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(54) PROFILE BASED CAPTURE COMPONENT

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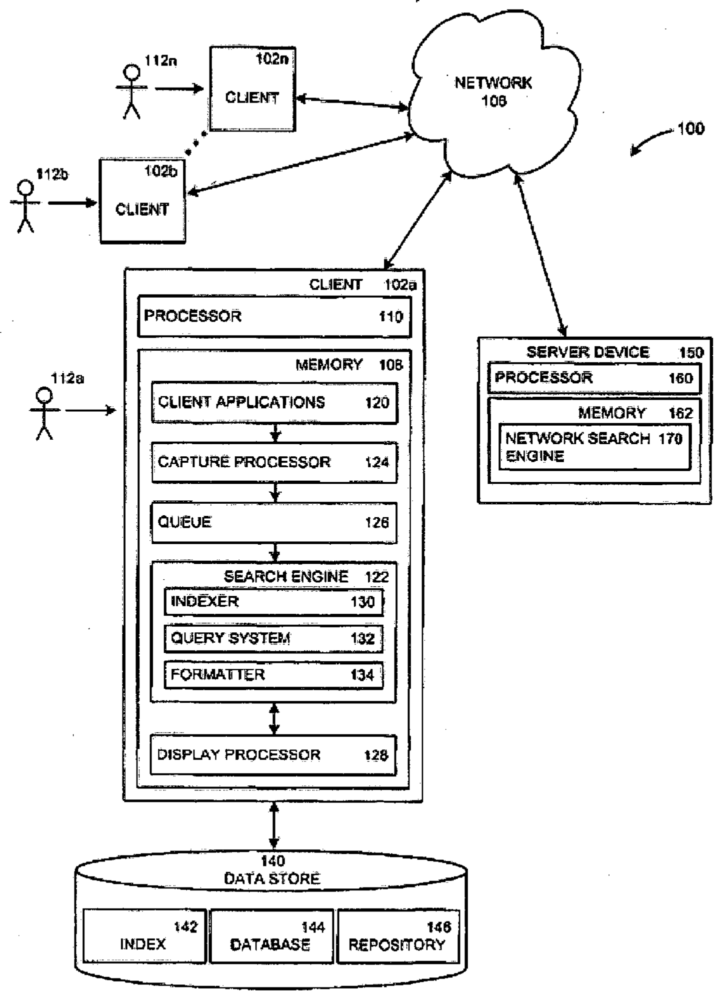
(57) ABSTRACT

An indexing system in a computer system may include applications, a capture processor, a queue, a search engine, and a display processor. The indexing system captures events of user interactions with the applications. Events are queued and if indexable, indexed and stored for user access through the search engine. Capture components in the capture processor can include a keyboard capture component that processes user keystrokes to determine events. A display capture component captures event data from windows associated with the applications. Display event data can be captured on a polling schedule or based on state changes of window elements. To determine target applications and window applications of interest application profiles and window profiles can be used.



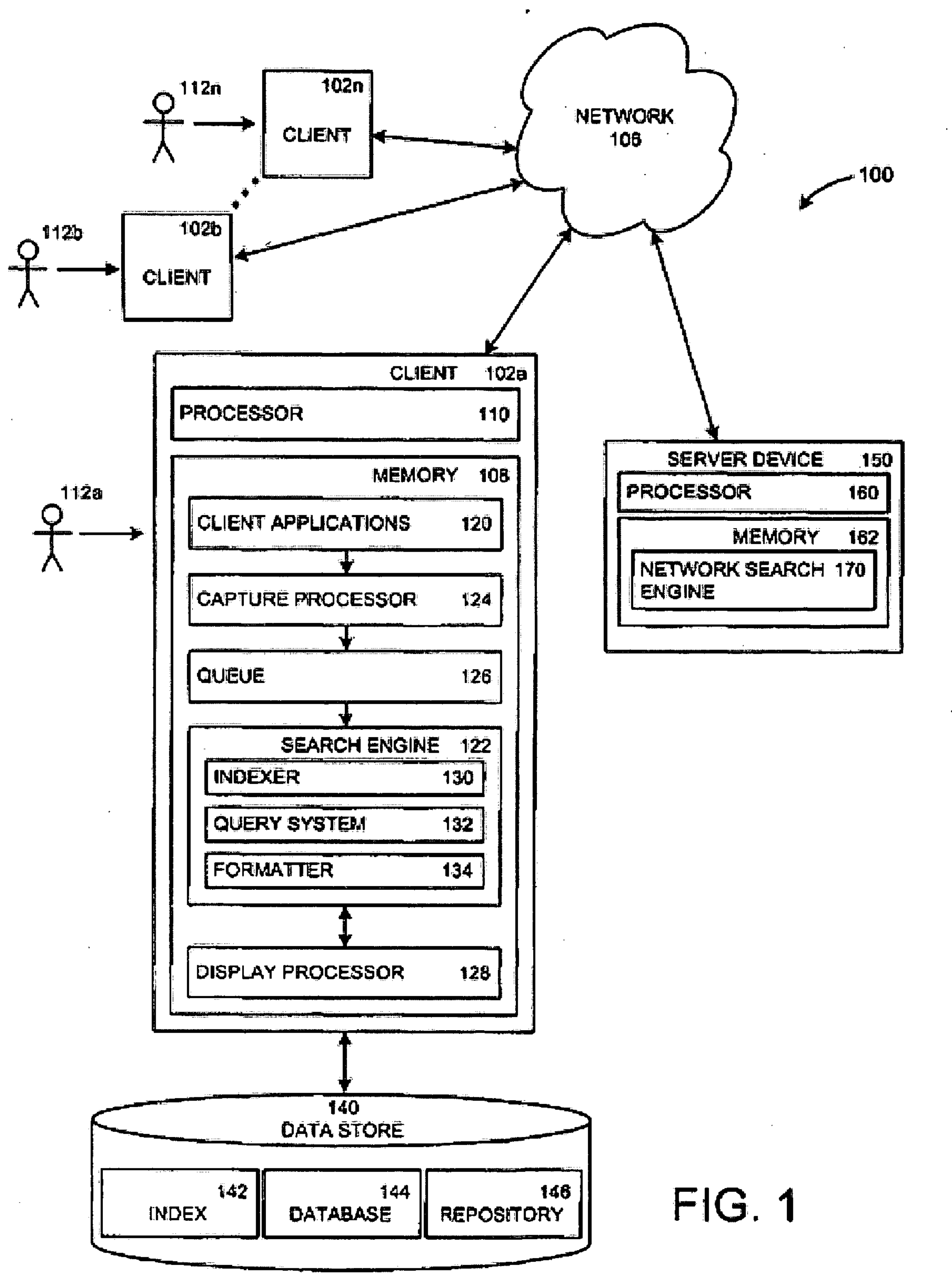

112n
102n
CLIENT
NETWORK
106
100
112b
102b
CLIENT
CLIENT 102a
PROCESSOR 110
MEMORY 108
112a
CLIENT APPLICATIONS 120
CAPTURE PROCESSOR 124
QUEUE 126
SEARCH ENGINE 122
INDEXER 130
QUERY SYSTEM 132
FORMATTER 134
DISPLAY PROCESSOR 128
SERVER DEVICE 150
PROCESSOR 160
MEMORY 162
NETWORK SEARCH ENGINE 170
140
DATA STORE
142
INDEX
144
DATABASE
146
REPOSITORY

