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Contextual text lookup for images

Abstract

The subject technology provides for contextual text lookup for images. When a request is received by an electronic device to perform a lookup or search for text in an image that is displayed at the electronic device, the electronic device may obtain one or more search results, based on the text itself and based on contextual information derived, by the electronic device, from the image. In one or more implementations, application information associated with an application that displays the image may also be used as contextual metadata for enhancing the results of the search for the text from the image.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application claims the benefit of priority to U.S. Provisional Patent Application No. 63/336,987, entitled, “Contextual Text Lookup for Images”, filed on Apr. 29, 2022, the disclosure of which is hereby incorporated herein in its entirety.

TECHNICAL FIELD

(1) The present description generally relates to machine learning, including, for example, using machine learning for contextual text lookup for images.

BACKGROUND

(2) Conventional search engines are configured to perform searches for strings of text, typically entered by a user into a browser application at an end user's device. For example, a user of an electronic device that sees a product name may open a browser application, type the product name into the browser application, and submit the typed text to a search engine for lookup via the browser application.

Description

BRIEF DESCRIPTION OF DRAWINGS

(1) Certain features of the subject technology are set forth in the appended claims. However, for purpose of explanation, several embodiments of the subject technology are set forth in the following figures.

(2) FIG. 1 illustrates an example network environment in accordance with one or more implementations of the subject technology.

(3) FIG. 2 illustrates an example system in accordance with one or more implementations of the subject technology.

(4) FIG. 3 illustrates an example of an electronic device displaying an image in accordance with one or more implementations of the subject technology.

(5) FIG. 4 illustrates an example of an electronic device displaying context-based search results for image text in accordance with one or more implementations of the subject technology.

(6) FIG. 5 illustrates a flowchart of an example process that may be performed by an electronic device for contextual text lookup for an image in accordance with one or more implementations of the subject technology.

(7) FIG. 6 illustrates a flowchart of another example process that may be performed by an electronic device for contextual text lookup for an image in accordance with one or more implementations of the subject technology.

(8) FIG. 7 illustrates a flowchart of an example process that may be performed by a server for contextual text lookup for an image in accordance with one or more implementations of the subject technology.

(9) FIG. 8 illustrates an example electronic system with which aspects of the subject technology may be implemented in accordance with one or more implementations.

DETAILED DESCRIPTION

(10) The detailed description set forth below is intended as a description of various configurations of the subject technology and is not intended to represent the only configurations in which the subject technology can be practiced. The appended drawings are incorporated herein and constitute a part of the detailed description. The detailed description includes specific details for the purpose of providing a thorough understanding of the subject technology. However, the subject technology is not limited to the specific details set forth herein and can be practiced using one or more other implementations. In one or more implementations, structures and components are shown in block diagram form in order to avoid obscuring the concepts of the subject technology.

(11) Electronic devices are provided that can recognize text in an image being displayed by the electronic device, and provide a user with options to select or otherwise interact with the recognized text in the image. In one or more implementations, the user may request a search for (e.g., a lookup of) some or all of the text a displayed image.

(12) In accordance with one or more implementations, the subject technology provides improved

text lookup for text identified in an image displayed by an electronic device, by using other contextual information in the image, and/or associated with the image, to enhance the search results. For example, contextual information may be derived from the image and may include other text in the image or on the screen, an object type of an object in the image or on the screen, one or more embeddings of portions of the image, application information for an application displaying the image, location information for the image and/or for the device displaying the image, or any other information that can be extracted from or derived from the image.

(13) In accordance with various implementations, the contextual information can be used to locally rank server-provided search results at the device displaying the image, or the contextual information can be sent to a server with the selected text to enhance the search results from the server. The server-provided search results can also be displayed with locally generated dictionary results (e.g., a dictionary entry for word or words in the selected text) in one or more implementations.

(14) FIG. 1 illustrates an example network environment **100** in accordance with one or more implementations of the subject technology. Not all of the depicted components may be used in all implementations, however, and one or more implementations may include additional or different components than those shown in the figure. Variations in the arrangement and type of the components may be made without departing from the spirit or scope of the claims as set forth herein. Additional components, different components, or fewer components may be provided.

(15) The network environment **100** includes a computing device **110** (also referred herein to as an electronic device), and a server **120**. The network **106** may communicatively (directly or indirectly) couple the computing device **110** and/or the server **120**. In one or more implementations, the network **106** may be an interconnected network of devices that may include, or may be communicatively coupled to, the Internet. For explanatory purposes, the network environment **100** is illustrated in FIG. 1 as including the computing device **110**, and the server **120**; however, the network environment **100** may include any number of electronic devices and any number of servers.

(16) The computing device **110** may be, for example, a desktop computer, a portable computing device such as a laptop computer, a smartphone, a peripheral device (e.g., a digital camera, headphones), a tablet device, a wearable device such as a watch, a band, and the like. In FIG. 1, by way of example, the computing device **110** is depicted as a smartphone. The computing device **110** may be, and/or may include all or part of, the systems discussed below with respect to FIG. 2 and/or FIG. 8.

(17) In one or more implementations, the computing device **110** may provide a system for training a machine learning model using training data, where the trained machine learning model is subsequently deployed locally at the computing device **110**. Further, the computing device **110** may provide one or more frameworks for training machine learning models and/or developing applications using the machine learning models. In an example, the computing device **110** may be a user device (e.g., a smartphone, a tablet device, a laptop computer, a desktop computer, a wearable electronic device, etc.) that displays an image that includes selectable and/or searchable text. In one or more implementations as described herein, the computing device **110** may communicate with a server **120** (e.g., a back-end server or a search server), such as to obtain search results (e.g., context-based search results) for text in an image displayed by the computing device **110**.

