SUMMARY

In one general aspect, a computer-implemented method can include inserting an annotation associated with an augmented reality (AR) object in an augmented environment, the annotation being visual information, and changing a size of the annotation based on a threshold distance (e.g. depth) from the AR object.

In another general aspect, a computer-implemented method can include inserting an annotation associated with an augmented reality (AR) object in an augmented environment, the annotation being visual information, changing a first size of the annotation based on a first threshold distance when the user is farther from the AR object, and changing a second size of the annotation based on a second threshold distance when the user is closer to the AR object.

The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating a system according to an example implementation.

FIGS. 2A and 2B illustrate an example AR display presenting an annotation associated with a real world object in accordance with an example implementation.

FIGS. 3A and 3B illustrate another example AR display presenting an annotation associated with a real world object in accordance with an example implementation.

FIGS. 4A through 4C illustrate another example AR display presenting an annotation associated with a real world object in accordance with an example implementation.

FIG. 5 is a flowchart illustrating example operations of the systems of FIG. 1.

FIG. 6 is a flowchart illustrating another example operations of the systems of FIG. 1.

FIGS. 7A and 7B illustrate a conventional AR display presenting an annotation associated with a real world object in accordance with an example implementation.

FIGS. 8A and 8B illustrate a conventional AR display presenting an annotation associated with a real world object in accordance with an example implementation.

Reference will now be made in detail to non-limiting examples of this disclosure, examples of which are illustrated in the accompanying drawings. The examples are described below by referring to the drawings, wherein like reference numerals refer to like elements. When like reference numerals are shown, corresponding description(s) are not repeated and the interested reader is referred to the previously discussed figure(s) for a description of the like element(s).

DETAILED DESCRIPTION

Annotations may be inserted or added into an image or a user's field of view or otherwise tracked within a three-dimensional (3D) environment. For example, an augmented reality (AR) system may generate an augmented environment for a user by inserting annotations. The augmented environment can be generated by superimposing computer-generated annotation on a user's field of view of the real world. For example, the computer-generated annotation can include one or more labels, textual information, images, symbols, sprites, and/or three-dimensional entities. Although many of the examples described herein are directed to legibility of text, the examples herein can be applied to any type of annotation as described above. The computer-generated annotation may be displayed at a position in the user's field of view to appear overlaid on an object in the real world and to be spatially retained relative to the real world even when outside of the user's field of view. Similarly, the computer-generated annotation may be overlaid on a displayed image. Various properties may be used to display the computer-generated annotation in a particular environment.

An example AR system is a portable electronic device, such as a smartphone, that includes a camera and a display device. The portable electronic device may capture images using the camera and show AR images on the display device, which may be referred to as an AR display. The AR images may include computer-generated annotation overlaid upon the images captured by the camera.

Another example AR system includes a head-mounted display (HMD) (e.g., wearable goggles or glasses) that is worn by a user. The HMD includes a display device that is positioned in front of a user's eyes. For example, the HMD may occlude the user's entire field of view so that the user can only see the content displayed by the display device. In some examples, the display device is configured to display two different images, one that is viewable by each of the user's eyes. For example, at least some of the content in one of the images may be slightly offset relative to the same content in the other image, to generate the perception of a three-dimensional scene based on parallax. In some implementations, the HMD includes a chamber in which a portable electronic device, such as a smartphone, may be placed to permit viewing of the display device of the portable electronic device through the HMD.

Another example AR system includes a HMD that permits the user to see the physical space while the HMD is being worn. The HMD may include a micro-display device that displays computer-generated content that is overlaid on the user's field of view. For example, the HMD may include an at least partially transparent visor that includes a combiner that permits light from the physical space to reach the user's eye while also reflecting images displayed by the micro-display device toward the user's eye.

AR systems can be designed to enable interaction between the displayed AR content and a user of the AR system. To initiate or facilitate such interactions, it may be necessary for the user to first select desired AR content, e.g., from among all available AR content being displayed at the time of selection.

In most AR systems, the computer-generated annotations may be difficult to view (text may not be legible) when the user moves around in a virtual environment. For example, when the user moves farther away from the viewed object, the text becomes smaller and smaller and the user has difficulty reading the text on the annotation.

Conventionally, in order to maintain a desirable view (e.g., text legibility) of annotations for AR systems, one method is to maintain a scale of the annotations fixed relative to a display screen. In other words, the scale of the annotation is relatively fixed to a size of the display screen. For example, as shown in FIGS. 7A and 7B, annotation 705A of FIG. 7A has the same size as annotation 705B of FIG. 7B in relation to the display screen. In this example, the real world object 700 is a painting. As shown in FIG. 7A, the user is at a first distance from the object 700 having a first size. In this example, the first distance is farther away from the user because the entire painting fits (or displayed) within the display screen. As shown in FIG. 7B, when the user moves to a second distance to the object 700, the size of the object 700 has a second size (e.g., larger). In this example, the second distance is closer to the user because only a portion of the real world object 700 (e.g., painting) is displayed on the display screen. In other words, the real world object 700 appears to be zoomed-in (e.g., enlarged) in the AR display. In comparison to FIGS. 7A and 7B, the size of annotation 705B is the same as the size of annotation 705A. That is, the scale of the annotation 705B in relation to the display screen is fixed, and therefore, has the same scale as when the user was at the first distance or the second distance. As a result, no matter how far away a user is to the object, the scale (or size) of annotation 705A or 705B stays the same on the display screen. In other words, the annotation feels as if it is screen-locked to the display screen. While this may resolve the text legibility, the annotation looks two-dimensional, and does not feel what a user perceives in a three-dimensional real world. Once the user moves the AR system (e.g., phone or HMD) to different distances, the immersion feeling is lost. Thus, the conventional art as shown in FIGS. 7A and 7B produces an unrealistic real world experience.

In other conventional art, as shown in FIGS. 8A and 8B, annotations 805A and 805B can be fixed to a real world object 800. Similar to a label fixed to an object. Therefore, when the user moves closer to the object 800, the AR display will display an enlarged object 800. For purposes of simplicity, object 800 is the same as object 700 (e.g., a painting). In addition, besides the enlarged object 800 being displayed, annotation 805A can be proportionately enlarged, as shown in FIG. 8B. This may feel immersive to the user because the system provides an illusion that the AR annotation 805B is part of the real world (e.g., fixed to the real world object 800). However, as shown in FIG. 8B, only a portion of the annotation 805B can be displayed on the AR display when the user moves closer to the object 800. In order to fit (or display) the entire object 800 in the AR display, the user will have to move farther away from the object 800. However, this causes the annotation 805B to become smaller, and thus, text legibility will be difficult due to the smaller text size.

In order to resolve the text legibility of annotations associated with a real world object, the systems and methods of example implementations as described herein create the annotations to be fixed to the real world object at various viewing distances. In some implementations, the system can insert an annotation associated with an augmented reality (AR) object in an augmented environment, and change a scale of the annotation based on a threshold distance from the AR object. In other words, the annotation is fixed to the object and does not change its scale until the viewing distance is greater than (or less than) a threshold. For example, when the user moves farther away from the object, the text on the annotation becomes smaller (and possibly illegible) until a predetermined threshold is reached. Once the threshold is reached, the scale of the annotation is popped-up (enlarged) to a predetermined scale so the text becomes legible (or more legible). In another example, when the user moves closer to the object, the scale of the annotation becomes larger in relation to the object until the viewing distance threshold is reach. In this case, the system shrinks down (reduces) the scale of the annotation so that the annotation has a scale with respect to the object that is proportional. In some implementations, the scale of the reduced annotation has a similar scale (or size) as compared to the enlarged annotation when the user is farther from the object. In some implementations, the annotation size is fixed relative to a display screen size. For example, the size of the enlarged annotation (when the user is farther away from the object) is the same as the size of the reduced annotation (when the user is closer to the object). As a result, the experience is more immersive in the augmented environment as if the annotation is a part of the physical world.