FIG. 1

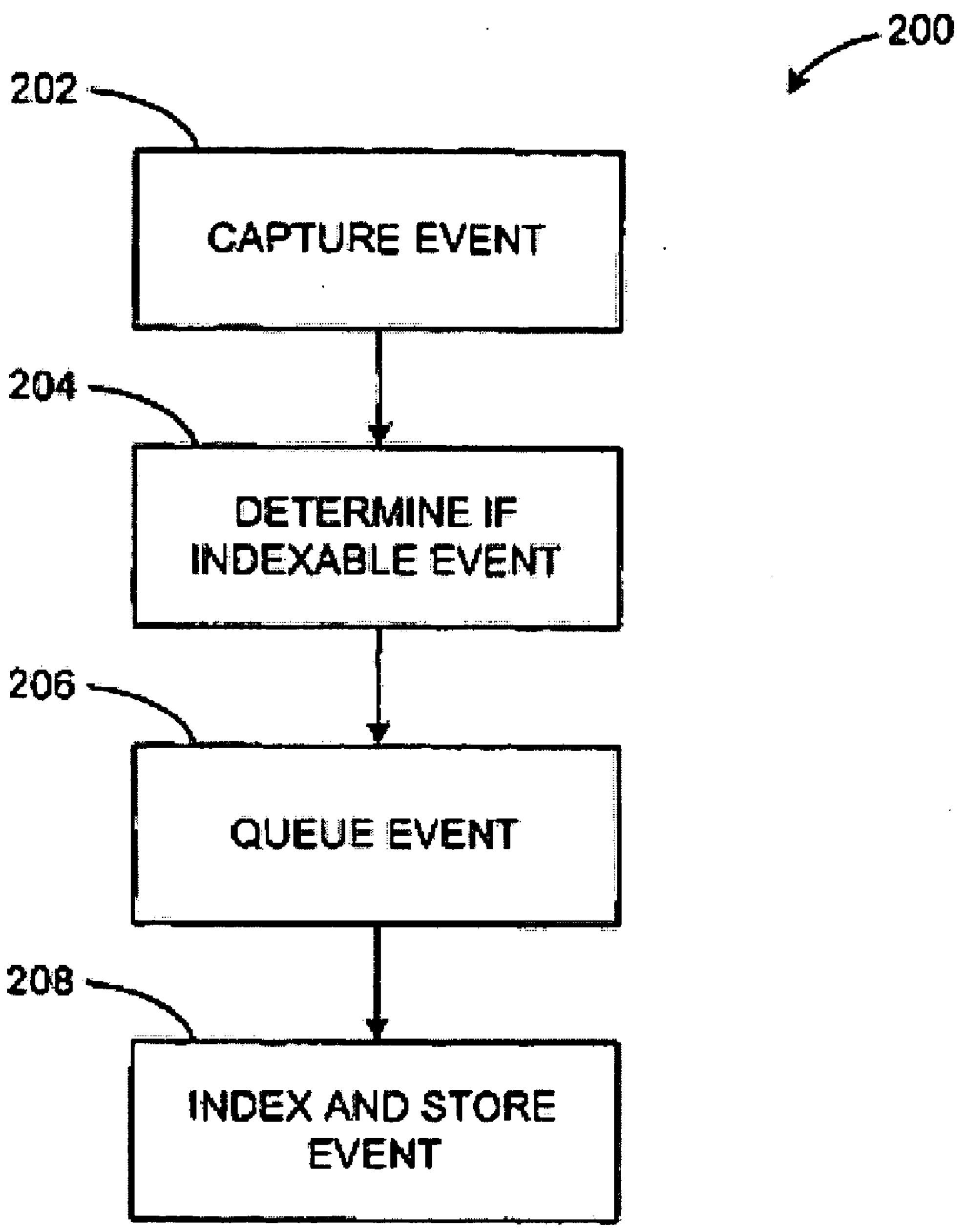
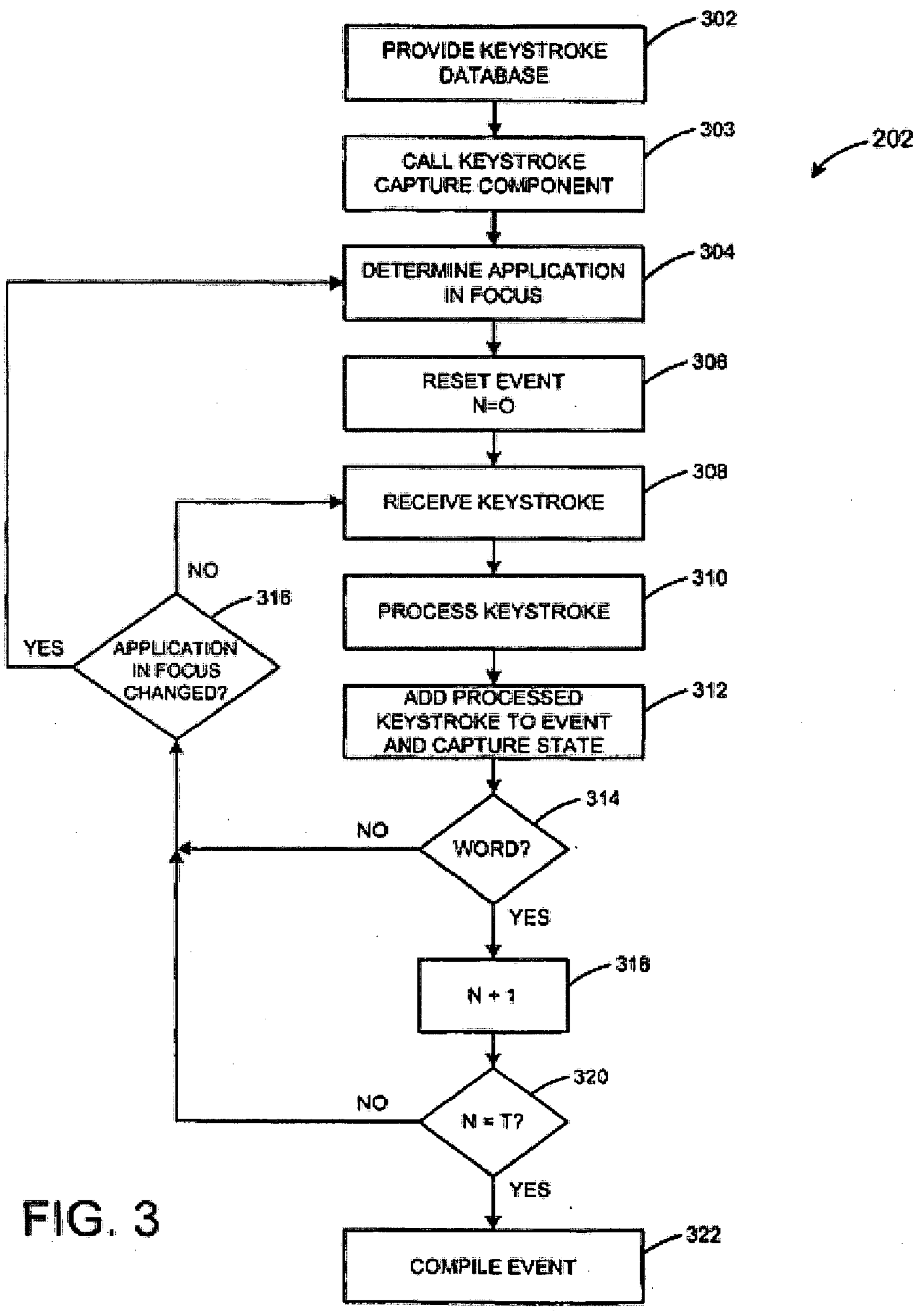

200
202
CAPTURE EVENT
204
DETERMINE IF INDEXABLE EVENT
206
QUEUE EVENT
208
INDEX AND STORE EVENT

FIG. 2



202
PROVIDE KEYSTROKE DATABASE
302
CALL KEYSTROKE CAPTURE COMPONENT
303
DETERMINE APPLICATION IN FOCUS
304
RESET EVENT N=O
306
RECEIVE KEYSTROKE
308
PROCESS KEYSTROKE
310
ADD PROCESSED KEYSTROKE TO EVENT AND CAPTURE STATE
312
WORD?
314
NO
YES
N + 1
318
N = T?
320
NO
YES
COMPILE EVENT
322
APPLICATION IN FOCUS CHANGED?
316
YES
NO

FIG. 3

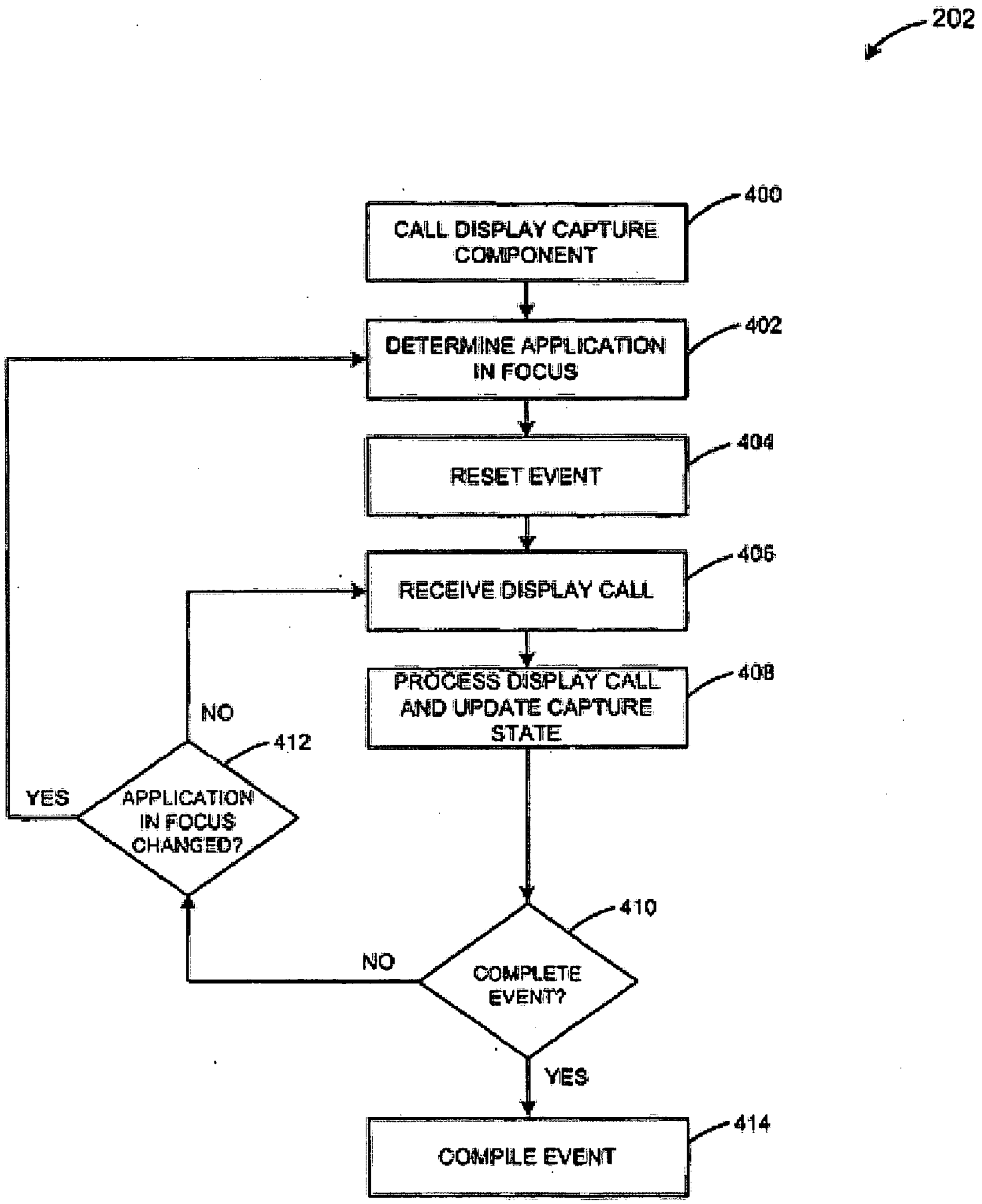

202
CALL DISPLAY CAPTURE COMPONENT
400
DETERMINE APPLICATION IN FOCUS
402
RESET EVENT
404
RECEIVE DISPLAY CALL
406
PROCESS DISPLAY CALL AND UPDATE CAPTURE STATE
408
COMPLETE EVENT?
410
NO
YES
APPLICATION IN FOCUS CHANGED?
412
NO
YES
COMPILE EVENT
414

