(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 December 2017 (21.12.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/218229 A1

(51) International Patent Classification:
G09B 5/02 (2006.01) *G06T 15/00* (2011.01)

(21) International Application Number:
PCT/US2017/036027

(22) International Filing Date:
06 June 2017 (06.06.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
15/181,340 13 June 2016 (13.06.2016) US

(71) Applicant: **MICROSOFT TECHNOLOGY LICENSING, LLC** [US/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US).

(72) Inventors: **NEUMANN, Blair Justice**; MICROSOFT TECHNOLOGY LICENSING, LLC, One Microsoft Way, Redmond, Washington 98052-6399 (US). **FU, Szu-Wei Silvia**; MICROSOFT TECHNOLOGY LICENSING, LLC, One Microsoft Way, Redmond, Washington 98052-6399 (US).

(74) Agent: **MINHAS, Sandip** et al.; MICROSOFT TECHNOLOGY LICENSING, LLC, One Microsoft Way, Redmond, Washington 98052-6399 (US).

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

(54) Title: REPRESENTING A DOCUMENT IN A VIRTUAL SPATIAL CONTEXT

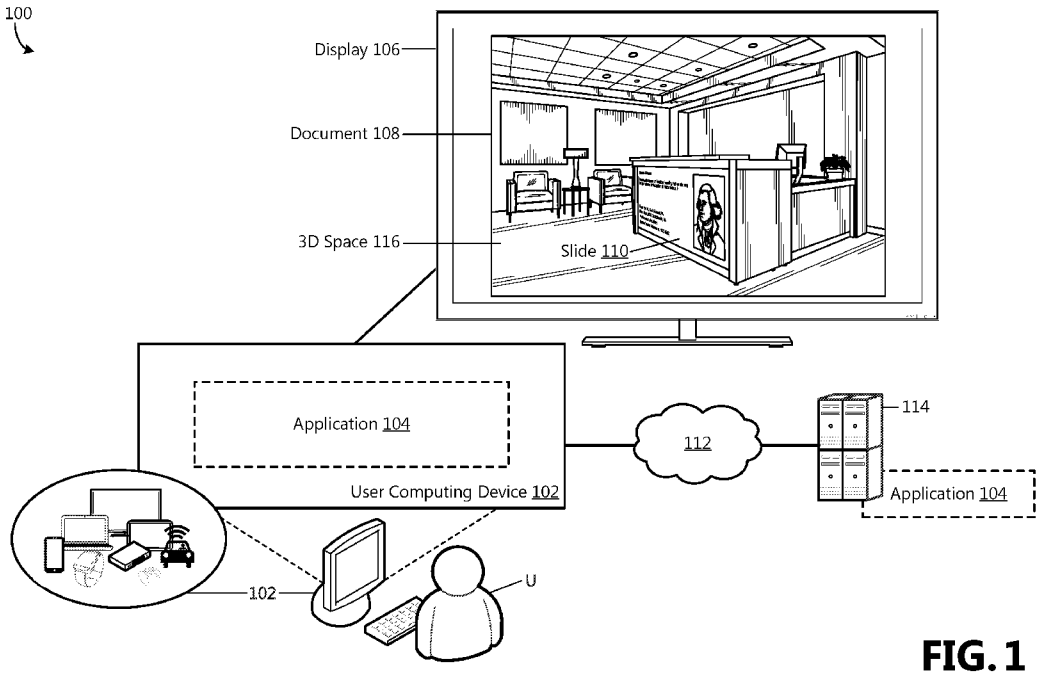


FIG. 1

(57) Abstract: Document reconfiguration for improved user efficiency is provided. Document content items in a document are reconfigured such that the content items are anchored to various objects displayed in a contiguous 3D space. The 3D space is navigated via realistic virtual camera movements between the document content items anchored to the various objects in a sequential order, wherein each object on which a document content item is anchored is a key frame and a stopping point in an animated virtual tour of the 3D space. Accordingly, each document content item is given spatial context associated with its location in the 3D space, enabling a user to associate document content with locations in the 3D space. Thus, the user's ability to recall the presented content is improved by enabling the user to employ spatial memory.

WO 2017/218229 A1

[Continued on next page]

SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

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

REPRESENTING A DOCUMENT IN A VIRTUAL SPATIAL CONTEXT

BACKGROUND

[0001] Spatial memory is the part of memory responsible for recording information about one's environment and its spatial orientation. People are typically good at remembering spatial information. Accordingly, by giving information a spatial context, such as placing pieces of information in an imagined sequence of locations, stronger memories can be formed. This technique is sometimes referred to as the "method of loci" or the "memory palace technique," and dates back to Roman and Greek orators who used such methods to memorize long speeches. For example, a memory palace is a place that an individual can imagine, such as a building, a city, a commute, etc., comprising a plurality of distinct locations. An individual can sequentially go around to the different locations (in the individual's mind), and associate pieces of information that he/she wants to remember with the different locations. Later, when the individual wants to recall the pieces of information, the individual can travel through the locations in his/her mind and recall the associated information.

[0002] Information that a person may want to recall may include information presented to the person, such as in an electronic slide presentation. An electronic slide presentation is a widely used tool across a variety of enterprises to communicate information to various audiences. For example, some popular uses of electronic slide presentations are as a teaching aid in a classroom setting, in corporate training sessions, business and marketing meetings, sales gatherings, etc. An electronic slide presentation typically includes a number of individual pages or slides, wherein a "slide" is analogous to a photographic slide shown via a slide projector. An author of an electronic slide presentation may include information in each slide in the form of text, graphics, sound, movies, and other objects. Generally, slides are displayed on discontiguous flat backgrounds, which provide no concept of space, and thus the applicability of spatial memory in association with content included in the electronic slide presentation is limited.

SUMMARY

[0003] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description section. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended as an aid in determining the scope of the claimed subject matter.

[0004] Aspects are directed to an automated system, method, and computer storage media for generating and applying spatial context to a document by reconfiguring document content into a contiguous three-dimensional (3D) space. For example, document content items are reconfigured such that the content items are anchored to various objects displayed in the contiguous 3D space. A user's efficiency in utilizing a productivity application to view the document is increased by anchoring the document content in the 3D space and enabling animated sequential transitions between the document content items anchored to the various objects via realistic virtual camera movements.

[0005] Examples are implemented as a computer process, a computing system, or as an article of manufacture such as a device, computer program product, or computer readable media. According to an aspect, the computer program product is a computer storage media readable by a computer system and encoding a computer program of instructions for executing a computer process.

[0006] The details of one or more aspects are set forth in the accompanying drawings and description below. Other features and advantages will be apparent from a reading of the following detailed description and a review of the associated drawings. It is to be understood that the following detailed description is explanatory only and is not restrictive of the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate various aspects. In the drawings:

FIGURE 1 is a simplified block diagram showing components of an example system for generating and applying spatial context to a document;

FIGURE 2 is a simplified block diagram showing a 3D space;

FIGURE 3A is an illustration of an example application user interface display showing a slide presentation document;

FIGURE 3B is an illustration of an example application user interface display showing a display of one or more 3D spaces from which a user may select to apply to a document;

FIGURE 3C is an illustration of an example application user interface display showing a first key frame in a virtual tour of the document in a 3D space;

FIGURE 3D is an illustration of an example application user interface display showing a second slide of the document in a second key frame in the virtual tour of the 3D space;

FIGURE 3E is an illustration of an example application user interface display showing a transition from the second key frame to a third key frame in the virtual tour of the 3D space;

FIGURE 3F is an illustration of an example application user interface display showing a third key frame in a virtual tour of the 3D space;

FIGURES 3G and **3H** are illustrations of an example application user interface display showing a transition from the third key frame to a fourth key frame in the virtual tour of the 3D space;

FIGURE 3I is an illustration of an example application user interface display showing a fourth slide of the document in the fourth key frame in the virtual tour of the 3D space;

FIGURE 4 is a flow chart showing general stages involved in an example method for reconfiguring a document into a 3D space;

FIGURE 5 is a block diagram illustrating example physical components of a computing device;

FIGURES 6A and **6B** are simplified block diagrams of a mobile computing device; and

FIGURE 7 is a simplified block diagram of a distributed computing system.

DETAILED DESCRIPTION

[0008] The following detailed description refers to the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the following description refers to the same or similar elements. While examples may be described, modifications, adaptations, and other implementations are possible. For example, substitutions, additions, or modifications may be made to the elements illustrated in the drawings, and the methods described herein may be modified by substituting, reordering, or adding stages to the disclosed methods. Accordingly, the following detailed description is not limiting, but instead, the proper scope is defined by the appended claims. Examples may take the form of a hardware implementation, or an entirely software implementation, or an implementation combining software and hardware aspects. The following detailed description is, therefore, not to be taken in a limiting sense.

[0009] Aspects of the present disclosure are directed to a method, system, and computer storage media for generating and applying spatial context to a document. For example, document content items are reconfigured such that the content items are

anchored to various objects displayed in the contiguous 3D space. The 3D space is navigated sequentially to present the document content to the user, wherein each object on which a document content item is anchored is a key frame and a stopping point in a virtual tour of the 3D space. Accordingly, each document content item is given spatial context associated with its location in the 3D space. The user is enabled to associate document content with locations in the 3D space, thus improving the user's ability to recall the presented content by employing spatial memory.

[0010] With reference now to **FIGURE 1**, a simplified block diagram illustrating aspects of an example system **100** for generating and applying spatial context to a document is shown. The example system **100** includes a computing device **102**, wherein the computing device **102** may be one of various types of computing devices (e.g., a tablet computing device, a desktop computer, a mobile communication device, a laptop computer, a laptop/tablet hybrid computing device, a large screen multi-touch display, a gaming device, a smart television, a wearable device, a connected automobile, a smart home device, or other type of computing device) for executing applications **104** for performing a variety of tasks.

[0011] A user U may utilize an application **104** on a computing device **102** for a variety of tasks, which may include, for example, to write, calculate, draw, organize, prepare and view presentations, send and receive electronic mail, take and organize notes, make music, and the like. Applications **104** may include thick client applications, which may be stored locally on the computing device **102** (as illustrated in **FIGURE 1**), or may include thin client applications (i.e., web applications) that may reside on a remote server **114** and accessible over a network **112** or combination of networks (e.g., the Internet, wide area networks, local area networks). A thin client application may be hosted in a browser-controlled environment or coded in a browser-supported language and reliant on a common web browser to render the application executable on a computing device **102**.

[0012] The computing device **102** is configured to receive content for input into a document **108** (e.g., a word processing document, a slide presentation document, a spreadsheet document, a notes document, and the like). For example, content may include various content items (e.g., text, charts, tables, images, videos). In examples, the application **104** receives input from a user, such as input relating to the document content, via various input methods, such as those relying on mice, keyboards, and remote controls, as well as Natural User Interface (NUI) methods, which enable a user to interact with a device in a "natural" manner, such as via speech recognition, touch and stylus recognition,

gesture recognition both on screen and adjacent to the screen, air gestures, head and eye tracking, voice and speech, vision, touch, hover, gestures, and machine intelligence. The user input results in content being added to the document **108**.

[0013] In some aspects, a document **108** is comprised of a plurality of pages. In a slide presentation document, a single page is a slide **110**. According to examples, a slide presentation document is comprised of a plurality of slides **110** arranged in a sequential order. When content is added to a slide presentation document **108**, the content is added to a particular slide **110**. This disclosure includes many examples that relate to slide presentation documents. It should be understood, however, that many of these examples are applicable to other types of documents **108** as well.

[0014] According to aspects, the application **104** operates to reconfigure document content into a contiguous three-dimensional (3D) space **116**. For example and with reference now to **FIGURE 2**, the 3D space **116** is a navigable 3D environment. In some examples, the 3D space **116** is a collection of overlapping two-dimensional (2D) images (e.g., photographs) that are reconstructed into a 3D model of the space. In other examples, the 3D space **116** is a recorded video capture of an environment. In other examples, the 3D space **116** is a computer-generated imagery (CGI) modeled environment. According to an aspect, the 3D space **116** comprises a plurality of salient features or objects **202a-c** (generally, **202**) that are configured to be key frames in a virtual tour of the environment. The plurality of salient features or objects **202** may include various locations in the 3D space **116** such as walls, furniture, floors, buildings, streets, sidewalks, signs, trees, and other locations that are distinct from other locations and on which document content can be displayed.

[0015] According to an aspect, portions of document content **204a-c** (generally, **204**) are reconfigured such that document content is anchored to various objects **202** along a virtual path through the 3D space **116**, wherein spatial relations of the objects **202** to each other enable a viewing user to experience each portion of document content **204** in context of its location in the 3D space **116**. In some examples, the portions of document content **204** that are anchored to objects **202** in the 3D space **116** are pages or slides **110** of the document **108**. In other examples, the portions of document content **204** are individual content items, such as text, charts, tables, images, videos, etc., anchored to various objects **202** in the 3D space **116**.

