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(54) **SYSTEMS AND METHODS FOR INTERACTIVE BROADCASTING**

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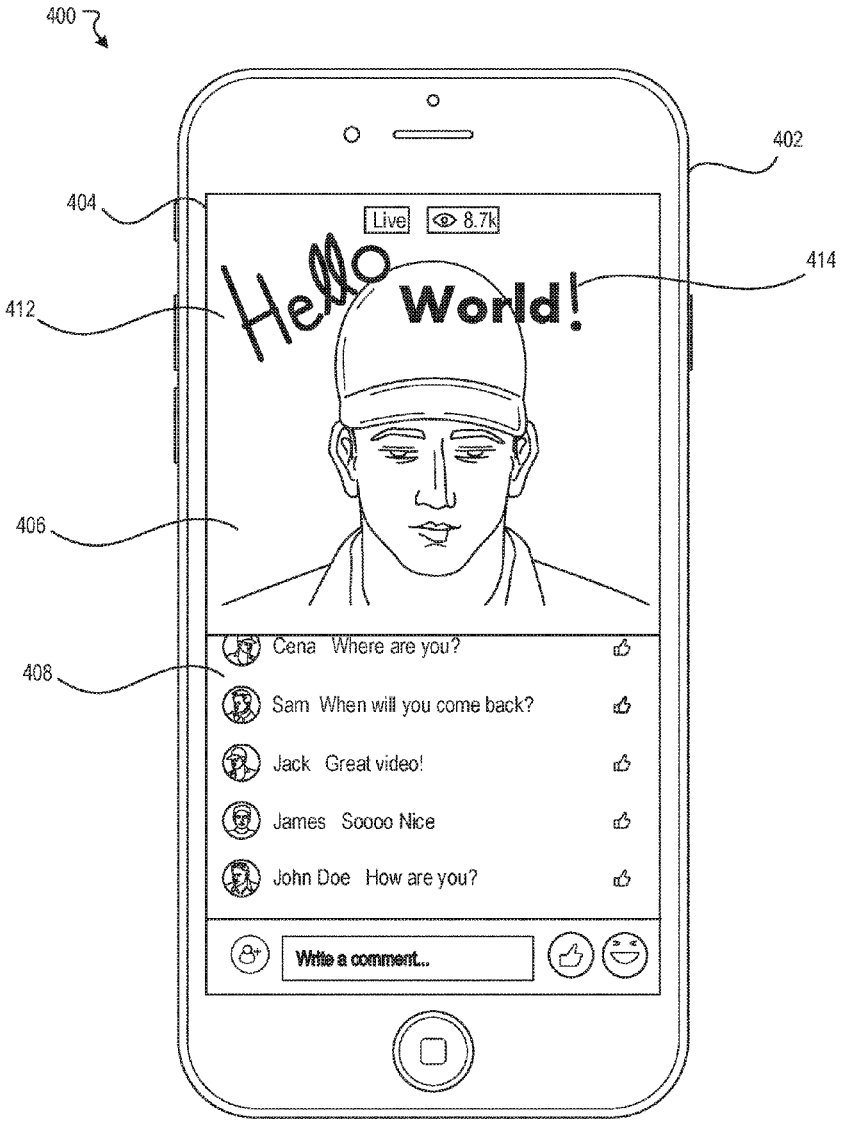
(57) **ABSTRACT**

Systems, methods, and non-transitory computer-readable media can provide an interface through which a live content stream is presented, the live content stream being accessed through a content provider system. A determination is made that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream. The interface is updated to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.



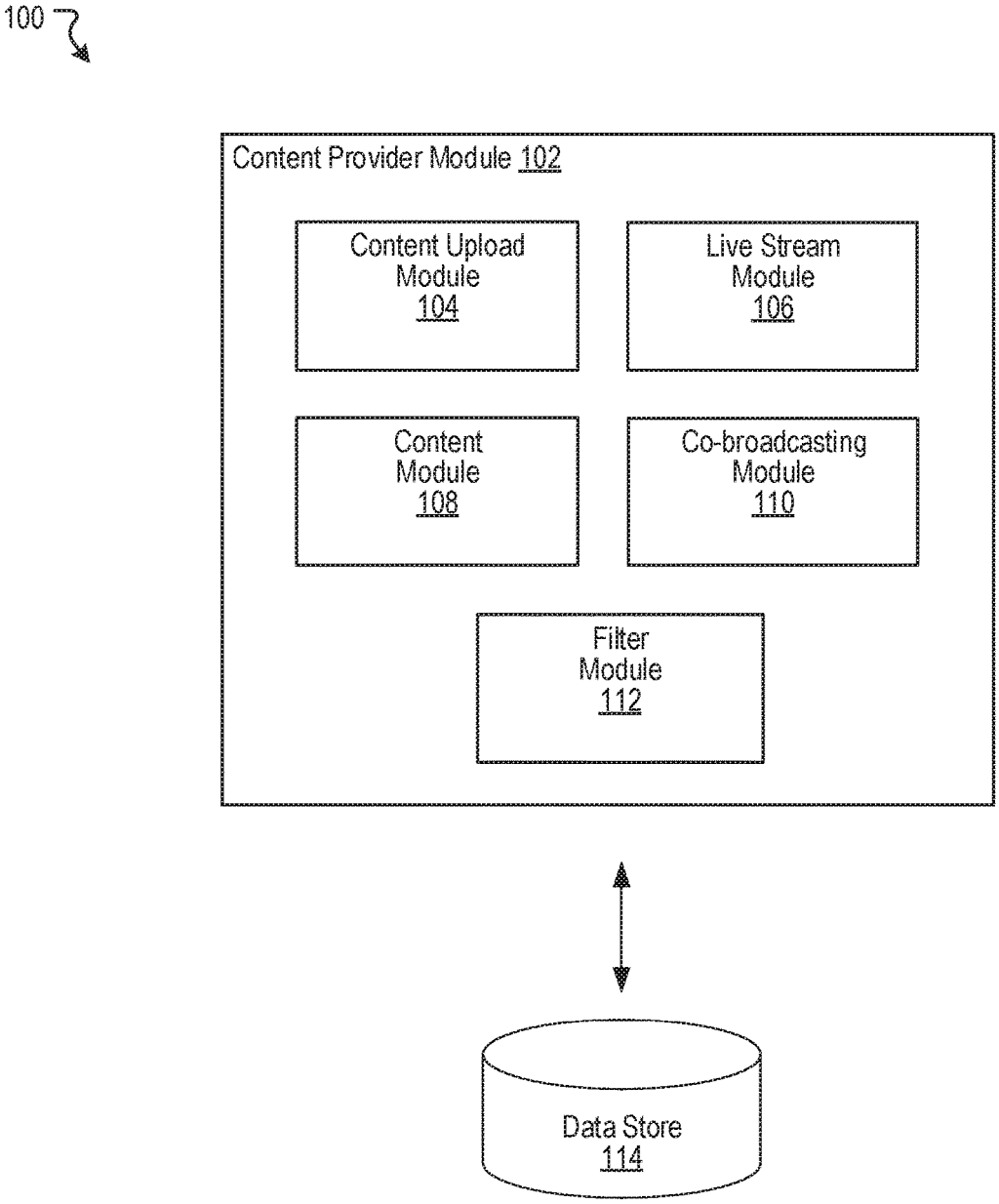

100
Content Provider Module 102
Content Upload Module 104
Live Stream Module 106
Content Module 108
Co-broadcasting Module 110
Filter Module 112
Data Store 114

FIGURE 1

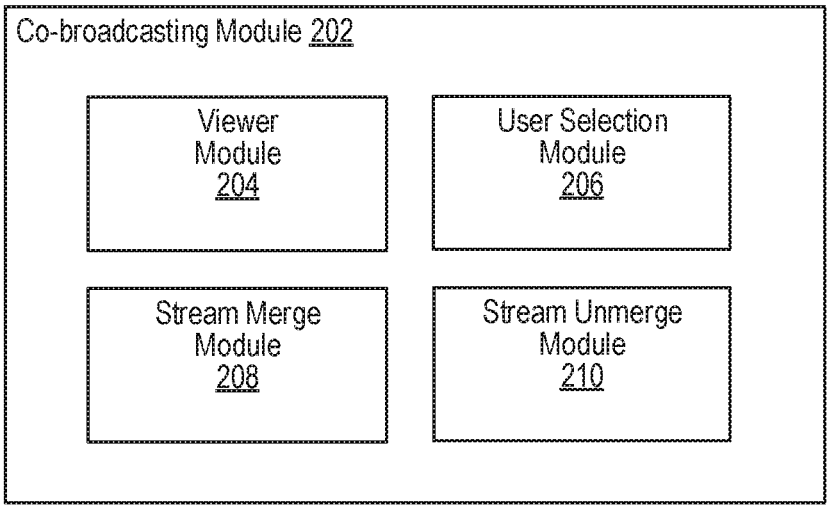

Co-broadcasting Module 202
Viewer Module 204
User Selection Module 206
Stream Merge Module 208
Stream Unmerge Module 210

FIGURE 2

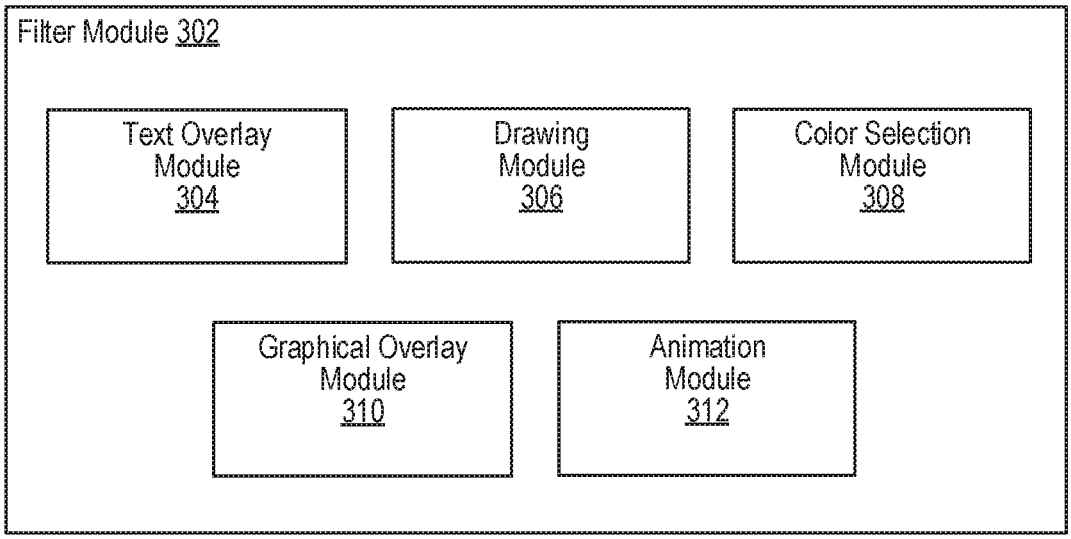

Filter Module 302
Text Overlay Module 304
Drawing Module 306
Color Selection Module 308
Graphical Overlay Module 310
Animation Module 312