(18) In an implementation, the server **120** may train one or more machine learning models for deployment to a client electronic device (e.g., the computing device **110**). In other implementations, the server **120** may provide a system for training a machine learning model using training data, where the trained machine learning model is subsequently deployed locally at the server **120**. The machine learning model may be deployed on the server **120** and/or the computing device **110** may then perform one or more machine learning algorithms. In one or more implementations, the server **120** may provide a cloud service that utilizes the trained machine learning model and is continually

refined over time. The server **120** may be, and/or may include all or part of, the systems discussed below with respect to FIG. 2 and/or FIG. 8.

(19) FIG. 2 illustrates an example system **200** in accordance with one or more implementations of the subject technology. In an example, the system **200** may be implemented in computing devices, such as the computing device **110**. In another example, the system **200** may be implemented either in a single device or in a distributed manner in a plurality of devices, the implementation of which would be apparent to a person skilled in the art.

(20) In an example, the system **200** may include a processor **202**, memory **204** (memory device) and a communication unit **210**. The memory **204** may store data **206** and one or more machine learning models **208**. In an example, the system **200** may include or may be communicatively coupled with a storage **212**. Thus, the storage **212** may be either an internal storage or an external storage. In the example of FIG. 2, the system **200** includes one or more camera(s) **211**, a display **214**, and one or more sensors(s) **216**. Camera(s) **211** may be operable to capture images, and may be mounted on front surface, a rear surface, or any other suitable location on the computing device **110** of FIG. 1. The display **214** may be operable to display images captured by the camera(s) **211** and/or received from another device or system and stored in storage **212** or in the memory **204**. Displayed images may include captured still images, live preview image frames from the camera(s) **211**, video frames, or any other digital images. Sensor(s) **216** may include location sensors (e.g., satellite positioning system sensors), motion sensors (e.g., inertial sensors), and/or depth sensors (e.g., stereo cameras, LIDAR sensors, radar sensors, time-of-flight sensors, or the like).

(21) In an example, the processor **202** may be a single processing unit or multiple processing units. The processor **202** may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor **202** is configured to fetch and execute computer-readable instructions and data stored in the memory **204**.

(22) The memory **204** may include any non-transitory computer-readable medium known in the art including, for example, volatile memory, such as static random access memory (SRAM) and dynamic random access memory (DRAM), and/or non-volatile memory, such as read-only memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

(23) The data **206** may represent, amongst other things, a repository of data processed, received, and generated by one or more processors such as the processor **202**. One or more of the aforementioned components of the system **200** may send or receive data, for example, using one or more input/output ports and one or more communication units.

(24) The machine learning model(s) **208**, in an example, may include one or more of machine learning based models and artificial intelligence-based models, such as, for example, neural networks, or any other models and/or machine learning architectures. In an example, the machine learning model(s) **208** may be trained using training data (e.g., included in the data **206** or other data) and may be implemented by the processor **202** for performing one or more of the operations, as described herein.

(25) In an example, the communication unit **210** may include one or more hardware units that support wired or wireless communication between the processor **202** and processors of other computing devices.

(26) In an example, an image may be displayed by the computing device **110** implementing the system **200**. The image may be stored in the storage **212**, the memory **204**, and/or may be received from a remote device or server. The image may be displayed in an image viewing application of the computing device **110**. In another example, the image may be displayed by a browser application, a social media application, a digital media player application, that can display images. In another example, the computing device **110** may display a live preview of a field of view, as captured by a

camera of the computing device **110**. According to an implementation of the present subject technology, the processor **202** may be configured to obtain the image being displayed by an application running on the computing device **110**. For example, the processor **202** may determine that an image is being displayed or is about to be displayed by an application running at the computing device, and may provide the image and/or a portion thereof to one or more of the machine-learning models **208**.

(27) The machine learning model(s) **208** may be trained to identify text, and/or one or more elements of interest in the image. For example, one or more of the machine-learning models may be configured to recognize text in an image displayed on the display **214**. For example, one or more of the machine learning model(s) **208** may receive the image as input and then output an object type of an object in the image and/or may output one or more embeddings of portions of the image. The processor **202** may also obtain other contextual information for the image, such as application information indicating the application that is displaying the image, and/or location information for the image and/or for the computing device **110** and/or system **200**.

(28) In one or more implementations, the processor **202** (e.g., using machine learning model(s) **208**) may identify the elements of interest in the image. As examples, a smart camera model may be implemented to detect any text, if present, in the image, an object detector may be implemented for identifying and/or classifying objects present in the image, and/or a gating model (also referred to herein as a coarse-classification model) may be implemented to classify the objects present in the image. In yet another example, a scene classification model may be implemented to detect and classify the overall scene depicted in the image. Thus, by implementing and/or executing the machine learning model(s) **208**, the processor **202** may derive contextual information from an image, such as by determining various types of elements of interest in the image, and/or extracting features, information, and/or other signals from the image.

(29) FIG. 3 illustrates an example in which the computing device **110** displays an image **300**. In this example, the image **300** is displayed by an application running on the computing device **110**, and an application identifier (ID) **308** for the displaying application is displayed with the image on the display **302** of the computing device **110**. For example, the display **302** of FIG. 3 may be an implementation of the display **214** of system **200** of FIG. 2, in one or more implementations. In the example of FIG. 3, additional information is also displayed with the image **300** on the display **302** of the computing device **110**. In this example, the additional information includes application controls **310** for the application displaying the image **300**, a current time **304**, and a location indicator **306** (e.g., indicating the current location of the computing device **110** is known, such as based on sensor data from sensor(s) **216**). For example, the application controls **310** maybe virtual buttons or other interactive features of the application that is displaying the image **300** (e.g., control buttons or interactive features for controlling a browser application, an image display application, a social media application, a camera application, a media playback application, etc.).

