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Singh et al.

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(54) **METHODS, SYSTEMS, AND COMPUTER PROGRAM PRODUCTS FOR DISPLAYING WINDOWS ON A GRAPHICAL USER INTERFACE BASED ON RELATIVE PRIORITIES ASSOCIATED WITH THE WINDOWS**

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(52) **U.S. Cl.** **715/803**; 715/790; 715/791; 715/792; 715/794; 715/797

(58) **Field of Classification Search** 715/803, 715/790–797
See application file for complete search history.

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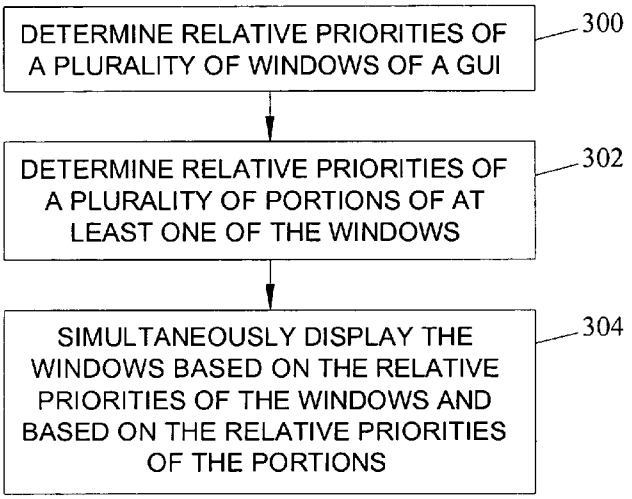
Primary Examiner — Robert Stevens
Assistant Examiner — Daniel Um

(57) **ABSTRACT**

Methods, systems, and computer program products for displaying windows on a graphical user interface based on relative priorities associated with the windows are disclosed. According to one method, relative priorities of a plurality of windows of a graphical user interface are determined. Further, relative priorities of a plurality of portions of at least one of the windows are determined. The windows are automatically arranged on the graphical user interface based on the relative priorities of the windows and based on the relative priorities of the portions. A higher priority window may cover a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window.

40 Claims, 12 Drawing Sheets



MOTOROLA-LENOVO EXHIBIT 1017

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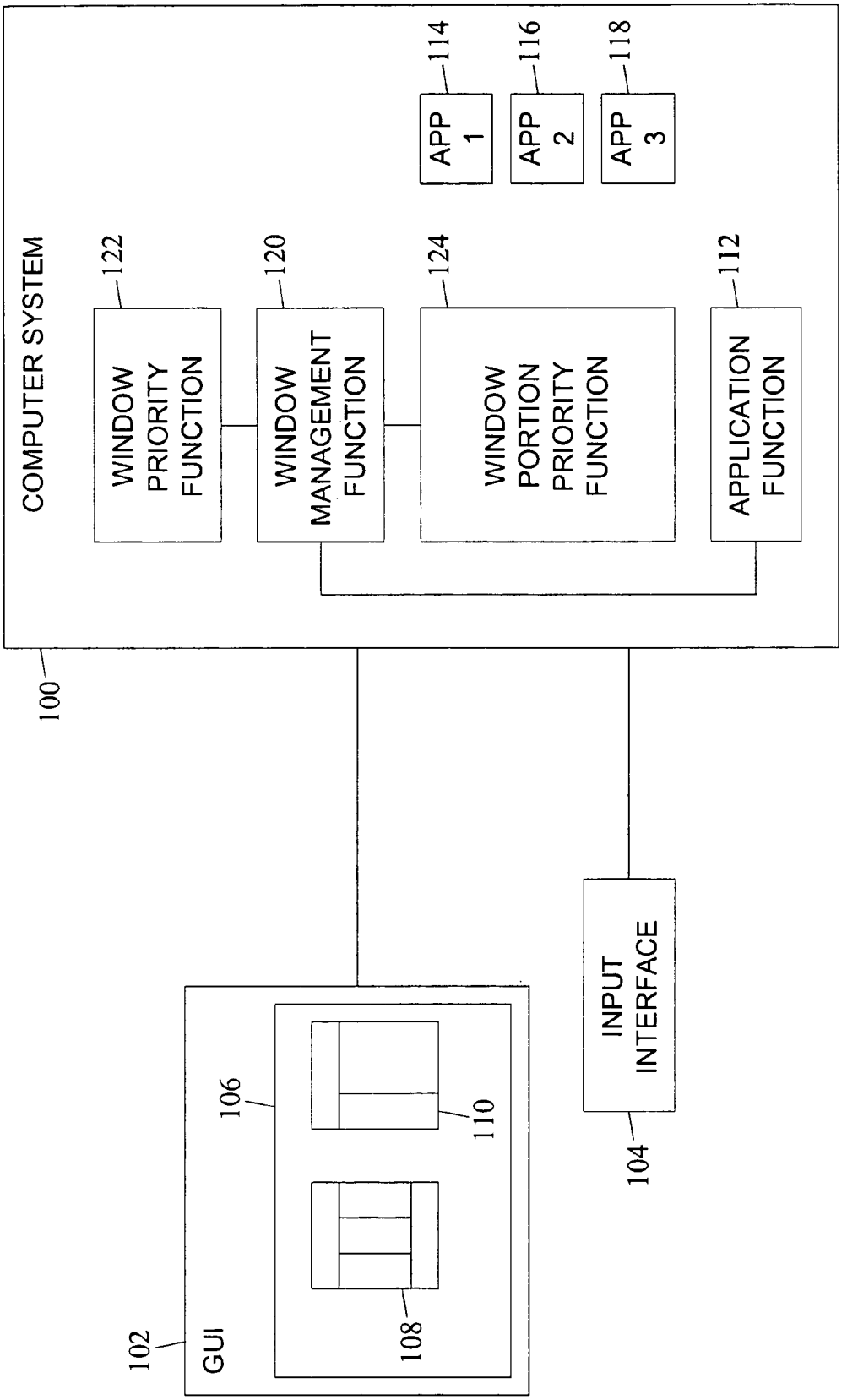
COMPUTER SYSTEM
100
WINDOW PRIORITY FUNCTION
122
WINDOW MANAGEMENT FUNCTION
120
WINDOW PORTION PRIORITY FUNCTION
124
APPLICATION FUNCTION
112
APP 1
114
APP 2
116
APP 3
118
INPUT INTERFACE
104
GUI
102
106
108
110

FIG. 1

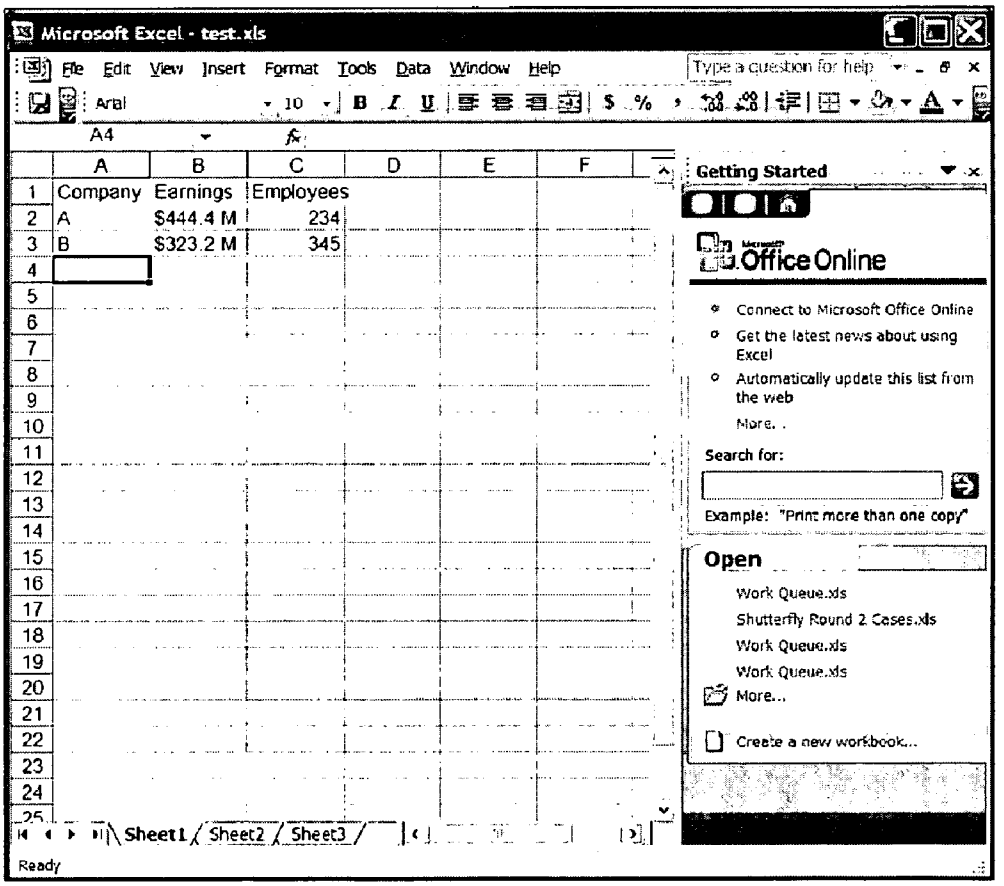
Microsoft Excel - test.xls
File Edit View Insert Format Tools Data Window Help
Type a question for help
Arial
10
A4
Company
Earnings
Employees
A
$444.4 M
234
B
$323.2 M
345
Sheet1
Sheet2
Sheet3
Ready
Getting Started
Office Online
Connect to Microsoft Office Online
Get the latest news about using Excel
Automatically update this list from the web
More...
Search for:
Example: "Print more than one copy"
Open
Work Queue.xls
Shutterfly Round 2 Cases.xls
Work Queue.xls
Work Queue.xls
More...
Create a new workbook...

