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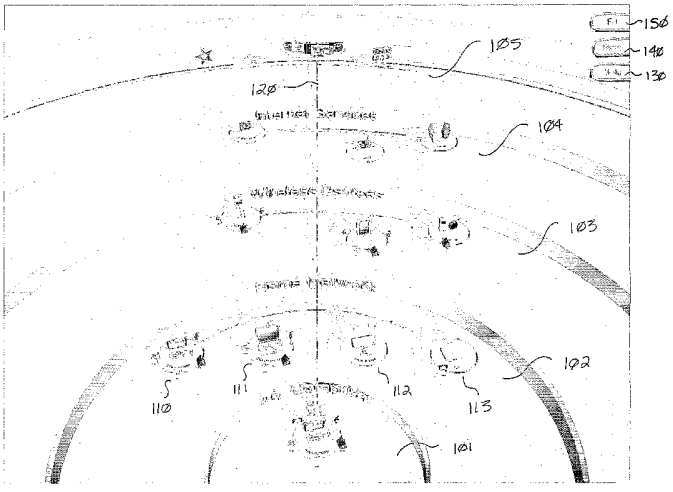
(54) Title: MODELLING RELATIONSHIPS WITHIN AN ON-LINE CONNECTIVITY UNIVERSE



(57) Abstract: Enhanced presentation techniques for modeling a connectivity universe associated with a particular user or device are provided. Example embodiments provide a WorldView Display System (a "WVDS"), which automatically organizes a user's online relationships with entities, such as devices, data collections, services, and people, and provides a user interface for accessing and interacting with these entities. The WVDS automatically determines the universe of objects that the user has relationships with, automatically groups objects having similar measures of access proximity, displays a multi-dimensional representation of these groups of objects on a display device, and provides a uniform user interface for initiating an interaction with any represented object. This abstract is provided to comply with rules requiring an abstract, and it is submitted with the intention that it will not be used to interpret or limit the scope or meaning of the claims.

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MODELLING RELATIONSHIPS WITHIN AN ON-LINE CONNECTIVITY UNIVERSE

TECHNICAL FIELD

The present invention relates to enhanced presentations and management of online information and, in particular, to techniques for modeling a user's connectivity relationships with network accessible devices, services, people, and data.

BACKGROUND

On-line communications have become an increasingly important aspect of people's lives. These communications can take many forms, including explicit person-to-person communication such as email, instant messaging, or other forms of sending electronic messages; communication with on-line services such as web sites, email servers, and other Internet Service Provider ("ISP") services; and communication with local and remote devices, such as printers, scanners, or fax machines on a home network or, for example, on-line phones, cameras, PDAs, and other portable computers or devices.

Managing and communicating with the morass of types of devices and connections has become difficult and not very "user-friendly" to a casual, or not necessarily technically savvy, user. Interfaces to devices are inconsistent, and the requirements for accessing services are not uniform or even well-known. In a typical conventional computing environment, a user conducts such communications by locating a user interface ("UI") associated with the desired target or task, figuring out how to use it, and then invoking it to conduct the desired communication. For example, to set up access to or to change default properties associated with access to a particular printer, a user is forced to find and invoke a "setup" tool (*e.g.*, a printer configuration tool) from a user interface presented by the underlying operating system, for example the Microsoft Windows™ "desktop." The setup tool displays a series of dialog boxes or other windows, whose user interface controls are dedicated to interacting with the target printer. The user is then forced to find the correct control, dialog, or other UI component to perform a desired operation. If the user can locate the appropriate user interface, recognize it as the needed one, and find the appropriate specific component to invoke, then the user can perform the desired task. However, for many users, management

tools such as this one are impenetrable black boxes with limited options for control and little instruction.

One reason for these difficulties is that the current metaphor for operating system user interfaces for personal computers is typically an "office" desktop or derivative thereof. The desktop metaphor was developed in the 1970's and was originally targeted to the office automation market. However, the office automation environment for which these user interfaces were designed no longer represents a reasonable facsimile of or metaphor for how many people today incorporate computers in everyday life.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an example screen display of an example connectivity universe presented by an example WorldView Display System.

Figure 2 is an example screen display of a device ring displayed by an example WorldView Display System.

Figure 3 is an example screen display of a data collection ring displayed by an example WorldView Display System.

For example, Figures 4A and 4B illustrate still images from an example screen display of a cycling presentation of an active photo collection.

Figure 5 is an example screen display of an animated representation of an active device.

Figure 6 is an example screen display of a data collection ring with a sub-collection ring displayed by an example WorldView Display System.

Figure 7 is an example block diagram of how components of an example WorldView Display System are incorporated in a computer system to provide a user interface to an example user's universe of devices, collections, and connections.

Figure 8 is an overview flow diagram of operations performed by an example WorldView Display System.

Figure 9 is an example block diagram of a portion of one internal model of an example connectivity universe by an example WorldView Display System.

Figure 10 is an example screen display of an example Buddy Room proximity band.

Figure 11 is an example screen display of an example Web proximity band.

Figure 12 is an example screen display of a close-up view of an example Web proximity band.

Figure 13 is an example screen display of a media view of an example WorldView Display System.

Figure 14 is an example screen display of media viewers presented by a media view of an example WorldView Display System.

Figure 15 is an example screen display of objects displayed as a result of filtering a media view of an example WorldView Display System.

Figure 16 is an example screen display of uber-collections presented by a media view of an example WorldView Display System.

Figure 17 is an example screen display of a combined device and media view of an example WorldView Display System.

Figures 18A and 18B are an example flow diagram of proximity band rendering supported by an example rendering system of a WorldView Display System.

Figure 19 is an example screen display of a presentation of objects grouped by access proximity as displayed by an example WorldView Display System.

Figure 20 is an example screen display of an example connectivity universe from a different viewing angle and level of perspective.

Figure 21 is an example screen display of a close-up view of a user interface displayed for an active device.

Figure 22 is an example screen display of a close-up view of a user interface displayed for an active collection.

Figure 23 is an example block diagram of an access control card for configuring access rights of a device or a collection for an individual.

Figure 24 is an example screen display of a data sharing relationship established between two collections.

Figure 25 is a block diagram of a general purpose computer system for practicing embodiments of a WorldView Display System.

DETAILED DESCRIPTION

Embodiments of the present invention provide enhanced computer- and network-based methods, systems, computer-readable instructions, and techniques for modeling and interacting with a user's universe of on-line relationships, including, for example, people, devices, content, services, and other entities that are connected to the user, directly or indirectly, via one or more networks. Each entity is associated with the user through an object, such as a physical or logical device, data collection, or service that is connected to the network. The objects associated with the entities to which a user has or potentially can have relationships are referred to collectively as a user's connectivity universe. Thus, for ease of description, a user's relationships with a set of entities are considered synonymous with the user's relationships with the objects that correspond to such entities, and the words "entity" and "object" are used interchangeably unless noted otherwise.

Example embodiments provide a WorldView Display System ("WVDS"), which automatically organizes a user's online relationships with such entities according to similarities of "access proximity" and provides a user interface for accessing and interacting with these entities. Access proximity is an assessment of the "closeness" of the relationship between an object, such as a device, a collection of data, a service, or other entity, and the user, as evaluated according to (or measured by) any one of a number of characteristics. Example characteristics include:

- physical proximity (*e.g.*, location of the object);
- prior access history (*e.g.*, access of the object by the user within a specified period of time);
- extent to which the object is under the user's control (*e.g.*, access rights to the object can be set by the user for the user and for others; object is hosted on a device controlled by the user as opposed to remotely hosted);
- type of device (*e.g.*, a PC, server, PDA, media-oriented device, such as a camera or phone, etc.);
- operational characteristics (*e.g.*, object is a public service such as "Hotmail" or "AOL Instant Messenger," a controlled-access device such as a personal computer, a physical, or a virtual device such as a "Buddy Room" that contains remotely hosted content);

- portion of the object that corresponds to the user (*e.g.*, percentage of a device occupied by the user's content);
- network connectivity characteristics (*e.g.*, type of object's connection to a network such as a wireless connection, object resides on a network dedicated to the user or resides on a network dedicated to a controlled-access group that includes the user, or object resides on a public shared network such as the Internet).

One skilled in the art will recognize that an assessment of access proximity may be determined, for example, as numeric values, ranges, the presence or absence or likeness of certain characteristics, or any other measurements, evaluations, or heuristics that provide a classification scheme (*i.e.*, a "taxonomy" of access proximity). Also, other types of characteristics may be used to assess access proximity and that combinations of characteristics can also be used.

The WVDS automatically determines the universe of objects that the user has relationships with, automatically groups objects having similar assessments of access proximity, displays a multi-dimensional representation of these groups of objects on a display device, and provides a uniform user interface for initiating an interaction with any displayed (represented) object. For example, the user can activate an object and "zoom in" to see what data content it contains; invoke a native user interface of the object; set up a data sharing relationship between data content; configure access permissions; etc. The user invokes these operations in a uniform way, that does not rely upon knowledge specific to the object.

Thus, in one aspect the WVDS provides an operating environment that models a connectivity universe from a user's point of view and that provides a metaphor for interacting with objects of potential interest to the user that is on-line centric as opposed to desktop centric. In addition, WVDS orients the user to focus on the media and media types that are present on devices in the user's connectivity universe as opposed to the configuration settings of particular devices. In another aspect, the WVDS provides a navigational model for viewing and interacting with a three-dimensional representation of the user's connectivity universe using graphics and rendering techniques that give an impression of moving (*e.g.*, "flying") through a virtual world (a 3-D universe) to locate and activate objects. In yet another aspect, the WVDS provides a graphical user interface for easily setting up data sharing relationships between any two objects in a uniform manner. Other aspects will be apparent and can be gleaned from the description that follows.

Figure 1 is an example screen display of an example connectivity universe presented by an example WorldView Display System. Figure 1 shows five different groupings of objects based upon access proximity classifications, including: My Computer 101; a Home Network group 102, a Wireless Devices group 103; an Internet Services group 104; and The Web group 105 from a particular user's perspective. Each group is related to the user through at least one network, in this case a wide area network 120 (a "WAN," *e.g.*, the Internet).

In one embodiment, the WVDS groups objects and displays each group as a "proximity band" in the user's connectivity universe. Each proximity band displays a set of objects that are related to each other, from the user's perspective, in that they have similar characteristics as measured by access proximity. That is, each proximity band corresponds to a different class of access proximity, as assessed by whatever characteristic(s) is(are) currently configured for evaluating access proximity. Each proximity band displays representations of the one or more objects that belong to (are grouped in) that band and a representation of the data content that is present on each such object.

For example, in the example embodiment illustrated in Figure 1, the WVDS represents each of groups 101-105 as a proximity band in the user's connectivity universe. Each proximity band displays a representation of the objects that are grouped in that proximity band (have similar access proximity). For example, the proximity band labeled "Home Network" 102 displays a representation of four objects (physical devices) 110-113 with which the user has a relationship through the user's home local area network ("LAN"). These devices include a computer system 110 representing the "Kids' computer;" a computer system 111 representing "Sue's computer;" and a photo printer 112 and a personal video recorder 113 that are shared resources connected to the user's home LAN. Note that each device is represented by the WVDS as a model of the device surrounded by a graphical indicator such as a "device ring," which displays a "hint" as to the type of content contained or managed by the device. The representation of the device, (*i.e.*, the device "model") may include, for example, an icon, character, symbol, label, drawing, or any other representation that is indicative of the device. Device rings are described further below with respect to Figure 2. In the illustrated scenario, physical proximity, device type, prior access history, extent of user control, operational characteristics, and network connectivity characteristics have been used to measure similarities of access proximity. The groups of objects (hence the proximity bands) are automatically determined by the WVDS relative to the user based upon similarities of access proximity characteristics and, in the

view of the connectivity universe illustrated in Figure 1, are displayed relative to a designated (host) device associated with the user, such as My Computer 101. One skilled in the art will recognize that if a different user initiates a session with the WVDS using computer system 101, if the same user initiates a session but designates a different host device or different access proximity characteristics, or if the user designates a different view that may not include displaying or designating a host device or certain proximity bands, then the layout displayed by the WVDS will be accordingly adjusted.

In one embodiment, each device representation is displayed along with a device ring that simultaneously shows the contents (as data collections) associated with that particular device. One skilled in the art will appreciate that other embodiments may incorporate different types of graphical indicators, which may partially surround or totally surround a device representation. The represented device may indicate a physical or virtual device, such as a virtual "device" that represents a means to get access to a relationship such as another user's data collection. Other embodiments may require the user to navigate to a closer "level of perspective" (or other ways of "zooming in" to the object) before displaying an associated device ring. Figure 2 is an example screen display of a device ring displayed by an example WorldView Display System. (It also shows navigation by zooming in closer to an object.) The represented computer system 201, labeled "My Computer," is shown in the center of a ring formed by at least one cable 210. (Multiple cables are used to indicate data sharing relationships and are described further below with respect to Figure 24.) The printer and scanner devices attached to computer system 201 are shown as devices 207 and 208, respectively. Each data collection present on the computer system 201 is represented along the ring as data collections 202-206. For example, video data is represented as data collection 202, contact data is represented as data collection 203, files are represented as data collection 204, photos are represented as data collection 205, and music data is represented as data collection 206.

Each device (or other displayed object) is considered active or inactive. The WVDS typically allows only one object (device or data collection) to be active at a time to control clutter and confusion. In some embodiments, the device needs to be made active before its device ring is displayed. In other embodiments, a device ring is displayed if appropriate to the device type. In a typical WVDS, the user activates a device (or data collection) by selecting the object using an input device, such as, for example, clicking on the object with a mouse cursor. The user can also select the object by "hovering" an input device

cursor over the object representation. Once an object is active, a user interface is displayed, such as palette 230, to allow the user to change WVDS device related attributes or access privileges associated with the object. The user can also change the level of perspective (zoom in or out) or can invoke a native user interface associated with the device. The object's representation is typically changed to indicate that the device is active.

Also, in some embodiments, the WVDS may recognize that a device is not currently on-line (accessible). In such a case, the WVDS may display an indication (not shown), such as a dashed line, or otherwise demarcated indicator, connecting the device ring associated with the device representation to the network cabling displayed in the associated proximity band.

Note that, in the illustrated embodiment shown in Figure 1, there is a single data collection represented for each type of data – other embodiments may organize the data differently. For example, when a device has multiple disk drives or types of internal or external storage, the WVDS may represent each drive's files as separate data collections or may represent all the files as a single collection which contains sub-collections associated with each drive. As another example, when a device has multiple groups of music (or other media) content, the WVDS may represent each group of music content as a separate music data collection (each potentially having sub-collections) on the device or as a single music collection which contains a sub-collection for each group of music (each potentially having sub-collections). In any case, any hierarchical organization of content present on devices is preserved through the notion of sub-collections, which are data collection groupings within a particular collection. A sub-collection also may correspond, for example, to a playlist, an album, a particular video, etc. For example, the music data collection 206 may have associated with it some number of sub-collections. When a data collection having sub-collections is viewed at a level of perspective ("LP") that presents its contents, then, in one embodiment, the WVDS displays each data sub-collection on a data collection ring of its parent collection.

Figure 3 is an example screen display of a data collection ring displayed by an example WorldView Display System. In Figure 3, music data collection 301 is displayed in a center of a data collection ring formed by a representation of a cable 320. Music data collection 301 comprises three sub-collections: favorites sub-collection 302, workout music sub-collection 303, and classical music sub-collection 304. In one embodiment, when a collection (or a sub-collection) is made active and displayed, an animation or cycling presentation

indicative of the contents of the data (*e.g.*, a slide show of the data contents) is also displayed to allow the user to better ascertain the contents of the data collection. For example, Figures 4A and 4B illustrate still images from an example screen display of a cycling presentation of an active photo collection. The user gets a "preview" of the photos (contents) present in the active collection.

Note that, although the representations of devices don't display data content directly as depicted in a WVDS universe (they display data collections which contain data content), the device representations may also be associated with some form of animation to highlight when they are active, or at other times. Figure 5 is an example screen display of an animated representation of an active device. The indicated Internet service 501 is an email account that uses Earthlink email. The animated presentation 502 hints at the functionality of the service and indicates that there is some sort of mail accessible as content.

Figure 6 is an example screen display of a data collection ring with a sub-collection ring displayed by an example WorldView Display System. Music data collection 301 from Figure 3 is displayed as music collection 601 with its surrounding data collection ring 320. When an active sub-collection, for example, the workout sub-collection 303, contains further sub-collections (*e.g.*, further groupings of data such as a particular album or a playlist), then a sub-collection ring of the further sub-collections is also displayed, if appropriate based upon the WVDS configuration settings. For example, in Figure 6, Workout music sub-collection 603 (which represents music sub-collection 303 from Figure 3) is displayed surrounded by a sub-collection ring 630, which further contains sub-collections Workout Albums music sub-collection 631 and From Pat music sub-collection 632.

In one embodiment, the WorldView Display System comprises one or more functional components/modules that work together with other parts of a user's online environment to model a user's connectivity universe. One skilled in the art will recognize that the components and/or sub-components of a WVDS may be implemented in software or hardware or a combination of both. Figure 7 is an example block diagram of how components of an example WorldView Display System are incorporated in a computer system to provide a user interface to an example user's universe of devices, collections, and connections. The WVDS 700 comprises WorldView display support modules 701 and one or more WVDS data repositories 702. The display support modules 701 support functions such as rendering a multi-dimensional representation, managing the information associated with the objects in users' connectivity universes (such as lists of devices, data

collections, connections, and configuration data), input device handling and management; status information regarding connectivity relationships, navigation support, and interfaces to various devices where appropriate. The data repositories 702 maintain information corresponding to the devices, collections, connections, access proximity groups, synchronization/sharing relationships, rendering information, and WVDS configuration data. In overview, the WVDS 700 communicates with other devices and collections 720 that are connected via one or more networks to obtain status information regarding objects and to share data content when appropriate. The WVDS 700 communicates with the native operating system 710 of the host device to obtain connectivity universe information and to interface to a particular device's native user interface (such as the default user interface on a Microsoft Windows-based computer system or whatever interface was last presented on the device). The WVDS 700 renders a representation of the user's connectivity universe on display system 704, and receives input from input devices, such as mouse 705. One skilled in the art will recognize that the environment demonstrated in Figure 7 is one example environment that can incorporate a WVDS and that many other environments with different components and different means for interacting with the various devices may be supported.

Figure 8 is an overview flow diagram of operations performed by an example WorldView Display System. In step 801, the WVDS determines the objects that comprise a particular user's connectivity universe. In step 802, the WVDS determines a measure of access proximity for each object in the inventory. In step 803, the WVDS arranges the objects with similar measures into groups according to an internal model of groups and any relevant WVDS configuration parameters. In step 804, the WVDS renders the groups of objects in a multi-dimensional rendering in accordance with an internal model. In step 805, the WVDS awaits input, for example from a user through user interface commands, or for example through a programming interface provided via an applications programming interface ("API"). The commands may include instructions to the WVDS to navigate to a particular location in the display, change the viewing angle, or change the detail shown, modify a user's access control relative to a particular object, configure WVDS parameters, set up data sharing connections, or invoke the native interface of an object. These commands are examples, and one skilled in the art will recognize that a variety of other commands additionally could be implemented by a WVDS. When a particular command is recognized by the

system, the WVDS returns to execute the appropriate step 801-804. Each of these steps is described in further detail in the description that follows.

Although the techniques of modeling a user's connectivity universe and the WorldView Display System are described with reference to a external application running as a separate module(s) in addition to a native operating system, one skilled in the art will recognize that the techniques of the present invention can also be used directly by an operating system to present an alternative metaphor to its own devices and data collections. In addition, the concepts and techniques described are applicable to other environments, including other applications, embedded systems, network management, etc. In brief, the concepts and techniques described are applicable to any display management environment or any other environment that desires to present a uniform interface to on-line entities and relationships.