(30) In the example of FIG. 3 the image **300** includes image text **312**, image text **318**, and objects such as a foreground object **314** and a background object **316**. As discussed herein in connection with, for example, FIG. 2, the computing device **110** may identify an object type (e.g., a classification) of the objects (e.g., foreground object **314** and/or background object **316**) in the image **300**. The computing device **110** may also recognize the image text **312** and the image text **318**, and modify the display of the image **300** to make the image text **312** and/or the image text **318** selectable and/or searchable. For example, once the computing device **110** makes the image text **312** and the image text **318** selectable, a user can tap or touch the location of the displayed text in the image **300**, causing a selection tool or highlighter to surface for selection of the displayed text in the image **300**. In this example, once the image text **312** and/or the image text **318** is highlighted or otherwise selected, the user can again tap or “right-click” on the selected text to surface options, such as a search or lookup option that causes the computing device **110** to obtain search results for the selected text.

(31) As an example, in one or more implementations, a user of the computing device **110** can interact with the image **300** using a finger, a cursor, or other input mechanism to select the image text **312**, and can initiate a search for the selected image text **312**. In another example, the user may see the image text **312** (or otherwise be provided with information indicating the presence of the image text **312**) in the displayed image **300** and use a voice input to a virtual assistant application running on the computing device **110** to request a search for the image text **312** that is included in the displayed image **300**.

(32) In one illustrative example, the image **300** may be an image of a storefront and the image **300** may include image text **312** indicating the name of the store. However, a search for only the image text indicating the name of the store may return search results that are not relevant to the store. For example, an image of a restaurant named “Butterfly” may be displayed on a user's smart phone, and the user may request a search for the text “Butterfly” displayed in the image **300**. However, because “butterfly” is a term that is not generally associated with restaurants, the search results may be unrelated to the desired search results for the text from the image.

(33) In one or more implementations, the subject technology provides improved text lookup or search for text identified in an image, by using other contextual information in the image to enhance the search results. For example, contextual information may include other text (e.g., unselected and/or unsearched text, such as the image text **318**) in the image **300** or elsewhere on the display **302** (e.g., text associated with the application ID **308**, and/or text associated with the application controls **310**), an object type of an object (e.g., the foreground object **314** and/or the background object **316**) in the image **300** or on the display **302**, one or more embeddings of portions of the image **300**, application information (e.g., the application identifier **308** or an application type) for an application displaying the image **300**, location information for the image **300** and/or for the computing device **110**, etc.

(34) In the previous example of the image of a restaurant named “Butterfly”, the computing device **110** may identify one or more objects in the image, such as plates of food, a menu, tables and chairs, doors or windows, or other objects indicative of a restaurant, may identify the relative depths of objects in the images, relative distances between objects and/or text in the image, may identify other text in the image (e.g., another word such as “restaurant”, “bistro”, “cafe”, or the like). The computing device **110** may then initiate an enhanced search for the image text “butterfly”, by including some or all of the derived the contextual information in a search request and/or in a sorting of search results obtained without the contextual information.

(35) It is appreciated that the example in which the image **300** is an image of a storefront from a restaurant is merely illustrative. In various implementations, the image **300** may be any stored or live preview image that includes text in an image context. As another illustrative example, the image **300** may be a rendered user interface of a media playback application, the image text **312** may be a song title of a song being played back by the media playback application, the foreground object **314** may be an album cover-art image, and the image text **318** may be an artist name and/or an album title. In this example, a search for the song name may be enhanced by using contextual information derived from the image **300**, such as the album title, the artist name, and/or the album art. In one or more use cases, information associated with the application displaying the image **300** may also be useful contextual information for enhancing a search for the image text **312**. For example, in the example in which the image **300** includes a rendered user interface of a media playback application, a search for selected text corresponding to a song title may be enhanced by including information indicating a media playback application in the contextual information that informs the search.

(36) This example of an image text **312** being a song title can particularly illustrate the enhancement provided by including contextual information in the text search when considering that the song title may be “Butterfly”, just as the name of a restaurant can be “Butterfly”. In this example, by including, in a search request and/or in a sorting or re-ranking of search results,

contextual information indicating the media playback application or indicating an artist's name, an album name, an embedding of a cover art image, and/or an object type of an object displayed in the album cover art, the obtained search results can be related to the song "Butterfly", rather than a restaurant "Butterfly", or the insect "Butterfly".

(37) In one or more implementations, depth information may also be derived from the image **300** and used as contextual information for searching for the image text **312**. The depth information may be obtained using depth sensors (e.g., depth sensor(s) **216**) of the computing device **110** while capturing the image **300**, or may be derived from the image **300** itself (e.g., using computer vision and/or other machine learning techniques to identify the relative depths of objects in an image). As an example, depth information derived for and/or from the image **300** may be used to determine that the foreground object **314** is a foreground object and/or that the background object **316** is a background object. In one or more implementations, a foreground object and/or an object nearer to the searched image text **312** may be weighted more heavily in aiding the search for the image text **312** than a background object or object that is relatively further from the searched image text **312** in the image **300**.

(38) In accordance with various implementations, the contextual information can be used to locally rank server search results for the selected text at the computing device **110**, and/or some of all of the contextual information can be sent to a server (e.g., a search server such as server **120**) with the image text **312** text, to enhance the search results from the server. The server-obtained search results can also be displayed with locally generated dictionary results in one or more implementations.