In another general aspect, a computer-implemented method can include inserting an annotation associated with an AR object in an augmented environment, the annotation being a textual information, changing a first size of the annotation based on a first threshold distance when the user is farther from the AR object, and changing a second size of the annotation based on a second threshold distance when the user is closer to the AR object, the second size annotation being the same as the first size annotation.

FIG. 1 is a block diagram illustrating a system 100 according to an example implementation. The system 100 generates an augmented reality (AR) environment for a user of the system 100. In some implementations, the system 100 includes a device smartphone 102, or other hardware platform or device, which itself includes, or is in communication with, a camera 104 and a display 106. For example, as referenced above, alternative types of hardware platforms may include various implementations of head-mounted systems with integrated camera and display. In other implementations, the camera 104 and the display 106 may be provided using separate hardware platforms, such as when a camera transmits to a separate display device.

The smartphone 102 includes various hardware elements, some of which are illustrated and described below for purposes of understanding example operations of the system 100. For example, as shown by separate call-out from the smartphone 102, the smartphone 102 may include memory 108, which may include one or more non-transitory computer-readable storage media. The memory 108 may store instructions and data that are usable to generate an AR environment for a user. A processor assembly 110 includes one or more processors and related devices that are configured to execute instructions, such as instructions stored by the memory

108, to perform various tasks associated with generating an AR environment. For example, the processor assembly 110 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 adjusting and rendering content using display parameters from a display management engine, may be offloaded from the CPU to the GPU.

The memory 108 and the processor assembly 110 may thus be used to execute an AR application 112. As described in detail, below, the AR application 112 may present or provide AR content to a user via the display 106, and/or one or more output devices, such as speakers. In some implementations, the AR application 112 includes instructions stored in the memory 108 that, when executed by the processor assembly 110, cause the processor assembly 110 to perform the operations described herein. For example, the AR application 112 may generate and present an AR environment to the user based on, for example, an AR object 118. The AR object 118 may include objects that corresponds to various objects in a physical space 114. The AR object 118 may be rendered as flat images or as three-dimensional (3D) objects.

For purposes of the simplified example of FIG. 1, the device 102 is a smartphone with integrated camera 104 and display 106, where the camera 104 may be directed to capture images of the physical space 114. The physical space 114 may include any area that the camera 104 is capable of capturing. In an example implementation, the physical space 114 includes a real world object 116, in which the camera 104 can capture an image. The system 100 may overlaid or otherwise included within the AR display 106, an annotation 122 associated with the AR object 118, to be displayed.

In some implementations, the AR application 112 may be configured to store data that may relate to the real world object 116. In other words, the AR application 112 may include data relating to the real world object 116 when the system captures the real world object 116 via the camera 104. Thus, the AR application 112 may function as a database of information related to the real world object 116. Such information may be used for an educational purpose and/or used to obtain further content.

As in any 3D space or 3D image, objects that are farther away appear to be smaller, so that the AR object 118 appears smaller within the AR display 106 than if the object was placed closer to the user. As a result, the annotation 122 that is associated with the AR object 118 in the display 106 is similarly displayed in the display 106 to be smaller. When the camera 104 moves farther away from the real world object 116, the corresponding displayed AR object 118 appears to get smaller, indicating that the AR object 118 is moving farther away from the user. Further, as previously discussed, because the annotation 122 is associated with the AR object 118, the annotation 122 is correspondingly smaller, which may cause difficulties in reading the text of the annotation 122.

To compensate for text illegibility, the system 100 includes an annotation scale selector 134. The annotation scale selector 134 may change a scale of the annotation 122 based on a threshold distance from the object 116, as will be discussed in detail later.

The AR application 112, and thus the annotation scale selector 134, may include, utilize, or otherwise have access to, various types of hardware and/or software features that may be instrumental in performing the functions of the system 100. For example, a location engine 136 may be configured to determine physical location information relevant to the physical space 114 and thus the AR display 106. In some implementations, the physical location information may be determined based on a coordinate system being mapped to the captured image. The captured image may be based on determining a location of the AR system based on using, for example, a visual positioning system or a global positioning system (GPS). When AR content is identified, the AR content may be adjusted based on display properties of the AR display 106, with respect to the size and location information determined, at least in part, by the location engine 136.

In some implementations, the AR application 112 may also use a sensor system 138 to determine a location and orientation of a user within the physical space 114, and/or to recognize features or objects within the physical space 114, perhaps in conjunction with coordinate or other positional information from the location engine 136. The sensor system 138 may include the camera 104, as well as other sensors, including, for example, an inertial motion unit (IMU), a light sensor, an audio sensor, an image sensor, a distance sensor, a proximity sensor, a contact sensor such as a capacitive sensor, a timer, and other sensors or different combinations of sensors.

For example, the AR application 112 may construct a model of the physical space 114 from images taken by the camera 104, and other available information from the sensor system 138 and otherwise. The AR application 112 may include, or utilize (using suitable Application Program Interfaces (APIs)), a development platform or toolkit to detect the size and location of surfaces, including horizontal, vertical and angled surfaces (e.g., the ground, a table, or walls). Using determined edges and depth information, these various surfaces may be joined into a three-dimensional (3D) model to for AR purposes. Other features, such as motion tracking or light estimation, also may be utilized to construct or modify the resulting 3D model.

The AR application 112 may use an I/O system 140 to receive a user input to control a cursor (not shown) or otherwise to operate the smartphone 102. For example, the I/O system 140 may provide for gesture commands, voice commands, actuation of a button, or other type of input that provides a user with an ability to move and otherwise utilize the cursor. In various implementations, a nature of the I/O system 140 will depend on a nature of the overall AR system 100, including the camera 104, the AR display 106, and the cursor. For example, when the device 102 is a smartphone, the I/O system 140 may enable a touchscreen interface for control and movement of the cursor.

Thus, as referenced, the annotation scale selector 134 may be understood to have access to the various described components of the AR system 100, and other standard AR components that may be useful in implementing the AR system 100 of FIG. 1, but that are not explicitly illustrated therein. More detailed discussion of example operations of the annotation scale selector 134 is provided below with reference of FIGS. 2A-2B and 3A-3B.

FIGS. 2A and 2B illustrate an example AR display 200 presenting or displaying an annotation 205A and 205B, respectively, associated with a real world object 201 in accordance with an example implementation. FIG. 2A illustrates a captured image of the real world object 201 including the annotation 205A before reaching a threshold distance. FIG. 2B illustrates a captured image of the real world object 201 including the annotation 205B after reaching the threshold distance.

Referring to FIG. 2A, the AR display 200, captured by the camera 104 of FIG. 1, illustrates a snap shot display of the captured image of the real world object 201. The AR display 200 also includes the annotation 205A, via the AR application 112, associated with the real world object 201. The annotation 205A can include a label (e.g., text, content, or information) to describe the real world object 201. In this example, the annotation 205A includes the text “This is a title placeholder” to indicate content (e.g., information) of the annotation.

In some implementations, a scale of the annotation 205A can be fixed to the real world object 201. In other words, a scale of the annotation 205A in relation to the real world object 201 will proportionally be the same at various distances. Therefore, if the size of the real world object 201 changes due to being at different distances, the scale of the annotation 205A will proportionally change based on the changed distances. For example, if the real world object 201 displayed on the AR display 200 has a first size, the scale of the annotation 205A displayed on the AR display 200 will proportionally change with respect to the first size of the real world object 201. Similarly, if the real world object 201 displayed on the AR display 200 has a second size, the scale of the annotation 205A displayed on the AR display 200 will proportionally change with respect to the second size of the real world object 201. In this example, the first size can be different (e.g., smaller or larger) than the second size.

