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(54) **ANNOTATION DATA GENERATION AND OVERLAY FOR ENHANCING READABILITY ON ELECTRONIC BOOK IMAGE STREAM SERVICE**

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(57) **ABSTRACT**

Provided are techniques for receiving a scanned image corresponding to a page; analyzing the scanned image to identify a set of characters (Ci) and corresponding positions (Pi) of each character of Ci on the page; applying natural language processing (NPL) and an analytic analysis algorithm to determine a semantic analysis relationship of phrases formed by Ci to determine meanings for the phrases; generating a plurality of annotations (Ai) indicating the determined meanings of the phrases, wherein each annotation is assigned a corresponding position (Qi) on the page based upon the Pi of the corresponding characters on the page; and storing, in a non-transitory computer-readable medium, the scanned image in conjunction with the plurality of annotations and the corresponding Qi.

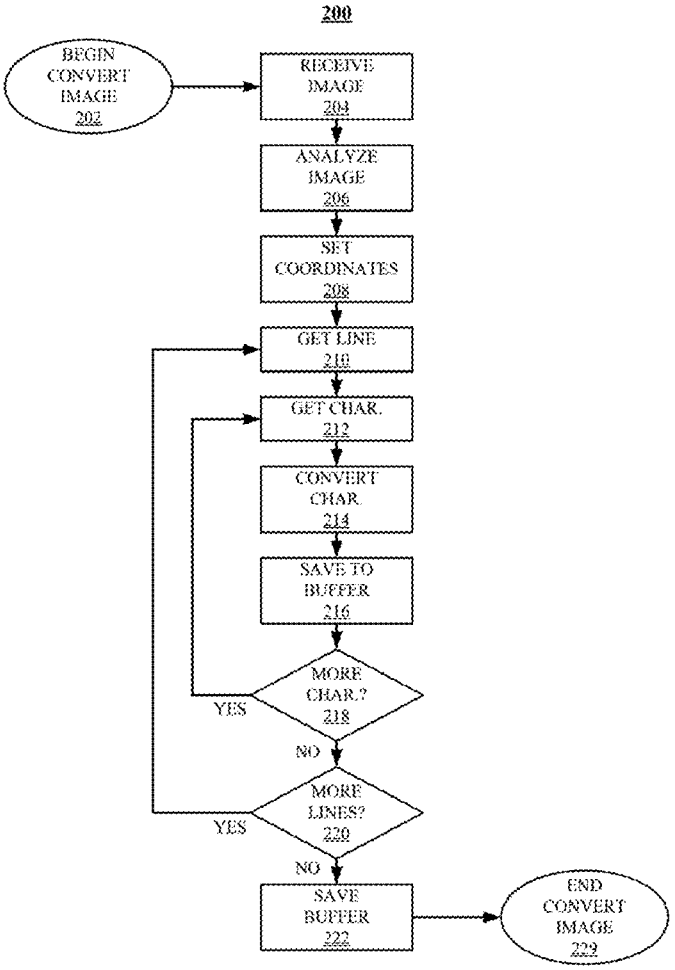


Figure 1

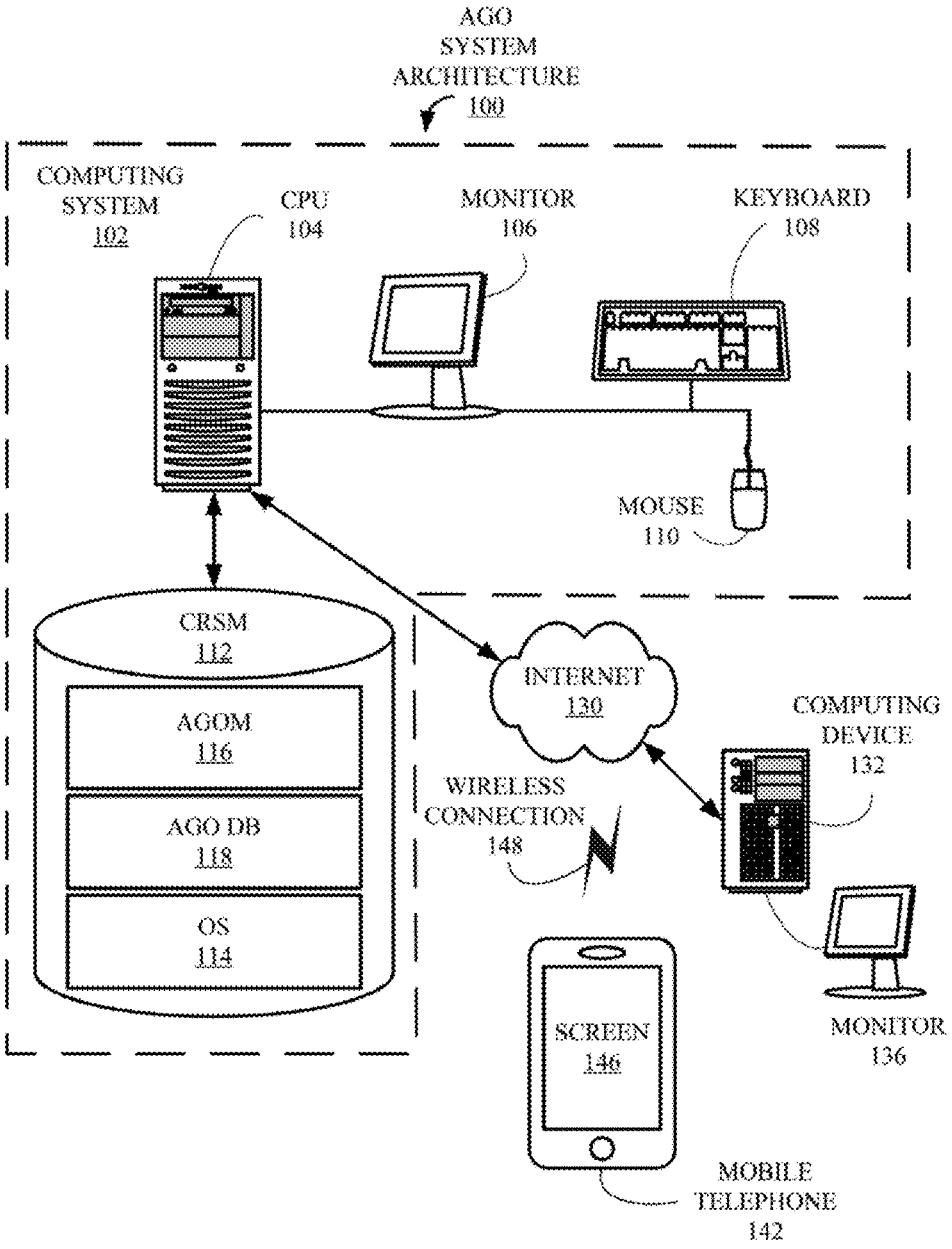

AGO
SYSTEM
ARCHITECTURE
100
COMPUTING
SYSTEM
102
CPU
104
MONITOR
106
KEYBOARD
108
MOUSE
110
CRSM
112
AGOM
116
AGO DB
118
OS
114
INTERNET
130
COMPUTING
DEVICE
132
WIRELESS
CONNECTION
148
SCREEN
146
MONITOR
136
MOBILE
TELEPHONE
142

