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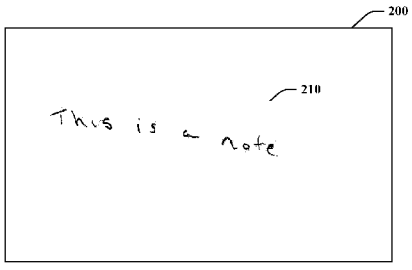

FIG. 2A

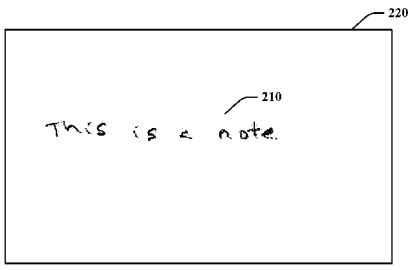

FIG. 2B

(57) Abstract: Described herein is a system and method for visually enhancing digital ink of an electronic document. A trigger to visually enhance digital ink of portion(s) of the electronic document is received. In response to the received trigger, the digital ink of portion(s) of the electronic document to determine a semantic structure of the digital ink in response to the received trigger. The digital ink of the portion(s) of the electronic document are visually enhanced in accordance with the determined semantic structure. Visual enhancement can include horizontal line adjustment, aligning line(s), aligning word in a particular line using a baseline, adjusting vertical spacing of lines, paragraphs, and/or lists, adjusting spacing between words and/or list items in a particular line, modifying ink styling (e.g., ink size, ink thickness, ink color), adjusting sizing of characters in a same group, unifying ink color, and/or unifying ink thickness.

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VISUALLY ENHANCED DIGITAL INK

BACKGROUND

[0001] With increasing frequency, computer users can add digital ink (electronic ink) to electronic documents. For example, a stylus or electronic pen can be used to write on an electronic input screen to add digital ink to a document. Many times, users create electronic notes with digital ink in a hurried manner and/or disorganized manner.

SUMMARY

[0002] Described herein is a system for visually enhancing digital ink of an electronic document, comprising: a processing system comprising a processor and a memory having computer-executable instructions stored thereupon which, when executed by the processor, cause the computer to: receive a trigger to visually enhance digital ink of at least a portion of the electronic document; analyze the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger; visually enhance the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and provide the visually enhanced digital ink of the at least the portion of the electronic document.

[0003] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Fig. 1 is a functional block diagram that illustrates a system for visually enhancing digital ink of an electronic document.

[0005] Figs. 2A-11 are exemplary user interfaces that illustrate exemplary visual enhancements to digital ink.

[0006] Fig. 12 is a functional block diagram that illustrates a system for displaying digital ink of an electronic document.

[0007] Fig. 13 is a flow chart that illustrates a method of visually enhancing digital ink of an electronic document.

[0008] Fig. 14 is a flow chart that illustrates a method of visually enhancing digital ink of an electronic document.

[0009] Fig. 15 is a flow chart that illustrates a method of visually enhancing digital ink of an electronic document.

[0010] Fig. 16 is a functional block diagram that illustrates an exemplary computing system.

DETAILED DESCRIPTION

[0011] Various technologies pertaining to visual enhancing digital ink of electronic document(s) are now described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more aspects. It may be evident, however, that such aspect(s) may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to facilitate describing one or more aspects. Further, it is to be understood that functionality that is described as being carried out by certain system components may be performed by multiple components. Similarly, for instance, a component may be configured to perform functionality that is described as being carried out by multiple components.

[0012] The subject disclosure supports various products and processes that perform, or are configured to perform, various actions regarding visually enhancing digital ink of electronic document(s). What follows are one or more exemplary systems and methods.

[0013] Aspects of the subject disclosure pertain to the technical problem of displaying digital ink. The technical features associated with addressing this problem involve receive a trigger to visually enhance digital ink of a portion of an electronic document. In response to the received trigger, the digital ink of the portion of the electronic document is analyzed to determine a semantic structure of the digital ink. The digital ink of the portion of the electronic document is visually enhanced in accordance with the determined semantic structure. The visually enhanced digital ink of the portion of the electronic document is provided (e.g., displayed). Accordingly, aspects of these technical features exhibit technical effects of more efficiently and effectively displaying digital ink thus reducing computer resource(s) and/or increasing user satisfaction.

[0014] Moreover, the term “or” is intended to mean an inclusive “or” rather than an exclusive “or.” That is, unless specified otherwise, or clear from the context, the phrase “X employs A or B” is intended to mean any of the natural inclusive permutations. That is, the phrase “X employs A or B” is satisfied by any of the following instances: X employs

A; X employs B; or X employs both A and B. In addition, the articles "a" and "an" as used in this application and the appended claims should generally be construed to mean "one or more" unless specified otherwise or clear from the context to be directed to a singular form.

[0015] As used herein, the terms "component" and "system," as well as various forms thereof (e.g., components, systems, sub-systems, etc.) are intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component may be, but is not limited to being, a process running on a processor, a processor, an object, an instance, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a computer and the computer can be a component. One or more components may reside within a process and/or thread of execution and a component may be localized on one computer and/or distributed between two or more computers. Further, as used herein, the term "exemplary" is intended to mean serving as an illustration or example of something, and is not intended to indicate a preference.

[0016] Ink (also called "digital ink" or "electronic ink") comprises a sequence or set of handwritten strokes. A sequence of strokes may include strokes in an ordered form. The sequence may be ordered in any suitable manner, such as by the time the stroke was captured and/or by where the stroke appears on a page. Other orders are possible.

[0017] With increasing frequency, computer users are using their computer systems for digital notetaking using an electronic pen or stylus. These notes can be taken casually or quickly resulting in content that is not well-organized and/or easy to follow.

[0018] Described herein are techniques for visually enhancing digital ink within an electronic document. In some embodiments, the techniques can be triggered explicitly by a user and/or inferred based upon user-configurable setting(s) and/or a particular user's previous history. In response to the trigger, the digital ink is analyzed to determine a semantic structure.

[0019] The digital ink of the electronic document can be visually enhanced in accordance with the determined semantic structure of the digital ink. In some embodiments, visual enhancement can include adjusting digital ink to be displayed horizontally, aligning line(s), aligning word in a particular line using a baseline, adjusting vertical spacing of lines, paragraphs, and/or lists, adjusting spacing between words and/or list items in a particular line, modifying ink styling (e.g., ink size, ink thickness, ink color), adjusting sizing of characters in a same group, unifying ink color, and/or unifying ink

thickness.

[0020] In some embodiments, the determined semantic structure can further be utilized to modify display of the digital ink based upon display characteristic(s) of a particular device. For example, digital ink created on a display of a laptop may not be displayed conveniently on a tablet device causing a user to pan-and-zoom many times to read a particular page of the document. Using the determined semantic structure and the display characteristic(s) (e.g., display size of a target device), display of the digital ink can be modified. In some embodiments, digital ink of a particular line can be re-flowed onto another line in order to enhance the user's viewing experience. In some embodiments, display of secondary content (e.g., annotation(s), comment(s) and/or callout(s)) can be modified, for example, moved to another display location and/or minimized from view.

[0021] Referring to Fig. 1, a system for visually enhancing digital ink of an electronic document 100 is illustrated. In some embodiments, the system 100 can be utilized to visually enhance digital ink, while keeping ink as ink, that is, without converting the digital ink to a textual representation.

[0022] The system 100 includes a trigger component 110 that receives a trigger to visually enhance digital ink within at least a portion of the electronic document. In some embodiments, the trigger is an explicit command invoked by a user (e.g., visual enhancement control displayed in ribbon of application). In some embodiments, the trigger is inferred based upon user-configurable setting(s). For example, a user can configure the trigger component 110 to trigger visual enhancement based upon expiration of a predetermined period of time, a predetermined period of user inactivity time, and/or a predetermined quantity of digital ink on the electronic document. In some embodiments, the trigger is inferred based upon a particular user's previous history of visually enhancing digital ink within electronic documents.

[0023] In some embodiments, digital ink within an entire document is visually enhanced. In some embodiments, digital ink of a predetermined portion of an electronic document is visually enhanced (e.g., a page). In some embodiments, digital ink of a user-selected portion of an electronic document is visually enhanced (e.g., user employs lasso-type selection mechanism to select digital ink to be visually enhanced).

[0024] The system 100 further include a semantic analysis component 120 that, in response to the received trigger, analyzes the digital ink of the portion of the electronic document to determine a semantic structure of the digital ink of the portion of the electronic document. In some embodiments, the semantic analysis component 120 can first

perform classification analysis to determine the type(s) of strokes included in the specific input data (e.g., whether individual strokes or stroke sets represent flow diagrams, freeform drawings, text, music, mathematics, charts, graphs, etc.). In some embodiments, the semantic analysis component 120 can utilize a parse tree which is a data structure representing the structure of the electronic document with the electronic document parsed into blocks, lines, words, and/or individual strokes.

[0025] In some embodiments, the semantic analysis component 120 can further employ one or more parse engines, for example, with each focusing on a particular task. In some embodiments, the semantic analysis component 120 can include individual parse engines for temporal line grouping, spatial block grouping, spatial line grouping, list detection, and/or spatial word grouping. In some embodiments, a parse engine takes a parse tree data structure as input and modifies it (if appropriate) to produce a parse tree with a different data structure, which in turn may be passed along as input to the next parse engine. Thus, the semantic analysis component 120 can ascertain certain information relating to the layout of ink strokes within the portion of the electronic document.

[0026] In some embodiments, the semantic analysis component 120 can perform layout analysis to combine and parse individual input strokes into associated stroke sets, such as words, lines, blocks, and/or other groupings . Based upon the layout analysis and the classification analysis, the semantic component 120 can determine a semantic structure of the digital ink of the portion of the document. In some embodiments, the semantic structure further includes identifying digital ink comprising secondary content (e.g., annotations and/or callouts).

[0027] The system 100 includes a visual enhancement component 130 that visually enhances the digital ink of the electronic document in accordance with the determined semantic structure. The system 100 further includes an output component 140 that provides (e.g., displays) the visually enhanced digital ink of the electronic document. In some embodiments, the output component 140 can further store the visually enhanced digital ink of the electronic document.

[0028] In some embodiments, visual enhancement can include horizontal line adjustment, aligning line(s), aligning word in a particular line using a baseline, adjusting vertical spacing of lines, paragraphs, and/or lists, adjusting spacing between words and/or list items in a particular line, modifying ink styling (e.g., ink size, ink thickness, ink color), adjusting sizing of characters in a same group, unifying ink color, and/or unifying ink thickness. In some embodiments, one or more template(s) can be utilized that define visual

enhancement setting(s), for example, based upon common combination(s), user-configurable setting(s), user history with the system 100, group(s), and/or entity(ies).

[0029] By way of explanation and not limitation Figs. 2-11 illustrate exemplary visual enhancements to digital ink by the system 100. Fig. 2A is a user interface 200 that illustrates digital ink 210. In this example, the digital ink 210 has been entered at an angle off of horizontal. Fig. 2B illustrates a user interface 220 in which digital ink 210 has been visually enhanced by the system 100 to be substantially horizontal.

[0030] Fig. 3A is a user interface 300 that illustrates a digital ink 310 comprising two lines of non-aligned ink. Fig. 3B illustrates a user interface 320 in which the digital ink 310 has been visually enhanced by the system 100 to be left aligned.

[0031] Fig. 4A is a user interface 400 that illustrates a digital ink 410 comprising a handwritten note. Fig. 4B illustrates a user interface 420 in which the digital ink 410 has been visually enhanced by the system 100 in which the words in the same line are auto-aligned by a same baseline.

[0032] Fig. 5A is a user interface 500 that illustrates a digital ink 510 comprising two paragraphs. Fig. 5B illustrates a user interface 520 in which the digital ink 510 has been visually enhanced by the system 100 to include vertical spacing between the two paragraphs.