Example embodiments described herein provide applications, tools, data structures and other support to implement a WorldView Display System to be used for managing relationships in a user's online world. One skilled in the art will recognize that other embodiments of the described techniques may be used for other purposes, including for other types of user interfaces. In the following description, numerous specific details are set forth, such as data formats and code sequences, etc., in order to provide a thorough understanding of the described techniques. One skilled in the art will recognize, however, that the present invention also can be practiced without some of the specific details described herein, or with other specific details, such as changes with respect to the ordering of the code flow or module arrangement.

As referred to in step 801 in Figure 8, the WVDS determines the objects that comprise a particular user's connectivity universe. The user's connectivity universe comprises a variety of objects, which include physical and virtual devices, services, and data collections. Typical devices supported include, and are not limited to: personal computers, portable computers, PDA's, phones, cameras, network servers, including email servers or messaging servers, web servers, buddy rooms, printers, scanners, disk drives, card readers, biometric scanners, music players, video players, etc. Typical data collection types include, and are not limited to: music, photos, video, files, contacts, email, web pages, newsgroups, favorites, history, and other types of media. Although "favorites" and "history" traditionally aren't treated as types of data, for the purposes of the WVDS they can be treated as such since a designation of "favorite" or on a recent "history" list connotes a determinable characteristic of the associated data. The

devices and data types recognized and supported by a WVDS may change over time.

In some embodiments, the WVDS supports an interface for adding new devices, collections, and types of data collections. By initiating a user interface dialog with the WVDS from a particular location on the displayed presentation, the user can bring up a dialog with the WVDS to specify a new device, collection, or collection type (media viewer/player). For example, by right clicking on a proximity band, the user can indicate a new device to be recognized (*e.g.*, a specific computer system or a newly attached printer) and added to that particular proximity band. In an alternative embodiment, the dialog and new device is not proximity band specific (or the user can specify that it is not) and the WVDS automatically determines where to add it in its internal model. Similarly, the user can right click on the Media Viewers proximity band to add a new type of collection viewer to be discoverable. Media Viewers are described below with reference to Figure 14. The user can also, for example, right click on a device to add a new collection. The WVDS may also support a general "settings" user interface, accessible from a button or other component on the screen, which also allows the user to configure devices, collections, collection types, access proximity characteristics, proximity band groupings, etc.

When initially executed, the WVDS creates and stores an initial inventory of the objects with which the user has a relationship. Since objects may come and go and relationships may change, this inventory is modified on some determined basis. For example, the WVDS may perform updates at specific times (such as the beginning of a session), at preprogrammed times (such as once a day), by registering a callback routine to be invoked by the operating system when a device is accessed or its settings changed, or, for example, in response to a specific update request initiated by the user. The initial inventory of objects may be constructed by discovering objects from a variety of resources, including, for example, from operating system services, which enumerate registered devices (*e.g.*, local disk drives, connected printers, scanners, email servers, and web page histories); application programs that interact with network devices; and user input provided in response to a specific query or provided as configuration information using a user interface of the WVDS, etc.

Once the universe of objects is determined, then the WVDS determines as assessment of access proximity for each object in the inventory. (See step 802 in Figure 8.) As described above, access proximity can be assessed by examining and evaluating the characteristics of the network

connectivity associated with the object relative to the user and the amount of control the user has over the object. For example, devices directly attached to the host device may be associated with one class of access proximity; devices that are connected via the same LAN to which the host device is connected may be associated with a second class of access proximity; devices to which the user relates through wireless connections may be associated with a third class of access proximity; objects to which the user shares data over the Internet but the source of the data is determined remotely may be associated with a fourth class of access proximity; and objects which the user has recently accessed over the Internet but has no control over may be associated with a fifth class of access proximity. One skilled in the art will recognize that many alternative classification schemes exist, and that the above example represents one of those contemplated.

After automatically determining the access proximity for each object, the WVDS arranges the objects with similar measurements into groups according to an internal model of groups and any relevant WVDS configuration parameters. (See step 803 in Figure 8.) One skilled in the art will recognize that the grouping of objects comprising the connectivity universe and the layout that supports representing the groupings is based upon an internal model of connectivity and access proximity that the WVDS dynamically builds and maintains over time and any relevant WVDS configuration parameters. In one embodiment, this model is configurable to the extent desired, including, for example, the characteristics used to determine access proximity, the number of groups (*e.g.*, proximity bands) and to what class (or characteristics) of access proximity each group corresponds, and a specification of the circumstances under which a particular group is displayed. For example, in an embodiment supporting proximity bands, certain bands may always be displayed, others displayed only if they contain objects, others displayed based upon rules such as the presence of another alternative band, and others displayed based upon particular viewing parameter settings. Other rules can also be incorporated as desired.

Figure 9 is an example block diagram of a portion of one internal model of an example connectivity universe by an example WorldView Display System. In Figure 9, the model 900 schematically illustrates objects organized according to five different groups 901, 910, 920, 930, and 940, each corresponding to a defined class of access proximity. An example WVDS may display many different graphical representations of the same model, including, for example, 2-D and 3-D representations, proximity bands, and other displays of groupings of objects. For purposes of illustration, the groups shown in Figure 9 correspond to

the proximity bands shown in Figure 1, although the particular objects shown in the model are not the same as those presented in Figure 1. Group 901 "My Computer" contains a single object computer system 902, with attached devices laser printer 903 and scanner 904. Group 901 is attached to all of the other groups through a "trunk" network 950, in this case the Internet (and to the user's Home Network group 910 through a LAN connection). Group 910 "Home Network" contains three devices that communicate with the user through a LAN 960: computer system 911, portable computer system 912, and computer system 913 with an attached photo printer 914. Group 920 "Wireless Devices" contains two devices, cellular phone 921 and PDA 922, that communicate with the user through trunk network (Internet) 950 and wireless connections 960 and 961. Group 930 "Internet Services" contains three services, two email services 931 and 933 and a messaging service 932, which communicate with the user through the Internet 950, and whose associated server devices are attached through Internet connections 970. Group 940 "The Web" contains links to pages of web sites 941 that the WVDS determines are of interest to the user based upon (optionally settable) parameters, such as newsgroups, favorites, and access history.

Table 1 below illustrates an example inventory created by a WVDS using one or more sources as described in step 801 and arranged according to the access proximity assessments described in steps 802-803.

Web Sites	
	60 Favorites with 8 sub-folders
	4 weeks of history entries, within a time hierarchy
	10 newsgroups accessed within a specific time period
Internet Services	
	Hotmail email account
	Earthlink email account
	AOL Instant Messenger service
Buddy Rooms	
	3 photo buddies
	2 chat buddies
Wireless Devices	
	1 cellular phone
	1 PDA
Home Network	
	1 laptop computer

	Spouse's computer with attached photo printer
	Kid's computer
My Computer	
	User's computer with attached laser printer and scanner
	Attached laser printer and scanner
	Flash card reader
	Internal storage: 1 hard drive, 1 DVD drive, 1 CD drive

Table 1

The objects shown in Table 1 are arranged according to the internal model of the WVDS, a portion of which is depicted in Figure 9. Although not shown in Table 1, the WVDS also keeps track of the particular types of data and collections of data associated with each object. One skilled in the art will recognize that any number of well-known ways can be used to do track the content of the objects, including querying a service, invoking the operating system to list a devices' contents, searching registries, etc.

The "Buddy Rooms" indicated in Table 1 are virtual devices that are used to navigate to or represent data collections to which the user has access rights but that are hosted remotely and are not represented to the user through some other device relationship that the user has sufficient access rights to see as a device in some other grouping. Thus, Buddy Rooms provide a means of user interface access to the user that otherwise wouldn't be available from the other groupings of objects. For example, if a data sharing relationship is established with a second user's photo collection, and that photo collection resides on a disk drive of the second user to which the user does not otherwise have access, then the WVDS may present the second user's photo collection as a Buddy Room in the user's connectivity universe.

Figure 10 is an example screen display of an example Buddy Room proximity band. Buddy Room proximity band 1001 contains three shared data collections: photo collection 1010, music collection 1011, and photo collection 1012. In one embodiment, each data collection is shown with a corresponding set of access cards 1020, 1021, and 1022, respectively, so that the user can see which users have what type of access to each shared data collection (presuming the user is authorized to see this information). The front of each access control card summarizes the access privileges associated with a particular user. Access control cards are described below with reference to Figure 23.

Once an inventory of objects (and their data collections) has been created and grouped according to the WVDS internal model (or modified as directed), then the WVDS renders the groups of objects in a multi-dimensional rendering such as the proximity bands illustrated in Figure 1 in accordance with the internal model. (See step 804 in Figure 8.) One skilled in the art will recognize that a different rendering engine may be incorporated into the WVDS to generate displays other than those described with reference to Figures 1-6.

In some embodiments, the WVDS represents the groups of objects in a user's connectivity universe using proximity bands and renders them to look three dimensional. In one such example embodiment, the WVDS defines several different views of default proximity bands – a device centric view, a media centric view, and a combination view. In an example embodiment, a device view displays data content present in the user's connectivity universe from within the context of the devices on which the data resides. Using device view, a user can easily view and specify settings for, and interact with devices. A media view displays data content present in the user's connectivity universe based on its media type, independent of the devices on which the data resides. Using media view, a user can easily view and manipulate data based upon its type regardless of where the data resides – and thus does not have to search for the data and perform a desired operation multiple times in multiple locations. The different views are toggled on and off using buttons 130 and 140. A mixed view can be achieved by toggling on device view and media view. Other combinations and other views, including filters of existing views, can similarly be incorporated.

In a typical default device view, such as that shown in Figure 1, several proximity bands are presented. A "My Computer" proximity band (*e.g.*, band 101) is typically displayed when the user's host device is a personal computer or when the user has designated a particular device as "My Computer" through the WVDS configuration tools. A "Home Network" proximity band (*e.g.*, band 102) is typically displayed if there is a home network. If the host device is on a LAN that isn't a home network, then a "LAN" proximity band is typically displayed. A "Wireless Devices" proximity band (*e.g.*, band 103) is displayed by default whether there are devices present within in or not. A "Buddy Room" proximity band is displayed if the user has access to shared data collections that are hosted remotely (on someone else's devices) and the shared data collections not already accessible through one or more devices that are shown in one of the other proximity bands. Each such shared data collection appears as a collection within the Buddy Room proximity band. If the source of the shared data is

controlled by or belongs to a device controlled by the user (as determined, for example, through access rights), then the shared data shows up as a collection on that device ring in an appropriate proximity band. A "Network Services" proximity band (*e.g.*, band 104, also referred to as "Internet Services" when the wide area network ("WAN") of interest is the Internet) is displayed by default whether there are objects present within it or not. A "Web" proximity band (*e.g.*, band 105, also referred to as a "Web Deck" or "The Web") is present if the underlying WAN is the Internet. The Web proximity band is described further with reference to Figures 11 and 12. Note that the behaviors of one or more of these proximity bands can be configured through the configuration interfaces of the WVDS, and proximity bands can be added or deleted.

Figure 11 is an example screen display of an example Web proximity band. Figure 12 is an example screen display of a close-up view of an example Web proximity band. The Web proximity band 1100 in Figure 11 and 1200 in Figure 12 is configured by default to show some number of the user's Favorites and History (as determined from parameters associated with the user's Internet browsers) websites, as well as public collections such as Usenet newsgroups. For example, in one embodiment the Web proximity band 1200 contains Favorites web pages 1202; History web pages 1203, which, for example, shows web pages access within a designated time frame; and Newsgroups 1204. The Web deck 1201 represents an "animation" of the data collections contained in the Web proximity band 1200. In one embodiment, when one of the data collections 1202-1204 is made active, the Web deck animation 1201 is changed to shown a representation of the contents of the data collection. One skilled in the art will recognize that many other data collections of web pages, for example, by search or sorting filters, etc., could be incorporated in a similar fashion.

Figure 13 is an example screen display of a default media view of an example WorldView Display System. Several proximity bands are displayed by default. For example, the "Media Viewers" proximity band is displayed by default whether there are objects present within it or not. This band groups all of the viewers for the different types of content (data collection) supported by the WVDS. An "All My Media" proximity band 1301 is used to group each type of data collection regardless of the device where the data collection is found, *e.g.*, all music collections accessible to the user across all devices with which the user has a relationship. That is, the data collections displayed in the All My Media proximity band 1302 are "uber-collections" – they represent all of the data found in data collections of a particular type, with which the user has a relationship, regardless of

location. The uber-collections displayed in proximity band 1302 in media view can be filtered based upon the buttons 105. Buttons 105 include support currently for several different "types" of media, including: files, videos, contacts, photos, music, favorites, newsgroups, IM messages, email, and history. One skilled in the art will recognize that different and/or additional media types are supportable by a WVDS. In one embodiment, two proximity bands are additionally displayed by default regardless of the view: an Internet Services proximity band 1303, and a The Web proximity band 1304. These are as described with reference to Figure 1.

Figure 14 is an example screen display of example media viewers presented by an example media view of an example WorldView Display System. It is a "close-up" of a portion of the Media Viewers proximity band 1301 representation illustrated in Figure 13, and can be achieved by navigation to that area of the representation. Specifically, the illustrated portion of the Media Viewers proximity band 1301 contains four data collection viewers: photo viewers 1410 and 1411 for interacting with photos and music viewers (players) 1412 and 1413. Each viewer is shown as a device ring (or data collection ring) without any collections. As mentioned, a user can add new media viewers to be discovered (recognized) by the WVDS by adding a new media viewer/player to the Media Viewers proximity band through a user interface available from the WVDS.

Figure 15 is an example screen display of objects displayed as a result of filtering a media view of an example WorldView Display System. In this case, the media view has been filtered to view "photos" only by pressing filter button 1524. (In one embodiment, each button cancels any prior filters and applies the a filter that corresponds to the current pressed button. Other filters can be cumulatively added by pressing a key in combination with the button. Other embodiments provide other behavior such each button is an on/off toggle, etc.) When filtered, the Media Viewers proximity band 1501 only contains the media viewers that correspond to the filtered data type(s), in this case the photo viewers 1410 and 1411 shown in Figure 14. The All My Media proximity band 1502 contains one uber-collection, photo collection 1503, which represents all of the photos that the user has a relationship with. When present, the contents of other proximity bands, such as the Internet Services proximity band and the Web proximity band, are also correspondingly filtered.

Figure 16 is an example screen display of a close-up of an uber-collection presented by a media view of an example WorldView Display System. In this case, the photo uber-collection 1503 is shown in close-up form, as a data

collection ring with several sub-collections 1601-1605. When a user activates one of these sub-collections, it may display further sub-collection rings as appropriate.

Figure 17 is an example screen display of a combined device and media view of an example WorldView Display System. Although it is not possible to view the whole universe in Figure 17 (the Web proximity band 1706 is not displayed at this camera angle and zoom setting), the representation shows all of the proximity bands 1701-1703 and 1705-1706 present in Figure 1 plus the uber-collections represented in the All My Media proximity band 1704. In addition, the buttons 1705 continue to be displayed so that the user can filter the uber-collections displayed in proximity band 1704 and any objects displayed within the other proximity bands.

As mentioned, views other than a device view or a media view can be supported by a WVDS. For example, a view that filters the connectivity universe by a user's relationships with certain individuals can be incorporated. In one embodiment, a People filter button (not shown) is presented along with the Media and Device view buttons (see, for example, button 130 and 140 in Figure 1). When the People view is toggled on, an additional row of filter buttons, with labels corresponding to the individuals with which the user has a relationship (as discovered by the WVDS or configured by the user) is presented like the media filter buttons 1705 in Figure 17. When a user selects a particular person filter button, then the WVDS adjusts the layout of the connectivity universe representation to show devices, media, viewers, etc. that are related to the relationship between the user and the designated person. For example, the devices, collections, and Buddy Rooms displayed are those to which the user and the persons designated by the selected filters have access. Other representations can also be adjusted as appropriated. For example, email viewers can be adjusted to only show data collections (email content) that relates to the filter universe of people. One skilled in the art will recognize that a variety of other types of filters could also be accommodated by a WVDS.

Once the WVDS has rendered a representation of the connectivity universe associated with a user, the user (or a program through an API) can navigate within the representation to perform a variety of functions. (See step 805 in Figure 8.) These functions include, for example, navigating to a particular location in the display; progressively examining the detail of the content associated with an object (such as the data collections available on a device); setting up sharing of data content; modifying a user's access control relative to a particular object; configuring aspects of the WVDS; adding devices and collections to be

recognized by the WVDS; and invoking the native interface or an object-specific interface provided by the WVDS that is associated with a particular object. In one embodiment of the WVDS, the user can navigate to view different locations in the representation (*e.g.*, by changing a rendering viewport), view the representation from different viewing angles (*e.g.*, by changing camera angles), and can zoom in and out according to different levels of perspective, where each level can be configured to present a different level of detail.

A user navigates the connectivity universe presented by the WVDS using an input device, such as a mouse, to control which portion of the universe is currently displayed on the display screen or to control the level of perspective (*i.e.*, the "zoom" level). The level of perspective controls how close or far the user appears to be from the objects in the displayed connectivity universe. In one embodiment, the WVDS provides the following levels of perspective in increasing order (farthest away to closest):

1. World
2. Proximity Band
3. Device
4. Active Device
5. Native UI
6. Collection
7. Active Collection
8. Sub-collection
9. Active Sub-collection
10. etc. (further levels of sub-collections)

Level 1 represents the outermost level of perspective. For example, in this embodiment, the definition of Level 1 specifies that the entire world is displayed and accessible (to the extent it can be viewed on the device). In Level 2, the focus is on proximity bands. Level 10 represents further inner levels of perspective until there are no more sub collection levels to be displayed or accessed. Level 5 represents displaying, in a "zoomed in" manner, the native user interface that is specific to the object or one provided by the WVDS (for example, if the device is not capable of providing access to its user interface from within the WVDS). Thus, when a user accesses a native user interface of an object in the WVDS, the user does so in the context of the user's entire connectivity universe and, by changing levels of perspective, the user can zoom in and out to access different portions of the user's universe.

Depending upon the WVDS configuration settings, different levels may also correspond to transitions in the amount of detail displayed. According to one WVDS definition, the level of perspective at which device rings are displayed around devices is termed the "device ring display level." Typically, the device ring display level is the Proximity Band level, although it is configurable. The level of perspective at which collections are displayed on the device rings is known as the "collection display level." Typically, this also occurs at the Proximity Band level, although, like all of the other levels, this behavior is configurable. The level of perspective at which sub-collections are displayed on the data collection rings is known as the "sub-collection display level." Typically, this occurs at the Active Collection level, although, like all of the other levels, this behavior is configurable.

The WVDS renders the objects in the user's connectivity universe based upon the current configuration of these levels of perspective. Figures 18A and 18B are an example flow diagram of proximity band rendering supported by an example rendering system of a WorldView Display System. One skilled in the art will appreciate that other steps could be implemented, and in different orders, yet still achieve the rendering functions of the WVDS. Steps 1801-1816 are executed for each (topmost level) object in each proximity band in the system, appropriate to the current level of perspective. In step 1801, the WVDS determines and renders the device image, size, and detail according to the current level of perspective (LP) and whether the device is active or not. In step 1802, the WVDS determines whether the device is active, and, if so, continues in step 1803, else continues in step 1804. In step 1803, the WVDS displays the device's WVDS user interface associated with manipulation at the connectivity universe level and may also display auxiliary features such as access control information or other information. In step 1804, the WVDS determines whether the current LP is at or below the device ring display level, and, if so, continues in step 1805 to display a corresponding device ring, else returns. In step 1806, the WVDS determines whether the current LP is at or below the collection display level, and, if so, continues in step 1807 to display any corresponding data collections, else returns. In step 1808, the WVDS determines whether any one of the data collections is active, and, if so, continues in step 1809 to display the collection ring associated with the active collection, else returns. In step 1810, the WVDS displays the active collection's UI and may also display auxiliary features such as access control information or other information. In steps 1811-1816, the WVDS executes a loop for each contained sub-collection to display the sub-collections and their associated sub-collection rings, as well as the sub-collection's UI. More

specifically, in step 1811, the WVDS determines whether the current LP is at or below the next sub-collection display level, and, if so, continues in step 1812, else returns. In step 1812, the WVDS determines whether there exist any sub-collections to display, and, if so, continues in step 1813, else returns. In step 1813, the WVDS displays the sub-collections. In step 1814, the WVDS determines whether a sub-collection is active, and, if so, continues in step 1815 to display the sub-collection ring associated with the active sub-collection, else returns. In step 1816, the WVDS displays the sub-collections UI, and may also display auxiliary features such as access control information or other information, and then returns to step 1811.