FIGURE 3

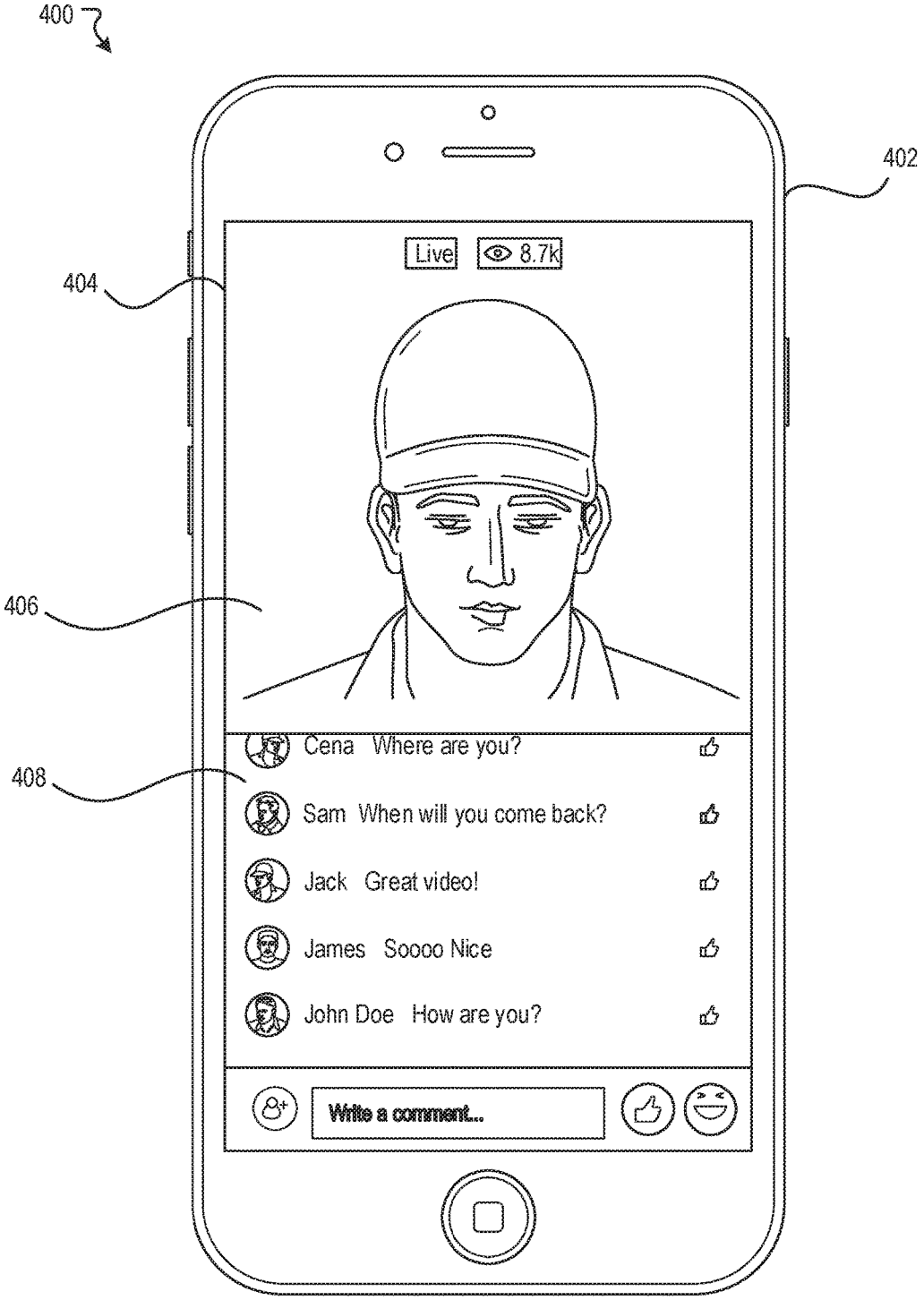

400
402
404
406
408
Live
8.7k
Cena Where are you?
Sam When will you come back?
Jack Great video!
James Soooo Nice
John Doe How are you?
Write a comment...

FIGURE 4A

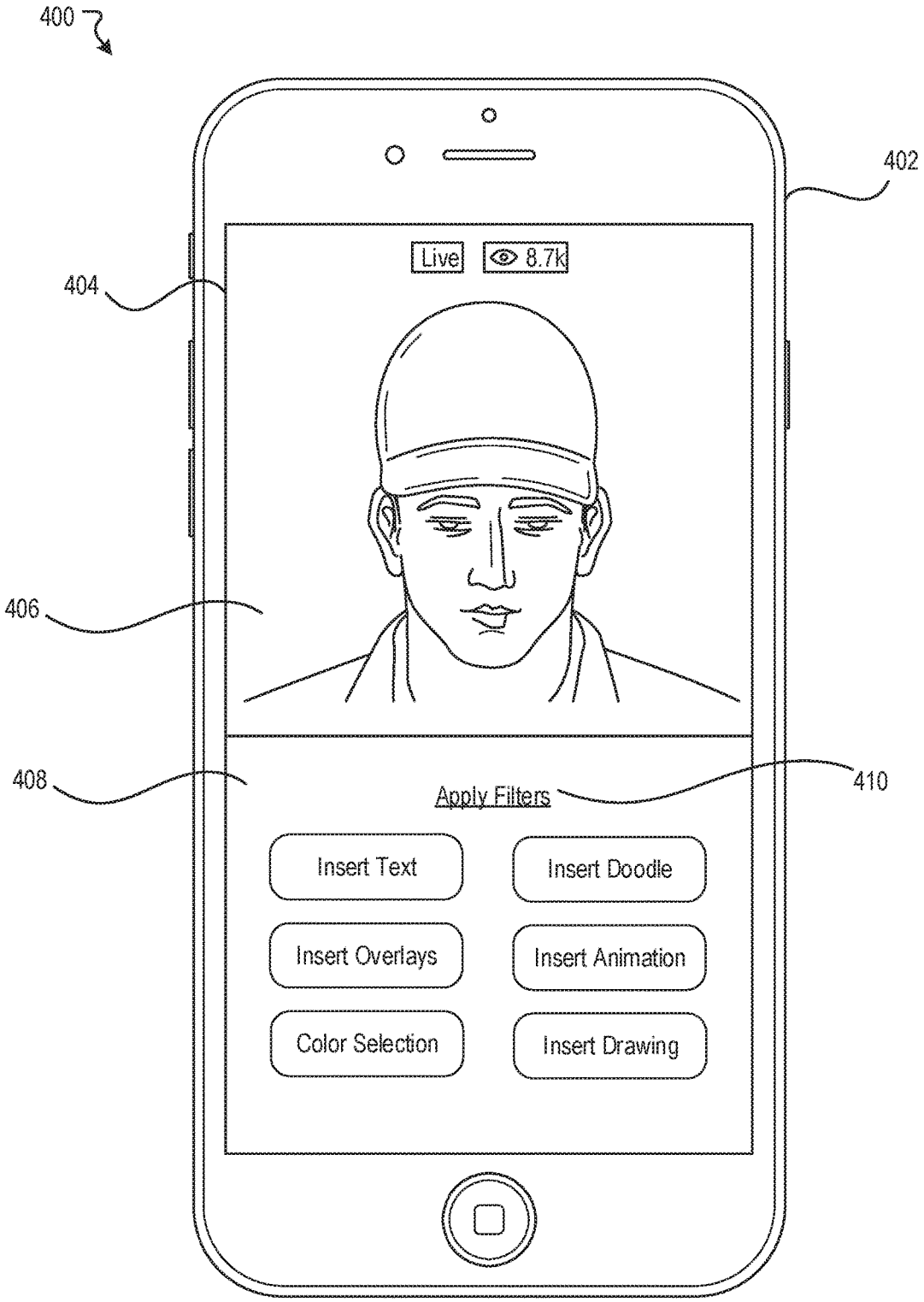

400
402
404
406
408
410
Live
8.7k
Apply Filters
Insert Text
Insert Doodle
Insert Overlays
Insert Animation
Color Selection
Insert Drawing

FIGURE 4B

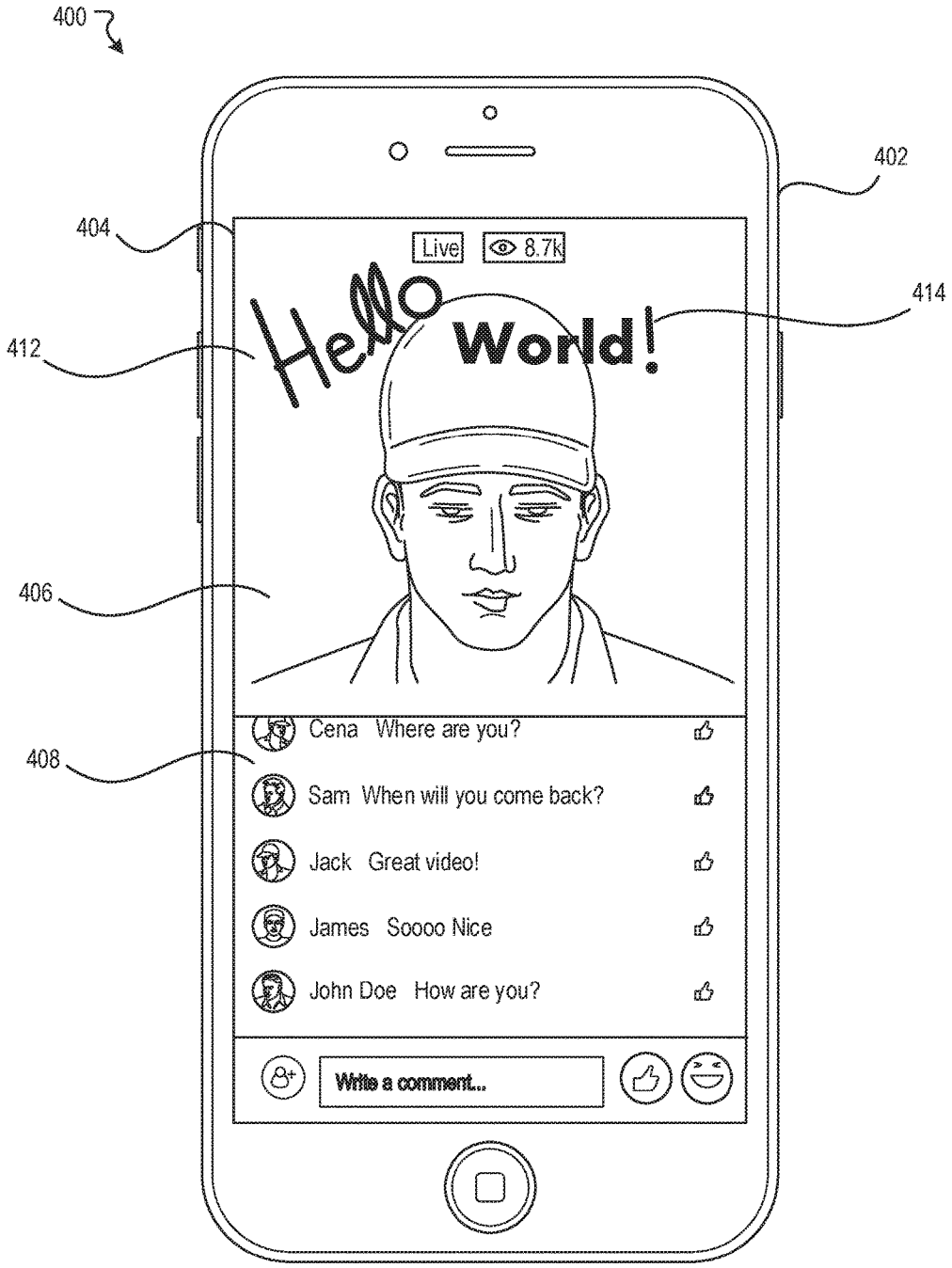

400
402
404
Live
8.7k
Hello World!
414
412
406
408
Cena Where are you?
Sam When will you come back?
Jack Great video!
James Soooo Nice
John Doe How are you?
Write a comment...

FIGURE 4C

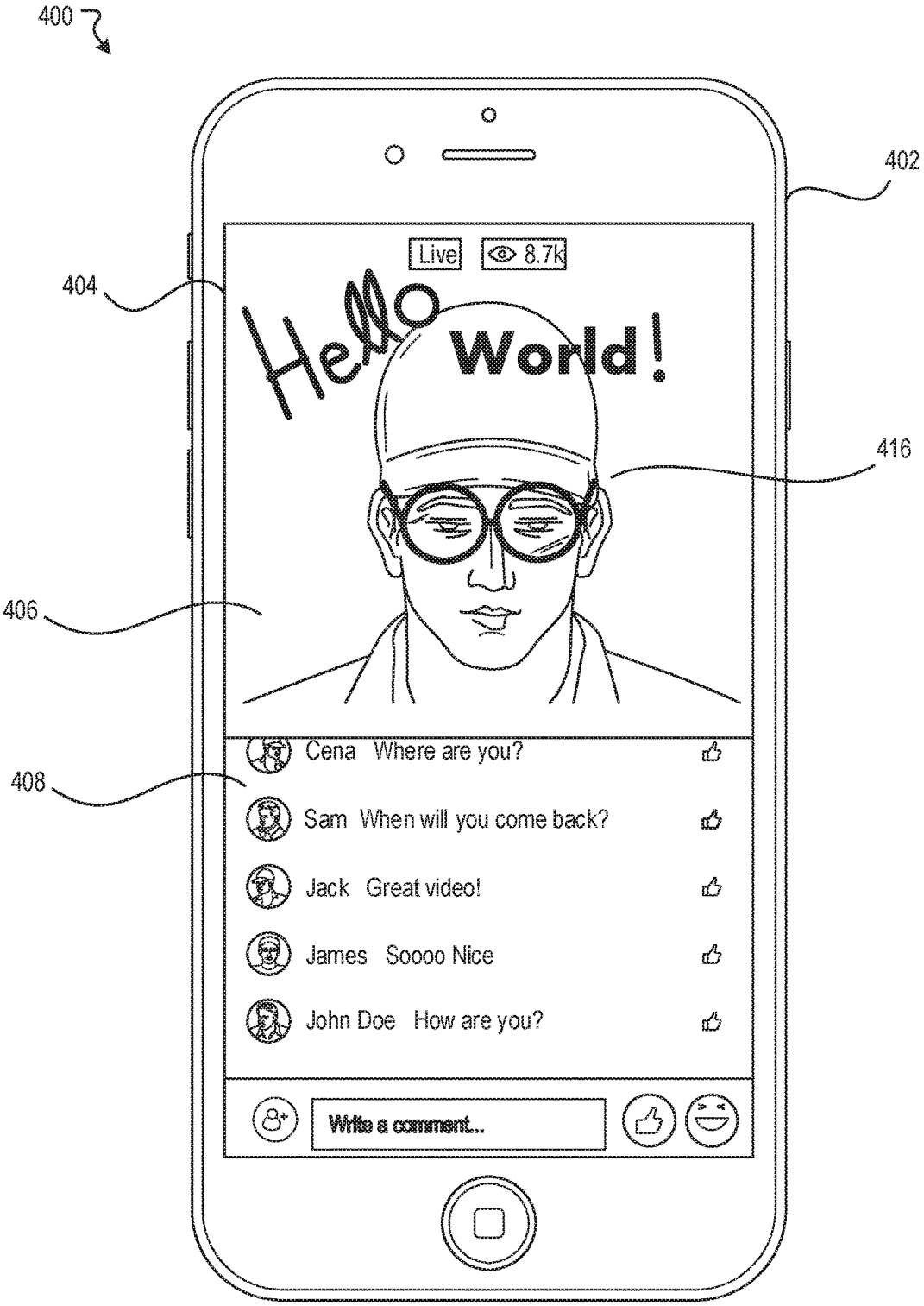

400
402
404
Live
8.7k
Hello World!
416
406
408
Cena Where are you?
Sam When will you come back?
Jack Great video!
James Soooo Nice
John Doe How are you?
Write a comment...