Figure 2

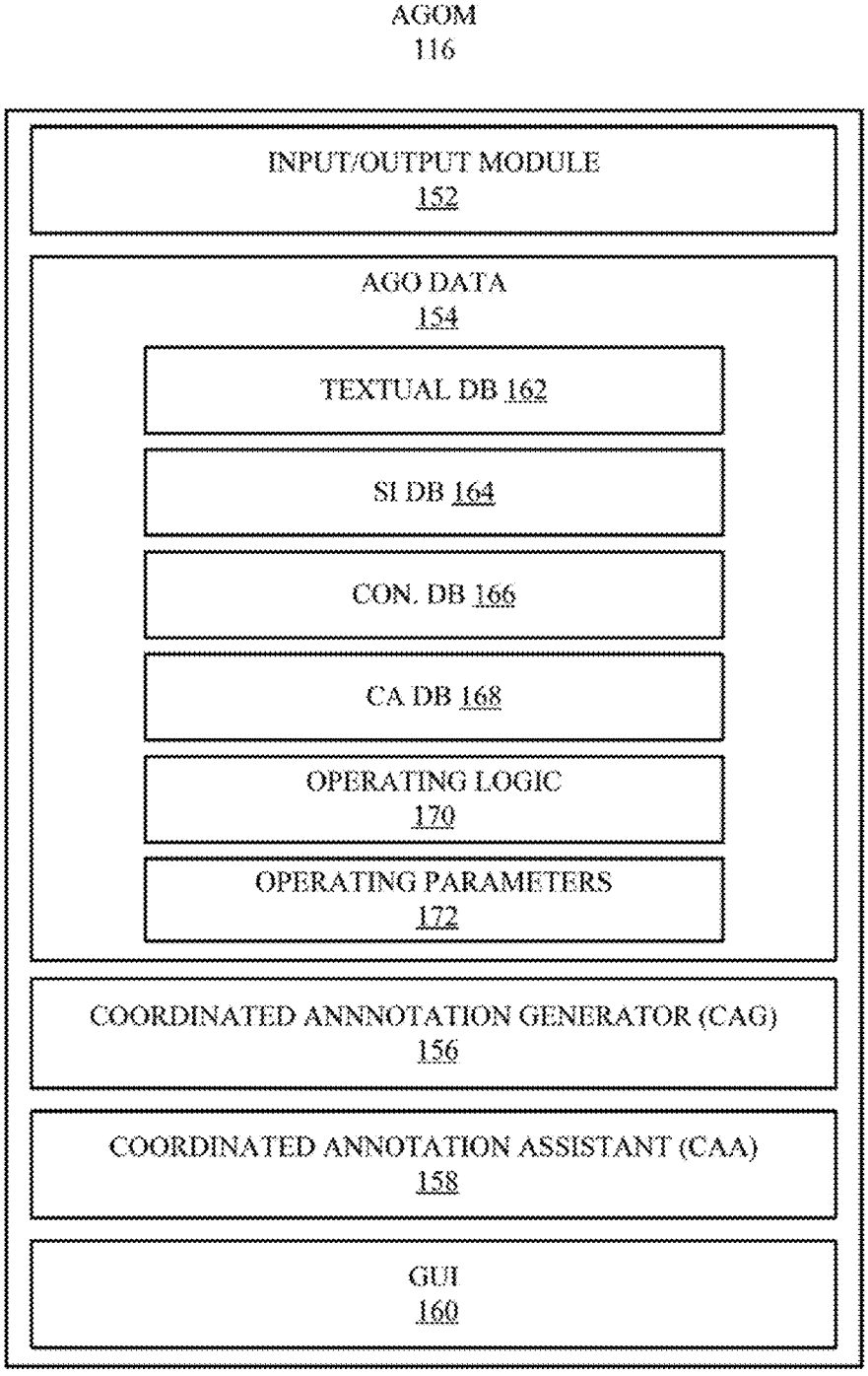

AGOM
116
INPUT/OUTPUT MODULE
152
AGO DATA
154
TEXTUAL DB 162
SI DB 164
CON. DB 166
CA DB 168
OPERATING LOGIC
170
OPERATING PARAMETERS
172
COORDINATED ANNNOTATION GENERATOR (CAG)
156
COORDINATED ANNOTATION ASSISTANT (CAA)
158
GUI
160

Figure 3

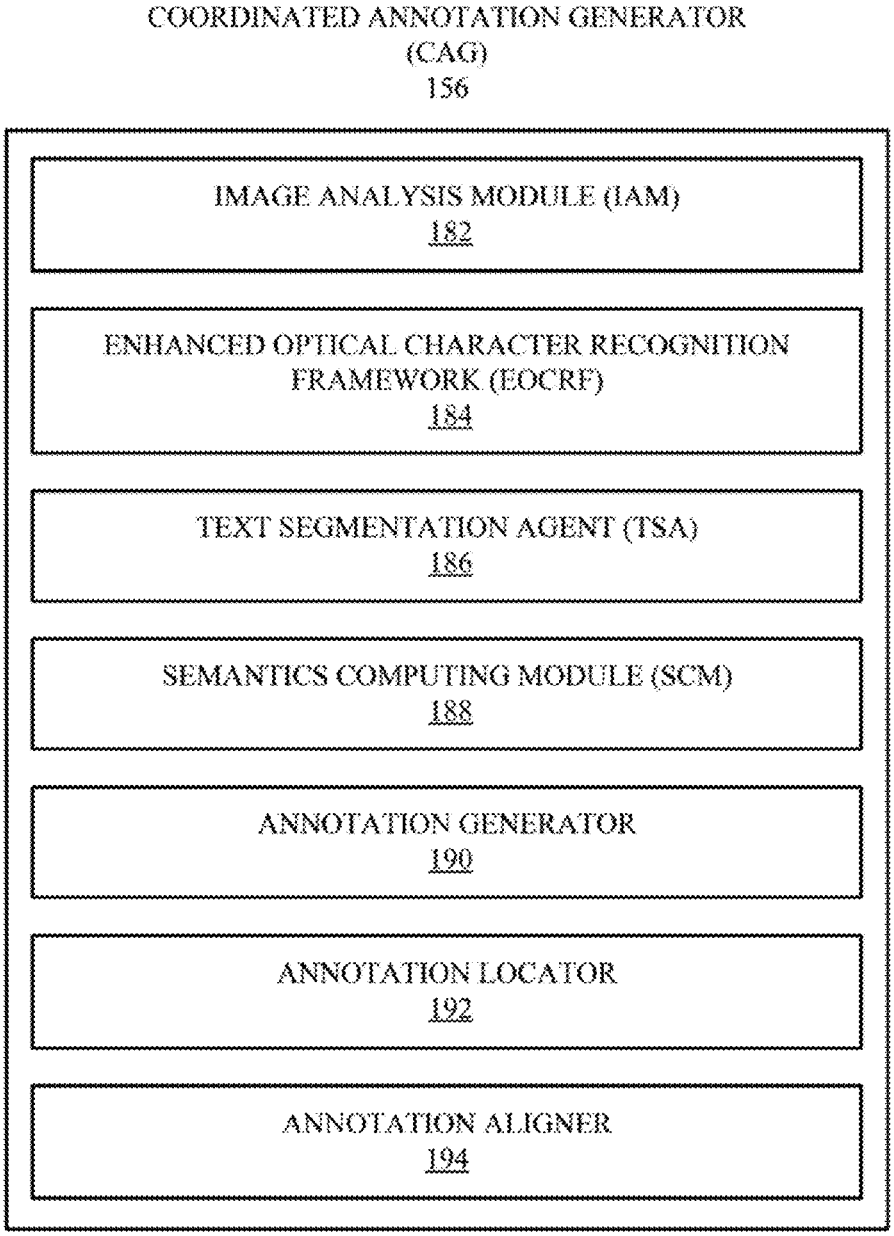

COORDINATED ANNOTATION GENERATOR
(CAG)
156
IMAGE ANALYSIS MODULE (IAM)
182
ENHANCED OPTICAL CHARACTER RECOGNITION
FRAMEWORK (EOCRF)
184
TEXT SEGMENTATION AGENT (TSA)
186
SEMANTICS COMPUTING MODULE (SCM)
188
ANNOTATION GENERATOR
190
ANNOTATION LOCATOR
192
ANNOTATION ALIGNER
194