Assuming that, at least at some point, the representation of the connectivity universe is larger than can fit on the display screen, the user controls the portion of the universe displayed by moving the input device to reflect the user's position. According to one embodiment, the input device behaves like a camera view finder. That is, as the user moves (as the input device indicates motion) in a forward direction, the user will see more objects ahead while those objects that were previously closest to the user will move behind the user and fall out of view. Also, as the user moves in a direction so that the user appears to be looking more directly downward (moves the point of view source higher), the user will see more of the top of objects and less of a side view. Similarly, as the user moves to the side, the user will see those objects to that side while objects on the other side fall out of view.

Many different graphics and rendering techniques are available to navigate through a two or three dimensional representation of the connectivity universe displayed on a display device. The following definition describes one user interface to effectuate the camera position, angle, and orientation movements described above. One skilled in the art will recognize that many equivalent user interface definitions can be similarly incorporated and that different user interfaces can be optimized for different input devices. For example, definitions may be created to support other input devices, such as joy sticks, that can control multidirectional, 3-D movement.

- Movement forward, backward, and side-to-side: the user's point of view follows the mouse (or similar input device) movement. This movement changes location, but doesn't change the direction the user is facing.
- Changing the view angle: pressing the two main mouse buttons simultaneously and moving the mouse changes the view angle in the direction of the mouse movement. A move right shifts the view to the

right; a move left shifts the view to the left; a move forward shifts the view downward; and a move backward shifts the view upward (or visa versa).

- Changing the level of perspective: rolling the mouse wheel moves the level of perspective up or down (closer or farther away) depending upon the direction of the roll.

These various movements may also be combined by the WVDS to automatically provide the user with user views. For example, as the level of perspective is changed to a closer level (showing more detail), the viewing angle may automatically be changed to provide a more front-on view of the objects.

Figure 19 is an example screen display of a representation of a user's connectivity universe as displayed by an example WorldView Display System after navigating to a new location. In Figure 19, only some of the proximity bands that represent the entire universe are displayed, the display viewing angle has been changed to appear as if the user is viewing the universe from a position closer to the ground (*e.g.*, the "floor" of the universe) as opposed to further up in space, and the various objects represented in the proximity bands appear larger.

Figure 20 is an example screen display of an example connectivity universe from a different viewing angle and a different level of perspective. In Figure 20 the user has navigated from the Proximity Band level of perspective ("LP") to the Active Collection LP. This transition results in the display of a photo sub-collection 2002 on the collection ring 2001, which is consistent with a WVDS configuration that specifies the Active Collection LP as the sub-collection display level. Note that the photo sub-collection 2002 comprises further sub-collections 2031-2035, whose contents (or further sub-collections) are displayed when the user zooms in to closer levels of perspective. In comparison to Figure 1, the viewing angle has also been changed to reflect a view source that is more level with the object, yielding a perception of traveling down and into the object, when the movement is rendered as a smooth animation.

In addition to general navigation, the user can also further manipulate objects and their content by activating them. As briefly mentioned with reference to Figure 2, when an object (device/service or data collection) is made active, the WVDS displays a user interface tool for further manipulating the object. Figure 21 is an example screen display of a close-up view of a user interface displayed for an active device. The cellular phone device 2101 is depicted with a UI palette 2120. Palette 2120 comprises two buttons: a "robot" button 2121 for setting up characteristics of the device (using the native user interface associated with the

device where available) and a "policeman" button 2122 for invoking an access control dialog (*e.g.*, to set up access permissions) with the user. The user can also manipulate an active device in other ways. In one embodiment, the user can bring up a user interface (for example, by right clicking on the device with a mouse or by selected the robot button 2121) to add new collections to be recognizable on the device. In addition, a maximize button 2102 is displayed to allow the user to easily (*e.g.*, in a single click) change the level of perspective to zoom into a native user interface associated with the device, for example, into whatever is currently being displayed on the display 2130 of device 2101. In one embodiment, the maximize button 2102 lets whatever is displayed on the display 2130 of device 2101 "take over" a majority of the screen, such as in a "full screen" mode. The user can use zoom handles button 2103 to adjustably zoom into whatever is currently being displayed on the display 2130 of the device 2101, for example, to see more of what is on display 2130 in the context of the connectivity universe. In one embodiment, the zoom handles button 2103 presents a handle which can be dragged by the user to adjust the zoom level. Also, in some embodiments the user can "open" the active device, for example, by double-clicking on the device representation (or through another button), to redirect input from the host system to be forwarded to a native user interface, or a WVDS provided one, associated with the active device. From the user's perspective, the user then appears to be interacting directly with the active device. One skilled in the art will appreciate that other buttons for other capabilities can be easily incorporated and that other iconic representations or symbols can be displayed. A more distant view of a UI palette displayed for an active device is shown as palette 230 in Figure 2.

Figure 22 is an example screen display of a close-up view of a user interface displayed for an active collection. A music data collection 2201 is depicted with a UI palette 2220. Palette 2220 comprises three buttons 2221-2223 and a sync/share interface cable 2224. The buttons include a "robot" button 2221 for setting up characteristics of the data collection, a "policeman" button 2222 for invoking an access control dialog (*e.g.*, to set up access permissions) with the user, and a "rose" button 2223 for opening the data collection using an appropriate media viewer. A further out view of a UI palette displayed for an active data collection is shown as UI palette 340 in Figure 3.

One skilled in the art will appreciate that other buttons for other capabilities can be easily incorporated and that other iconic representations or symbols can be displayed. For example, in one embodiment, the WVDS supports a uniform "media control" type interface on a data collection for manipulation of the

contents of the collection. Media controls includes commands such as a "play" command, "pause" command, a "next" command, a "previous" command, a "fast forward" command, and a "rewind" command, which are supported in the form of buttons or other UI components. The user can invoke these media controls to easily cycle through the data contents of a collection and to invoke the appropriate player/viewer to present the contents.

Using the access control button of either a device or data collection UI palette, for example buttons 2122 or 2222, the user can cause the WVDS to display an access control dialog (not shown) to configure access permissions on the corresponding device or collection to the extent that the user has permission to do so. Setting access permissions from this dialog allows the user to easily specify access permissions at the object level instead of setting them for each other user to whom the user desires to give access. Access control cards can be used to manage access permissions at an individual level. As described above, in one embodiment, access control cards are presented along with an active object's representation (and at other times).

Figure 23 is an example block diagram of an access control card for configuring access rights of a device or a collection for an individual. Access control card 2300 includes an indication of the user's identification 2301 and an indication of current state of access rights 2302. To change access rights, the user presses the Modify button 2303. One skilled in the art will recognize that many alternative yet equivalent implementations and presentations exist for setting up access permissions for a device or data collection of a WVDS.

In one embodiment, each access card has a front side and a back side. Once an access control card has been set up for a particular object, the WVDS may be configured to display the current settings on the front side of the card or a symbol of the user (or an avatar representing the user) as part of the representation of the object. In addition, an access control card may be displayed associated with a device or data collection for each user that has some type of access to the object. Typically, the WVDS displays the (front side of) associated access control cards for active objects. When a user then selects an access control card (to the extent the user's permissions allow), an animation turns the card from the front to the backside, resulting in the card as shown, for example, in Figure 23. The user can then modify the access permissions for the associated object. For example, in Figure 2, access control card 240 is displayed as part of the device ring presentation. Similarly, in Figure 10, access control cards 1020-1022 are displayed with shared collections 1010-1012.

In other embodiments, the WVDS can incorporate other types of settings and/or access control parameters. For example, controls that limit access based upon the type of content or device in combination with certain characteristics of a user, or based upon other limits such as time, may be implemented to effect a parental control interface. Such interfaces can be integrated into the WVDS, for example, as part of the settings or access control buttons available on the UI palettes, for example, robot button (2121 and 2221 in Figures 21 and 22, respectively) or policeman button (2122 or 2222 in Figures 21 and 22, respectively),

The sync/share interface cable present on a UI palette of a data collection, for example the cable 2224 in Figure 22, is used to set up a data sharing relationship, which may be synchronized in some manner, between two (or more) collections of data. Two collections have a synchronized data sharing relationship when data is automatically transferred between them as either acquires new or modified data. For example, when a music data collection on the user's My Computer device (on the My Computer proximity band) has a synchronized data sharing relationship set up with a music data collection on the user's portable device (accessible for example, via a Home Network proximity band), then the two collections are automatically synchronized whenever one of them is changed. This functionality is useful in a variety of scenarios, for example, keeping address books and contact lists synchronized between a user's personal computer and cell phone; sharing photos with family members and friends; and sharing photos between a user's personal computer and a portable device such as a PDA. In all such cases, the WVDS is responsible for synchronizing updated content and no further actions need be taken by the recipient user. Note that in some alternative embodiments, the data may be shared and not automatically synchronized, or such aspects may be configurable.

Data sharing relationships may be one-way or two-way. A one way relationship implies that one data collection serves as a source for data updates and one data collection servers as a target. A two-way relationship implies that each collection acts as a source collection for the other when their respective data content changes and that each collection acts as a target collection (recipient) for the other's changed data content. Thus, the shared data is transferred in two directions and the sharing relationship can be termed bi-directional.

Also, data sharing relationships may involve the actual transfer of data or may involve "virtual" transfers, in which the device associated with the target collection receives a description of the modified data content, but the actual

transfer is delayed until a user tries to access it (*e.g.*, the recipient collection may contain a link to the shared source data).

The WVDS also provides a user with an ability to set up "functional agents" at each end of the data sharing relationship. These functional agents provide hooks into code that is executed as appropriate upon the sending or receiving of data by a collection. One skilled in the art will appreciate that many such functional agents can be defined. In an example embodiment, the WVDS supports the following functional agents:

- Send New - A basic sending agent that detects when new data is deposited in the associated collection and sends the new data to the other collections that have data sharing relationships with the associated collection.
- Filter and Send – A sending agent that detects when new data is deposited in the associated collection and only sends it when the data passes user-configured (or WVDS-defined) filters.
- Receive and Store – A basic receiving agent that detects when new data is received and stores it in the associated collection. The agent is responsible for storing the received data in local storage associated with the device that corresponds to the receiving collection (or other data repository) and adjusting any records that define the receiving collection's content.
- Receive and Filter – A receiving agent that detects when new data is received and only stores it (and updates appropriate records) when the data passes user-configured (or WVDS-defined) filters.
- Receive and Display – A receiving agent that detects when new data is received and displays it.
- Receive and Notify - A receiving agent that detects when new data is received and notifies the user that the data has been received. The type and location of the notification can be configured by setting corresponding WVDS parameters.

In one embodiment, data sharing relationships are established by connecting (such as by dragging or using other direct manipulation input commands) a representation of a sync/share cable from a source collection or device onto a target collection or device. More specifically, the user drags a "sharing cable" with a plug within the displayed universe (using other navigation commands as appropriate) and "plugs" the cable plug into a "receptor" on a target data collection or device by, for example, a drop movement. Upon plugging in the

sharing cable, the WVDS automatically establishes a (typically) synchronized data sharing relationship between a corresponding source data collection and a (direct or implied) target data collection. Optionally, a sharing "settings" configuration dialog or a confirmation dialog may be displayed before completing the connection. In one embodiment that utilizes a mouse, when the user clicks on a sharing cable with the plug, the mouse can be used to drag the cable (which is pulled out from the collection/device as needed to follow the mouse around) without depressing any buttons. (The WVDS accomplishes this functionality by implementing modal operation when the mouse is used to click on the cable with the plug.) The user is thus able to use full navigation commands, including changing the level of perspective, to find an appropriate target collection. While a cable is being dragged, appropriate candidate target collections may be highlighted or otherwise given emphasis (or devices when the level of perspective is too far to present collections). In some embodiments, inappropriate targets are dimmed. When the cable plug nears a candidate collection, the candidate collection may display a receptor or other target indicator to indicate to the user that the cable can be attached to that collection.

Devices can also display receptors when a cable plug comes near them. Even though data sharing relationships are ultimately established between data collections, the WVDS will automatically attempt to set up a relationship between corresponding types of data collections when the user specifies a device as either the source or target of a drag operation of a sharing cable. For example, when the user drags a cable from a collection to a target device, the WVDS creates a data sharing relationship between the source collection and a collection of the same type on the target device. If there is more that one collection of that type on the device, then the user is queried to determine the desired target. If there are no collections of that type yet on the device, then a new collection is created.

Both data collections and devices can include sharing cables with plugs. For example, the sync/share interface cable 2224 in Figure 22 is an example sharing cable with a plug associated with a data collection. Similarly, a sync/share interface cable 220 is an example sharing cable with a plug associated with a device. When a sharing cable plug of a device is plugged into a receptor of a target data collection, then a matching type of data collection on the source device is presumed to be the source data collection for the data sharing relationship. Again, if there is more than one possible match, the user is queried to determine the intended source. When, instead the sharing cable plug of the

device is plugged into a receptor of a target device, then, the WVDS queries the user to specify which collections on the source and target devices should be shared and sets up new collections on the target device if they are non-existent.

Data sharing relationships also may be set up between an external source object to which the user has limited current access rights (the user can access data from the object and is not currently viewing the object within the WVDS display) and a target object to which the user has access rights and which is being displayed in the current WVDS representation. The WVDS will display an appropriate indication to show that data for the data sharing relationship is coming from an external object. For example, the WVDS may display a cable representation that appears to go "off-screen" with a terminator that indicates the source of the data. A corresponding data sharing relationship can be set up with an external object as the target object and an appropriate indicator displayed to indicate that data sharing relationship.

When a data sharing relationship is established, the WVDS may present a user interface to allow the user to configure the parameters and settings of the relationship, including whether the relationship is one-way or two-way (uni- or bi-directional), parameters such as frequency of updates, desirability of virtual transfers, etc., and the specification of special functional agents.

Once the relationship is fully established and configured, in one embodiment, the WVDS indicates the data sharing relationship graphically on the presentation of the connectivity universe, for example, using a colored cable between the relevant collections. Figure 24 is an example screen display of a data sharing relationship established between two collections. In Figure 24, a data sharing relationship has been established between a music data collection 2410 on a device ring that surrounds the computer system 2401 and a music data collection 2420 on a device ring that surrounds a different computer system 2402 in a different proximity band. Colored cabling, for example, the red cabling 2430, is added between the two collections with the data sharing relationship.

One of the functions available through the WVDS interface is to allow a user to invoke the native interface (or WVDS provided object-specific interface) associated with a particular object. In one embodiment of the WVDS, a device's display screen (for example, the computer system 101 in Figure 1) is generally always active; that is, a smaller replica of what the native operating system interface is displaying is reflected in the device representation provided by WVDS. (The user is thus viewing what is on the device in the context of the user's connectivity universe.) When a device is active, the user can cause input from an

input device to be "redirected" to the active device, such as by "opening" the active device as described with reference to Figure 21. The WVDS can display an appropriate simile if the host's input devices aren't appropriate for indicating input to the active device. (For example, if the host device is a cell phone and the active device is a computer system, the WVDS can display a representation of a keyboard for entering input.)

In addition to interacting with the native UI of a device within the connectivity universe representation, the user can zoom in to a device by changing the level of perspective to a closer level until the device's native UI becomes "full screen" on the host device's display screen. The standard navigation techniques for changing levels of perspective can be used to accomplish this function. In addition, on device representations with which a user can interact in full screen mode, the user is able to select an area within the device representation display screen to invoke the underlying user interface – effectively zooming in (and changing the level of perspective) to "maximize" the interface shown on the device representation display screen. For example, as shown in Figure 21, the user can click on the maximize button 2102 as a shortcut to zoom into the native user interface and display the device's native UI "full screen" on the host device's display screen. In some embodiments, the WVDS also supports an adjustable zoom handle(s) for changing the size of what is displayed so that more or less of the content displayed on the device can be shown. For example, the user can select the zoom handles button 2103 to invoke an adjustable zoom into the display screen content.

Once the user has maximized a device representation so that the user is viewing only the native UI of the device's underlying system, the user can return to the WVDS connectivity universe representation by selecting a "WVDS Restore" button or other user interface component superimposed on (or otherwise integrated with) the native UI's display presentation. The specific user interface component added to each device's native interface to accomplish this restore functionality depends upon the type of device, its native user interface, and the operating system of the device. If the device is a Window's operating system driven device, then typically the WVDS can add a WVDS Restore button on each window's title bar that invokes a type of "restore" function to render the window(s) containing the native UI to their prior size – as a smaller replica within the connectivity universe representation.

The WorldView Display System also supports the ability for a user to "open" a collection to invoke a native user interface associated with the collection.

The "rose" (open) button in an active data collection's UI palette (see, for example, button 2223 in Figure 22) can be selected to open the underlying content using an appropriate media viewer. When the user selects the open button, the WVDS directs the host device's operating system to execute the host system's default application for displaying (or otherwise presenting) the active collection's content. For example, if the user opens an active music collection, then the default media player for presenting music is activated as playing the designating collection of music. Similarly, if the user opens an active photo collection, then the default photo viewer is invoked and displays the designed photos. In other embodiments, different techniques that incorporate the native UI of the associated device also may be used and the WVDS can allow the user to choose among available techniques.

As mentioned with reference to Figures 21 and 22, the UI palettes presented on active devices and collections also provide users an ability to change settings of the corresponding device or collection. Many different functions can be made available through such an interface, including using the settings button (or a UI component presented in a further response) to invoke a native UI that corresponds to the active device. This native UI can also be presented in a "full screen" mode, as described with reference to activating an active device's native UI. In addition, the WVDS can select between using a native UI to configure the active device or collection and using WVDS specific interfaces. Combinations between them are also possible.

In addition to the operations and functions described, one skilled in the art will appreciate that the WVDS can offer many additional enhancements. For example, the WVDS may also support a general "settings" user interface, accessible from a button or other component on the screen for configuring devices, collection types, and other WVDS configuration parameters. Such an interface can be used, for example, to configure the modeling parameters of the WVDS; configure thresholds such as the maximum number of proximity bands to display at certain levels of perspective; hide and unhide the display of particular proximity bands; set up characteristics to assess access proximity; map access proximity classes to proximity bands; specify that particular devices are mapped to particular proximity bands; specify collections on devices, etc. Lots of alternative interfaces to these functions can also be easily incorporated and are contemplated to operate with the techniques described herein.

Figure 25 is a block diagram of a general purpose computer system for practicing embodiments of a WorldView Display System. The general purpose

computer system 2500 may comprise one or more server and/or client computing systems and may span distributed locations. In addition, each block shown may represent one or more such blocks as appropriate to a specific embodiment or may be combined with other blocks. Moreover, the various blocks of the WorldView Display System 2510 may physically reside on one or more machines, which use standard interprocess communication mechanisms to communicate with each other.

In the embodiment shown, computer system 2500 comprises a computer memory ("memory") 2501, a display 2502, a Central Processing Unit ("CPU") 2503, Input/Output devices 2504, and Network Connections 2505. The WorldView Display System ("WVDS") 2510 is shown residing in memory 2501. The components of the WorldView Display System 2510 preferably execute on CPU 2503 and manage the generation and use of connectivity universes, as described in previous figures. Other downloaded code 2530, terminal emulators as required 2540 and potentially other data repositories, such as data repository 2520, also reside in the memory 2501, and preferably execute on one or more CPUs 2503. In addition, one or more components of the native operating system for the computer system 2550 reside in the memory 2501 and execute on one or more CPUs 2503. In a typical embodiment, the WVDS 2510 includes one or more Display Managers 2511, at least one Rendering Engine 2512, user interface support modules 2513, API support 2514, and WVDS data repository 2515, which contains for example WVDS configuration and connectivity universe information.