FIGURE 4D

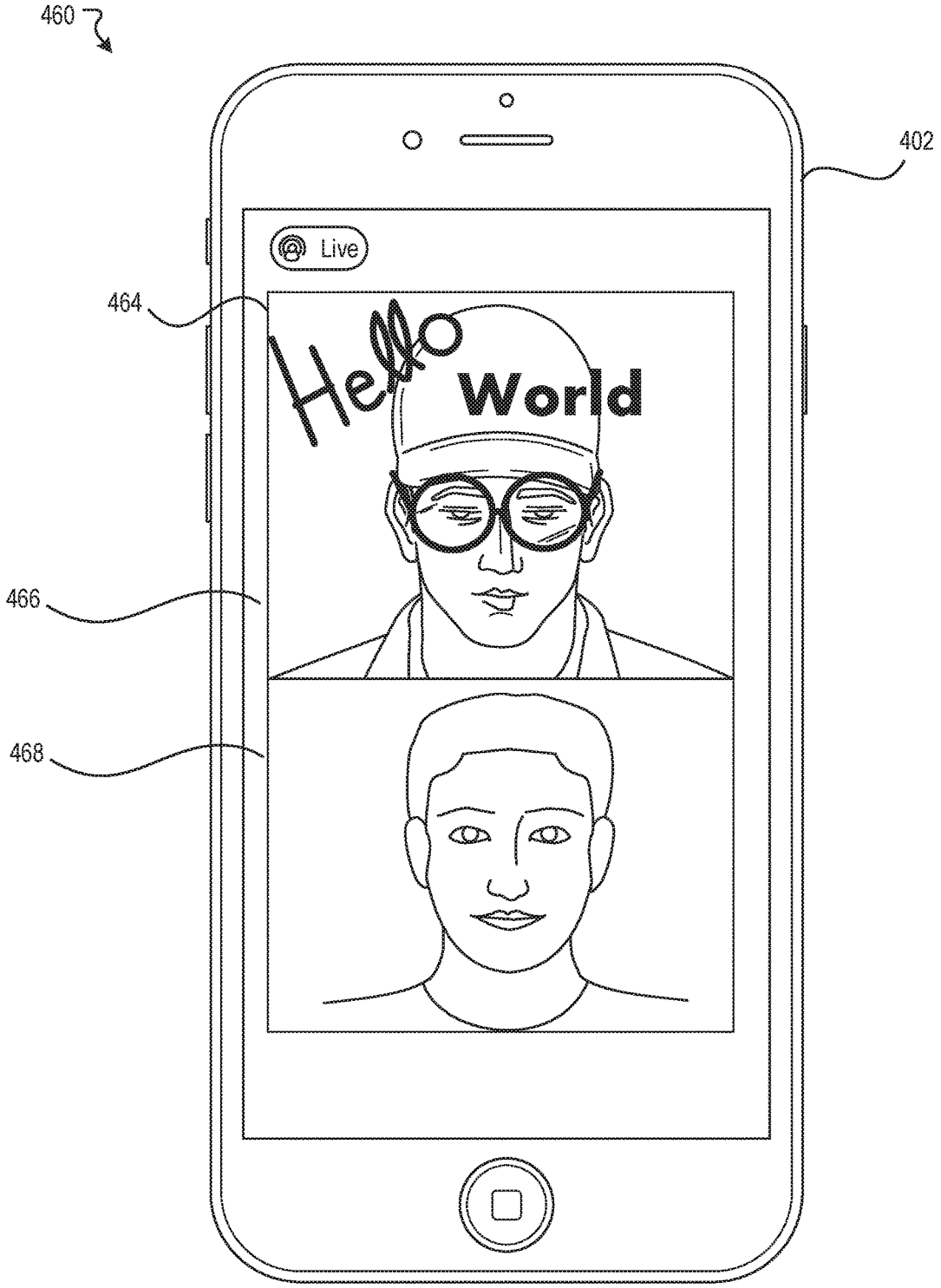


FIGURE 4E

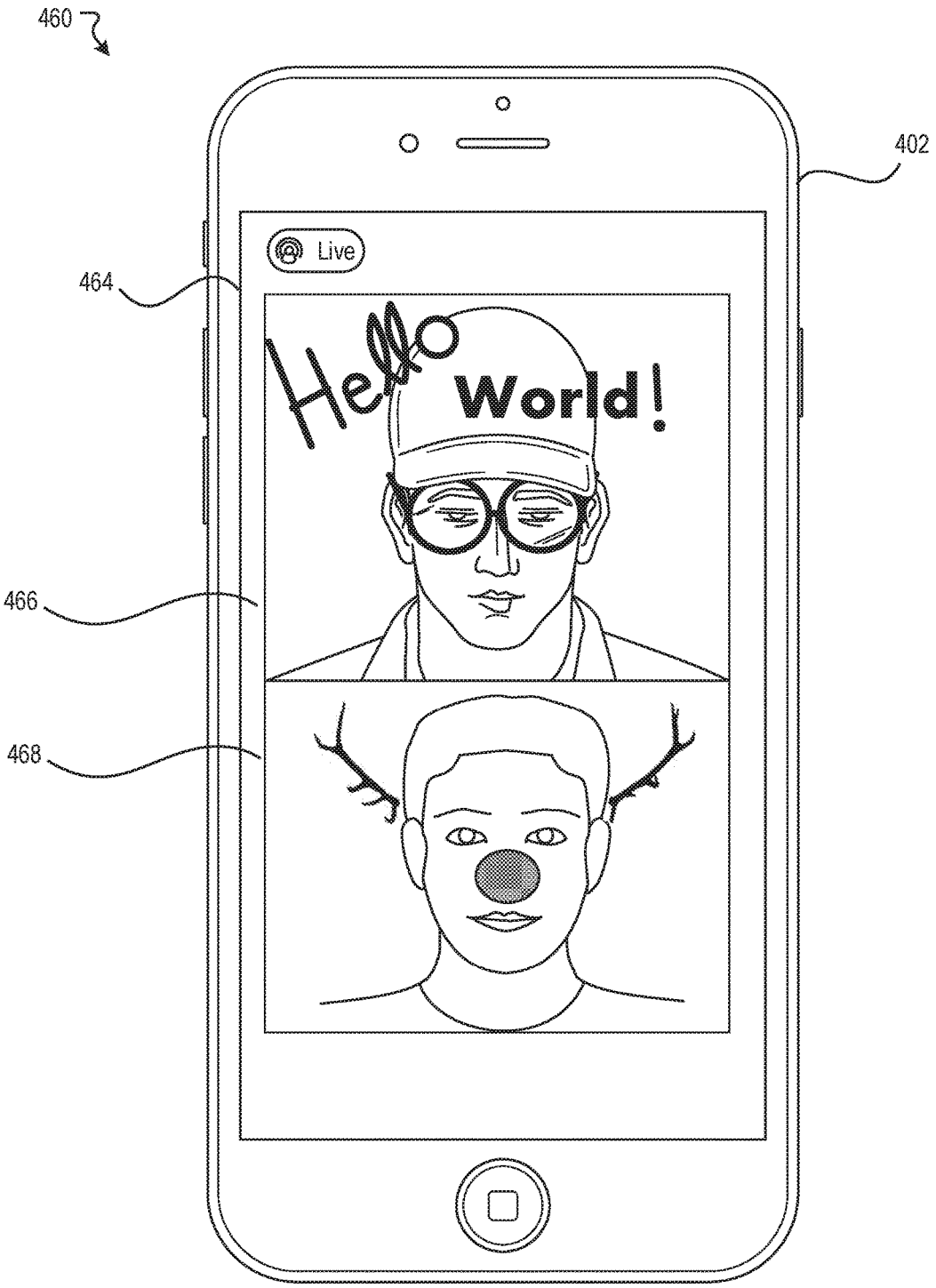


FIGURE 4F

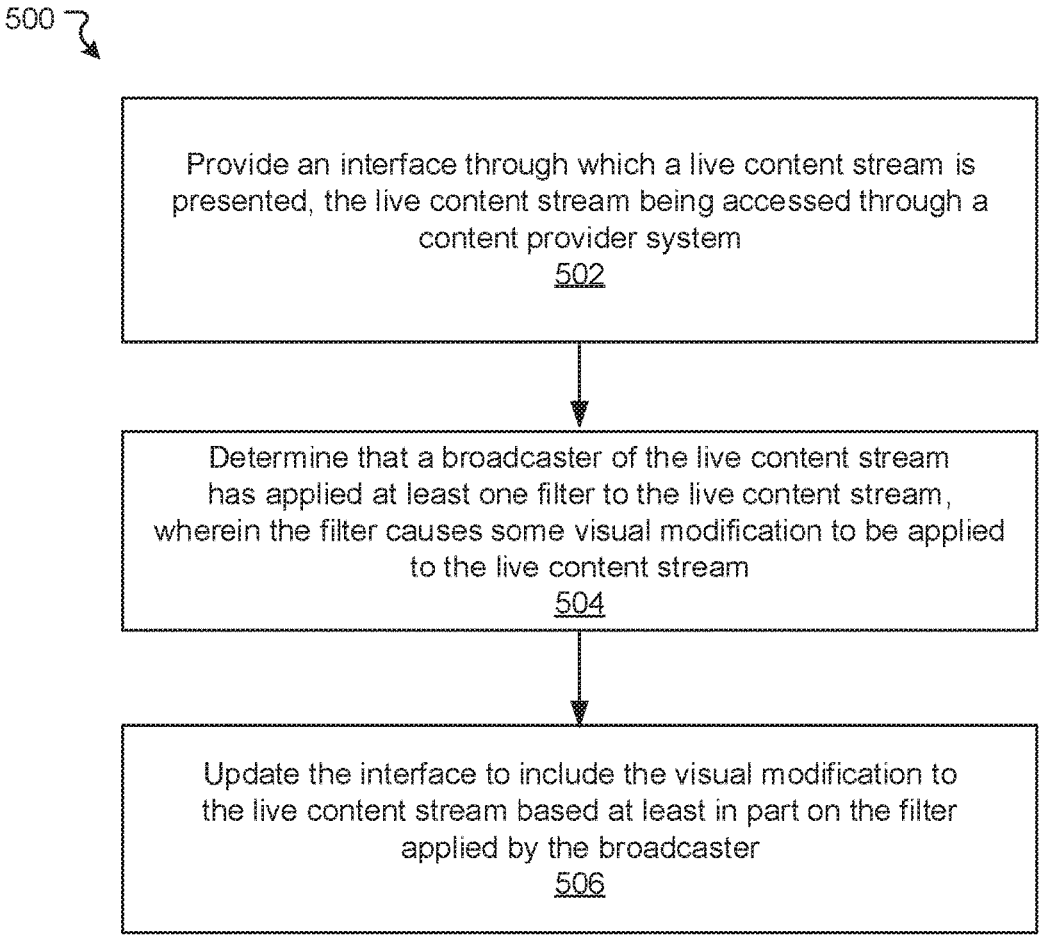

500
Provide an interface through which a live content stream is presented, the live content stream being accessed through a content provider system
502
Determine that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream
504
Update the interface to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster
506