FIG. 4

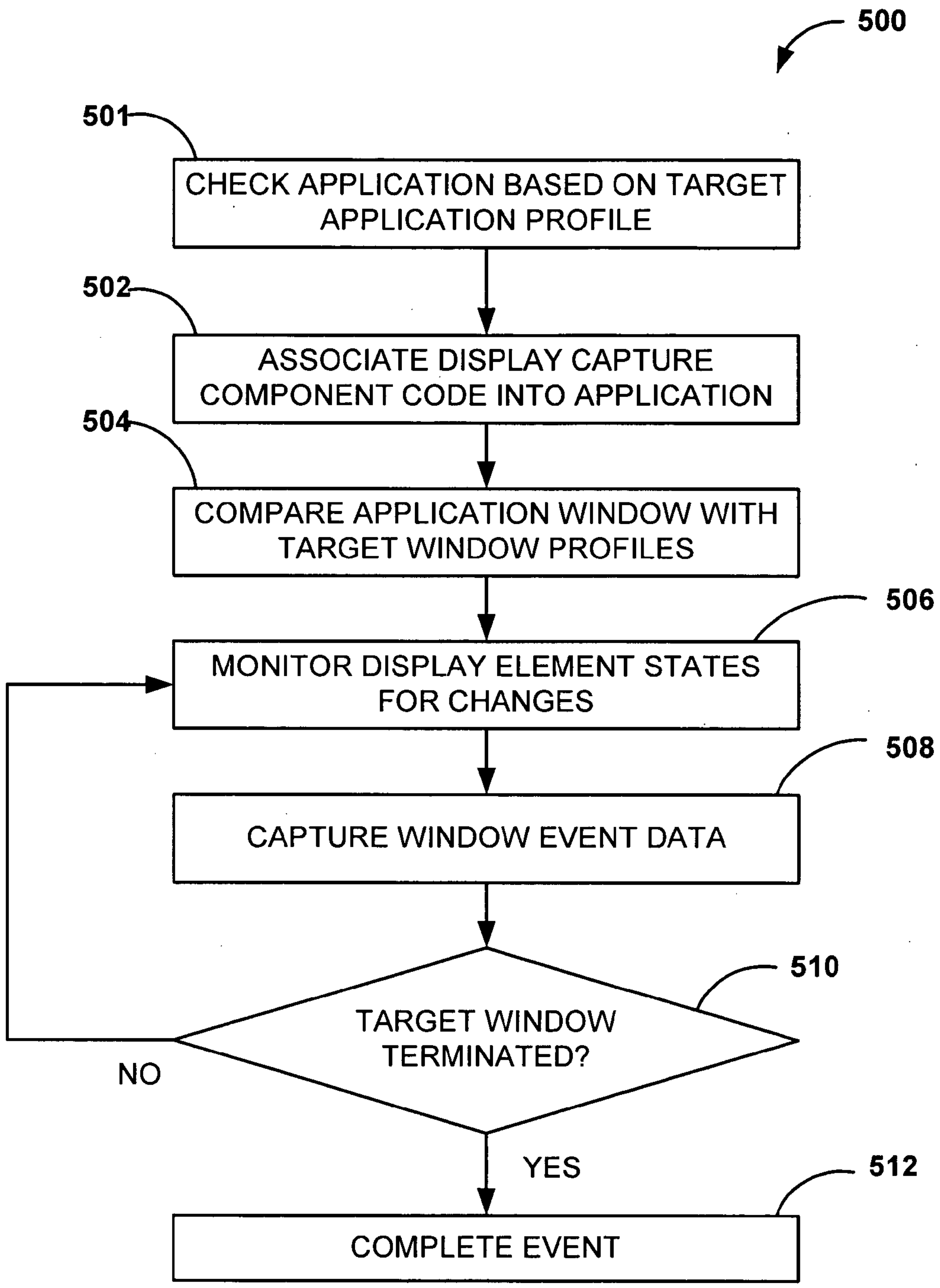

500
501
CHECK APPLICATION BASED ON TARGET APPLICATION PROFILE
502
ASSOCIATE DISPLAY CAPTURE COMPONENT CODE INTO APPLICATION
504
COMPARE APPLICATION WINDOW WITH TARGET WINDOW PROFILES
506
MONITOR DISPLAY ELEMENT STATES FOR CHANGES
508
CAPTURE WINDOW EVENT DATA
510
TARGET WINDOW TERMINATED?
NO
YES
512
COMPLETE EVENT

FIG. 5

PROFILE BASED CAPTURE COMPONENT

RELATED APPLICATIONS

[0001] This application is a continuation in part ("CIP") of and claims priority from U.S. application Ser. No. 10/814,773, titled "Methods and Systems for Information Capture" and filed on Mar. 31, 2004 by Lawrence et al.

FIELD OF THE INVENTION

[0002] The invention generally relates to search engines. More particularly, the invention relates to methods and systems for information capture.

BACKGROUND OF THE INVENTION

[0003] Users generate and access a large number of articles, such as emails, web pages, word processing documents, spreadsheet documents, instant messenger messages, presentation documents, multimedia files, and the like using a client device, such as a personal computer, personal digital assistant, mobile phone or the like. Some articles are stored on one or more storage devices coupled to, accessible by, or otherwise associated with the client device(s). Users sometimes wish to search the storage device(s) for articles.

[0004] Conventional client-device search applications significantly degrade the performance of the client device. For example, certain conventional client-device search applications typically use batch processing to index all articles, which results in noticeably slower performance of the client device during the batch indexing. Additionally, batch processing occurs only periodically. Therefore, when a user performs a search, the most recently accesses or created articles are sometimes not included in the results. Moreover, if the batch indexing is scheduled for a time when the client device is not turned on, it may not take place for an extended period of time. In that case, the index of articles associated with the client device can become significantly outdated. Conventional client-device search applications can also need to rebuild the index at each batch indexing or build new partial indexes and perform a merge operation that can use a lot of client-device resources.

[0005] Conventional client-device search applications also sometimes use a great deal of system resources when operational, resulting in slower performance of the client device.

[0006] Additionally, conventional client-device search applications generally require the user to explicitly provide a search query to the search application to generate results, and may be limited to examining file names or the contents of a particular application's files.

SUMMARY OF THE INVENTION

[0007] A computer based method for capturing event data from a target window of a target application in a computer system includes comparing window information with a target window profile that is associated with the target window of the target application and capturing event data from the target window upon detecting a state change of a state associated with an element in the window. Embodiments of the present invention include methods, systems, and computer-readable media for information capture, storage, and indexing.

[0008] In one embodiment, a method for capturing event data from a target window of a target application in a computer system additionally includes receiving window creation information from an application and determining whether the application is an instance of the target application. In one embodiment, to make this determination the window creation information is compared with a target application profile, which is associated with the target application.

[0009] In another embodiment, a computer based method for indexing events in a computer system includes receiving captured event data from a target window. The target window is associated with a target application. The method also includes determining an event based on the target application and also based on user input. In this embodiment, the method also includes determining whether to index the captured event data and storing the event.

[0010] Another aspect of the invention provides a computer-based method for determining indexing events by receiving a plurality of display calls. The display calls are associated with computer applications in the computer system. The method includes processing the plurality of display calls to determine a target window. The processing is based on target window profiles. The method also includes determining an event based, at least in part, on data captured from the target window.

[0011] In yet another embodiment, the invention provides a method that compares application related data with stored target application profiles associated with a plurality of target applications. The application related data is from applications associated with windows executing in a computer system. The method also includes subscribing to window creation events through the operating system of the computer system. Window creation request information is received from an application. The window creation request information is compared with the stored target application profiles. Then establishing hooks into processes for each target application. Window element information for each process of each target application is compared with a plurality of stored target window profiles associated with target windows of the target applications. The method also includes monitoring state changes for states associated with display elements in windows matching a target window profile. In this embodiment, the method includes capturing from each matched window event data upon detecting a state change of the monitored states. The event data is captured into an event associated with each matched window. This capturing includes modifying application behavior of the matched applications based on the capture component code. The method also includes completing the events associated with the matched windows in response to closure of the matched window.

[0012] The features and advantages described in the specification are not all inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1** is a diagram illustrating an exemplary environment in which one embodiment of the present invention may operate.

[0014] **FIG. 2** is a flow diagram illustrating an exemplary embodiment of a method for capturing and processing event data associated with a client device.

[0015] **FIG. 3** is a flow diagram illustrating an exemplary embodiment of a method for capturing keystroke information on a client device.

[0016] **FIG. 4** is a flow diagram illustrating an exemplary embodiment of a method for capturing display information on a client device.

[0017] **FIG. 5** is a flow diagram of one embodiment of a profile based display capture method.

[0018] The figures and the following description relate to preferred embodiments of the present invention by way of illustration only. It should be noted that from the following discussion, alternative embodiments of the structures and methods disclosed herein will be readily recognized as viable alternatives that may be employed without departing from the principles of the claimed invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0019] Referring now to the drawings in which like numerals indicate like elements throughout the several figures, **FIG. 1** shows a diagram illustrating an exemplary environment in which one embodiment of the present invention may operate. While the environment shown in **FIG. 1** reflects one client-side search engine architecture embodiment, other client-side or server-side embodiments are possible. The system **100** includes multiple client devices **102***a-n* that can communicate with a server device **150** over a network **106**, e.g., the Internet. In other embodiments, other networks, such as an intranet home local area network ("LAN"), or the like, may be used instead. Moreover, in other embodiments, functions described with respect to a client or a server in a distributed network environment may take place within a single client device without a server device or a network. The implementation of these techniques as well as similar adaptations falls within the scope of this invention.