In an example embodiment, components of the WVDS 2510 are implemented using standard programming techniques, including object-oriented techniques as well as monolithic programming techniques. In addition, programming interfaces to the data stored as part of the WVDS can be available by standard means such as through C, C++, C#, and Java API and through scripting languages such as XML, or through web servers supporting such. The WVDS data repository 2515 is preferably implemented for scalability reasons as a database system rather than as a text file, however any method for storing such information may be used.

One skilled in the art will recognize that the WVDS 2510 may be incorporated into a distributed environment that is comprised of multiple, even heterogeneous, computer systems and networks. For example, in one embodiment, the Display Manager 2511, the Rendering Engine 2512, and the WVDS data repository 2515 are all located in physically different computer systems. In another embodiment, various components of the WVDS 2510 are

hosted each on a separate server machine and may be remotely located from the tables which are stored in the WVDS data repository 2515. Different configurations and locations of programs and data are contemplated for use with techniques of the present invention. In example embodiments, these components may execute concurrently and asynchronously; thus the components may communicate using well-known message passing techniques. One skilled in the art will recognize that equivalent synchronous embodiments are also supported by an WVDS implementation.

The capabilities of the WVDS described above can be implemented on a general purpose computer system, such as that described with reference to Figure 25, using well-known programming techniques.

One of the capabilities of WVDS interface available to a user once the connectivity universe is presented, allows a user to invoke a native interface associated with a particular device. In one embodiment, the WVDS supports the ability to "open" an active device (that is not the host device), thereby enabling the user to send input to the active device. The manner in which the WVDS can implement a native user interface mode of a device is device, and its underlying operating system, dependent. Some devices and their native systems support drawing directly to a window that is contained within the display provided by the WVDS. In this case, the WVDS does not need to intervene to handle display from the native user interfaces to a display screen associated with the host device (that is hosting the WVDS software).

In other cases, where the device cannot draw directly to a WVDS display "window," other techniques are incorporated. For example, in one embodiment, the WVDS requests the operating system of the host device to execute a terminal emulator for communicating between the WVDS and the active device. The WVDS also invokes a corresponding host software routine (code) on the active device's native operating system for communicating with the terminal emulator on the host device. Input received by the WVDS host input devices is passed to the terminal emulator, which forwards the input to the corresponding software routine on the active device. Screen updates that originate on the active device are then passed from the corresponding software routine to the terminal emulator residing on the host device, which are then forwarded through to the WVDS to render them on the display screen representation of the active device representation. (In an alternative implementation, the terminal emulator can write directly to a WVDS display "window" thus expediting screen updates.) One skilled in the art will appreciate that other alternative implementations are possible.

Some devices, for example, currently cameras, do not support even terminal emulation capabilities. In such cases, if there are no alternatives for displaying the native UI of a device, then the WVDS may disable this function for that device or offer an alternative user interface.

The user can also "open" an active collection to invoke a native user interface associated with the collection. In one embodiment, when the collection resides on the host device, the WVDS directs the host device's operating system to execute the default application for displaying (or otherwise presenting) the active collection's content. In other embodiments, for example when the collection resides on a device other than the host device, the WVDS may use terminal emulation techniques as described above, or other means of communicating with the native UI of the device associated with the collection, to present the designated collection.

From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. For example, one skilled in the art will recognize that the methods and systems for performing presentation and rendering discussed herein are applicable to other architectures other than a Microsoft Windows operating system architecture. One skilled in the art will also recognize that the methods and systems discussed herein are applicable to differing protocols, communication media (optical, wireless, cable, etc.) and devices (such as wireless handsets, electronic organizers, personal digital assistants, portable email machines, game machines, pagers, navigation devices such as GPS receivers, etc.).

CLAIMS

1. A computer-implemented method for modeling a connectivity universe having a plurality of devices and a plurality of data collections associated with a user, comprising:

automatically determining a plurality of objects and an assessment of access proximity relative to the user for each such object;

automatically determining a plurality of groupings of the determined objects, each grouping associated with a different class of access proximity and with at least one of a device or a data collection; and

displaying a representation of the automatically determined groupings that indicates the access proximity associated with each grouping.

2. The method of claim 1 wherein the automatically determined plurality of objects comprise a plurality of devices.

3. The method of claim 1 wherein the automatically determined plurality of objects comprise a plurality of data collections.

4. The method of claim 3, further comprising:

providing an interface to enable the manipulation of each data collection object using media controls.

5. The method of claim 4 wherein the media controls comprise at least one of a play command, a pause command, a next command, a previous command, a fast forward command, or a rewind command.

6. The method of claim 3, further comprising:

displaying a grouping of data associated with at least one of the data collections.

7. The method of claim 6 wherein the grouping of data is a playlist or an album.

8. The method of claim 1 wherein the determined assessment of access proximity is based upon at least one of physical proximity to the user, extent of

control available to the user, prior access history, type of object, portion of object associated with the user, operational characteristics, or network connectivity characteristics.

9. The method of claim 1 wherein the displaying the representation of the automatically determined groupings is displayed relative to a designated host device.

10. The method of claim 1, the displaying the representation of the automatically determined groupings further comprising:

displaying an indication of each class of access proximity; and

for each indicated class, displaying a representation of a plurality of the determined objects that are associated with that class.

11. The method of claim 10, the displaying the representation of the automatically determined groupings further comprising:

determining a layout of the plurality of groupings relative to the different classes of access proximity; and

displaying a representation of the automatically determined grouping according to the determined layout.

12. The method of claim 10, the displaying the representation of the plurality of determined objects that are associated with that class further comprising:

displaying a representation of a device at least partially surrounded by a graphical indicator that indicates the contents of the device.

13. The method of claim 10, the displaying the representation of the plurality of determined objects that are associated with that class further comprising:

displaying a representation of a data collection.

14. The method of claim 1, the displaying the representation of the determined objects further comprising:

displaying a plurality of proximity bands.

15. The method of claim 14, the displaying the plurality of proximity bands further comprising:

for each proximity band, displaying a representation of a connection to at least one device and an indication of at least one data collection associated with the at least one device.

16. The method of claim 14, the displaying the plurality of proximity bands further comprising:

displaying at least one of a proximity band associated with a host device, a proximity band associated with a network, a proximity band associated with a wireless device, a proximity band associated with shared data, a proximity band associated with internet services, or a proximity band associated with websites.

17. The method of claim 14, the displaying the plurality of proximity bands further comprising:

displaying at least one proximity band associated with at least one media collection of at least one type.

18. The method of claim 17 wherein the particular type is at least one of photos, images, music, files, contacts, videos, email, instant messages, newsgroups, favorites, history, or web pages.

19. The method of claim 17, the displaying the at least one proximity band, further comprising:

displaying at least one proximity band associated with at least one media collection of at least one type, wherein the sub-collections of the media collection reside on a plurality of devices.

20. The method of claim 17, the displaying the plurality of proximity bands further comprising:

displaying at least one proximity band associated with at least one device that is different from the proximity band associated with the at least one media collection.

21. The method of claim 1, the displaying the representation of the automatically determined groupings further comprising:

displaying at least one of a device ring or a data collection ring.

22. The method of claim 1, the displaying the representation of the automatically determined groupings further comprising:

displaying an indication of a synchronization relationship between at least two of the objects.

23. The method of claim 1, the displaying the representation of the automatically determined groupings further comprising:

displaying an indication of a sharing relationship between at least two of the objects.

24. The method of claim 1, each automatically determined object associated with content, further comprising:

receiving an indication of a selected representation of a displayed object; and

displaying the content associated with the indicated object.

25. A computer-readable memory medium containing instructions that, when executed, control a computer processor to model a connectivity universe having a plurality of devices and a plurality of data collections associated with a user, by:

automatically determining a plurality of objects and an assessment of access proximity relative to the user for each such object;

automatically determining a plurality of groupings of the determined objects, each grouping associated with a different class of access proximity and with at least one of a device or a data collection; and

displaying a representation of the automatically determined objects that indicates the access proximity associated with each grouping.

26. The memory medium of claim 25 wherein the automatically determined plurality of objects comprise a plurality of devices.

27. The memory medium of claim 25 wherein the automatically determined plurality of objects comprise a plurality of data collections.

28. The memory medium of claim 27, further comprising instructions that, when executed, provide an interface to enable the manipulation of each data collection object using media controls.

29. The memory medium of claim 28 wherein the media controls comprise at least one of a play command, a pause command, a next command, a previous command, a fast forward command, or a rewind command.

30. The memory medium of claim 27, further comprising instructions that, when executed display a grouping of data associated with at least one of the data collections.

31. The memory medium of claim 30 wherein the grouping of data is a playlist or an album.

32. The memory medium of claim 25 wherein the determined assessment of access proximity is based upon at least one of physical proximity to the user, extent of control available to the user, prior access history, type of object, portion of object associated with the user, operational characteristics, or network connectivity characteristics.

33. The memory medium of claim 25 wherein the displaying the representation of the automatically determining groupings is displayed relative to a designated host device.

34. The memory medium of claim 25, the displaying the representation further comprising:

displaying a representation of each class of access proximity; and

for each class, displaying an indication of a plurality of the determined objects that are associated with that class.

35. The memory medium of claim 34, the displaying the representation further comprising:

determining a layout of the plurality of groupings relative to the different classes of access proximity; and

displaying a representation of the automatically determined grouping according to the determined layout.

36. The memory medium of claim 34, the displayed representation further comprising displaying a representation of a device at least partially surrounded by a graphical indicator.

37. The memory medium of claim 34, the displayed representation further comprising displaying a representation of a data collection.

38. The memory medium of claim 25, the displayed representation further comprising displaying a plurality of proximity bands.

39. The memory medium of claim 38, further comprising instructions that , when executed, control the computer processor by:

for each displayed proximity band, displaying a representation of a connection to at least one device and an indication of at least one data collection associated with the at least one device.

40. The memory medium of claim 38, the proximity bands further comprising at least one of a proximity band associated with a host device, a proximity band associated with a network, a proximity band associated with a wireless device, a proximity band associated with shared data, a proximity band associated with internet services, or a proximity band associate with websites.

41. The memory medium of claim 38, the proximity bands further comprising at least one proximity band associated with at least one media collection of at least one type.

42. The memory medium of claim 41 wherein the at least one media collection is associated with sub-collections that reside on a plurality of devices.

43. The memory medium of claim 41, the proximity bands further comprising at least one proximity band associated with at least one device in addition to the proximity band associated with the at least one media collection.

44. The memory medium of claim 25, further comprising instructions that, when executed, control the computer processor by:

displaying at least one of a device ring or a data collection ring.

45. The memory medium of claim 25, further comprising instructions that, when executed, control the computer processor by:

displaying an indication of a synchronization relationship between at least two of the objects.

46. The memory medium of claim 25, further comprising instructions that, when executed, control the computer processor by:

displaying an indication of a sharing relationship between at least two of the objects.

47. The memory medium of claim 25, each determined object associated with content, further comprising instructions that, when executed, control the computer processor by:

receiving an indication of a selected representation of a displayed object; and

displaying the content associated with the indicated object.

48. A computer system comprising:

a plurality of devices;

a plurality of data collections; and

a display manager that is structured to:

automatically determine a plurality of objects and an assessment of access proximity relative to the user for each such object , each object associated with at least one of the plurality of devices or at least one of the plurality of data collections;

automatically determining a plurality of groupings of the determined objects, each grouping associated with a different class of access proximity; and

display a plurality of proximity bands, each proximity band corresponding to a determined grouping and indicating the class of access proximity associated with the grouping.

49. The system of claim 48 wherein the plurality of objects comprise a plurality of devices.

50. The system of claim 48 wherein the plurality of objects comprise a plurality of data collections.

51. The system of claim 50, the display manager having a user interface that is structured to enable the manipulation of each data collection object using media controls.

52. The system of claim 51 wherein the media controls comprise at least one of a play command, a pause command, a next command, a previous command, a fast forward command, or a rewind command.

53. The system of claim 50, the display manager further structured to display a grouping of data associated with at least one of the data collections.

54. The system of claim 53 wherein the grouping of data is a playlist or an album.

55. The system of claim 48 wherein the determined class of access proximity is based upon at least one of physical proximity to the user, extent of control available to the user, prior access history, type of object, portion of object associated with the user, operational characteristics, or network connectivity characteristics.

56. The system of claim 48 wherein the plurality of proximity bands are displayed relative to a designated host device.

57. The system of claim 48, the display manager further structured to:

for each displayed proximity band, display a representation of a plurality of the determined objects that are associated with the class of access proximity associated with the proximity band.

58. The system of claim 48, the display manager further structured to:

determine a layout of the proximity bands relative to the classes of access proximity; and

display the proximity bands and the representation of the plurality of determined objects based upon the determined layout.

59. The system of claim 57 wherein at least one of the displayed proximity bands displays a representation of a device at least partially surrounded by a graphical indicator.

60. The system of claim 57 wherein the graphical indicator is a device ring.

61. The system of claim 57 wherein at least one of the displayed proximity bands displays a representation of a data collection.

62. The system of claim 48 wherein at least one of the displayed proximity bands indicates a connection to at least one device and indicates at least one data collection associated with the at least one device.

63. The system of claim 48 wherein the proximity bands comprise at least one of a proximity band associated with a host device, a proximity band associated with a network, a proximity band associated with a wireless device, a proximity band associated with shared data, a proximity band associated with internet services, or a proximity band associated with websites.

64. The system of claim 48 wherein the proximity bands comprise at least one proximity band associated with at least one media collection of at least one type.

65. The system of claim 64 wherein the at least one media collection of the at least one type is associated with sub-collections that reside on a plurality of devices.

66. The system of claim 64 wherein the proximity bands comprise at least one proximity band associated with a device in addition to the proximity band associated with the at least one media collection.

67. The system of claim 48 wherein at least one of the displayed proximity bands displays a data collection ring.

68. The system of claim 48 wherein the displayed proximity bands display a device ring and a data collection ring.

69. The system of claim 48 wherein the displayed proximity bands display an indication of a synchronization relationship between at least two of the determined objects.

70. The system of claim 48, wherein the displayed proximity bands display an indication of a sharing relationship between at least two of the determined objects.

71. The system of claim 48, each automatically determined object associated with content, wherein the display manager is further structured to:

receive an indication of a selected representation of a displayed object; and

display the content associated with the indicated object.

72. A computer-implemented method for modeling a connectivity universe having a plurality of devices and a plurality of data collections associated with a user, comprising:

automatically determining a plurality of objects and an assessment of access proximity relative to the user for each such object;

automatically determining a plurality of groupings of the determined objects, each grouping associated with a different class of access proximity and with at least one of a device or a data collection; and

displaying a multi-dimensional representation of the the determined objects arranged according to the classes of access proximity associated with the groupings.

73. The method of claim 72, the displaying the multi-dimensional representation of the the determined objects further comprising:

displaying a three dimensional proximity band for each class of access proximity.

74. The method of claim 72 wherein the multi-dimensional representation is a three dimensional representation.

75. The method of claim 72, the displayed multi-dimensional representation being capable of manipulation by a user in a manner that gives an impression that the user is moving through the connectivity universe.

76. The method of claim 72, the displayed multi-dimensional representation being capable of manipulation by a user in a manner that gives an impression that the user is flying through the connectivity universe.

77. The method of claim 72, the displayed multi-dimensional representation appearing as a virtual world that the user navigates by moving an input device to indicate three dimensional movement.

78. The method of claim 77, further comprising:

causing animation effects associated with at least one of the determined objects.

79. The method of claim 72, further comprising:

in response to a received input command, reorienting the multi-dimensional representation to perform at least one of zooming, panning, or changing a source of viewing perspective.

80. The method of claim 72, further comprising:

in response to a received indication of a directional movement of an input device, causing the display of a new location in the connectivity universe.

81. The method of claim 72, further comprising:

in response to a received input command, enabling interaction with a native user interface of a designated object.

82. The method of claim 81 wherein the enabling the interaction with the native user interface of the designated object enables interaction with a native user interface of a designated object from within a representation of the connectivity universe.

83. The method of claim 72, the multi-dimensional representation of the determined objects being associated with at least one of a plurality of levels of perspective, and further comprising:

in response to a received indication from an input device, causing display of the connectivity universe according to a different level of perspective.

84. The method of claim 83, the plurality of levels of perspective representing progressively increasing amounts of detail of the connectivity universe, wherein the causing display of the connectivity universe according to the different level of perspective further comprises:

displaying the multi-dimensional representation of the groupings of the determined objects according to a current level of perspective.

85. The method of claim 83 wherein the causing display of the connectivity universe according to the different level of perspective is associated with a zoom movement.

86. The method of claim 83, the causing display of the connectivity universe according to the different level of perspective further comprising:

causing the display of the connectivity universe to show an increasing level of detail by displaying data collections associated with each device.

87. The method of claim 83, the causing display of the connectivity universe according to the different level of perspective further comprising:

causing the display of the connectivity universe to show an increasing level of detail by displaying data sub-collections associated with a designated media type.

88. The method of claim 83, the causing display of the connectivity universe according to the different level of perspective further comprising:

causing an effect of zooming into a designated object such that content associated with a native user interface of the object is displayed in a manner that allows a user to interact with the native user interface of the object.

89. The method of claim 83, the causing display of the connectivity universe according to the different level of perspective further comprising:

causing an effect of zooming out from a designated object such that a native user interface display of the object is shown in a context of the multi-dimensional representation of the determined objects arranged according to the classes of access proximity.

90. A computer-readable memory medium containing instructions that, when executed, control a computer processor to model a connectivity universe of a plurality of devices and a plurality of data collections associated with a user, by:

automatically determining a plurality of objects and an assessment of access proximity relative to the user for each such object;

automatically determining a plurality of groupings of the determined objects, each grouping associated with a different class of access proximity and with at least one of a device or a data collection; and

displaying a multi-dimensional representation of the determined objects arranged according to the classes of access proximity associated with the groupings.

91. The memory medium of claim 90 wherein the multi-dimensional representation comprises a three dimensional proximity band for each class of access proximity.

92. The memory medium of claim 90 wherein the multi-dimensional representation comprises a three dimensional representation.

93. The memory medium of claim 90, further comprising instructions that, when executed, enable a user to navigate within the multi-dimensional representation in a manner that gives an impression that the user is moving through the connectivity universe.

94. The memory medium of claim 90, further comprising instructions that, when executed, enable a user to navigate within the multi-dimensional representation in a manner that gives an impression that the user is flying through the connectivity universe.

95. The memory medium of claim 90, the multi-dimensional representation of the determined objects in the connectivity universe being presented as a virtual world.

96. The memory medium of claim 95, further comprising instructions that, when executed, cause animation effects associated with at least one of the determined objects.

97. The memory medium of claim 90, further comprising instructions that, when executed, reorient the multi-dimensional representation to perform at least one of zooming, panning, or changing a source of viewing perspective.

98. The memory medium of claim 90, further comprising instructions that, when executed, in response to a received indication of a directional movement of an input device, cause the display of a new location in the connectivity universe.

99. The memory medium of claim 90, further comprising instructions that, when executed, in response to a received input command, enable interaction with a native user interface of a designated object.

100. The memory medium of claim 99 wherein the enabled interaction enables interaction with a native user interface of a designated object from within a representation of the connectivity universe.

101. The memory medium of claim 90, the multi-dimensional representation being associated with at least one of a plurality of levels of perspective, further comprising instructions that, when executed, cause display of the connectivity universe according to a different level of perspective.

102. The memory medium of claim 101, the plurality of levels of perspective representing progressively increasing amounts of detail of the connectivity universe, and wherein the multi-dimensional representation is displayed according to a current level of perspective.

103. The memory medium of claim 101, the display of the connectivity universe according to the different level of perspective associated with a zoom movement.