FIGURE 5

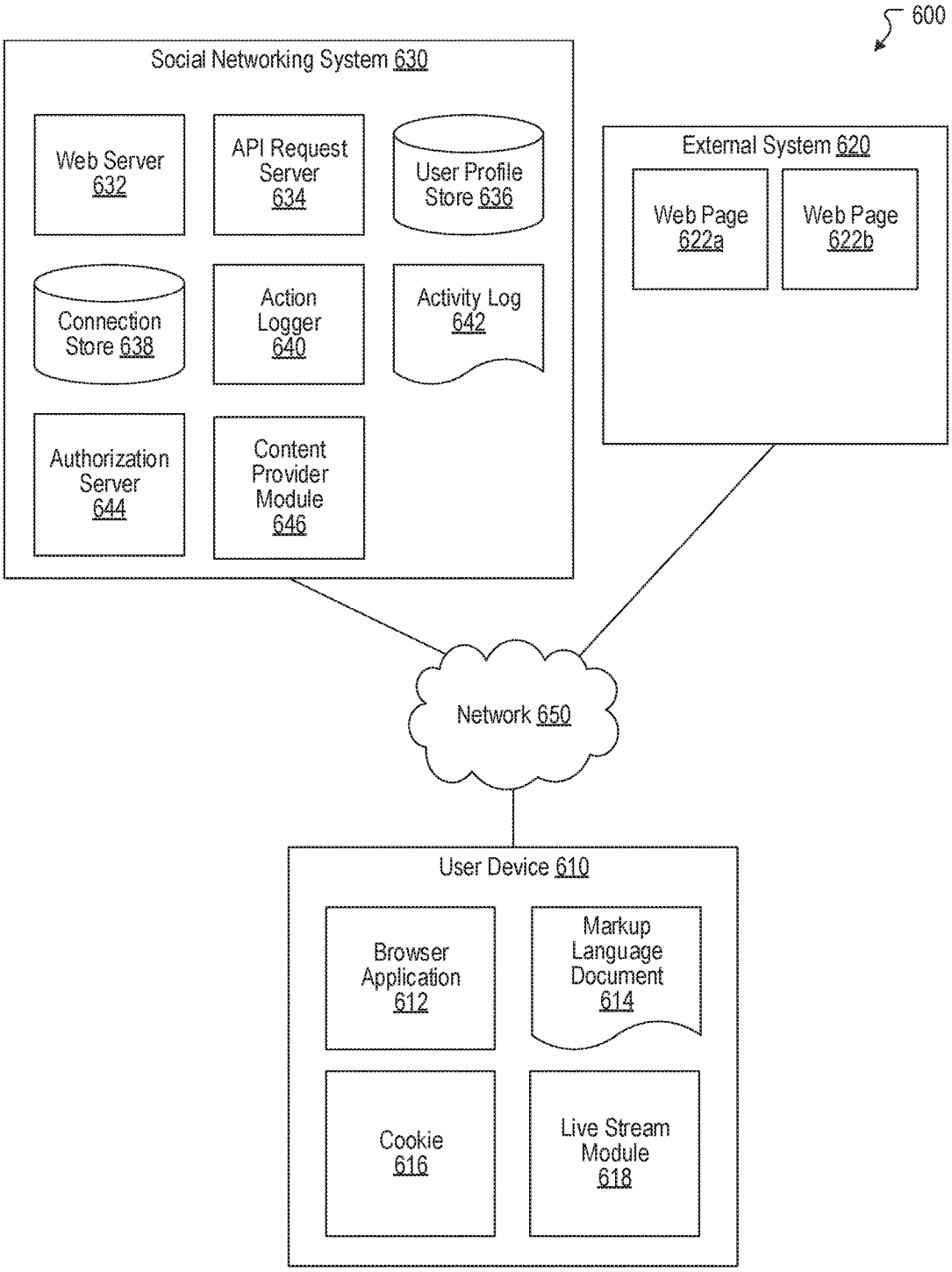

600
Social Networking System 630
Web Server 632
API Request Server 634
User Profile Store 636
Connection Store 638
Action Logger 640
Activity Log 642
Authorization Server 644
Content Provider Module 646
External System 620
Web Page 622a
Web Page 622b
Network 650
User Device 610
Browser Application 612
Markup Language Document 614
Cookie 616
Live Stream Module 618

FIGURE 6

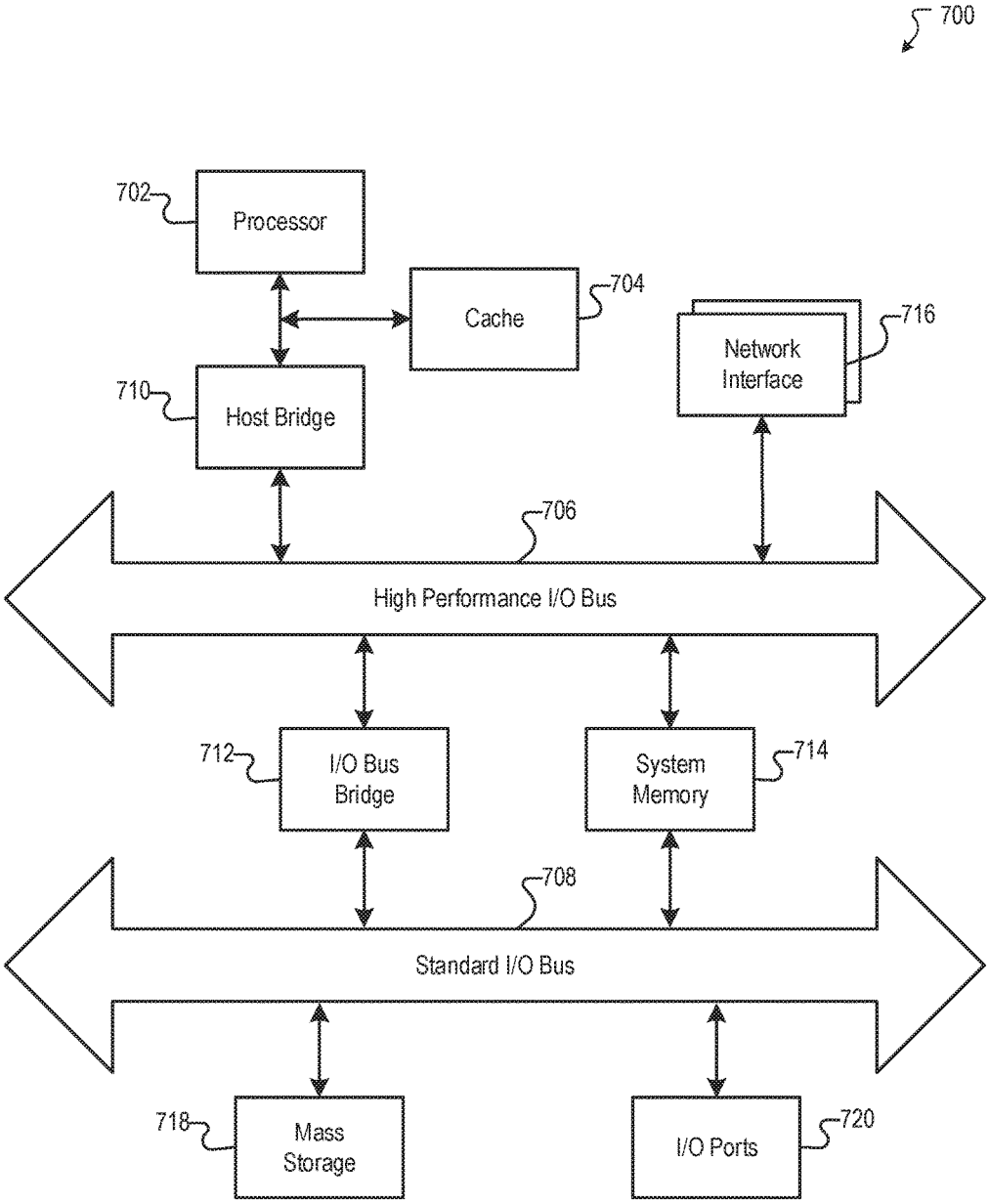

700
702
Processor
Cache
704
Network Interface
716
710
Host Bridge
706
High Performance I/O Bus
712
I/O Bus Bridge
System Memory
714
708
Standard I/O Bus
718
Mass Storage
I/O Ports
720

FIGURE 7

SYSTEMS AND METHODS FOR INTERACTIVE BROADCASTING

FIELD OF THE INVENTION

[0001] The present technology relates to the field of content broadcasting. More particularly, the present technology relates to techniques for broadcasting live content.

BACKGROUND

[0002] Today, people often utilize computing devices (or systems) for a wide variety of purposes. Users can use their computing devices to, for example, interact with one another, access content, share content, and create content. In some cases, content items can include postings from members of a social network. The postings may include text and media content items, such as images, videos, and audio. The postings may be published to the social network for consumption by others.

SUMMARY

[0003] Various embodiments of the present disclosure can include systems, methods, and non-transitory computer readable media configured to provide an interface through which a live content stream is presented, the live content stream being accessed through a content provider system. A determination is made that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream. The interface is updated to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.

[0004] In an embodiment, the visual modification corresponds to at least a text overlay, graphical overlay, virtual doodle, text animation, graphical animation, or placement of a face mask.

[0005] In an embodiment, the visual modification made to the live content stream based on the filter applied by the broadcaster is presented in the respective interfaces of viewers accessing the live content stream through the content provider system.

[0006] In an embodiment, the systems, methods, and non-transitory computer readable media are configured to determine that the broadcaster has invited a user of the content provider system to join the live content stream as a co-broadcaster; determine that the user has selected an option to accept the invitation to join the live content stream as co-broadcaster; and cause the user to be added to the live content stream as co-broadcaster.

[0007] In an embodiment, the systems, methods, and non-transitory computer readable media are configured to cause the live content stream broadcast to be merged with a different live content stream being broadcasted using a computing device of the user, wherein the viewers accessing the live content stream are shown the merged live content stream.

[0008] In an embodiment, the merged live content stream is presented to users in an interface that includes a first region and a second region, wherein the broadcaster's live content stream is shown in the first region, and wherein the user's different live content stream is shown in the second region.

[0009] In an embodiment, the broadcaster is able to apply additional filters to the live content stream of the broadcaster, wherein visual modifications made in response to the additional filters are presented in the first region of the interface.

[0010] In an embodiment, the broadcaster is able to apply additional filters to the different live content stream of the co-broadcaster, wherein visual modifications made in response to the additional filters are presented in the second region of the interface.

[0011] In an embodiment, the co-broadcaster is able to apply additional filters to the live content stream of the broadcaster, wherein visual modifications made in response to the additional filters are presented in the first region of the interface.

[0012] In an embodiment, the co-broadcaster is able to apply additional filters to the different live content stream of the co-broadcaster, wherein visual modifications made in response to the additional filters are presented in the second region of the interface.

[0013] It should be appreciated that many other features, applications, embodiments, and/or variations of the disclosed technology will be apparent from the accompanying drawings and from the following detailed description. Additional and/or alternative implementations of the structures, systems, non-transitory computer readable media, and methods described herein can be employed without departing from the principles of the disclosed technology.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** illustrates an example system including an example content provider module configured to provide access to various content items, according to an embodiment of the present disclosure.

[0015] FIG. **2** illustrates an example of a co-broadcasting module, according to an embodiment of the present disclosure.

[0016] FIG. **3** illustrates an example of a filter module, according to an embodiment of the present disclosure.

[0017] FIGS. **4**A-F illustrate example interfaces, according to an embodiment of the present disclosure.

[0018] FIG. **5** illustrates an example process, according to various embodiments of the present disclosure.

[0019] FIG. **6** illustrates a network diagram of an example system including an example social networking system that can be utilized in various scenarios, according to an embodiment of the present disclosure.

[0020] FIG. **7** illustrates an example of a computer system or computing device that can be utilized in various scenarios, according to an embodiment of the present disclosure.

[0021] The figures depict various embodiments of the disclosed technology for purposes of illustration only, wherein the figures use like reference numerals to identify like elements. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated in the figures can be employed without departing from the principles of the disclosed technology described herein.

DETAILED DESCRIPTION

Approaches for Interactive Broadcasting

[0022] Today, people often utilize computing devices (or systems) for a wide variety of purposes. Users can use their computing devices to, for example, interact with one another, access content, share content, and create content. In some cases, content items can include postings from members of a social network. The postings may include text and media content items, such as images, videos, and audio. The postings may be published to the social network for consumption by others.