FIG. 2

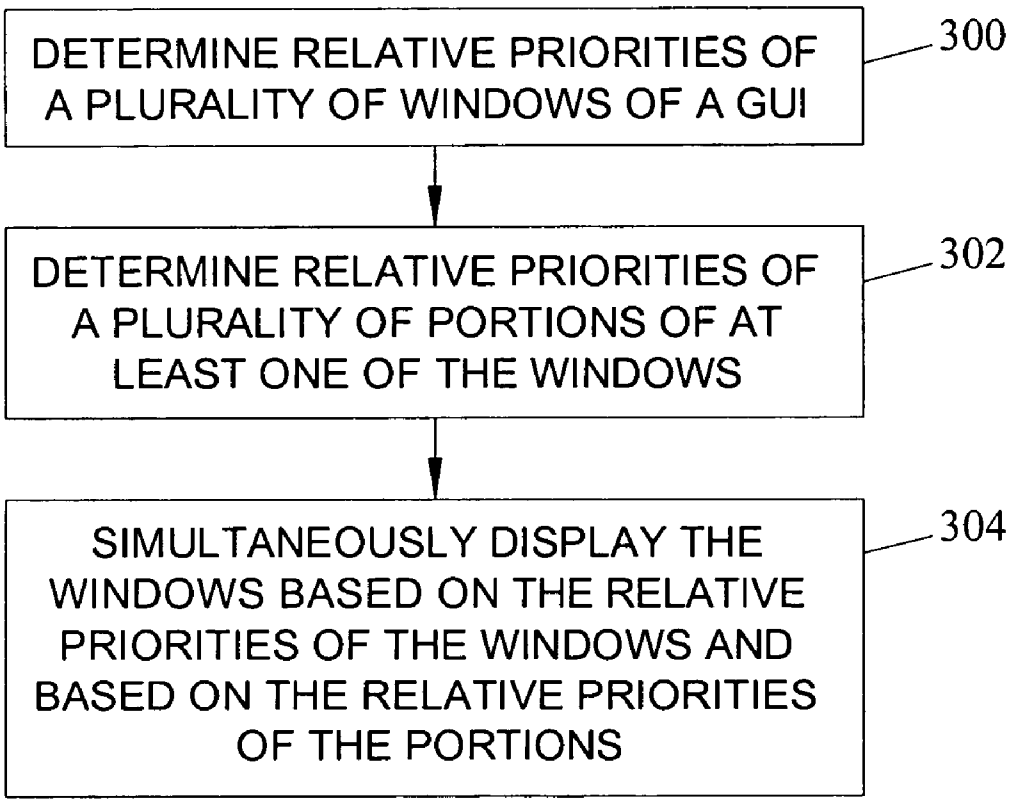
DETERMINE RELATIVE PRIORITIES OF A PLURALITY OF WINDOWS OF A GUI
300
DETERMINE RELATIVE PRIORITIES OF A PLURALITY OF PORTIONS OF AT LEAST ONE OF THE WINDOWS
302
SIMULTANEOUSLY DISPLAY THE WINDOWS BASED ON THE RELATIVE PRIORITIES OF THE WINDOWS AND BASED ON THE RELATIVE PRIORITIES OF THE PORTIONS
304

FIG. 3

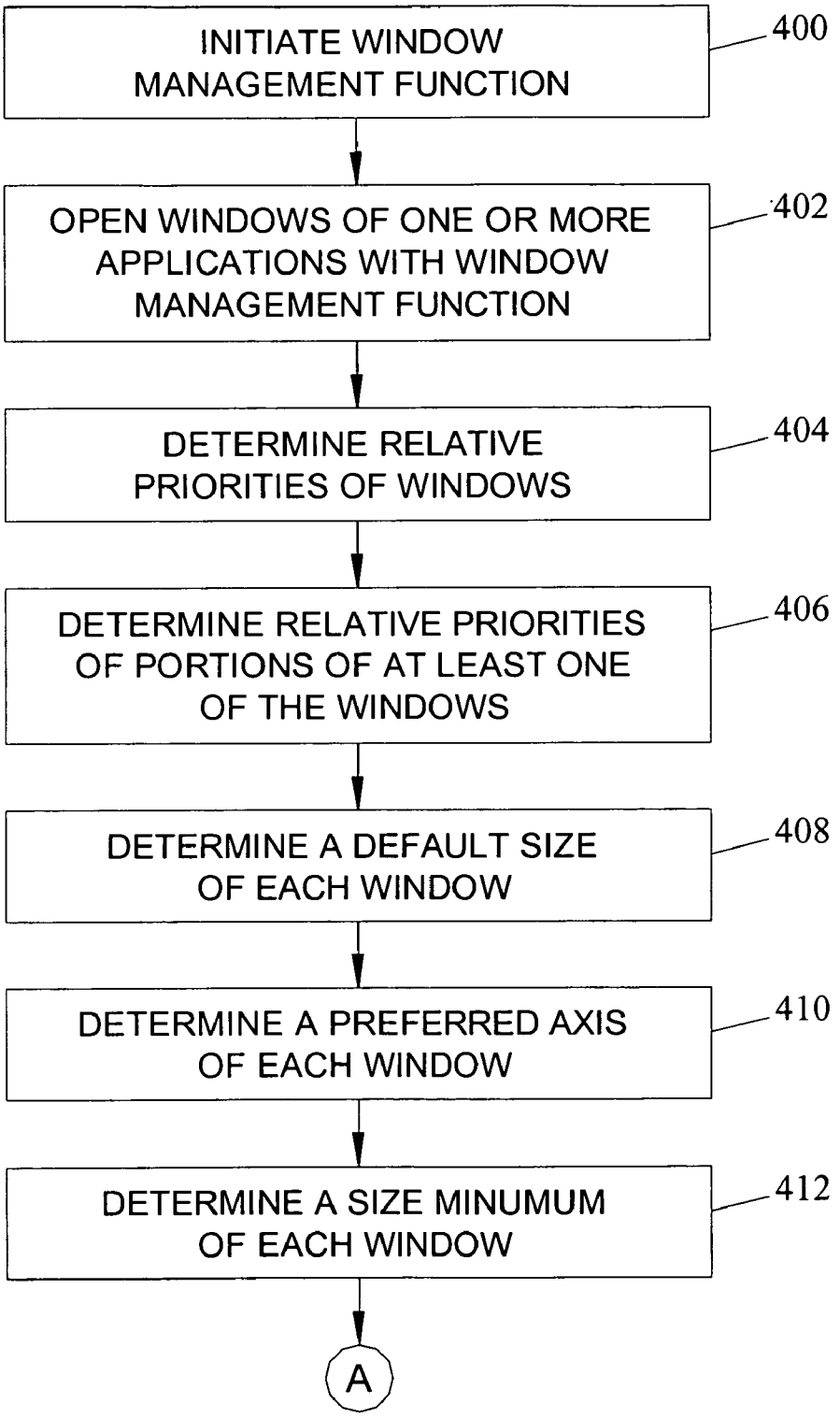
INITIATE WINDOW MANAGEMENT FUNCTION
400
OPEN WINDOWS OF ONE OR MORE APPLICATIONS WITH WINDOW MANAGEMENT FUNCTION
402
DETERMINE RELATIVE PRIORITIES OF WINDOWS
404
DETERMINE RELATIVE PRIORITIES OF PORTIONS OF AT LEAST ONE OF THE WINDOWS
406
DETERMINE A DEFAULT SIZE OF EACH WINDOW
408
DETERMINE A PREFERRED AXIS OF EACH WINDOW
410
DETERMINE A SIZE MINUMUM OF EACH WINDOW
412
A

FIG. 4A

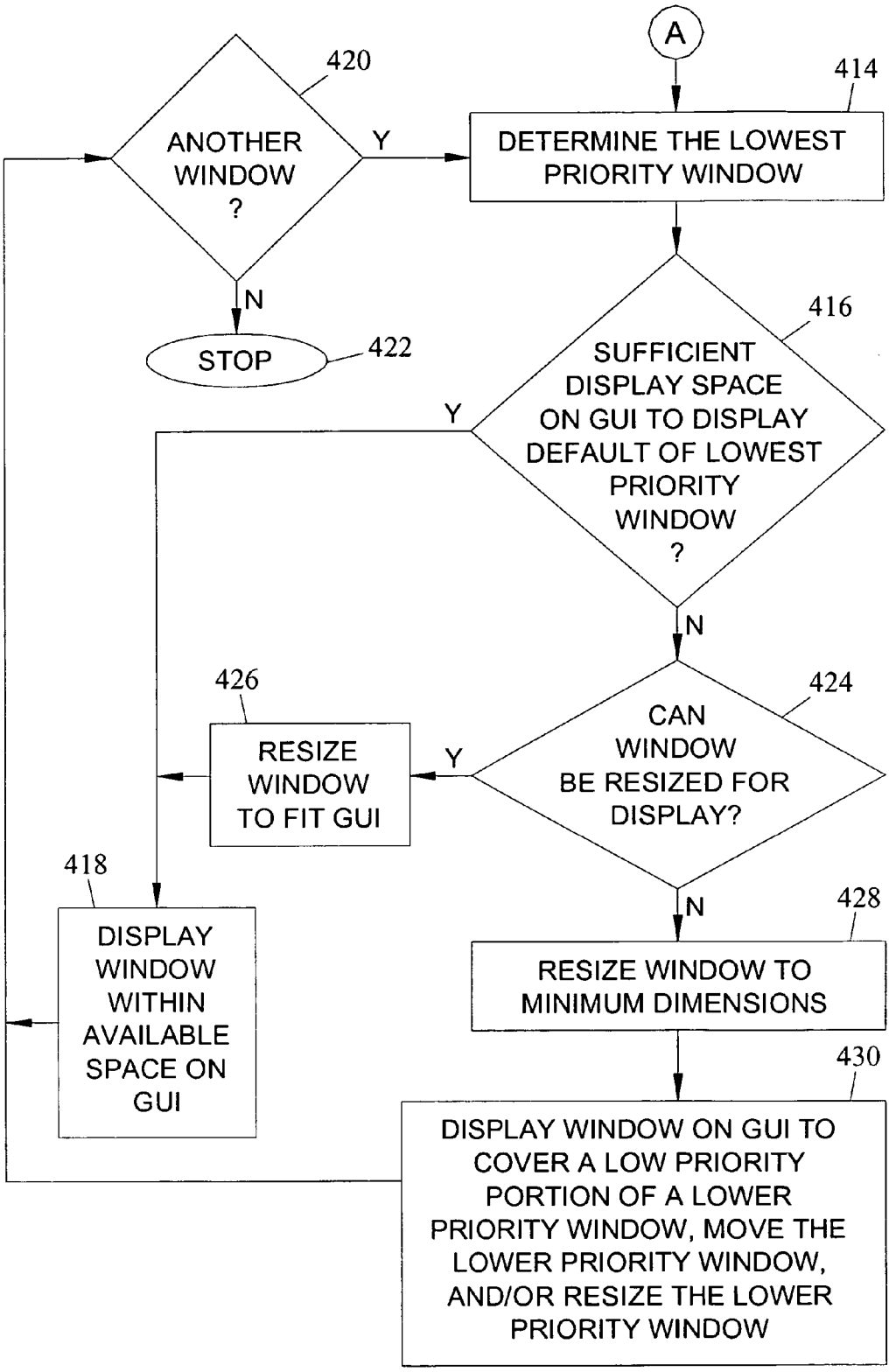
A
414
DETERMINE THE LOWEST PRIORITY WINDOW
420
ANOTHER WINDOW ?
Y
N
STOP
422
416
SUFFICIENT DISPLAY SPACE ON GUI TO DISPLAY DEFAULT OF LOWEST PRIORITY WINDOW ?
Y
N
424
CAN WINDOW BE RESIZED FOR DISPLAY?
Y
N
426
RESIZE WINDOW TO FIT GUI
418
DISPLAY WINDOW WITHIN AVAILABLE SPACE ON GUI
428
RESIZE WINDOW TO MINIMUM DIMENSIONS
430
DISPLAY WINDOW ON GUI TO COVER A LOW PRIORITY PORTION OF A LOWER PRIORITY WINDOW, MOVE THE LOWER PRIORITY WINDOW, AND/OR RESIZE THE LOWER PRIORITY WINDOW