(39) For example, FIG. 4 illustrates an example in which search results for the image text **312** are presented by the computing device **110**. In the example of FIG. 4, the search results for the image text **312** include local result(s) **400**, such as locally generated dictionary results obtained by searching for the image text **312** in a local dictionary stored at the computing device **110**, and obtaining a dictionary definition, a synonym, and antonym, or other dictionary entry for the image text **312** (e.g., a dictionary entry that is obtained without using contextual information). In the example of FIG. 4, the search results for the image text **312** also include context-based server results **402**. As discussed in further detail herein, the context-based server results **402** may be obtained by providing the image text **312** and contextual information for the image **300** to a server, such as the server **120** of FIG. 1, and receiving search results generated based both on the image text **312** and the contextual information, or by providing only the image text **312** to the search server, receiving text-only based search results from the server, and sorting or re-ranking the text-only based search results using the contextual information (e.g., to move more relevant search results to the top of the presented list of search results).

(40) FIG. 5 illustrates a flow diagram of an example process **500** for performing a contextual text lookup for text in an image, in accordance with one or more implementations. For explanatory purposes, the process **500** is primarily described herein with reference to the computing device **110** of FIG. 1. However, the process **500** is not limited to the computing device **110**, and one or more blocks (or operations) of the process **500** may be performed by one or more other components and/or other suitable devices. Further for explanatory purposes, the blocks of the process **500** are described herein as occurring in serial, or linearly. However, multiple blocks of the process **500** may occur in parallel. In addition, the blocks of the process **500** need not be performed in the order shown and/or one or more blocks of the process **500** need not be performed and/or can be replaced by other operations.

(41) At block **502**, an electronic device (e.g., computing device **110**) that is displaying an image (e.g., image **300**) may receive a request to perform a search for text (e.g., image text **312**) in the image. For example, receiving the request may include receiving, by the electronic device while displaying the image, a selection of the text in the image (e.g., a user selection of the text). As another example, receiving the request may include receiving the request from a user via a voice

input to the application and/or to a voice assistant application running on the device.

(42) In one or more implementations, the image is a flat image (e.g., an array of pixel values without metadata indicating the contents of the image), and the process **500** also includes, prior to receiving the request: detecting, by the electronic device in the flat image while the flat image is displayed, the text; and modifying the display of the flat image to display the text as selectable text. In one or more implementations, the process **500** may also include obtaining the image from memory of the electronic device, from memory of a remote device, or from a camera of the electronic device, and displaying the image with the electronic device (e.g., with the display **302**, as shown in the example of FIG. **3**). In one or more other implementations, the electronic device may be detected the text in a flat image responsive to receiving a user interaction with the image, such as an attempt to select the text in the flat image.

(43) At block **504**, the electronic device may derive contextual information from the image that includes the text. In one or more implementations as discussed herein, deriving the contextual information may include, by the electronic device (e.g., by providing the image as input to one or more of machine learning model(s) **208**), determining a label for an object (e.g., foreground object **314**, background object **316**, and/or any other image object) in the image. In various implementations, the contextual information may be derived from the image prior to receiving the request for the search, or responsive to receiving the request for the search.

(44) In one or more implementations as discussed herein, deriving the contextual information may include, by the electronic device (e.g., by providing the image as input to one or more of machine learning model(s) **208**), obtaining an embedding of a region of interest in the image. In one or more implementations as discussed herein, deriving the contextual information may include, by the electronic device (e.g., by providing the image as input to one or more of machine learning model(s) **208**), obtaining unselected text and/or unsearched text (e.g., image text **318** or other text not interacted with by the user in connection with the search request) from the image. In one or more implementations as discussed herein, deriving the contextual information may include, by the electronic device (e.g., by providing the image as input to one or more of machine learning model(s) **208** and/or by obtaining location information from a location sensor or process at the electronic device), determining a location associated with the image (e.g., a location at which the image was captured, such as from location metadata of the image and/or by identifying location-specific information, such as a street sign, in the image). In one or more implementations as discussed herein, deriving the contextual information may include, by the electronic device (e.g., by providing the image as input to one or more of machine learning model(s) **208**), obtaining depth information associated the image (e.g., from depth metadata captured using one or more depth sensors (e.g., depth sensors of sensor(s) **216**) at the time the image was obtained, and/or by inferring relative depths of objects in the image from the image itself). For example, deriving the contextual information may include identifying and/or distinguishing one or more foreground objects (e.g., foreground object **314**) from one or more background objects (e.g., background object **316**).

(45) At block **506**, the electronic device may obtain, responsive to the request, one or more search results based on the text and the contextual information.

(46) In one or more implementations, obtaining the one or more search results includes providing the text from the electronic device to a server (e.g., server **120**), receiving a ranked set of search results from the server at the electronic device, and re-ranking the ranked set of search results based on the contextual information to generate the one or more search results for output by the electronic device. For example, the ranked set of search results may be a set of search results that is ranked and/or ordered according to a server-determined relevance to the text. However, as described herein, relevance to the text alone may not coincide with relevance to the user's desired information about the searched text from a displayed image. Accordingly, in one or more implementations, the contextual information derived from the image may be used to re-rank and/or reorder the set of

search results received from the server to place search results most relevant to the searched text and one or more contextual aspects of the image at the top of the displayed/output set of search results.

(47) In one or more implementations, obtaining the one or more search results may include providing the text and the contextual information from the electronic device to a server (e.g., the server **120**), and receiving the one or more search results from the server. In these implementations, the one or more search results from the server may already be ranked and/or ordered for relevance based on the contextual information (e.g., without performing a context-based re-ranking at the electronic device). As discussed herein, in one or more implementations, the contextual information may include application information (e.g., an application identifier, such as application ID **308**, application text associated with application controls, such as application controls **310**, and/or any other information indicating a particular application or type of application) for an application by which the image is displayed. In these implementations, obtaining the one or more search results may include obtaining, by the electronic device, application information for an application by which the image is displayed; and obtaining the one or more search results based on the text, the contextual information, and the application information.

(48) In one or more implementations, when a search request is received from an interface separate from the display displaying the image (e.g., via a voice input, such as if a user speaks a request to the computing device **110** to search for image text **312** while the image **300** is displayed on the display **302**), the computing device **110** may determine that the requested search relates to and/or is the same as some or all of the text display in the image, and then obtain search results for the requested search using the contextual information derived from the image based on that determination.