[0020] The client devices **102***a-n* shown in **FIG. 1** each include a computer-readable medium **108**, e.g., memory devices, storage media, and the like. In one embodiment, a client device **102***a* includes a random access memory (RAM) **108** coupled to a processor **110**. The processor **110** executes computer-executable program instructions stored in memory **108**. Such processors may include a microprocessor, an ASIC, state machines, or other processors, and can be any of a number of suitable computer processors, such as processors from Intel Corporation of Santa Clara, Calif. and Motorola Corporation of Schaumburg, Ill. Such processors include, or may be in communication with, media **108**, for example computer-readable media, which stores instructions that, when executed by the processor, cause the processor to perform the steps described herein. Embodiments of computer-readable media **108** include, but are not limited to, an electronic, optical, magnetic, or other storage or transmission device capable of providing a processor, such as the processor **110** of client **102***a,* with computer-readable instructions. Other examples of suitable media include, but are not limited to, a floppy disk, CD-ROM, DVD, magnetic disk, memory chip, ROM, RAM, an ASIC, a configured processor, all optical media, all magnetic tape or other magnetic media, or any other medium from which a computer processor can read instructions. Also, various other forms of computer-readable media may transmit or carry instructions to a computer, including a router, private or public network, or other transmission device or channel, both wired and wireless. The instructions may include code from any suitable computer-programming language, including, for example, C, C++, C#, Visual Basic, Java, Python, Perl, and JavaScript.

[0021] Client devices **102***a-n* can be coupled to a network **106**, or alternatively, can be stand alone machines. Client devices **102***a-n* may also include a number of external or internal devices such as a mouse, a CD-ROM, DVD, a keyboard, a display device, or other input or output devices. Examples of client devices **102***a-n* are personal computers, digital assistants, personal digital assistants, cellular phones, mobile phones, smart phones, pagers, digital tablets, laptop computers, Internet appliances, and other processor-based devices. In one embodiment, the client devices **102***a-n* may be any type of processor-based platform that operates on any suitable operating system, such as Microsoft® Windows® or Linux, and that are capable of executing one or more client application programs. For example, the client device **102***a* can include a personal computer executing client application programs, also known as client applications **120**. The client applications **120** can be contained in memory **108** and can include, for example, a word-processing application, a spreadsheet application, an email application, an instant messenger application, a presentation application, an Internet browser application, a calendar/organizer application, a video playing application, an audio playing application, an image display application, a file management program, an operating system shell, and other applications capable of being executed by a client device. Client applications **120** may also include client-side applications that interact with or accesses other client or remote applications (such as, for example, a web-browser executing on the client device **102***a* that interacts with a remote e-mail server to access e-mail).

[0022] The user **112***a* can interact with the various client applications **120** and articles associated with the client applications **120** via various input and output devices of the client device **102***a*. Articles include, for example, word processor documents, spreadsheet documents, presentation documents, emails, instant messenger messages, database entries, calendar entries, appointment entries, task manager entries, source code files, and other client application program content, files, messages, items, web pages of various formats, such as HTML, XML, XHTML, Portable Document Format (PDF) files, and media files, such as image files, audio files, and video files, or any other documents or items or groups of documents or items or information in electronic form suitable for storage access in client devices.

[0023] The user's **112***a* interaction with articles, the client applications **120**, and the client device **102***a* creates event data that may be observed, recorded, analyzed or otherwise used. An event can be any occurrence possible associated with an article, client application **120**, or client device **102***a*, such as inputting text in an article, displaying an article on a display device, sending an article, receiving an article, manipulating an input device, opening an article, saving an article, printing an article, closing an article, opening a client application program, closing a client application program, idle time, processor load, disk access, memory usage, bringing a client application program to the foreground, changing visual display details of the application (such as resizing or minimizing), interacting with windows associated with the client applications, and any other suitable occurrence associated with an article, a client application program, or the client device whatsoever. Additionally, event data can be generated when the client device **102***a* interacts with an article independent of the user **112***a*, such as when receiving an email or performing a scheduled task.

[0024] In one embodiment, the memory **108** of the client device **102***a* can also contain a capture processor **124**, a queue **126**, and a search engine **122**. The client device **102***a* can also contain or is in communication with a data store **140**. The capture processor **124** can capture events and pass them to the queue **126**. The queue **126** can pass the captured events to the search engine **122** or the search engine **122** can retrieve new events from the queue **126**. In one embodiment, the queue **126** notifies the search engine **122** when a new event arrives in the queue **126** and the search engine **122** retrieves the event (or events) from the queue **126** when the search engine **122** is ready to process the event (or events). When the search engine receives an event it can be processed and can be stored in the data store **140**. The search engine **122** can receive an explicit query from the user **112***a* or generate an implicit query and it can retrieve information from the data store **140** in response to the query. In another embodiment, the queue is located in the search engine **122**. In still another embodiment, the client device **102***a* does not have a queue and the events are passed from the capture processor **124** directly to the search engine **122**. According to other embodiments, the event data is transferred using an information exchange protocol. The information exchange protocol can include, for example, any suitable rule or convention facilitating data exchange, and can include, a communication mechanism: such as, for example, Extensible Markup Language - Remote Procedure Calling protocol (XML/RPC), Hypertext Transfer Protocol (HTTP), Simple Object Access Protocol (SOAP), shared memory, sockets, local or remote procedure calling, or any other suitable information exchange mechanism.

[0025] The capture processor **124** can capture an event by identifying and extracting event data associated with an event. Examples of events include sending or receiving an instant messenger message, a user viewing a web page, saving a word processing document, printing a spreadsheet document, inputting text to compose or edit an email, opening a presentation application, closing an instant messenger application, entering a keystroke, moving the mouse, hovering the mouse over a hyperlink, clicking on buttons in windows, selecting from menus, or the like. An example of event data captured by the capture processor **124** for an event involving the viewing of a web page by a user includes the URL of the web page, the time and date the user viewed the web page, and content of the web page. In addition, in one embodiment additional event data can be captured from remote locations that include information related to the event or article. For example, artist and other related information, e.g., album, director, genre, and the like, for a movie or music file accessed by a user can be retrieved from a network database server across the network **106**.

[0026] In one embodiment, the capture processor **124** may include multiple capture components. For example, the capture processor **124** can include a separate capture component for each client application in order to capture events associated with each application. The capture processor **124** can also include a separate capture component to monitor and capture keystrokes input by the user and a separate capture component that can monitor and capture items, such as text, displayed on a display device associated with the client device **102***a*. The keystroke capture component and the display capture component can be used to capture events when a client application capture component is not available for a client application or in conjunction with a client application capture component. The keystroke capture component can also contain or access a keystroke database. The keystroke database can provide correlation between keystrokes and actions for applications. The keystroke capture component and the display capture component can also contain or access a history of previous keyboard or display events.

[0027] In one embodiment, the capture processor **124** can include a separate capture component that monitors overall network activity in order to capture event data associated with network activity, such as the receipt of an instant messenger message. The capture processor **124** can include a separate capture component that monitors overall client device performance data, such as processor load, idle time, disk access, the client applications in use, and the amount of memory available. An individual capture component can monitor multiple client applications and multiple capture components can monitor different aspects of a single client application.

[0028] In one embodiment, the capture processor **124**, through the individual capture components, can monitor activity on the client device and can capture events by a generalized event definition and registration mechanism, such as an event schema. Each capture component can define its own event schema or can use a predefined one. Event schemas can differ depending on the client application or activity the capture component is monitoring. Generally, the event schema can describe the format for an event, for example, by providing fields for event data associated with the event (such as time of the event) and fields related to any associated article (such as title) as well as the content of any associated article (such as document body). An event schema can describe the format for any suitable event data that relates to an event. For example, an event schema for user input, such as words typed or displayed to a display device, can include the application used for the input, the format of the text, the words and other items input, and the time input. An event schema for an email event received by a user can include header information, such as the content from the subject, to, from, cc, and time received fields, and body information. An event schema for a web page currently being viewed by a user can include the Uniform Resource Locator (URL) of the web page, the time being viewed, and the content of the web page. An event schema for a word processing document being saved by a user can include the title of the document, the time saved, the location of the document, the format of the document, the text of the document, and a pointer to the location of the document.

[0029] In one embodiment, the keyboard capture component may not use an event schema. Rather, in this embodiment, the keyboard capture component can convert keystrokes to a sequence of words and then can pass the sequence of words to another component, such as the word processing capture component. The word processing capture component can use an event schema to express information sent by the keystroke capture component.

[0030] More generally, an event schema can describe the state of the system around the time of the event. For example, an event schema can contain a URL for a web page event associated with a previous web page that the user navigated from. In addition, event schema can describe fields with more complicated structure like lists. For example, an event schema can contain fields that list multiple recipients. An event schema can also contain optional fields so that an application can include additional event data if desired.

[0031] The capture processor **124** can capture events occurring presently (or "real-time events") and can capture events that have occurred in the past (or "historical events"). Real-time events can be "indexable" or "non-indexable". In one embodiment, the search engine **122** indexes indexable real-time events, but does not index non-indexable real-time events. The search engine **122** may determine whether to index an event based on the importance of the event. Indexable real-time events can be more important events associated with an article, such as viewing a web page, loading or saving a file, and receiving or sending an instant message ("IM") or electronic mail ("email"). Non-indexable events can be deemed not important enough by the search engine **122** to index and store the event, such as moving the mouse or selecting a portion of text in an article. Non-indexable events can be used by the search engine **122** to update the current user state. While all real-time events can relate to what the user is currently doing (or the current user state), indexable real-time events can be indexed and stored in the data store **140**.