FIG. 4B

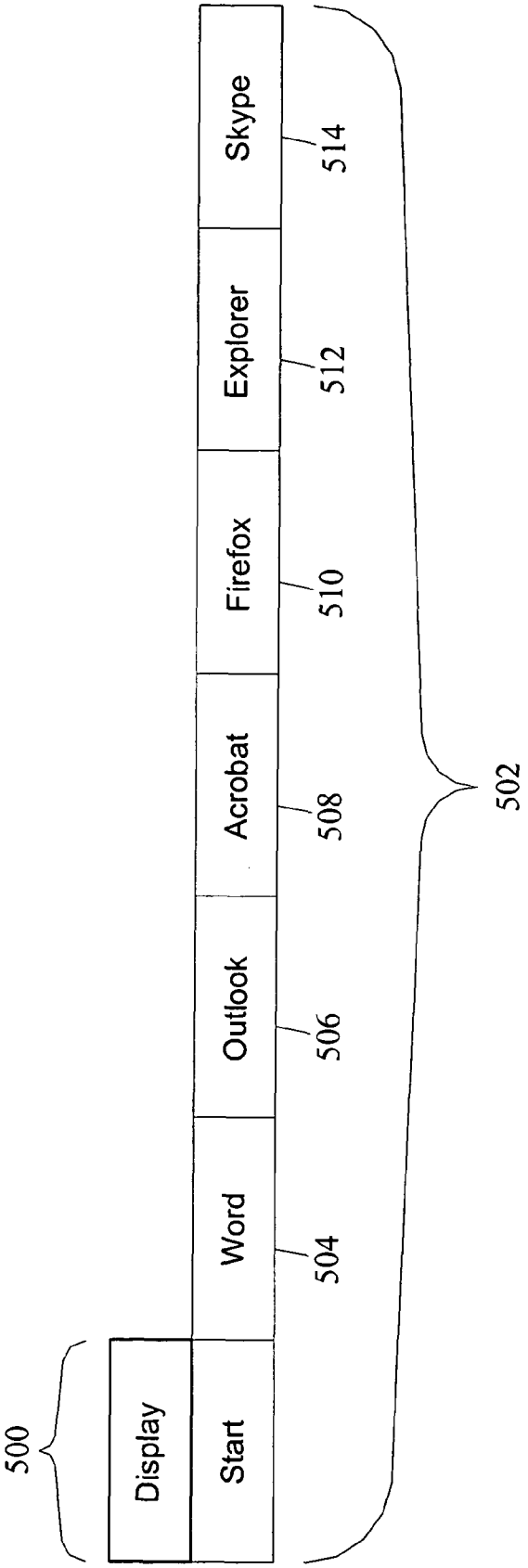
500
Display
Start
Word
504
Outlook
506
Acrobat
508
Firefox
510
Explorer
512
Skype
514
502

FIG. 5

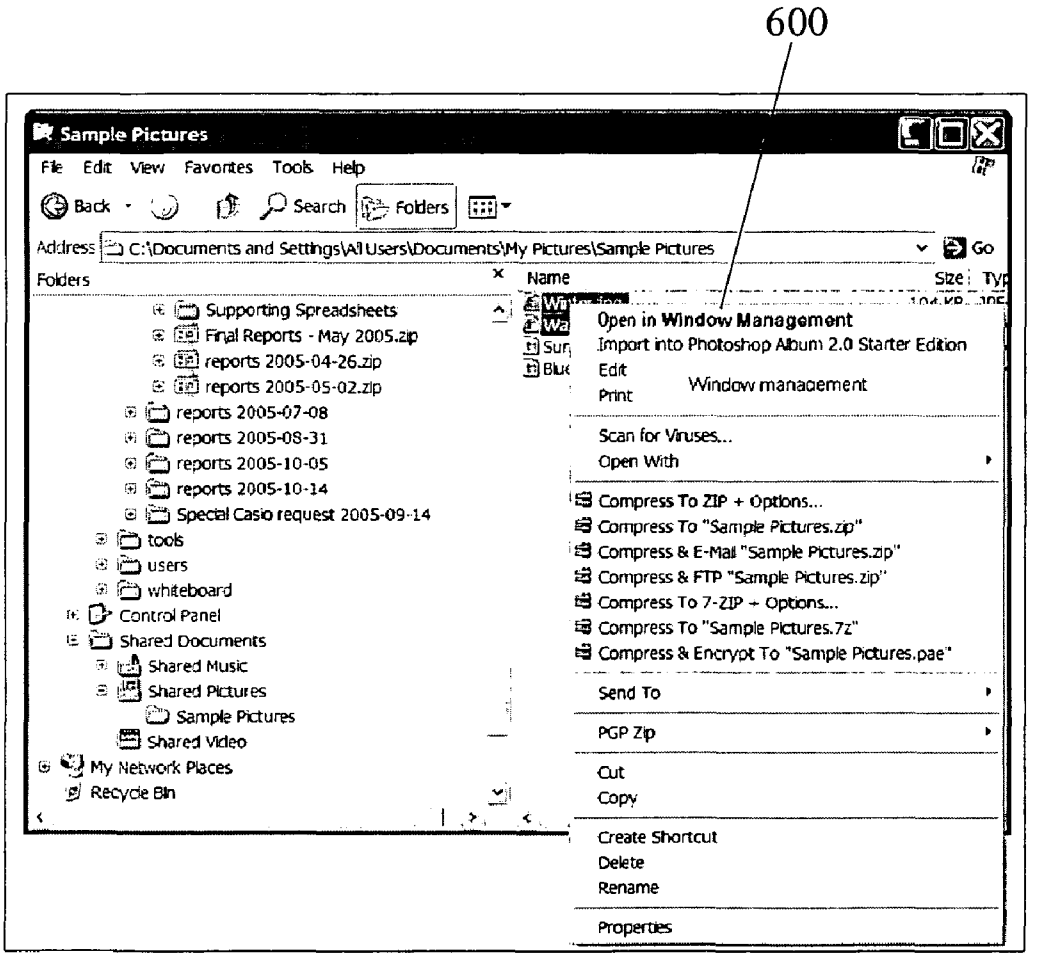
600
Sample Pictures
File Edit View Favorites Tools Help
Back Search Folders
Address C:\Documents and Settings\All Users\Documents\My Pictures\Sample Pictures
Go
Folders
Name
Size
Supporting Spreadsheets
Final Reports - May 2005.zip
reports 2005-04-26.zip
reports 2005-05-02.zip
reports 2005-07-08
reports 2005-08-31
reports 2005-10-05
reports 2005-10-14
Special Casio request 2005-09-14
tools
users
whiteboard
Control Panel
Shared Documents
Shared Music
Shared Pictures
Sample Pictures
Shared Video
My Network Places
Recycle Bin
Open in Window Management
Import into Photoshop Album 2.0 Starter Edition
Edit
Print
Window management
Scan for Viruses...
Open With
Compress To ZIP + Options...
Compress To "Sample Pictures.zip"
Compress & E-Mail "Sample Pictures.zip"
Compress & FTP "Sample Pictures.zip"
Compress To 7-ZIP + Options...
Compress To "Sample Pictures.7z"
Compress & Encrypt To "Sample Pictures.pae"
Send To
PGP Zip
Cut
Copy
Create Shortcut
Delete
Rename
Properties

FIG. 6

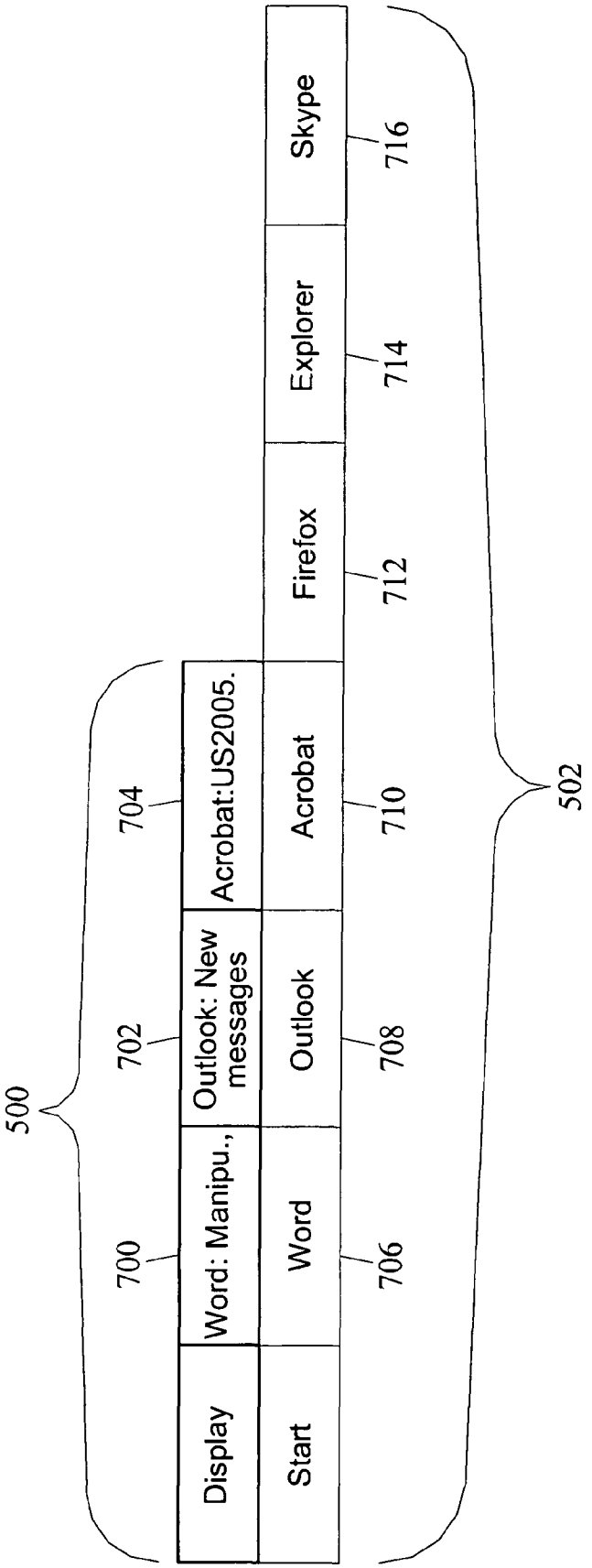
Display
Start
Word: Manipu.,
Word
Outlook: New messages
Outlook
Acrobat:US2005.
Acrobat
Firefox
Explorer
Skype
500
700
702
704
706
708
710
712
714
716
502