(49) At block **508**, the electronic device may provide the one or more search results for output by the electronic device. For example, providing the one or more search results for output may include providing the one or more search results for display by a display (e.g., display **302**) of the electronic device (e.g., as described herein in connection with FIG. **4**).

(50) FIG. **6** illustrates a flow diagram of another example process **600** for performing a contextual text lookup for text in an image, in accordance with one or more implementations. For explanatory purposes, the process **600** is primarily described herein with reference to the computing device **110** of FIG. **1**. However, the process **600** is not limited to the computing device **110**, and one or more blocks (or operations) of the process **600** may be performed by one or more other components and/or other suitable devices. Further for explanatory purposes, the blocks of the process **600** are described herein as occurring in serial, or linearly. However, multiple blocks of the process **600** may occur in parallel. In addition, the blocks of the process **600** need not be performed in the order shown and/or one or more blocks of the process **600** need not be performed and/or can be replaced by other operations.

(51) At block **602**, an electronic device (e.g., computing device **110**) may receive a request to perform a search for text (e.g., image text **312**) in an image (e.g., image **300**) displayed by an application running on the electronic device. For example, receiving the request may include receiving, by the electronic device while displaying the image, a selection of the text in the image (e.g., a user selection of the text). As another example, receiving the request may include receiving the request from a user via a voice input to the application and/or to a voice assistant application running on the device.

(52) At block **604**, the electronic device may obtain, responsive to the request, application information for the application. As examples, the application information may include an application identifier, such as application ID **308**, application text associated with application controls, such as application controls **310**, and/or any other information indicating a particular application or type of application. In one illustrative example, the application information may include an application type (e.g., media player, browser, camera, or other type). In another illustrative example, the application information includes a file type of a file accessed by the

application and associated with the image (e.g., an audio file type having an associated album artwork image, or a video file type having an associated cover or poster artwork image). In various implementations, the application information may be obtained from the image prior to receiving the request for the search, or responsive to receiving the request for the search.

(53) At block **606**, the electronic device may obtain, based on the text and the application information, one or more search results. In one or more implementations, obtaining the one or more search results may also include obtaining, based on the application information, image context information for the image, and obtaining the one or more search results based on the text and the image context information. For example, an image of album art may not be identifiable as album art only from the image of the album art. However, the electronic device may determine that the image is an image of album art in part based on the media player type of the application and/or an audio file type of a file from which audio content is being played by a media player application. In one or more implementations, the search results obtained at block **606** may also be obtained based on contextual information derived from the image, using one or more of the operations described herein in connection with any of FIGS. 2-5.

(54) In one or more implementations, obtaining the one or more search results may include providing the text from the electronic device to a server, receiving a ranked set of search results from the server at the electronic device, and re-ranking the ranked set of search results based on the application information to generate the one or more search results for output by the electronic device. In one or more other implementations, obtaining the one or more search results may include providing the text and the application information from the electronic device to a server (e.g., server **120**), and receiving the one or more search results from the server (e.g., with or without performing a re-ranking of the one or more search results from the server locally at the electronic device).

(55) At block **608**, the electronic device may provide the one or more search results for output by the electronic device. For example, providing the one or more search results for output may include providing the one or more search results for display by a display (e.g., display **302**) of the electronic device (e.g., as described herein in connection with FIG. 4).

(56) FIG. 7 illustrates a flow diagram of an example process **700** for performing a contextual text lookup for text in an image at a server, in accordance with one or more implementations. For explanatory purposes, the process **700** is primarily described herein with reference to the server **120** of FIG. 1. However, the process **700** is not limited to the computing server **120**, and one or more blocks (or operations) of the process **700** may be performed by one or more other components and/or other suitable devices. Further for explanatory purposes, the blocks of the process **700** are described herein as occurring in serial, or linearly. However, multiple blocks of the process **700** may occur in parallel. In addition, the blocks of the process **700** need not be performed in the order shown and/or one or more blocks of the process **700** need not be performed and/or can be replaced by other operations.

(57) At block **702**, a server (e.g., server **120**) may receive, from an electronic device (e.g., computing device **110**), text (e.g., image text **312**) extracted from an image (e.g., image **300**) by the electronic device, and contextual metadata for the image. For example, receiving the text and the contextual metadata may include receiving the text and the contextual metadata from the electronic device via a network, such as the network **106** of FIG. 1 (e.g., following selection of the text within an image displayed at the electronic device). The text may have been, as examples, extracted from the image by the electronic device by, for example, identifying the text in the image, displaying the image with the text in a selectable and/or searchable state, and receiving, from a user a request to search for the text displayed in the selectable and/or searchable state.

(58) At block **704**, the server may generate one or more search results for the text based on the text and the contextual metadata. As examples, the contextual metadata may include one or more of a label for an object (e.g., foreground object **314** and/or background object **316**) in the image, an

embedding of a region of interest in the image, additional text (e.g., unselected text and/or unsearched text, such as image text **318**) from the image, a location associated with the image, or depth information associated objects in the image. In one or more implementations, the contextual metadata may also, or alternatively, include application information for an application associated with the image at the electronic device.

(59) In one or more implementations, generating the one or more search results includes generating a ranked set of search results based on the text, and re-ranking the ranked set of search results based on the contextual metadata to generate the one or more search results. In one or more other implementations, generating the one or more search results may include performing, by the server, a search for a combination of the text and the contextual metadata (e.g., by providing both the text and the contextual metadata as concurrent inputs to a search engine, and receiving the one or more search results as an output of the search engine).

(60) At block **706**, the server may provide the one or more search results to the electronic device. For example, providing the one or more search results may include transmitting the one or more search results to the electronic device via a network, such as the network **106** of FIG. **1**.