[0023] Under conventional approaches, content may be broadcast through a content provider (e.g., social networking system) using various broadcast mediums (e.g., Internet broadcasting, etc.). In one example, a live content stream can include content that is being captured and streamed live by a user (e.g., a broadcaster). For example, the broadcaster can capture and stream an event (e.g., a live video of the broadcaster, concert, speech, etc.) as part of a live content stream. Such events can be captured using computing devices (e.g., mobile devices with audio and video capture capabilities) and/or standalone devices (e.g., video cameras and microphones). A user (e.g., a viewer) operating a computing device can access the live content stream through the content provider. In response, the content provider encodes and provides data corresponding to the live content stream to the user's computing device over a network (e.g., the Internet) in real-time. The computing device can decode and present the live content stream, for example, through a display screen of the computing device. In general, the live content stream continues to be provided to the user's computing device until the broadcaster discontinues broadcasting the live content stream or the user instructs the computing device to stop accessing the live content stream, for example. Such live broadcasts allow broadcasters to communicate with their viewing audience in real-time. In some instances, broadcasters may benefit from other unconventional approaches for engaging with their viewing audience. Accordingly, conventional approaches may not be effective in addressing these and other problems arising in computer technology.

[0024] An improved approach rooted in computer technology overcomes the foregoing and other disadvantages associated with conventional approaches specifically arising in the realm of computer technology. In various embodiments, a content provider (e.g., social networking system) is configured to provide various options that allow broadcasters (or co-broadcasters) to interact with their viewing audiences. For example, in some embodiments, broadcasters of a live content stream can select filters to be applied to their live content stream. Such filters can involve changing the appearance of a broadcaster, for example, using augmented reality and/or applying graphical overlays. In some embodiments, these filters can also be applied to co-broadcasters of the live content stream. Having the ability to apply various filters to a live broadcast allows broadcasters to continually engage their viewers throughout the live broadcast.

[0025] FIG. **1** illustrates an example system **100** including an example content provider module **102** configured to provide access to various content items, according to an embodiment of the present disclosure. As shown in the example of FIG. **1**, the content provider module **102** can include a content upload module **104**, a live stream module **106**, a content module **108**, a co-broadcasting module **110**, and a filter module **112**. In some instances, the example system **100** can include at least one data store **114**. The components (e.g., modules, elements, etc.) shown in this figure and all figures herein are examples only, and other implementations may include additional, fewer, integrated, or different components. Some components may not be shown so as not to obscure relevant details.

[0026] In some embodiments, the content provider module **102** can be implemented, in part or in whole, as software, hardware, or any combination thereof. In general, a module as discussed herein can be associated with software, hardware, or any combination thereof. In some implementations, one or more functions, tasks, and/or operations of modules can be carried out or performed by software routines, software processes, hardware, and/or any combination thereof. In some cases, the content provider module **102** can be implemented, in part or in whole, as software running on one or more computing devices or systems, such as on a user or client computing device. In one example, the content provider module **102** or at least a portion thereof can be implemented as or within an application (e.g., app), a program, or an applet, etc., running on a user computing device or a client computing system, such as the user device **610** of FIG. **6**. In another example, the content provider module **102** or at least a portion thereof can be implemented using one or more computing devices or systems that include one or more servers, such as network servers or cloud servers. In some instances, the content provider module **102** can, in part or in whole, be implemented within or configured to operate in conjunction with a social networking system (or service), such as the social networking system **630** of FIG. **6**.

[0027] The content provider module **102** can be configured to communicate and/or operate with the at least one data store **114**, as shown in the example system **100**. The at least one data store **114** can be configured to store and maintain various types of data. For example, the data store **114** can store information describing various content that is being streamed live through the social networking system and/or content items that have been posted by users of the social networking system. In some implementations, the at least one data store **114** can store information associated with the social networking system (e.g., the social networking system **630** of FIG. **6**). The information associated with the social networking system can include data about users, social connections, social interactions, locations, geo-fenced areas, maps, places, events, pages, groups, posts, communications, content, feeds, account settings, privacy settings, a social graph, and various other types of data. In some implementations, the at least one data store **114** can store information associated with users, such as user identifiers, user information, profile information, user specified settings, content produced or posted by users, and various other types of user data.

[0028] The content provider module **102** can be configured to provide users with access to content items that are posted through a social networking system. For example, a user can interact with an interface that is provided by a software application (e.g., a social networking application) running on a computing device of the user. This interface can include an option for posting, or uploading, content items to the social networking system. When posting a content item, the content upload module **104** can be utilized to commu-

nicate data describing the content item from the computing device to the social networking system. Such content items may include text, images, audio, and videos, for example. The social networking system can then provide the content item through the social networking system including, for example, in one or more news feeds. In some embodiments, the interface can also include an option for live streaming content through the social networking system. When initiating a live content stream, the live stream module **106** can be utilized to communicate data (e.g., audio data, video data, etc.) corresponding to the content to be streamed live from the computing device and through the social networking system. The live stream module **106** can utilize any generally known techniques that allow for live streaming of content including, for example, the Real Time Messaging Protocol (RTMP). In various embodiments, the computing device from which the live content stream is being provided can be equipped to capture data (e.g., video data, audio data, etc.) corresponding to the live content stream.

[0029] The interface provided by the software application can also be used to access posted content items, for example, using the content module **108**. For example, the content module **108** can include content items in a user's news feed. Such content items may include on-demand content items (e.g., video on-demand or "VOD") as well as content that is being streamed live. In this example, the user can access content items while browsing the news feed. In another example, the user can access content items by performing searches through the interface. For example, the user can search for a given content item or live content stream, for a user that posted a content item or live content stream, and/or for search terms that correspond to a content item or live content stream. In one example, the user may select an option to view a live content stream and, in response, the social networking system can send data corresponding to the live content stream to a computing device of the user. In this example, the social networking system can continue send data corresponding to the live content stream until, for example, the broadcaster of the live content stream discontinues streaming or if the user selects an option to discontinue playback of the live content stream. The co-broadcasting module **110** can be configured to provide various options for adding co-broadcasters to live content streams and/or removing co-broadcasters that were added to live content streams. More details regarding the co-broadcasting module **110** will be provided below with reference to FIG. **2**. The filter module **112** can be configured to provide various options for interacting with viewers of live content streams. More details regarding the filter module **112** will be provided below with reference to FIG. **3**.

[0030] FIG. **2** illustrates an example of a co-broadcasting module **202**, according to an embodiment of the present disclosure. In some embodiments, the co-broadcasting module **110** of FIG. **1** can be implemented as the co-broadcasting module **202**. As shown in FIG. **2**, the co-broadcasting module **202** can include a viewer module **204**, a user selection module **206**, a stream merge module **208**, and a stream unmerge module **210**.

[0031] In various embodiments, the co-broadcaster module **202** can be utilized to add co-broadcasters to live content streams and/or to remove co-broadcasters from live content streams. For example, a user operating a computing device can access (e.g., view) a live content stream through a content provider. In one example, the live content stream may be accessed through a content item in a news feed. In another example, the user may have searched for the live content stream through the content provider. When accessed, the content provider can encode and send data corresponding to the live content stream to the computing device of the user. The computing device can decode and present video data corresponding to the live content stream, for example, in an interface being provided through a display screen of the computing device. Any audio data corresponding to the live content stream can be played or reproduced, for example, through an audio output source (e.g., speaker(s)) associated with the computing device. In some embodiments, while the live content stream is being accessed, the interface can provide the user with one or more options for interacting with the live content stream. For example, the interface can include an option for "liking" the live content stream, one or more options for reacting to the live content stream, an option for posting comments in response to the live content stream, or an option to share the live content stream with other users (e.g., social connections), to name some examples.

[0032] In some embodiments, the broadcaster of the live content stream can access an interface to view various information while the live broadcast is in progress. For example, while broadcasting the live content stream, the broadcaster can access an interface through a display screen of the broadcaster's computing device. The interface can include a first region in which the live content stream being broadcasted is presented, for example, to allow the broadcaster to monitor the live content stream. The interface can also include a second region through which the broadcaster can access various information relating to the broadcast. For example, in some embodiments, the interface includes a second region that displays comments that were posted by various users in response to the live content stream. In some embodiments, the broadcaster can access information describing users that are viewing the live content stream. For example, the broadcaster can select an option through the interface to access a list of users that are viewing the live content stream. In another example, the broadcaster can perform a swipe gesture in the second region in which comments are being displayed to access the list of users that are viewing the live content stream. The viewer module **204** can determine which users are viewing the live content stream. The viewer module **204** can then provide the list of users for display, for example, in the second region of the interface. The list of users can include additional information for the users including, for example, a corresponding image of the user, the user's name, how long the user has been viewing the live content stream (e.g., a number of minutes, hours, etc.), and the strength (or quality) of the data connection available to the user's computing device (e.g., the strength or quality of the user's mobile signal, Internet connection, etc.), to name some examples. The image may correspond to an image being used in a social profile of the user in a social networking system. In some embodiments, the broadcaster of the live content stream can invite users to join the live content stream as co-broadcasters. For example, the broadcaster can select any of the users shown in the list of users that are viewing the live content stream. Alternatively, in some embodiments, the broadcaster is able to search for users to be invited to join the live content stream as co-broadcasters.

[0033] Once the broadcaster has selected a user to join as a co-broadcaster, the user selection module **206** is configured to send one or more invite notifications to the chosen user. In one example, such invite notifications can be provided to the user as notifications through the user's computing device. In some embodiments, such invite notifications are provided to the user as messages sent to the user in a social networking system. A user can choose to accept or decline the invitation to join the broadcast. In some embodiments, when the user declines the invitation, a notification is provided to the broadcaster indicating that the invitation was declined. In some embodiments, when the user accepts the invitation, the user's computing device is instructed to capture and provide a separate live content stream to the content provider, as described above. Once the user's separate live content stream is active, the stream merge module **208** merges the broadcaster's live content stream and the user's live content stream so that both the broadcaster (i.e., primary broadcaster) and the user (i.e., co-broadcaster) appear in a merged live content stream. In some embodiments, the merged live content stream is presented to users in a split screen that is divided into a first region and a second region. In such embodiments, the broadcaster's live content stream is presented in the first region while the co-broadcaster's live content stream is presented in the second region. In one example, the split screen may be divided horizontally so that the first region is positioned above the second region. In another example, the split screen may be divided vertically so that the first region and the second region are positioned side-by-side. In some embodiments, the regions may be sized differently for broadcasters and co-broadcasters. For example, the first region in which the broadcaster's live content stream is presented may be larger than the second region in which the co-broadcaster's live content stream is presented. In some embodiments, additional co-broadcasters can be added to the merged live content stream, as described above. In such embodiments, the screen may be divided accordingly to accommodate the additional co-broadcasters.

[0034] There may be instances in which a co-broadcaster needs to be removed from the merged live content stream. In some embodiments, the co-broadcaster can select an option to end their broadcast. In such embodiments, the stream unmerge module **210** unmerges the merged live content stream to disconnect the live content stream corresponding to the co-broadcaster. In some embodiments, the primary broadcaster and/or authorized users (e.g., moderators, etc.) are permitted to remove, or disconnect, any co-broadcasters from the merged live content stream. Once disconnected, the live content stream continues broadcasting without the co-broadcaster.

[0035] FIG. **3** illustrates a filter module **302**, according to an embodiment of the present disclosure. In some embodiments, the filter module **112** of FIG. **1** can be implemented with the filter module **302**. As shown in the example of FIG. **3**, the filter module **302** can include a text overlay module **304**, a drawing module **306**, a color selection module **308**, a graphical overlay module **310**, and an animation module **312**. In various embodiments, the filter module **302** can provide options that allow broadcasters (or co-broadcasters) to visually modify a live content stream during the broadcast. For example, while broadcasting the live content stream, a broadcaster can access an interface through a display screen of the broadcaster's computing device. The interface can include a first region in which the live content stream being broadcasted is presented, for example, to allow the broadcaster to monitor the live content stream. The interface can also include a second region through which the broadcaster can access the various filtering options for visually modifying the live content stream. In some embodiments, the interface can be accessed through a software application (e.g., a social networking application) running on a broadcaster's computing device. In general, any visual modifications made to a live content stream by a broadcaster can be shared with other users that are viewing the live content stream. That is, the visual modifications are visible in the respective viewer interfaces being accessed by the broadcaster's viewing audience.

[0036] In some embodiments, the filtering options can include an option for adding one or more text overlays to the live content stream. When this option is selected, the text overlay module **304** can allow the broadcaster to input text to be incorporated into the live content stream. For example, the broadcaster can input the text through a computing device being operated by the broadcaster. In some embodiments, a virtual keyboard is presented in the interface to allow the broadcaster to input text. The broadcaster can modify the font, or style, used for the text overlays. The broadcaster can also modify the color(s) used for the text overlays through the color selection module **308**. In various embodiments, the broadcaster can drag and position the text overlays in the live content stream as desired. In some embodiments, a text overlay can be wrapped, for example, around shapes (e.g., circle, square, etc.) to create curve-shaped or bent text.