[0033] Fig. 6A is a user interface 600 that illustrates a digital ink 610 comprising a lines of ink. Fig. 6B illustrates a user interface 620 in which the digital ink 610 has been visually enhanced by the system 100 to include auto-spacing between words and/or list items in a same line horizontally.

[0034] Fig. 7A is a user interface 700 that illustrates a digital ink 710 comprising two lines of ink. Fig. 7B illustrates a user interface 720 in which the digital ink 710 has been visually enhanced by the system 100 to include auto-ink styling based on ink size, thickness, and/or color (e.g., underlining, heading, italics, highlighting).

[0035] Fig. 8A is a user interface 800 that illustrates a digital ink 810 comprising a line of ink. Fig. 8B illustrates a user interface 820 in which the digital ink 810 has been visually enhanced by the system 100 to auto-size characters in a same group.

[0036] Fig. 9A is a user interface 900 that illustrates a digital ink 810 comprising a line of ink. Fig. 9B illustrates a user interface 920 in which the digital ink 910 has been visually enhanced by the system 100 to unify ink thickness and/or coloring.

[0037] Fig. 10A is a user interface 1000 that illustrates a digital ink 1110 comprising two lines of ink. Fig. 10B illustrates a user interface 1020 in which the digital

ink 1010 has been visually enhanced by the system 100 with manual user input (e.g., to vertically align).

[0038] Turning to Fig. 11, a user interface 1100 that a plurality of exemplary user controls that can be invoked to trigger visual enhancement of digital ink (e.g., selected portion, page, and/or document). By way of explanation and not limitation, the user interface 1100 nine controls. A first control 1104 invokes the system 100 to left align the digital ink. A second control 1108 invokes the system 100 to center the digital ink. A third control 1112 invokes the system 100 to left alight the digital ink.

[0039] A fourth control 1116 invokes the system 100 to indent right the digital ink. A fifth control 1120 invokes the system 100 to indent left the digital ink. A sixth control 1124 invokes the system 100 to spatially align words.

[0040] A seventh control 1128 invokes the system 100 to create a bullet point list using the digital ink. An eighth control 1132 invokes the system 100 to rotate the digital ink. A ninth control 1136 invokes the system 100 to visually enhance the digital ink (e.g., based on default setting(s) and/or user-configurable setting(s)).

[0041] Turning to Fig. 12, a system for displaying digital ink of an electronic document 1200 is illustrated. The system 1200 includes a display enhancement component 120 that can employ the determined semantic structure provided by the semantic analysis component 120, discussed above, to modify display of the digital ink based upon display characteristic(s) of a particular device. For example, digital ink created on a display of a laptop may not be displayed conveniently on a tablet device causing a user to pan-and-zoom many times to read a particular page of the document. Using the determined semantic structure and the display characteristic(s) (e.g., display size of a target device), a display enhancement component can cause display of the digital ink to be modified. In some embodiments, digital ink of a particular line can be re-flowed onto another line in order to enhance the user's viewing experience. In some embodiments, display of secondary content (e.g., annotation(s) and/or callout(s)) can be modified, for example, moved to another display location and/or minimized from view.

[0042] Figs. 13-15 illustrate exemplary methodologies relating to visually enhancing digital ink. While the methodologies are shown and described as being a series of acts that are performed in a sequence, it is to be understood and appreciated that the methodologies are not limited by the order of the sequence. For example, some acts can occur in a different order than what is described herein. In addition, an act can occur concurrently with another act. Further, in some instances, not all acts may be required to

implement a methodology described herein.

[0043] Moreover, the acts described herein may be computer-executable instructions that can be implemented by one or more processors and/or stored on a computer-readable medium or media. The computer-executable instructions can include a routine, a sub-routine, programs, a thread of execution, and/or the like. Still further, results of acts of the methodologies can be stored in a computer-readable medium, displayed on a display device, and/or the like.

[0044] Referring to Fig. 13, a method of visually enhancing digital ink of an electronic document 1300 is illustrated. In some embodiments, the method 1300 is performed by the system 100.

[0045] At 1310, a trigger to visually enhance digital ink of at least a portion of an electronic document is received. At 1320, in response to the received trigger, the digital ink of the at least the portion of the electronic document is analyzed to determine a semantic structure of the digital ink.

[0046] At 1330, the digital ink of the at least the portion of the electronic document is visually enhanced in accordance with the determined semantic structure. At 1340, the visually enhanced digital ink of the at least the portion of the electronic document is provided (e.g., displayed and/or stored).

[0047] Next, turning to Fig. 14, a method of visually enhancing digital ink of an electronic document 1400 is illustrated. In some embodiments, the method 1400 is performed by the system 100.

[0048] At 1410, user input to modify display of at least a portion of an electronic document comprising digital ink is received. At 1420, information regarding display characteristics of a particular device is received.

[0049] At 1430, the digital ink of the at least the portion of the electronic document is analyzed to determine a semantic structure of the digital ink. At 1440, display of the at least the portion of the electronic document is modified in accordance with the display characteristic(s) of the particular device and the determined semantic structure of the digital ink of the at least the portion of the electronic document.

[0050] Referring to Fig. 15, a method of visually enhancing digital ink of an electronic document 1500 is illustrated. In some embodiments, the method 1500 is performed by the system 100 and/or the system 1200.

[0051] At 1510, a trigger to visually enhance digital ink of at least a portion of an electronic document is received. At 1520, in response to the received trigger, the digital

ink of the at least the portion of the electronic document is analyzed to determine a semantic structure of the digital ink.

[0052] At 1530, the digital ink of the at least the portion of the electronic document is visually enhanced in accordance with the determined semantic structure. At 1540, the visually enhanced digital ink of the at least the portion of the electronic document is provided (e.g., displayed and/or stored).

[0053] At 1550, user input to modify display of at least the portion of an electronic document comprising digital ink is received. At 1560, display of the at least the portion of the electronic document is modified in accordance with the display characteristic(s) (e.g., of a particular device and/or received from a user) and the determined semantic structure of the digital ink of the at least the portion of the electronic document.

[0054] Described herein is a system for visually enhancing digital ink of an electronic document, comprising: a processing system comprising a processor and a memory having computer-executable instructions stored thereupon which, when executed by the processor, cause the computer to: receive a trigger to visually enhance digital ink of at least a portion of the electronic document; analyze the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger; visually enhance the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and provide the visually enhanced digital ink of the at least the portion of the electronic document.

[0055] The system can include wherein the trigger is a command invoked by a user. The system can include wherein the trigger is inferred based upon a user-configurable setting. The system can include wherein the user-configurable setting comprises at least one of an expiration of a predetermined period of time, a predetermined period of user inactivity time, a predetermined quantity of digital ink on the electronic document.

[0056] The system can include wherein the trigger is inferred based upon a particular user's previous history of visually enhancing digital ink within electronic documents. The system can include wherein the semantic structure of the digital ink is based upon layout analysis to combine and parse individual input strokes into associated stroke sets. The system can include wherein the semantic structure of the digital ink is further based upon classification analysis to determine types of strokes included in the digital ink.

[0057] The system can include wherein the visual enhancement comprises at least one of horizontal line adjustment, line alignment, word alignment in a particular line using a particular baseline, vertical spacing adjustment of lines, vertical spacing adjustment of paragraphs, vertical spacing adjustment of a list, spacing adjustment between words, spacing adjustment between list items, ink styling modification, adjusting sizing of characters adjustment, ink color unification, or ink thickness unification.

[0058] The system can include the memory having further computer-executable instructions stored thereupon which, when executed by the processor, cause the computer to: receive user input to modify display of the portion of the electronic document based upon a display characteristic of a particular device; and modify the display of the at least the portion of the electronic document in accordance with the display characteristic of the particular device and the determined semantic structure of the at least the portion of the electronic document. The system can include wherein modify the display comprises at least one of reflow of a portion of a line onto another line, minimization of display of secondary content, or change of display location of secondary content.

[0059] Described herein is a method of visually enhancing digital ink of an electronic document, comprising: receiving a trigger to visually enhance digital ink of at least a portion of the electronic document; analyzing the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger; visually enhancing the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and providing the visually enhanced digital ink of the at least the portion of the electronic document.

[0060] The method can include wherein the trigger is a command invoked by a user. The method can include wherein the trigger is inferred based upon a user-configurable setting. The method can include wherein the user-configurable setting comprises at least one of an expiration of a predetermined period of time, a predetermined period of user inactivity time, a predetermined quantity of digital ink on the electronic document.

[0061] The method can include wherein the semantic structure of the digital ink is based upon layout analysis to combine and parse individual input strokes into associated stroke sets. The method can include wherein the semantic structure of the digital ink is further based upon classification analysis to determine types of strokes included in the digital ink. The method can include wherein the visual enhancement comprises at least one

of horizontal line adjustment, line alignment, word alignment in a particular line using a particular baseline, vertical spacing adjustment of lines, vertical spacing adjustment of paragraphs, vertical spacing adjustment of a list, spacing adjustment between words, spacing adjustment between list items, ink styling modification, adjusting sizing of characters adjustment, ink color unification, or ink thickness unification.

[0062] Described herein is a computer storage media storing computer-readable instructions that when executed cause a computing device to: receive a trigger to visually enhance digital ink of at least a portion of the electronic document; analyze the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger; visually enhance the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and provide the visually enhanced digital ink of the at least the portion of the electronic document.

[0063] The computer storage media can include wherein the visual enhancement comprises at least one of horizontal line adjustment, line alignment, word alignment in a particular line using a particular baseline, vertical spacing adjustment of lines, vertical spacing adjustment of paragraphs, vertical spacing adjustment of a list, spacing adjustment between words, spacing adjustment between list items, ink styling modification, adjusting sizing of characters adjustment, ink color unification, or ink thickness unification. The computer storage media can include store further computer-readable instructions that when executed cause a computing device to: receive user input to modify display of the portion of the electronic document based upon a display characteristic of a particular device; and modify the display of the at least the portion of the electronic document in accordance with the display characteristic of the particular device and the determined semantic structure of the at least the portion of the electronic document.

[0064] With reference to Fig. 16, illustrated is an example general-purpose processing system, computer or computing device 1602 (e.g., mobile phone, desktop, laptop, tablet, watch, server, hand-held, programmable consumer or industrial electronics, set-top box, game system, compute node, etc.). For instance, the computing device 1602 may be used in a system for visually enhancing digital ink of an electronic document 100 and/or a system for displaying digital ink of an electronic document 1200.

[0065] The computer 1602 includes one or more processor(s) 1620, memory 1630, system bus 1640, mass storage device(s) 1650, and one or more interface components 1670. The system bus 1640 communicatively couples at least the above system

constituents. However, it is to be appreciated that in its simplest form the computer 1602 can include one or more processors 1620 coupled to memory 1630 that execute various computer executable actions, instructions, and or components stored in memory 1630. The instructions may be, for instance, instructions for implementing functionality described as being carried out by one or more components discussed above or instructions for implementing one or more of the methods described above.

[0066] The processor(s) 1620 can be implemented with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. The processor(s) 1620 may also be implemented as a combination of computing devices, for example a combination of a DSP and a microprocessor, a plurality of microprocessors, multi-core processors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. In one embodiment, the processor(s) 1620 can be a graphics processor.

[0067] The computer 1602 can include or otherwise interact with a variety of computer-readable media to facilitate control of the computer 1602 to implement one or more aspects of the claimed subject matter. The computer-readable media can be any available media that can be accessed by the computer 1602 and includes volatile and nonvolatile media, and removable and non-removable media. Computer-readable media can comprise two distinct and mutually exclusive types, namely computer storage media and communication media.