FIG. 7

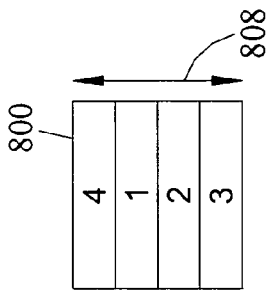

FIG. 8A

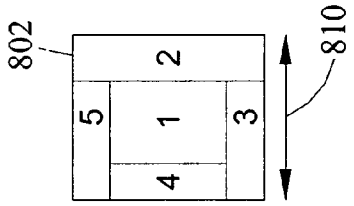

FIG. 8B

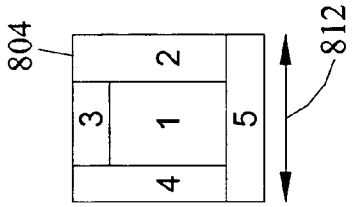

FIG. 8C

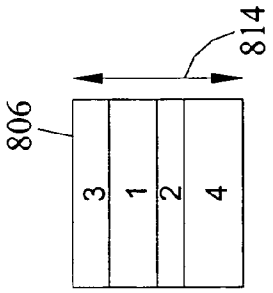

FIG. 8D

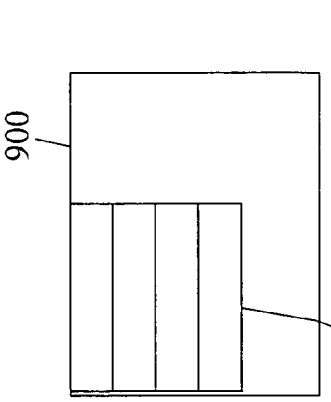

FIG. 9A

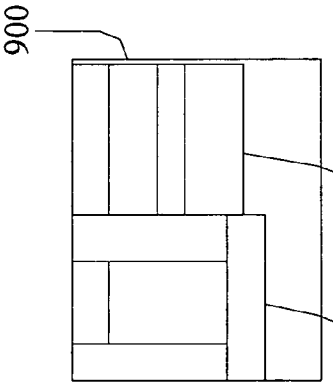

FIG. 9B

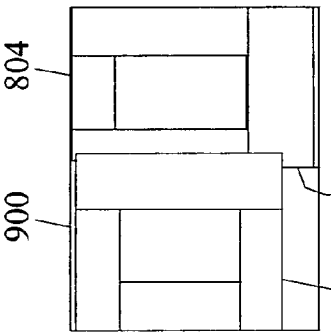

FIG. 9C

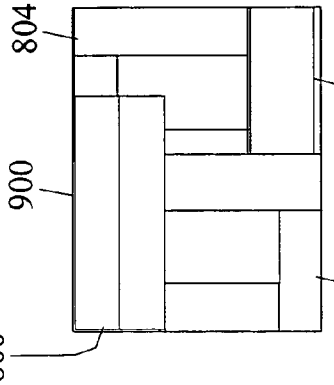

FIG. 9D

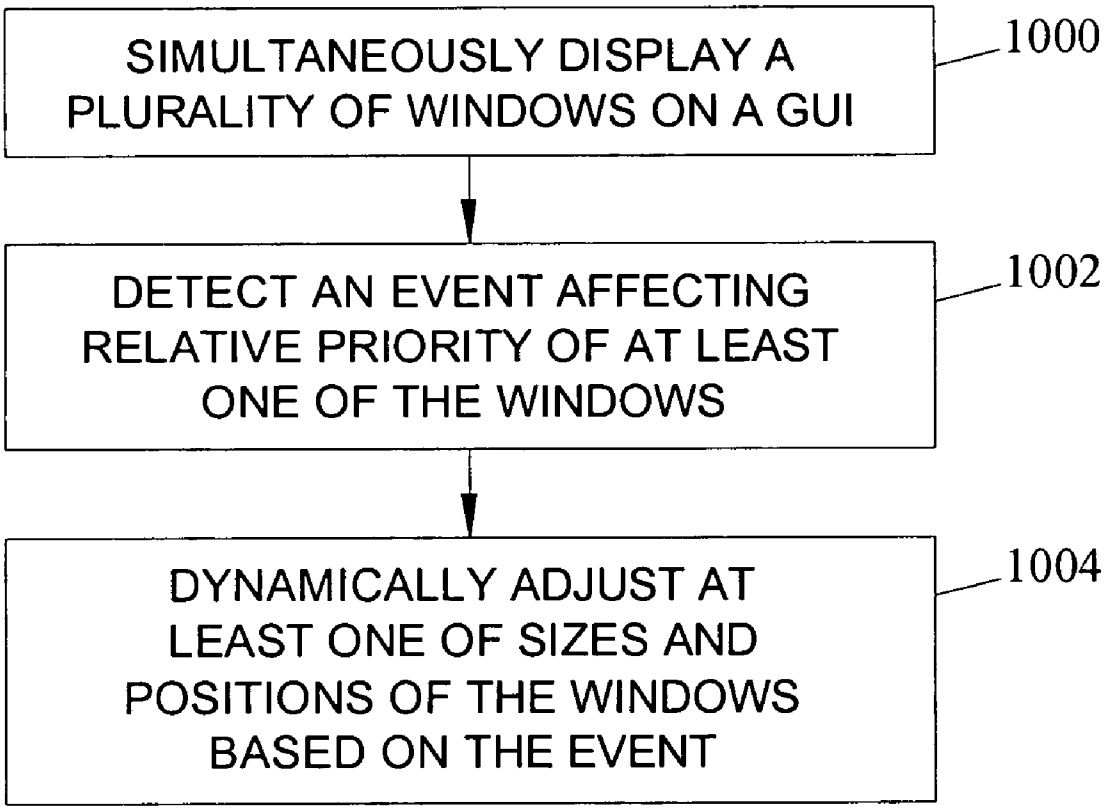
SIMULTANEOUSLY DISPLAY A PLURALITY OF WINDOWS ON A GUI
1000
DETECT AN EVENT AFFECTING RELATIVE PRIORITY OF AT LEAST ONE OF THE WINDOWS
1002
DYNAMICALLY ADJUST AT LEAST ONE OF SIZES AND POSITIONS OF THE WINDOWS BASED ON THE EVENT
1004

FIG. 10

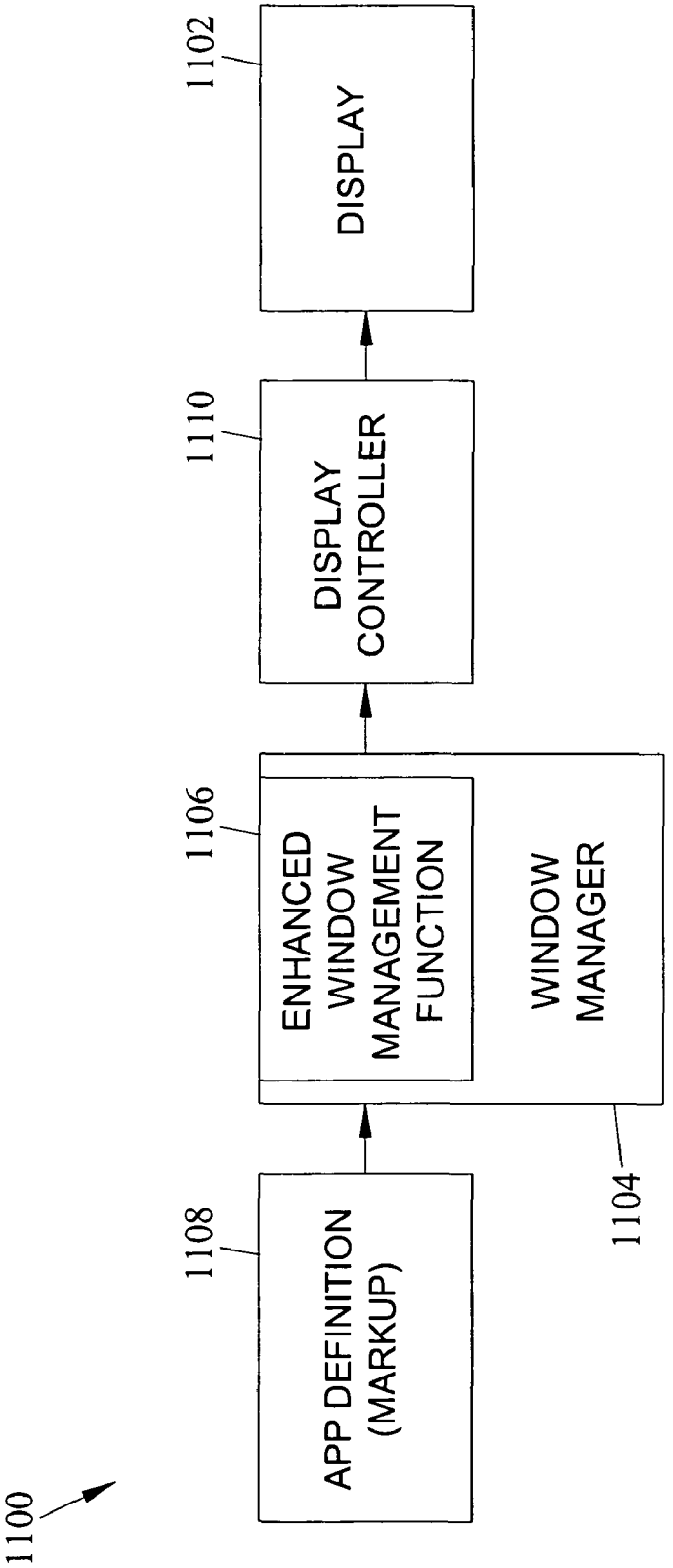
1100
1108
APP DEFINITION (MARKUP)
1106
ENHANCED WINDOW MANAGEMENT FUNCTION
WINDOW MANAGER
1104
1110
DISPLAY CONTROLLER
1102
DISPLAY