[0032] Alternatively, in one embodiment, the search engine **122** can index all real-time events. Real-time events can include, for example, sending or receiving an article, such as an instant messenger message, examining a portion of an article, such as selecting a portion of text or moving a mouse over a portion of a web page, changing an article, such as typing a word in an email or pasting a sentence in a word processing document, closing an article, such as closing an instant messenger window or changing an email message being viewed, loading, saving, opening, or viewing an article, such as a word processing document, web page, or email, listening to or saving an MP3 file or other audio/video file, or updating the metadata of an article, such as book marking a web page, printing a presentation document, deleting a word processing document, or moving a spreadsheet document.

[0033] Historical events are similar to indexable real-time events except that the event occurred before the installation of the search engine **122** or was otherwise not captured, because, for example, the search engine **122** was not operational for a period of time while the client device **102***a* was operational or because no capture component existed for a specific type of historical event at the time the event took place. Examples of historical events include the user's saved word processing documents, media files, presentation documents, calendar entries, and spreadsheet documents, the emails in a user's inbox, and the web pages bookmarked by the user. The capture processor **124** can capture historical events by periodically crawling the memory **108** and any associated data storage device for events not previously captured by the capture processor **124**. The capture processor **124** can also capture historical events by requesting certain client applications, such as a web browser or an email application, to retrieve articles and other associated information. For example, the capture processor **124** can request that the web browser application obtain all viewed web pages by the user or request that the email application obtain all email messages associated with the user. These articles may not currently exist in memory **108** or on a storage device of the client device **102***a*. For example, the email application may have to retrieve emails from a server device. In one embodiment, the search engine **122** indexes historical events.

[0034] In the embodiment shown in **FIG. 1**, events captured by the capture processor **124** are sent to the queue **126** in the format described by an event schema. The capture processor **124** can also send performance data to the queue **126**. Examples of performance data include current processor load, average processor load over a predetermined period of time, idle time, disk access, the client applications in use, and the amount of memory available. Performance data can also be provided by specific performance monitoring components, some of which may be part of the search engine **122**, for example. The performance data in the queue **126** can be retrieved by the search engine **122** and the capture components of the capture processor **124**. For example, capture components can retrieve the performance data to alter how many events are sent to the queue **126** or how detailed the events are that are sent (fewer or smaller events when the system is busy) or how frequently events are sent (events are sent less often when the system is busy or there are too many events waiting to be processed). The search engine **122** can use performance data to determine when it indexes various events and when and how often it issues implicit queries.

[0035] In one embodiment, the queue **126** holds events until the search engine **122** is ready to process an event or events. Alternatively, the queue **126** uses the performance data to help determine how quickly to provide the events to the search engine **122**. The queue **126** can include one or more separate queues, for example, a user state queue and an index queue. In one embodiment, the index queue can queue indexable events. Alternatively, the queue **126** can have additional queues or include a single queue. The queue **126** can be implemented as a circular priority queue using memory mapped files. The queue can be a multiple-priority queue where higher priority events are served before lower priority events, and other components may be able to specify the type of events they are interested in. Generally, real-time events can be given higher priority than historical events, and indexable events can be given higher priority than non-indexable real-time events. Other implementations of the queue **126** are possible. In another embodiment, the client device **102***a* does not have a queue **126**. In this embodiment, events are passed directly from the capture processor **124** to the search engine **122**. In other embodiments, events can be transferred between the capture components and the search engine using suitable information exchange mechanisms such as: Extensible Markup Language - Remote Procedure Calling protocol (XML/RPC), Hypertext Transfer Protocol (HTTP), Simple Object Access Protocol (SOAP), shared memory, sockets, local or remote procedure calling, or any other suitable information exchange mechanism.

[**0036**] Referring back to **FIG. 1**, in one embodiment, the search engine **122** can contain an indexer **130**, a query system **132**, and a formatter **134**. The query system **132** can retrieve all real-time events and performance data from the queue **126**. The query system **132** can use performance data and real-time events to update the current user state and generate an implicit query. An implicit query can be an automatically generated query based on the current user state. The query system **132** can also receive and process explicit queries from the user **112***a*. Performance data can also be retrieved by the search engine **122** from the queue **126** for use in determining the amount of activity possible by the search engine **122**.

[**0037**] In the embodiment shown in **FIG. 1**, indexable real-time events and historical events (indexable events) are retrieved from the queue **126** by the indexer **130**. Alternatively, the queue **126** may send the indexable events to the indexer **130**. The indexer **130** can index the indexable events and can send them to the data store **140** where they are stored. The data store **140** can be any type of computer-readable media and can be integrated with the client device **102***a,* such as a hard drive, or external to the client device **102***a,* such as an external hard drive or on another data storage device accessed through the network **106**. The data store can be one or more logical or physical storage areas. In one embodiment, the data store **140** can be in memory **108**. The data store **140** may facilitate one method or a combination of methods for storing data, including without limitation, arrays, hash tables, lists, and pairs, and may include compression and encryption. In the embodiment shown in **FIG. 1**, the data store includes an index **142**, a database **144** and a repository **146**.

[**0038**] In the embodiment shown in **FIG. 1**, when the indexer **130** receives an event, the indexer **130** can determine, from the event schema, terms (if any) associated with the event, the time of the event (if available), images (if any) associated with the event, and/or other information defining the event. The indexer **130** can also determine if the event relates to other events and associate the event with related events. For example, for an event concerning a web page, the indexer **130** can associate this event with other events concerning the same web page. This association information can be stored in the database **133** in a document for each group of related events.

[**0039**] The indexer **130** can send and incorporate the terms and times associated with the event in the index **142** of the data store **140**. The event can be sent to the database **144** for storage and the content of the associated article and any associated images can be stored in the repository **146**. The conversation object associated with instant messenger messages can be stored in the database **144**.

[**0040**] In the embodiment shown in **FIG. 1**, a user **112***a* can input an explicit query into a search engine interface on the client device **102***a,* which is received by the search engine **122**. In one embodiment, the search engine interface on the client device **102***a* includes a graphical/textual display, e.g., an HTML-based web page. In alternative embodiments the search engine interface includes various input/output modes—for example, a voice activated system, a touch based system, or the like.

[**0041**] The search engine **122** can also generate an implicit query based on a current user state, which can be determined by the query system **132** from real-time events. Based on the query, the query system **132** can locate relevant information in the data store **140** and provide a result set. In one embodiment, the result set includes article identifiers for articles associated with the client applications **120** or client articles. Client articles include articles associated with the user **112***a* or client device **102***a,* such as the user's emails, word processing documents, instant messenger messages, previously viewed web pages and any other article or portion of an article associated with the client device **102***a* or user **112***a*. An article identifier may be, for example, a Uniform Resource Locator (URL), a file name, a link, an icon, a path for a local file, any alphanumerical identifier, or other suitable information that may identify an article. In another embodiment, the result set also includes article identifiers for articles located on other systems on the network **106**, e.g., network articles located by a search engine on a server device. Network articles include articles located on systems on the network **106** not previously viewed or otherwise referenced by the user **112***a,* such as web pages not previously viewed by the user **112***a*.

[**0042**] The formatter **134** can receive the search result set from the query system **132** of the search engine **122** and can format the results for output to a display processor **128**. In one embodiment, the formatter **134** can format the results in XML, HTML, or tab delineated text. The display processor **128** can be contained in memory **108** and can control the display of the result set on a display device associated with the client device **102***a*. The display processor **128** may include various components. For example, in one embodiment, the display processor **128** includes a Hypertext Transfer Protocol (HTTP) server that receives requests for information and responds by constructing and transmitting Hypertext Markup Language (HTML) pages. In one such embodiment, the HTTP server includes a scaled-down version of the Apache Web server. The display processor **128** can be associated with a set of APIs to allow various applications to receive the results and display them in various formats. The display APIs can be implemented in various ways, including, for example, as DLL exports, COM interface, VB, JAVA, or NET libraries, or as a web service.

[**0043**] Through the client devices **102***a-n,* users **112***a -n* can communicate over the network **106**, with each other and with other systems and devices coupled to the network **106**. As shown in **FIG. 1**, a server device **150** can be coupled to the network **106**. In the embodiment shown in **FIG. 1**, the search engine **122** can transmit a search query included in an explicit or implicit query or both to the server device **150**. The user **112***a* can also enter a search query in a search engine interface, which can be transmitted to the server device **150** by the client device **102***a* via the network **106**. In another embodiment, the query signal may instead be sent to a proxy server (not shown), which then transmits the query signal to server device **150**. Other configurations are also possible.

[0044] The server device **150** can include a server executing a search engine application program, such as the Google™ search engine. In other embodiments, the server device **150** can include a related information server or an advertising server. Similar to the client devices **102***a-n,* the server device **150** can include a processor **160** coupled to a computer-readable memory **162**. Server device **150**, depicted as a single computer system, may be implemented as a network of computer processors. Examples of a server device **150** include servers, mainframe computers, networked computers, a processor-based device, and similar types of systems and devices. The server processor **160** can be any of a number of computer processors, such as processors from Intel Corporation of Santa Clara, Calif. and Motorola Corporation of Schaumburg, Ill. In another embodiment, the server device **150** may exist on a client-device. In still another embodiment, there can be multiple server devices **150**.

[0045] Memory **162** contains the search engine application program, also known as a network search engine **170**. The search engine **170** can locate relevant information from the network **106** in response to a search query from a client device **102***a.* The search engine **170** then can provide a result set to the client device **102***a* via the network **106**.