As the user moves farther away from the real world object 201, the real world object 201 is displayed to be smaller. Further, as the user continues to move farther away, the real world object 201 is displayed to be even smaller. Correspondingly, the annotation 205A associated with the real world object 201 is displayed to be smaller as well. However, at a predetermined point (e.g. distance), the scale of the annotation 205A, and thus the text of the annotation 205A becomes so small that the text becomes, for example, illegible. In order to resolve the text illegibility, the system 100, via the annotation scale selector 134, triggers the scale (at a threshold) of the annotation 205A to change to a different scale (e.g., larger), as shown by 205B in FIG. 2B. For example, the scale of annotation 205A (FIG. 2A) is enlarged to the scale of annotation 205B (FIG. 2B). As a result, the text in the annotation 205B is larger, and thus, the user has no difficulties in reading the text of the annotation 205B.

When the user is at a predetermined distance from the real world object 201, a threshold is satisfied to trigger a change of the scale of the annotation 205A. In one example implementation, the threshold can be based on a predetermined distance. For example, the predetermined distance may be 1 meter from the real world object 201. When the user is beyond the 1 meter distance threshold (or depth threshold), the system 100 triggers the annotation 205A to change scale. Other distances may be employed as long as the text legibility is achieved.

In some implementations, the threshold can be based on multiple different distances. For example, when the user is 1 meter away from the real world object 201, the annotation can be approximately 1 inch that is displayed on the display screen. When the user is 2 meters away from the real world object 201, the annotation can be approximately 2 centimeters that is displayed on the display screen. When the user is 3 meters away from the real world object 201, the annotation can be approximately 3 centimeters that is displayed on the display screen.

In some implementations, the threshold can be based on pixels. In other words, the system may change the scale of the annotation when a certain resolution of the image is satisfied. For example, when the real world object 201 has a 200 pixel count, the scale of the annotation can be changed to a larger scale.

In some implementations, the threshold can be based on a percentage of the real world object 201 being displayed on the display screen. For example, when the real world object 201 is displayed of approximately 10 percent of the display screen, the scale of the annotation can be changed (e.g., to a larger scale).

In some implementations, the threshold can be based on a combination of the above discussed thresholds. For example, the annotation can change scale based on the distance (or depth) from the real world object 201 and the pixel count. In another example, the annotation can change scale based on the distance from the real world object and the percentage of the displayed real world object 201 on the display screen. In another example, the annotation can change scale based on the pixel count and the percentage of the displayed real world object on the display screen.

FIGS. 3A and 3B illustrate an example AR display 300 presenting or displaying an annotation 305A and 305B, respectively, associated with a real world object 201 in accordance with an example implementation. For purposes of simplicity sake, the real world object 201 in FIGS. 3A and 3B is the same as illustrated in FIGS. 2A and 2B. FIG. 3A illustrates a captured image of the real world object 201 including the annotation 305A before reaching a threshold distance (or depth). FIG. 3B illustrates a captured image of the real world object 201 including the annotation 305B after reaching the threshold distance.

Referring to FIG. 3A, the AR display 300, captured by the camera 104 of FIG. 1, illustrates a snapshot display of the captured image of the real world object 201. In the AR display 300, the annotation 305A associated with the real world object 201 is shown. Similarly, as discussed above, the annotation 305A includes a label (e.g., text, content, or information) to describe the real world object 201. For example, the annotation 305A includes the text “This is a title placeholder” to indicate content (e.g., information) of the annotation 305A.

In comparison to the real world object 201 of FIG. 2A, the real world object 201 of FIG. 3A is displayed to be larger because the user has moved closer to the real world object 201. Additionally, the real world object 201 may continue to be larger as the user moves closer to the real world object 201. Correspondingly, as shown in FIG. 3A, the annotation 305A associated with the real world object 201 is also displayed to be larger. As the user continues to move closer to the real world object 201, the annotation 305A will correspondingly get larger until at a predetermined point (e.g. distance), the scale of the annotation 305A becomes so large that the annotation 305A takes up a large portion of the AR display 300. In other words, the annotation 305A will be displayed on a large portion of the AR display 300. Because the size of the annotation 305A is disproportionately large on the AR display 300, the annotation 305A appears fake and does not feel immersed in the augmented environment. In order to obtain the immersive environment, the system 100, via the annotation scale selector 134, triggers the scale of the annotation 205A to change to a different scale (e.g., smaller), as shown by 305B in FIG. 3B. For example, the scale of annotation 305A (FIG. 3A) is reduced (e.g., decreased, shortened, compressed, or downsized), to the reduced scale of annotation 305B (FIG. 3B). As a result, the scale of the annotation 305B (including the text in the annotation 305A) is displayed to be smaller as compared to annotation 305A. In addition, the reduced annotation 305B is made to be proportional to the size of the real world object 305B. This helps with the immersive experience in the augmented environment by the user.

When the user is at a predetermined distance from the real world object 201, a threshold is satisfied to trigger a change in the scale of annotation 305A to the reduced scale annotation 305B. In some implementations, the threshold can be based on a predetermined distance. For example, the predetermined distance may be 0.5 meter from the real world object 201. When the user is within the 0.5 meter distance threshold, the system 100 triggers the annotation 305A to change scale.

In some implementations, the threshold to reduce the annotation 305A to annotation 305B can be based on other thresholds, as similarly discussed above. For example, the combinations of multiple distances, pixel count, and/or percentage of the displayed real world object 201 on the display screen.

In some implementations, the size of annotation 305B of FIG. 3B can be the same as the size of annotation 205B of FIG. 2B. In other words, the annotation size 205B of FIG. 2B displayed on the display screen can be same as the annotation size 305B of FIG. 3B displayed on the display screen. For example, the size of annotations 205B and 305B displayed on the display screen can be 0.5 inch in width and 2 inches in length.

FIGS. 4A and 4B illustrate another example AR display 400 presenting (or displaying) annotations 405A and 405B, respectively, associated with the real world object 201 in accordance with an example implementation. For sake of simplicity, the real world object 201 of FIGS. 4A and 4B is the same as the real world object 201 as discussed above. As shown in FIGS. 4A and 4B, the real world object 201 can be displayed at a different angle. In other words, the real world object 201 can be rotated from an initial position (e.g., frontal view of the object). For example, the real world object 201 can be rotated 90°.

When the user moves an at different angle (e.g., rotated 90°), the annotation 405A can remain fixed to the real world object 201. That is, the annotation 405A remains fixed to the real world object 201 and displayed at a front portion of the real world object 201 as if the annotation 405 is part of (and rotates with) the real world object 201. To explain in another manner, the annotation 405A can be perceived as a label that is attached to the front portion of the real world object 201. However, at this viewing angle, the text on the annotation 405A can sometimes be difficult to read because the text is at an angle.

In order to compensate for the viewing angle, the system 100, via the annotation scale selector 134, triggers (at a threshold angle) the annotation 405A to rotate to a different viewing angle, as shown by 405B in FIG. 4B. For example, the annotation 405A can be rotated such that the annotation 405A is now facing the user (or the text on the annotation 405B is horizontal on the display screen). As a result, the annotation 405B including the text is displayed to be legible.

When the user is at a predetermined rotated position from the real world object 201, a threshold is satisfied to trigger a rotation of the annotation 405A. For example, rotating the annotation 405A of FIG. 4A to the rotated annotation 405B of FIG. 4B. In one example implementation, the threshold can be based on a predetermined rotated viewing angle. For example, the predetermined rotated viewing angle may be 90°from the real world object 201.