FIG. 11

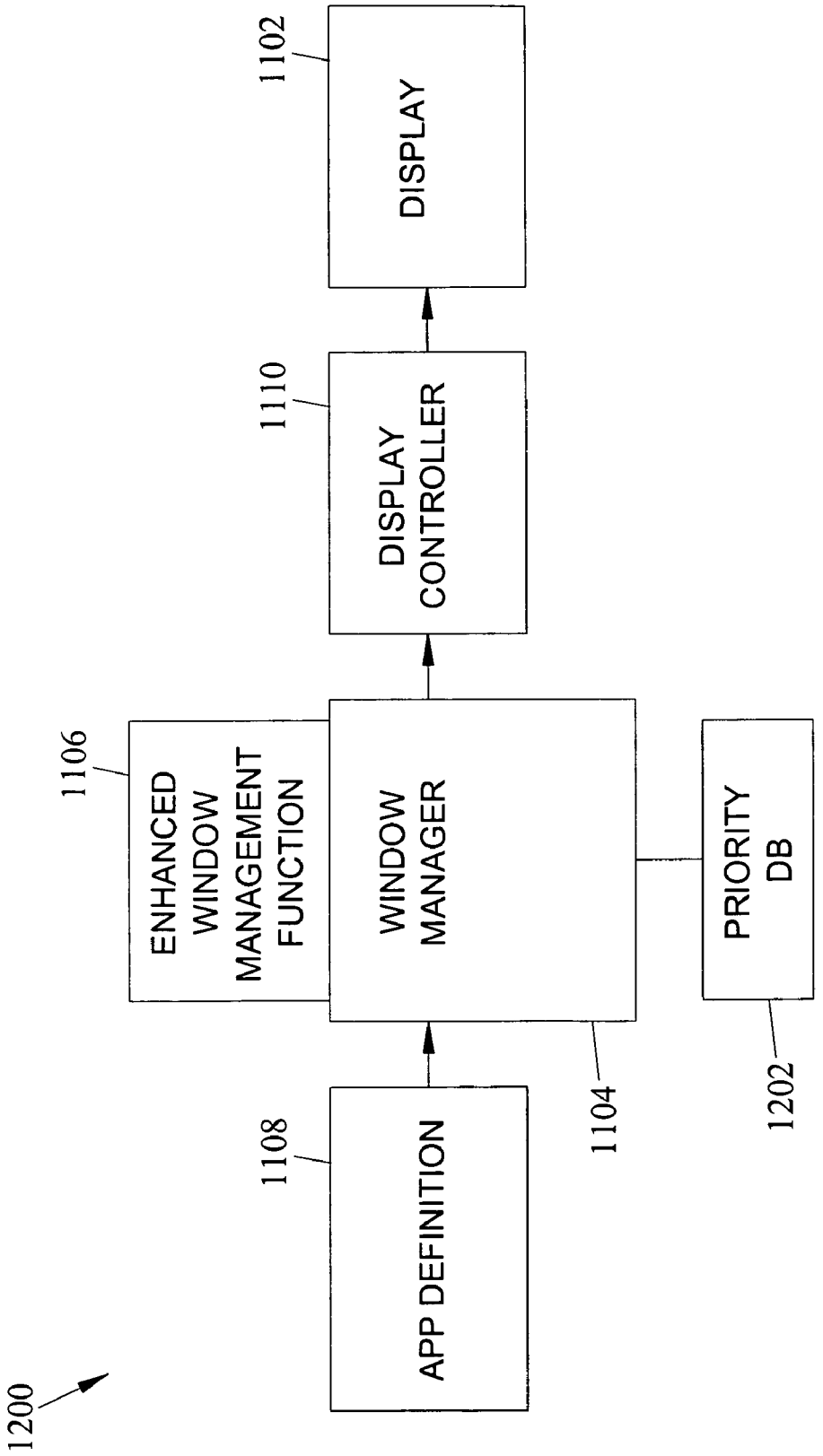
1200
1108
APP DEFINITION
1106
ENHANCED WINDOW MANAGEMENT FUNCTION
WINDOW MANAGER
1104
1110
DISPLAY CONTROLLER
1102
DISPLAY
PRIORITY DB
1202

FIG. 12

METHODS, SYSTEMS, AND COMPUTER PROGRAM PRODUCTS FOR DISPLAYING WINDOWS ON A GRAPHICAL USER INTERFACE BASED ON RELATIVE PRIORITIES ASSOCIATED WITH THE WINDOWS

TECHNICAL FIELD

The subject matter described herein relates to methods, systems, and computer program products for displaying windows on a graphical user interface (GUI). More particularly, the subject matter described herein relates to methods, systems, and computer program products for displaying windows on a GUI based on relative priorities associated with the windows.

BACKGROUND

Computers and other electronic devices are typically operable to execute multiple applications concurrently. For example, a computer may concurrently execute a word processing application, a web browser application, and an e-mail application. One or more of these multiple applications can be simultaneously displayed to a user using separate windows of a GUI of the computer. Further, each of these multiple applications can have multiple windows displayed on the GUI.

The concurrent display of multiple windows can be beneficial to a user when the user is working on a single task associated with each of the displayed windows. In this instance, the user can view information shown by the windows at the same time. For example, in a video conference, a user may desire to simultaneously display windows for a video conferencing application, a word processing application, and a spreadsheet application.

One problem with the simultaneous display of multiple windows is the arrangement of the windows on the GUI. The display area of the graphical user interface available to windows is limited. Therefore, it is desirable to position, size, and/or configure the windows on the GUI in order to maximize the benefit of the display area of the GUI for the user.

One existing method for arranging the display of multiple windows is to let the user arrange the windows manually to a desirable configuration. The user could rearrange the windows by re-sizing the windows and/or re-positioning the windows on the display. This manual rearrangement of the windows can be an inconvenient and time-consuming process.

Techniques have been developed for automatically rearranging windows on the GUI. For example, one system arranges windows on a display screen based on a class designation associated with the windows. However, the space on a display screen may not be optimally utilized because components within the windows are not arranged based on their importance to a user. For example, a portion within a window that is unimportant to a user may be arranged on a display screen in a position that is more prominent than a more important portion of the window. In addition, conventional systems that arrange windows based on display class do not dynamically update the arrangement of the windows as the relative importance of the windows or portions within the windows changes.

In view of the shortcomings of existing techniques for displaying windows, there exists a need for improved methods, systems, and computer program products for displaying windows on a GUI based on a relationship of the windows with one another.

SUMMARY

According to one aspect, the subject matter described herein includes a method for displaying windows on a GUI. The method includes determining relative priorities of a plurality of windows of a GUI. Further, the method includes determining relative priorities of a plurality of portions of at least one of the windows. The windows may be automatically arranged in the GUI based on the relative priorities of the windows and based on the relative priorities of portions of the windows. A higher priority window covers a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window.

The subject matter described herein can be implemented as a computer program product comprising computer executable instructions embodied in a computer readable medium. Exemplary computer readable media suitable for implementing the subject matter described herein include disk memory devices, chip memory devices, application specific integrated circuits, programmable logic devices, and downloadable electrical signals. In addition, a computer program product that implements the subject matter described herein may be located on a single device or computing platform. Alternatively, the subject matter described herein can be implemented on a computer program product that is distributed across multiple devices or computing platforms.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the subject matter will now be explained with reference to the accompanying drawings, of which:

FIG. **1** is a block diagram illustrating an exemplary computer system for displaying windows on a GUI according to an embodiment of the subject matter described herein;

FIG. **2** is a screen display of an exemplary window for displaying data and images associated with a spreadsheet application;

FIG. **3** is a flow chart of an exemplary process for displaying windows on a GUI according to an embodiment of the subject matter described herein;

FIGS. **4**A and **4**B are a flow chart of another exemplary process for displaying windows on a GUI shown in FIG. **1** according to an embodiment of the subject matter described herein;

FIG. **5** is a block diagram of an exemplary display organizer icon and a display taskbar according to an embodiment of the subject matter described herein;

FIG. **6** is a screen display of an exemplary window including a menu option for opening a file in a window management function according to an embodiment of the subject matter described herein;

FIG. **7** is a block diagram of an exemplary display organizer icon and a display taskbar populated with application windows according to an embodiment of the subject matter described herein;

FIGS. **8**A-**8**D are screen displays of exemplary windows having different priorities and portions within the windows having different priorities according to one embodiment of the subject matter described herein;

FIGS. **9**A-**9**D are screen displays of a sequential arrangement of the windows shown in FIGS. **8**A-**8**D according to an embodiment of the subject matter described herein;

FIG. **10** is a flow chart of an exemplary process for dynamically adjusting display of a plurality of windows on a GUI according to an embodiment of the subject matter described herein;

FIG. **11** is a block diagram illustrating an exemplary system for displaying windows on a GUI according to an embodiment of the subject matter described herein; and

FIG. **12** is a block diagram illustrating another exemplary system for displaying windows on a GUI according to an embodiment of the subject matter described herein.

DETAILED DESCRIPTION

According to one aspect, a system for displaying windows on a GUI may be implemented as hardware, software, and/or firmware components executing on one or more components of a system having a GUI. FIG. **1** illustrates an example of a computer system **100** for displaying windows on a GUI **102** according to an embodiment of the subject matter described herein. Computer system **100** may be any suitable system for displaying one or more windows on a GUI, such as a personal computer, mobile phone, personal digital assistant, and the like. The displayed windows may be associated with one or more applications. An application may provide instructions for displaying a window on GUI **102**. Referring to FIG. **1**, computer system **100** may include an input interface **104** by which a user inputs data. For example, input interface **104** may be a keyboard, a keypad, a touch screen interface, a tablet PC interface, or a mouse. The user can input data into input interface **104** for selecting one or more windows for display on GUI **102** and interacting with the displayed windows.

A window may be a user interface through which a user interacts with an application or an instance of an application. For example, a window may be one or more graphical images and/or data that appears on a display screen and corresponds to an application. FIG. **2** is a screen display of an exemplary window for displaying data and images associated with a spreadsheet application. Referring to FIG. **2**, the spreadsheet application is the Microsoft Excel spreadsheet software available from Microsoft Corporation of Redmond, Wash. A user may utilize an input interface for editing or otherwise interacting with the data and/or images displayed in the window. Further, the user may also change the dimensions or other characteristics of the display of the window. For example, the user may resize the window. In another example, the user may also selectively remove or adjust the size of a portion of the window in order to increase the available display space of the GUI. The size of a portion of a window may also be increased if space on the GUI provides.

Referring again to FIG. **1**, GUI **102** may be any suitable interface for visually representing programs and files with graphical images, such as icons, menus, and dialog boxes on a screen. Examples of GUIs suitable for use with embodiments of the subject matter described herein include any GUIs that represent files and programs using windows. Some current examples of GUIs that use windows are the desktop interfaces provided by MICROSOFT WINDOWS®, Red Hat LINUX®, and the X-Windows System developed by the Massachusetts Institute for Technology. In addition to these GUIs, the subject matter described herein may also be suitable for use with windows-based GUIs designed for mobile phones, PDAs, appliances, or other devices with visual interfaces.

In the illustrated example, GUI **102** may include a display area **106** for displaying windows **108** and **110** for view by the user. Windows **108** and **110** may also include a plurality of portions, shown by the lines within each window, that are of different relative importance to the user. For example, a portion in which the user is currently reading or entering text may be of higher importance than a taskbar portion.

System **100** may include an application function **112** for storing, managing, and executing one or more applications. For example, function **112** may simultaneously execute applications **114**, **116**, and **118**. An application may be an executable program. Applications may or may not operate with a user interface. A user may interact with an instance created by an application. For example, a spreadsheet application may execute an instance of a file for interaction by the user. A spreadsheet containing data associated with the file may be displayed in a window of GUI **102**.

Each application **114**, **116**, and **118** may be associated with one or more windows displayed on display area **106**. For example, applications **114** and **116** may be associated with windows **108** and **110**, respectively. Data, such as text and images associated with the applications, may be displayed within windows on display area **106**. For example, spreadsheet data generated by an application may be presented to a user in a window displayed on GUI **102**.