[0037] In some embodiments, the filtering options can include an option for drawing content (e.g., doodling) in the live content stream. When this option is selected, the drawing module **306** can present an interface that allows the broadcaster to select a virtual writing instrument. The broadcaster can use a selected virtual writing instrument to doodle virtually in the live content stream. In some embodiments, the virtual writing instruments that are available for selection include a marker, a brush, and eraser. In some embodiments, the interface also includes a color palette from which the broadcaster can select colors to be used when drawing with the selected writing instrument. In some embodiments, the broadcaster can adjust the tip size of a selected writing instrument, for example, by increasing or decreasing a tip size selector. Once a virtual writing instrument is selected, the broadcaster can doodle using the virtual writing instrument directly through a touch screen display of the computing device, for example, using the broadcaster's finger as a physical drawing instrument. Visual modifications that result from such broadcaster interaction can be presented as an overlay in the interface through which the live content stream is being presented.

[0038] In various embodiments, the color selection module **308** can provide the broadcaster with options for selecting a color to be used, for example, when drawing using a virtual writing instrument or inputting text. In some embodiments, the color selection module **308** provides a virtual color palette that includes options for selecting various colors that are available. In some embodiments, the color selection module **308** provides a virtual color spectrum from which the broadcaster can select colors. For example, the broadcaster can tap and navigate the broadcaster's finger across the virtual color spectrum to choose a desired color.

In some embodiments, the color selection module **308** can provide an eyedropper tool. The broadcaster can use the eyedropper tool to select a portion of a live content stream. Upon selecting the portion, the color selection module **308** can select a color corresponding to the selected portion, for example, to be used when drawing or inputting text.

[0039] In some embodiments, the graphical overlay module **310** can provide the broadcaster with options for inserting graphical overlays in live content streams. For example, the graphical overlay module **310** can provide the broadcaster with a set of virtual stickers that can be inserted in a live content stream. Upon selecting one or more of the virtual stickers, the graphical overlay module **310** can insert the selected virtual stickers into a desired location in the live content stream. The broadcaster can drag and position any of the virtual stickers in the live content stream as desired, for example, by performing various touch screen gestures (e.g., drag gesture). In some embodiments, the graphical overlay module **310** provides suggestions for graphical overlays, or virtual stickers, to be used in a live content stream. In such embodiments, the graphical overlay module **310** can analyze the subject matter of the live content stream, for example, using a trained machine learning model (e.g., content classifier) to identify various objects (e.g., identities, or names, of individuals, objects, activities, products, logos, animals, points of interest, or other concepts) present in the live content stream. Based on the identified objects, the graphical overlay module **310** can suggest various graphical overlays that are available for selection to the broadcaster.

[0040] In some embodiments, the animation module **312** can provide the broadcaster with options for animating text and/or graphics. For example, after inputting text, the broadcaster can select an animate option that causes the text to animate. The animate options can include options to make characters in the text move along one or more directions (e.g., jiggling characters, animating text along in a specified trajectory or path, text moves around in the interface and bounces off the edges of the interface, etc.). In some embodiments, the animation module **312** can provide the broadcaster with options for inserting animated graphical overlays in live content streams. In some embodiments, the graphical overlays are animated virtual stickers, as described above. In some embodiments, the graphical overlays are animated to trace, or follow, a one or more paths, trajectories, or boundaries of objects in the live content stream. One example of animated graphical overlays can include various masks that can be positioned over faces (e.g., faces of broadcasters) in live content streams. In some embodiments, the rate, or speed, at which a graphical overlay is animated can be adjusted. In some embodiments, the broadcaster operating the computing device can manually define an outline along which a graphical overlay will be positioned and animated in a live content stream. In some embodiments, the animation module **312** can automatically determine one or more outlines along which a graphical overlay will be animated in a live content stream, for example, using generally known line detection techniques and/or edge detection techniques. In some embodiments, animated graphical overlays can be suggested by detecting facial features in a live content stream using generally known face detection techniques. In this example, the placement of a given animated graphical overlay can be determined based on facial features (e.g., eyes, nose, mouth, ears, etc.) that were detected in a live content stream. In some embodiments, such outlines can be provided to broadcasters as suggestions when selecting filters to be applied in the live content stream. In some embodiments, broadcasters can upload their own graphical overlays to be incorporated into live content streams using the techniques described above. In some embodiments, the animation module **312** is configured to utilize generally known augmented reality techniques. As mentioned, any visual modification of a live content stream that results from applying the any of the filters described above can be presented as overlays in the respective interfaces through which the live content stream is being accessed. In some embodiments, the filter module **302** can provide an option to remove any of the filters that were applied to a live content stream. When this option is selected, any visual modifications performed by a selected filter (or by any filter) are removed from the live content stream(s).

[0041] FIG. **4**A illustrates an example **400** of an interface **404**, according to an embodiment of the present disclosure. The interface **404** is presented on a display screen of a computing device **402**. The interface **404** may be provided through an application (e.g., a web browser, a social networking application, etc.) running on the computing device **402**. In this example, the interface **404** includes a region **406** in which a live content stream that is being broadcasted through a content provider using the computing device **402** is displayed. The interface **404** also includes a region **408** in which comments posted by viewers of the live content stream are displayed. In this example, the broadcaster of the live content stream can interact with the interface **404** to apply various filters to the live broadcast. In some embodiments, the broadcaster can access options for applying the filters through the interface **404**. For example, the broadcaster can perform one or more touch screen gestures to reveal the filter options. In this example, the broadcaster can perform a swipe gesture in the region **408** to reveal a set of options **410** for applying various filters, as illustrated in the example of FIG. **4**B. The broadcaster can select any of the options to apply the various filters described above. Any content that is inserted into the live content stream using the filter options can appear as one or more overlay in the interface **404** through which the live content stream is being presented. As mentioned, such visual modifications to the live content stream can also be applied, or propagated, to the respective interfaces of viewers that are accessing the live content stream. In the example of FIG. **4**B, the broadcaster can select an option to draw (or doodle) in the live content stream. The broadcaster can also select an option to insert text into the live content stream. Once complete, these visual modifications can be presented in the interface **404**, as illustrated in the example of FIG. **4**C. As shown, the interface **404** in FIG. **4**C has been updated to include the broadcaster's doodle **412** and inserted text **414**. As mentioned, the broadcaster can also apply various other types of filters including, for example, graphics and/or animations that may be implemented. For example, FIG. **4**D illustrates a pair of virtual eyeglasses **416** that have been inserted in the live content stream. In this example, the virtual eyeglasses **416** can be inserted using generally known augmented reality techniques so that the virtual eyeglasses **416** appear as having actually been placed over the broadcaster's face.

[0042] In some embodiments, the broadcaster can invite other users to join the live content stream as co-broadcasters. In such embodiments, if the invited user accepts the invita-

tion to join the broadcast, the user's computing device is instructed to capture and provide a separate live content stream to the content provider, as described above. Once the user's separate live content stream is active, the live content streams of both the broadcasting user and the user appear in a merged live content stream, as illustrated in the example FIG. **4**E. In some embodiments, the merged live content stream is presented to users as a split screen **464** that is divided into a first region **466** and a second region **468**. In such embodiments, the broadcaster's live content stream can be presented in the first region **466** while the co-broadcaster's live content stream can be presented in the second region **468**. In some embodiments, the broadcaster (and co-broadcaster) can apply various filters to any of the merged live content streams. For example, the broadcaster can apply filters to the broadcaster's live content stream. In this example, any visual modifications to the live content stream can appear in the first region **466** through which the broadcaster's live content stream is being presented. The broadcaster can also apply filters to the co-broadcaster's live content stream. In this example, any visual modifications to the co-broadcaster's live content stream can appear in the second region **468** through which the co-broadcaster's live content stream is being presented. Similarly, the co-broadcaster can apply filters to the co-broadcaster's live content stream and/or the broadcaster's live content stream. In the example of FIG. **4**F, the broadcaster has applied a graphical overlay in the co-broadcaster's live content stream as shown in the second region **468**.

[0043] FIG. **5** illustrates an example process **500** for co-broadcasting a live content stream, according to various embodiments of the present disclosure. It should be appreciated that there can be additional, fewer, or alternative steps performed in similar or alternative orders, or in parallel, within the scope of the various embodiments discussed herein unless otherwise stated.

[0044] At block **502**, the example process **500** provides an interface through which a live content stream is presented, the live content stream being accessed through a content provider system. At block **504**, a determination is made that a broadcaster of the live content stream has applied at least one filter to the live content stream. The filter can cause some visual modification to be applied to the live content stream. At block **506**, the interface is updated to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.

[0045] It is contemplated that there can be many other uses, applications, and/or variations associated with the various embodiments of the present disclosure. For example, in some cases, user can choose whether or not to opt-in to utilize the disclosed technology. The disclosed technology can also ensure that various privacy settings and preferences are maintained and can prevent private information from being divulged. In another example, various embodiments of the present disclosure can learn, improve, and/or be refined over time.

Social Networking System—Example Implementation

[0046] FIG. **6** illustrates a network diagram of an example system **600** that can be utilized in various scenarios, in accordance with an embodiment of the present disclosure. The system **600** includes one or more user devices **610**, one or more external systems **620**, a social networking system (or service) **630**, and a network **650**. In an embodiment, the social networking service, provider, and/or system discussed in connection with the embodiments described above may be implemented as the social networking system **630**. For purposes of illustration, the embodiment of the system **600**, shown by FIG. **6**, includes a single external system **620** and a single user device **610**. However, in other embodiments, the system **600** may include more user devices **610** and/or more external systems **620**. In certain embodiments, the social networking system **630** is operated by a social network provider, whereas the external systems **620** are separate from the social networking system **630** in that they may be operated by different entities. In various embodiments, however, the social networking system **630** and the external systems **620** operate in conjunction to provide social networking services to users (or members) of the social networking system **630**. In this sense, the social networking system **630** provides a platform or backbone, which other systems, such as external systems **620**, may use to provide social networking services and functionalities to users across the Internet.

[0047] The user device **610** comprises one or more computing devices (or systems) that can receive input from a user and transmit and receive data via the network **650**. In one embodiment, the user device **610** is a conventional computer system executing, for example, a Microsoft Windows compatible operating system (OS), Apple OS X, and/or a Linux distribution. In another embodiment, the user device **610** can be a computing device or a device having computer functionality, such as a smart-phone, a tablet, a personal digital assistant (PDA), a mobile telephone, a laptop computer, a wearable device (e.g., a pair of glasses, a watch, a bracelet, etc.), a camera, an appliance, etc. The user device **610** is configured to communicate via the network **650**. The user device **610** can execute an application, for example, a browser application that allows a user of the user device **610** to interact with the social networking system **630**. In another embodiment, the user device **610** interacts with the social networking system **630** through an application programming interface (API) provided by the native operating system of the user device **610**, such as iOS and ANDROID. The user device **610** is configured to communicate with the external system **620** and the social networking system **630** via the network **650**, which may comprise any combination of local area and/or wide area networks, using wired and/or wireless communication systems.

[0048] In one embodiment, the network **650** uses standard communications technologies and protocols. Thus, the network **650** can include links using technologies such as Ethernet, 802.11, worldwide interoperability for microwave access (WiMAX), 3G, 4G, CDMA, GSM, LTE, digital subscriber line (DSL), etc. Similarly, the networking protocols used on the network **650** can include multiprotocol label switching (MPLS), transmission control protocol/Internet protocol (TCP/IP), User Datagram Protocol (UDP), hypertext transport protocol (HTTP), simple mail transfer protocol (SMTP), file transfer protocol (FTP), and the like. The data exchanged over the network **650** can be represented using technologies and/or formats including hypertext markup language (HTML) and extensible markup language (XML). In addition, all or some links can be encrypted using conventional encryption technologies such as secure sockets layer (SSL), transport layer security (TLS), and Internet Protocol security (IPsec).

[0049] In one embodiment, the user device **610** may display content from the external system **620** and/or from the social networking system **630** by processing a markup language document **614** received from the external system **620** and from the social networking system **630** using a browser application **612**. The markup language document **614** identifies content and one or more instructions describing formatting or presentation of the content. By executing the instructions included in the markup language document **614**, the browser application **612** displays the identified content using the format or presentation described by the markup language document **614**. For example, the markup language document **614** includes instructions for generating and displaying a web page having multiple frames that include text and/or image data retrieved from the external system **620** and the social networking system **630**. In various embodiments, the markup language document **614** comprises a data file including extensible markup language (XML) data, extensible hypertext markup language (XHTML) data, or other markup language data. Additionally, the markup language document **614** may include JavaScript Object Notation (JSON) data, JSON with padding (JSONP), and JavaScript data to facilitate data-interchange between the external system **620** and the user device **610**. The browser application **612** on the user device **610** may use a JavaScript compiler to decode the markup language document **614**.

[0050] The markup language document **614** may also include, or link to, applications or application frameworks such as FLASH™ or Unity™ applications, the Silverlight™ application framework, etc.

[0051] In one embodiment, the user device **610** also includes one or more cookies **616** including data indicating whether a user of the user device **610** is logged into the social networking system **630**, which may enable modification of the data communicated from the social networking system **630** to the user device **610**.