In some implementations, other thresholds may be employed to trigger the rotation of the annotation, such as, for example, viewing angles of 30°, 45°, or 60°. In some implementations, multiple different rotation thresholds of the object 201 can be applied to trigger rotation of the annotation (e.g., annotation 405).

In some implementations, the threshold may be based on, in addition to rotation, a predetermined distance, as discussed above. For example, the annotation can change scale when the user has rotated 90° and moved 1 meter from the real world object 201.

FIG. 4C illustrates an example AR display 400 presenting (or displaying) an annotation 406 associated with the real world object 201 in accordance with an example implementation. In this implementation, the annotation 406 is displayed at an angle with respect to the real world object 201. In this example, the angled annotation 406 is in relation to a front view position of the real world object 201.

When the user rotates to a different rotated position, annotation 406 can remain fixed to a previous position, and hence, annotation 406 can be at an angle with respect to the real world object 201. In order to compensate for the different angled annotation 406, the system 100, via the annotation scale selector 134, can rotate the annotation 406 to its original position (e.g., facing the user). In this example, the annotation 406 can be positioned at the front portion of the real world object 201 in a horizonal position in the display screen.

FIG. 5 is a flowchart 500 illustrating example operations of the system of FIG. 1. In the example of FIG. 5, an annotation 122 may be inserted associated with an AR object 118 in an augmented environment (S502). In some implementations, the annotation 122 may be a textual label within an AR display 106 of a physical real world object 116 captured by the camera 104 (shown in FIG. 1). In some implementations, the annotation scale selector 134 of FIG. 1 may insert the annotation 122 within the AR display 106 of FIG. 1, associated with the AR object 118. The AR object 118 simulating a three-dimensional position within the physical space 114 relative to the camera 104. The annotation scale selector 134 may detect a position of the AR object 118 within the AR display 106 of FIG. 1. The detected AR object 118 may be detected and otherwise expressed in x, y, z coordinates of a coordinate system used to map the AR display 106 to a corresponding physical space, such as the physical space 114. In other words, an x, y, z, coordinate system of the physical space 114 may be mapped to a corresponding x, y, z coordinate system of the AR display 106, so that positions of imaged content within the physical space 114 may be correlated with the positions to any AR object. The x, y, z coordinate system may be defined with respect to a camera used to generate the AR display 106, such as a camera.

In S504, a scale of the annotation 122 may then be changed based on a threshold distance from the AR object 118. The annotation scale can be fixed relative to a display screen size. For example, as described herein, the annotation scale selector 134 of FIG. 1 may execute one or more scaling algorithms to calculate and dynamically adjust the scale of the annotation 122, where such scaling algorithms may include factors including, but not limited to, a distance of the real world object from the camera, a distance of the AR object from the camera, a size of at least one AR object, and/or a default threshold distance and various combinations of such factors.

In some implementations, the annotation 122 can be fixed to the AR object and does not change its scale until the viewing distance is greater than a threshold. For example, when the user moves farther away from the object, the text on the annotation 122 becomes smaller and illegible until a threshold is reached. Once the threshold is reached, the size of the annotation 122 is enlarged to a predetermined scale so the text becomes legible. In another example, when the user moves closer to the object, the scale of the annotation 122 becomes larger in relation to the object until a threshold is reach. Once reached, the system 100 reduces the size of the annotation 122, having a similar size (or scale) as compared to the user that was farther from the object. As a result, the annotation scale is fixed relative to a display screen size.

FIG. 6 is a flowchart 600 illustrating another example operation of the system of FIG. 1. In the embodiments similar to those of FIG. 5, the annotation scale selector 134 of FIG. 1 may insert the annotation within the AR display 106 of FIG. 1, associated with the AR object in an augmented environment (S602). In one implementation, the annotation may be a textual label within an AR display 106 of a physical real world object 116 captured by the camera 104.

In S604, a first scale of the annotation may then be changed based on a first threshold distance from the AR object. For example, as illustrated in FIGS. 2A and 2B, when the camera 104 of FIG. 1 moves farther away from the AR object 201, the first scale of the annotation 205A is reduced, and as a result, text on the annotation 205A becomes illegible. Then, when the first threshold distance is met, the annotation scale selector 134 of FIG. 1 may execute an algorithm to calculate and dynamically adjust the scale of the annotation 205A. For example, as shown in FIG. 2B, when the first threshold distance is met, the annotation scale selector 134 executes a scaling function that enlarges the annotation 205B to a larger size. This provides the text on the annotation 205B to become legible.

In S606, a second scale of the annotation may then be changed based on a second threshold distance from the AR object 201. For example, as illustrated in FIGS. 3A and 3B, when the camera 104 of FIG. 1 moves closer to from the AR object 201, the first scale of the annotation 305A is enlarged, and as a result, the size of the annotation 305A is larger in relation to the AR object 201. In other words, size on the annotation 305A becomes so large that it takes up a larger portion of viewing in the display. Then, when a second threshold distance is met, the annotation scale selector 134 of FIG. 1 may execute an algorithm to calculate and dynamically adjust the scale of the annotation 305A. For example, when the second threshold distance is satisfied, the annotation scale selector 134 executes a scaling function that reduces the annotation 305A to a smaller size, and thus, producing annotation 305B. This provides the size on the annotation 305B to a proportionate size while maintaining text legibility. This also creates a more immersive experience in the augmented environment.

In some implementations, the first scale of annotation 205B (FIG. 2B) can be the same as the second scale of annotation 305B (FIG. 3B). In some implementations, the first scale of annotation 205B can be different to the second scale of annotation 305B.

A number of embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of this description.

In addition, the logic flows depicted in the figures do not require the particular order shown, or sequential order, to achieve desirable results. In addition, other steps may be provided, or steps may be eliminated, from the described flows, and other components may be added to, or removed from, the described systems.

In this specification and the appended claims, the singular forms "a," "an" and "the" do not exclude the plural reference unless the context clearly dictates otherwise. Further, conjunctions such as “and,” “or,” and “and/or” are inclusive unless the context clearly dictates otherwise. For example, “A and/or B” includes A alone, B alone, and A with B. Further, connecting lines or connectors shown in the various figures presented are intended to represent exemplary functional relationships and/or physical or logical couplings between the various elements. It should be noted that many alternative or additional functional relationships, physical connections or logical connections may be present in a practical device. Moreover, no item or component is essential to the practice of the embodiments disclosed herein unless the element is specifically described as “essential” or “critical”.

While certain features of the described implementations have been illustrated as described herein, many modifications, substitutions, changes and equivalents will now occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the scope of the implementations. It should be understood that they have been presented by way of example only, not limitation, and various changes in form and details may be made. Any portion of the apparatus and/or methods described herein may be combined in any combination, except mutually exclusive combinations. The implementations described herein can include various combinations and/or sub-combinations of the functions, components and/or features of the different implementations described.

ABSTRACT

In at least one general aspect, a computer-implemented method can include inserting an annotation associated with an augmented reality (AR) object in an augmented environment, the annotation being a textual information, and changing a size of the annotation based on a threshold distance from the AR object.