Figure 4

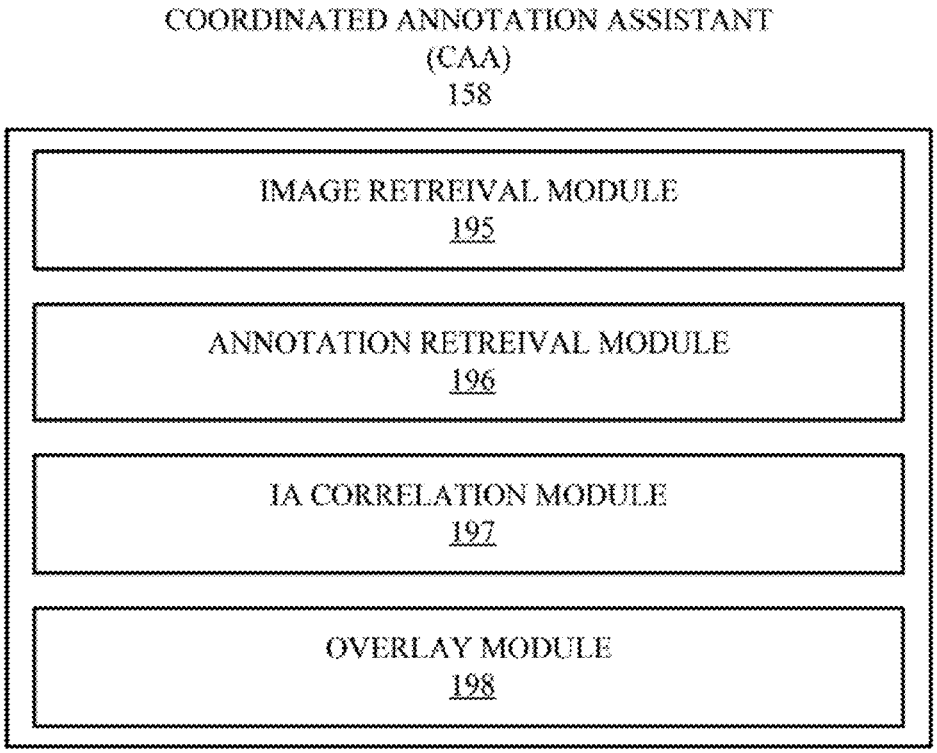

COORDINATED ANNOTATION ASSISTANT
(CAA)
158
IMAGE RETREIVAL MODULE
195
ANNOTATION RETREIVAL MODULE
196
IA CORRELATION MODULE
197
OVERLAY MODULE
198

Figure 5

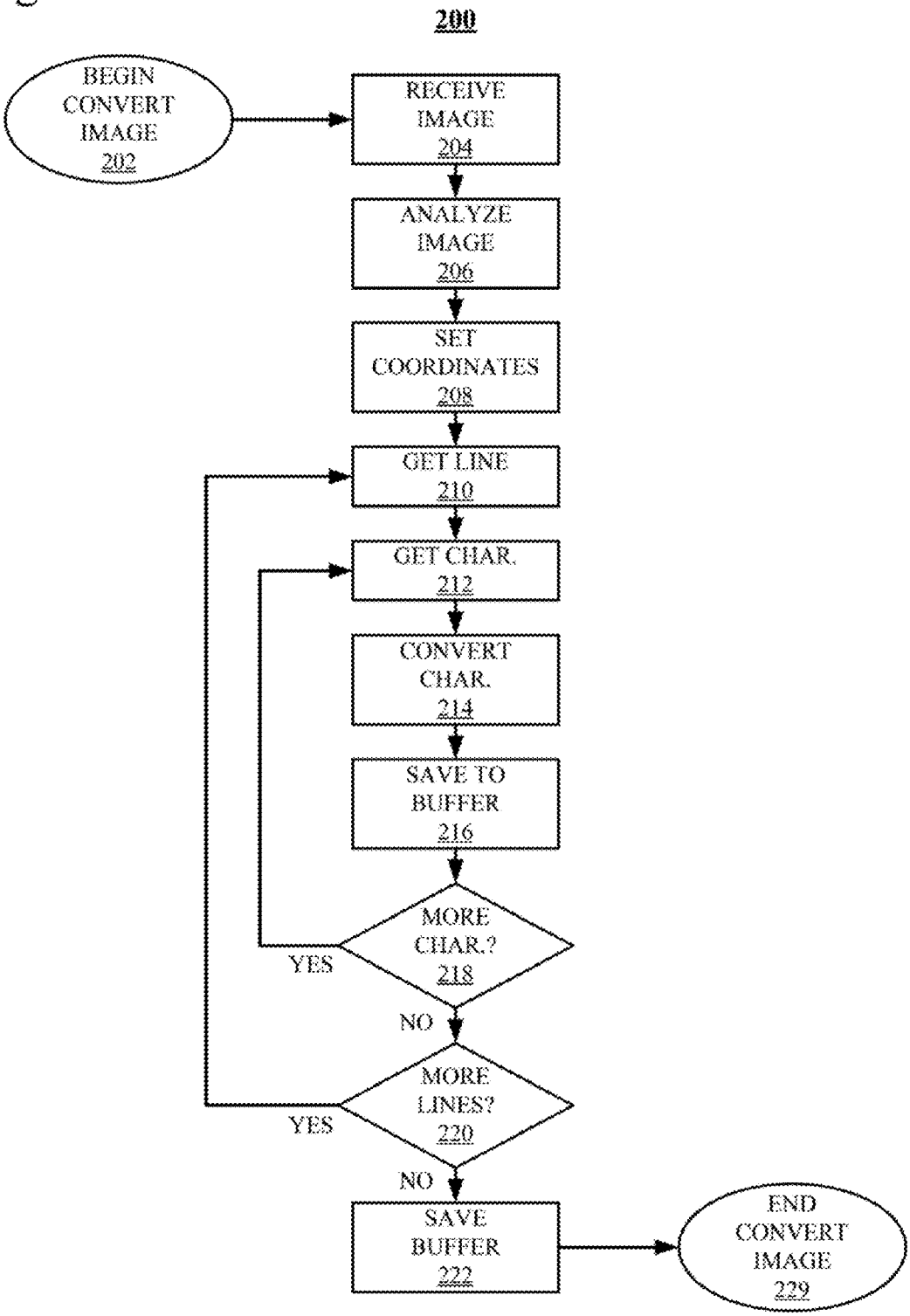

200
BEGIN CONVERT IMAGE 202
RECEIVE IMAGE 204
ANALYZE IMAGE 206
SET COORDINATES 208
GET LINE 210
GET CHAR. 212
CONVERT CHAR. 214
SAVE TO BUFFER 216
MORE CHAR.? 218
YES
NO
MORE LINES? 220
YES
NO
SAVE BUFFER 222
END CONVERT IMAGE 229