[0068] Computer storage media includes 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, program modules, or other data. Computer storage media includes storage devices such as memory devices (e.g., random access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), etc.), magnetic storage devices (e.g., hard disk, floppy disk, cassettes, tape, etc.), optical disks (e.g., compact disk (CD), digital versatile disk (DVD), etc.), and solid state devices (e.g., solid state drive (SSD), flash memory drive (e.g., card, stick, key drive) etc.), or any other like mediums that store, as opposed to transmit or communicate, the desired information accessible by the computer

1602. Accordingly, computer storage media excludes modulated data signals as well as that described with respect to communication media.

[0069] Communication media embodies 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. The term "modulated data signal" means a signal that has one or more of its 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, RF, infrared and other wireless media.

[0070] Memory 1630 and mass storage device(s) 1650 are examples of computer-readable storage media. Depending on the exact configuration and type of computing device, memory 1630 may be volatile (e.g., RAM), non-volatile (e.g., ROM, flash memory, etc.) or some combination of the two. By way of example, the basic input/output system (BIOS), including basic routines to transfer information between elements within the computer 1602, such as during start-up, can be stored in nonvolatile memory, while volatile memory can act as external cache memory to facilitate processing by the processor(s) 1620, among other things.

[0071] Mass storage device(s) 1650 includes removable/non-removable, volatile/non-volatile computer storage media for storage of large amounts of data relative to the memory 1630. For example, mass storage device(s) 1650 includes, but is not limited to, one or more devices such as a magnetic or optical disk drive, floppy disk drive, flash memory, solid-state drive, or memory stick.

[0072] Memory 1630 and mass storage device(s) 1650 can include, or have stored therein, operating system 1660, one or more applications 1662, one or more program modules 1664, and data 1666. The operating system 1660 acts to control and allocate resources of the computer 1602. Applications 1662 include one or both of system and application software and can exploit management of resources by the operating system 1660 through program modules 1664 and data 1666 stored in memory 1630 and/or mass storage device (s) 1650 to perform one or more actions. Accordingly, applications 1662 can turn a general-purpose computer 1602 into a specialized machine in accordance with the logic provided thereby.

[0073] All or portions of the claimed subject matter can be implemented using standard programming and/or engineering techniques to produce software, firmware,

hardware, or any combination thereof to control a computer to realize the disclosed functionality. By way of example and not limitation, system 100 or portions thereof, can be, or form part, of an application 1662, and include one or more modules 1664 and data 1666 stored in memory and/or mass storage device(s) 1650 whose functionality can be realized when executed by one or more processor(s) 1620.

[0074] In accordance with one particular embodiment, the processor(s) 1620 can correspond to a system on a chip (SOC) or like architecture including, or in other words integrating, both hardware and software on a single integrated circuit substrate. Here, the processor(s) 1620 can include one or more processors as well as memory at least similar to processor(s) 1620 and memory 1630, among other things. Conventional processors include a minimal amount of hardware and software and rely extensively on external hardware and software. By contrast, an SOC implementation of processor is more powerful, as it embeds hardware and software therein that enable particular functionality with minimal or no reliance on external hardware and software. For example, the system 100 and/or associated functionality can be embedded within hardware in a SOC architecture.

[0075] The computer 1602 also includes one or more interface components 1670 that are communicatively coupled to the system bus 1640 and facilitate interaction with the computer 1602. By way of example, the interface component 1670 can be a port (e.g., serial, parallel, PCMCIA, USB, FireWire, etc.) or an interface card (e.g., sound, video, etc.) or the like. In one example implementation, the interface component 1670 can be embodied as a user input/output interface to enable a user to enter commands and information into the computer 1602, for instance by way of one or more gestures or voice input, through one or more input devices (e.g., pointing device such as a mouse, trackball, stylus, touch pad, keyboard, microphone, joystick, game pad, satellite dish, scanner, camera, other computer, etc.). In another example implementation, the interface component 1670 can be embodied as an output peripheral interface to supply output to displays (e.g., LCD, LED, plasma, etc.), speakers, printers, and/or other computers, among other things. Still further yet, the interface component 1670 can be embodied as a network interface to enable communication with other computing devices (not shown), such as over a wired or wireless communications link.

[0076] What has been described above includes examples of aspects of the claimed subject matter. It is, of course, not possible to describe every conceivable combination of components or methodologies for purposes of describing the claimed subject matter, but

one of ordinary skill in the art may recognize that many further combinations and permutations of the disclosed subject matter are possible. Accordingly, the disclosed subject matter is intended to embrace all such alterations, modifications, and variations that fall within the spirit and scope of the appended claims. Furthermore, to the extent that the term "includes" is used in either the details description or the claims, such term is intended to be inclusive in a manner similar to the term "comprising" as "comprising" is interpreted when employed as a transitional word in a claim.

CLAIMS

1. A system for visually enhancing digital ink of an electronic document, comprising:

a processing system comprising a processor and a memory having computer-executable instructions stored thereupon which, when executed by the processor, cause the computer to:

receive a trigger to visually enhance digital ink of at least a portion of the electronic document;

analyze the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger;

visually enhance the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and

provide the visually enhanced digital ink of the at least the portion of the electronic document.

2. The system of claim 1, wherein the trigger is a command invoked by a user.

3. The system of claim 1, wherein the trigger is inferred based upon a user-configurable setting.

4. The system of claim 3, wherein the user-configurable setting comprises at least one of an expiration of a predetermined period of time, a predetermined period of user inactivity time, a predetermined quantity of digital ink on the electronic document.

5. The system of claim 1, wherein the trigger is inferred based upon a particular user's previous history of visually enhancing digital ink within electronic documents.

6. The system of claim 1, wherein the semantic structure of the digital ink is based upon layout analysis to combine and parse individual input strokes into associated stroke sets.

7. The system of claim 6, wherein the semantic structure of the digital ink is further based upon classification analysis to determine types of strokes included in the digital ink.

8. The system of claim 1, wherein the visual enhancement comprises at least one of horizontal line adjustment, line alignment, word alignment in a particular line using a particular baseline, vertical spacing adjustment of lines, vertical spacing adjustment of paragraphs, vertical spacing adjustment of a list, spacing adjustment between words, spacing adjustment between list items, ink styling modification, adjusting sizing of characters adjustment, ink color unification, or ink thickness unification.

9. The system of claim 1, the memory having further computer-executable instructions stored thereupon which, when executed by the processor, cause the computer to:

receive user input to modify display of the portion of the electronic document based upon a display characteristic of a particular device; and

modify the display of the at least the portion of the electronic document in accordance with the display characteristic of the particular device and the determined semantic structure of the at least the portion of the electronic document.

10. The system of claim 9, wherein modify the display comprises at least one of reflow of a portion of a line onto another line, minimization of display of secondary content, or change of display location of secondary content.

11. A method of visually enhancing digital ink of an electronic document, comprising:

receiving a trigger to visually enhance digital ink of at least a portion of the electronic document;

analyzing the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger;

visually enhancing the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and

providing the visually enhanced digital ink of the at least the portion of the electronic document.

12. The method of claim 11, wherein the semantic structure of the digital ink is based upon layout analysis to combine and parse individual input strokes into associated stroke sets.

13. The method of claim 11, wherein the visual enhancement comprises at least one of horizontal line adjustment, line alignment, word alignment in a particular line using a particular baseline, vertical spacing adjustment of lines, vertical spacing adjustment of paragraphs, vertical spacing adjustment of a list, spacing adjustment between words, spacing adjustment between list items, ink styling modification, adjusting sizing of characters adjustment, ink color unification, or ink thickness unification.

14. A computer storage media storing computer-readable instructions that when executed cause a computing device to:

receive a trigger to visually enhance digital ink of at least a portion of the electronic document;

analyze the digital ink of the at least the portion of the electronic document to determine a semantic structure of the digital ink in response to the received trigger;

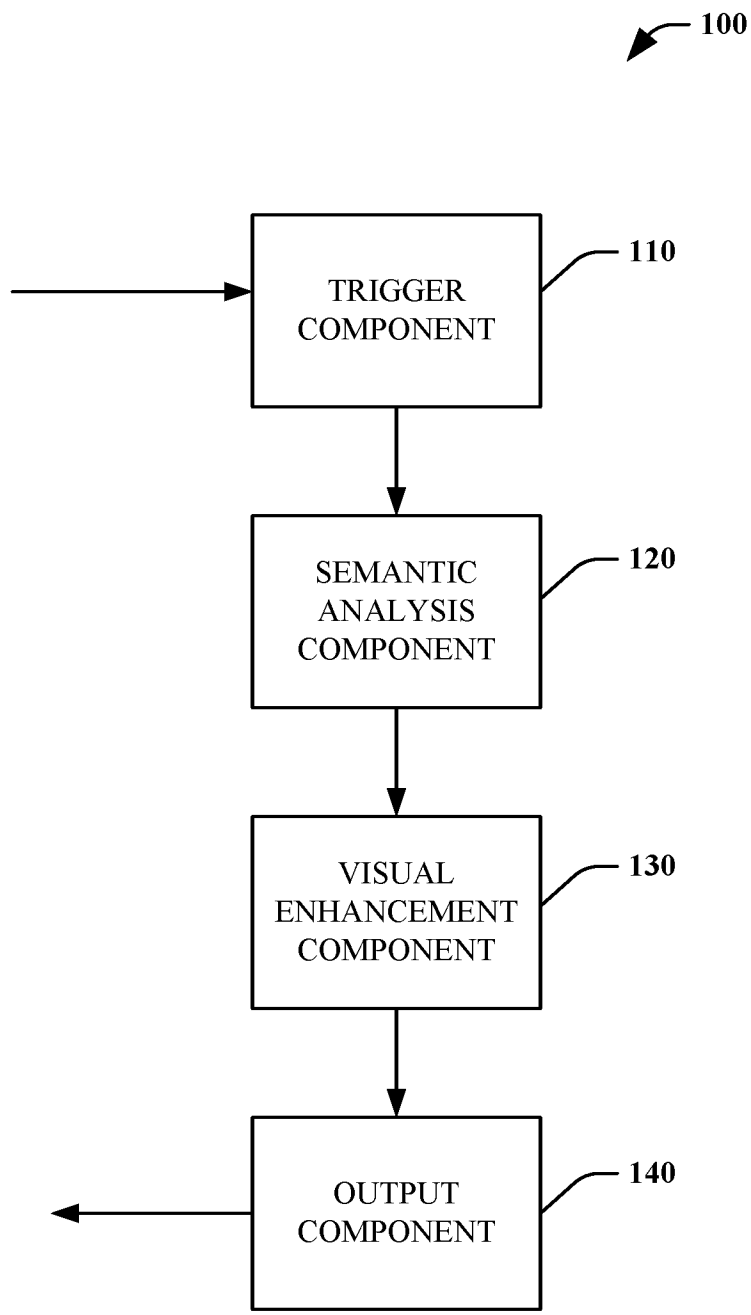
visually enhance the digital ink of the portion of the at least the portion of the electronic document in accordance with the determined semantic structure; and

provide the visually enhanced digital ink of the at least the portion of the electronic document.