[0052] The external system **620** includes one or more web servers that include one or more web pages **622***a*, **622***b*, which are communicated to the user device **610** using the network **650**. The external system **620** is separate from the social networking system **630**. For example, the external system **620** is associated with a first domain, while the social networking system **630** is associated with a separate social networking domain. Web pages **622***a*, **622***b*, included in the external system **620**, comprise markup language documents **614** identifying content and including instructions specifying formatting or presentation of the identified content. As discussed previously, it should be appreciated that there can be many variations or other possibilities.

[0053] The social networking system **630** includes one or more computing devices for a social network, including a plurality of users, and providing users of the social network with the ability to communicate and interact with other users of the social network. In some instances, the social network can be represented by a graph, i.e., a data structure including edges and nodes. Other data structures can also be used to represent the social network, including but not limited to databases, objects, classes, meta elements, files, or any other data structure. The social networking system **630** may be administered, managed, or controlled by an operator. The operator of the social networking system **630** may be a human being, an automated application, or a series of applications for managing content, regulating policies, and collecting usage metrics within the social networking system **630**. Any type of operator may be used.

[0054] Users may join the social networking system **630** and then add connections to any number of other users of the social networking system **630** to whom they desire to be connected. As used herein, the term "friend" refers to any other user of the social networking system **630** to whom a user has formed a connection, association, or relationship via the social networking system **630**. For example, in an embodiment, if users in the social networking system **630** are represented as nodes in the social graph, the term "friend" can refer to an edge formed between and directly connecting two user nodes.

[0055] Connections may be added explicitly by a user or may be automatically created by the social networking system **630** based on common characteristics of the users (e.g., users who are alumni of the same educational institution). For example, a first user specifically selects a particular other user to be a friend. Connections in the social networking system **630** are usually in both directions, but need not be, so the terms "user" and "friend" depend on the frame of reference. Connections between users of the social networking system **630** are usually bilateral ("two-way"), or "mutual," but connections may also be unilateral, or "one-way." For example, if Bob and Joe are both users of the social networking system **630** and connected to each other, Bob and Joe are each other's connections. If, on the other hand, Bob wishes to connect to Joe to view data communicated to the social networking system **630** by Joe, but Joe does not wish to form a mutual connection, a unilateral connection may be established. The connection between users may be a direct connection; however, some embodiments of the social networking system **630** allow the connection to be indirect via one or more levels of connections or degrees of separation.

[0056] In addition to establishing and maintaining connections between users and allowing interactions between users, the social networking system **630** provides users with the ability to take actions on various types of items supported by the social networking system **630**. These items may include groups or networks (i.e., social networks of people, entities, and concepts) to which users of the social networking system **630** may belong, events or calendar entries in which a user might be interested, computer-based applications that a user may use via the social networking system **630**, transactions that allow users to buy or sell items via services provided by or through the social networking system **630**, and interactions with advertisements that a user may perform on or off the social networking system **630**. These are just a few examples of the items upon which a user may act on the social networking system **630**, and many others are possible. A user may interact with anything that is capable of being represented in the social networking system **630** or in the external system **620**, separate from the social networking system **630**, or coupled to the social networking system **630** via the network **650**.

[0057] The social networking system **630** is also capable of linking a variety of entities. For example, the social networking system **630** enables users to interact with each other as well as external systems **620** or other entities through an API, a web service, or other communication channels. The social networking system **630** generates and maintains the "social graph" comprising a plurality of nodes interconnected by a plurality of edges. Each node in the

social graph may represent an entity that can act on another node and/or that can be acted on by another node. The social graph may include various types of nodes. Examples of types of nodes include users, non-person entities, content items, web pages, groups, activities, messages, concepts, and any other things that can be represented by an object in the social networking system **630**. An edge between two nodes in the social graph may represent a particular kind of connection, or association, between the two nodes, which may result from node relationships or from an action that was performed by one of the nodes on the other node. In some cases, the edges between nodes can be weighted. The weight of an edge can represent an attribute associated with the edge, such as a strength of the connection or association between nodes. Different types of edges can be provided with different weights. For example, an edge created when one user "likes" another user may be given one weight, while an edge created when a user befriends another user may be given a different weight.

[0058] As an example, when a first user identifies a second user as a friend, an edge in the social graph is generated connecting a node representing the first user and a second node representing the second user. As various nodes relate or interact with each other, the social networking system **630** modifies edges connecting the various nodes to reflect the relationships and interactions.

[0059] The social networking system **630** also includes user-generated content, which enhances a user's interactions with the social networking system **630**. User-generated content may include anything a user can add, upload, send, or "post" to the social networking system **630**. For example, a user communicates posts to the social networking system **630** from a user device **610**. Posts may include data such as status updates or other textual data, location information, images such as photos, videos, links, music or other similar data and/or media. Content may also be added to the social networking system **630** by a third party. Content "items" are represented as objects in the social networking system **630**. In this way, users of the social networking system **630** are encouraged to communicate with each other by posting text and content items of various types of media through various communication channels. Such communication increases the interaction of users with each other and increases the frequency with which users interact with the social networking system **630**.

[0060] The social networking system **630** includes a web server **632**, an API request server **634**, a user profile store **636**, a connection store **638**, an action logger **640**, an activity log **642**, and an authorization server **644**. In an embodiment of the invention, the social networking system **630** may include additional, fewer, or different components for various applications. Other components, such as network interfaces, security mechanisms, load balancers, failover servers, management and network operations consoles, and the like are not shown so as to not obscure the details of the system.

[0061] The user profile store **636** maintains information about user accounts, including biographic, demographic, and other types of descriptive information, such as work experience, educational history, hobbies or preferences, location, and the like that has been declared by users or inferred by the social networking system **630**. This information is stored in the user profile store **636** such that each user is uniquely identified. The social networking system **630** also stores data describing one or more connections between different users in the connection store **638**. The connection information may indicate users who have similar or common work experience, group memberships, hobbies, or educational history. Additionally, the social networking system **630** includes user-defined connections between different users, allowing users to specify their relationships with other users. For example, user-defined connections allow users to generate relationships with other users that parallel the users' real-life relationships, such as friends, co-workers, partners, and so forth. Users may select from predefined types of connections, or define their own connection types as needed. Connections with other nodes in the social networking system **630**, such as non-person entities, buckets, cluster centers, images, interests, pages, external systems, concepts, and the like are also stored in the connection store **638**.

[0062] The social networking system **630** maintains data about objects with which a user may interact. To maintain this data, the user profile store **636** and the connection store **638** store instances of the corresponding type of objects maintained by the social networking system **630**. Each object type has information fields that are suitable for storing information appropriate to the type of object. For example, the user profile store **636** contains data structures with fields suitable for describing a user's account and information related to a user's account. When a new object of a particular type is created, the social networking system **630** initializes a new data structure of the corresponding type, assigns a unique object identifier to it, and begins to add data to the object as needed. This might occur, for example, when a user becomes a user of the social networking system **630**, the social networking system **630** generates a new instance of a user profile in the user profile store **636**, assigns a unique identifier to the user account, and begins to populate the fields of the user account with information provided by the user.

[0063] The connection store **638** includes data structures suitable for describing a user's connections to other users, connections to external systems **620** or connections to other entities. The connection store **638** may also associate a connection type with a user's connections, which may be used in conjunction with the user's privacy setting to regulate access to information about the user. In an embodiment of the invention, the user profile store **636** and the connection store **638** may be implemented as a federated database.

[0064] Data stored in the connection store **638**, the user profile store **636**, and the activity log **642** enables the social networking system **630** to generate the social graph that uses nodes to identify various objects and edges connecting nodes to identify relationships between different objects. For example, if a first user establishes a connection with a second user in the social networking system **630**, user accounts of the first user and the second user from the user profile store **636** may act as nodes in the social graph. The connection between the first user and the second user stored by the connection store **638** is an edge between the nodes associated with the first user and the second user. Continuing this example, the second user may then send the first user a message within the social networking system **630**. The action of sending the message, which may be stored, is another edge between the two nodes in the social graph representing the first user and the second user. Additionally, the message itself may be identified and included in the

social graph as another node connected to the nodes representing the first user and the second user.

[0065] In another example, a first user may tag a second user in an image that is maintained by the social networking system **630** (or, alternatively, in an image maintained by another system outside of the social networking system **630**). The image may itself be represented as a node in the social networking system **630**. This tagging action may create edges between the first user and the second user as well as create an edge between each of the users and the image, which is also a node in the social graph. In yet another example, if a user confirms attending an event, the user and the event are nodes obtained from the user profile store **636**, where the attendance of the event is an edge between the nodes that may be retrieved from the activity log **642**. By generating and maintaining the social graph, the social networking system **630** includes data describing many different types of objects and the interactions and connections among those objects, providing a rich source of socially relevant information.

[0066] The web server **632** links the social networking system **630** to one or more user devices **610** and/or one or more external systems **620** via the network **650**. The web server **632** serves web pages, as well as other web-related content, such as Java, JavaScript, Flash, XML, and so forth. The web server **632** may include a mail server or other messaging functionality for receiving and routing messages between the social networking system **630** and one or more user devices **610**. The messages can be instant messages, queued messages (e.g., email), text and SMS messages, or any other suitable messaging format.

[0067] The API request server **634** allows one or more external systems **620** and user devices **610** to call access information from the social networking system **630** by calling one or more API functions. The API request server **634** may also allow external systems **620** to send information to the social networking system **630** by calling APIs. The external system **620**, in one embodiment, sends an API request to the social networking system **630** via the network **650**, and the API request server **634** receives the API request. The API request server **634** processes the request by calling an API associated with the API request to generate an appropriate response, which the API request server **634** communicates to the external system **620** via the network **650**. For example, responsive to an API request, the API request server **634** collects data associated with a user, such as the user's connections that have logged into the external system **620**, and communicates the collected data to the external system **620**. In another embodiment, the user device **610** communicates with the social networking system **630** via APIs in the same manner as external systems **620**.

[0068] The action logger **640** is capable of receiving communications from the web server **632** about user actions on and/or off the social networking system **630**. The action logger **640** populates the activity log **642** with information about user actions, enabling the social networking system **630** to discover various actions taken by its users within the social networking system **630** and outside of the social networking system **630**. Any action that a particular user takes with respect to another node on the social networking system **630** may be associated with each user's account, through information maintained in the activity log **642** or in a similar database or other data repository. Examples of actions taken by a user within the social networking system **630** that are identified and stored may include, for example, adding a connection to another user, sending a message to another user, reading a message from another user, viewing content associated with another user, attending an event posted by another user, posting an image, attempting to post an image, or other actions interacting with another user or another object. When a user takes an action within the social networking system **630**, the action is recorded in the activity log **642**. In one embodiment, the social networking system **630** maintains the activity log **642** as a database of entries. When an action is taken within the social networking system **630**, an entry for the action is added to the activity log **642**. The activity log **642** may be referred to as an action log.

[0069] Additionally, user actions may be associated with concepts and actions that occur within an entity outside of the social networking system **630**, such as an external system **620** that is separate from the social networking system **630**. For example, the action logger **640** may receive data describing a user's interaction with an external system **620** from the web server **632**. In this example, the external system **620** reports a user's interaction according to structured actions and objects in the social graph.

[0070] Other examples of actions where a user interacts with an external system **620** include a user expressing an interest in an external system **620** or another entity, a user posting a comment to the social networking system **630** that discusses an external system **620** or a web page **622***a* within the external system **620**, a user posting to the social networking system **630** a Uniform Resource Locator (URL) or other identifier associated with an external system **620**, a user attending an event associated with an external system **620**, or any other action by a user that is related to an external system **620**. Thus, the activity log **642** may include actions describing interactions between a user of the social networking system **630** and an external system **620** that is separate from the social networking system **630**.

[0071] The authorization server **644** enforces one or more privacy settings of the users of the social networking system **630**. A privacy setting of a user determines how particular information associated with a user can be shared. The privacy setting comprises the specification of particular information associated with a user and the specification of the entity or entities with whom the information can be shared. Examples of entities with which information can be shared may include other users, applications, external systems **620**, or any entity that can potentially access the information. The information that can be shared by a user comprises user account information, such as profile photos, phone numbers associated with the user, user's connections, actions taken by the user such as adding a connection, changing user profile information, and the like.

[0072] The privacy setting specification may be provided at different levels of granularity. For example, the privacy setting may identify specific information to be shared with other users; the privacy setting identifies a work phone number or a specific set of related information, such as, personal information including profile photo, home phone number, and status. Alternatively, the privacy setting may apply to all the information associated with the user. The specification of the set of entities that can access particular information can also be specified at various levels of granularity. Various sets of entities with which information can be shared may include, for example, all friends of the user, all friends of friends, all applications, or all external systems

620. One embodiment allows the specification of the set of entities to comprise an enumeration of entities. For example, the user may provide a list of external systems **620** that are allowed to access certain information. Another embodiment allows the specification to comprise a set of entities along with exceptions that are not allowed to access the information. For example, a user may allow all external systems **620** to access the user's work information, but specify a list of external systems **620** that are not allowed to access the work information. Certain embodiments call the list of exceptions that are not allowed to access certain information a "block list". External systems **620** belonging to a block list specified by a user are blocked from accessing the information specified in the privacy setting. Various combinations of granularity of specification of information, and granularity of specification of entities, with which information is shared are possible. For example, all personal information may be shared with friends whereas all work information may be shared with friends of friends.