Figure 6

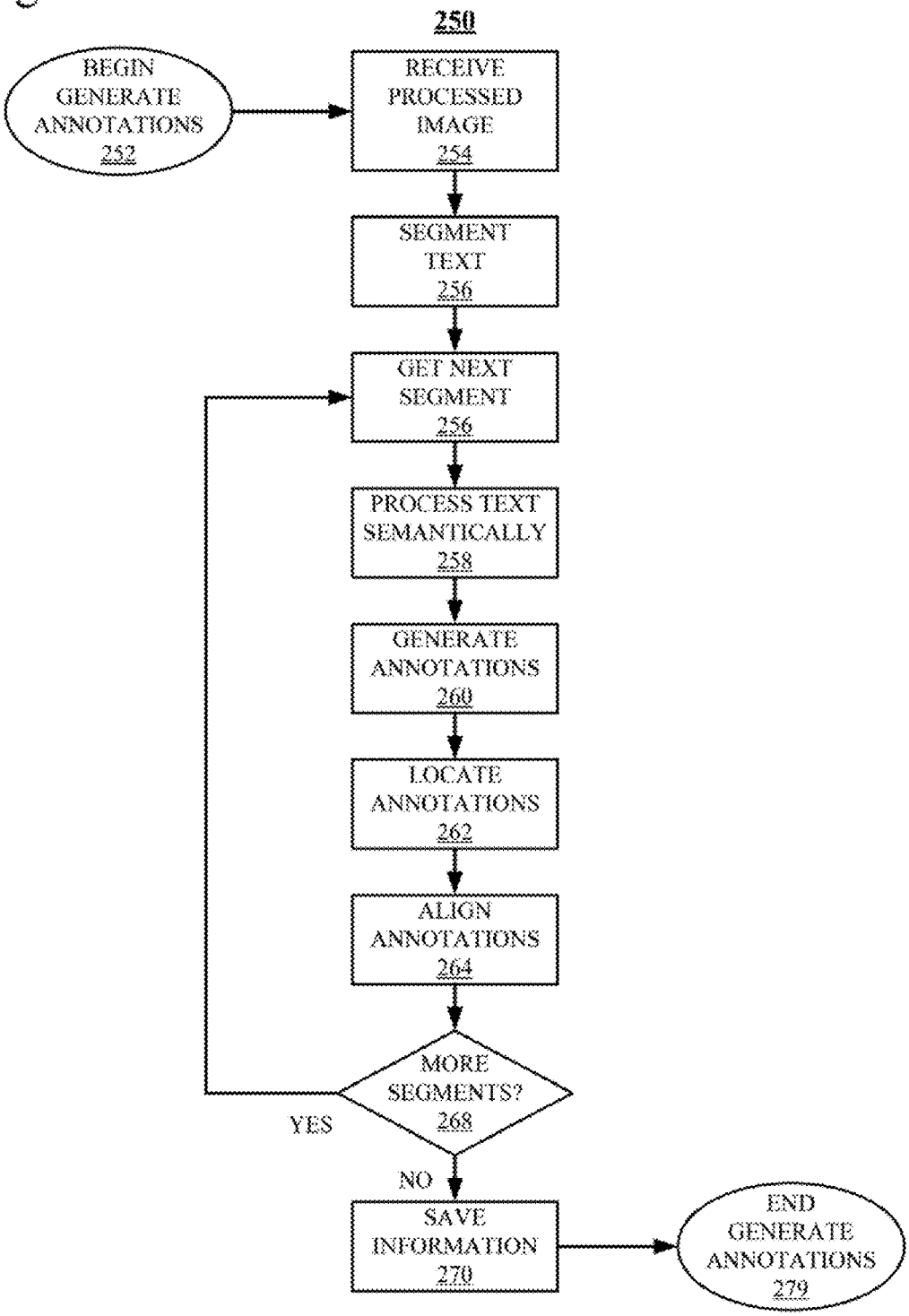

250
BEGIN GENERATE ANNOTATIONS 252
RECEIVE PROCESSED IMAGE 254
SEGMENT TEXT 256
GET NEXT SEGMENT 256
PROCESS TEXT SEMANTICALLY 258
GENERATE ANNOTATIONS 260
LOCATE ANNOTATIONS 262
ALIGN ANNOTATIONS 264
MORE SEGMENTS? 268
YES
NO
SAVE INFORMATION 270
END GENERATE ANNOTATIONS 279

Figure 7

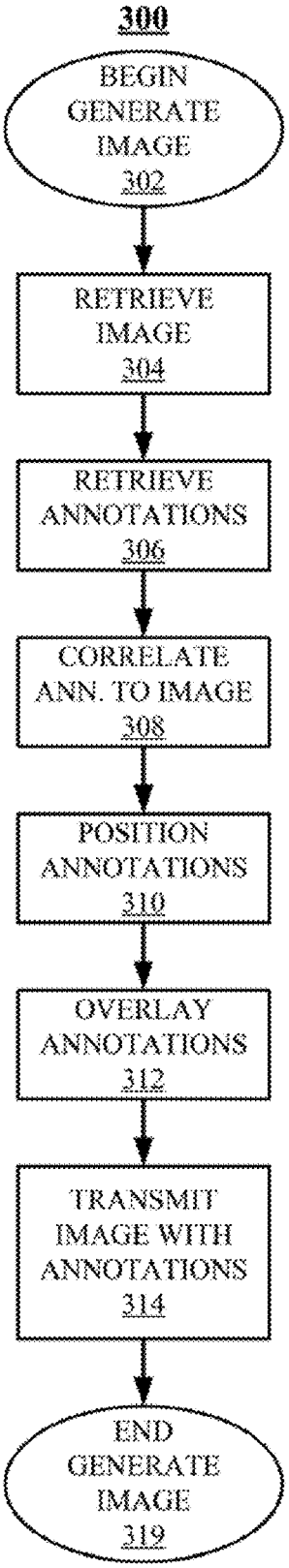
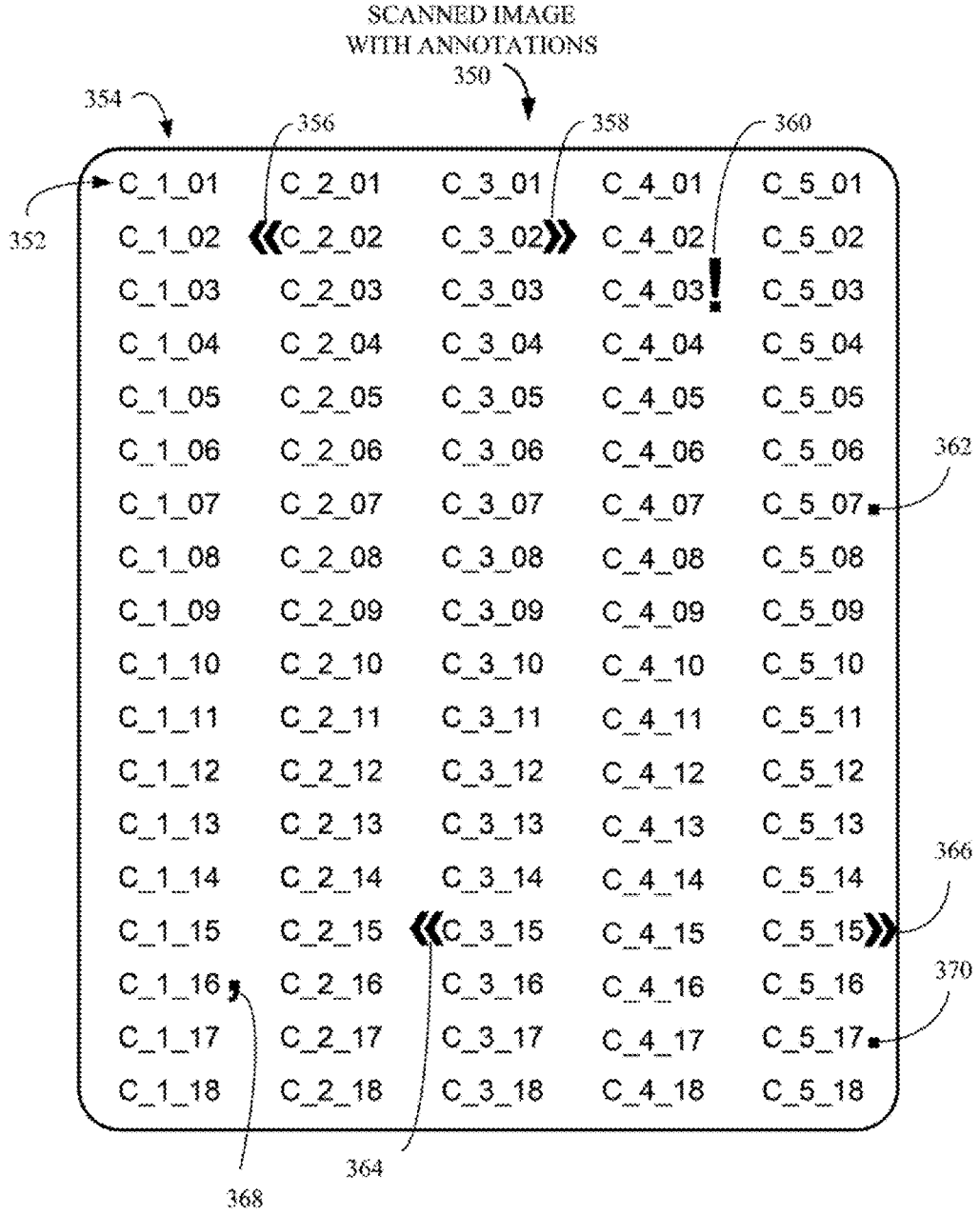