15. The computer storage media of claim 14 storing further computer-readable instructions that when executed cause a computing device to:

receive user input to modify display of the portion of the electronic document based upon a display characteristic of a particular device; and

modify the display of the at least the portion of the electronic document in accordance with the display characteristic of the particular device and the determined semantic structure of the at least the portion of the electronic document.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SEMANTIC ANALYSIS COMPONENT
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VISUAL ENHANCEMENT COMPONENT
130
OUTPUT COMPONENT
140

FIG. 1

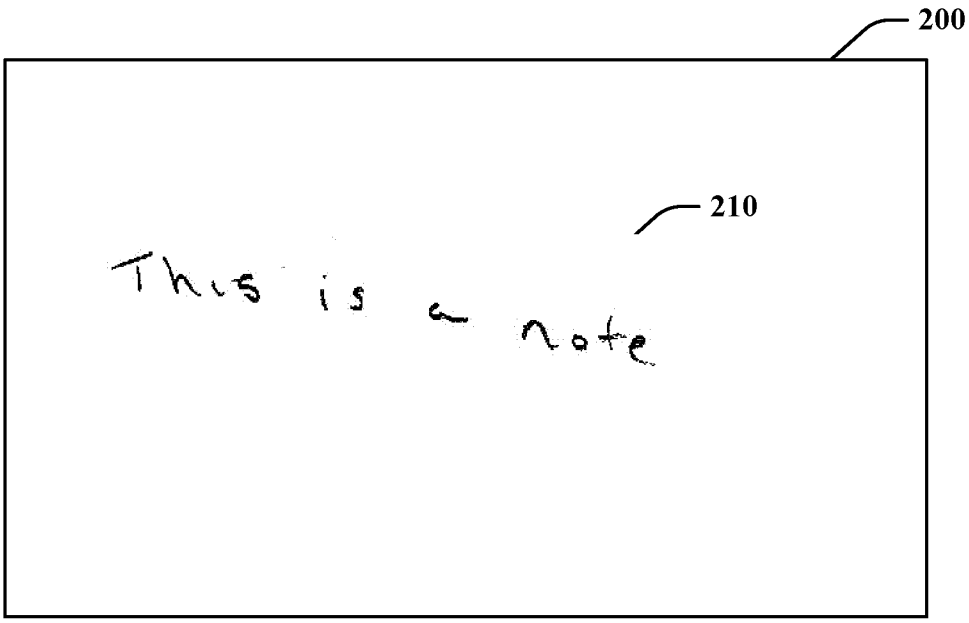

FIG. 2A

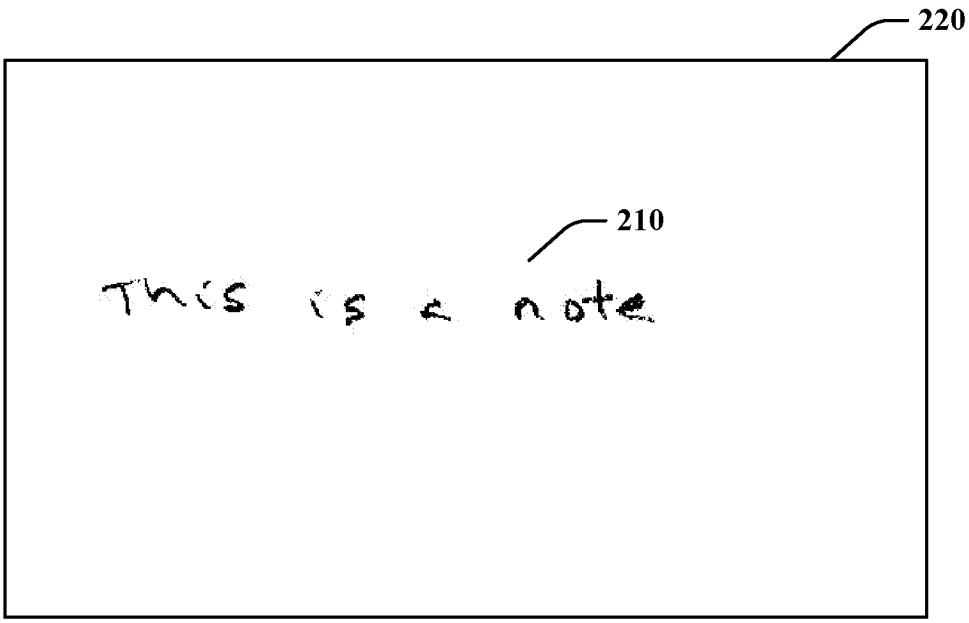

FIG. 2B

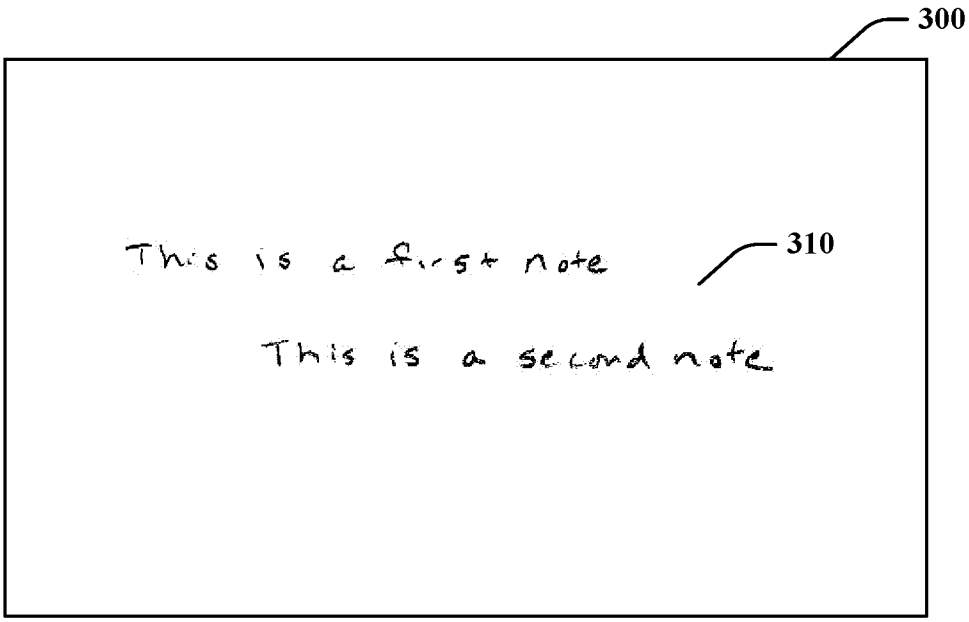
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FIG. 3A

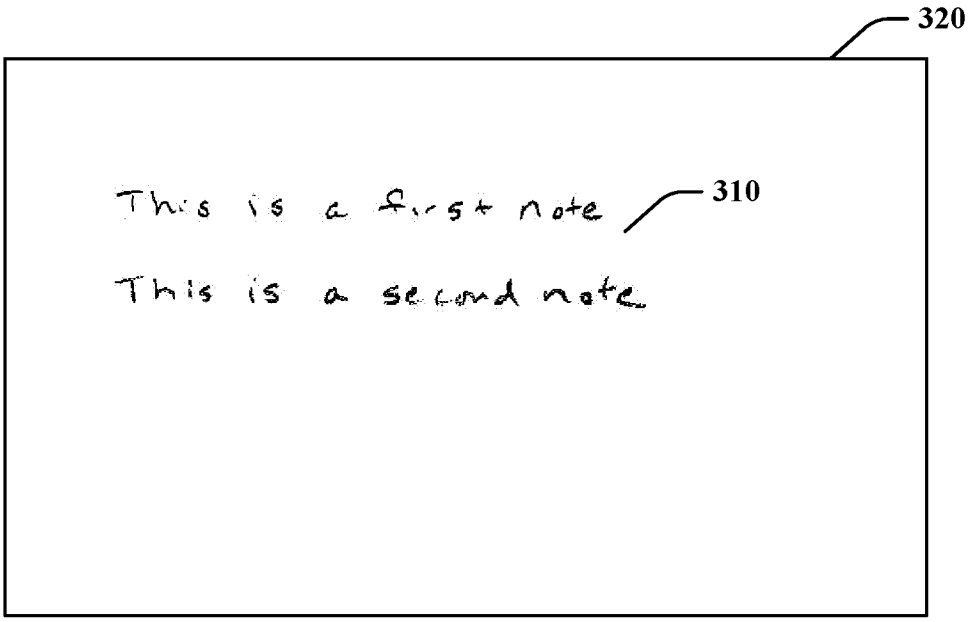
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FIG. 3B

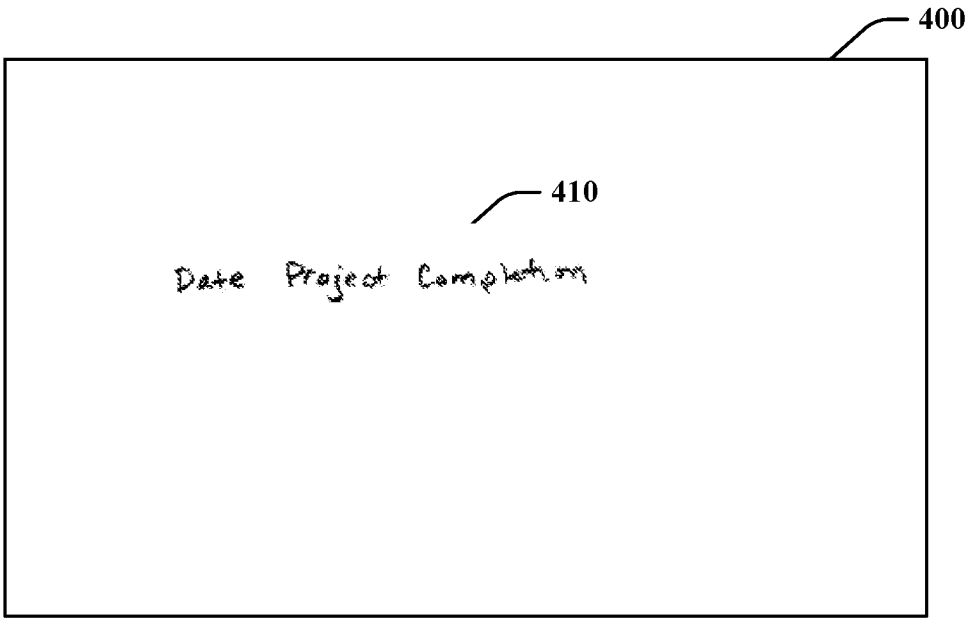
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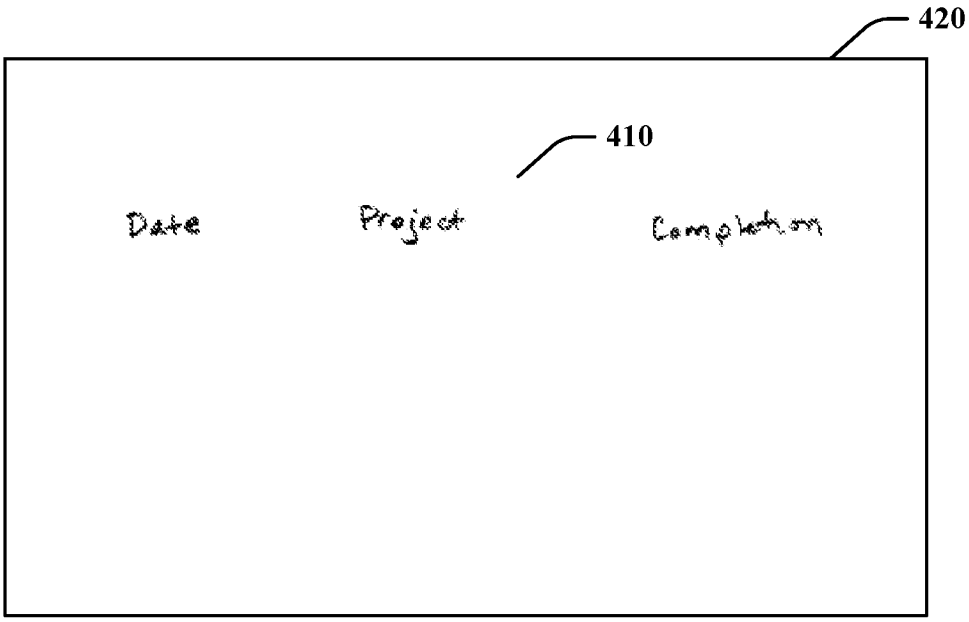
FIG. 4A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Date
Project
Completion