[0016] As mentioned above, the objects **202** on which document content **204** are anchored are key frames in a virtual tour of the 3D space **116**. For example, when a user

views the document **108**, portions of the document (e.g., slides **110**, pages, content items) are sequentially displayed on objects **202** throughout the 3D space **116**. According to an aspect, navigation of the document **108** includes movement of a virtual camera **206** through the 3D space **116**, providing an animated view of the 3D space. Transitions **208a-c** (generally, **208**) between the portions of the document content **204** occur when a user moves from one document portion to a next document portion during an on-screen display or presentation of the document **108**. According to an aspect, a transition **208** includes a realistic movement of the virtual camera **206** through the 3D space **116** to an object **202** on which the next portion of the document content **204** is anchored. For example, if the document **108** is a slide presentation document, transitions **208** between the slides **110**/**204** are simulated as a virtual walk from a first slide to a next slide through the 3D space **116**. Each portion of document content **204** is given spatial context associated with its location in the 3D space **116**, thus enabling the user to associate the portions of document content **208** with particular locations in the 3D space. Accordingly, the user's efficiency in utilizing the application **104** is increased, and the user's ability to recall the presented content is improved by employing spatial memory.

[0017] With reference now to **FIGURES 3A-3I**, example application user interfaces are illustrated that may be displayed on any suitable computing device display **106**. In the illustrated examples, the application user interfaces comprise a display of a slide presentation document **108**. In **FIGURE 3A**, the slide presentation document **108** is shown in a normal or editing mode. In some examples, the application user interface **300** includes a slide pane **302** comprising thumbnails of the slides **110a-d** (collectively, **110**) in the document **108**. As described above, a user U may input various content items, such as text, charts, tables, images, videos, etc., into a slide **110**. In some examples, the user U may apply animations to the slide **110**, such as entrance or exit animation effects, sound effects, motion paths of content items, etc. In other examples, the user U may record a narration to apply to the document **108**.

[0018] As illustrated, the user interface **300** may comprise a toolbar **304** that includes various functionalities, tools, and settings related to authoring the document **108**, such as: cut, copy, and paste tools; font settings; animation settings, layout settings; etc. In other examples, the toolbar **304** includes fewer, additional, or different tools, functionalities, and settings. According to an aspect, a functionality command **306** is provided for enabling a user to select to reconfigure the document **108** into a 3D space **116**. For example, the functionality command **306** may be provided in the toolbar **304** as

illustrated. In other examples, reconfiguration of the document **108** into a 3D space **116** may be invoked via other methods, such as via voice command, keyboard input, or other command.

[0019] According to an example and as illustrated in **FIGURE 3B**, upon receiving an indication of a selection to reconfigure the document **108** into a 3D space **116**, the application **104** is operative to provide a display of one or more 3D spaces **116a-d** (collectively, **116**) from which the user U may select to apply to the document **108**. In some examples, each 3D space **116** may have a maximum number of objects **202** that are available for anchoring document content **204**. As illustrated in **FIGURE 3B**, the number **308** of available objects **202** in the 3D space **116** that can be used to anchor document content **204** to is displayed. For example, if a slide presentation document **108** has 50 slides **110**, the user U may select 3D space **116c** in order to have enough objects **202** for anchoring each of the slides. In some examples, the application **104** is operative to automatically select a 3D space **116** for reconfiguration of the document **108**. The selection may be based on various factors, such as a number of slides **110** or pages in the document **108**, the type of content **204** included in the document **108**, previously used 3D spaces **116**, or other factors. According to an aspect, when the user U selects a 3D space **116** (or when the user U selects a 3D functionality command **306**), the application **104** is operative to reconfigure the document **108** into the selected 3D space **116**. For example, if the document **108** is a slide presentation document, for each slide **110** in the document, the application **104** extracts the slide, and anchors the slide to a first available object **202** in the 3D space **116**.

[0020] **FIGURES 3C-3I** show examples of a presentation of the document **108** in the 3D space **116**. With reference now to **FIGURE 3C**, a first key frame **310a** in the virtual tour of the 3D space **116** includes content **204** from the first slide **110a**, the second slide **110b**, and the third slide **110c** anchored to objects in the 3D space **116**. For example, textual content **204a** from the first slide **110a** is anchored to a banner object **202a**, the second slide **110b** is anchored to a sidewalk object **202b**, and the third slide **110c** is anchored to a building object **202c** above a doorway.

[0021] With reference now to **FIGURE 3D**, an example of a second key frame **310b** is illustrated. According to an aspect, the presentation of the document **108** includes transitions **208** between key frames **310**. For example, the transition **208** from the first key frame **310a** to the second key frame **310b** is a virtual navigation via the virtual camera **206** along a path from a view of the first slide **110a** anchored to a first object **202a** to a view of

the second slide **110b** anchored to a second object **202b**. In the illustrated example, the second slide **110b** is shown anchored to a sidewalk object **202b**, and the second key frame **310b** is a top view of the second slide **110b**.

[0022] With reference now to **FIGURE 3E**, an example of a transition **208a** from the second key frame **310b** to a third key frame is illustrated. For example, the movement of the virtual camera **206** through the 3D space **116** may include panning upward from the second slide **110b** anchored to the sidewalk object **202b**, and moving along the z-axis towards the building object **202c** where the third slide **110c** is anchored. Transitions **208** may include various types of movements (e.g., zooming, panning, sweeping). In some examples, the transition **208** is a smooth movement. In other examples, the transition **208** simulates a human's walking motion. Other examples may simulate movement of a vehicle, such as an automobile, airplane, helicopter, boat, drone, etc., movement of an animal, etc. According to an aspect, a transition **208** may include movement of document content **204** (e.g., a slide **110**) into the 3D space **116**. For example, the content **204**/slide **110** may be anchored to a mobile object **202** that moves into the environment.

[0023] Transitions **208** between key frames **310** may occur automatically, such as after a preset duration of display of the previous key frame, or may occur in response to user interaction, such as a mouse or other pointer click, a gesture, voice command, etc. In some examples, transitions **208** are controllable via a user U. For example, the user U may be enabled to control the speed of the transition **208**, camera panning, zooming, the direction of movement, and the like. According to one aspect, if a user U wishes to transition from one slide **110** to a previous slide, the transition **208** may include a virtual camera **206** movement simulating turning from the currently-viewed slide, and moving toward the previous slide following the path back to the previous slide.

[0024] **FIGURE 3F** is an illustration of an example of the third key frame **310c**. For example, the third key frame **310c** includes a zoomed-in display of the third slide **110c** anchored to the building object **202c**. **FIGURES 3G** and **3H** illustrate an example transition **208b** from the third key frame **310c** to a fourth key frame **310d**. **FIGURE 3I** is an illustration of the fourth key frame in the virtual tour of the 3D space **116**. For example, in the fourth key frame **310d**, the fourth slide **110d** of the document **108** is shown anchored to a receptionist desk object **202d**. Although the illustrated examples show slides **110a-d** anchored to objects **202a-d** in the 3D space **116**, in some examples, select document content items **204** (e.g., text, charts, graphs, images, videos) may be extracted from a page or slide **110** and anchored to objects. According to an aspect, the document

108 may include a number of additional slides **110**. Presentation of the document **108** continues with sequential transitions through the additional slides **110** shown anchored to additional objects **202** along a virtual pathway through the 3D space **116**. As should the appreciated, the user interface displays **300** illustrated in **FIGURES 3A-3I** are for purposes of illustration. Aspects may be implemented in many different forms and should not be construed as limited to the illustrated examples.

[0025] Having described an operating environment and various user interface display examples with respect to **FIGURES 1-3I**, **FIGURE 4** is a flow chart showing general stages involved in an example method **400** for restructuring a document **108** into a 3D space **116**. The method **400** starts at OPERATION **402**, where a document **108** is created or opened in an application **104**. For example, the document **108** may be a word processing document, a spreadsheet document, a slide presentation document, or other type of document.

[0026] The method **400** proceeds to OPERATION **404**, where a selection to reconfigure the document **108** into a 3D space **116** is received. For example, a user U may select a functionality command **306**, such as the example functionality command illustrated in **FIGURE 3A**, or input another command for instructing the application **104** to reconfigure the document **108** into a 3D space **116**. In some examples, the user U may be presented with various 3D spaces **116** from which to select to apply to the document **108**, such as illustrated in the example interface of **FIGURE 3B**. In other examples, a 3D space **116** is automatically selected.

[0027] The method **400** continues to OPERATION **406**, where the application **104** reconfigures the document **108** into the 3D space **116**. For example, portions of the document content **204** (e.g., slides **110**, pages, content items) are sequentially anchored to various objects **202** along a virtual path in the 3D space **116**. For example, document content **204** is linked to a surface of an object **202** in the 3D space **116**. In some examples, the objects **202** to which to link to document content **204** are automatically selected. For example, certain objects **202** within the 3D space **116** may be more preferential for anchoring content to due to various factors, such as size, location, proximity to other objects, a level of salience, etc. In an example, when a number of document content items **204** in a document **108** are less than the number of objects **202** in the 3D space **116** that are available to link content to, the application **104** may automatically select a preferred group of objects **202**. According to an aspect, the reconfigured document is saved as a presentation-version of the document **108**.

[0028] At OPERATION **408**, an indication of a selection to present the document **108** is received. For example, a functionality command associated with displaying the document in a presentation mode may be selected by a user U. In response, the method **400** proceeds to OPERATION **410**, where the application user interface **300** is updated to display the presentation-version of the document **108**. For example, the portions of the document **108** are sequentially displayed on a screen **106** in a virtual walk-through of the 3D space **116**, wherein the portions of document content **204** are anchored to objects **202** in the 3D space. As described above, a virtual camera **206** transitions between key frames **310**, where a focus is made on a next document content portion anchored to an object **202**. Accordingly, each portion of document content **204** (e.g., page, slide, content item) is given spatial context associated with its location in the 3D space **116**, enabling the viewing user to associate document content with locations in the 3D space and thus improve the user's ability to recall the presented content by employing spatial memory. The method **400** ends at OPERATION **498**.

[0029] While implementations have been described in the general context of program modules that execute in conjunction with an application program that runs on an operating system on a computer, those skilled in the art will recognize that aspects may also be implemented in combination with other program modules. Generally, program modules include routines, programs, components, data structures, and other types of structures that perform particular tasks or implement particular abstract data types.

[0030] The aspects and functionalities described herein may operate via a multitude of computing systems including, without limitation, desktop computer systems, wired and wireless computing systems, mobile computing systems (e.g., mobile telephones, netbooks, tablet or slate type computers, notebook computers, and laptop computers), hand-held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, minicomputers, and mainframe computers.

[0031] In addition, according to an aspect, the aspects and functionalities described herein operate over distributed systems (e.g., cloud-based computing systems), where application functionality, memory, data storage and retrieval and various processing functions are operated remotely from each other over a distributed computing network, such as the Internet or an intranet. According to an aspect, user interfaces and information of various types are displayed via on-board computing device displays or via remote display units associated with one or more computing devices. For example, user interfaces and information of various types are displayed and interacted with on a wall surface onto

which user interfaces and information of various types are projected. Interaction with the multitude of computing systems with which implementations are practiced include, keystroke entry, touch screen entry, voice or other audio entry, gesture entry where an associated computing device is equipped with detection (e.g., camera) functionality for capturing and interpreting user gestures for controlling the functionality of the computing device, and the like.

[0032] **FIGURES 5-7** and the associated descriptions provide a discussion of a variety of operating environments in which examples are practiced. However, the devices and systems illustrated and discussed with respect to **FIGURES 5-7** are for purposes of example and illustration and are not limiting of a vast number of computing device configurations that are utilized for practicing aspects, described herein.

[0033] **FIGURE 5** is a block diagram illustrating physical components (i.e., hardware) of a computing device **500** with which examples of the present disclosure may be practiced. In a basic configuration, the computing device **500** includes at least one processing unit **502** and a system memory **504**. According to an aspect, depending on the configuration and type of computing device, the system memory **504** comprises, but is not limited to, volatile storage (e.g., random access memory), non-volatile storage (e.g., read-only memory), flash memory, or any combination of such memories. According to an aspect, the system memory **504** includes an operating system **505** and one or more program modules **506** suitable for running software applications **550**. According to an aspect, the system memory **504** includes productivity application **104**. The operating system **505**, for example, is suitable for controlling the operation of the computing device **500**. Furthermore, aspects are practiced in conjunction with a graphics library, other operating systems, or any other application program, and is not limited to any particular application or system. This basic configuration is illustrated in **FIGURE 5** by those components within a dashed line **508**. According to an aspect, the computing device **500** has additional features or functionality. For example, according to an aspect, the computing device **500** includes additional data storage devices (removable and/or non-removable) such as, for example, magnetic disks, optical disks, or tape. Such additional storage is illustrated in **FIGURE 5** by a removable storage device **509** and a non-removable storage device **510**.