Further, system **100** includes means for automatically arranging windows in a graphical user interface based on relative priorities of the windows and based on relative priorities of portions of at least one of the windows. For example, system **100** may include a window management function **120** for automatically arranging windows on GUI **102** based on the relative priorities of windows and based on the relative priorities of portions of at least one of the windows. Function **120** may arrange the windows such that a higher priority window covers a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window. The windows may be arranged by positioning (or repositioning) the windows, sizing one or more windows, and/or the contents of one or more portions of the windows. For example, a window may be resized by changing the size of the window in a vertical direction and/or horizontal direction. In another example, a window may be positioned at a predetermined position with respect to another window. In another example, a portion of a window may be covered by another window based on the relative priorities of all of the windows on GUI **102** and the relative priorities of portions of the window. A window or portion of a window may be positioned and/or sized such that a higher priority window or portion of the higher priority window is viewable by the user.

System **100** may include a means for determining relative priorities of windows of a GUI. For example, system **100** may include a window priority function **122** for determining relative priorities of windows of GUI **102**. Relative priorities of windows may be determined based on a comparison of priorities assigned to two or more windows. The priorities assigned to each of the windows may be set by the user, the computer system, or by both the user and the computer system. For example, a user may assign a word processing window a higher priority than an e-mail management window. An application associated with the window may provide information about the window's priority to function **122**. For example, the application may provide to functions **122** and **124** one or more priority identifiers for identifying the priority of a window and/or the priority of portions of the window.

System **100** may include a means for determining relative priorities of portions of at least one of the windows. For example, system **100** may include a window portion priority function **124** for determining relative priorities of portions of at least one of the windows of GUI **102**. Relative priorities of portions of a window may be determined based on a compari-

son of priorities assigned to the portions of the window. The priorities of portions of each window may be assigned by the user, the computer system, or by both the user and the computer system. For example, a higher priority may be assigned to a portion of a word processing window in which text is being entered than an unused portion of the word processing window or of another window. In another example, a photographic image in a photography editing window may have a higher priority than a portion of the window associated with saving files and printing images.

According to one embodiment, system **100** may dynamically adjust the display of windows on GUI **102** based on events affecting the priority of one of the windows. GUI **102** may simultaneously display windows **108** and **110**. Further, the sizes and/or positions of the windows may be set according to relative priorities of the windows. Window management function **120** may detect an event affecting the relative priority of one of the displayed windows. For example, the event may be that one of the windows is being accessed by a user. The window being accessed may then be associated to have a higher priority than the other window. In another example, the event may be that one of the windows is being closed by a user. On detection of an event affecting the relative priority of one of the displayed windows, function **120** can dynamically adjust at least one of the sizes and positions of the windows based on the event.

FIG. **3** is a flow chart illustrating an exemplary process for displaying windows on a GUI according to an embodiment of the subject matter described herein. Referring to FIG. **3**, block **300** includes determining relative priorities of a plurality of windows of a GUI. In block **302**, relative priorities of a plurality of portions of at least one of the windows are determined. The windows are automatically arranged on the GUI based on the relative priorities of the windows and based on the relative priorities of the portions (block **304**). A higher priority window may cover a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window.

FIGS. **4**A and **4**B are a flow chart illustrating another exemplary process for displaying windows on GUI **102** shown in FIG. **1** according to an embodiment of the subject matter described herein. The relative priorities of each window in a set may be provided by a user. The user may select the relative priorities of windows for carrying out a task. The relative priorities of the windows may be based on the task. Alternatively, the priorities of the windows may be set by the application associated with each window. Referring to FIG. **4**A, block **400** includes initiating window management function **120** for selecting windows to be arranged on GUI **102** according to their relative priorities. Function **120** can be initiated by selecting a display organizer icon on GUI **102**. When function **120** is initiated, a display organizer icon may be displayed on GUI **102**. The display organizer icon may be associated with a display taskbar such as the display taskbar displayed on a GUI by any of the windows operating systems available from Microsoft Corporation. For example, the display organizer icon may be positioned adjacent to the display taskbar or otherwise positioned near to the display taskbar.

FIG. **5** is a block diagram illustrating an exemplary display organizer icon **500** and display taskbar **502** according to one embodiment of the subject matter described herein. Referring to FIG. **5**, display organizer icon **500** is positioned adjacent to taskbar **502**. Taskbar **502** may include various sub-icons that represent and indicate applications that are currently being executed by a computer system. For example, taskbar **502** includes sub-icons **504**, **506**, **508**, **510**, **512**, and **514**. The sub-icons can be selected for displaying a window of the corresponding application. None of the applications being executed by the computer system have been added to display organizer icon **500**.

Referring again to FIG. **4**A, windows of applications may be opened with window management function **120** (block **402**). The windows opened may be a set of windows designated by the user for automatic arrangement by function **120** on GUI **102**. A user may open a window of an application with function **120** by selecting a file to open and selecting a menu option for opening the application in function **120**. FIG. **6** is a screen display of an exemplary window including a menu option for opening a file in a window management function according to one embodiment of the subject matter described herein. Referring to FIG. **6**, the user can use a mouse to move a cursor for selecting the menu option "Open in Window Management" **600** for opening a file with the window management function.

The opened application may generate a sub-icon representation of the application in the display taskbar and a sub-icon representation of the application in a display organizer icon. In one embodiment, the same open application may have an instance residing as normal in the computer's operating system and an instance residing in the window management function **120**. The windows may be separate in their display parameters while maintaining synchronized contents or data. An instance of the application may be closed in function **120** without affecting the instance of the application in the computer's operating system. Further, a user may alternate between a window of the application as displayed by the different instances. Further, the application may remain open when function **120** is closed.

FIG. **7** illustrates a screen display of display organizer icon **500** and display taskbar **502** simultaneously maintaining instances of applications. Referring to FIG. **7**, display organizer icon **500** includes sub-icons **700**, **702**, and **704** that correspond to instances of three different applications having windows managed by function **120**. Display taskbar **502** includes sub-icons **706**, **708**, **710**, **712**, **714**, and **716** that correspond to instances of six different applications having windows managed by a computer's operating system. Sub-icons **700**, **702**, and **704** are associated with the same applications as sub-icons **706**, **708**, and **710**, respectively.

In one example, a window may be provided to windows management function **120** for management by "dragging and dropping" a sub-icon from a display taskbar onto the display organizer icon. For example, a sub-icon of a window may be shown on a display such as in a display taskbar. The sub-icon may be selected and moved to the display organizer icon to add the window to function **120** for management and arrangement with other windows on GUI **102**.

In another example, a window may be provided to function **120** for management by a combination of use of a keyboard keystrokes, mouse buttons and/or mouse positioning. It is envisioned that a variety of key combinations may be suitable for providing a window to function **120** for management. These key combinations include selecting items on a taskbar associated with the windows (e.g., depressing a shift button or a control button) with the mouse, right clicking the mouse, and selecting an "add to Window Management" button. In another example, a window's title bars may be selected for moving the window rather than the taskbar items associated with the windows.

In another example, a window may be provided to function **120** for management by selecting a display organizer icon of an open application or an unopened file. The window may be

provided to function **120** by moving the window's title bar to an icon associated with function **120**.

Referring again to FIG. **4**A, in block **404**, window priority function **122** determines relative priorities of windows. The relative priorities of windows may be determined based on an order that the windows are selected or positioned in the display organizer icon. For example, when a window A is opened before a window B, window A may be assigned a higher priority than window B. In another example, a user may selectively assign a priority number or other indicia to a window such that the window may be compared to other windows having an assigned priority. After windows have been added to the display organizer icon, the windows' priorities can be reordered by arranging the windows in the display organizer icon in a different order from the order that the windows were added to the display organizer icon. Further, window priorities may be adjusted by adding new windows to the display organizer icon. The position of sub-icon of a window in the display organizer may determine its relative priority. For example, a sub-icon may have a higher priority than all sub-icons positioned to its right.

In block **406**, window portion priority function **124** determines relative priorities of portions of at least one of the windows. As stated above, relative priorities of portions of a window may be determined by comparing priorities associated with two or more portions of a window. For example, in a graphics application window (such as ACROBAT® software available from the Adobe Systems Incorporated of San Jose, Calif.), the main contents portion of the window (e.g., the portion including graphics or text contained in an opened file) may have a higher priority than the search bar and thumbnail portions of the window. Further, for example, a portion of a window that is selected by a user (e.g., with a cursor or another suitable input device) may have a higher priority than any other portion of the window and displayed window.

In block **408**, window management function **120** may determine a default size of each window. For example, if a window has not previously been opened by a user, a default size of a window may be the default size of the window provided by the application associated with the window. The default size of a window may depend upon amount of that is being conveyed to the user by the window. For example, the default size for a chat application window may be small as compared to the total display area of a GUI. Conversely, the default size for a word processing application window may be large as compared to the total display area of a GUI. In another example, for a window that has been previously opened, the default size of the window may be the size of the window when the window was last closed. In another example, when a window is a copy of another window, the window copy may be sized the same as the size of the window that was copied.

In block **410**, function **120** may determine a preferred axis of each window. The preferred axis of a window may be provided by the application associated with the window. The preferred axis may be the dimension of the window that stretches or compresses more than another axis of the window. For example, in a window of a word processing application, the window may permit scrolling in the vertical direction. The user may also have scrolled in the vertical direction. In such windows, the vertical direction may be the preferred axis. Conversely, in a window of a spreadsheet application, the window may permit scrolling in a horizontal direction. In such windows, the horizontal direction may be the preferred axis. For windows having scroll bars for the horizontal and vertical directions, the dimensions of the scroll bars may be compared to determine the major preferred axis.

In block **412**, function **120** may determine a minimum size of each window. The minimum size of a window may be provided by the application associated with the window. For example, a minimum dimension of a window in the vertical direction and/or the horizontal direction may be determined. In one example of a word processing application window, the minimum size may be equal to the text width in the horizontal direction and five lines in the vertical direction. In an image editing application window, the minimum size may be the size of an object image being edited.

Blocks **414-430** represent a process for automatically arranging the designated set of windows for display on GUI **102**. The process of blocks **414-430** may be performed by function **120** for each window in a sequential order from the lowest priority window to the highest priority window in the set. In block **414**, function **120** may determine the lowest priority window for display among the set of windows designated for display. In block **416**, function **120** may determine whether sufficient display space is available on GUI **102** for displaying a default of the lowest priority window in the set that has not yet been arranged by the process on GUI **102** or otherwise processed. If sufficient display space is available, the window is positioned within the available space of GUI **102** (block **418**). The window may be repositioned, resized, and/or a portion of the window covered based on the processing of higher priority windows in the set.

In block **420**, it is determined whether another window is in the set that has not yet been arranged on GUI **102** by the process or otherwise processed. If there is not another window for display, the process stops (block **422**). Otherwise, if there is another window for display, the process may proceed to block **414** for processing the next lowest priority window in the set that has not yet been arranged on GUI **102** or otherwise processed.