FIG. 4B

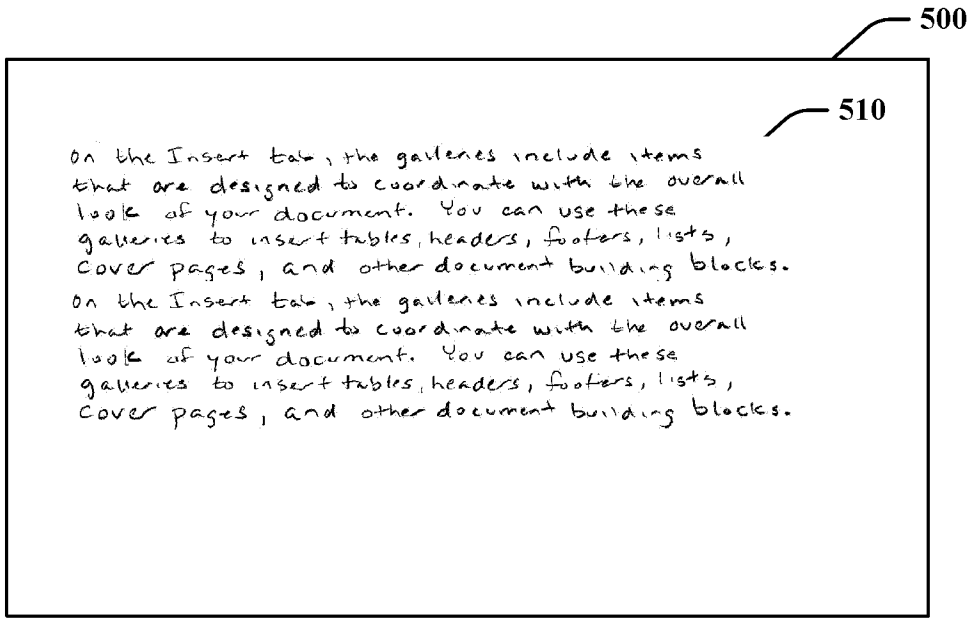
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FIG. 5A

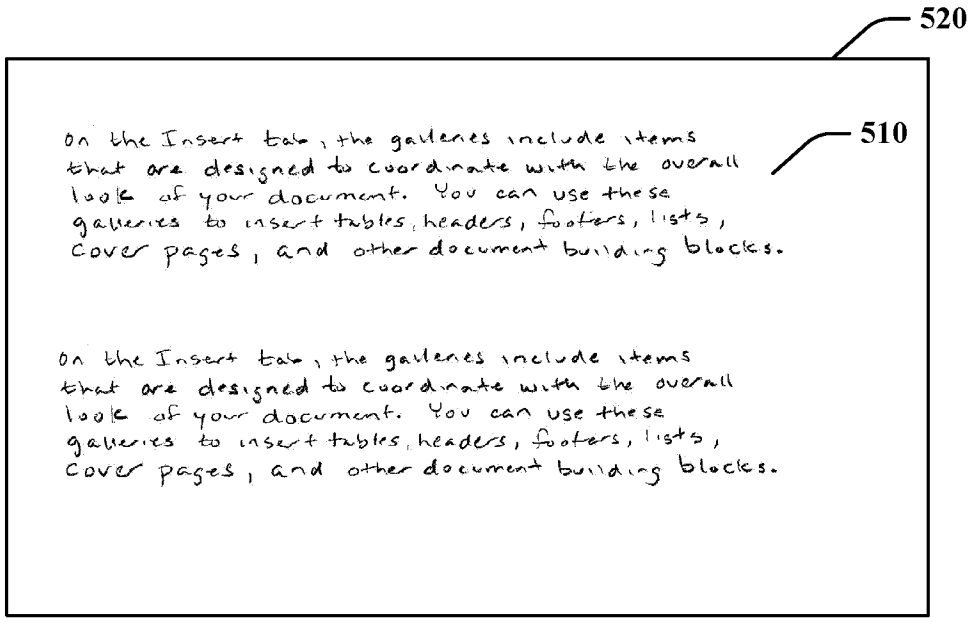
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FIG. 5B

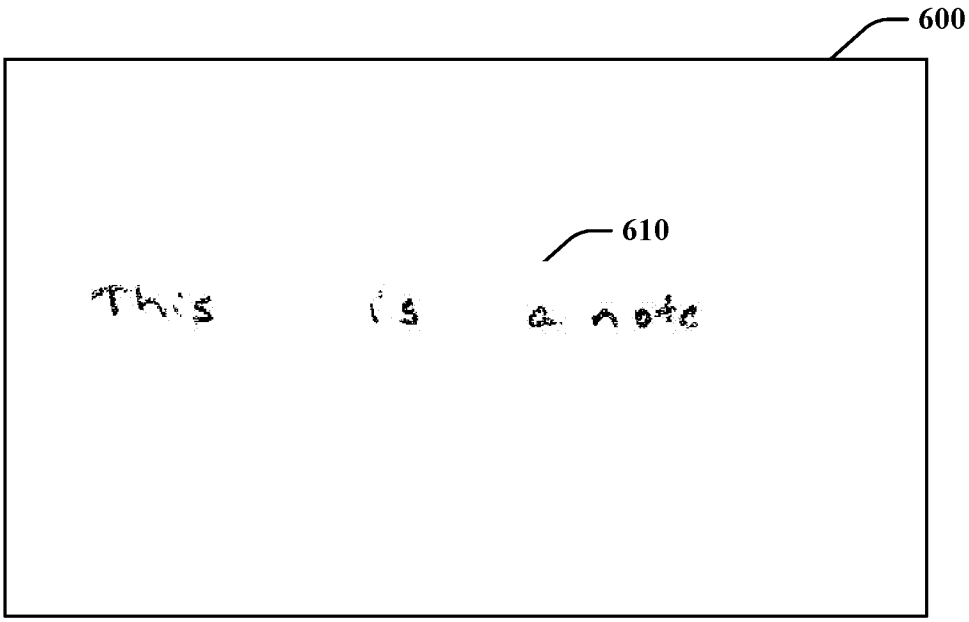

FIG. 6A

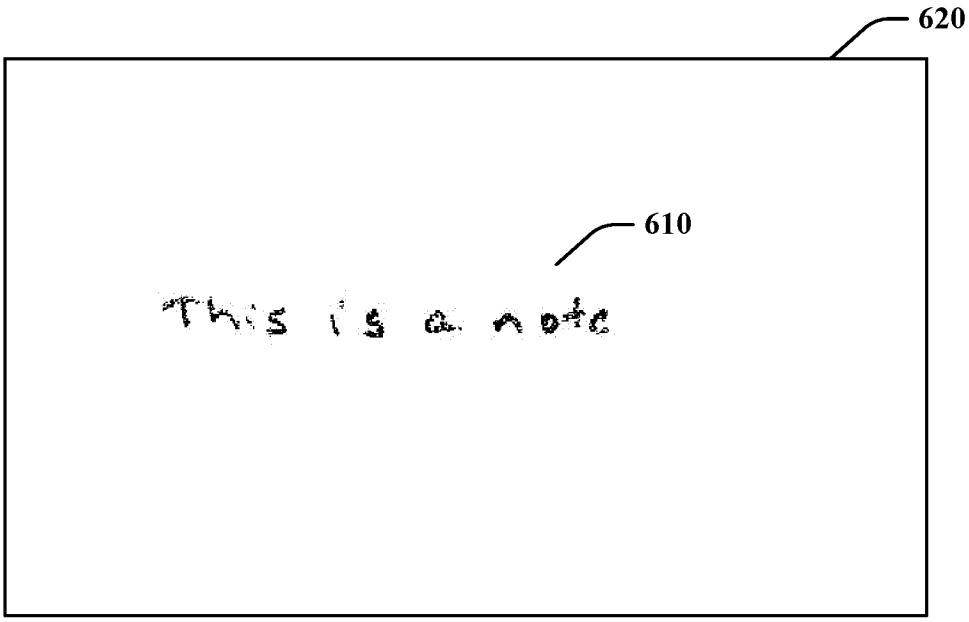

FIG. 6B

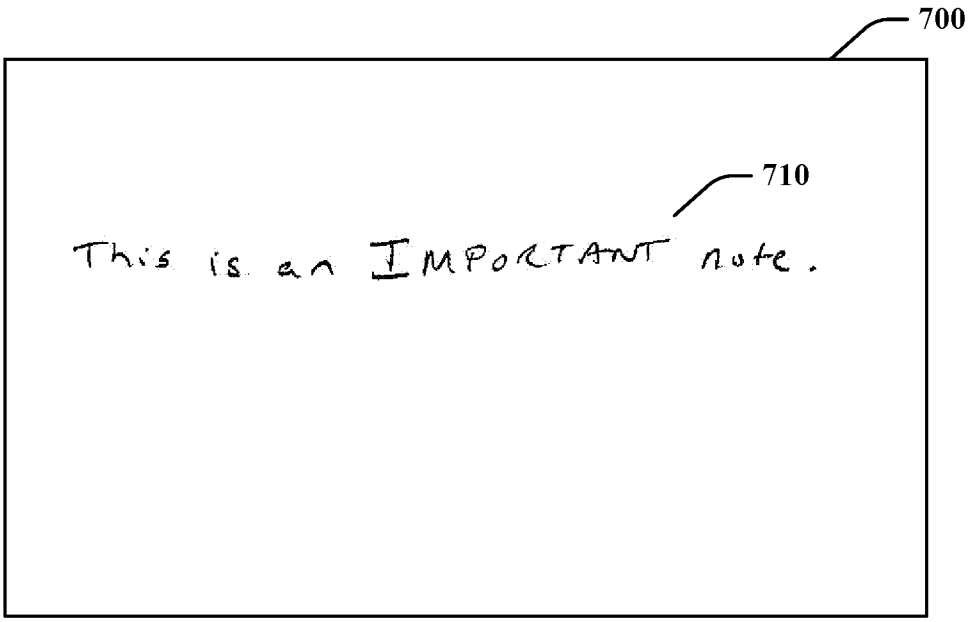
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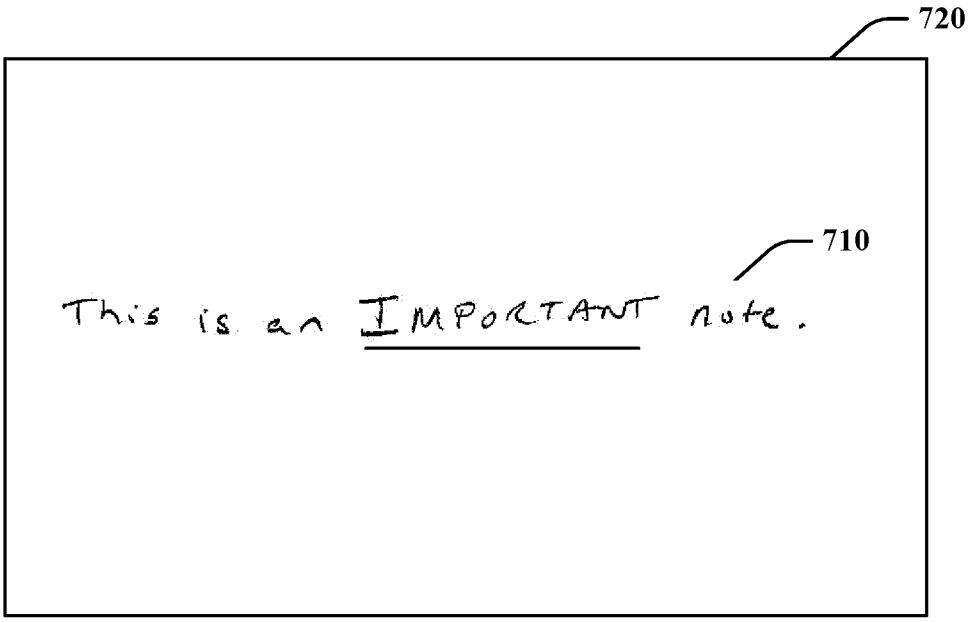
FIG. 7A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This is an IMPORTANT note.