104. The memory medium of claim 101, the display of the connectivity universe according to the different level of perspective showing an increasing level of detail by displaying data collections associated with each device.

105. The memory medium of claim 101, the display of the connectivity universe according to the different level of perspective showing an increasing level of detail by displaying data sub-collections associated with a designated media type.

106. The memory medium of claim 101, the display of the connectivity universe according to the different level of perspective causing an effect of zooming into a designated object such that content associated with a native user interface of the object is displayed in a manner that enables a user to interact with the native user interface of the object.

107. The memory medium of claim 101, the display of the connectivity universe according to the different level of perspective causing an effect of zooming out from a designated object such that a native user interface display of the object is shown in a context of the multi-dimensional representation of the determined objects arranged according to the classes of access proximity.

108. A computer system for managing a connectivity universe of a plurality of devices and a plurality of data collections associated with a user, comprising:

a display manager that is structured to

automatically determine a plurality of objects and an assessment of access proximity for each such object relative to the user;

automatically determine a plurality of groups of the determined objects, each group associated with a different class of access proximity; and

displaying a multi-dimensional representation of the determined objects arranged according to the classes of access proximity associated with the groups.

109. The system of claim 108 wherein the multi-dimensional representation comprises a three dimensional proximity band for each class of access proximity.

110. The system of claim 108 wherein the multi-dimensional representation comprises a three dimensional representation.

111. The system of claim 108, the display manager further structured to support navigation within the multi-dimensional representation in a manner that simulates the user moving through the connectivity universe.

112. The system of claim 108, the display manager further structured to support navigation within the multi-dimensional representation in a manner that simulates the user flying through the connectivity universe.

113. The system of claim 108, the multi-dimensional representation of the determined objects in the connectivity universe comprising a virtual world.

114. The system of claim 113, the display manager further structured to cause animation effects associated with at least one of the determined objects.

115. The system of claim 108, the display manager further structured to perform at least one of zooming, panning, or changing a source of viewing perspective.

116. The system of claim 108, the display manager further structured to, in response to a received indication of a directional input, cause the display of a new location in the connectivity universe.

117. The system of claim 108, the display manager further structured to enable interaction with a native user interface of a designated object.

118. The system of claim 108, wherein the display manager enables interaction with the native user interface of the designated object from within a representation of the connectivity universe.

119. The system of claim 108, the multi-dimensional representation being associated with at least one of a plurality of levels of perspective, the display manager further structured to cause display of the connectivity universe according to a different level of perspective.

120. The system of claim 119, the plurality of levels of perspective representing progressively increasing amounts of detail of the connectivity universe, and wherein the multi-dimensional representation is displayed according to a current level of perspective.

121. The system of claim 119 wherein the display of the connectivity universe according to the different level of perspective is associated with a zoom movement.

122. The system of claim 119, the display of the connectivity universe according to the different level of perspective showing an increasing level of detail by displaying data collections associated with each device.

123. The system of claim 119, the display of the connectivity universe according to the different level of perspective showing an increasing level of detail by displaying data sub-collections associated with a designated media type.

124. The system of claim 119, the display of the connectivity universe according to the different level of perspective causing an effect of zooming into a designated object such that content associated with a native user interface of the object is displayed in a manner that allows a user to interact with the native user interface of the object.

125. The system of claim 119, the display of the connectivity universe according to the different level of perspective causing an effect of zooming out from a designated object such that a display of a native user interface of the object is shown in a context of the multi-dimensional representation of the determined objects arranged according to the classes of access proximity.

126. A method for interacting with a device from within a representation of a connectivity universe comprising a plurality of devices displayed on a host computer system, comprising:

receiving an indication of a designated device from among the plurality of devices displayed within the representation of the connectivity universe;

initiating execution of a terminal emulator application on the host system to communicate with the designated device from the host system;

causing corresponding code to be executed on the designated device; and

receiving output from the corresponding code executing on designated device through the terminal emulator; and

causing the received output to be displayed on a display device of the host system.

127. The method of claim 126 wherein the causing the received output to be displayed on the display device of the host system comprises causing display of the received output on the display device within a context of the displayed connectivity universe.

128. The method of claim 126 wherein the causing the received output to be displayed on the display device of the host system comprises causing display of the received output on the display device in a maximized form.

129. The method of claim 126, further comprising:

receiving input from an input device of the host system; and

forwarding the received input to the corresponding code executing on the designated device through the terminal emulator application.

130. A computer-implemented method for establishing a sharing relationship between collections of data, comprising:

displaying, in proximity to a first object associated with a first device, a user interface for setting up a data sharing relationship, the user interface capable of establishing a two-way sharing relationship between the first object and a second object by connecting a single portion of the displayed user interface;

receiving an indication that the portion of the displayed user interface has been connected to the second object associated with a second one of the devices; and

in response to the received indication, establishing a sharing relationship between the first object and the second object such that, when data content associated with the first object changes, the changed data content is automatically reflected in data content associated with the second object.

131. The method of claim 130, further comprising displaying the first and second objects in locations that are based upon associated access proximity characteristics.

132. The method of claim 130 wherein the receiving the indication that the portion of the displayed user interface has been connected to the second object further comprises receiving an indication that the portion of the displayed user interface has been dragged to the second object via direct manipulation of an input device.

133. The method of claim 130, the establishing the sharing relationship between the first object and the second object further comprising:

establishing a synchronized sharing relationship between the first object and the second object such that data content is synchronized between the first and second objects.

134. The method of claim 130 wherein the sharing relationship is established to share at least one of images, photographs, music, contact information or multimedia content.

135. The method of claim 130 wherein, when the data content associated with the first object is changed by adding new data content to content associated with the first object, the new data content is automatically added to the data content associated with the second object.

136. The method of claim 130, the establishing the sharing relationship further comprising:

establishing a two-way sharing relationship between the first object and the second object such that, when data content associated with the first object changes, the changed data content is automatically reflected in the data content associated with the second object, and when data content associated with the second object changes,

the changed data content associated with the second object is automatically reflected in the data content associated with the first object.

137. The method of claim 130, further comprising:

automatically reflecting changed data content associated with the first object by virtual transfer of the changed data content to the data content associated with the second object.

138. The method of claim 130, further comprising:

associating a functional agent with at least one endpoint of the established sharing relationship.

139. The method of claim 130 wherein the functional agent comprises at least one of a send new data agent, a filter and send agent, a receive and store agent, a receive and filter agent, a receive and display agent, or a receive and notify agent.

140. The method of claim 130 wherein the first object and the second object represent data collections.

141. The method of claim 130 wherein the first object and the second object represent devices.

142. The method of claim 141 wherein the changed data content resides in a data collection.

143. The method of claim 141 wherein the devices are physical devices in the real-world.

144. The method of claim 130 wherein the first object represents a data collection and the second object represents a device.

145. The method of claim 130 wherein the first object and the second object are not directly physically connected to each other.

146. The method of claim 130 wherein the first object is the same device as the second object.

147. The method of claim 130 wherein the portion of the displayed user interface depicts at least a portion of a cable.

148. The method of claim 147 wherein the at least the portion of the cable depicts a plug.

149. The method of claim 148, further comprising:

in response to receiving an indication that the portion of the displayed user interface has been moved near a second object associated with a second one of the devices, displaying a receptor for the plug.

150. The method of claim 130, the establishing the sharing relationship between the first object and the second object further comprising:

establishing a sharing relationship between the first object and the second object such that, when data content associated with the first object changes and the data content associated with the second object is not accessible, recording the change for later synchronization such that, when the data content associated with the second object becomes accessible, the changed data content is automatically reflected in data content associated with the second object.

151. The method of claim 130, further comprising:

displaying a graphical indication of the established sharing relationship in proximity to the first object.

152. The method of claim 151, further comprising:

displaying a graphical indication of the established sharing relationship in proximity to the second object.

153. The method of claim 151 wherein the graphical indication is an indicator that extends between the first object and the second object.

154. The method of claim 153 wherein the indicator is a representation of a colored cable.

155. The method of claim 151 wherein the indicator indicates a two-way sharing relationship.

156. A computer-readable memory medium containing instructions that, when executed, control a computer processor to establish a sharing relationship between collections of data, by:

displaying, in proximity to a first object associated with a first device, a user interface for setting up a data sharing relationship, the user interface capable of establishing a two-way sharing relationship between the first object and a second object by connecting a single portion of the displayed user interface;

receiving an indication that a portion of the displayed user interface has been associated with the second object that is associated with a second one of the devices; and

in response to the received indication, establishing a sharing relationship between the first object and the second object such that, when data content associated with the first object changes, the changed data content is automatically reflected in data content associated with the second object.

157. The memory medium of claim 156, further comprising instructions that, when executed, cause the first and second objects to be displayed in locations that are based upon associated access proximity characteristics.

158. The memory medium of claim 156 wherein the sharing relationship established between the first and second object causes data content to be synchronized between the first and second objects.

159. The memory medium of claim 156, the contained instructions used to share at least one of photographs, images, music, contact information, or multimedia content.

160. The memory medium of claim 156 wherein, when the data content associated with the first object is changed by adding new data content to content associated with the first object, instructions are executed to automatically add the new data content to the data content associated with the second object.

161. The memory medium of claim 156, further comprising instructions that when executed control a computer processor by:

when data content associated with the second object changes, automatically reflecting the changed data content associated with the second object in the data content associated with the first object.

162. The memory medium of claim 156, further comprising instructions that when executed control a computer processor by:

automatically reflecting changed data content associated with the first object by virtual transfer of the changed data content to the data content associated with the second object such that the changed data content is not actually transferred until an attempt to access the virtually transferred changed data content is made.

163. The memory medium of claim 156, further comprising instructions that when executed control a computer processor by:

associating a functional agent with at least one endpoint of the established sharing relationship.

164. The memory medium of claim 156 wherein the functional agent comprises at least one of a send new data agent, a filter and send agent, a receive and store agent, a receive and filter agent, a receive and display agent, or a receive and notify agent.

165. The memory medium of claim 156 wherein the first object and the second object represent data collections.

166. The memory medium of claim 156 wherein the first object and the second object represent devices.

167. The memory medium of claim 166 wherein the devices are physical devices in the real world.

168. The memory medium of claim 156 wherein the first object represents a data collection and the second object represents a device.

169. The memory medium of claim 156 wherein the first device is the same device as the second device.

170. The memory medium of claim 156 wherein the portion of the displayed user interface depicts at least a portion of a cable.

171. The memory medium of claim 156 wherein the portion of the displayed user interface is associated with the second object by performing an input device dragging operation on a representation of a cable.

172. The memory medium of claim 156 wherein, when data content associated with the first object changes and the data content associated with the second object is not accessible, recording the change for later synchronization such that, when the data content associated with the second object becomes accessible, the changed data content is automatically reflected in data content associated with the second object.

173. The memory medium of claim 156, further comprising:
displaying a graphical indication of the established sharing relationship.

174. A computer system, comprising:
a first device having a first data collection;
a second device having a second data collection;
a user interface that is configured to:
display a first object associated with the first device and a second object associated with the second device;
display in proximity to the displayed first object an indicator of a source endpoint for a data sharing relationship;
when the indicator of the source endpoint is associated with the displayed second object, determine whether one-way or two-way directional sharing is desired and automatically establish a data sharing relationship between the first data collection and the second data collection, such that the first data collection is automatically shared with the second data collection according to the determined one-way or two-way directional sharing.

175. The system of claim 174 wherein the first data collection is automatically synchronized with the second data collection in at least one direction by

automatically reflecting in the second data collection changes occurring to the first data collection.

176. The system of claim 175 wherein the first data collection is automatically synchronized in two directions with the second data collection by automatically reflecting in the first data collection changes occurring to the second data collection.

177. The system of claim 174 wherein, when the new data content is added to content associated with the first data collection, the new data content is automatically added to the second data collection.

178. The system of claim 174 wherein the automatic sharing is performed by virtually transfer of changed data content associated with the first data collection to the second data collection.

179. The system of claim 178 wherein actual data transfer of the changed data content associated with the first data collection occurs when a user attempts to access the virtually transferred changed data content.

180. The system of claim 174, the user interface further configured to:

associate a functional agent with at least one endpoint of the established sharing relationship.

181. The system of claim 174 wherein the functional agent comprises at least one of a send new data agent, a filter and send agent, a receive and store agent, a receive and filter agent, a receive and display agent, or a receive and notify agent.

182. The system of claim 174 wherein the user interface is further configured to display in proximity to the displayed second object an indicator of a target endpoint for the data sharing relationship.

183. The system of claim 182 wherein the indicator of the target endpoint represents a receptacle for a plug.

184. The system of claim 174 wherein the user interface is further configured to display a sharing indicator between the displayed first object and the displayed second object, thereby indicating the establishment of the sharing relationship between the first data collection and the second data collection.

185. The system of claim 184 wherein the sharing indicator is a representation of a cable that appears to link the first object and the second object.

186. The system of claim 185 wherein the sharing indicator represents a colored cable.

187. The system of claim 174 wherein the first and second objects are displayed in locations that are based upon associated access proximity characteristics.

188. The system of claim 174 wherein the synchronized sharing relationship is established to share at least one of photographs, images, music, contact information, or multimedia content.

189. The system of claim 174 wherein the first object and the second object represent the first data collection and second data collection, respectively.

190. The system of claim 174 wherein the first object and the second object represent the first device and the second device, respectively.

191. The system of claim 174 wherein the first object represents a data collection and the second object represents a device.

192. The system of claim 174 wherein the first device and the second device are connected via a network.

193. The system of claim 174 wherein the first device is the same device as the second device.

194. The system of claim 174 wherein the indicator of the source endpoint depicts a plug of a cable.

195. The system of claim 174 wherein the portion of the displayed user interface is associated with the second object by performing an input device dragging operation on a representation of a cable.

196. The system of claim 174, the user interface further configured to:

when data content associated with the first data collection changes and the second data collection is not accessible, recording the change for later synchronization such that, when the second data collection becomes accessible, the changed data content is automatically reflected in the second data collection.

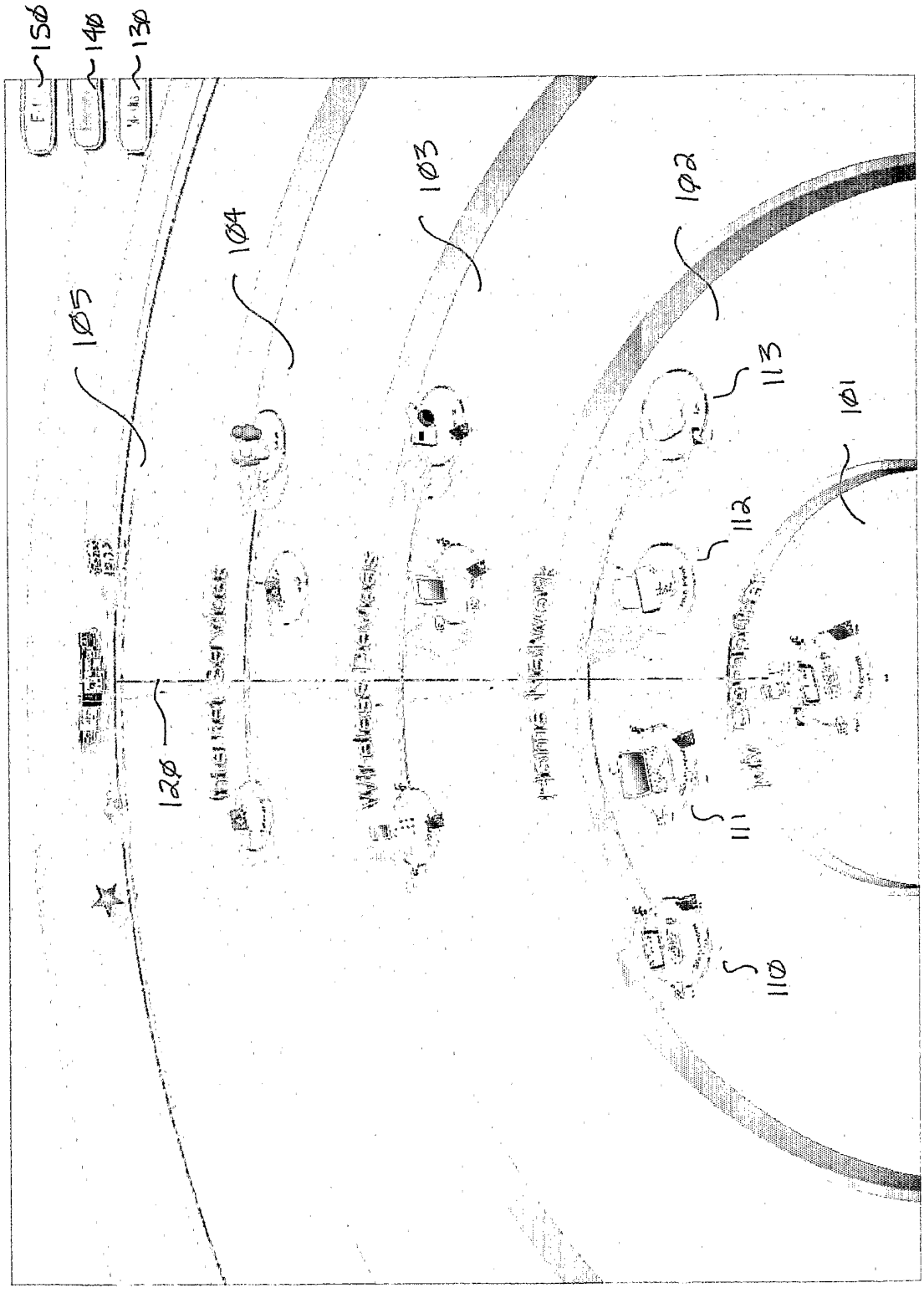

Fig. 1

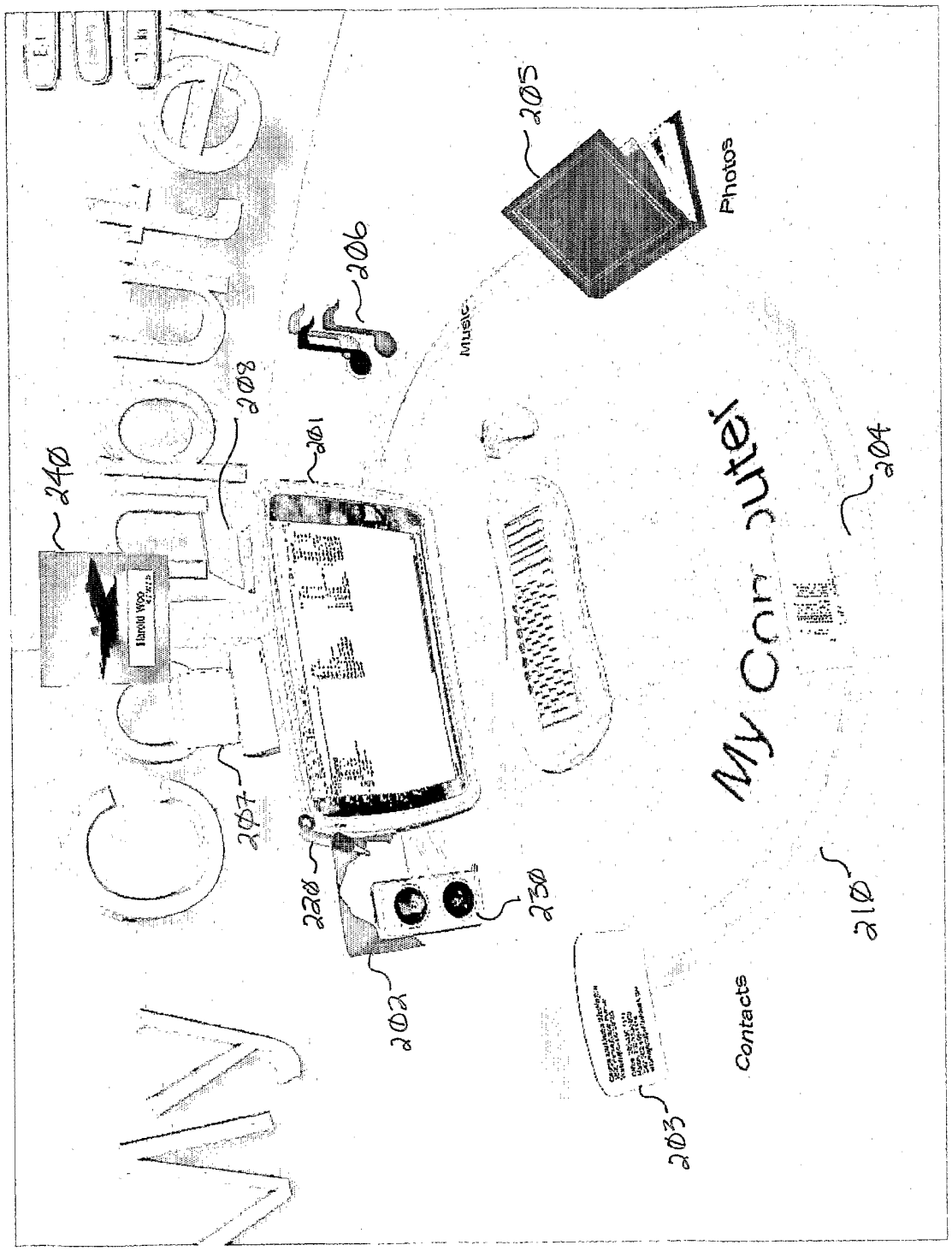
My Computer
Photos
Contacts
240
208
201
206
205
207
220
230
202
203
204
210