[0046] The result set can include one or more article identifiers. An article identifier may be, for example, a Uniform Resource Locator (URL), a file name, a link, an icon, a path for a local file, or anything else that identifies an article. In one embodiment, an article identifier can include a URL associated with an article.

[0047] In one embodiment, the server device **150**, or related device, has previously performed a crawl of the network **106** to locate articles, such as web pages, stored at other devices or systems coupled to the network **106**, and indexed the articles in memory **162** or on another data storage device.

[0048] It should be noted that other embodiments of the present invention may include systems having a different architecture than that which is shown in **FIG. 1**. For example, in some other embodiments of the present invention, the client device **102***a* is a stand-alone device and is not coupled to a network.

[0049] Now referring to **FIG. 2**, a flow diagram illustrating an exemplary embodiment of a method for capturing and processing event data associated with a client device is shown. It should be noted that various event data capturing and processing methods in accordance with embodiments of the present invention may be carried out. For example, in one embodiment, application data is captured based on an application program interface ("API") associated with an application that is provided for interacting with the application. In another embodiment, keystrokes associated with an application are captured and events are determined based on, among other things, actions associated with the keystrokes. In another embodiment, display elements and related information is captured and events are determined based on, at least in part, the captured display information. These are some non-exhaustive examples of the multiple event data capturing and processing methods in accordance with embodiments of the present invention.

[0050] In one embodiment, it can be determined whether to index the event, and the event can be indexed and stored if it is so determined.

[0051] **FIG. 2** illustrates an exemplary method **200** that provides a method for capturing and processing a real-time event. This exemplary method is provided by way of example, as it will be appreciated from the foregoing description of exemplary embodiments that there are a variety of ways to carry out methods in other embodiments of the present invention. The method **200** shown in **FIG. 2** can be executed or otherwise performed by any of various systems. The method **200** is described below as carried out by the system **100** shown in **FIG. 1** by way of example, and various elements of the system **100** are referenced in explaining the example method of **FIG. 2**.

[0052] In **202**, the capture processor **124** captures an event. The capture processor **124** can capture an event by identifying and compiling event data associated with the event upon the occurrence of the event. The capture processor **124** may have separate capture components for each client application, network monitoring, performance data capture, keystroke capture, and display capture. For example, an event can occur when a user **112***a* types a predetermined number of words in a client application. The event data associated with this event can be, for example, the application used for the input, the format of the text, the words input; and the time input. In one embodiment, the capture component can use a generalized event definition mechanism, such as an event schema that it has previously registered with the client device **102***a,* to capture or express the event.

[0053] **FIG. 3** provides an example of capturing a real-time event of step **202**. Specifically, **FIG. 3** shows a flow diagram illustrating an exemplary embodiment of a method for capturing keystroke information on a client device. In this embodiment, a plurality of keystrokes associated with an application is received, each keystroke is processed to determine an associated action forming a plurality of associated actions, and an event is determined based at least in part on the plurality of associated actions. An application in focus can first be determined.

[0054] In one embodiment, the event can be a number of words and it can be determined that the plurality of associated actions forms a word or words. The word or words can be determined at least in part by the receipt of at least one keystroke indicating a space or a punctuation symbol. In another embodiment, the event can be a number of characters and it can be determined that the plurality of associated actions form a character or characters.

[0055] In one embodiment, a capture state can be updated after each keystroke is processed. In one embodiment, a current user state can be updated based at least in part on the event. The event can be indexed and stored.

[0056] In one embodiment, each associated action can be determined at least in part by matching the keystroke to an entry in a keystroke table and determining an action in the keystroke table associated with the entry. The action can include one of adding a character to a word, deleting a character from a word, inserting a character, overwriting a character, deleting a word, deleting a paragraph, selecting an item, and repositioning the cursor. The keystroke table can be associated with the application or can be a generic keystroke table.

[0057] In another embodiment, keystrokes associated with an application are received, an event is determined based on user input, and it is determined whether to index the event. User input can be one or more of a number of words determined from the keystrokes, a number of characters determined from the keystrokes, and a change is focus from the application to another application. Determining whether to index the event can include determining whether the event is important to the user.

[0058] In **302**, a keystroke database is provided. The keystroke database can contain, for various client applications, tables of keystroke commands and the respective action for each command. In one embodiment, the keystroke database has a separate table for each separate client application. A generic table may be used for an application if a specific table does not exist for the particular application. In one embodiment, the same table may be used for groups of applications. For example, the same table may be used for applications from the same developer. For example, the same table may be used for all Microsoft® applications and a different table may be used for all applications from Lotus®. Additionally, the same table may be used for related applications, such as Office® applications from Microsoft®, or word processing applications from any developer. The keystroke tables can be created manually for each application. Alternatively, the keystroke tables can be created automatically by automatically determining respective actions of each keystroke for each application.

[0059] In **303**, the keystroke capture component is called. The keystroke capture component can operate regularly or even constantly so that it monitors all keystroke activity or can be selectively called by the capture processor **124** or other capture components when needed or at various times. In **304**, th e keystroke capture component can determine the client application in focus. The application in focus is the client application currently being used by the user **112***a*. For example, it can be the client application that the user **112***a* is inputting text in. In one embodiment, the application in focus is determined so that the keystroke capture component can use the keystroke table associated with the application in focus from the keystroke database. For example, if the application in focus is a specific word processing application, the keystroke capture component can call up the corresponding specific word processing application keystroke table.

[0060] In **306**, the event data is reset by the keystroke capture component. In one embodiment, event data is complied in an event in a format defined by an event schema and the keystroke capture component can register a specific keystroke capture event schema, and resetting the event includes clearing out any existing event data. A counter N can also be reset. In one embodiment, the counter counts the number of words captured by the keystroke capture component. In such an embodiment, when the event is reset the counter is reset to zero.

[0061] In **308**, the keystroke capture component captures a keystroke input by the user **112***a*. A user can input a keystroke through a variety of input devices, such as a keyboard. A keystroke can include a single key input or a multiple key input and can include a text input and an editing command input. For example, a keystroke can include the "G" key or the "Shift" and the "G" keys. A keystroke can also include the "Backspace" key or the "Control" and "Backspace" keys. The keystroke capture component can receive a keystroke by receiving keystroke messages through an application callback that can be invoked by the operating system. The keystroke capture component can also receive a keystroke through monitoring an input buffer, such as a keyboard buffer, at the operating system level. Other methods of inputting characters, such as handwriting, can be captured.

[0062] In **310**, the keystroke capture component processes the keystroke. In the embodiment shown, the keystroke capture component processes the received keystroke by matching the keystroke to an entry in the keystroke table for the specific application in focus, and determining the respective action for the keystroke. For example, if the received keystroke is the "SHIFT" key and the "G" key in a specific word processing application, the keystroke capture component can match the "SHIFT" key and the "G" key in the keystroke table for the specific application and determine the associated action, for example, the output of the letter "G". If the received keystroke is the "Control" and "Backspace" keys, the keystroke capture component can match these keys with the respective action in the keystroke table for the specific application and determine the associated action, for example, the action of deleting the word preceding the cursor. Other possible actions include moving the cursor up or down one line, moving the cursor up or down one paragraph, and moving the cursor to the beginning or end of a document, for example. The keystroke capture component can keep track of the current position of the cursor with respect to previous characters entered. For example, if the user types 5 characters, hits "left arrow" three times, types one character, and hits "right arrow" three times, the component can identify that the user went back and inserted a character in the word (for applications where "left arrow" corresponds with moving the cursor back one character). The component can further keep track of whether each application is in "insert" mode, so that it knows if new characters overlay any existing characters.

[0063] In another embodiment, the keystroke capture component may not process the keystrokes directly. Instead, the keystroke capture component may first pass keystrokes to the operating system, as if the user had actively sent them to the keyboard capture component, and not an application. In this way, the operating system can do the work of translating keystrokes into higher level messages (characters, key movement, etc.), and can then return these messages to the keystroke capture component for further processing. Sending keystrokes to the operating system for intermediate processing, instead of processing them directly, may be advantageous for several reasons. For example, it may avoid some of the difficulties of handling multi-keystroke characters (including non-English character entry), and it may ensure keystrokes get processed in a manner that is consistent with operating system behavior.

[0064] In **312**, the keystroke capture component adds the processed keystroke to the event data. In the embodiment shown, the keystroke capture component captures event data as described by the event schema and the processed keystroke is added to the event data. For example, if the processed keystroke indicates the addition of the letter G, the letter G is added to the event data. If the processed keystroke indicates to delete the word preceding the cursor and a word is contained in the event data this word can be deleted. Additionally, the keystroke capture component can add the processed keystroke to a capture state. The keystroke capture component can maintain the capture state containing previous keystrokes as it is determined what recent word(s) the user has entered. The capture state can be updated before an event is generated.

[0065] In **314**, the keystroke capture component determines if a complete word has been added to the event. A word can be a series of characters representing a spoken word, abbreviation, term, or semantic unit. For example, "WORLD SERIES", "ASCII", "MR" and "GOOGLE" can be words. The keystroke capture component can determine if a complete word has been entered by a variety of methods. In one embodiment, the keystroke capture component looks for a series of characters followed by a space, such as "GOOGLE", or certain punctuation characters, such as "GOOGLE," to determine if a complete word has been entered. If a complete word has not been entered, then the keystroke capture component goes to step **316**. In **316**, the keystroke capture component can determine whether-the application previously in focus is still in focus or if the application in focus has changed and another application is now in focus. If the application in focus has not changed, the keystroke capture component returns to step **308** and receives another keystroke. If the application in focus has changed, the keystroke capture component returns to step **304** and determines the current application in focus. If the keystroke capture component identifies an action such as moving the cursor up one line, it may update the capture state to reflect the new cursor location. If the keystroke capture component does not have the capture state for that location, or cannot accurately pinpoint the new location, it may simply reset any partially captured word. As another example, the keystroke "shift left arrow" may select the previous character in a particular application. The keystroke capture component can recognize this action and possible subsequent actions such as deleting the selection or pasting the selection elsewhere in the document.