[0034] As stated above, according to an aspect, a number of program modules and data files are stored in the system memory **504**. While executing on the processing unit **502**, the program modules **506** (e.g., productivity application **104**) perform processes

including, but not limited to, one or more of the stages of the method **400** illustrated in **FIGURE 4**. According to an aspect, other program modules are used in accordance with examples and include applications such as electronic mail and contacts applications, word processing applications, spreadsheet applications, database applications, slide presentation applications, drawing or computer-aided application programs, etc.

[0035] According to an aspect, aspects are practiced in an electrical circuit comprising discrete electronic elements, packaged or integrated electronic chips containing logic gates, a circuit utilizing a microprocessor, or on a single chip containing electronic elements or microprocessors. For example, aspects are practiced via a system-on-a-chip (SOC) where each or many of the components illustrated in **FIGURE 5** are integrated onto a single integrated circuit. According to an aspect, such an SOC device includes one or more processing units, graphics units, communications units, system virtualization units and various application functionality all of which are integrated (or "burned") onto the chip substrate as a single integrated circuit. When operating via an SOC, the functionality, described herein, is operated via application-specific logic integrated with other components of the computing device **500** on the single integrated circuit (chip). According to an aspect, aspects of the present disclosure are practiced using other technologies capable of performing logical operations such as, for example, AND, OR, and NOT, including but not limited to mechanical, optical, fluidic, and quantum technologies. In addition, aspects are practiced within a general purpose computer or in any other circuits or systems.

[0036] According to an aspect, the computing device **500** has one or more input device(s) **512** such as a keyboard, a mouse, a pen, a sound input device, a touch input device, etc. The output device(s) **514** such as a display, speakers, a printer, etc. are also included according to an aspect. The aforementioned devices are examples and others may be used. According to an aspect, the computing device **500** includes one or more communication connections **516** allowing communications with other computing devices **518**. Examples of suitable communication connections **516** include, but are not limited to, radio frequency (RF) transmitter, receiver, and/or transceiver circuitry; universal serial bus (USB), parallel, and/or serial ports.

[0037] The term computer readable media as used herein include computer storage media. Computer storage media include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, or program modules. The system

memory **504**, the removable storage device **509**, and the non-removable storage device **510** are all computer storage media examples (i.e., memory storage.) According to an aspect, computer storage media includes RAM, ROM, electrically erasable programmable read-only memory (EEPROM), flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other article of manufacture which can be used to store information and which can be accessed by the computing device **500**. According to an aspect, any such computer storage media is part of the computing device **500**. Computer storage media does not include a carrier wave or other propagated data signal.

[0038] According to an aspect, communication media is embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and includes any information delivery media. According to an aspect, the term "modulated data signal" describes a signal that has one or more characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), infrared, and other wireless media.

[0039] **FIGURES 6A** and **6B** illustrate a mobile computing device **600**, for example, a mobile telephone, a smart phone, a tablet personal computer, a laptop computer, and the like, with which aspects may be practiced. With reference to **FIGURE 6A**, an example of a mobile computing device **600** for implementing the aspects is illustrated. In a basic configuration, the mobile computing device **600** is a handheld computer having both input elements and output elements. The mobile computing device **600** typically includes a display **605** and one or more input buttons **610** that allow the user to enter information into the mobile computing device **600**. According to an aspect, the display **605** of the mobile computing device **600** functions as an input device (e.g., a touch screen display). If included, an optional side input element **615** allows further user input. According to an aspect, the side input element **615** is a rotary switch, a button, or any other type of manual input element. In alternative examples, mobile computing device **600** incorporates more or less input elements. For example, the display **605** may not be a touch screen in some examples. In alternative examples, the mobile computing device **600** is a portable phone system, such as a cellular phone. According to an aspect, the mobile computing device **600** includes an optional keypad **635**. According to an aspect, the

optional keypad **635** is a physical keypad. According to another aspect, the optional keypad **635** is a "soft" keypad generated on the touch screen display. In various aspects, the output elements include the display **605** for showing a graphical user interface (GUI), a visual indicator **620** (e.g., a light emitting diode), and/or an audio transducer **625** (e.g., a speaker). In some examples, the mobile computing device **600** incorporates a vibration transducer for providing the user with tactile feedback. In yet another example, the mobile computing device **600** incorporates input and/or output ports, such as an audio input (e.g., a microphone jack), an audio output (e.g., a headphone jack), and a video output (e.g., a HDMI port) for sending signals to or receiving signals from an external device. In yet another example, the mobile computing device **600** incorporates peripheral device port **640**, such as an audio input (e.g., a microphone jack), an audio output (e.g., a headphone jack), and a video output (e.g., a HDMI port) for sending signals to or receiving signals from an external device.

[0040] **FIGURE 6B** is a block diagram illustrating the architecture of one example of a mobile computing device. That is, the mobile computing device **600** incorporates a system (i.e., an architecture) **602** to implement some examples. In one example, the system **602** is implemented as a "smart phone" capable of running one or more applications (e.g., browser, e-mail, calendaring, contact managers, messaging clients, games, and media clients/players). In some examples, the system **602** is integrated as a computing device, such as an integrated personal digital assistant (PDA) and wireless phone.

[0041] According to an aspect, one or more application programs **650** are loaded into the memory **662** and run on or in association with the operating system **664**. Examples of the application programs include phone dialer programs, e-mail programs, personal information management (PIM) programs, word processing programs, spreadsheet programs, Internet browser programs, messaging programs, and so forth. According to an aspect, productivity application **104** is loaded into memory **662**. The system **602** also includes a non-volatile storage area **668** within the memory **662**. The non-volatile storage area **668** is used to store persistent information that should not be lost if the system **602** is powered down. The application programs **650** may use and store information in the non-volatile storage area **668**, such as e-mail or other messages used by an e-mail application, and the like. A synchronization application (not shown) also resides on the system **602** and is programmed to interact with a corresponding synchronization application resident on a host computer to keep the information stored in the non-volatile

storage area **668** synchronized with corresponding information stored at the host computer. As should be appreciated, other applications may be loaded into the memory **662** and run on the mobile computing device **600**.

[0042] According to an aspect, the system **602** has a power supply **670**, which is implemented as one or more batteries. According to an aspect, the power supply **670** further includes an external power source, such as an AC adapter or a powered docking cradle that supplements or recharges the batteries.

[0043] According to an aspect, the system **602** includes a radio **672** that performs the function of transmitting and receiving radio frequency communications. The radio **672** facilitates wireless connectivity between the system **602** and the "outside world," via a communications carrier or service provider. Transmissions to and from the radio **672** are conducted under control of the operating system **664**. In other words, communications received by the radio **672** may be disseminated to the application programs **650** via the operating system **664**, and vice versa.

[0044] According to an aspect, the visual indicator **620** is used to provide visual notifications and/or an audio interface **674** is used for producing audible notifications via the audio transducer **625**. In the illustrated example, the visual indicator **620** is a light emitting diode (LED) and the audio transducer **625** is a speaker. These devices may be directly coupled to the power supply **670** so that when activated, they remain on for a duration dictated by the notification mechanism even though the processor **660** and other components might shut down for conserving battery power. The LED may be programmed to remain on indefinitely until the user takes action to indicate the powered-on status of the device. The audio interface **674** is used to provide audible signals to and receive audible signals from the user. For example, in addition to being coupled to the audio transducer **625**, the audio interface **674** may also be coupled to a microphone to receive audible input, such as to facilitate a telephone conversation. According to an aspect, the system **602** further includes a video interface **676** that enables an operation of an on-board camera **630** to record still images, video stream, and the like.

[0045] According to an aspect, a mobile computing device **600** implementing the system **602** has additional features or functionality. For example, the mobile computing device **600** includes additional data storage devices (removable and/or non-removable) such as, magnetic disks, optical disks, or tape. Such additional storage is illustrated in **FIGURE 6B** by the non-volatile storage area **668**.

[0046] According to an aspect, data/information generated or captured by the mobile computing device **600** and stored via the system **602** is stored locally on the mobile computing device **600**, as described above. According to another aspect, the data is stored on any number of storage media that is accessible by the device via the radio **672** or via a wired connection between the mobile computing device **600** and a separate computing device associated with the mobile computing device **600**, for example, a server computer in a distributed computing network, such as the Internet. As should be appreciated such data/information is accessible via the mobile computing device **600** via the radio **672** or via a distributed computing network. Similarly, according to an aspect, such data/information is readily transferred between computing devices for storage and use according to well-known data/information transfer and storage means, including electronic mail and collaborative data/information sharing systems.

[0047] **FIGURE 7** illustrates one example of the architecture of a system for restructuring a document **108** into a 3D space **116** as described above. Content developed, interacted with, or edited in association with the productivity application **104** is enabled to be stored in different communication channels or other storage types. For example, various documents may be stored using a directory service **722**, a web portal **724**, a mailbox service **726**, an instant messaging store **728**, or a social networking site **730**. The productivity application **104** is operative to use any of these types of systems or the like for restructuring a document **108** into a 3D space **116**, as described herein. According to an aspect, a server **720** provides the productivity application **104** to clients **705a,b,c**. As one example, the server **720** is a web server providing the productivity application **104** over the web. The server **720** provides the productivity application **104** over the web to clients **705** through a network **740**. By way of example, the client computing device is implemented and embodied in a personal computer **705a**, a tablet computing device **705b** or a mobile computing device **705c** (e.g., a smart phone), or other computing device. Any of these examples of the client computing device are operable to obtain content from the store **716**.

[0048] Implementations, for example, are described above with reference to block diagrams and/or operational illustrations of methods, systems, and computer program products according to aspects. The functions/acts noted in the blocks may occur out of the order as shown in any flowchart. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved.

[0049] The description and illustration of one or more examples provided in this application are not intended to limit or restrict the scope as claimed in any way. The aspects, examples, and details provided in this application are considered sufficient to convey possession and enable others to make and use the best mode. Implementations should not be construed as being limited to any aspect, example, or detail provided in this application. Regardless of whether shown and described in combination or separately, the various features (both structural and methodological) are intended to be selectively included or omitted to produce an example with a particular set of features. Having been provided with the description and illustration of the present application, one skilled in the art may envision variations, modifications, and alternate examples falling within the spirit of the broader aspects of the general inventive concept embodied in this application that do not depart from the broader scope.

CLAIMS

1. A computer-implemented method for improving user efficiency in utilizing a productivity application for viewing a document with spatial context, comprising:

receiving an indication of a selection to reconfigure the document into a three-dimensional (3D) space;

anchoring document content to a plurality of objects within the 3D space;

receiving an indication of a selection to present the document; and

displaying an animated view of the 3D space including a sequential display of the document content anchored to the plurality of objects along a virtual path through the 3D space.

2. The method of claim 1, wherein anchoring document content to a plurality of objects within the 3D space comprises linking a page of the document to a surface of an object.

3. The method of claim 2, wherein anchoring document content to a plurality of objects within the 3D space comprises linking a slide of a slide presentation document to a surface of an object.

4. The method of claim 1, wherein displaying an animated view of the 3D space comprises transitioning between sequential displays of document content via moving a virtual camera along the virtual path.

5. The method of claim 4, wherein transitioning between sequential displays of document content comprises displaying transitions between key frames of document content in the animated view of the 3D space.

6. The method of claim 1, wherein prior to anchoring document content to a plurality of objects within the 3D space:

displaying a plurality of 3D spaces from which a user is enabled to select; and

receiving a selection of a 3D space from the plurality of 3D spaces.

7. The method of claim 1, further comprising receiving a 3D space, wherein the 3D space is one of:

a collection of overlapping two-dimensional (2D) images that are reconstructed into a 3D model;

a recorded video capture; or

a computer-generated imagery (CGI) modeled environment.

8. A system for improving user efficiency in utilizing a productivity application for viewing a document with spatial context, the system comprising a computing device, the computing device comprising:

at least one processing device; and

at least one computer readable data storage device storing instructions that, when executed by the at least one processing device are operable to provide a productivity application, operative to:

receive an indication of a selection to reconfigure the document into a three-dimensional (3D) space;

anchor document content to a plurality of objects within the 3D space;

receive an indication of a selection to present the document; and

generate a display of an animated view of the 3D space including a sequential display of the document content anchored to the plurality of objects along a virtual path through the 3D space.