Fig. 2

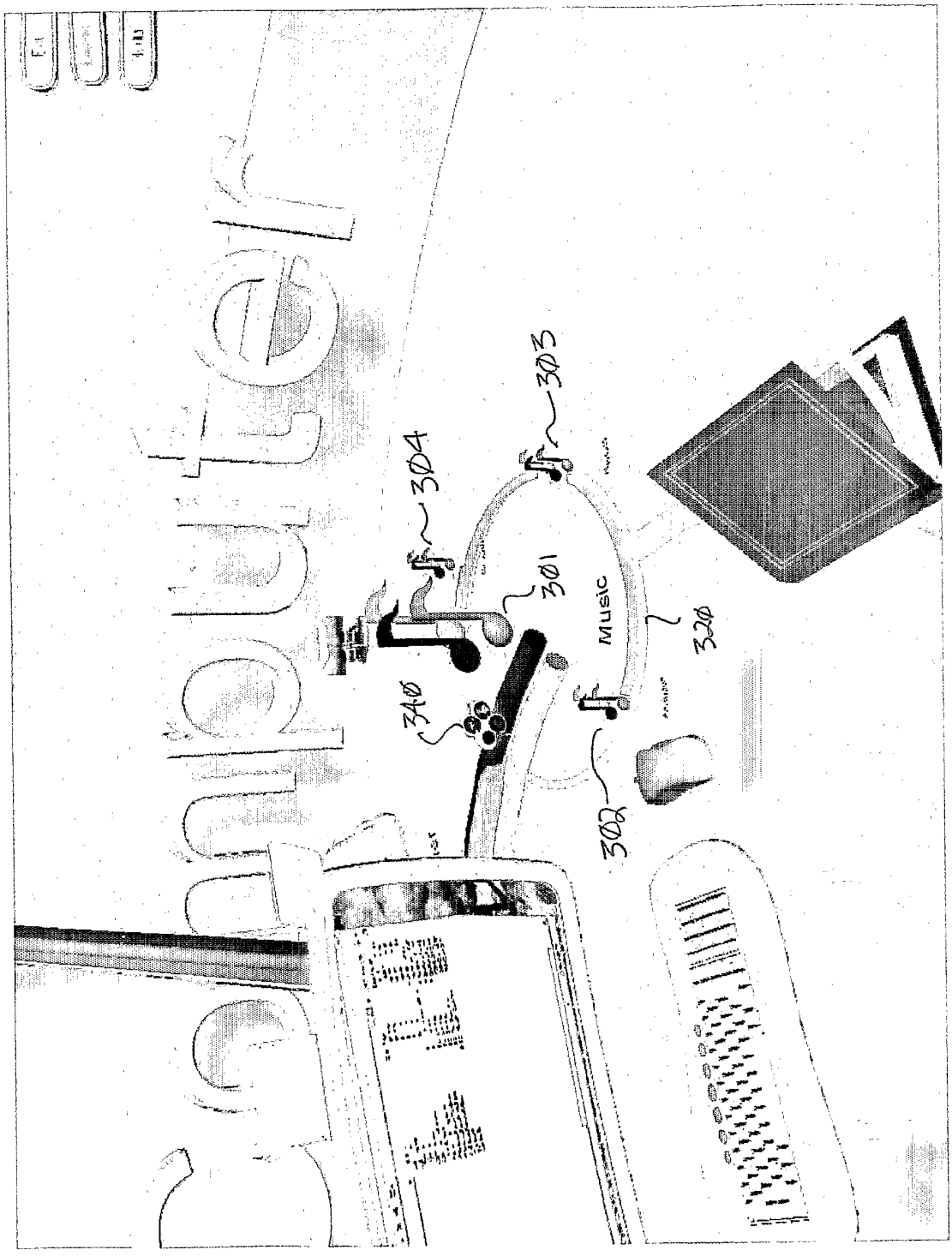

Fig. 3

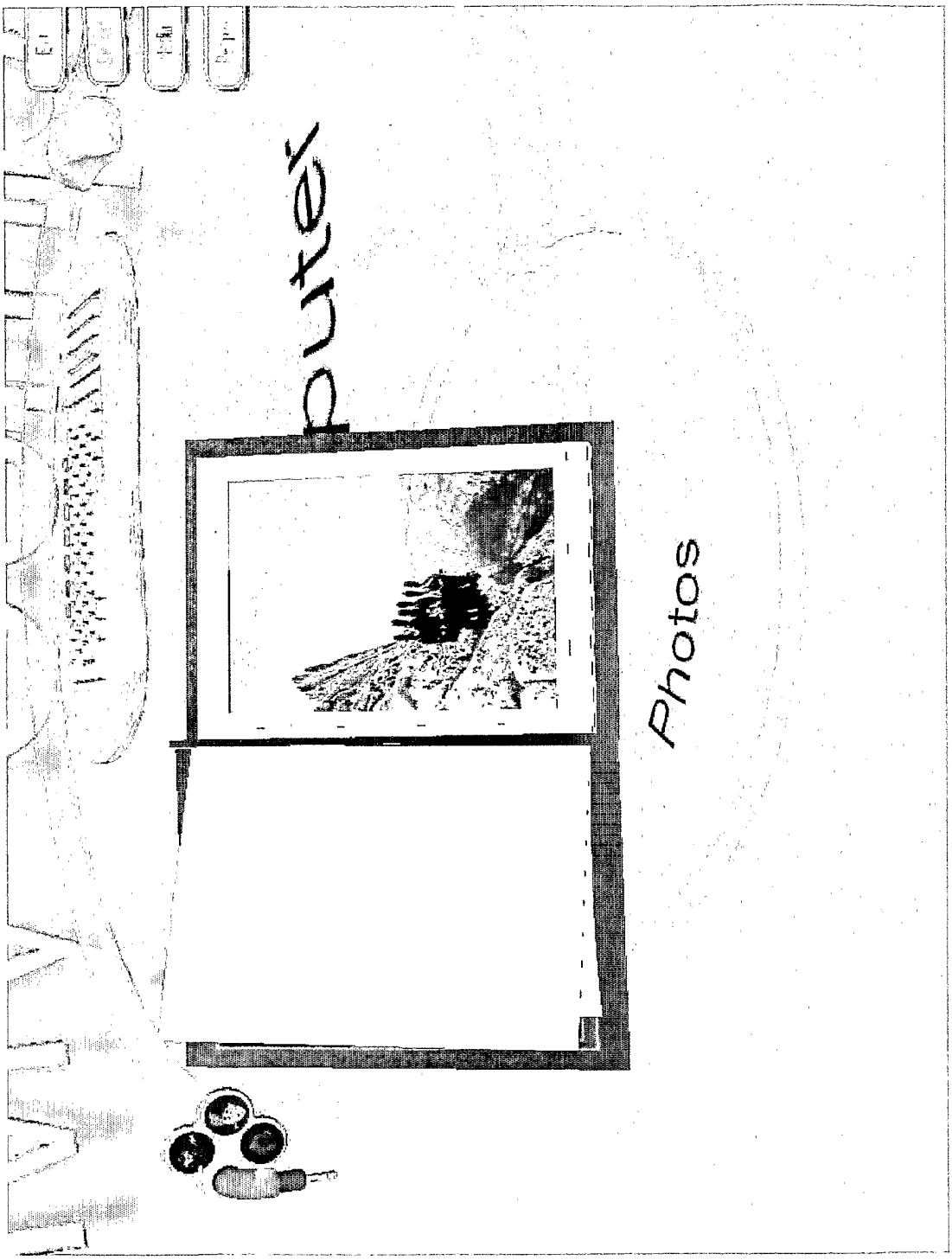

Fig. 4A

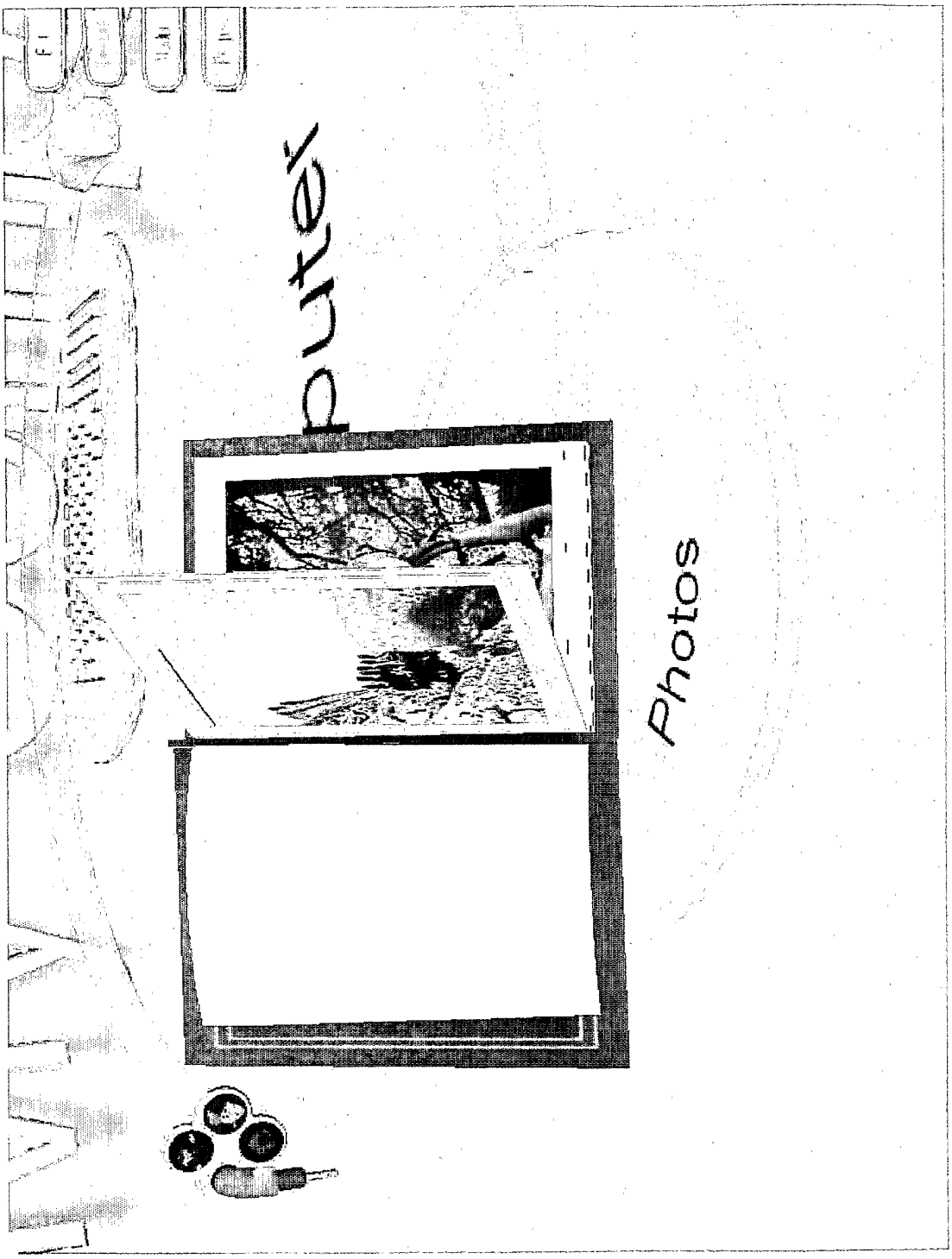

Fig. 4B

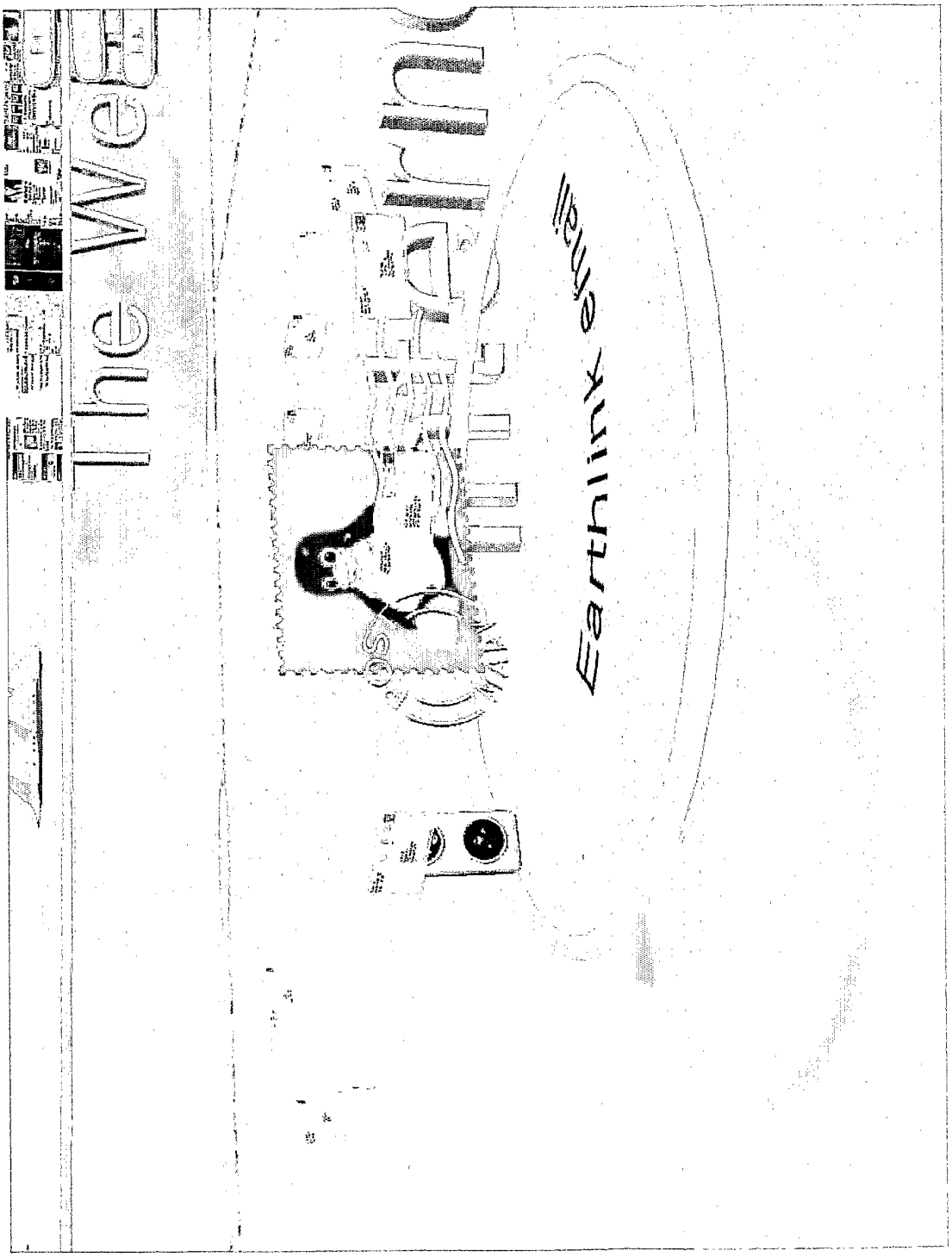

Fig. 5

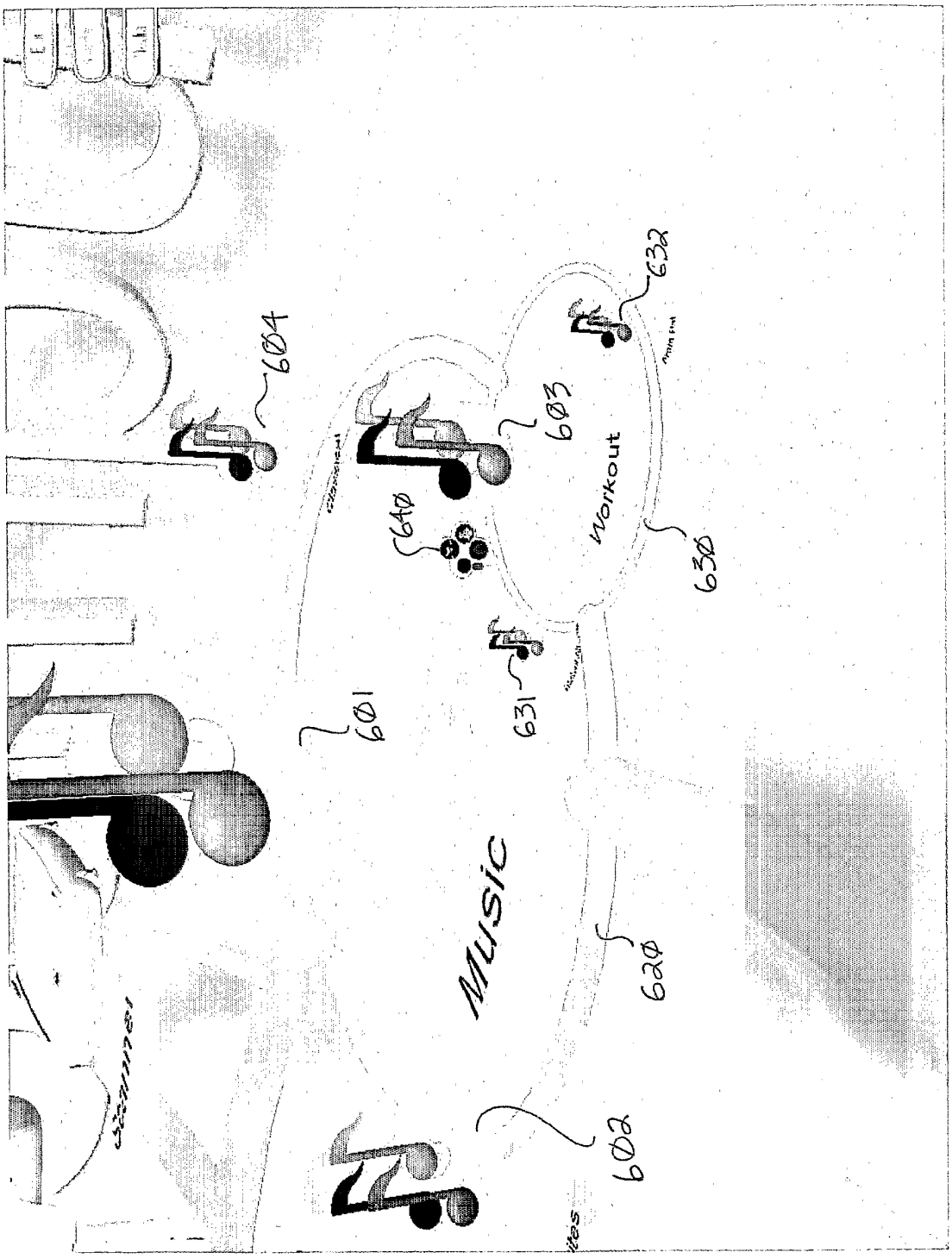

Fig. 6

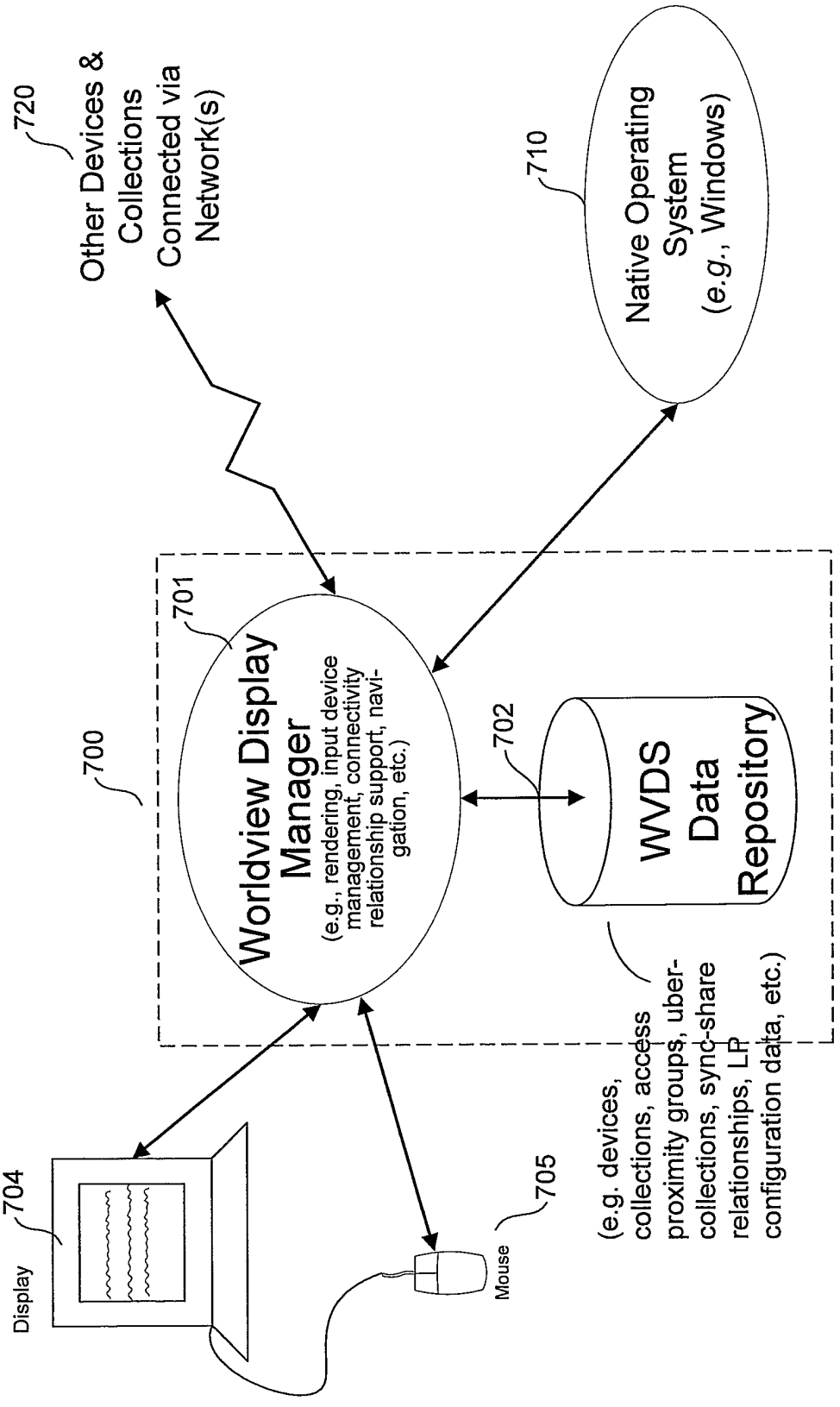
720
Other Devices & Collections Connected via Network(s)
710
Native Operating System (e.g., Windows)
700
701
Worldview Display Manager
(e.g., rendering, input device management, connectivity relationship support, navigation, etc.)
702
WVDS Data Repository
(e.g. devices, collections, access proximity groups, uber-collections, sync-share relationships, LP configuration data, etc.)
704
Display
705
Mouse

Fig. 7

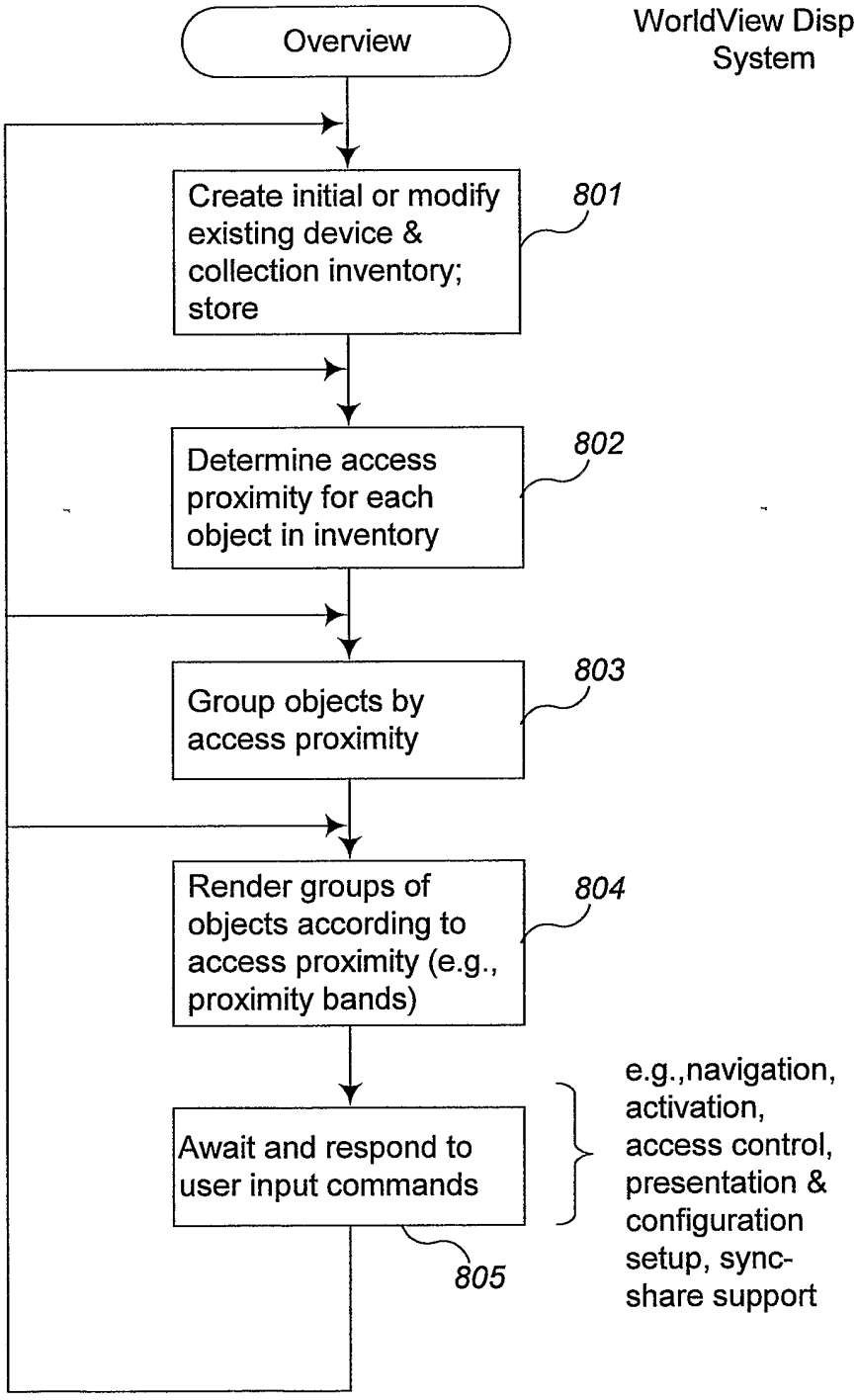
Overview
WorldView Display System
Create initial or modify existing device & collection inventory; store