FIG. 7B

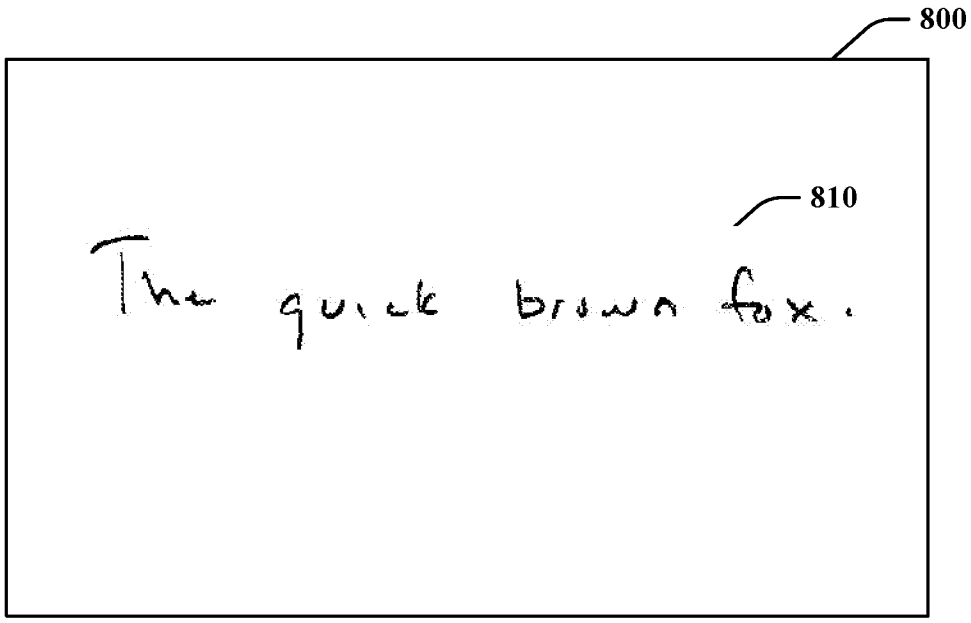


FIG. 8A

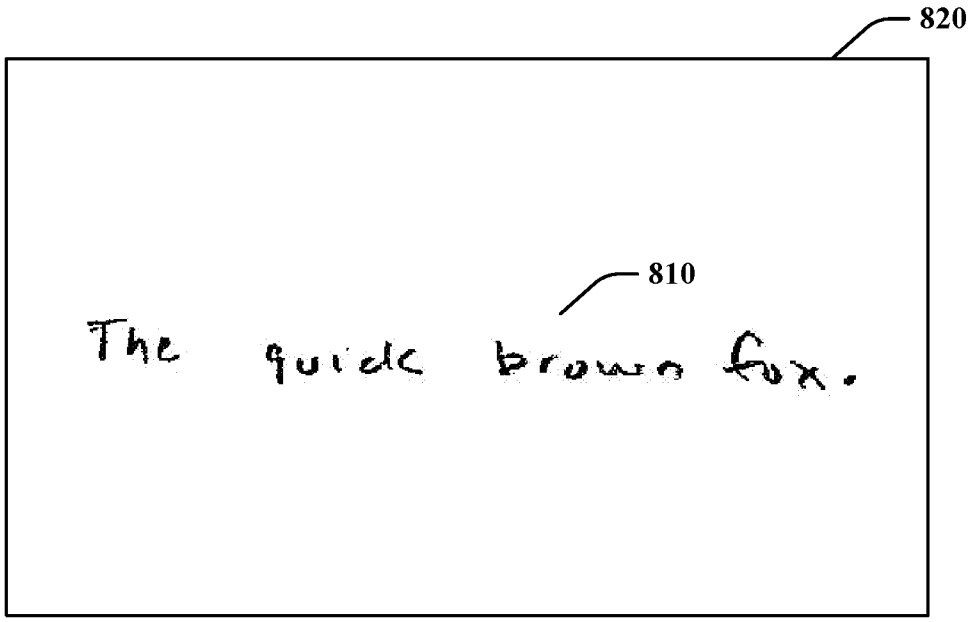


FIG. 8B

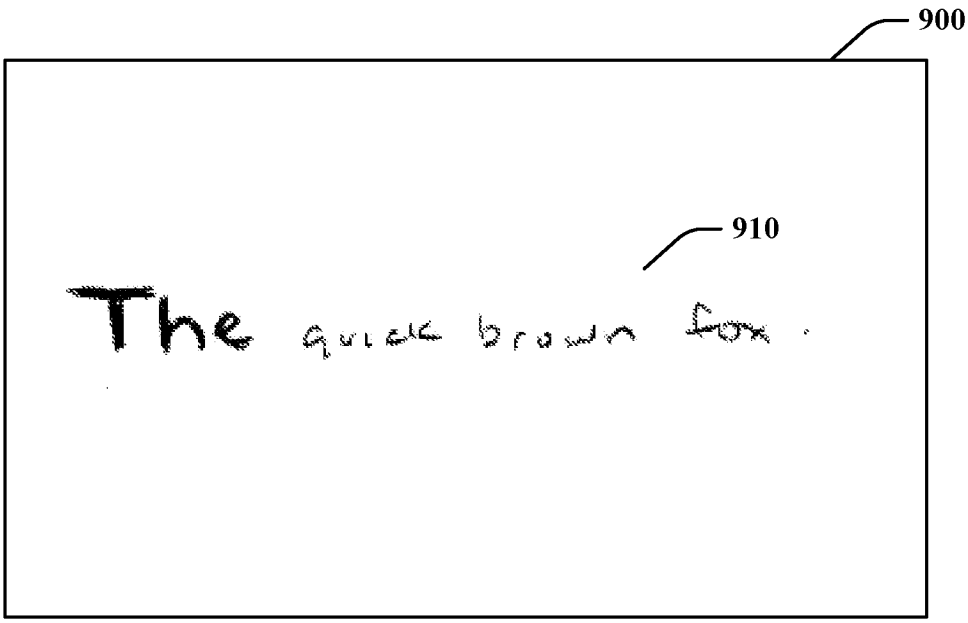


FIG. 9A

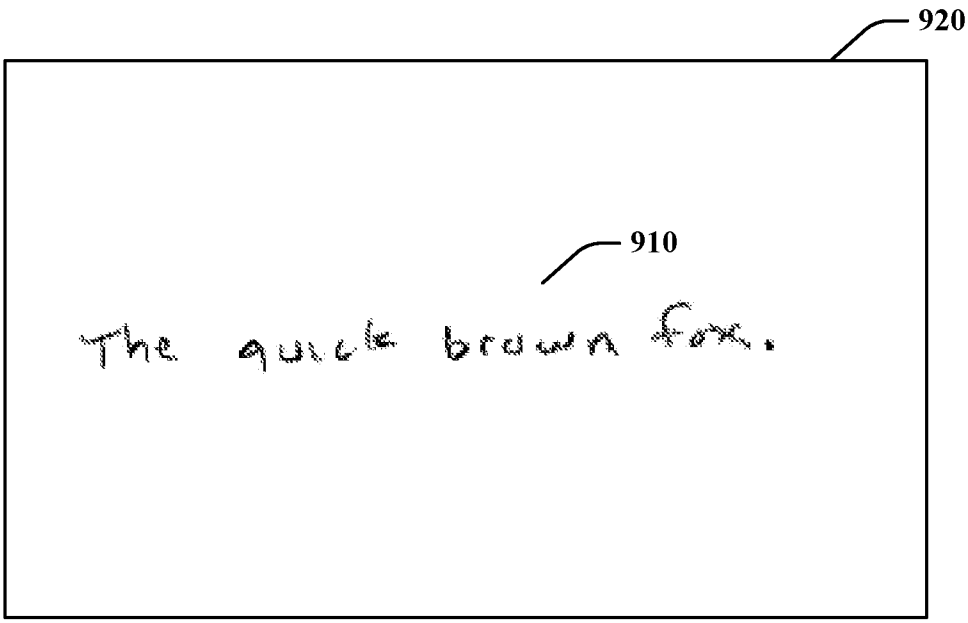


FIG. 9B

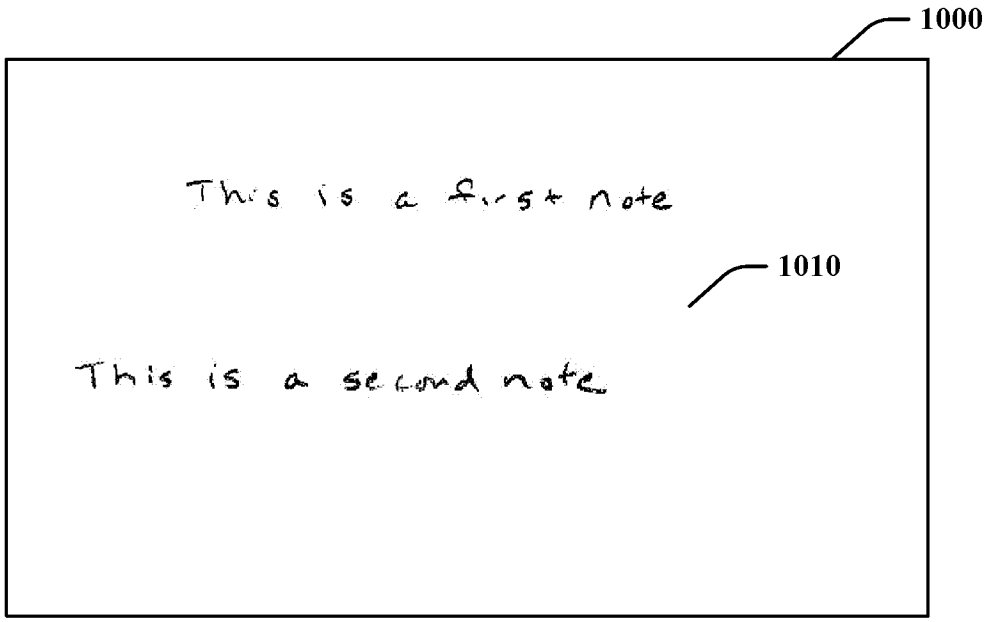


FIG. 10A

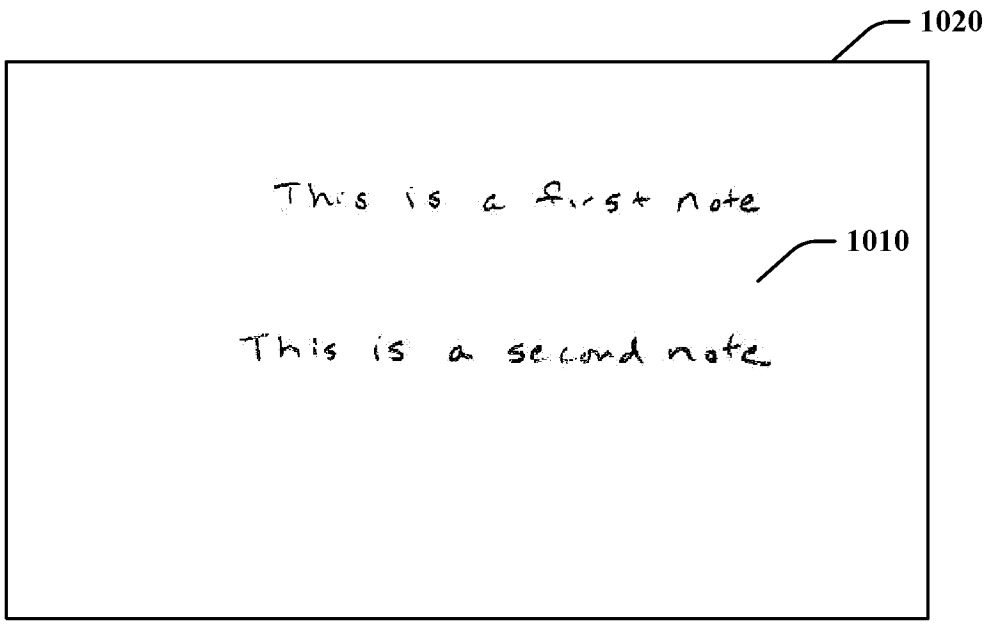


FIG. 10B

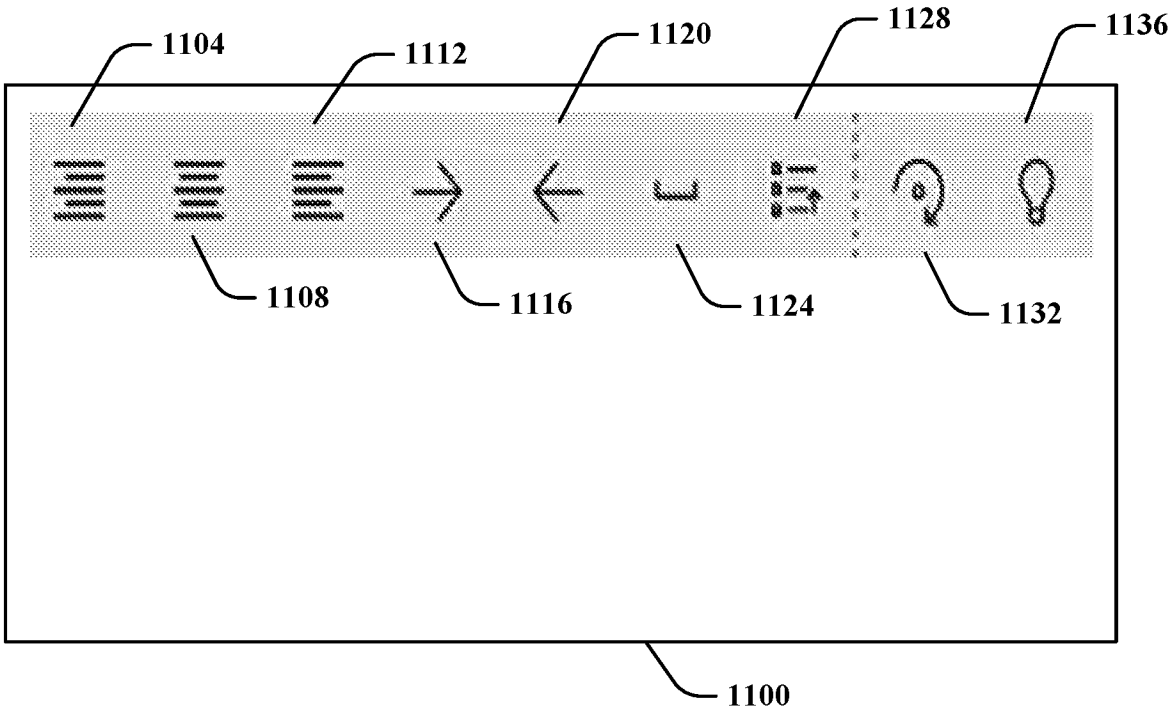
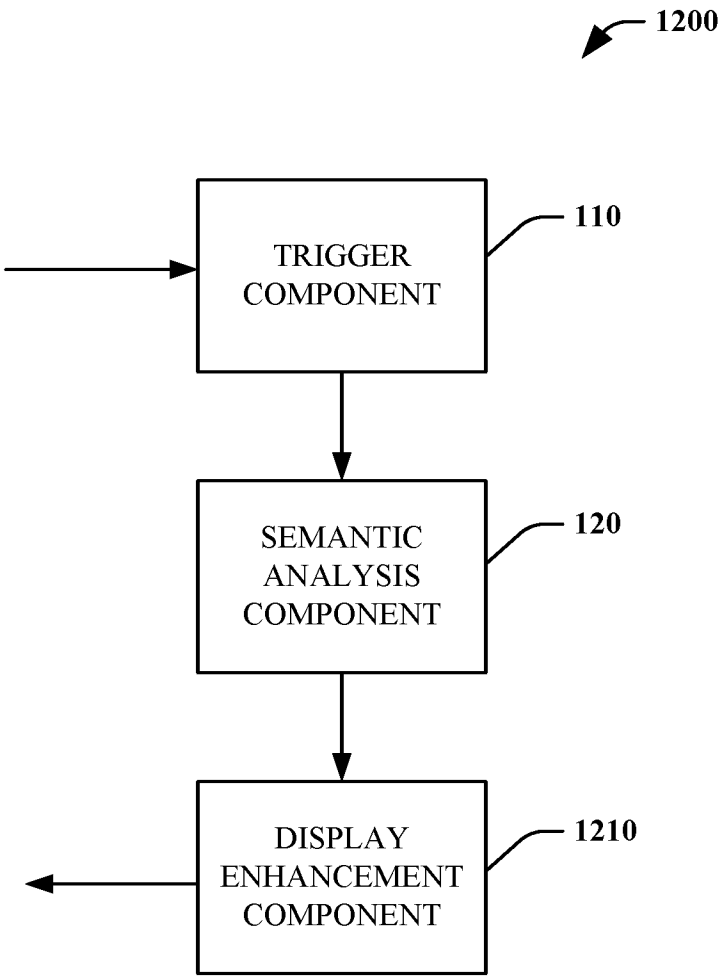


FIG. 11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SEMANTIC ANALYSIS COMPONENT