(61) As described above, one aspect of the present technology is the gathering and use of data available from specific and legitimate sources for contextual lookup for images. The present disclosure contemplates that in some instances, this gathered data may include personal information data that uniquely identifies or can be used to identify a specific person. Such personal information data can include demographic data, location-based data, online identifiers, telephone numbers, email addresses, home addresses, data or records relating to a user's health or level of fitness (e.g., vital signs measurements, medication information, exercise information), date of birth, or any other personal information.

(62) The present disclosure recognizes that the use of such personal information data, in the present technology, can be used to the benefit of users. For example, the personal information data can be used for contextual lookup for images. Accordingly, use of such personal information data may facilitate transactions (e.g., on-line transactions). Further, other uses for personal information data that benefit the user are also contemplated by the present disclosure. For instance, health and fitness data may be used, in accordance with the user's preferences to provide insights into their general wellness, or may be used as positive feedback to individuals using technology to pursue wellness goals.

(63) The present disclosure contemplates that those entities responsible for the collection, analysis, disclosure, transfer, storage, or other use of such personal information data will comply with well-established privacy policies and/or privacy practices. In particular, such entities would be expected to implement and consistently apply privacy practices that are generally recognized as meeting or exceeding industry or governmental requirements for maintaining the privacy of users. Such information regarding the use of personal data should be prominently and easily accessible by users, and should be updated as the collection and/or use of data changes. Personal information from users should be collected for legitimate uses only. Further, such collection/sharing should occur only after receiving the consent of the users or other legitimate basis specified in applicable law. Additionally, such entities should consider taking any needed steps for safeguarding and securing access to such personal information data and ensuring that others with access to the personal information data adhere to their privacy policies and procedures. Further, such entities can subject themselves to evaluation by third parties to certify their adherence to widely accepted privacy policies and practices. In addition, policies and practices should be adapted for the particular types of personal information data being collected and/or accessed and adapted to applicable laws and standards, including jurisdiction-specific considerations which may serve to impose a higher standard. For instance, in the US, collection of or access to certain health data may be governed by federal and/or state laws, such as the Health Insurance Portability and Accountability Act (HIPAA); whereas health data in other countries may be subject to other

regulations and policies and should be handled accordingly.

(64) Despite the foregoing, the present disclosure also contemplates embodiments in which users selectively block the use of, or access to, personal information data. That is, the present disclosure contemplates that hardware and/or software elements can be provided to prevent or block access to such personal information data. For example, in the case of contextual lookup for images, the present technology can be configured to allow users to select to “opt in” or “opt out” of participation in the collection of personal information data during registration for services or anytime thereafter. In addition to providing “opt in” and “opt out” options, the present disclosure contemplates providing notifications relating to the access or use of personal information. For instance, a user may be notified upon downloading an app that their personal information data will be accessed and then reminded again just before personal information data is accessed by the app.

(65) Moreover, it is the intent of the present disclosure that personal information data should be managed and handled in a way to minimize risks of unintentional or unauthorized access or use. Risk can be minimized by limiting the collection of data and deleting data once it is no longer needed. In addition, and when applicable, including in certain health related applications, data de-identification can be used to protect a user's privacy. De-identification may be facilitated, when appropriate, by removing identifiers, controlling the amount or specificity of data stored (e.g., collecting location data at city level rather than at an address level), controlling how data is stored (e.g., aggregating data across users), and/or other methods such as differential privacy.

(66) Therefore, although the present disclosure broadly covers use of personal information data to implement one or more various disclosed embodiments, the present disclosure also contemplates that the various embodiments can also be implemented without the need for accessing such personal information data. That is, the various embodiments of the present technology are not rendered inoperable due to the lack of all or a portion of such personal information data.

(67) FIG. 8 illustrates an electronic system **800** with which one or more implementations of the subject technology may be implemented. The electronic system **800** can be, and/or can be a part of, one or more of the computing device **110** and/or the server **120** shown in FIG. 1, and/or the system **200** of FIG. 2. The electronic system **800** may include various types of computer readable media and interfaces for various other types of computer readable media. The electronic system **800** includes a bus **808**, one or more processing unit(s) **812**, a system memory **804** (and/or buffer), a ROM **810**, a permanent storage device **802**, an input device interface **814**, an output device interface **806**, and one or more network interfaces **816**, or subsets and variations thereof.

(68) The bus **808** collectively represents all system, peripheral, and chipset buses that communicatively connect the numerous internal devices of the electronic system **800**. In one or more implementations, the bus **808** communicatively connects the one or more processing unit(s) **812** with the ROM **810**, the system memory **804**, and the permanent storage device **802**. From these various memory units, the one or more processing unit(s) **812** retrieves instructions to execute and data to process in order to execute the processes of the subject disclosure. The one or more processing unit(s) **812** can be a single processor or a multi-core processor in different implementations.

(69) The ROM **810** stores static data and instructions that are needed by the one or more processing unit(s) **812** and other modules of the electronic system **800**. The permanent storage device **802**, on the other hand, may be a read-and-write memory device. The permanent storage device **802** may be a non-volatile memory unit that stores instructions and data even when the electronic system **800** is off. In one or more implementations, a mass-storage device (such as a magnetic or optical disk and its corresponding disk drive) may be used as the permanent storage device **802**.

(70) In one or more implementations, a removable storage device (such as a floppy disk, flash drive, and its corresponding disk drive) may be used as the permanent storage device **802**. Like the permanent storage device **802**, the system memory **804** may be a read-and-write memory device. However, unlike the permanent storage device **802**, the system memory **804** may be a volatile read-

and-write memory, such as random access memory. The system memory **804** may store any of the instructions and data that one or more processing unit(s) **812** may need at runtime. In one or more implementations, the processes of the subject disclosure are stored in the system memory **804**, the permanent storage device **802**, and/or the ROM **810**. From these various memory units, the one or more processing unit(s) **812** retrieves instructions to execute and data to process in order to execute the processes of one or more implementations.