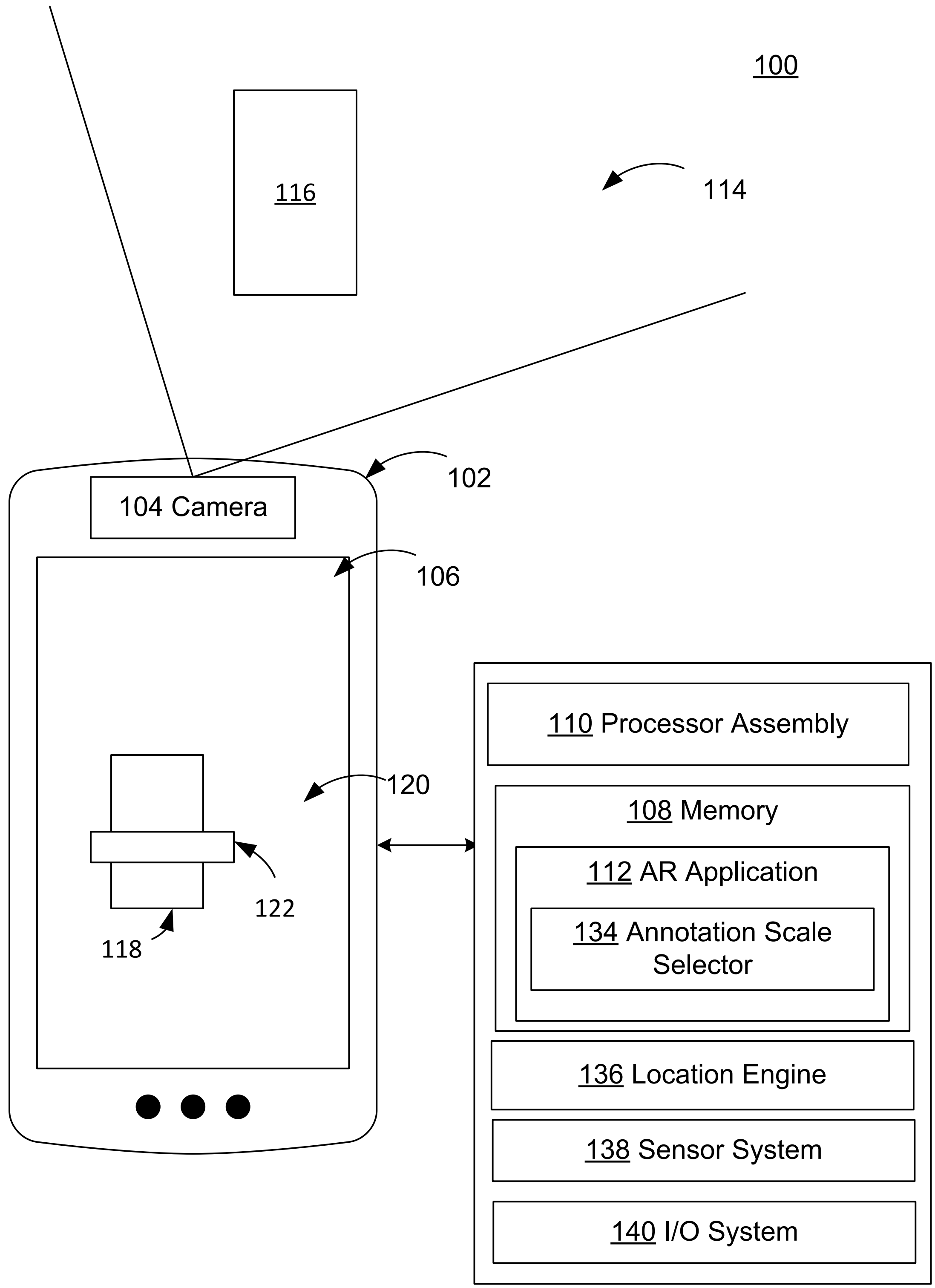
100
116
114
102
104 Camera
106
120
122
118
110 Processor Assembly
108 Memory
112 AR Application
134 Annotation Scale Selector
136 Location Engine
138 Sensor System
140 I/O System

FIG.1

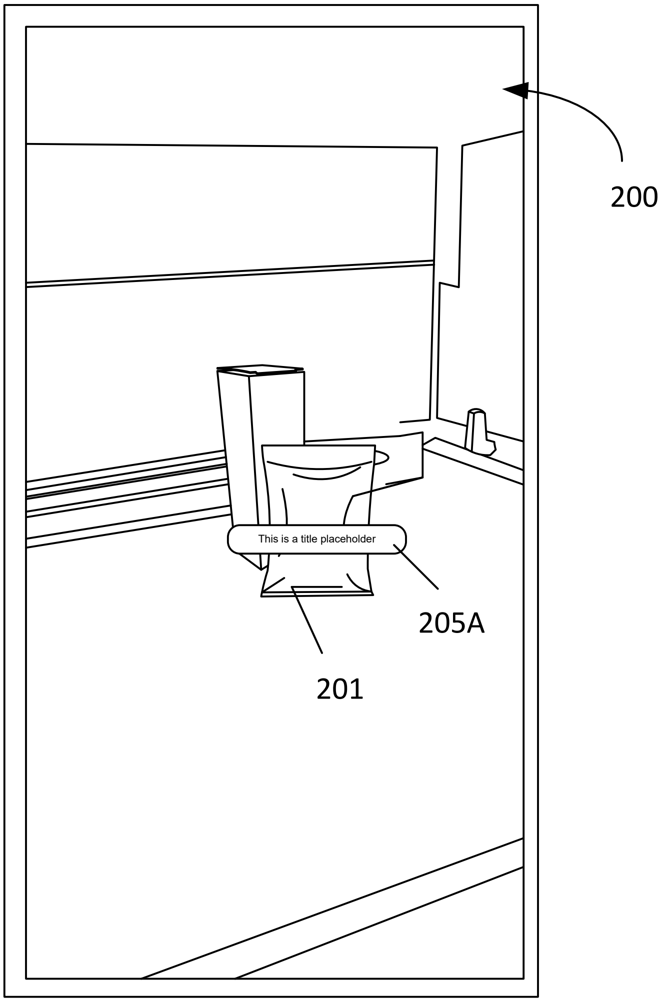
200
This is a title placeholder
205A
201

FIG. 2A

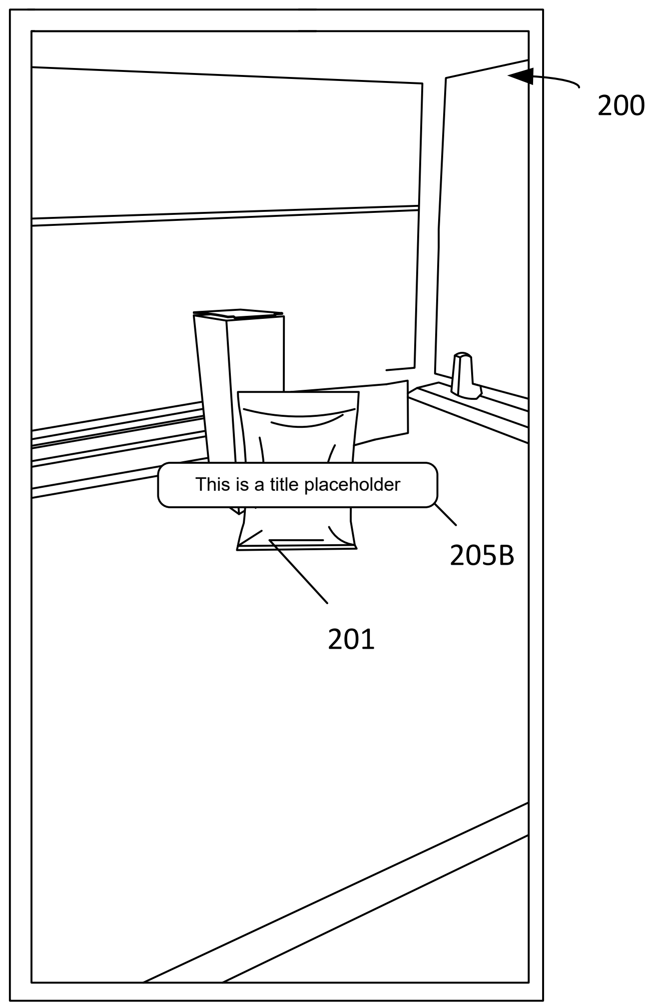
200
This is a title placeholder
205B
201