Referring again to block **416**, if sufficient display space is not available on GUI **102**, function **120** may determine whether the window can be resized for display on GUI **102** (block **424**). If the window can be resized for display on GUI **102**, the window is resized (block **426**). The window may be resized by adjusting the size of the window in the vertical direction and/or the horizontal direction. The size of the window may be reduced to a size that is small enough to fit in an available display space of GUI **102**. Alternatively, the size of the window may be adjusted to a size for fitting the window by increasing the size of the window if another window has been reduced in size by an event. The size of the window may not be reduced to a size less than the minimum dimensions for the window. In one embodiment, function **120** may determine whether the window can be resized along its preferred axis to fit the available space of GUI **102** without reducing the size of the window below its minimum dimension. If the window cannot be resized to a small enough size along its preferred axis to fit the available space of GUI **102**, function **120** may determine whether the window can be resized along its other axis to fit the available space of GUI **102** without reducing the size of the window below its minimum dimension. If the window cannot fit within the available space of GUI **102** at its minimum dimensions, the window may be reduced in size to its minimum dimensions (block **428**) for covering a low priority portion of a lower priority window. Alternatively, the size of a window may be increased in the vertical and/or horizontal directions when an event occurs that closes or reduces the size of another window.

In block **430**, the window may be displayed on GUI **102** to cover a low priority portion of a lower priority window. Further, in block **430** the lower priority window may be moved and/or resized. As stated above, the relative priorities of win-

dows may be determined at block **404**, and the relative priorities of portions of the windows may be determined at block **406**. When a portion of a window is resized or a portion of the window covered, information regarding an unused portion of the window (e.g., white space in the margins) may be hidden from view on the display of GUI **102** by resizing the window or covering the unused portion. For example, it may be preferred to cover white space over text or pictures in a window. Next, the process may proceed to block **420** to determine whether there is another window for display. As a result of the arrangement process, a higher priority window may cover a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window. Further, the lower priority window may be resized and moved for providing more display space for the higher priority window and positioning the higher priority window in a better location.

According to one embodiment, the window management function may determine a relationship of windows with one another. For example, applications may be closely related to one another because the windows associated with the applications may be opened simultaneously to perform a task. The synergistic nature of applications is recognized for arranging windows on a GUI. For example, an e-mail application may be synergistic with a chat application but not with a camera software update application. If a user selects windows for arrangement by a window management function, the portions of the windows that have synergy with the highest priority window may be considered to have a high priority. A window having synergy with a high priority window may be assigned with a new priority that is higher than its previous priority based on its synergy with the highest priority window. Further, when a user interacts with a window, the window becomes the highest priority window and the priority of a window having synergy with the highest priority window may be rearranged based on its association with the highest priority window. A user may interact with a window by positioning a cursor on the window. Further, gaze equipment may be included for determining a portion of a window to which a user's eyes are directed, and the window portion to which the user's eyes are directed may be assigned the highest priority among the displayed windows.

In one example, a user may want to initiate a task for putting contact information into a message to send to another person. The contact information may be contained in an address book application. The user may open windows for a messaging application and the address book application with a window management function. The applications may be defined as being synergistic. The user may interact with the window of the address book application for searching for an address. Since the applications are synergistic, the portion of the address book window that includes the address search results may be assigned a high priority so that the messaging window does not cover the portion containing the search results. Further, for example, a selected portion containing information of a contact in the window may have a higher priority over the other portions containing contact information.

According to one embodiment, the number of windows managed by the window management function may be limited. The number of windows practically arranged by the window management function may be limited. For example, the function may not be able to practically manage **100** windows on a typical GUI.

FIGS. **8**A-**8**D illustrate screen displays of exemplary windows **800**, **802**, **804**, and **806** having different priorities and portions having different priorities according to one embodiment of the subject matter described herein. Windows **800**, **802**, **804**, and **806** may be associated with a set selected by a user for display on a display screen. FIGS. **9**A-**9**D illustrate screen displays of the sequential display and arrangement of windows **800**, **802**, **804**, and **806** shown in FIGS. **8**A-**8**D on a display screen **900** according to one embodiment of the subject matter described herein. Referring to FIGS. **8**A-**8**D, window **800** has a higher priority than windows **802**, **804**, and **806**. Window **802** has the next highest priority besides window **800**. Window **806** has the lowest priority among the windows. Window **804** has a higher priority than window **806** and a lower priority than window **802**. The priority of windows may be based on their selection for display by a user.

Portions of windows **800**, **802**, **804**, and **806** are designated according to their priority relative to the other portions of the same window. The portions are designated **1**-**5** according to priority with the highest priority being designated **1** and the lowest priority being designated **5**. Arrows **808**, **810**, **812**, and **814** indicate the preferred axis for windows **800**, **802**, **804**, and **806**, respectively.

Referring to FIG. **9**A, window **806** may be the first window positioned on display screen **900** because the window has the lowest priority among the set. Window **806** may be resized small enough to fit within display screen **900**.

Referring to FIG. **9**B, window **804** may be positioned on display screen **900**. Further, window **806** may be reduced in size to fit with window **804** on display because window **806** has a lower priority than window **804**. Window **806** may be reduced in size to its minimum dimensions if necessary to fit window **806** with window **804**. Further, if window **806** is reduced to its minimum size and does not fit with window **804**, window **804** may cover a low priority portion of window **806**. In this example, windows **804** and **806** are positioned on display screen **900** without reducing the size of window **806** or covering window **806**. Further, window **804** is positioned in a preferred position of display screen **900** at the upper left portion. Window **806** is moved.

Referring to FIG. **9**C, window **802** may be positioned on display screen **900** and cover portions of windows **804** and **806**. Recall that window **804** as a whole has a higher priority than window **806**. Accordingly, lower priority portions of window **806** are covered by window **804**. Window **802** may be reduced to its minimum size. Window **804** is positioned above window **806** on the right portion of display screen **900**. Window **806** is positioned on the preferred left portion of display screen **900**.

Referring to FIG. **9**D, window **800** may be positioned on display screen **900** and cover low priority portions of windows **802** and **804**. Window **800** may be reduced to its minimum size. Windows **802**, **804**, and **806** are moved to a lower portion of display screen **900**.

According to one embodiment, the display of windows on a GUI may be dynamically adjusted based on an event affecting the relative priority of one of the windows. Referring again to FIG. **1**, system **100** includes means for simultaneously displaying a plurality of windows on a GUI where at least one of sizes and positions of the windows are set according to relative priorities of the windows and of portions of the windows. As stated above, functions **120**, **122**, and **124** may operate together for simultaneously displaying a plurality of windows on GUI **102**. At least one of the sizes and positions of the windows are set according to relative priorities of the windows and of portions of the windows.

System **100** may also include a means for detecting an event affecting the relative priority of at least one of the windows. For example, window management function **120**

may detect an event affecting the relative priority of at least one of the displayed windows. The event may be a user accessing one of the windows or closing one of the windows. A window may be closed by removing a sub-icon associated with the window from a display organizer icon. For example, a user may close the window by selecting the close button in the window's title bar, by "right-clicking" on a mouse and selecting close, or by "clicking-and-dragging" the window's sub-icons off of the display organizer icon.

Further, system **100** may include a means for dynamically adjusting at least one of the sizes and positions of the windows based on the detected event such that a higher priority window covers a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window. For example, function **120** may dynamically adjust at least one of the sizes and position of the windows based on the detected event such that a higher priority window covers a lower priority portion of a lower priority window.

FIG. **10** is a flow chart illustrating an exemplary process for dynamically adjusting display of a plurality of windows on a GUI according to an embodiment of the subject matter described herein. Referring to FIG. **10**, block **1000** includes simultaneously displaying a plurality of windows on a GUI where at least one of sizes and positions of the windows are set according to relative priorities of the windows and of portions of the windows. In block **1002**, an event affecting the relative priority of at least one of the windows is detected. Further, at least one of the sizes and positions of the windows may be adjusted based on the detected event (block **1004**). The windows may be adjusted such that a higher priority window covers a lower priority portion of a lower priority window to provide for a simultaneous viewing of the higher priority window and a higher priority portion of the lower priority window.

FIG. **11** illustrates an example of a system **1100** for displaying windows on a display **1102** according to an embodiment of the subject matter described herein. Referring to FIG. **11**, system **1100** includes a windows manager **1104** and an enhanced window management function **1106**. Window manager **1104** may be a conventional window manager such as that provided by any of the WINDOWS® operating systems available from Microsoft Corporation. Window management function **1106** may manage the display of windows on display **1102** in accordance with the subject matter described herein.

According to one embodiment, applications may be specified by an application definition function **1108**. Function **1108** may include instructions in a markup language, such as XML user interface language (XUL) (available from Mozilla Foundation of Mountain View, Calif.) and extensible application markup language (XAML) (available from the Microsoft Corporation). A markup language may aide a programmer to specify the components that compose an application. The markup language may be translated into procedural invocations on an application programming interface (API) of window manager **1104** or interpreted by window manager **1104**. Manager **1104** may interpret a markup language or intercept procedure invocations made to manager **1104**. Further, function **1108** may specify the relative priorities of portions of windows for display. A markup language may support extensibility such that relative priorities of window portions may be added by a programmer. Based on the relative priorities of portions of a window for display, function **1106** may send instructions to a display controller **1110** for controlling display **1102** to display the window according to the subject matter described herein.

FIG. **12** illustrates an example of another system **1200** for displaying windows on display **1102** according to an embodiment of the subject matter described herein. Referring to FIG. **12**, system **1200** operates similar to system **1100** shown in FIG. **11**. System **1200** further includes a priority database **1202** for maintaining priorities of windows and portions of windows generated by applications. Windows and assigned priorities may be associated by identifiers. Function **1106** may retrieve the priority of a window from database **1202** for arranging the window on display **1102** according to the subject matter described herein.

The subject matter described herein provides the advantage of displaying windows on a GUI in a way that considers several factors about the windows. For example, systems and methods described herein determine optimal display utilization of GUI display space. Further, the subject matter described herein allows a user to define the relative priorities of a set of windows to be displayed.

In one embodiment, a window management function as described herein and a conventional window management function, such as provided by any of the WINDOWS® operating systems, may operate in parallel. The window management function may be utilized on a task-by-task basis. For a particular task, a user may open or select windows for arrangement by the window management function. Once the task is complete, the user may close the window management function for the task and initiate the window management function for a different task. Windows may not be closed just because the window management function is closed. The windows may still be operating based on the conventional window management function. Further, multiple instances of the window management function described herein may simultaneously operate for managing and displaying windows associated with different tasks.

In another embodiment, a user may select between the display of windows by a window management function as described herein and a conventional window management function such as that provided by any of the WINDOWS® operating systems. Thus, the user is provided with options for the display of windows on a GUI.

In one embodiment, a desktop window may be provided on a GUI. The desktop window may be a view of the desktop as a window on a display organizer icon. For example, the upper-right quadrant of a display screen may include a view of the desktop. A user may "click-and-drag" an application window from the upper-left quadrant display organizer to the recycle bin to remove the window. Thus, the user may be able to view the desktop when a GUI is otherwise filled with windows.