300
BEGIN GENERATE IMAGE 302
RETRIEVE IMAGE 304
RETRIEVE ANNOTATIONS 306
CORRELATE ANN. TO IMAGE 308
POSITION ANNOTATIONS 310
OVERLAY ANNOTATIONS 312
TRANSMIT IMAGE WITH ANNOTATIONS 314
END GENERATE IMAGE 319

Figure 8


SCANNED IMAGE
WITH ANNOTATIONS
350
352
354
356
358
360
362
364
366
368
370
C_1_01 C_2_01 C_3_01 C_4_01 C_5_01
C_1_02 C_2_02 C_3_02 C_4_02 C_5_02
C_1_03 C_2_03 C_3_03 C_4_03 C_5_03
C_1_04 C_2_04 C_3_04 C_4_04 C_5_04
C_1_05 C_2_05 C_3_05 C_4_05 C_5_05
C_1_06 C_2_06 C_3_06 C_4_06 C_5_06
C_1_07 C_2_07 C_3_07 C_4_07 C_5_07
C_1_08 C_2_08 C_3_08 C_4_08 C_5_08
C_1_09 C_2_09 C_3_09 C_4_09 C_5_09
C_1_10 C_2_10 C_3_10 C_4_10 C_5_10
C_1_11 C_2_11 C_3_11 C_4_11 C_5_11
C_1_12 C_2_12 C_3_12 C_4_12 C_5_12
C_1_13 C_2_13 C_3_13 C_4_13 C_5_13
C_1_14 C_2_14 C_3_14 C_4_14 C_5_14
C_1_15 C_2_15 C_3_15 C_4_15 C_5_15
C_1_16 C_2_16 C_3_16 C_4_16 C_5_16
C_1_17 C_2_17 C_3_17 C_4_17 C_5_17
C_1_18 C_2_18 C_3_18 C_4_18 C_5_18

ANNOTATION DATA GENERATION AND OVERLAY FOR ENHANCING READABILITY ON ELECTRONIC BOOK IMAGE STREAM SERVICE

FIELD OF DISCLOSURE

[0001] The claimed subject matter relates generally to techniques for e-book streaming services and, more specifically, to generation and display of annotations in conjunction with displayed images of pages within e-books.

BACKGROUND OF THE INVENTION

[0002] Subscription-based streaming services is a big market. In the USA, e-book stream business sales are approximately four (4) billion dollars in 2015 and as much as fifteen (15) billion dollars globally. Google, Inc. of Mountain, Calif. has scanned more than thirty (30) million books for Google library; Internet Archive is digitizing ancient East Asia books; Fujitsu, Inc. of Tokyo, Japan is scanning three hundred thousand (300,000) Ancient Chinese books for Shanxi Library and, other digitizing vendors are targeting 2,500,000 ancient Chinese books.

[0003] Scanned images may be either delivered directly as an e-book image stream service or converted to textural documents for information processing. Thus, users have options to access scanned images or read converted textual documents through subscribed e-book stream services. Although scanned images of old books can be converted into text using technologies (such as Optical Text Recognition, or "OCR"), in certain cases, the scanned images of the books are preferred for their originality and authenticity. For example, historians and archaeologists may prefer to get first hand materials in their original from, i.e., an image, for the purposes of research and study.

SUMMARY

[0004] Provided are techniques for receiving a scanned image corresponding to a page; analyzing the scanned image to identify a set of characters (Ci) and corresponding positions (Pi) of each character of Ci on the page; applying natural language processing (NPL) and an analytic analysis algorithm to determine a semantic analysis relationship of phrases formed by Ci to determine meanings for the phrases; generating a plurality of annotations (Ai) indicating the determined meanings of the phrases, wherein each annotation of Ai is assigned a corresponding position (Qi) on the page based upon the Pi of the corresponding characters on the page; and storing, in a non-transitory computer-readable medium, the scanned image in conjunction with the plurality of annotations Ai and the corresponding Qi.

[0005] This summary is not intended as a comprehensive description of the claimed subject matter but, rather, is intended to provide a brief overview of some of the functionality associated therewith. Other systems, methods, functionality, features and advantages of the claimed subject matter will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] A better understanding of the claimed subject matter can be obtained when the following detailed description of the disclosed embodiments is considered in conjunction with the following figures, in which:

[0007] FIG. **1** is one example of a computing system architecture that may implement the claimed subject matter.

[0008] FIG. **2** is a block diagram of an Annotation Generation and Overlay Module (AGOM), first introduced in FIG. **1**, in greater detail.

[0009] FIG. **3** is a block diagram of a Coordinated Annotation Generator (CAG)), first introduced in FIG. **2**, that may implement aspects of the claimed subject matter.

[0010] FIG. **4** is a block diagram of a Coordinated Annotation Assistant (CAA), first introduced in FIG. **2**, that may implement aspects of the claimed subject matter.

[0011] FIG. **5** is a flowchart of one example of a Convert Image process that may implement aspects of the claimed subject matter.

[0012] FIG. **6** is a flowchart of one example of a Generate Annotations process that may implement aspects of the claimed subject matter.

[0013] FIG. **7** is a flowchart of a Generate Image process that may implement aspects of the claimed subject matter.

[0014] FIG. **8** is an example of a scanned image with annotations generated in accordance with the disclosed technology.

DETAILED DESCRIPTION

[0015] The present invention may be a system, a method, and/or a computer program product at any possible technical detail level of integration. The computer program product may include a computer readable storage. medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

[0016] The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through as fiber-optic cable), or electrical signals transmitted through a wire.