FIG. 2B

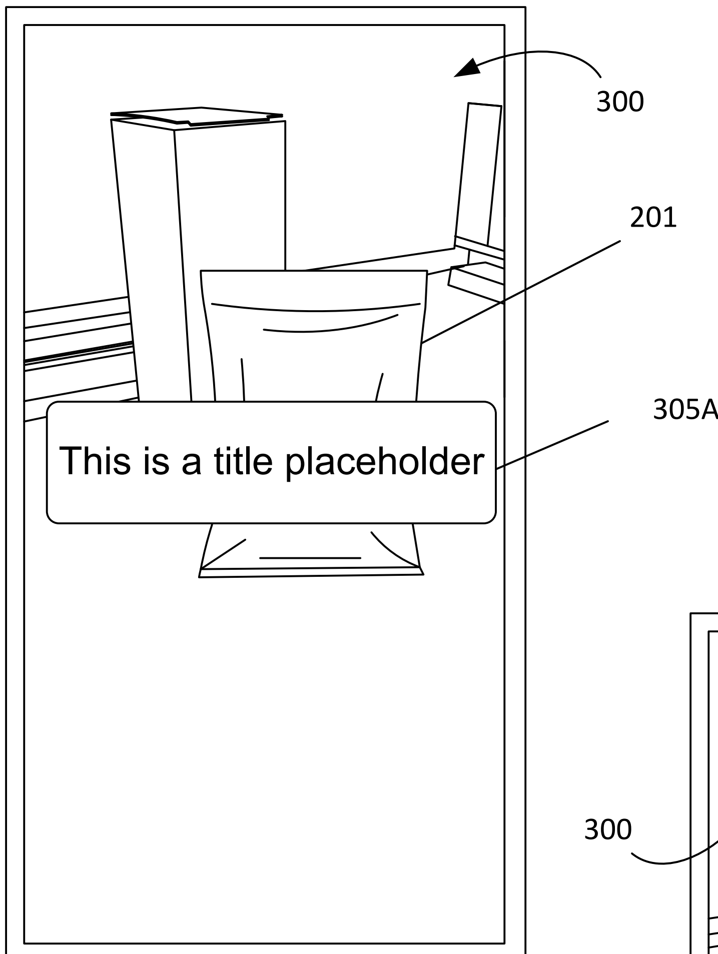
300
201
305A
This is a title placeholder

FIG. 3A

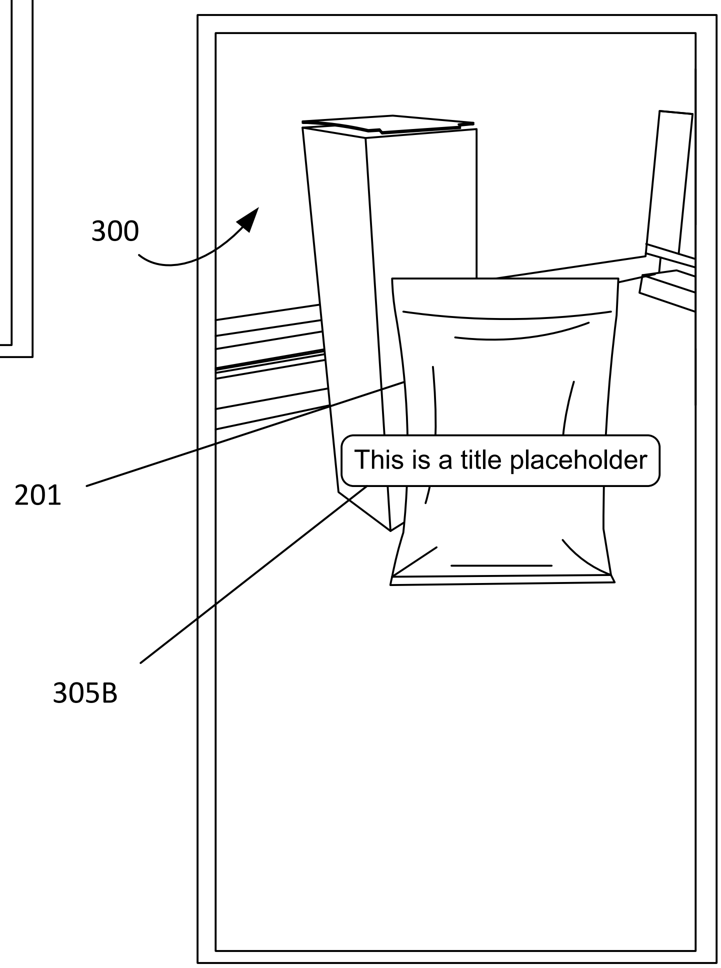
300
201
This is a title placeholder
305B