(71) The bus **808** also connects to the input and output device interfaces **814** and **806**. The input device interface **814** enables a user to communicate information and select commands to the electronic system **800**. Input devices that may be used with the input device interface **814** may include, for example, alphanumeric keyboards and pointing devices (also called “cursor control devices”). The output device interface **806** may enable, for example, the display of images generated by electronic system **800**. Output devices that may be used with the output device interface **806** may include, for example, printers and display devices, such as a liquid crystal display (LCD), a light emitting diode (LED) display, an organic light emitting diode (OLED) display, a flexible display, a flat panel display, a solid state display, a projector, or any other device for outputting information. One or more implementations may include devices that function as both input and output devices, such as a touchscreen. In these implementations, feedback provided to the user can be any form of sensory feedback, such as visual feedback, auditory feedback, or tactile feedback; and input from the user can be received in any form, including acoustic, speech, or tactile input.

(72) Finally, as shown in FIG. **8**, the bus **808** also couples the electronic system **800** to one or more networks and/or to one or more network nodes, such as the server **120** shown in FIG. **1**, through the one or more network interface(s) **816**. In this manner, the electronic system **800** can be a part of a network of computers (such as a LAN, a wide area network (“WAN”), or an Intranet, or a network of networks, such as the Internet. Any or all components of the electronic system **800** can be used in conjunction with the subject disclosure.

(73) Implementations within the scope of the present disclosure can be partially or entirely realized using a tangible computer-readable storage medium (or multiple tangible computer-readable storage media of one or more types) encoding one or more instructions. The tangible computer-readable storage medium also can be non-transitory in nature.

(74) The computer-readable storage medium can be any storage medium that can be read, written, or otherwise accessed by a general purpose or special purpose computing device, including any processing electronics and/or processing circuitry capable of executing instructions. For example, without limitation, the computer-readable medium can include any volatile semiconductor memory, such as RAM, DRAM, SRAM, T-RAM, Z-RAM, and TTRAM. The computer-readable medium also can include any non-volatile semiconductor memory, such as ROM, PROM, EPROM, EEPROM, NVRAM, flash, nvSRAM, FeRAM, FeTRAM, MRAM, PRAM, CBRAM, SONOS, RRAM, NRAM, racetrack memory, FJG, and Millipede memory.

(75) Further, the computer-readable storage medium can include any non-semiconductor memory, such as optical disk storage, magnetic disk storage, magnetic tape, other magnetic storage devices, or any other medium capable of storing one or more instructions. In one or more implementations, the tangible computer-readable storage medium can be directly coupled to a computing device, while in other implementations, the tangible computer-readable storage medium can be indirectly coupled to a computing device, e.g., via one or more wired connections, one or more wireless connections, or any combination thereof.

(76) Instructions can be directly executable or can be used to develop executable instructions. For example, instructions can be realized as executable or non-executable machine code or as instructions in a high-level language that can be compiled to produce executable or non-executable machine code. Further, instructions also can be realized as or can include data. Computer-executable instructions also can be organized in any format, including routines, subroutines,

programs, data structures, objects, modules, applications, applets, functions, etc. As recognized by those of skill in the art, details including, but not limited to, the number, structure, sequence, and organization of instructions can vary significantly without varying the underlying logic, function, processing, and output.

(77) While the above discussion primarily refers to microprocessor or multi-core processors that execute software, one or more implementations are performed by one or more integrated circuits, such as ASICs or FPGAs. In one or more implementations, such integrated circuits execute instructions that are stored on the circuit itself.

(78) Those of skill in the art would appreciate that the various illustrative blocks, modules, elements, components, methods, and algorithms described herein may be implemented as electronic hardware, computer software, or combinations of both. To illustrate this interchangeability of hardware and software, various illustrative blocks, modules, elements, components, methods, and algorithms have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application. Various components and blocks may be arranged differently (e.g., arranged in a different order, or partitioned in a different way) all without departing from the scope of the subject technology.

(79) It is understood that any specific order or hierarchy of blocks in the processes disclosed is an illustration of example approaches. Based upon design preferences, it is understood that the specific order or hierarchy of blocks in the processes may be rearranged, or that all illustrated blocks be performed. Any of the blocks may be performed simultaneously. In one or more implementations, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

(80) As used in this specification and any claims of this application, the terms “base station”, “receiver”, “computer”, “server”, “processor”, and “memory” all refer to electronic or other technological devices. These terms exclude people or groups of people. For the purposes of the specification, the terms “display” or “displaying” means displaying on an electronic device.

(81) As used herein, the phrase “at least one of” preceding a series of items, with the term “and” or “or” to separate any of the items, modifies the list as a whole, rather than each member of the list (i.e., each item). The phrase “at least one of” does not require selection of at least one of each item listed; rather, the phrase allows a meaning that includes at least one of any one of the items, and/or at least one of any combination of the items, and/or at least one of each of the items. By way of example, the phrases “at least one of A, B, and C” or “at least one of A, B, or C” each refer to only A, only B, or only C; any combination of A, B, and C; and/or at least one of each of A, B, and C.

(82) The predicate words “configured to”, “operable to”, and “programmed to” do not imply any particular tangible or intangible modification of a subject, but, rather, are intended to be used interchangeably. In one or more implementations, a processor configured to monitor and control an operation or a component may also mean the processor being programmed to monitor and control the operation or the processor being operable to monitor and control the operation. Likewise, a processor configured to execute code can be construed as a processor programmed to execute code or operable to execute code.