9. The system of claim 8, wherein the productivity application is further operative to:

display a plurality of 3D spaces from which a user is enabled to select; and

receive a selection of a 3D space from the plurality of 3D spaces.

10. The system of claim 8, wherein the 3D space is one of:

a collection of overlapping two-dimensional (2D) images that are reconstructed into a 3D model;

a recorded video capture; or

a computer-generated imagery (CGI) modeled environment.

11. The system of claim 8, wherein in anchoring document content to a plurality of objects within the 3D space, the productivity application is operative to anchor at least one of:

a document page;

textual content;

a chart;

a table;

an image; and

a video.

12. The system of claim 8, wherein:

the document is a slide presentation document; and

in anchoring document content to a plurality of objects within the 3D space, the productivity application is operative to anchor slides to a plurality of objects within the 3D space.

13. The system of claim 8, wherein in displaying an animated view of the 3D space, the productivity application is further operative to display transitions between sequential displays of document content, the transitions comprising movement of a virtual camera along the virtual path.

14. The system of claim 13, wherein the sequential displays of document content are key frames in the animated view of the 3D space.

15. A computer readable storage device including computer readable instructions, which when executed by a processing unit is operative to:

receive an indication of a selection to reconfigure the document into a three-dimensional (3D) space;

display a plurality of 3D spaces from which a user is enabled to select;

receive a selection of a 3D space from the plurality of 3D spaces;

anchor document content to a plurality of objects within the 3D space;

receive an indication of a selection to present the document; and

generate a display of an animated view of the 3D space including a sequential display of the document content anchored to the plurality of objects along a virtual path through the 3D space.

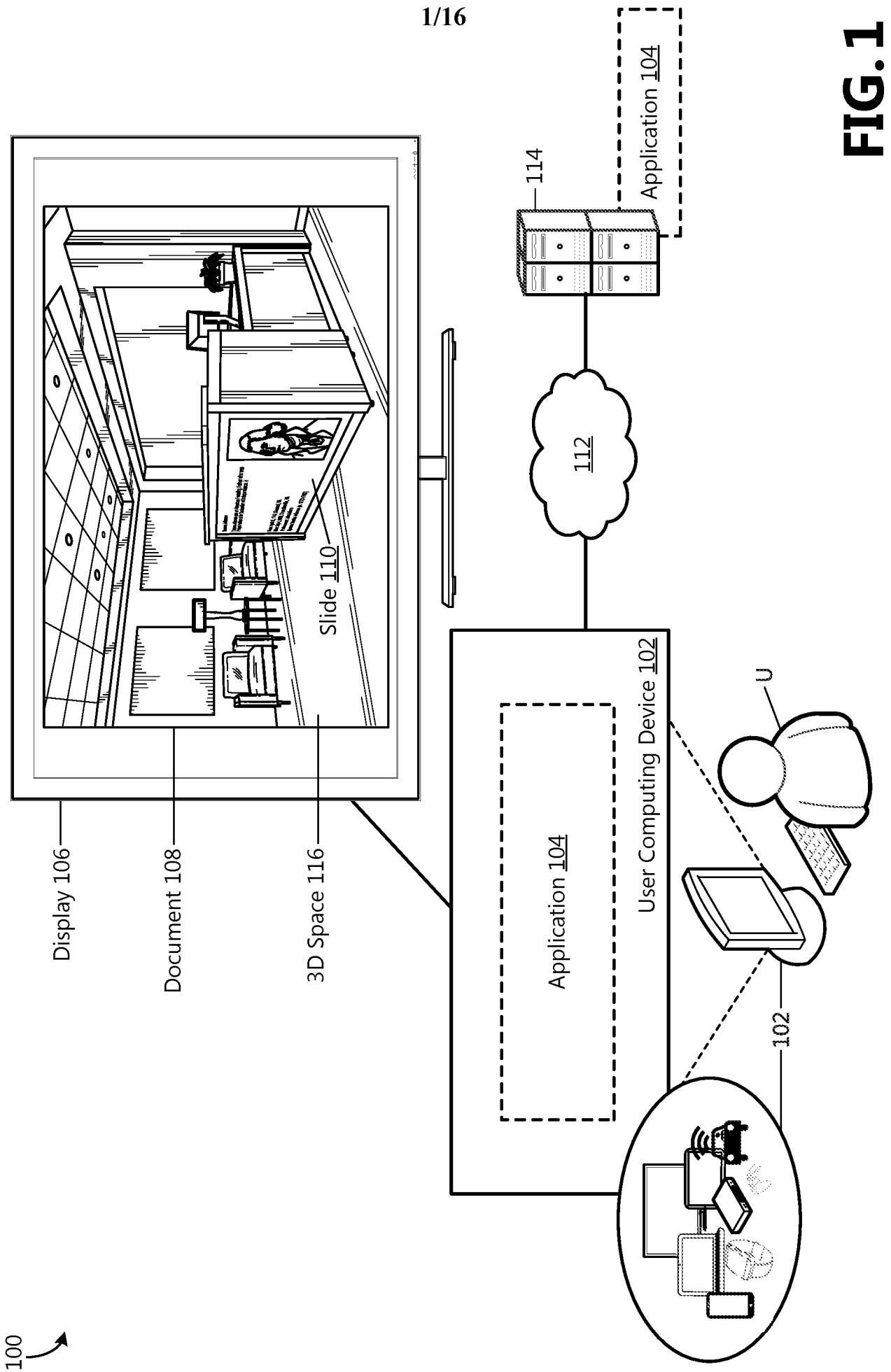
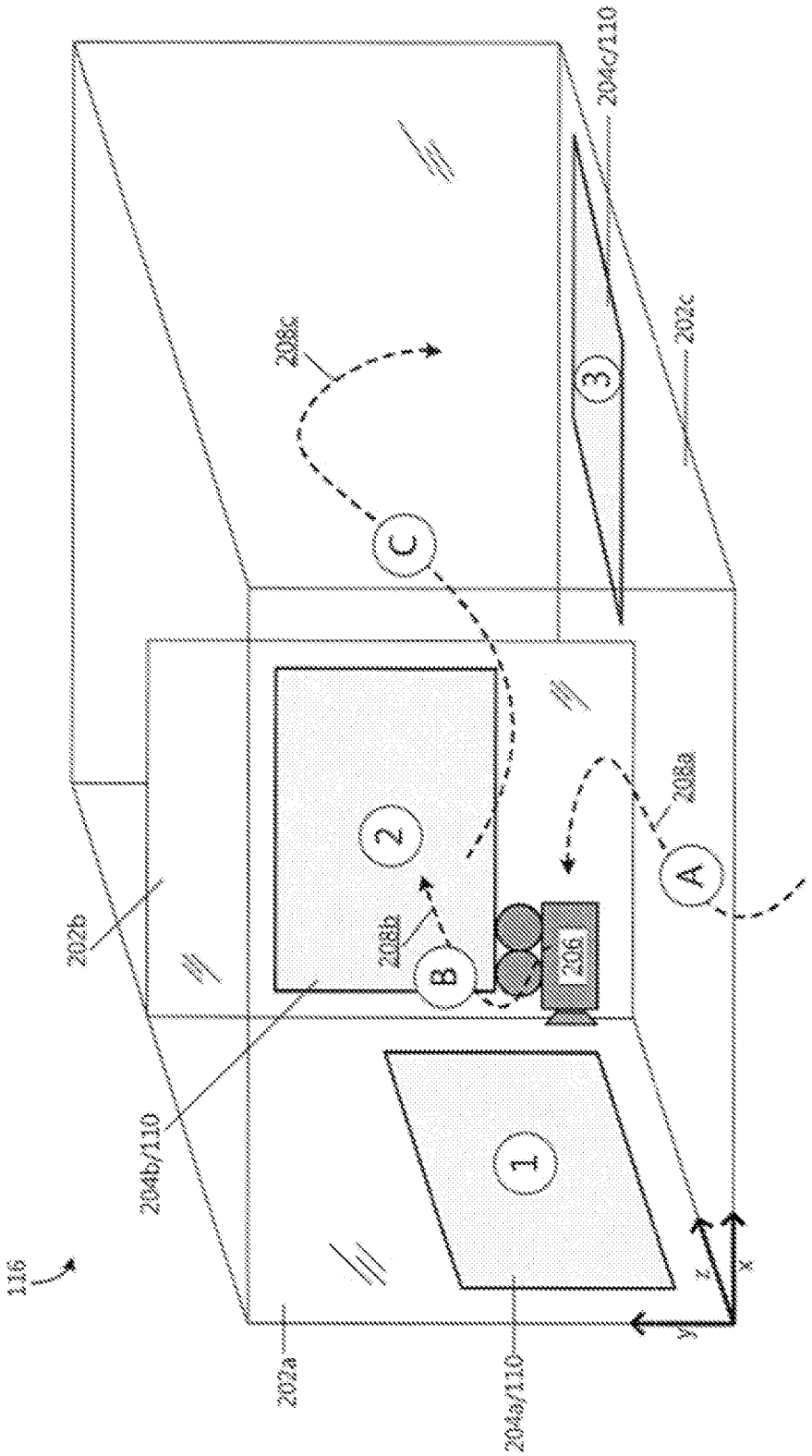

100
Display 106
Document 108
3D Space 116
Slide 110
Application 104
User Computing Device 102
112
114
Application 104
U
102

FIG. 1

FIG. 2


116
202a
202b
202c
204a/110
204b/110
204c/110
206
208a
208b
208c
A
B
C
1
2
3
x
y
z

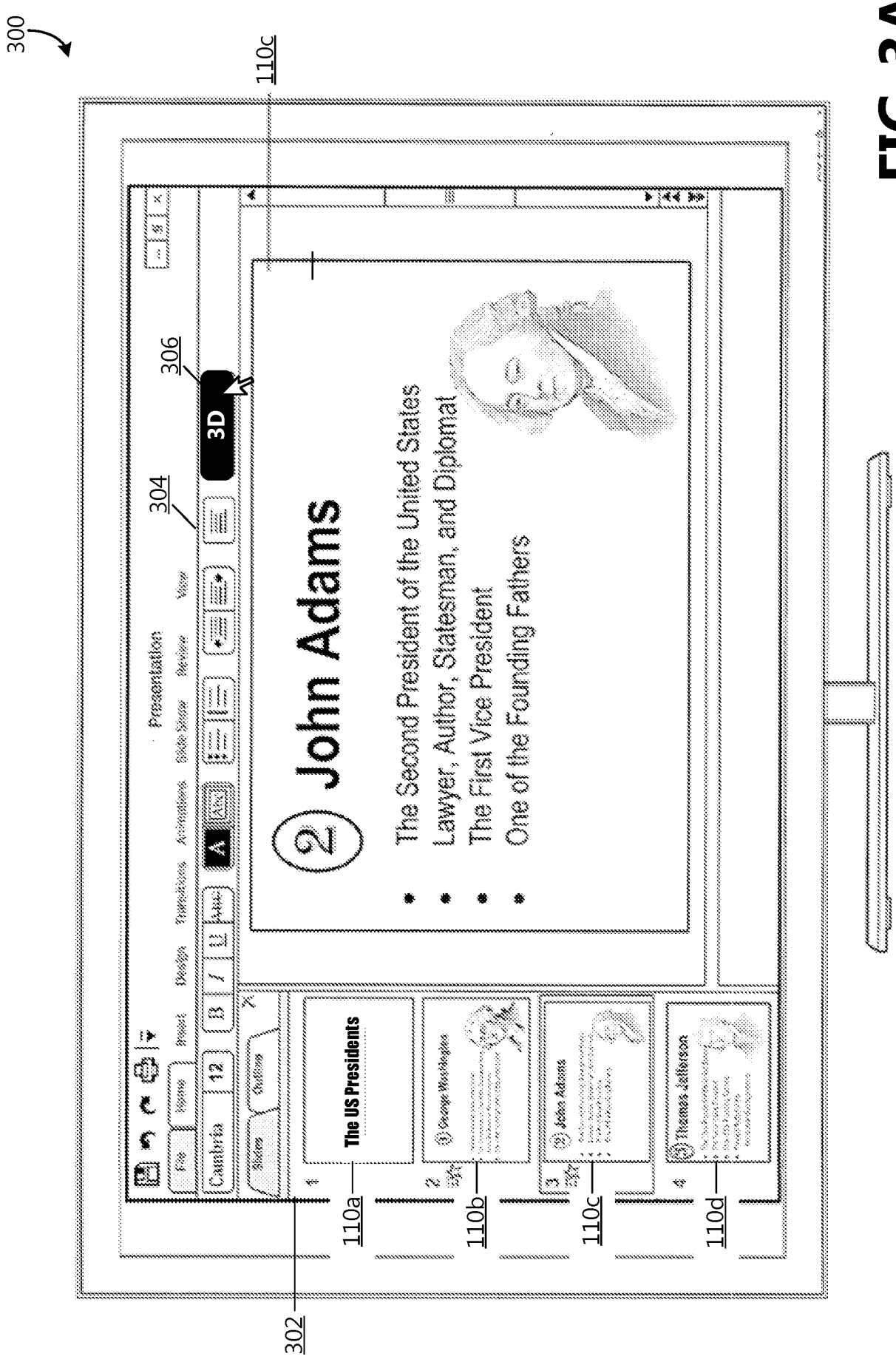

300
110c
306
304
3D
2 John Adams
The Second President of the United States
Lawyer, Author, Statesman, and Diplomat
The First Vice President
One of the Founding Fathers
The US Presidents
110a
110b
110c
110d
302