FIG. 3B

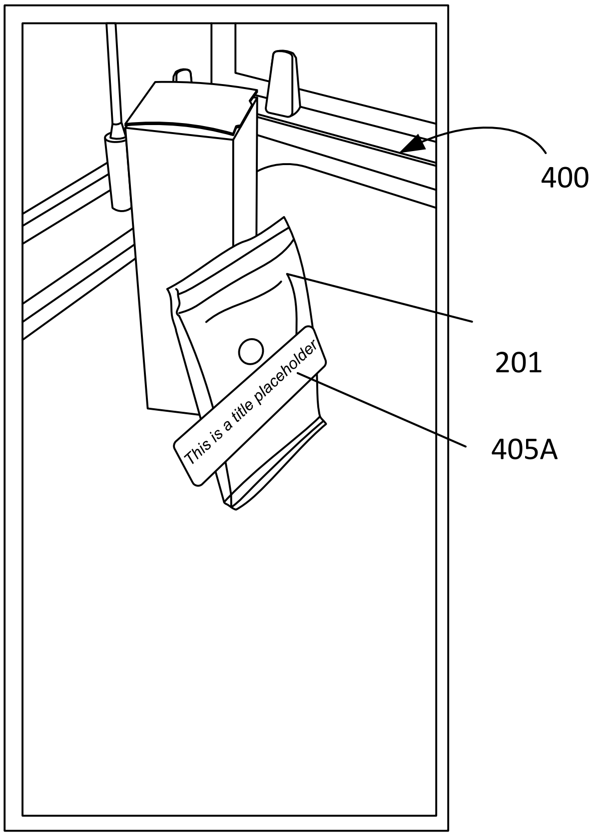

FIG. 4A

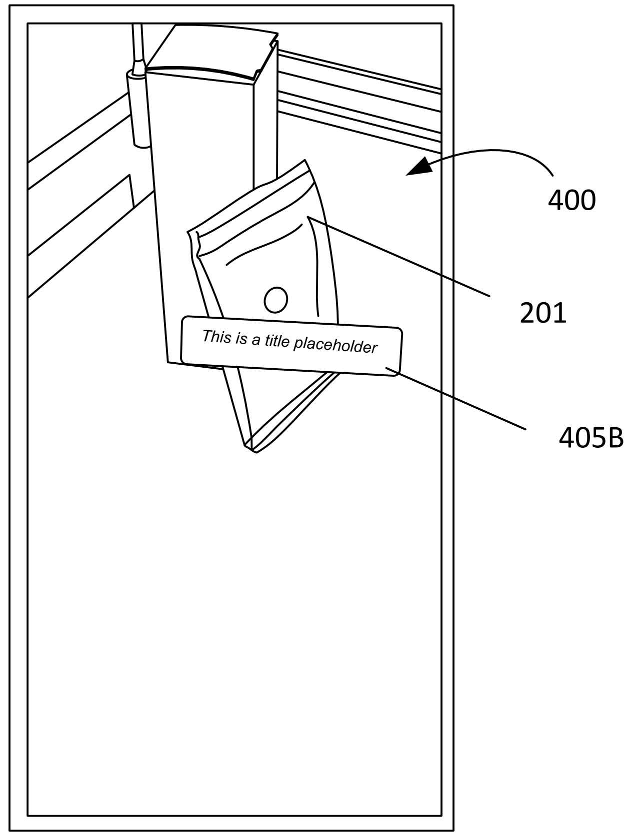

FIG. 4B

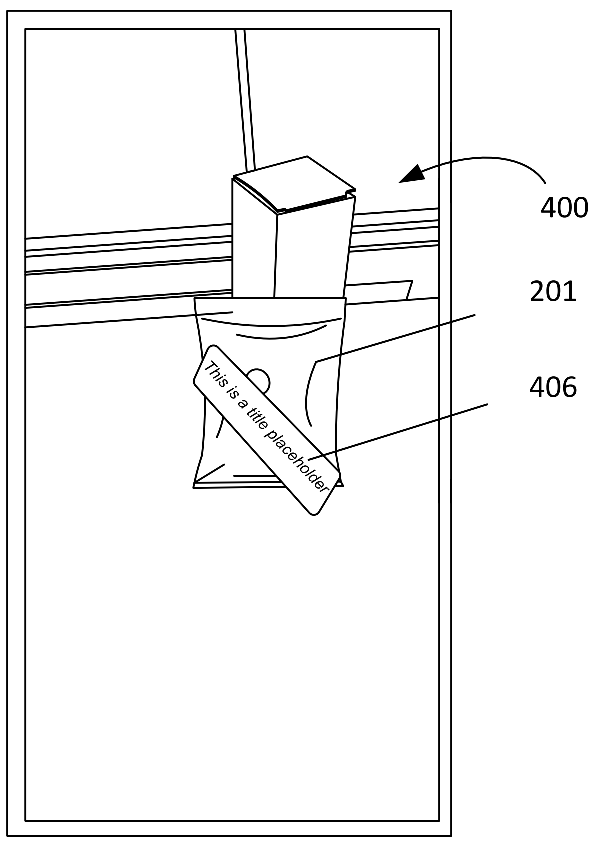

FIG. 4C

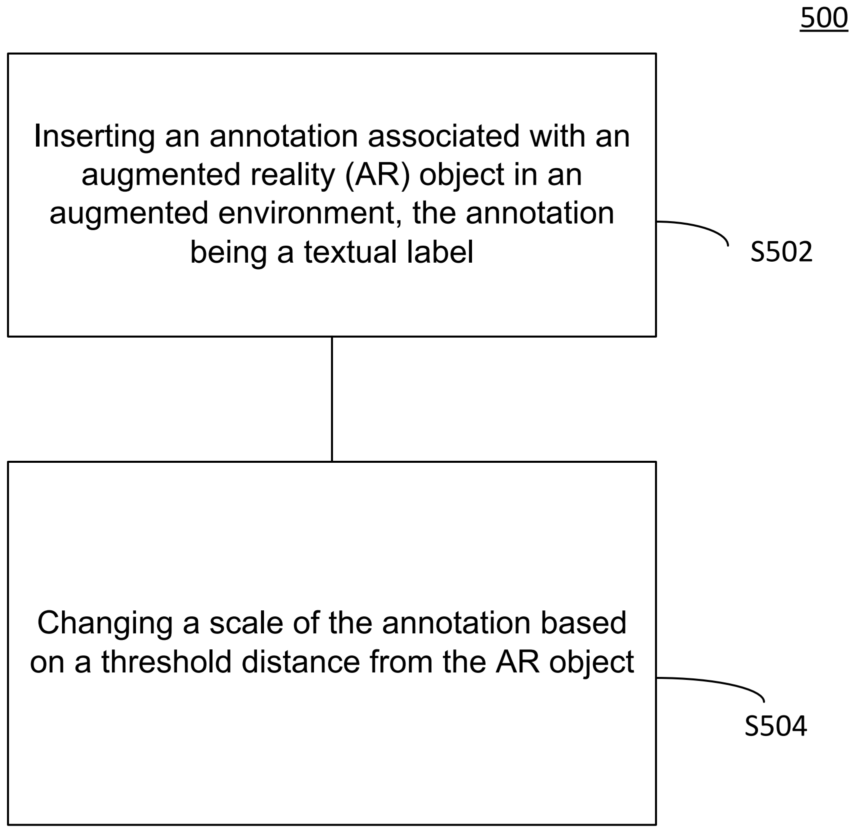
500
Inserting an annotation associated with an augmented reality (AR) object in an augmented environment, the annotation being a textual label
S502
Changing a scale of the annotation based on a threshold distance from the AR object
S504

FIG. 5

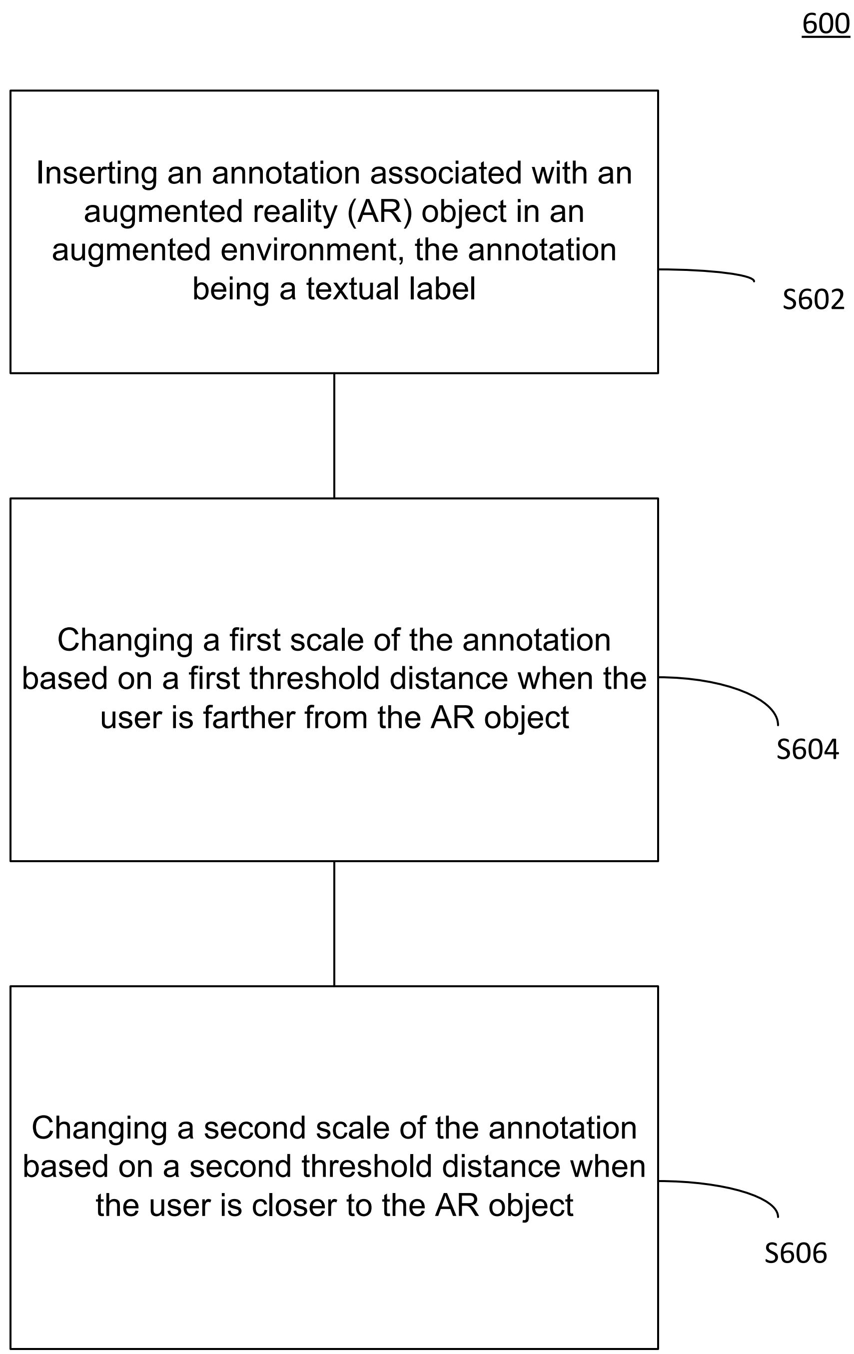
600
Inserting an annotation associated with an augmented reality (AR) object in an augmented environment, the annotation being a textual label
S602
Changing a first scale of the annotation based on a first threshold distance when the user is farther from the AR object
S604
Changing a second scale of the annotation based on a second threshold distance when the user is closer to the AR object
S606