[0017] Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via as network, for example, the Internet, as local area network, a wide area network and/or a wireless network. The network

may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

[0018] Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, configuration data for integrated circuitry, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++, or the like, and procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

[0019] Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

[0020] These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

[0021] The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0022] The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted in the blocks may occur out of the order noted in the Figures. 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 involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

[0023] Turning now to the figures, FIG. **1** is one example of an Annotation Generation and Overlay (AGO) system architecture **100** that may implement the claimed subject matter. A computing system **102** includes a central processing unit (CPU) **104**, coupled to a monitor **106**, a keyboard **108** and a pointing device, or "mouse," **110**, which together facilitate human interaction with AGO system **100** and computing system **102**. Also included in computing system **102** and attached to CPU **104** is a computer-readable storage medium (CRSM) **112**, which may either be incorporated into computing system **102** i.e. an internal device, or attached externally to CPU **104** by means of various, commonly available connection devices such as but not limited to, a universal serial bus (USB) port (not shown).

[0024] CRSM **112** is illustrated storing an operating system (OS) **114** and an AGO module (AGOM) **116** that incorporates aspects of the claimed subject matter. CRSM **112** also stores an AGO Database (DB) **118** that stores data for the operation and configuration of AGOM **116**. AGOM **116** and AGO DB **118** are explained in more detail below in conjunction with FIGS. **2-7**. In an alternative embodiment, AGO DB **118** may simply be incorporated into AGOM **116** (see **154**, FIG. **3**).

[0025] Computing system **102** is illustrated communicatively coupled to the Internet **130**. Also coupled to Internet **130** are a computing device **132** and a mobile telephone **142**, which is connected to Internet **130** via a wireless connection **148**. Although in this example, computing system **102**, computing device **132** and mobile telephone **142** are communicatively coupled via Internet **130**, they could also be coupled through any number of communication mediums such as, but not limited to, a local area network (LAN) (not shown) and any other types of connections, both wired and wireless.

[0026] Computing device **132** and mobile telephone **142** are used as examples of devices that may take advantage of the claimed subject matter to display annotated, scanned images (see FIG. **6**) generated in accordance with the claimed subject matter. To take advantage of the claimed functionality, computing device **132** includes a monitor **136** and mobile telephone **142** includes a screen **146**. It should be noted that computing system **102**, computing device **132** and mobile telephone **142** would typically include many additional elements but for the sake of simplicity only a few relevant ones are illustrated. Further, it should be noted there are many possible AGO architecture configurations, of which AGO architecture **100** is only one simple example.

[0027] FIG. **2** is a block diagram of Annotation Generation and Overlay Module (AGOM) **116**, first introduced in FIG. **1**, in greater detail. In this example, logic associated with AGOM **116** is stored on CRSM **112** (FIG. **1**) and executed on one or more processors (not shown) of CPU **104** (FIG. **1**) and computing system **102** (FIG. **1**).

[0028] AGOM **116** includes an Input/Output (I/O) module **152**, AGO data **154** (shown as a standalone module AGO DB **118** in FIG. **1**), a Coordinated Annotation Generator (CAG) **156**, a Coordinated Annotation Assistant (CAA) **158** and a graphical user interface (GUI) **160**. I/O module **152** handles any communication AGOM **116** has with other components of computing system **102** and architecture **100** (FIG. **1**). AGO data **154** is a data repository for information and parameters that AGOM **116** requires during normal operation. Although illustrated as part of AGOM **116**, AGO data **154** may also be implemented as a standalone data device (see **118**, FIG. **1**). Examples of the types of information stored in data module **154** include a textual DB **162**, a Scanned image (SI) DB **164**, a Coordination (Con.) DB **166**, a Coordinated Annotation (CA) DB **168**, operating logic **170** and operating parameters **172**. The use of Textual DB **162**, SI DB **164**, Con. DB **166** and CA DB **168** are explained in more detail below in conjunction with FIGS. **3-8**. Operating logic **170** includes executable code for implementing AGOM **116**. Operating parameters **172** includes information on various user and administrative preferences and parameters that have been set.

[0029] CAG **156** is responsible for the processing of scanned images (see **200**, FIG. **5**). CAA **158** is responsible for the display and distribution of images processed in accordance with the claimed subject matter (see **250**, FIG. **6**). Both CAG **156** and CAA **158** are described in greater detail in conjunction with FIGS. **3-7**. GUI **160** enables users AGOM **116** to interact with and to define the desired functionality of AGOM **116**.

[0030] FIG. **3** is a block diagram of Coordinated Annotation Generator (CAG) **156**, first introduced in conjunction with FIG. **2**, in greater detail. As a component of AGOM **116** (FIGS. **1** and **2**), logic associated with CAG **156** is stored on AGOM **112** (FIG. **1**) and executed on one or more processors (not shown) of CPU **104** (FIG. **1**) and computing system **102** (FIG. **1**).

[0031] CAG **156** includes an Image Analysis Module (IAM) **182**, an Enhanced Optical Character Recognition Framework (EOCRF) **184**, a Text Segmentation Module (TSA) **186**, a Semantics Computing Module (SCM) **188**, an Annotation Generator **190**, an Annotation Locator **192** and an Annotation Aligner **194**.

[0032] IAM **182** is responsible for retrieving an image to be processed and determining relevant information about the retrieved image. For example, IAM **182** determines whether an image being processed has been presented in a vertical or horizontal mode. EOCRF **184** extracts textual information from the retrieved image. In addition to extracting textual information like a typical OCR module, EOCRF **184** characters are located in the image and correlated coordination data is recorded and saved into coordination database **166** (FIG. **2**). TSA **186** processes the textual data produced by EOCRF **184** to meaningful phrases within the textual information.

[0033] SCM **188** processes the meaningful phrases identified by TSA **186** to extract semantic compositions for annotation generation. Annotation Generator **190** generates annotation corresponding to the textual information based upon the semantic compositions identified by SCM **188**. Annotation Generator **190** can process different types of documents differently. For example, some annotations may be related to, but are not limited to, punctuation, ancient script interpretation and footnotes. Annotation generator **190** may be implemented as a standalone module or as an add-on functionality or a plug-in module of EOCRF **184**. In addition, Annotation Generator **190** may either produce metadata for a corresponding image or may produce a transparent overlay for the image containing annotations in appropriate positions as though the annotations are part of the image.

[0034] Annotation Locator **192** maps four-corner coordination data to the each character identified by EOCRF **184** so that the data can be used to overlay annotation on the scanned image. Annotation Aligner **194** analyzes the relationship among character location, textual meaning and annotations so that annotations can be precisely aligned with a displayed image (see **300**, FIG. **7**). Components **182**, **184**, **186**, **188**, **190**, **192** and **194** are described in more detail below in conjunction with FIGS. **5-8**.

[0035] FIG. **4** is a block diagram of Coordination Annotation Assistant (CAA) **158**, first introduced in conjunction with FIG. **2**, that may implement aspects of the claimed subject matter. As a component of AGOM **116** (FIGS. **1** and **2**), logic associated with CAA **158** is stored on CRSM **112** (FIG. **1**) and executed on one or more processors (not shown) of CPU **104** (FIG. **1**) and computing system **102** (FIG. **1**).