801
Determine access proximity for each object in inventory
802
Group objects by access proximity
803
Render groups of objects according to access proximity (e.g., proximity bands)
804
Await and respond to user input commands
805
e.g.,navigation, activation, access control, presentation & configuration setup, sync-share support

Fig. 8

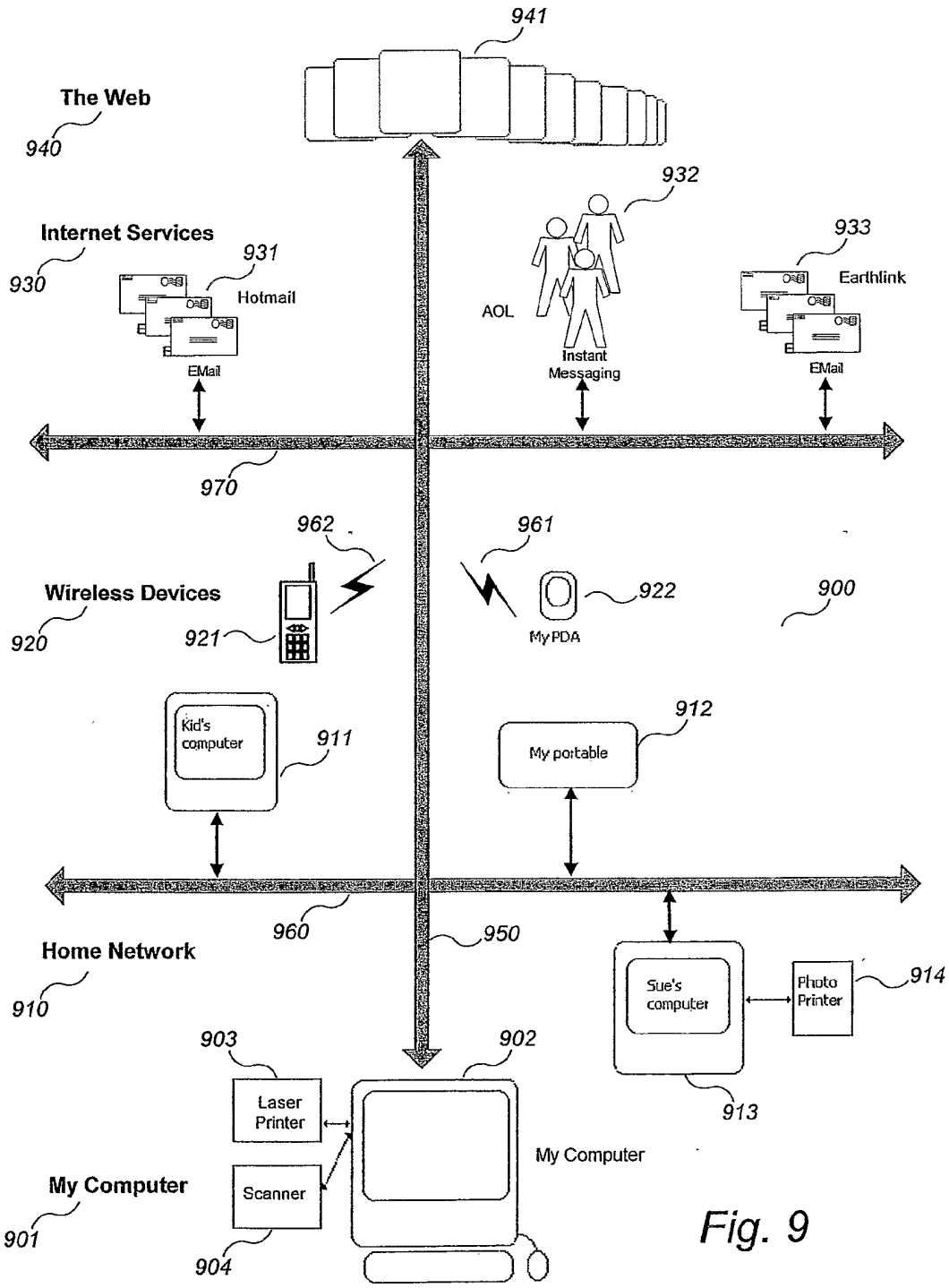
941
The Web
940
932
Internet Services
930
931
Hotmail
933
Earthlink
AOL
Instant Messaging
EMail
EMail
970
962
961
Wireless Devices
920
921
922
900
My PDA
Kid's computer
911
912
My portable
960
950
Home Network
910
Sue's computer
Photo Printer
914
903
902
Laser Printer
My Computer
Scanner
913
My Computer
901
904

Fig. 9

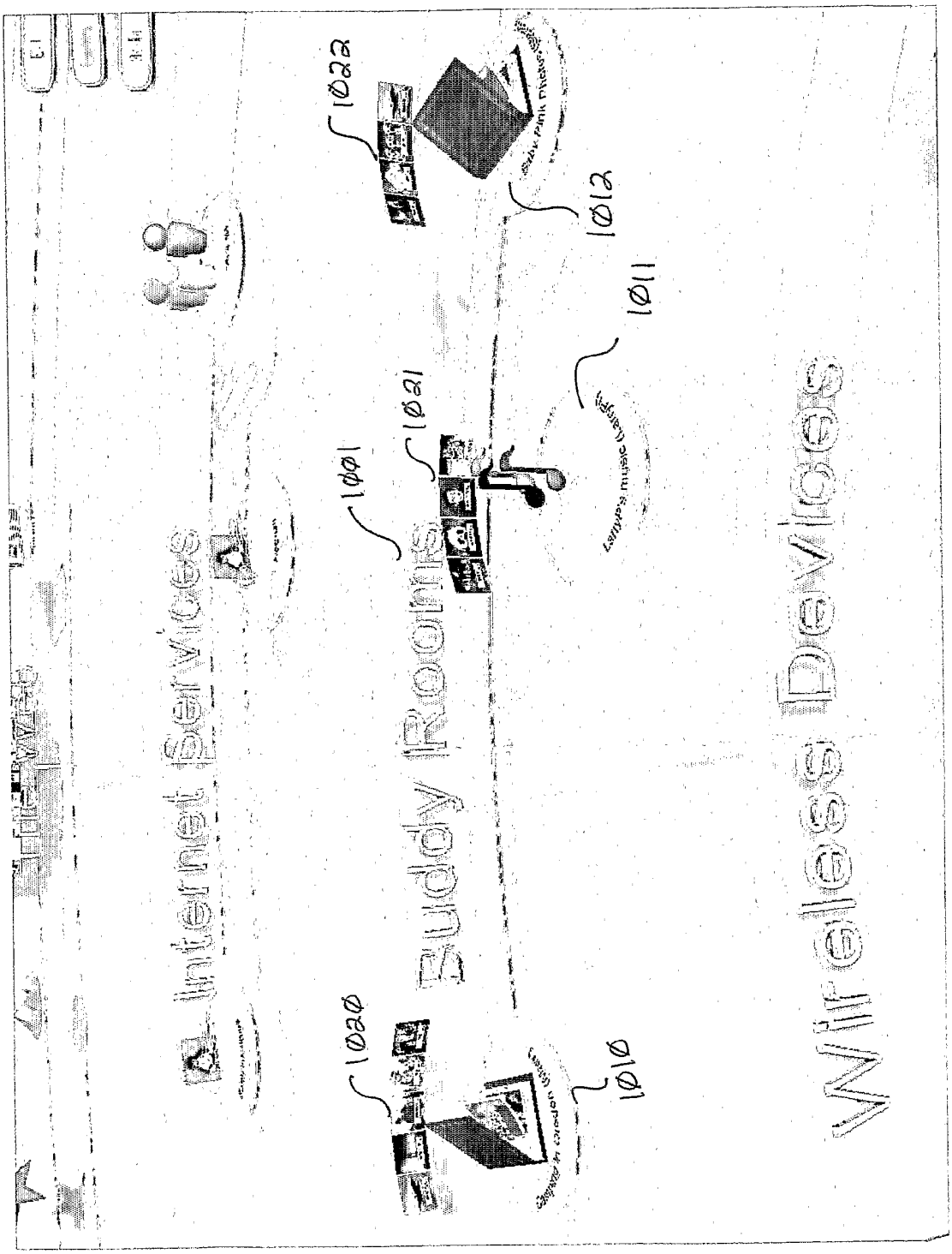
Internet Services
Buddy Rooms
Wireless Devices
1000
1001
1011
1012
1016
1021
1022