FIG. 3A

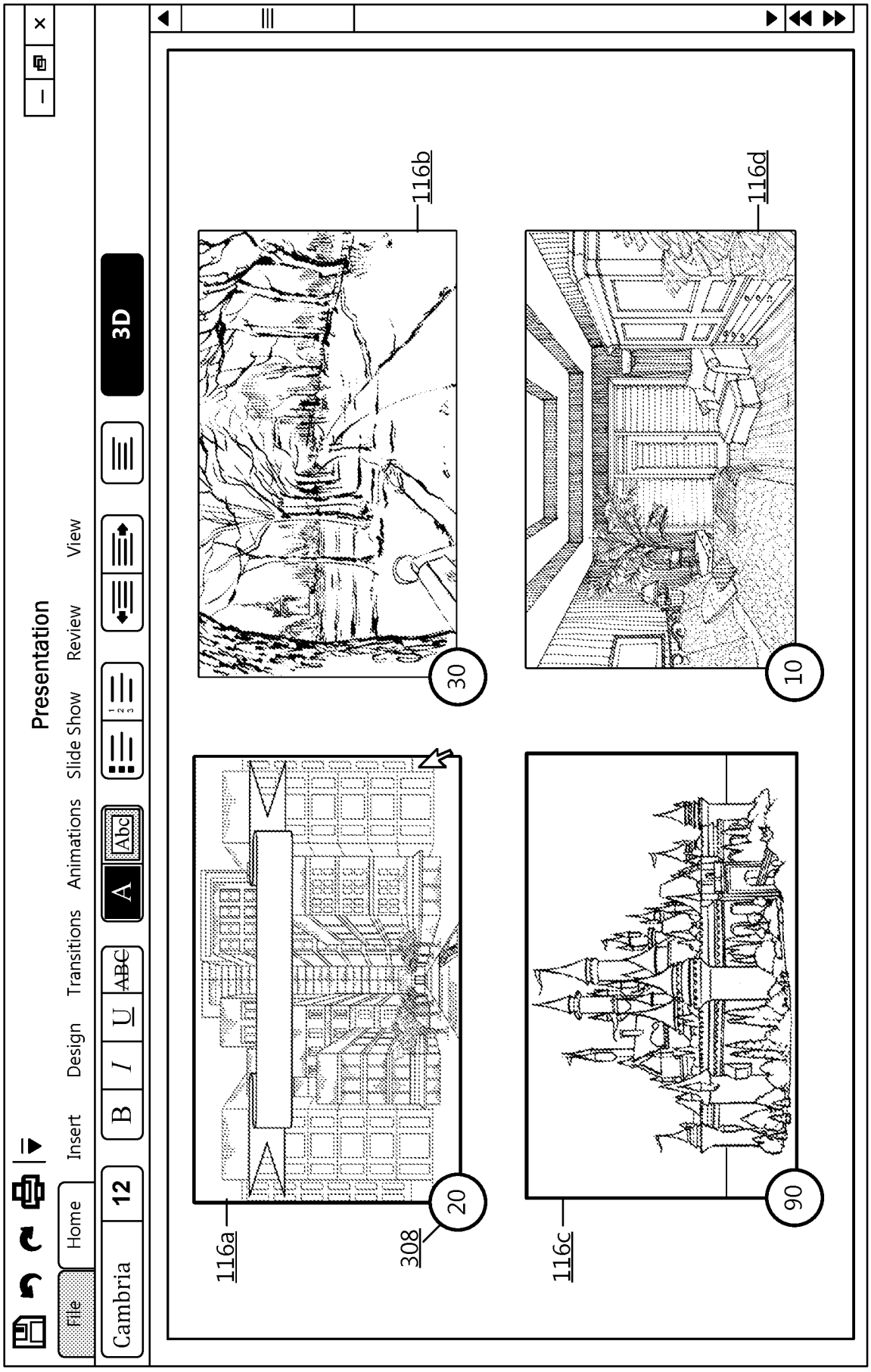

Presentation
File
Home
Insert
Design
Transitions
Animations
Slide Show
Review
View
Cambria
12
3D
116a
308
20
116b
30
116c
90
116d
10

FIG. 3B

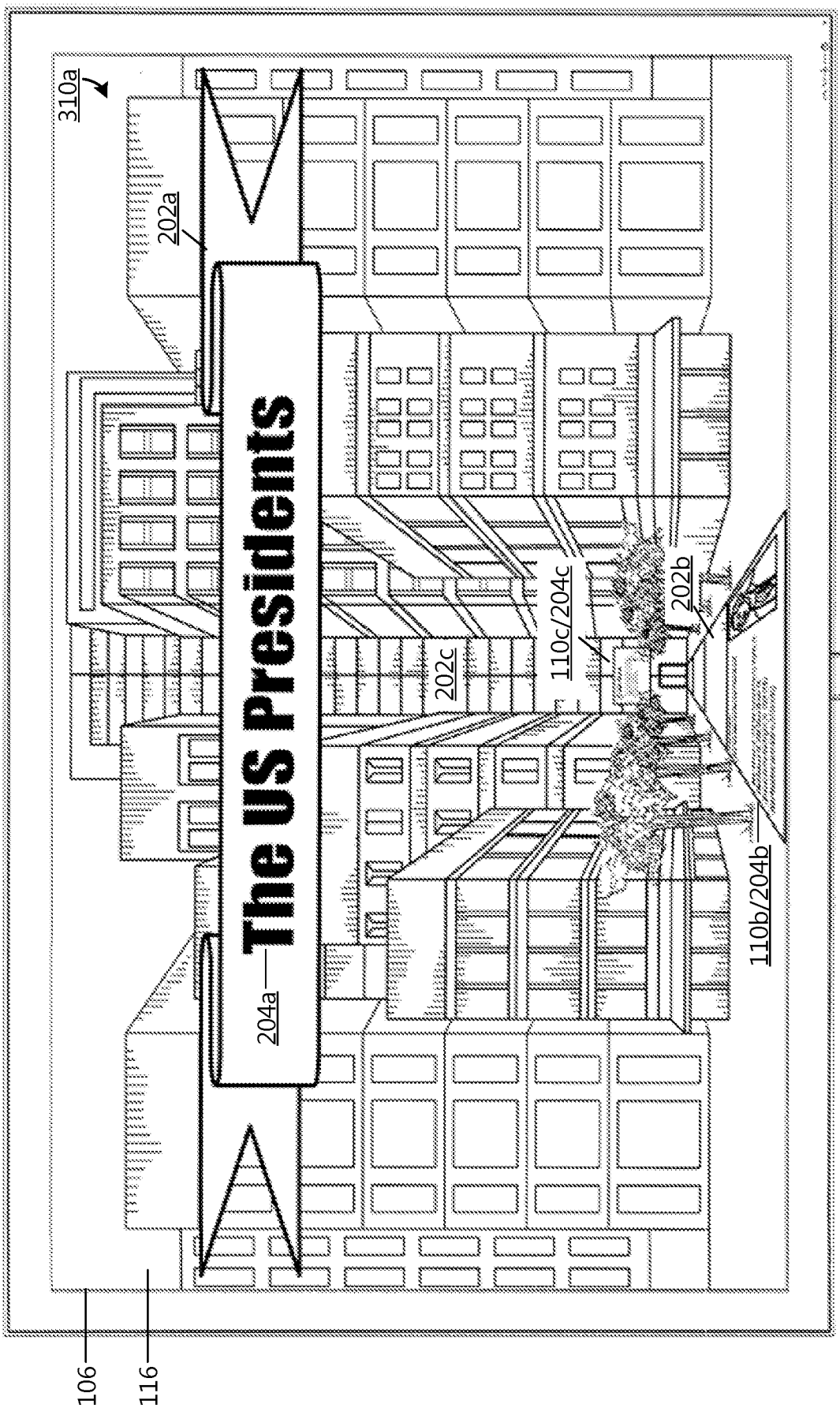

310a
202a
The US Presidents
204a
202c
110c/204c
202b
110b/204b
106
116

FIG. 3C

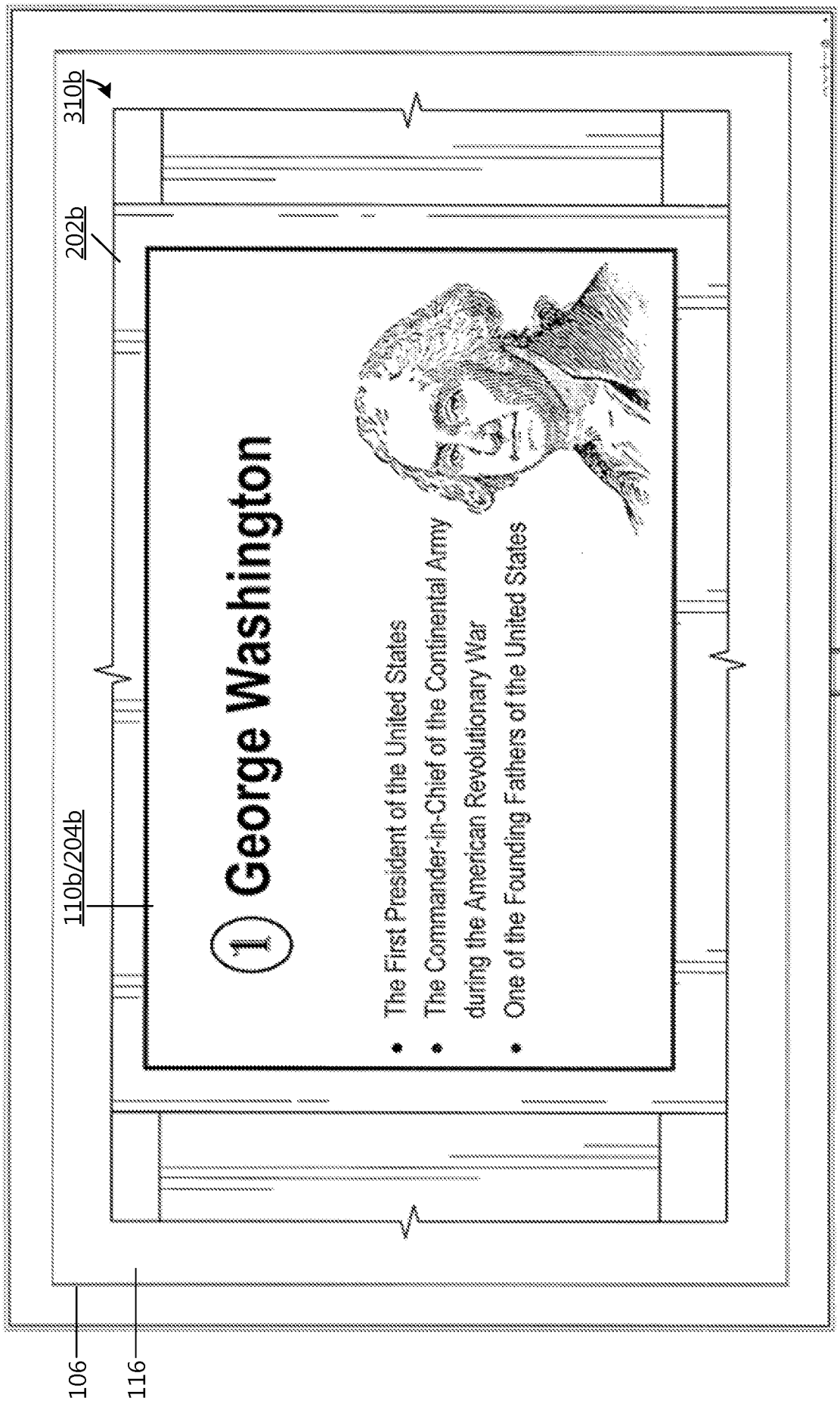

106
116
110b/204b
202b
310b
1 George Washington
The First President of the United States
The Commander-in-Chief of the Continental Army during the American Revolutionary War
One of the Founding Fathers of the United States