[0073] The authorization server **644** contains logic to determine if certain information associated with a user can be accessed by a user's friends, external systems **620**, and/or other applications and entities. The external system **620** may need authorization from the authorization server **644** to access the user's more private and sensitive information, such as the user's work phone number. Based on the user's privacy settings, the authorization server **644** determines if another user, the external system **620**, an application, or another entity is allowed to access information associated with the user, including information about actions taken by the user.

[0074] In some embodiments, the social networking system **630** can include a content provider module **646**. The content provider module **646** can, for example, be implemented as the content provider module **102** of FIG. **1**. In some embodiments, the user device **610** can include a live stream module **618**. The live stream module **618** can, for example, be implemented as the live stream module **106** of FIG. **1**. As discussed previously, it should be appreciated that there can be many variations or other possibilities.

Hardware Implementation

[0075] The foregoing processes and features can be implemented by a wide variety of machine and computer system architectures and in a wide variety of network and computing environments. FIG. **7** illustrates an example of a computer system **700** that may be used to implement one or more of the embodiments described herein in accordance with an embodiment of the invention. The computer system **700** includes sets of instructions for causing the computer system **700** to perform the processes and features discussed herein. The computer system **700** may be connected (e.g., networked) to other machines. In a networked deployment, the computer system **700** may operate in the capacity of a server machine or a client machine in a client-server network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. In an embodiment of the invention, the computer system **700** may be the social networking system **630**, the user device **610**, and the external system **720**, or a component thereof. In an embodiment of the invention, the computer system **700** may be one server among many that constitutes all or part of the social networking system **630**.

[0076] The computer system **700** includes a processor **702**, a cache **704**, and one or more executable modules and drivers, stored on a computer-readable medium, directed to the processes and features described herein. Additionally, the computer system **700** includes a high performance input/output (I/O) bus **706** and a standard I/O bus **708**. A host bridge **710** couples processor **702** to high performance I/O bus **706**, whereas I/O bus bridge **712** couples the two buses **706** and **708** to each other. A system memory **714** and one or more network interfaces **716** couple to high performance I/O bus **706**. The computer system **700** may further include video memory and a display device coupled to the video memory (not shown). Mass storage **718** and I/O ports **720** couple to the standard I/O bus **708**. The computer system **700** may optionally include a keyboard and pointing device, a display device, or other input/output devices (not shown) coupled to the standard I/O bus **708**. Collectively, these elements are intended to represent a broad category of computer hardware systems, including but not limited to computer systems based on the x86-compatible processors manufactured by Intel Corporation of Santa Clara, Calif., and the x86-compatible processors manufactured by Advanced Micro Devices (AMD), Inc., of Sunnyvale, Calif., as well as any other suitable processor.

[0077] An operating system manages and controls the operation of the computer system **700**, including the input and output of data to and from software applications (not shown). The operating system provides an interface between the software applications being executed on the system and the hardware components of the system. Any suitable operating system may be used, such as the LINUX Operating System, the Apple Macintosh Operating System, available from Apple Computer Inc. of Cupertino, Calif., UNIX operating systems, Microsoft® Windows® operating systems, BSD operating systems, and the like. Other implementations are possible.

[0078] The elements of the computer system **700** are described in greater detail below. In particular, the network interface **716** provides communication between the computer system **700** and any of a wide range of networks, such as an Ethernet (e.g., IEEE 802.3) network, a backplane, etc. The mass storage **718** provides permanent storage for the data and programming instructions to perform the above-described processes and features implemented by the respective computing systems identified above, whereas the system memory **714** (e.g., DRAM) provides temporary storage for the data and programming instructions when executed by the processor **702**. The I/O ports **720** may be one or more serial and/or parallel communication ports that provide communication between additional peripheral devices, which may be coupled to the computer system **700**.

[0079] The computer system **700** may include a variety of system architectures, and various components of the computer system **700** may be rearranged. For example, the cache **704** may be on-chip with processor **702**. Alternatively, the cache **704** and the processor **702** may be packed together as a "processor module", with processor **702** being referred to as the "processor core". Furthermore, certain embodiments of the invention may neither require nor include all of the above components. For example, peripheral devices coupled to the standard I/O bus **708** may couple to the high performance I/O bus **706**. In addition, in some embodiments, only a single bus may exist, with the components of the computer system **700** being coupled to the single bus. Moreover, the

computer system **700** may include additional components, such as additional processors, storage devices, or memories.

[0080] In general, the processes and features described herein may be implemented as part of an operating system or a specific application, component, program, object, module, or series of instructions referred to as "programs". For example, one or more programs may be used to execute specific processes described herein. The programs typically comprise one or more instructions in various memory and storage devices in the computer system **700** that, when read and executed by one or more processors, cause the computer system **700** to perform operations to execute the processes and features described herein. The processes and features described herein may be implemented in software, firmware, hardware (e.g., an application specific integrated circuit), or any combination thereof.

[0081] In one implementation, the processes and features described herein are implemented as a series of executable modules run by the computer system **700**, individually or collectively in a distributed computing environment. The foregoing modules may be realized by hardware, executable modules stored on a computer-readable medium (or machine-readable medium), or a combination of both. For example, the modules may comprise a plurality or series of instructions to be executed by a processor in a hardware system, such as the processor **702**. Initially, the series of instructions may be stored on a storage device, such as the mass storage **718**.

[0082] However, the series of instructions can be stored on any suitable computer readable storage medium. Furthermore, the series of instructions need not be stored locally, and could be received from a remote storage device, such as a server on a network, via the network interface **716**. The instructions are copied from the storage device, such as the mass storage **718**, into the system memory **714** and then accessed and executed by the processor **702**. In various implementations, a module or modules can be executed by a processor or multiple processors in one or multiple locations, such as multiple servers in a parallel processing environment.

[0083] Examples of computer-readable media include, but are not limited to, recordable type media such as volatile and non-volatile memory devices; solid state memories; floppy and other removable disks; hard disk drives; magnetic media; optical disks (e.g., Compact Disk Read-Only Memory (CD ROMS), Digital Versatile Disks (DVDs)); other similar non-transitory (or transitory), tangible (or non-tangible) storage medium; or any type of medium suitable for storing, encoding, or carrying a series of instructions for execution by the computer system **700** to perform any one or more of the processes and features described herein.

[0084] For purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the description. It will be apparent, however, to one skilled in the art that embodiments of the disclosure can be practiced without these specific details. In some instances, modules, structures, processes, features, and devices are shown in block diagram form in order to avoid obscuring the description. In other instances, functional block diagrams and flow diagrams are shown to represent data and logic flows. The components of block diagrams and flow diagrams (e.g., modules, blocks, structures, devices, features, etc.) may be variously combined, separated, removed, reordered, and replaced in a manner other than as expressly described and depicted herein.

[0085] Reference in this specification to "one embodiment", "an embodiment", "other embodiments", "one series of embodiments", "some embodiments", "various embodiments", or the like means that a particular feature, design, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of, for example, the phrase "in one embodiment" or "in an embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, whether or not there is express reference to an "embodiment" or the like, various features are described, which may be variously combined and included in some embodiments, but also variously omitted in other embodiments. Similarly, various features are described that may be preferences or requirements for some embodiments, but not other embodiments.

[0086] The language used herein has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the inventive subject matter. It is therefore intended that the scope of the invention be limited not by this detailed description, but rather by any claims that issue on an application based hereon. Accordingly, the disclosure of the embodiments of the invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

What is claimed is:

1. A computer-implemented method comprising:

providing, by a computing device, an interface through which a live content stream is presented, the live content stream being accessed through a content provider system;

determining, by the computing device, that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream; and

updating, by the computing device, the interface to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.

2. The computer-implemented method of claim **1**, wherein the visual modification corresponds to at least a text overlay, graphical overlay, virtual doodle, text animation, graphical animation, or placement of a face mask.

3. The computer-implemented method of claim **1**, wherein the visual modification made to the live content stream based on the filter applied by the broadcaster is presented in the respective interfaces of viewers accessing the live content stream through the content provider system.

4. The computer-implemented method of claim **1**, the method further comprising:

determining, by the computing device, that the broadcaster has invited a user of the content provider system to join the live content stream as a co-broadcaster;

determining, by the computing device, that the user has selected an option to accept the invitation to join the live content stream as co-broadcaster; and

causing, by the computing device, the user to be added to the live content stream as co-broadcaster.

5. The computer-implemented method of claim **4**, wherein causing the user to be added to the live content stream as a co-broadcaster further comprises:

causing, by the computing device, the live content stream broadcast to be merged with a different live content stream being broadcasted using a computing device of the user, wherein the viewers accessing the live content stream are shown the merged live content stream.

6. The computer-implemented method of claim **5**, wherein the merged live content stream is presented to users in an interface that includes a first region and a second region, wherein the broadcaster's live content stream is shown in the first region, and wherein the user's different live content stream is shown in the second region.

7. The computer-implemented method of claim **6**, wherein the broadcaster is able to apply additional filters to the live content stream of the broadcaster, wherein visual modifications made in response to the additional filters are presented in the first region of the interface.

8. The computer-implemented method of claim **6**, wherein the broadcaster is able to apply additional filters to the different live content stream of the co-broadcaster, wherein visual modifications made in response to the additional filters are presented in the second region of the interface.

9. The computer-implemented method of claim **6**, wherein the co-broadcaster is able to apply additional filters to the live content stream of the broadcaster, wherein visual modifications made in response to the additional filters are presented in the first region of the interface.

10. The computer-implemented method of claim **6**, wherein the co-broadcaster is able to apply additional filters to the different live content stream of the co-broadcaster, wherein visual modifications made in response to the additional filters are presented in the second region of the interface.

11. A system comprising:

at least one processor; and

a memory storing instructions that, when executed by the at least one processor, cause the system to perform:

providing an interface through which a live content stream is presented, the live content stream being accessed through a content provider system;

determining that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream; and

updating the interface to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.

12. The system of claim **11**, wherein the visual modification corresponds to at least a text overlay, graphical overlay, virtual doodle, text animation, graphical animation, or placement of a face mask.

13. The system of claim **11**, wherein the visual modification made to the live content stream based on the filter applied by the broadcaster is presented in the respective interfaces of viewers accessing the live content stream through the content provider system.

14. The system of claim **11**, wherein the instructions further cause the system to perform:

determining that the broadcaster has invited a user of the content provider system to join the live content stream as a co-broadcaster;

determining that the user has selected an option to accept the invitation to join the live content stream as co-broadcaster; and

causing the user to be added to the live content stream as co-broadcaster.

15. The system of claim **14**, wherein causing the user to be added to the live content stream as a co-broadcaster further causes the system to perform:

causing the live content stream broadcast to be merged with a different live content stream being broadcasted using a computing device of the user, wherein the viewers accessing the live content stream are shown the merged live content stream.

16. A non-transitory computer-readable storage medium including instructions that, when executed by at least one processor of a computing system, cause the computing system to perform a method comprising:

providing an interface through which a live content stream is presented, the live content stream being accessed through a content provider system;

determining that a broadcaster of the live content stream has applied at least one filter to the live content stream, wherein the filter causes some visual modification to be applied to the live content stream; and

updating the interface to include the visual modification to the live content stream based at least in part on the filter applied by the broadcaster.

17. The non-transitory computer-readable storage medium of claim **16**, wherein the visual modification corresponds to at least a text overlay, graphical overlay, virtual doodle, text animation, graphical animation, or placement of a face mask.

18. The non-transitory computer-readable storage medium of claim **16**, wherein the visual modification made to the live content stream based on the filter applied by the broadcaster is presented in the respective interfaces of viewers accessing the live content stream through the content provider system.

19. The non-transitory computer-readable storage medium of claim **16**, wherein the instructions further cause the computing system to perform:

determining that the broadcaster has invited a user of the content provider system to join the live content stream as a co-broadcaster;

determining that the user has selected an option to accept the invitation to join the live content stream as co-broadcaster; and

causing the user to be added to the live content stream as co-broadcaster.

20. The non-transitory computer-readable storage medium of claim **19**, wherein causing the user to be added to the live content stream as a co-broadcaster further causes the computing system to perform:

causing the live content stream broadcast to be merged with a different live content stream being broadcasted using a computing device of the user, wherein the viewers accessing the live content stream are shown the merged live content stream.

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