[0036] CAA **158** includes an Image Retrieval Module **195**, an Annotation Retrieval Module **196**, and Image/Annotation (IA) Correlation module **197** and an Overlay module **198**. Image Retrieval module **195** is responsible for retrieving an image selected for display by a user. In the following examples, an image is selected by a user who is viewing a documents on either monitor **136** (FIG. **1**) or telephone **142** (FIG. **1**). The "selection" of an image may be as simple as tuning a page in a multi-page electronic document. It should be understood that processing associated with CAA **158** may be performed in either a batch mode or a page-by-page mode. In other words, when a user downloads a document to telephone **142**, processing for all the pages may already be completed, either concurrently with a request or off-line, and the only modified images are actually transmitted to telephone **142** or pages are processed only as they are accessed.

[0037] Annotation Retrieval module **196** correlates a particular image with specific annotation data (see **162**, FIG. **2**) and retrieves the relevant annotation data. IA Correlation module **197** determines the proper position of each datum of the annotation data retrieved by Annotation Retrieval mod-

ule **196** with the image retrieved by Image Retrieval module **195**. Overlay module **198** generates a modified image (see FIG. **8**) with the annotation overlaid on the image in appropriate positions as determined by module **197**. This modified image is then transmitted to monitor **136** or telephone **142** for display to the user.

[0038] FIG. **5** is a flowchart of one example of a Convert Image process **200** that may implement aspects of the claimed subject matter. In this example, process **200** is associated with logic stored on CRSM **112** (FIG. **1**) in conjunction with AGOM **116** (FIGS. **1** and **2**) and executed on one or more processors (not shown) of computing system **102** (FIG. **1**).

[0039] Process **200** starts in a "Begin Convert Image" block **202** and proceeds immediately to a "Receive Image" block **204**. During processing associated with block **204**, an image is received for processing. Typically, a document to be processed may be associated with many images such as an image for each page. Process **200** is described in terms of processing images one at a time although such processing would typically be performed in batches. In addition such processing may be performed on demand or in advance to make certain documents available more quickly. Once an image has been received for processing, control proceeds to an "Analyze Image" block **206**. During processing associated with block **206**, the image received during processing associated with block **204** is examined as a whole. In other words, the document is scanned to determine the size and orientation of the image and coordinates of the edges. During processing associated with a "Set Coordinates" block **208**, information identifying the size, orientation and outline of the image is saved in SI DB **164** (FIG. **2**).

[0040] During processing associated with a "Get Line" block **210**, optical character recognition (OCR) technology is employed to determine a line of text in the image, in this example starting at the top of the image and working down. Once a line of text has been identified, a first character in the line is identified in the image, in this example starting at the left and working to the right. Although the following example is described as a top-to-down and left-to-right process, it should be understood that, depending upon the type of image, some character sets are read and thus processed in a different manner. For example, some documents are typically read from right-to-left or bottom-to-top.

[0041] During processing associated with a "Get Next Character (Char.)) block **212**, an unprocessed character in the line retrieved during processing associated with block **210** is identified for processing. During processing associated with a "Convert Character (Char.)" block **214**, the image of the character identified during processing associated with block **212** is analyzed to determine a textual equivalent. In addition, information identifying a position, or coordinate, of the character within the image is generated. During processing associated with a "Save to Buffer" block **216**, the textual equivalent and position information of the character are stored in a temporary buffer (not shown).

[0042] During processing associated with a "More Char.?" block **218**, a determination is made as to whether or not the line identified during processing associated with block **210** has any unprocessed, or converted, characters. If so, control returns to Get Char. block **212**, the next unprocessed character is identified and processing continues as described above. If a determination is made that there are no addition characters, control proceeds to a "More Lines?" block **220**. During processing associated with block **220**, a determination is made as to whether or not there are any additional, unprocessed lines in the image. If so, control returns to Get Line block **210**, the next line is identified and processing continues as described above.

[0043] If, during processing associated with block **220**, a determination is made that there are no unprocessed lines, control proceeds to a "Save Buffer" block **222**. During processing associated with block **222**, information in the temporary buffer (see **216**) is stored in textual DB **162** (FIG. **2**) and Con. DB **166** (FIG. **2**) for further processing. Finally, once the temporary buffer has been saved, control proceeds to an "End Convert Image" block in which process **200** is complete.

[0044] FIG. **6** is a flowchart of one example of a Generate Annotations process **250** that may implement aspects of the claimed subject matter. In this example, like process **200**, process **250** is associated with logic stored on CRSM **112** (FIG. **1**) in conjunction with AGOM **116** (FIGS. **1** and **2**) and executed on one or more processors (not shown) of computing system **102** (FIG. **1**).

[0045] Process **250** starts in a "Begin Generate Annotations" block **252** and proceeds immediately to a "Receive Processed Image" block **254**. During processing associated with block **254**, an image processed in accordance with process **200** (FIG. **5**) is retrieved from SI DB **164** (FIG. **2**) along with corresponding textual information from textual DB **162** (FIG. **2**). During processing associated with a "Segment Text" block **256**, the image and corresponding data received during processing associated with block **254** are analyzed by TSA **186** (FIG. **3**) to identify "meaningful phrases." It should be understood that the identification of meaningful phrases is typically language dependent and there are a number of commercially available different segmentation algorithms from which to choose. During processing associated with a "Get Next Segment" block **256**, an unprocessed segment identified during processing associated with block **254** is identified for processing.

[0046] During processing associated with a "Process Text Semantically" block **258**, the segment identified during processing associated with block **256** is analyzed by SCM **188** (FIG. **3**) to generate meaningful information, or semantic compositions, related to the segment. Examples such information includes, but is not limited to, translations, references to other works, explanations and so on. During processing associated with a "Generate Annotations" block **260**, the semantic compositions generated during processing associated with block **258** are converted into annotations (see **190**, FIG. **3**) that may be displayed on the image received during processing associated with block **254**. During processing associated with a "Locate Annotations" block **262**, appropriate positions for the annotations generated during processing associated with block **260** are calculated by IA Correlation module **197** (FIG. **4**). The annotations are then aligned with the image in during processing associated with an "Align Annotations" block **264**. It should he understood that there are different possible styles for the positioning and alignment of annotations, all of which may be presented in accordance with the claimed subject matter, depending upon the configuration desired for any particular document. For example, annotations may be presented within the text of a document or at the bottom of a page.

[0047] During processing associated with a "More Segments?" block **268**, a determination is made as to whether or

not there are additional, unprocessed segments in the image received during processing associated with block **254**. If so, control returns to Get Next Segment block **256**, another segment is identified for processing and processing continues as described above. If there are not addition, unprocessed segments, control proceeds to a "Save Information" block **270** during which the information generated during processing associated with blocks **256**, **258** **260**, **262**, **264** and **266** is saved to the appropriate data storages in AGO Data **154** (FIG. **2**). Finally, control proceeds to an "End Generate Annotations" block **279** during which process **250** is complete.

[0048] FIG. **7** is a flowchart of a Generate Image process **300** that may implement aspects of the claimed subject matter. In this example, like processes **250** and process **300**, process **300** is associated with logic stored on CRSM **112** (FIG. **1**) in conjunction with AGOM **116** (FIGS. **1** and **2**.) and executed on one or more processors (not shown) of computing system **102** (FIG. **1**).

[0049] Process **300** starts in a "Begin Generate Image" block **302** and proceeds immediately to a "Retrieve Image" block **304**. During processing associated with block **304**, an image requested by, in this example, computing device **132** (FIG. **1**) or mobile telephone **142** (FIG. **1**) for display in accordance with the claimed subject matter is retrieved from SI DB **164** (FIG. **2**). During processing associated with a "Retrieve Annotations" block **306**, annotations corresponding to the image retrieved during processing associated with block **304** (see **190**, FIG. **3**; **260**, FIG. **6**) are retrieved from Con. DB **166** (FIG. **2**). During processing associated with a "Correlate Annotations (Ann.) to Image" block **308**, the annotations retrieved during processing associated with block **306** and the image retrieved during processing associated with block **304** are coordinated with respect to the text within the image from textual DB **162** (FIG. **2**).