FIG. 3D

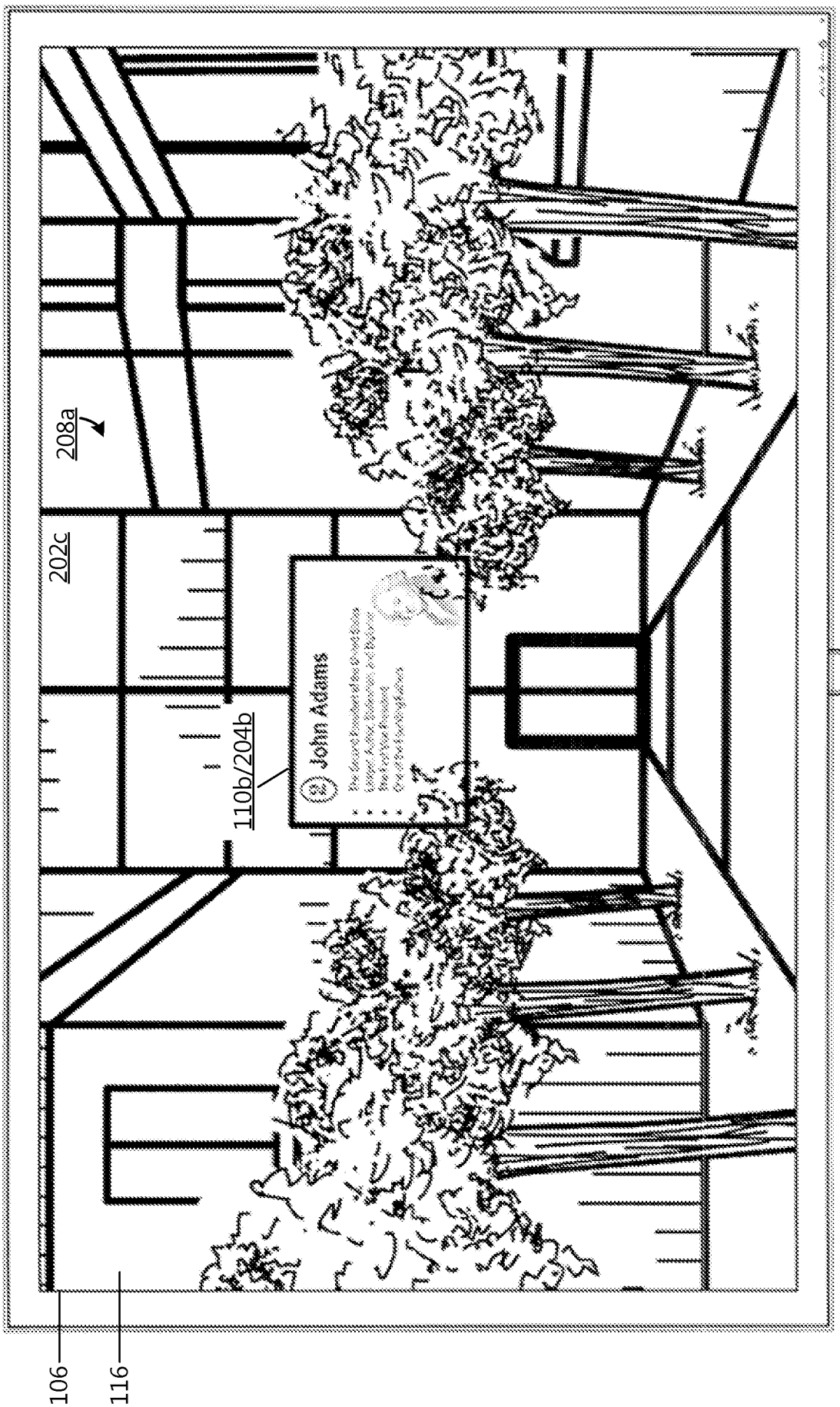


FIG. 3E

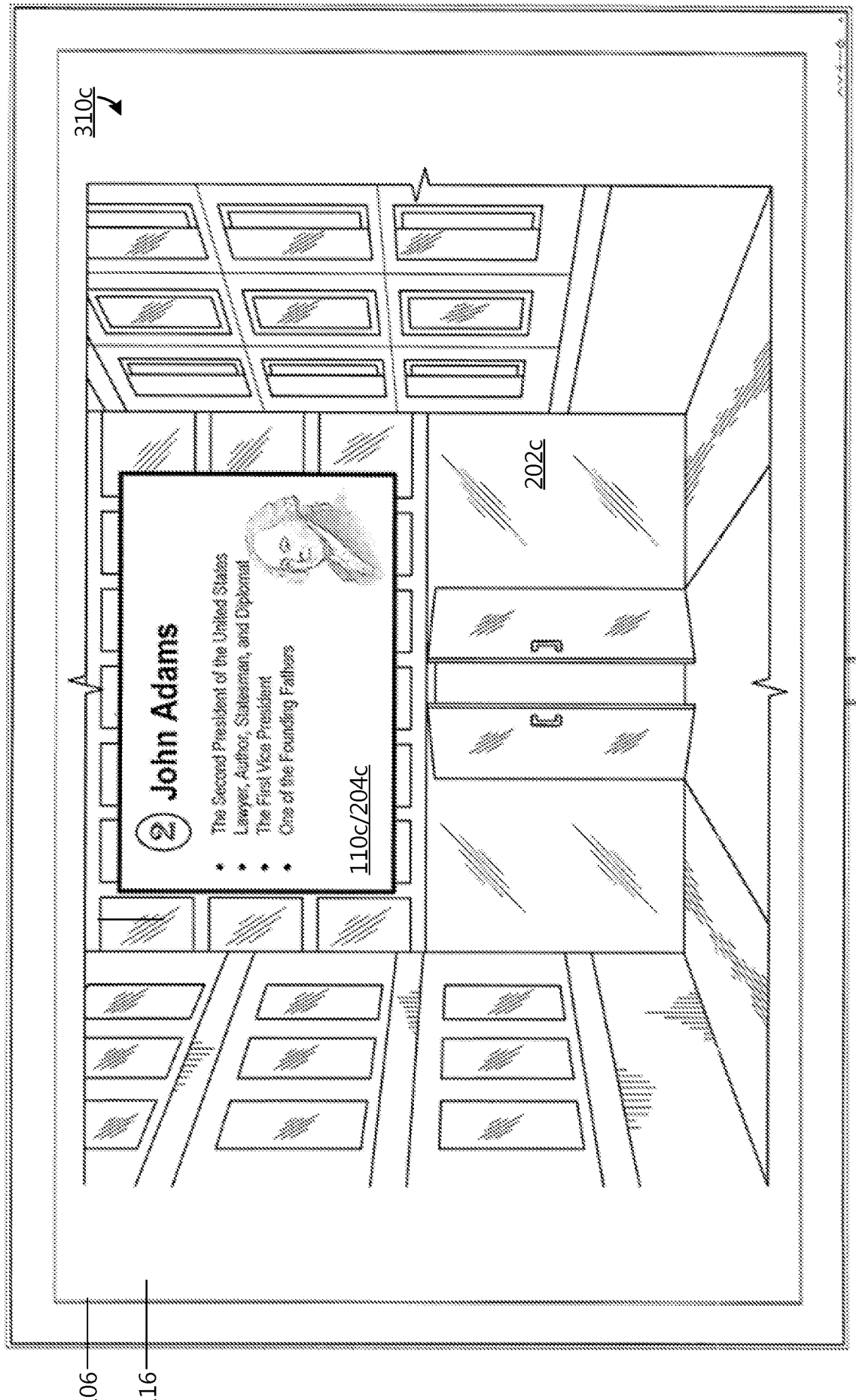

310c
202c
② John Adams
The Second President of the United States
Lawyer, Author, Statesman, and Diplomat
The First Vice President
One of the Founding Fathers
110c/204c
106
116