[0066] If, in step **314**, the keystroke capture component determines that a complete word has been received, then in step **318** the counter N is incremented by one. In step **320**, the capture processor determines if the counter N equals an integer T. The integer T can be, for example, a number of words. The number of words can be predetermined or can be determined based on a variety of suitable factors, such as the current application in focus or other user activity. In one example, T equals one so that the keystroke capture component may create an event upon the identification of each word entered by the user **112***a*. Alternatively, T can be a number of characters. Like the number of words, the number of characters can be predetermined or can be determined based on a variety of suitable factors. If, in step **320**, N is found not to equal T, then the keystroke capture component goes to step **316**, where the keystroke capture component determines if the application in focus has changed. If the keystroke capture component determines that N does equal T, then the keystroke capture component proceeds to step **322**. For example, if N is a counter counting the number of words captured and T is set to one and "GOOGLE" is received, then the keystroke capture component proceeds to step **322**.

[0067] In **322**, the keystroke capture component compiles the event. In the embodiment shown, the keystroke capture component compiles the event by compiling the event data associated with specific fields described by the event schema. For example, the event data can include the application used for the input, the format of the text, the word or words input, and the time input. When the keystroke capture component has compiled the event, the method **200** can continue at step **204** as shown in **FIG. 2**.

[0068] **FIG. 4** provides another example of capturing an event, for example, a real time event **202** as shown in **FIG. 2**, based on display information. **FIG. 4** shows a flow diagram illustrating an exemplary embodiment of a method for capturing display information on a client device. Typically, applications in a client device invoke display calls to display information associated with the application on a user display, such as a monitor, liquid crystal display, plasma display, or the like. In one embodiment, the capture processor **124** includes a display capture component for determining events based on, at least in part, the displays or windows associated with applications. It should be noted that windows associated with applications may be hidden or displayed and visible to the user at any given time. Information on a display can be determined at least in part by using an array of a current state of the display. and updating the array with display calls. Information on a display can also be determined, at least in part, by constructing display items based at least in part on display positions of the display calls. The display calls can be processed by analyzing one or more of the x,y coordinates, lengths, or relative positions of several items output to the display using display calls.

[0069] In one embodiment, an application in focus is first determined from which to capture associated display information to generate events. Events can include, for example, a number of words determined to be output on the display. In one embodiment, a capture state can be updated after each display call is processed and a current user state can be updated based at least in part on the event.

[0070] With respect to **FIG. 4**, initially, a display capture component is called **400**. The display capture component can operate regularly, e.g., on a schedule, or even constantly so that it monitors all display activity, or can be selectively called when needed. Then, the application in focus is determined **402**. In one embodiment, the application in focus is the client application currently being used. For example, in a windows-based operating system environment the display capture component determines which window the user is actively using.

[0071] For a first or new call, the event is reset **404**. An event may be reset for a variety of reasons, such as, for example, the user having switched the application in focus, an event having been captured and sent for processing, or for a variety of other reasons. In one embodiment, resetting **404** an event includes indicating or generating a new event. The existing event data prior to the resetting **404** is saved in a capture state and maintained until the reset. The indication of a new event triggers the sending of the existing event data in the previous event for processing. For example, in one embodiment, the reset finction saves the previous event and sends it to the queue **126** before initializing the new event. In one embodiment, new events can be generated according to an event schema associated with an event type. The event schemas can include formatting for various data fields associated with the different types of events.

[0072] Next, a display call is received **406**. For example, in one embodiment, the display capture component receives a display call. A display call can be an instruction sent by the operating system to the display device associated with the client device that instructs the display device to display an item or change the display of an item on the display device. For example, the display call can be to display the text "Google" in font "Times New Roman" at a display position, such as position x,y. This display call can, for example, cause the display on the screen of a computer monitor of the text "Google" at the position x,y in the active window and in the font "Times New Roman". A display call can also be, for example, to delete an item at a given position, change the font of a word, change the position of an item on the display, or the like. In one embodiment, display calls can also be determined by injecting code into applications or through the use of Dynamic Link Libraries ("DLLs") to hook and intercept operating system API calls as further detailed below. In another embodiment, other methods of output, such as calls to a printer driver, an audio driver, or the like, can also be captured.

[0073] After the display call is received **406**, the display call is processed **408** to determine the event data associated with the current display. The display includes the visual information the user sees in the window or windows. In one embodiment, the event data associated with the current display is captured and placed in an event format according to an event schema associated with the particular event type or application. In one embodiment, the captured event data may be saved or maintained in a capture state, for example, by keeping an array of items that have been output to the current display. For example, in one embodiment, a display capture component can use the x and y coordinates of the items to determine words, spaces between words, and the beginning of a new line. The display call may be used by the display capture component to update the array of the current display. For example, if the display call is to write the text "Google" in font "Times New Roman" at position x,y, previously displaying the word "Goolge," then the text "Google" in font "Times New Roman" is added to the display at position x,y replacing the text "Goolge." The updated array associated with the current display, including the text "Google" can then be added to the event. The capture state can also be updated by replacing the previous state array, "Goolge," with the updated array, "Google." Accordingly, updates to the display can be reflected in the associated event for as long as the event is not complete.

[0074] Whether a complete event has occurred is next determined **410**. In one embodiment, to determine **410** whether an event is complete, a complete condition is checked. For example, a complete condition can include adding a single word or a predetermined number of words to the display on the display device. Alternatively, as another example, a complete condition can include a particular user action on the display, e.g., a mouse click on a hyperlink, a button, a menu item, or the like. If a complete event has not yet occurred, then it is determined **412** whether the application in focus has changed. If the application in focus has not changed, the next display call associated with the active window is received **406**. Conversely, if the application in focus has changed, the new application in focus is again determined **402** and the capturing process for a new event starts.

[0075] If it is determined **410** that a complete event has occurred, then the completed event is compiled **414**. For example, in one embodiment, the display capture component compiles an event by providing all the event related data according to an event schema. The event data can include the application used, the format of the display, the time of display, the content displayed, the font and font size of any words displayed and any other data associated with the event that can be subsequently useful for indexing or to a user.

[0076] Now referring to **FIG. 5**, a flow diagram of one embodiment of a profile based display capture method **500** is shown. In this embodiment, a display capture component can be configured to capture information associated with windows for selected applications. The application windows may be displayed in the user's view or hidden within the computer system. Some examples of selected applications for which display capture components may be configured include applications that do not provide a public API, applications that encrypt or otherwise protect against data capture from its application windows, or the like. The capture processor in this embodiment can include several capture components. For some of the target applications from which event data is captured, a profile-based capture component is used.

[0077] Accordingly, in one embodiment, upon initialization of the capture component process, preexisting applications with associated windows are first checked **501** in order to determine their identity. In one embodiment, a target application profile is used for determining the identity of the running applications. The application profile includes identifying information associated with the target applications. The application profile may include, for example, a unique window class name associated with windows of a target application (whether hidden or displayed), a unique system path name for stored binary files associated with the target application, operating system registry entries associated with the target application, or the like. In one embodiment, upon initialization and after the existing applications are checked **501**, notifications for subsequent window creation events are received, for example, by subscribing through the operating system to window creation events. For every window creation event, the originating application is checked **501** to determine if it is a selected target application.

[0078] Once a target application is identified, computer code for an application-specific display capture component is associated **502** with the target application. For example, in one embodiment, a Windows® API based hook is set to load the display capture code from a dynamic link library ("DLL") into the target application process. In one embodiment, the display capture code circumvents the encryption/data capture protection features of the target application by modifying, intercepting, or bypassing its interactions with the operating system.

[0079] In one embodiment, event data from a target application is derived from a subset of the windows associated with the target application. Accordingly, the windows associated with the target applications are compared **504** with stored window profiles. The window profiles contain information that can be used to identify. target windows, including, for example, text to be contained in the window's title, the number and type of display elements (e.g., buttons, pull-down menus, text input boxes, and the like), text to be displayed on display elements, the location or arrangement of display elements, and the like.

[0080] For example, in one embodiment, a text window of an instant messaging ("IM") target application is the target window. The instant message text (both that which is input, and that which is received) is the event data to be captured and associated with an IM event (i.e., one data field in the IM event schema includes the text exchanged by the users in one session). The window profile in this example (i.e., the window profile of the target window, which is the IM conversation window) includes the string "Chatting with" in the window title, a "Send" button, and a large free text input box.

[0081] For each target window in the target application, the state of display elements or other target window display related variables is monitored **506**. For example, the state of handlers associated with display buttons or equivalent keyboard shortcuts (e.g., the "Send" button or the Ctrl+Enter key sequence) is monitored. Upon detection of the state change of a display element (e.g., a button) of interest, event data in the target window is captured **508**.

[0082] In one embodiment, the data capture is enabled by the display capture component code hooked into the target application process. This code intercepts operating system messages between the target application and the operating system, and modifies responses to these operating system messages in order to enable the data capture. For example, in a Windows® based system, an application configured to provide an empty string in response to every "get text" command (e.g., WM_GETTEXT) is modified by the capture component code to use the default handler to provide the window display text. Thus, the capture component code inserted into the target process allows the modification of application behavior, for example, to bypass data capture prevention measures from within the process.

[0083] The event data display capture **508** can be repeated based on state changes, and the capture state associated with an event can be updated with newly captured event data. For example, for every user click on the "Send" button in an IM application, the text associated with an instant message chat session can be captured **508** and stored in memory in a data structure associated with an IM event for the current session. Subsequent clicks on the "Send" button can cause the capture of additional text exchanges in the IM session between the users. Such state-based data capture beneficially provides an efficient scheme to capture display data upon user interaction with a target window. Time-based polling schemes can be less efficient since they may operate even if the user does not provide any new input to the target process. Moreover, state-based data capture can reduce the likelihood of missing some entered data because generally, after a user input, some state change is required (e.g., clicking on a "Send" button, an "OK" button, a "Continue" button, or typing equivalent keyboard shortcuts or the like).