In another embodiment, a user may "click-and-drag" an icon associated with a window out of a display organizer icon for removing the window from management and display by a window management function. In response, the window management function may dynamically adjust the display of other windows managed by the function according to the subject matter described herein. The other windows may be dynamically adjusted based on the relative priorities of the windows and based on the relative priorities of the portions.

In another embodiment, a system according to the subject matter described herein may learn that a particular user has a tendency to delete particular portions of a window. Thus, these portions of the window are not as important to the user as other portions. A priority may be assigned to a portion of the window based on the user's interaction with the portion. For example, the time that the portion is kept open by a user relative to the total amount of time that the window is kept open may be measured. The time may be averaged over a

predetermined number of instances of the window (e.g., 10 times that the window is opened). For example, in one application, the main portion of a window may be viewed **220** out of 220 times that the window is open, and the thumbnails sidebar portion of the window may be viewed **11** out of 220 times. Based on these measurements, the thumbnails sidebar portion may be assigned a lower priority.

It will be understood that various details of the subject matter described herein may be changed without departing from the scope of the subject matter described herein. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation.

What is claimed is:

1. A method for displaying windows on a graphical user interface, the method comprising:

determining relative priorities of a plurality of windows of a graphical user interface;

determining relative priorities of a plurality of portions of a plurality of the plurality of windows based in part on user input; and

automatically arranging the windows on the graphical user interface based on the relative priorities of the windows and based on the relative priorities of the portions such that at least one higher priority window covers a lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window, wherein automatically arranging the windows includes dynamically arranging the windows when at least one of at least one relative priority of the relative priorities of the windows and at least one of the relative priorities of the plurality of portions changes,

wherein at least one of the preceding actions is performed on at least one electronic hardware component.

2. The method of claim **1** wherein determining relative priorities of a plurality of windows includes receiving user input for determining the relative priorities of the windows.

3. The method of claim **2** wherein receiving user input for determining the relative priorities of the windows includes displaying a display organizer for receiving input from a user for associating the plurality of windows with the display organizer, the display organizer displayed as an icon.

4. The method of claim **1** wherein determining relative priorities of a plurality of windows includes determining relative priorities of a group of windows corresponding to applications selected by a user to perform a task, wherein the relative priorities are based on the task.

5. The method of claim **1** wherein determining relative priorities of a plurality of windows includes:

determining a position of a cursor with respect to the displayed windows; and

assigning priorities to the windows based on the position of the cursor.

6. The method of claim **5** wherein determining a position of the cursor includes determining which window or portion is selected via user input to the graphical user interface.

7. The method of claim **5** wherein determining a position of the cursor includes determining whether the cursor is on one of the displayed windows, and wherein assigning relative priorities to the windows includes assigning a higher priority to the window on which the cursor is located than to the remaining windows.

8. The method of claim **5** wherein determining a position of the cursor includes determining whether the cursor is on one of the plurality of portions, and wherein assigning relative priorities to the portions includes assigning a higher priority to the portion on which the cursor is located than to the remaining portions.

9. The method of claim **1** wherein determining relative priorities of a plurality of portions of a plurality of the plurality of windows includes receiving priority identifiers for the plurality of portions from an application associated with the plurality of the plurality of windows.

10. The method of claim **1** comprising receiving user input identifying an additional window for display, and re-organizing display of the plurality of windows in the graphical user interface for displaying the additional window in response to the user input.

11. The method of claim **10** wherein re-organizing display of the windows for displaying the additional window includes determining a relative priority of the additional window with respect to the plurality of windows and displaying the additional window with the plurality of windows according to the relative priorities.

12. The method of claim **1** wherein automatically arranging the windows in the graphical user interface includes resizing one of the windows based on the relative priorities of the windows and based on the relative priorities of portions of the plurality of the plurality of windows.

13. The method of claim **12** wherein resizing one of the windows includes adjusting the size of the one window in a vertical direction.

14. The method of claim **12** wherein resizing one of the windows includes adjusting the size of the one window in a horizontal direction.

15. The method of claim **12** wherein resizing one of the windows includes not reducing the size of the one window beyond a minimal acceptable size specified for the window.

16. A method for dynamically adjusting display of a plurality of windows on a graphical user interface, the method comprising:

simultaneously displaying a plurality of windows on a graphical user interface where at least one of sizes and positions of the plurality of windows are set according to relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows, the relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows based in part on user input;

detecting an event affecting the relative priority of at least one of the plurality of windows; and

dynamically adjusting the at least one of sizes and positions of the plurality of windows based on the event such that at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window,

wherein at least one of the preceding actions is performed on at least one electronic hardware component.

17. The method of claim **16** wherein detecting the event includes detecting that one of the windows is being accessed by a user.

18. The method of claim **16** wherein detecting the event includes detecting that one of the windows is being closed by a user.

19. A system for displaying windows on a graphical user interface, the system comprising system components including:

a window priority function configured to determine relative priorities of a plurality of windows of a graphical user interface;

a window portion priority function configured to determine relative priorities of a plurality of portions of a plurality of the plurality of windows based in part on user input; and

a window management function configured to automatically arrange the windows on the graphical user interface based on the relative priorities of the windows and based on the relative priorities of the portions such that at least one higher priority window covers a lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window, wherein automatically arranging the windows includes dynamically arranging the windows when at least one of at least one relative priority of the relative priorities of the windows and at least one relative priority of the relative priorities of the plurality of portions changes,

wherein at least one of the system components includes at least one electronic hardware component.

20. The system of claim **19** wherein the window priority function is operable to receive user input for determining the relative priorities of the plurality of windows.

21. The system of claim **20** wherein the window priority function is operable to control the graphical user interface for displaying a display organizer for receiving input from a user for associating the plurality of windows with the display organizer, the display organizer displayed as an icon.

22. The system of claim **19** wherein the window priority function is operable to determine relative priorities of a group of windows corresponding to applications selected by a user to perform a task, wherein the relative priorities are based on the task.

23. The system of claim **19** wherein the window priority function is operable to determine a position of a cursor with respect to the displayed windows, and the window priority function is operable to assign priorities to the plurality of windows based on the position of the cursor.

24. The system of claim **23** wherein the window priority function is operable to determine which window or portion is selected via user input to the graphical user interface.

25. The system of claim **23** wherein the window priority function is operable to determine whether the cursor is on one of the displayed windows, and wherein the window priority function is operable to assign a higher priority to the window on which the cursor is located than to the remaining windows.

26. The system of claim **23** wherein the window portion priority function is operable to determine whether the cursor is on one of the plurality of portions, and wherein the window portion priority function is operable to assign a higher priority to the portion on which the cursor is located than to the remaining portions.

27. The system of claim **19** wherein the window portion priority function is operable to receive priority identifiers for the plurality of portions from an application associated with the plurality of the plurality of windows.

28. The system of claim **19** wherein the window management function is operable to receive user input identifying an additional window for display, and operable to re-organize display of the plurality of windows in the graphical user interface for displaying the additional window in response to the user input.

29. The system of claim **28** wherein the window management function is operable to determine a relative priority of the additional window with respect to the plurality of windows and display the additional window with the plurality of windows according to the relative priorities.

30. The system of claim **19** wherein the window management function is operable to resize one of the windows based on the relative priorities of the windows and based on the relative priorities of portions of the plurality of the plurality of windows.

31. The system of claim **30** wherein the window management function is operable to adjust the size of the one window in a vertical direction.

32. The system of claim **30** wherein the window management function is operable to adjust the size of the one window in a horizontal direction.

33. The system of claim **30** wherein the window management function is operable to not reduce the size of the one window beyond a minimal acceptable size specified for the window.

34. A system for dynamically adjusting display of a plurality of windows on a graphical user interface, the system comprising system components including:

a graphical user interface operable to simultaneously display a plurality of windows where at least one of sizes and positions of the plurality of windows are set according to relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows, the relative priorities of the plurality of windows and relative priorities of the portions of the plurality of windows based in part on user input; and

a window management function operable to detect an event affecting the relative priority of at least one of the plurality of windows, and dynamically adjust the at least one of sizes and positions of the plurality of windows based on the event such that at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window,

wherein at least one of the system components includes at least one electronic hardware component.

35. The system of claim **34** wherein the event includes detecting that one of the plurality of windows is being accessed by a user and the window management function is operable to detect that one of the plurality of windows is being accessed by a user.

36. The system of claim **34** wherein the event includes detecting that one of the plurality of windows is being closed by a user and the window management function is operable to detect that the one of the plurality of windows is being closed by a user.

37. A system for displaying windows on a graphical user interface, the system comprising components including:

means for determining relative priorities of a plurality of windows of a graphical user interface;

means for determining relative priorities of a plurality of portions of a plurality of the plurality of windows based in part on user input; and

means for automatically arranging the windows on the graphical user interface based on the relative priorities of the windows and based on the relative priorities of the portions such that at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window, wherein automatically arranging the windows includes dynamically arranging the windows when at least one of at least one relative priority of the relative

priorities of the windows and at least one of the relative priorities of the plurality of portions changes,

wherein at least one of the means includes at least one electronic hardware component.

38. A system for dynamically adjusting display of a plurality of windows on a graphical user interface, the system comprising components including:

means for simultaneously displaying a plurality of windows on a graphical user interface where at least one of sizes and positions of the plurality of windows are set according to relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows, the relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows based in part on user input;

means for detecting an event affecting the relative priority of at least one of the plurality of windows; and

means for dynamically adjusting the at least one of sizes and positions of the plurality of windows based on the event such that at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window,

wherein at least one of the means includes at least one electronic hardware component.

39. A computer program product comprising computer executable instructions embodied in a non-transitory computer readable medium for performing steps comprising:

determining relative priorities of a plurality of windows of a graphical user interface;

determining relative priorities of a plurality of portions of a plurality of the plurality of windows based in part on user input; and

automatically arranging the windows on the graphical user interface based on the relative priorities of the windows and based on the relative priorities of the portions, wherein at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window, wherein automatically arranging the windows includes dynamically arranging the windows when at least one of at least one relative priority of the relative priorities of the windows and at least one of the relative priorities of the plurality of portions changes.

40. A computer program product comprising computer executable instructions embodied in a non-transitory computer readable medium for performing steps comprising:

simultaneously displaying a plurality of windows on a graphical user interface where at least one of sizes and positions of the plurality of windows are set according to relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows, the relative priorities of the plurality of windows and relative priorities of portions of the plurality of windows based in part on user input;

detecting an event affecting the relative priority of at least one of the windows; and

dynamically adjusting the at least one of sizes and positions of the plurality of windows based on the event such that at least one higher priority window covers at least one lower priority portion of at least one lower priority window to provide for a simultaneous viewing of the at least one higher priority window and a higher priority portion of the at least one lower priority window.

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