FIG. 3F

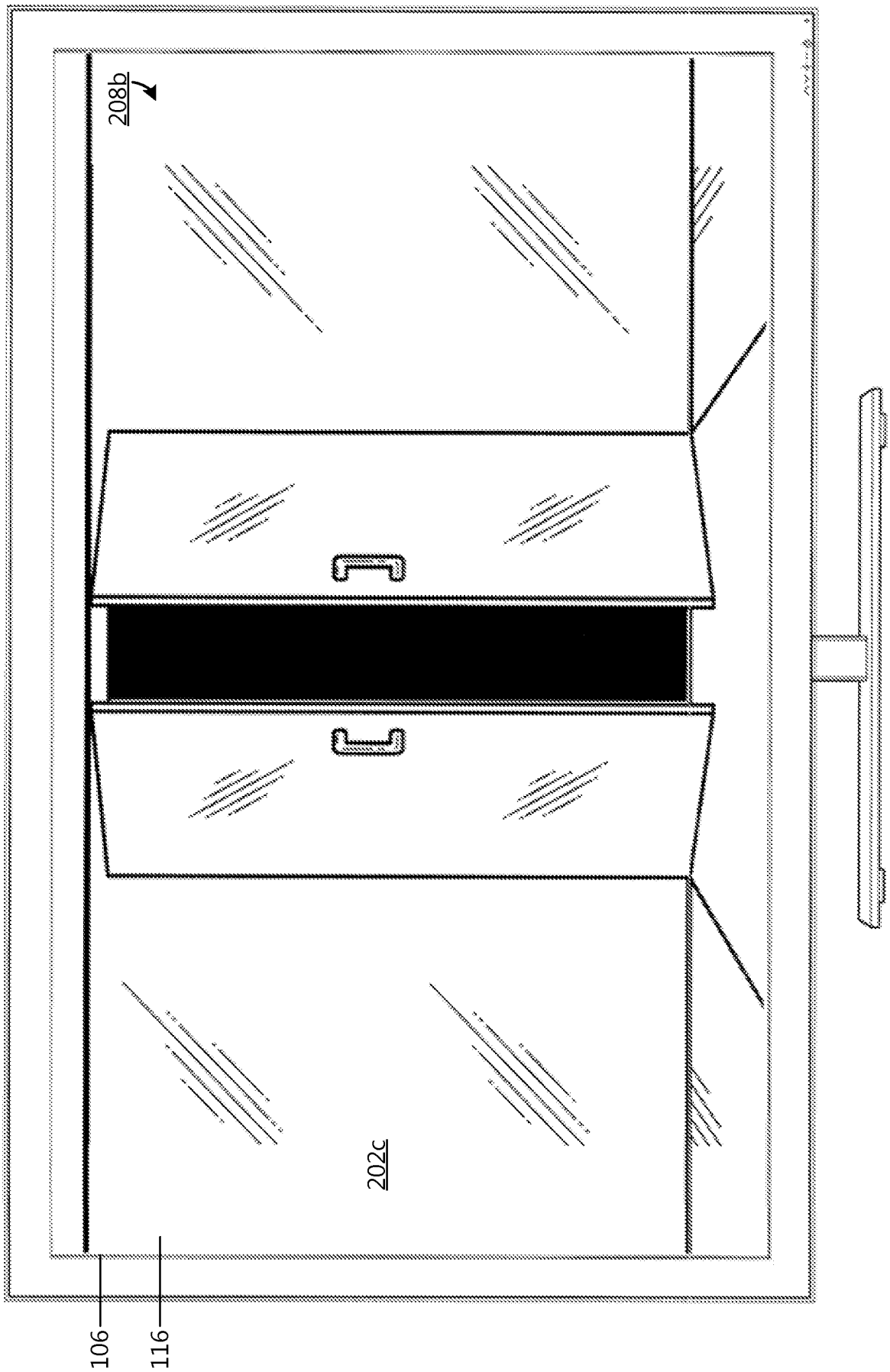


FIG. 3G

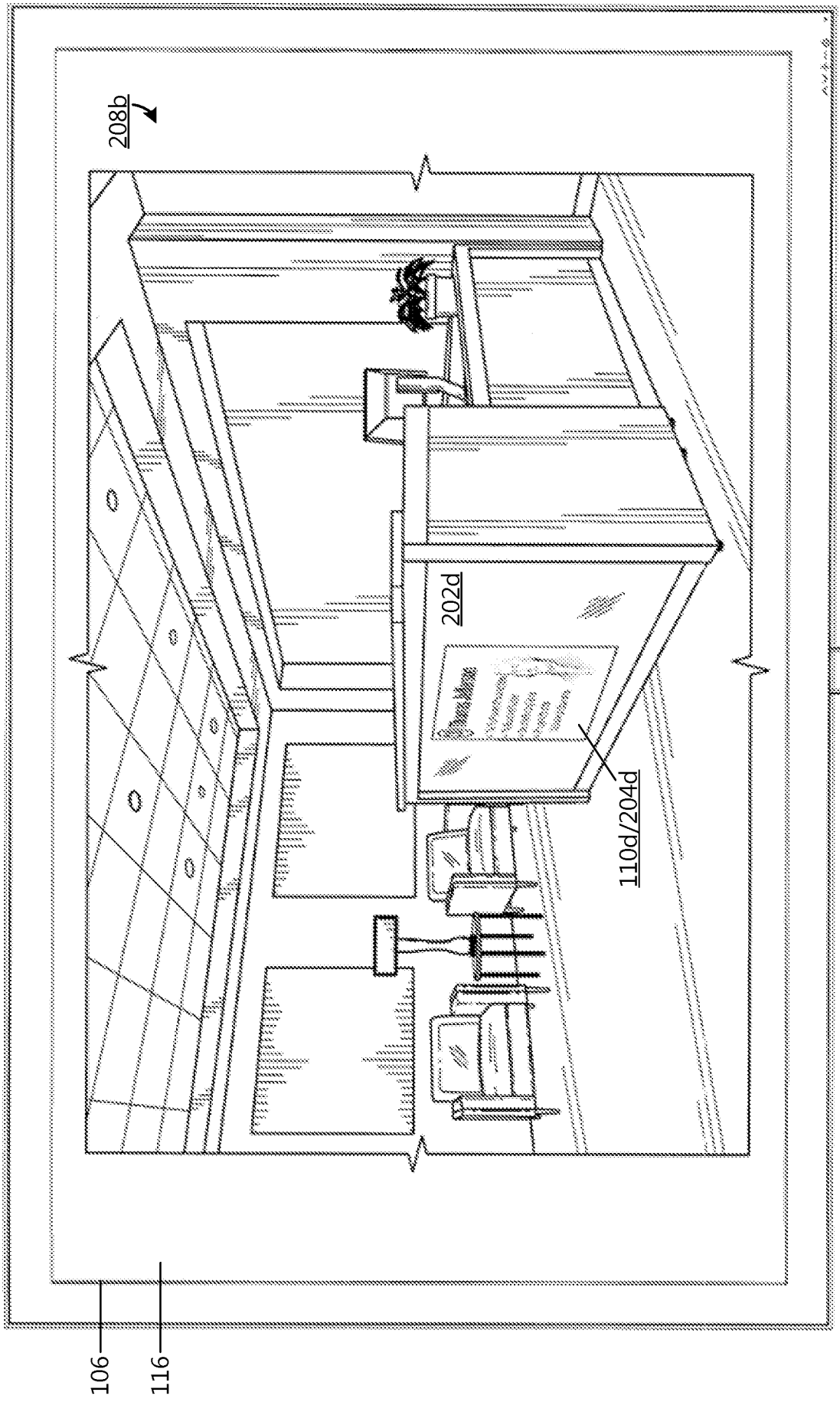


FIG. 3H

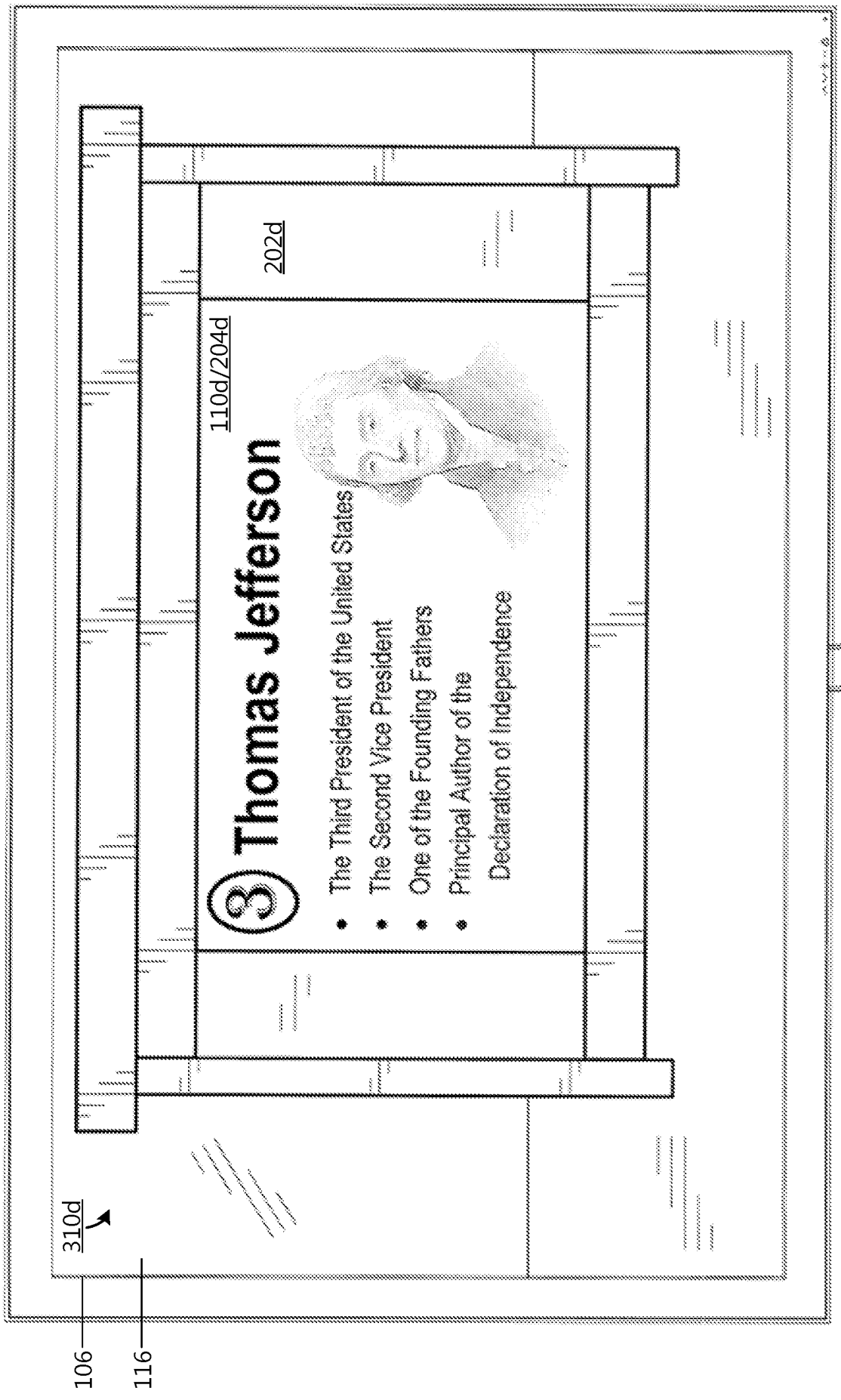

106
116
310d
202d
110d/204d
3 Thomas Jefferson
The Third President of the United States
The Second Vice President
One of the Founding Fathers
Principal Author of the Declaration of Independence

FIG. 3I

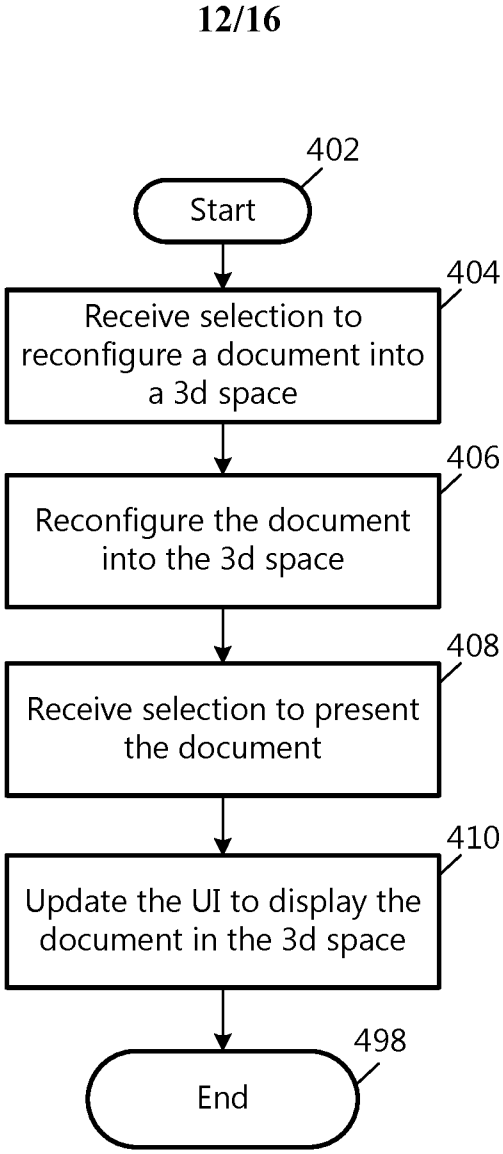

400
402
Start
404
Receive selection to reconfigure a document into a 3d space
406
Reconfigure the document into the 3d space
408
Receive selection to present the document
410
Update the UI to display the document in the 3d space
498
End

FIG. 4

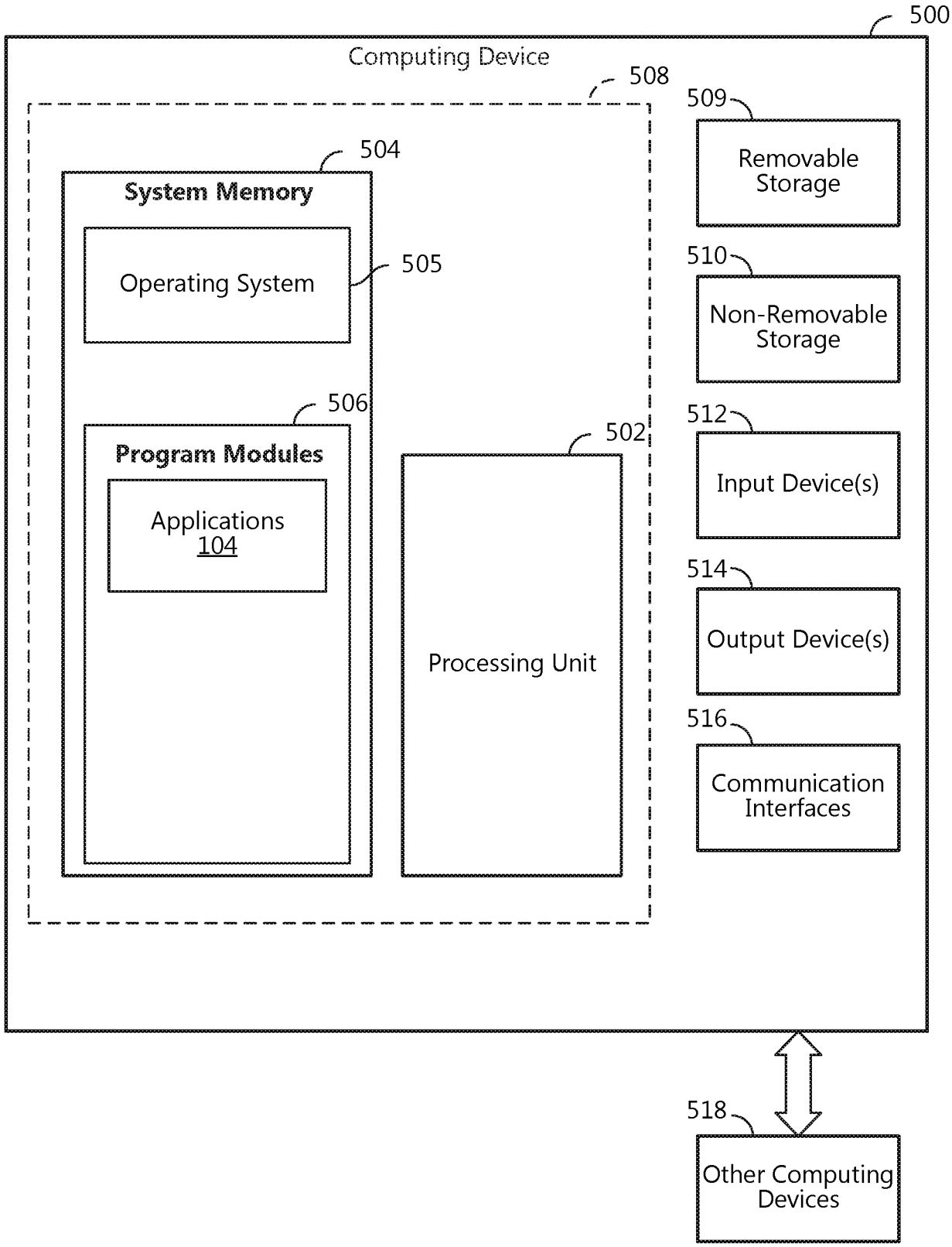
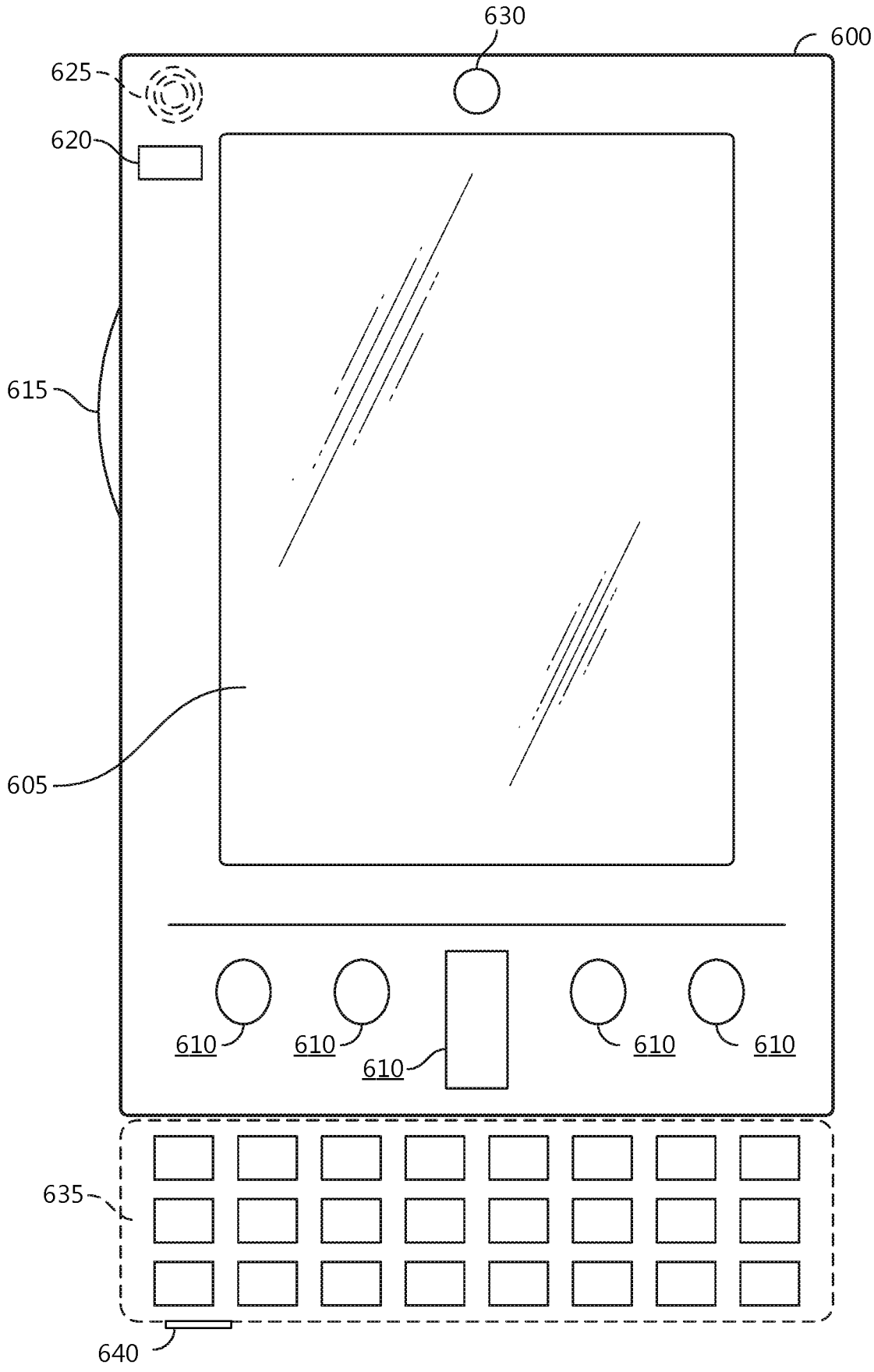