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DISPLAY ENHANCEMENT COMPONENT
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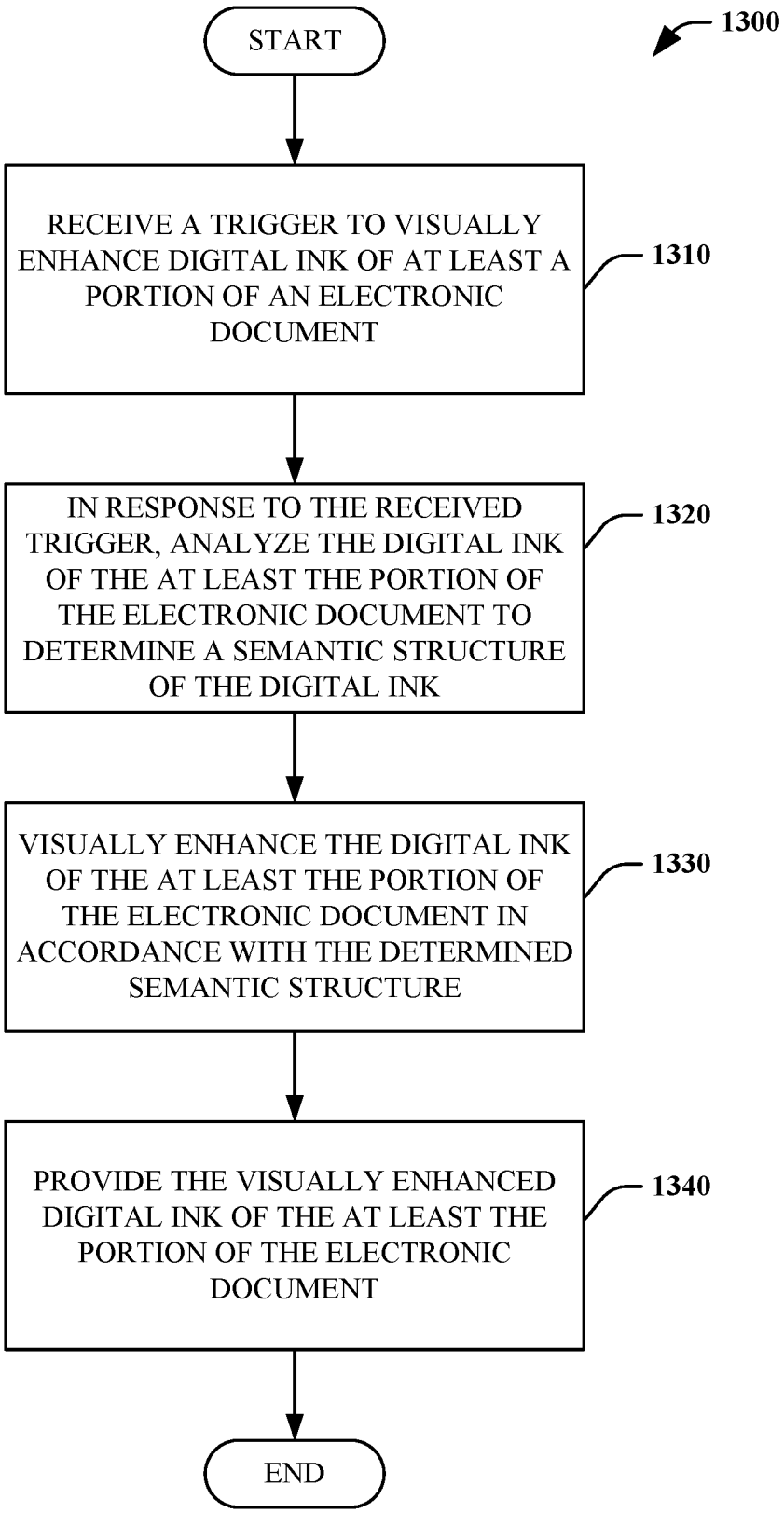
FIG. 12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1320
VISUALLY ENHANCE THE DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT IN ACCORDANCE WITH THE DETERMINED SEMANTIC STRUCTURE
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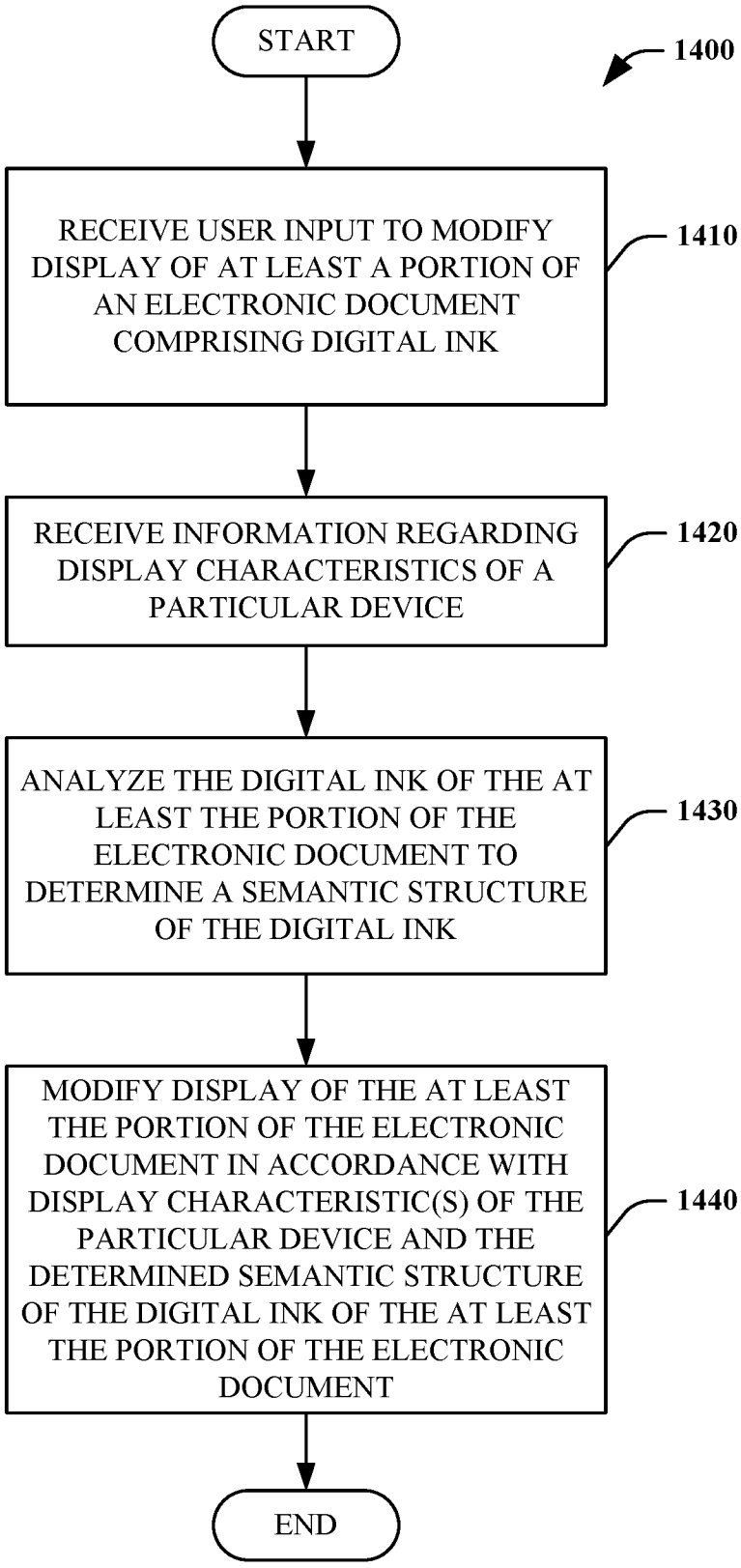
PROVIDE THE VISUALLY ENHANCED DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT
1340
END