[0050] During processing associated with a "Position Annotations" block **310**, the annotations are positioned with respect to the image. As explained above in conjunction with FIG. **6**, annotations may be placed in different positions depending upon a desired configuration. During processing associated with an "Overlay Annotations" block **312**, the annotations and the image are combined. This may be accomplished either by modifying the image to include the annotations or by generating a transparent overlay that includes the annotations for placement over the image.

[0051] During processing associated with a "Transmit Image with Annotations" block **314**, the image or image and overlay generated during processing associated with block **312** is transmitted for display to the device, such as telephone **142**, that requested the image. Finally, control proceeds to an "End Generate Image" block **319** during which process **300** is complete.

[0052] FIG. **8** is an example of a scanned image with annotations **350** generated in accordance with the disclosed technology. In this example, image **350** is displayed on screen **146** (FIG. **1**) of mobile telephone **142** (FIG. **1**). The scanned image is composed of a number of minimum character/word/phrase blocks, hereinafter simply referred to a "characters" for the sake of simplicity, organized into rows and columns and represented as "C_1_01," "C_2_01." and so on. In should be understood that the illustrated characters in FIG. **8** are meta-characters that represent the any of many different character/word/phrase blocks that may be in a scanned document. The first number in each meta-character, e.g., the '1' in "C_1_01," represents the column and the second numbers, e.g., the "01," represent the row. For the sake of simplicity, only the first row **352** and the first column **354** are labeled. For example, the meta-character "C_3_13" represents a character in the third (3^{rd}) column and the thirteenth (13^{th}) row. it should be understood this particular notation is being employed to represent any actual characters that may be within a scanned document. It should be noted that the column and row may be, but are not limited to, either character based row and column index, such as in Chinese, Japanese, Latin, and Cyrillic scripts, or pure coordinator system for composing word and phrase blocks, such as in Arabic, Urdu and Indie. Further, it should be noted that the claimed subject matter covers all languages and layout cases. In some languages, such as Arabic and Urdu, "characters" may be connected even when typewritten and may have multiple different shapes according to their position in a word.

[0053] Actual characters may be letters that form words in languages such as English or Russian or characters found in languages such as Arabic, Chinese or Japanese that represent entire words or phrases. In addition, although described as organized from right-left and then top-to-bottom, other character sets may be organized in a different fashion. The examples provided should not limit the languages or types of characters that might be found in a scanned document.

[0054] In addition to the characters in a particular scanned document, FIG. **8** also illustrates annotation generated in accordance with the claimed subject matter. In this example, a word or phrase represented by the meta-characters "C_2_02" and "C_3_02" are enclosed in a pair of brackets, i.e., a left_double_angle_bracket **356** and a right_double_angle_bracket **358**. Brackets **356** and **358** indicate that the enclosed word or phrase has a corresponding annotation that may be viewed by positioning a pointing device, such as mouse **110** (FIG. **1**), within brackets **356** and **358** and "clicking" mouse **110**. The choice of brackets to enclose characters is arbitrary and does not affect the scope of the claimed subject matter. Punctuation mark, or exclamation mark '!' **360**, and periods, or '.' **362** and **370** and a comma, or ',' **368** are also illustrated. There are also an additional pair of brackets **364** and **366**. The choice of specific punctuation marks is typically dependent upon a particular language or character set and the ones illustrated are merely used for explanatory purposes.

[0055] As explained above in conjunction with FIGS. **1-7**, annotations **356**, **358**, **360**, **362**, **364**, **366**, **368** and **370**, which have been generated in accordance with the disclosed technology, are either placed into the scanned image represented by characters C_01_01, C_2-01 through C_5_18 or placed in a transparent overlay and displayed in conjunction with the scanned image.

[0056] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0057] The corresponding structures, materials, acts, and equivalents of all means or step plus function elements in the claims below are intended to include any structure, material, or act for performing the function in combination with other claimed elements as specifically claimed. The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The embodiment was chosen and described in order to best explain the principles of the invention and the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

[0058] The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function (s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. 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 involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, ear combinations of special purpose hardware and computer instructions.

1-7. (canceled)

8. An apparatus, comprising:

a processor;

a computer-readable storage device coupled to the processor; and

instructions, stored on the computer-readable storage device and executed on the processor, for performing a method, the method comprising:

receiving a scanned image corresponding to a page of text;

analyzing the scanned image to identify a set of characters (Ci) and corresponding positions (Pi) of each character of Ci on the page;

applying natural language processing (NPL) and an analytic analysis algorithm to determine a semantic analysis relationship of phrases formed within Ci and to determine meanings for the phrases;

generating a plurality of annotations (Ai) indicating the determined meanings of the corresponding phrases, wherein each annotation of Ai is assigned a corresponding position Qi on the page based upon the Pi of the corresponding characters on the page; and

storing, in a non-transitory computer-readable medium, the scanned image in conjunction with the plurality of annotations and the corresponding Qi.

9. The apparatus of claim **8**, the method further comprising:

generating a transparent overly comprising the plurality of annotations, each annotation at the corresponding Qi; and

transmitting, to a display device for display on the display device, the scanned image and the transparent overly.

10. The apparatus of claim **8**, the method further comprising:

superimposing the plurality of annotations on the scanned image, each annotation at the corresponding Qi, to produce a modified scanned image; and

transmitting, to a display device for display on the display device, the modified scanned image.

11. The apparatus of claim **8**, wherein the annotations are punctuation corresponding to textual content of the scanned image.

12. The apparatus of claim **8**, wherein the annotation is reference notes corresponding to the phrases.

13. The apparatus of claim **8**, wherein each characters of Ci represents a letter.

14. The apparatus of claim **8**, wherein each character of Ci represents a word.

15. A computer programming product for the production of annotated images, comprising a non-transitory computer-readable storage medium having program code embodied therewith, the program code executable by a plurality of processors to perform a method comprising:

receiving a scanned image corresponding to a page of text;

analyzing the scanned image to identify a set of characters (Ci) and corresponding positions (Pi) of each character of Ci on the page;

applying natural language processing (NPL) and an analytic analysis algorithm to determine a semantic analysis relationship of phrases formed within Ci and to determine meanings for the phrases;

generating a plurality of annotations (Ai) indicating the determined meanings of the corresponding phrases, wherein each annotation of Ai is assigned a corresponding position Qi on the page based upon the Pi of the corresponding characters on the page; and

storing, in a non-transitory computer-readable medium, the scanned image in conjunction with the plurality of annotations and the corresponding Qi.

16. The computer programming product of claim **15**, the method further comprising:

generating a transparent overly comprising the plurality of annotations, each annotation at the corresponding Qi; and

transmitting, to a display device for display on the display device, the scanned image and the transparent overly.

17. The computer programming product of claim **15**, the method further comprising:

superimposing the plurality of annotations on the scanned image, each annotation at the corresponding Qi, to produce a modified scanned image; and

transmitting, to a display device for display on the display device, the modified scanned image.

18. The computer programming product of claim **15**, wherein the annotations are punctuation corresponding to textual content of the scanned image.

19. The computer programming product of claim **15**, wherein the annotation is reference notes corresponding to the phrases.

20. The computer programming product of claim **15**, wherein each characters of Ci represents a letter.

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