FIG. 6

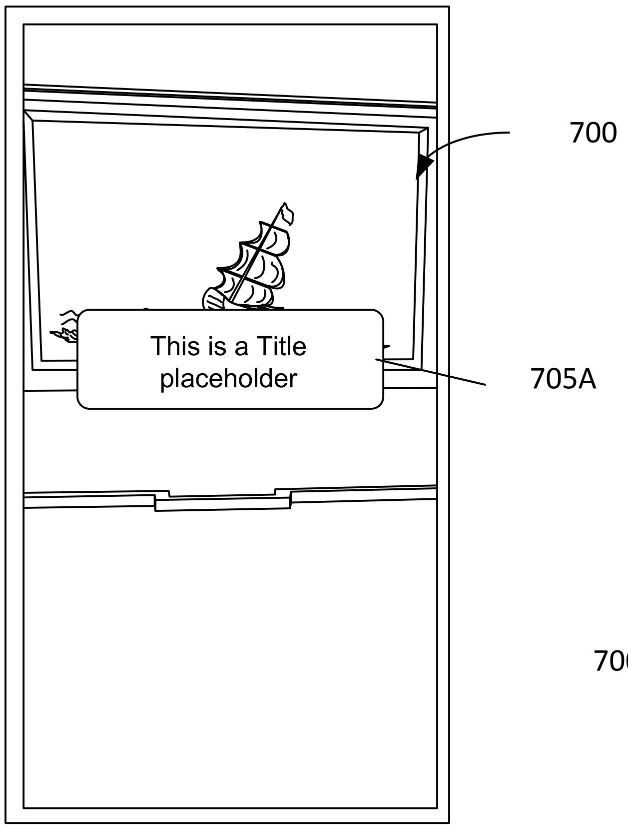
700
This is a Title placeholder
705A

FIG. 7A

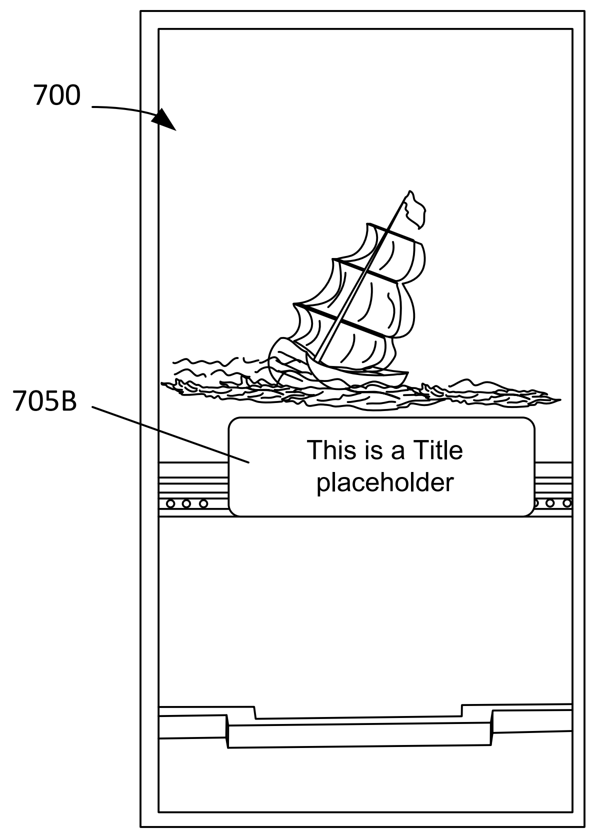
700
705B
This is a Title placeholder

FIG. 7B

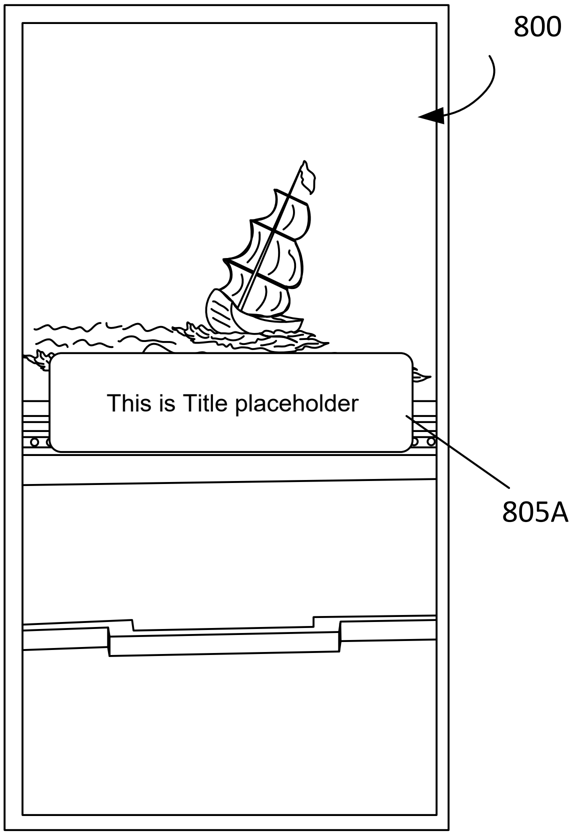

FIG. 8A

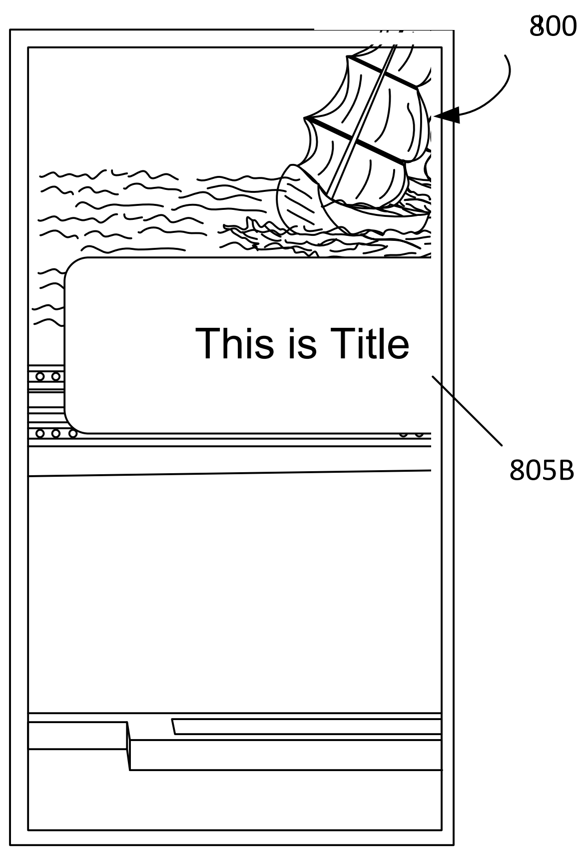

FIG. 8B