FIG. 13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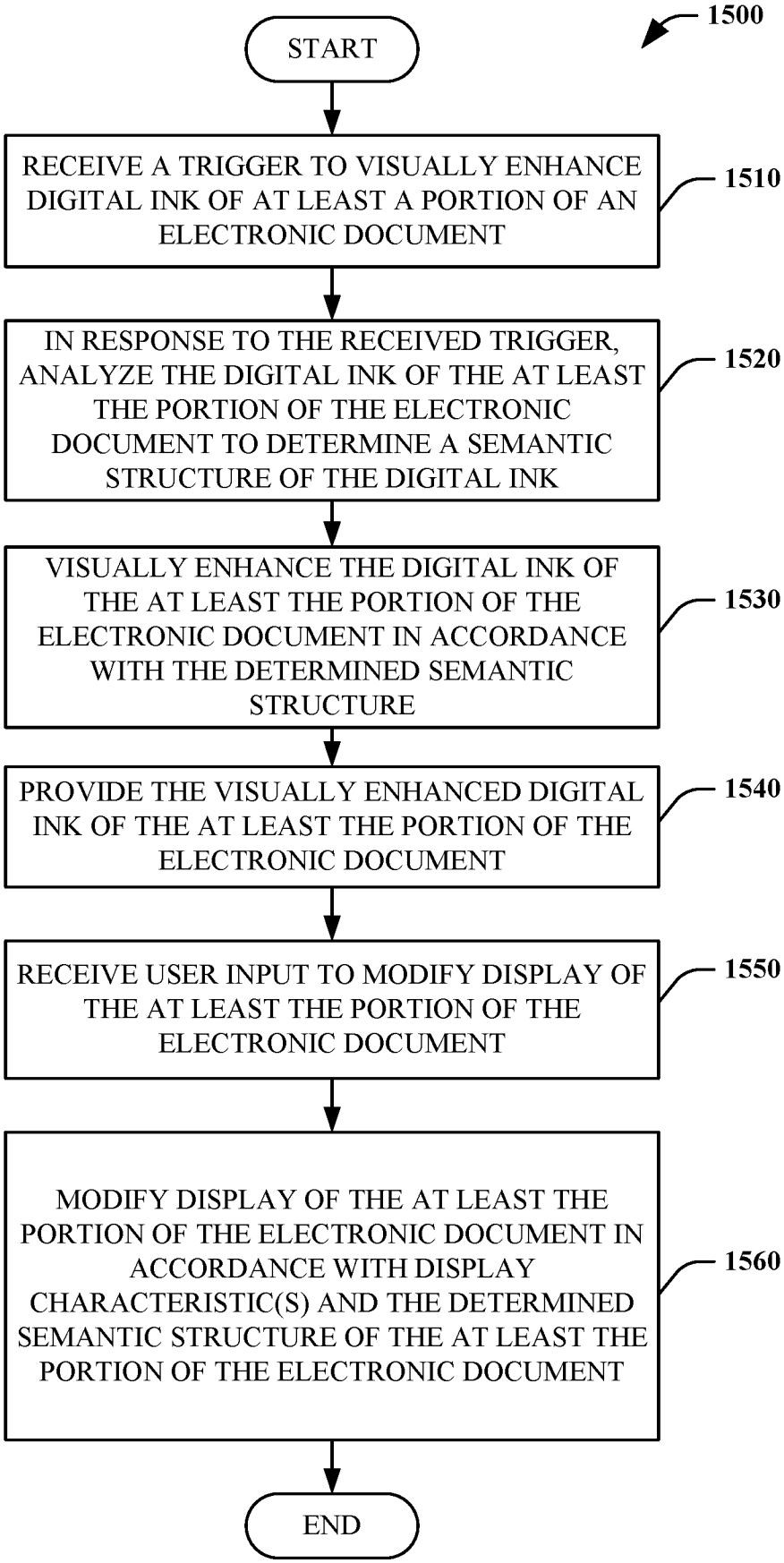
RECEIVE INFORMATION REGARDING DISPLAY CHARACTERISTICS OF A PARTICULAR DEVICE
1420
ANALYZE THE DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT TO DETERMINE A SEMANTIC STRUCTURE OF THE DIGITAL INK
1430
MODIFY DISPLAY OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT IN ACCORDANCE WITH DISPLAY CHARACTERISTIC(S) OF THE PARTICULAR DEVICE AND THE DETERMINED SEMANTIC STRUCTURE OF THE DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT
1440
END

FIG. 14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1510
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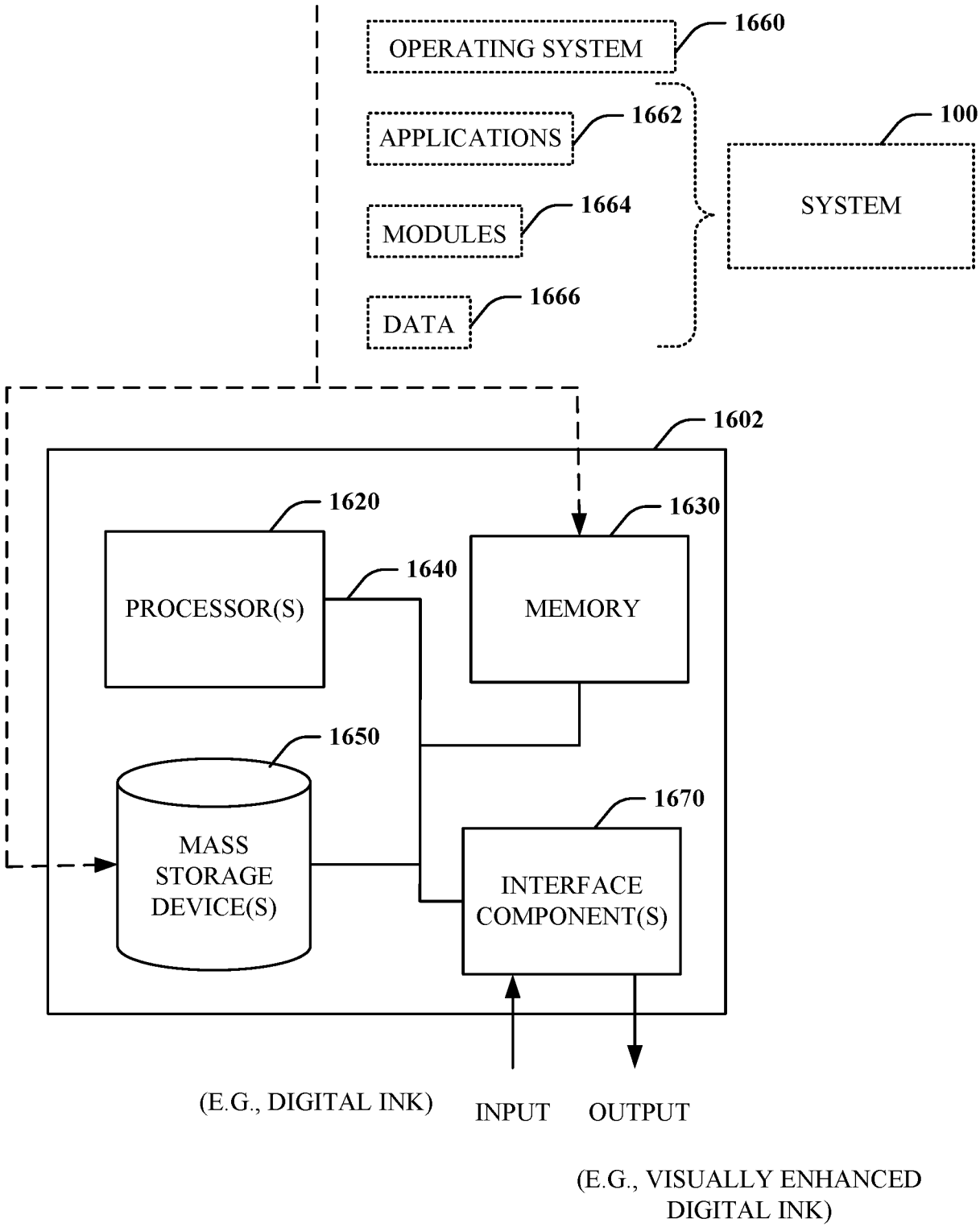
1520
VISUALLY ENHANCE THE DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT IN ACCORDANCE WITH THE DETERMINED SEMANTIC STRUCTURE
1530
PROVIDE THE VISUALLY ENHANCED DIGITAL INK OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT
1540
RECEIVE USER INPUT TO MODIFY DISPLAY OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT
1550
MODIFY DISPLAY OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT IN ACCORDANCE WITH DISPLAY CHARACTERISTIC(S) AND THE DETERMINED SEMANTIC STRUCTURE OF THE AT LEAST THE PORTION OF THE ELECTRONIC DOCUMENT
1560
END

FIG. 15


OPERATING SYSTEM
1660
APPLICATIONS
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MODULES
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DATA
1666
100
SYSTEM
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1620
PROCESSOR(S)
1640
1630
MEMORY
1650
MASS STORAGE DEVICE(S)
1670
INTERFACE COMPONENT(S)
(E.G., DIGITAL INK)
INPUT
OUTPUT
(E.G., VISUALLY ENHANCED DIGITAL INK)

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/020990

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F17/24
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)
G06F

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 Y	US 2016/147723 A1 (LEE DONG-HYUK [KR] ET AL) 26 May 2016 (2016-05-26) paragraphs [0005] - [0030], [0112] - [0140], [0145] - [0153]; figures 1-16, 18 -----	1-8, 11-13 9,10,15
X	US 2012/096345 A1 (HO RONALD [US] ET AL) 19 April 2012 (2012-04-19) claims 1-10, 20-24; figures 2,4 -----	1,2,6, 8-10, 13-15
Y	EP 1 486 883 A2 (MICROSOFT CORP [US]) 15 December 2004 (2004-12-15) paragraphs [0025], [0030], [0033], [0061]; claims 1,12,13; figure 11 -----	9,10,15
Y	EP 1 174 801 A2 (MICROSOFT CORP [US]) 23 January 2002 (2002-01-23) claims 1-10, 20-24; figures 12, 15 -----	9,10,15

☐ 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
23 May 2019	03/06/2019

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	Alt, Susanne

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2019/020990

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016147723 A1	26-05-2016	CN 107003994 A	01-08-2017
		EP 3224704 A1	04-10-2017
		KR 20160062566 A	02-06-2016
		US 2016147723 A1	26-05-2016
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		CN 1609846 A	27-04-2005
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