(83) Phrases such as an aspect, the aspect, another aspect, some aspects, one or more aspects, an implementation, the implementation, another implementation, some implementations, one or more implementations, an embodiment, the embodiment, another embodiment, some implementations, one or more implementations, a configuration, the configuration, another configuration, some configurations, one or more configurations, the subject technology, the disclosure, the present

disclosure, other variations thereof and alike are for convenience and do not imply that a disclosure relating to such phrase(s) is essential to the subject technology or that such disclosure applies to all configurations of the subject technology. A disclosure relating to such phrase(s) may apply to all configurations, or one or more configurations. A disclosure relating to such phrase(s) may provide one or more examples. A phrase such as an aspect or some aspects may refer to one or more aspects and vice versa, and this applies similarly to other foregoing phrases.

(84) The word “exemplary” is used herein to mean “serving as an example, instance, or illustration”. Any embodiment described herein as “exemplary” or as an “example” is not necessarily to be construed as preferred or advantageous over other implementations. Furthermore, to the extent that the term “include”, “have”, or the like is used in the description or the claims, such term is intended to be inclusive in a manner similar to the term “comprise” as “comprise” is interpreted when employed as a transitional word in a claim.

(85) All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. § 112(f) unless the element is expressly recited using the phrase “means for” or, in the case of a method claim, the element is recited using the phrase “step for”.

(86) The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but are to be accorded the full scope consistent with the language claims, wherein reference to an element in the singular is not intended to mean “one and only one” unless specifically so stated, but rather “one or more”. Unless specifically stated otherwise, the term “some” refers to one or more. Pronouns in the masculine (e.g., his) include the feminine and neuter gender (e.g., her and its) and vice versa. Headings and subheadings, if any, are used for convenience only and do not limit the subject disclosure.

Claims

1. A method, comprising: receiving, by an electronic device, from an application displaying an image having text therein in a selectable or searchable state, a request to perform a search for text in the image; deriving, by the electronic device, contextual information from the image that includes the text; obtaining, responsive to the request, by the electronic device and from a server, one or more ranked search results based on the text; re-ranking, by the electronic device, the one or more ranked search results based in part on at least the contextual information derived from the image and an application information provided by the application; and providing the one or more re-ranked search results for output by the application.
2. The method of claim 1, wherein receiving the request comprises receiving, by the electronic device while displaying the image, a selection of the text in the image.
3. The method of claim 1, wherein obtaining the one or more ranked search results comprises: providing the text from the electronic device to the server.
4. The method of claim 1, wherein deriving the contextual information comprises, by the electronic device, at least one of: determining a label for an object in the image; obtaining an embedding of a region of interest in the image; obtaining unselected text from the image; determining a location associated with the image; or obtaining depth information associated the image.
5. The method of claim 1, further comprising: obtaining the image from memory of the electronic device, from memory of a remote device, or from a camera of the electronic device.

6. The method of claim 1, further comprising: obtaining the one or more ranked search results based on the text, the contextual information, and the application information.
7. The method of claim 1, wherein the application information provided by the application comprises at least one of an application identifier, an application text associated with application controls, a type of application, a file type of a file accessed by the application, a file type associated with the image.
8. A device comprising: a display; at least one processor; and a memory including instructions that, when executed by the at least one processor, cause the at least one processor to: receive, from an application after displaying on the display an image having text therein in a selectable or searchable state, a request to perform a search for text in the image; derive contextual information from the image that includes the text; obtain responsive to the request, from a server, one or more ranked search results based on the text; re-rank the one or more ranked search results based in part on at least the contextual information derived from the image and an application information provided by the application; and provide the one or more re-ranked search results for output by the application.
9. The device of claim 8, wherein receiving the request comprises receiving, while displaying the image, a selection of the text in the image.
10. The device of claim 8, wherein obtaining the one or more ranked search results comprises: providing the text to the server.
11. The device of claim 8, wherein deriving the contextual information comprises at least one of: determining a label for an object in the image; obtaining an embedding of a region of interest in the image; obtaining unselected text from the image; determining a location associated with the image; or obtaining depth information associated the image.
12. The device of claim 8, further comprising: obtaining the image from the memory, from a memory of a remote device, or from a camera of the device.
13. The device of claim 8, wherein obtaining the one or more ranked search results comprises: providing the text and the contextual information to a server; and receiving the one or more ranked search results from the server.
14. The device of claim 8, further comprising: obtaining the one or more ranked search results based on the text, the contextual information, and the application information.
15. A non-transitory computer-readable medium comprising instructions, which when executed by at least one computing device, cause the at least one computing device to perform operations comprising: receiving, after displaying by an application on the computing device an image having text therein in a selectable or searchable state, a request to perform a search for text in the image; deriving contextual information from the image that includes the text; obtaining responsive to the request, from a server, one or more ranked search results based on the text; re-ranking the one or more ranked search results based in part on at least the contextual information derived from the image and an application information provided by the application; and providing the one or more re-ranked search results for output by the application.
16. The non-transitory computer-readable medium of claim 15, wherein receiving the request comprises receiving, while displaying the image, a selection of the text in the image.
17. The non-transitory computer-readable medium of claim 15, wherein deriving the contextual information comprises at least one of: determining a label for an object in the image; obtaining an embedding of a region of interest in the image; obtaining unselected text from the image; determining a location associated with the image; or obtaining depth information associated the image.
18. The non-transitory computer-readable medium of claim 15, further comprising: obtaining the image from the computer-readable medium, from a memory of a remote device, or from a camera of the computing device.
19. The non-transitory computer-readable medium of claim 15, wherein obtaining the one or more ranked search results comprises: providing the text and the contextual information to a server; and

receiving the one or more ranked search results from the server.

20. The non-transitory computer-readable medium of claim 15, further comprising: obtaining the one or more ranked search results based on the text, the contextual information, and the application information.