[0084] Referring again to **FIG. 5**, the state of the target window termination is monitored **510**. Upon termination of the target window an event can be completed **512**. Any event data entry into the event data store can be finished and the captured event can be sent to the indexer. While the target window remains active, the display capture can continue for every state change in the window.

[0085] Referring now back to **FIG. 2**, once an event is captured (e.g., as described with respect to **FIGS. 4 and 5**), the event. data processing method proceeds with step **204**. The keystroke capture component described with respect to **FIG. 4** and the display capture component described with respect to **FIG. 5** can be used together in a capture processor **124**, in addition to other capture components, to determine user activity (for example, what the user is viewing on a visual output device, such as a display). Other capture components can include audio and video data capturing techniques, e.g., voice recognition, image processing, and the like, for audio and video events that can be included in the index.

[0086] After an event is captured, it is determined **204** whether the event is an indexable event. As explained above, some real-time events may not be indexed (non-indexable real-time events). In one embodiment, non-indexable real-time events are used to update the current user state and can be, for example, examining a portion of an article, changing an article, and closing an article. In this embodiment, non-indexable events are not indexed or sent for storage by the indexer **130**. Indexable events can be indexable real-time events or historical events. Keystrokes and display calls can be non-indexable events, such as the input of a number of words by a user or the display of a number of words on a display device. Keystrokes and display calls can also be indexable events, such as, for example, when an entire article or portion of an article is input by a user or displayed on a display device.

[0087] If an indexable event is determined **204**, then, the event can be sent **206** for indexing, e.g., to queue **126**, with an indication that it is an indexable event. In the embodiment shown in **FIG. 1**, indexable real-time events are sent to both a user state queue and an index queue within queue **126**, and historical events are sent to the index queue within the queue **126**. Alternatively, indexable real-time events may not be sent to the user state queue to save computational time. The capture processor **124** can send the event in a form described by an event schema to the queue **126**.

[0088] If the event is determined **204** to be a non-indexable event, then, the non-indexable event can be sent **206** for further processing, e.g., to a user state queue of the queue **126**, with an indication that it is not to be indexed. For example, when a user is composing an email a capture component can capture a number of words input by the user in the composition of the email. A capture component can capture the input text as an event. While this event can be helpful in determining a current state of the user **112***a,* it may not be important enough to be indexed and sent for storage by the search engine, so that the user may later retrieve this information. Alternatively, in an example where a user opens a received email, such an event can provide information on a current user state, but it can also be indexed and sent for storage by the search engine **122**, because the user **112***a* may later be interested in retrieving this email.

[0089] In one embodiment, the queue **126** holds the event until the search engine is ready to receive it. Based on the event data, the event can be prioritized on the queue **126** for handling. For example, historical events can be given a lower priority for processing by the queue **126** than real-time events. In one embodiment, when the indexer **130** is ready to process another event, it can retrieve one or more events from the index queue in the queue **126**. The query system **132** can retrieve one or more events from the user state queue of the queue **126** when it is ready to update the user state. In another embodiment, a queue is not used and events are sent directly to the search engine **122** from the capture processor **124**.

[**0090**] After indexing determinations are made **204** and events are properly queued **206**, events are indexed and stored **208**. In one embodiment, the indexer **130** can retrieve an event from the queue **126** when it is ready to process the event. The indexer **130** determines if the event is a duplicate event and if not assigns an Event ID to the event. The indexer **130** can also associate the event with related events. For example, in an embodiment as shown in **FIG. 2**, using the event schema, the indexer **130** determines indexable terms associated with the event, dates and times associated with the event, and other data associated with the event. The indexer **130** can associate the Event ID with the indexable terms that are contained in the index **142**. The event can be stored in the database **144** and the content of the event can be stored in the repository **146**.

[**0091**] The environment shown reflects a client-side search engine architecture embodiment. Other embodiments are possible, such as a stand alone client device or a network search engine.

[**0092**] While particular embodiments and applications of the present invention have been illustrated and described herein, it is to be understood that the invention is not limited to the precise construction and components disclosed herein and that various modifications, changes, and variations may be made in the arrangement, operation, and details of the methods and apparatuses of the present invention without departing from the spirit and scope of the invention as it is defined in the appended claims.

What is claimed is:

1. A computer based method for capturing event data from a target window of a target application in a computer system, the method comprising:

comparing window information with a target window profile associated with the target window of the target application; and

capturing event data from the target window upon detecting a state change of a state associated with an element in the window.

2. The method of claim 1, further comprising:

receiving window creation information from a first application; and

determining whether the first application is an instance of the target application.

3. The method of claim 2, wherein determining comprises comparing the window creation information with a target application profile associated with the target application.

4. The method of claim 2, further comprising:

determining whether a second application associated with an existing window is an instance of the target application.

5. The method of claim 4, wherein determining comprises comparing application related data from the second application with the target application profile associated with the target application.

6. The method of claim 4, wherein the application related data includes at least one of a window class name, a path name, or a registry entry associated with the application.

7. The method of claim 1, wherein capturing event data further comprises storing captured window information in a data structure associated with an event according to an event schema.

8. The method of claim 7, further comprising indexing and storing the event.

9. The method of claim 1, further comprising:

updating a capture state of an event with additional captured event data from the window in response to a subsequent state change of the state associated with the element in the window.

10. The method of claim 1, wherein the element in the window includes at least one of a button, a pull-down menu, or a hyperlink.

11. The method of claim 2, wherein the window creation information includes at least one of a window class name, a path name, or a registry entry associated with the first application.

12. The method of claim 3, wherein the target application profile includes at least one of a window class name, a path name, or a registry entry associated with the target application.

13. The method of claim 1, wherein the target application is associated with a plurality of target window profiles, each target window profile comprising identifying display element information for target windows from which to capture event data.

14. The method of claim 1, further comprising:

associating display capturing code within a target application.

15. The method of claim 14, wherein the display capturing code modifies responses of the target application to operating system requests.

16. The method of claim 15, wherein the operating systems requests include messages from other applications based on an application programming interface associated with the operating system.

17. The method of claim 15, wherein the operating system requests include requests for text in the target window.

18. The method of claim 14, wherein associating display capturing code includes setting a hook with respect to the target application process.

19. The method of claim 14, wherein the hook is configured to intercept messages between an operating system and the target application.

20. A computer based method for determining indexing events, comprising:

receiving a plurality of display calls associated with computer applications in a computer system;

processing the plurality of display calls to determine a target window based on a target window profile;

determining an event based at least in part on data captured from the target window; and

indexing the data captured from the target window and storing the event.

21. The method of claim 20, further comprising determining a target application based on a plurality of stored target application profiles, and farther wherein the plurality of display calls are associated with target applications.

22. The method of claim 20, further comprising capturing text input to the target window by a user and wherein the event includes the captured text.

23. The method of claim 20, further comprising updating a capture state after each display call is processed.

24. The method of claim 23, wherein updating is in response to a state change associated with a display element of the target window.

25. The method of claim 20, further comprising determining whether to index the event.

26. The method of claim 20, wherein indexing and storing the event takes place after terminating the target window.

27. The method of claim 20, wherein processing the plurality of display calls to determine a target window comprises analyzing one or more of the x,y coordinates, lengths, and relative positions of a plurality of display items written to the display using display calls and comparing them with the stored target window profile.

28. A computer-readable medium containing program code for capturing event data from a target window of a target application in a computer system, comprising:

program code for comparing window information with a target window profile associated with the target window of the target application; and

program code for capturing event data from the target window upon detecting a state change of a state associated with an element.

29. A computer-readable medium containing program code for determining indexing events, comprising:

program code for receiving a plurality of display calls associated with computer applications in a computer system;

program code for processing the plurality of display calls to determine a target window based on a target window profile; program code for determining an event based at least in part on data captured from the target window; and

program code for indexing the data captured from the target window and storing the event.

30. A method, comprising:

comparing application related data from applications associated with windows executing in a computer system with stored target application profiles associated with a plurality of target applications;

subscribing to window creation events through an operating system in the computer system;

receiving window creation request information from an application;

comparing the window creation request information with the stored target application profiles;

establishing a hook with capture component code into processes for each application matching to a target application profile;

comparing window element information for each process of each target application with a plurality of stored target window profiles associated with target windows of the target applications;

monitoring state changes for states associated with display elements in windows matching a target window profile;

capturing from each matched window event data into an event associated with each matched window upon detecting a state change of the monitored states, wherein capturing comprises modifying application behavior of the matched applications based on the capture component code; and

completing the events associated with the matched windows in response to closure of the matched window.

31. A method, comprising:

determining whether an application is an instance of a target application by comparing application related data from the application associated with a window executing in a computer system with a target application profile associated with a target application, wherein the target application is configured to provide a null string in response to a window text request;

establishing a hook with capture component code into a processes for the application, the capture component code configured to intercept messages between the application and an operating system;

determining whether a window associated with the application is an instance of a target window by comparing window information from the window of the application with a target window profile associated with the target window of the target application;

monitoring state changes for states associated with display elements in the window;

capturing text within the window upon detecting a state change of the monitored states, wherein capturing comprises intercepting a window text request and providing the window text prior to the application responding to the window text request; and

indexing the captured text upon termination of the window.

32. A computer system for capturing event data from a target window of a target application in a computer system, the system comprising:

means for comparing window information with a target window profile associated with the target window of the target application; and

means for capturing event data from the target window upon detecting a state change of a state associated with an element.

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