500
Computing Device
508
509
Removable Storage
504
System Memory
Operating System
505
510
Non-Removable Storage
506
Program Modules
Applications 104
502
512
Input Device(s)
514
Output Device(s)
Processing Unit
516
Communication Interfaces
518
Other Computing Devices

FIG. 5



MOBILE COMPUTING DEVICE

FIG. 6A

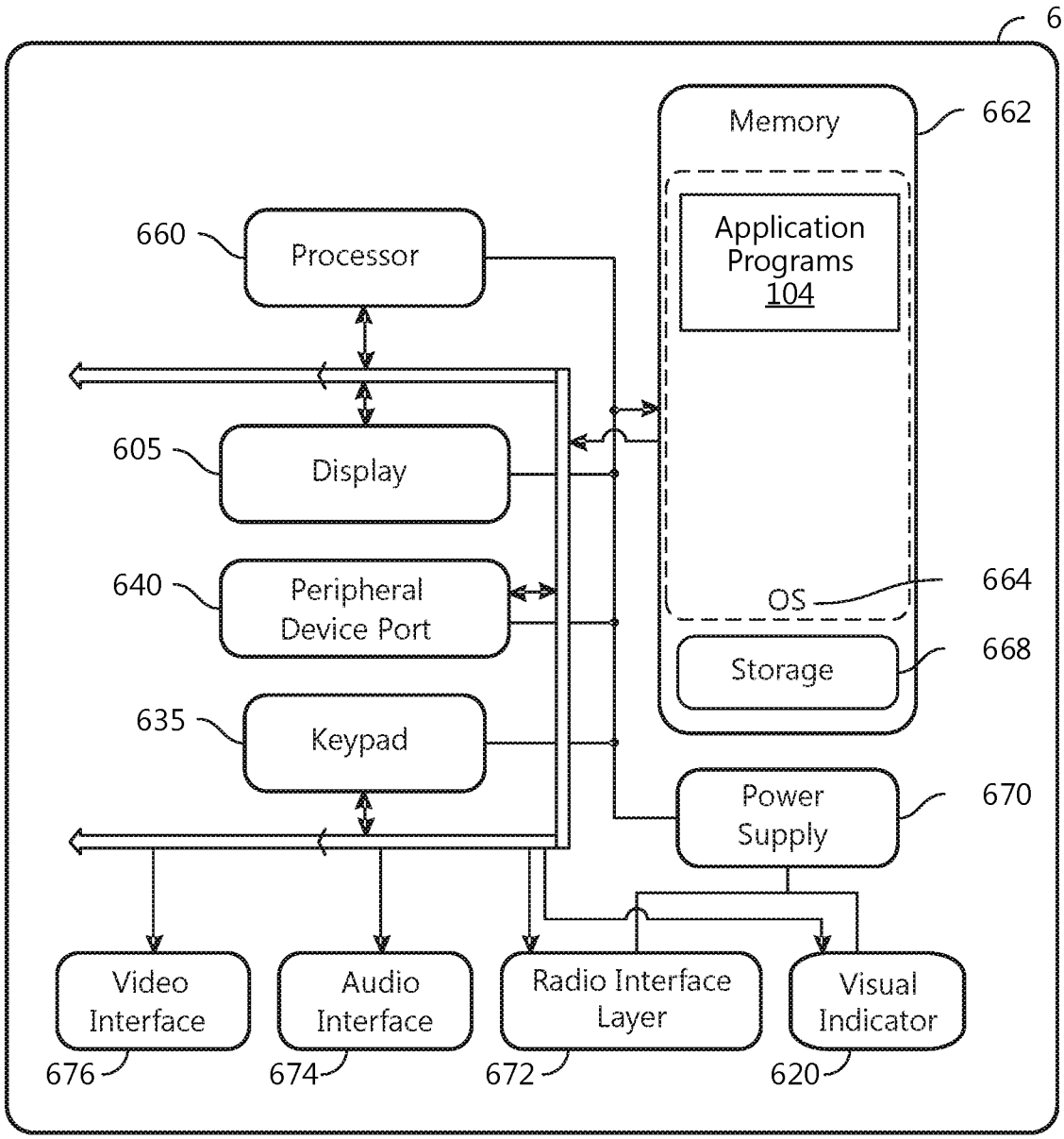

602
Memory
662
Application Programs 104
660
Processor
605
Display
640
Peripheral Device Port
OS
664
Storage
668
635
Keypad
Power Supply
670
Video Interface
Audio Interface
Radio Interface Layer
Visual Indicator
676
674
672
620

FIG. 6B

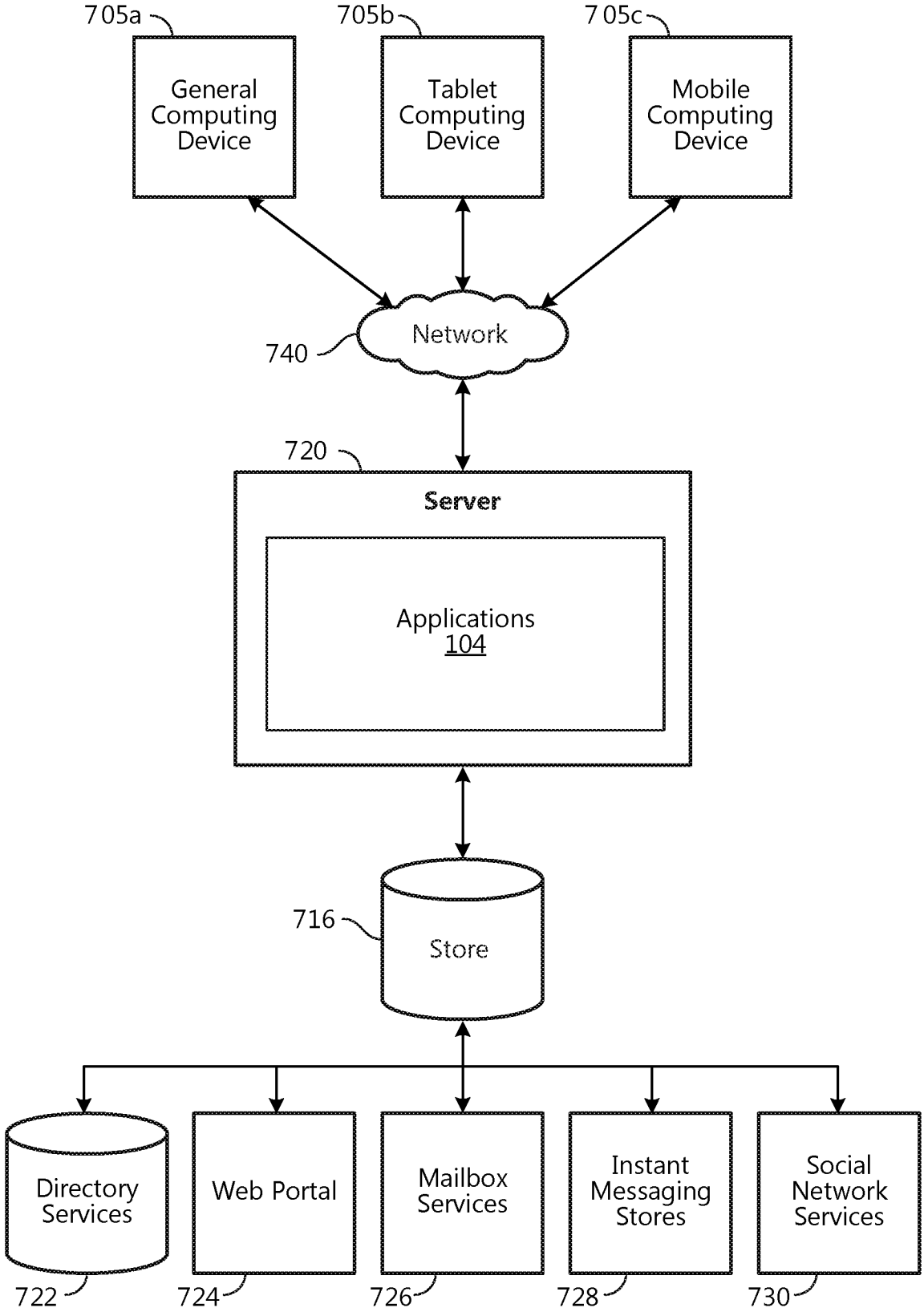

705a
General Computing Device
705b
Tablet Computing Device
705c
Mobile Computing Device
Network
740
720
Server
Applications
104
716
Store
Directory Services
722
Web Portal
724
Mailbox Services
726
Instant Messaging Stores
728
Social Network Services
730

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/036027

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09B5/02 G06T15/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09B G06T

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/267248 A1 (ZOU LINCAN [US] ET AL) 18 September 2014 (2014-09-18) paragraph [0021] paragraph [0025] paragraph [0027] -----	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 August 2017	09/08/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hanon, David

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/036027

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014267248 A1	18-09-2014	EP 2973426 A1	20-01-2016
		US 2014267248 A1	18-09-2014
		WO 2014159285 A1	02-10-2014