Fig. 10

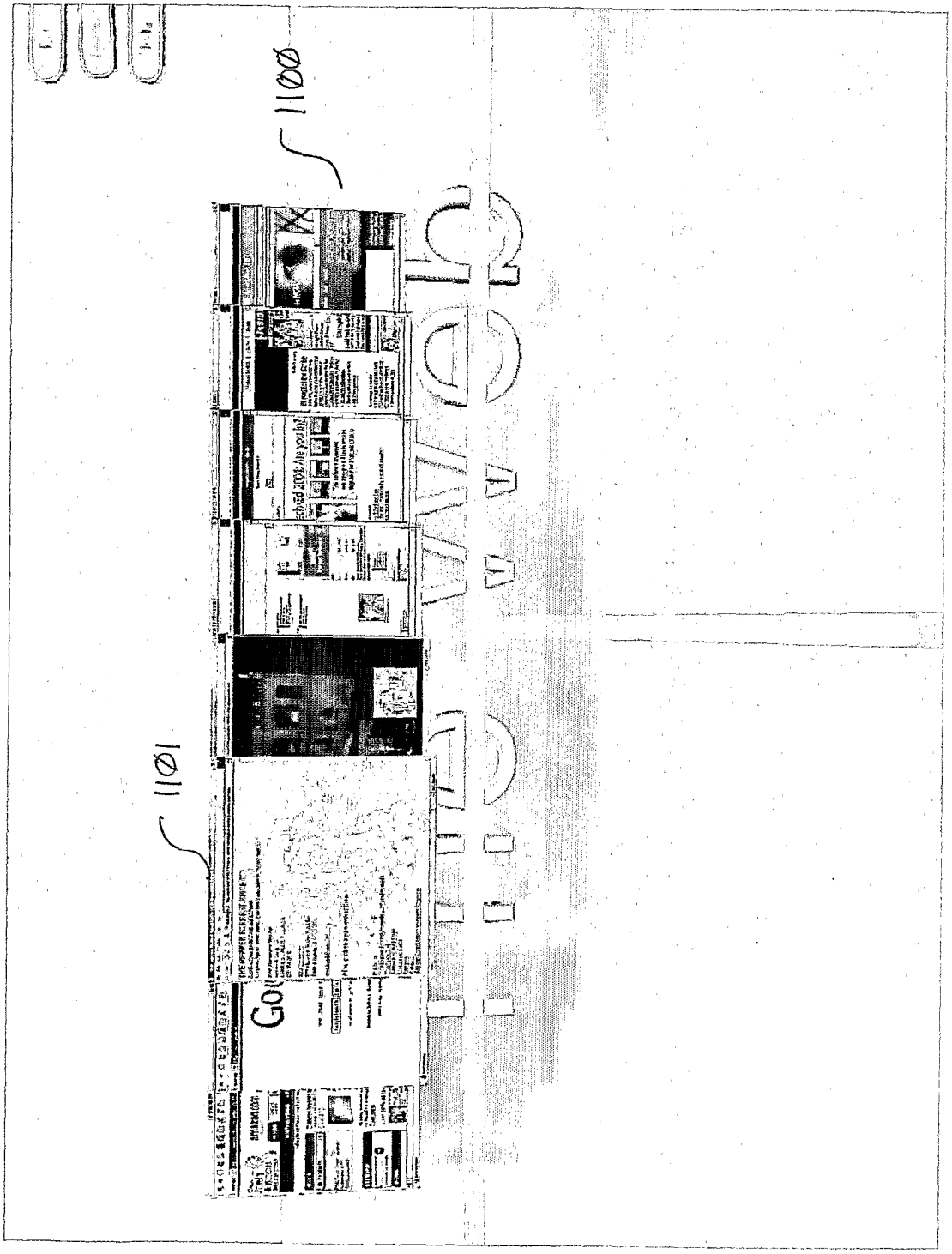

Fig. 11

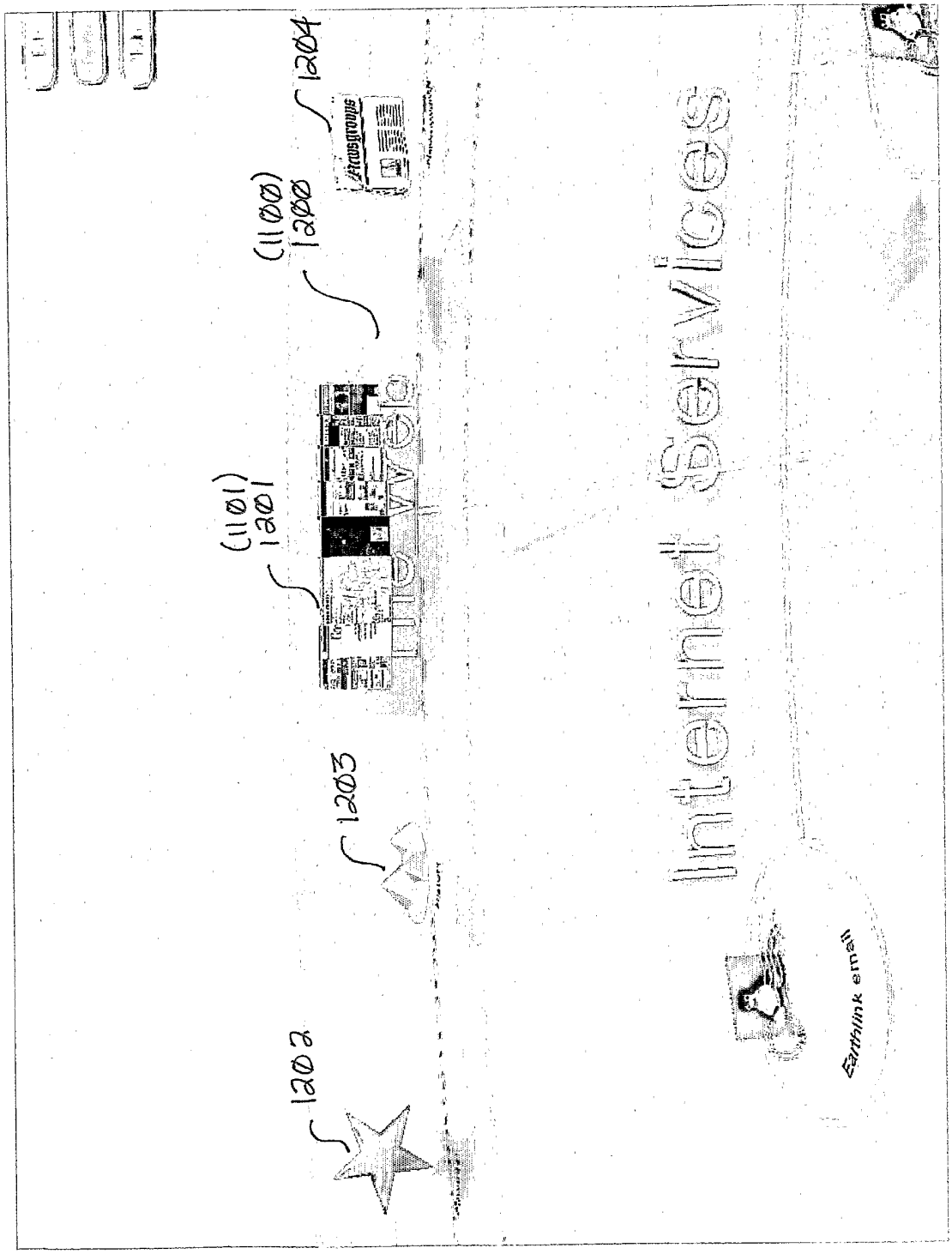
1202
1203
(1101)
1201
(1100)
1200
1204
Internet services
Sunlink email

Fig. 12

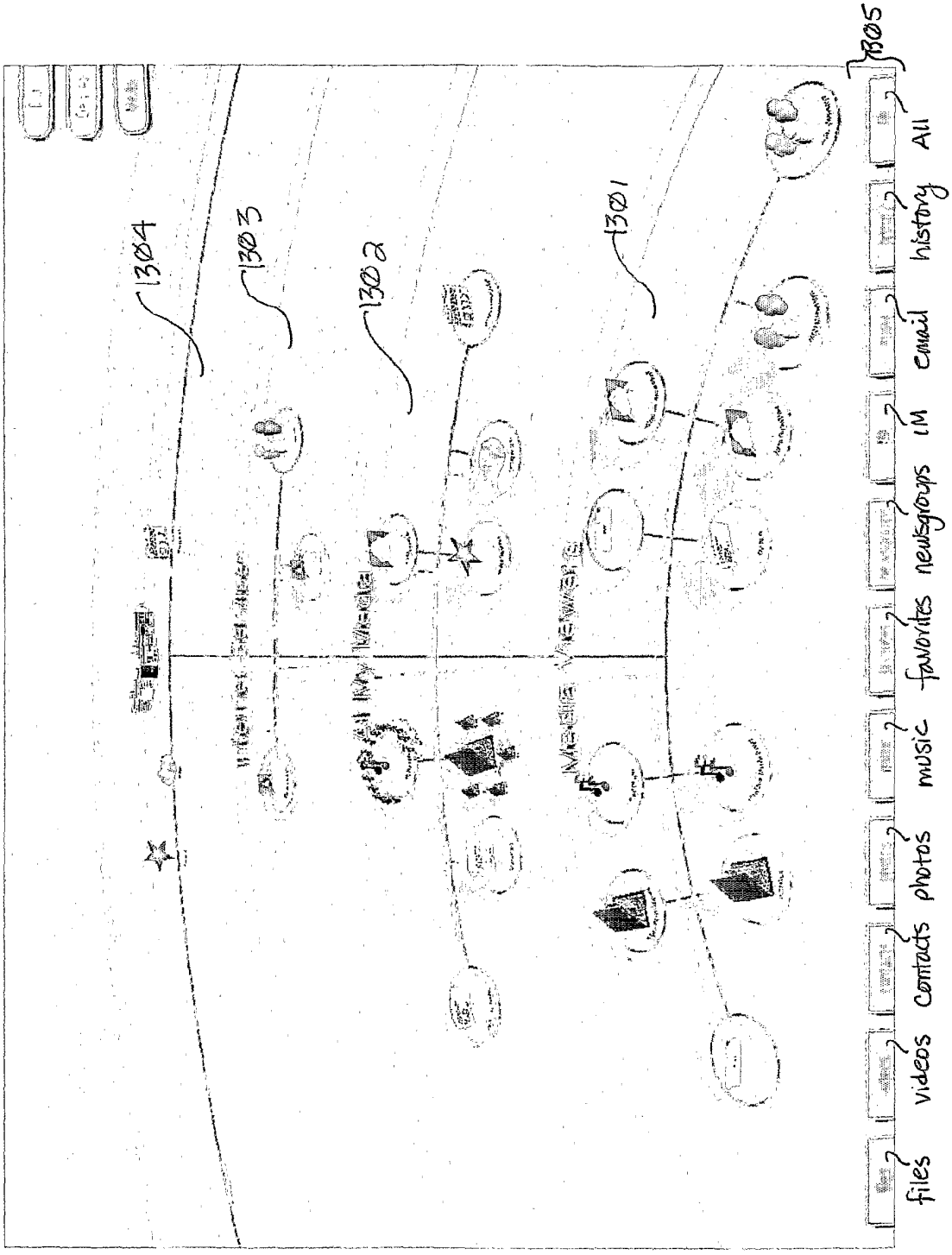
1304
1303
1302
1301
1305
files
videos
contacts
photos
music
favorites
newsgroups
IM
email
history
All

Fig. 13

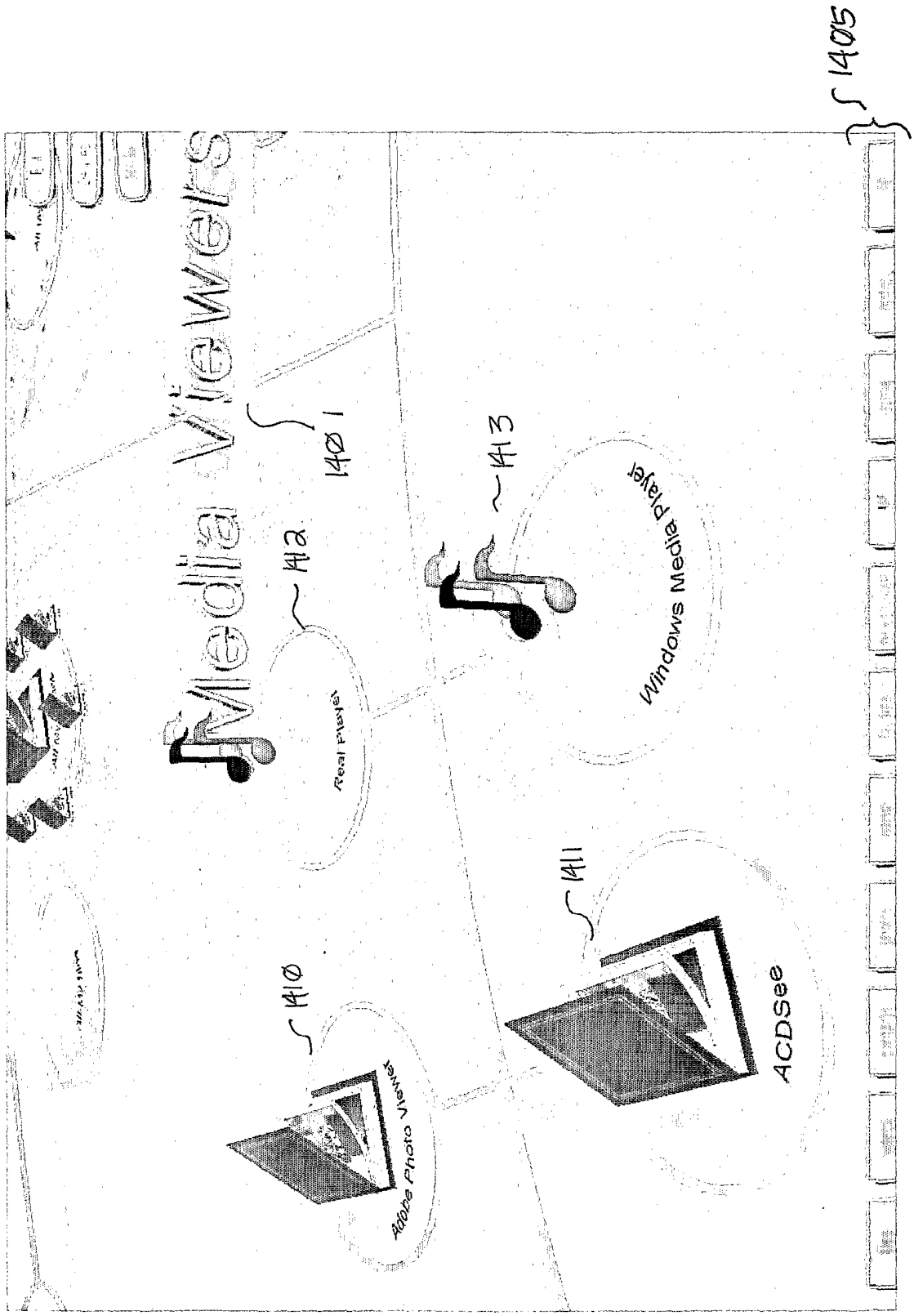
1405
Media Viewers
1401
1412
Real Player
1413
Windows Media Player
1410
Adobe Photo Viewer
1411
ACDSee

Fig. 14

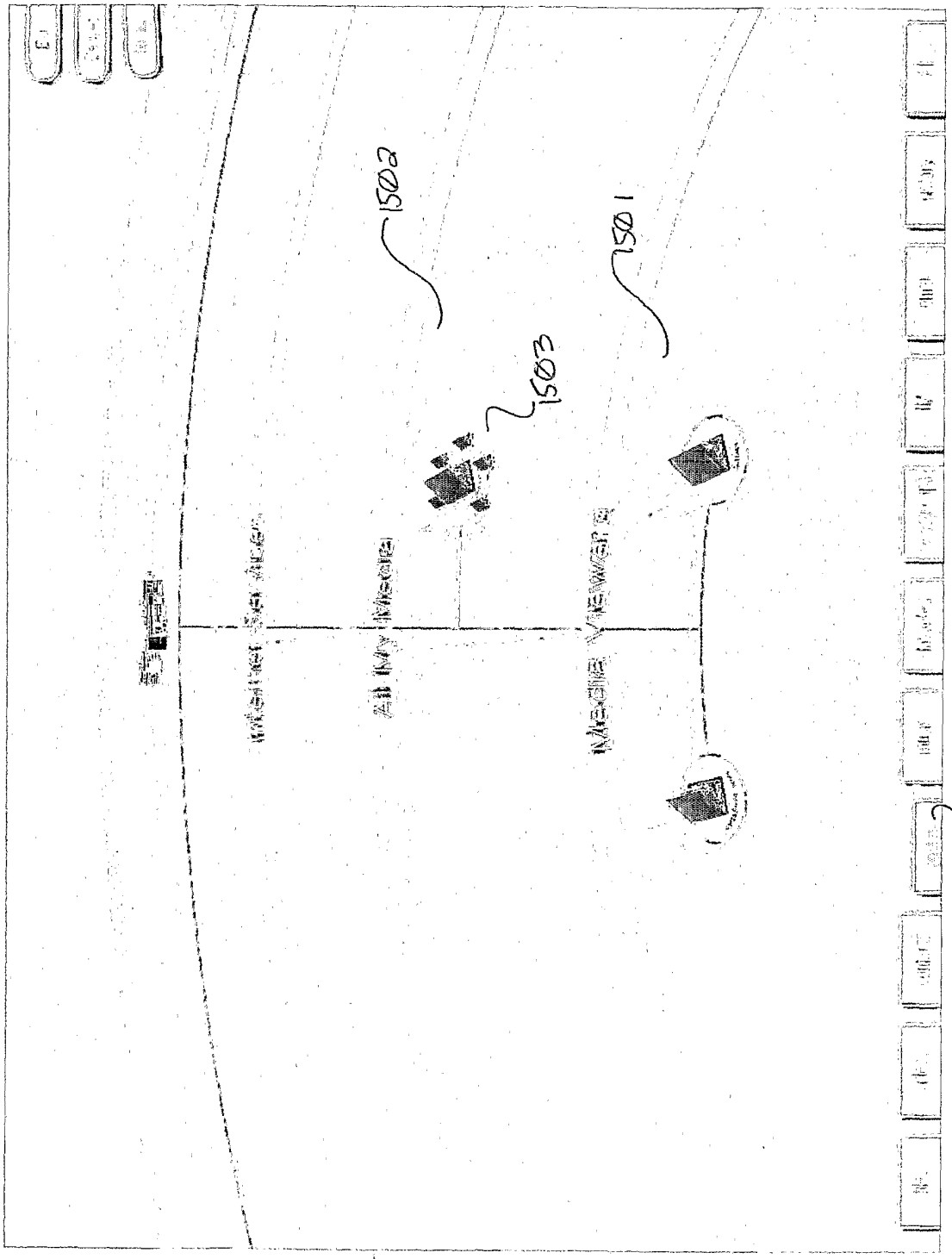

Fig. 15

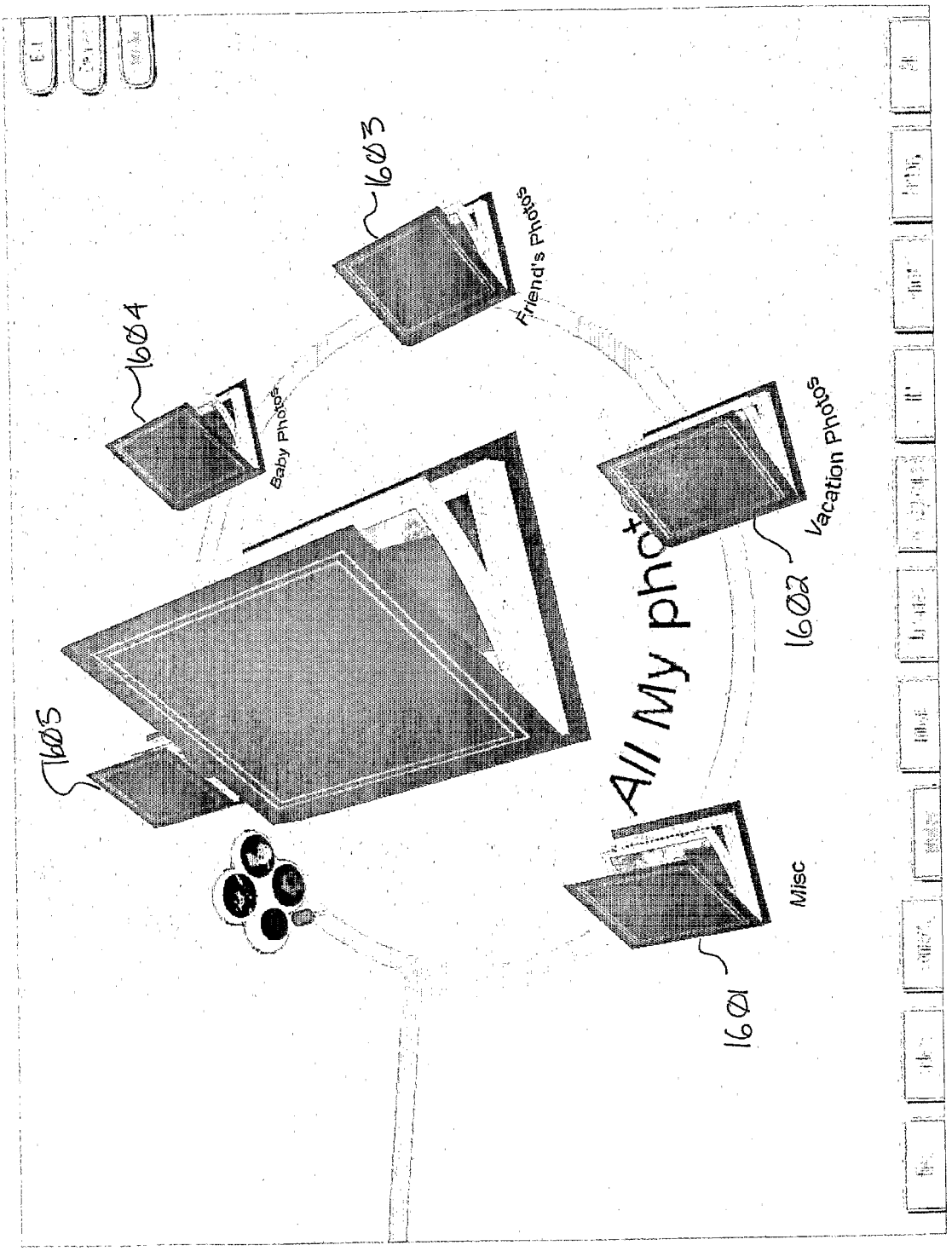
All My photos
Misc
Vacation Photos
Friend's Photos
Baby Photos
1601
1602
1603
1604
1605

Fig. 16

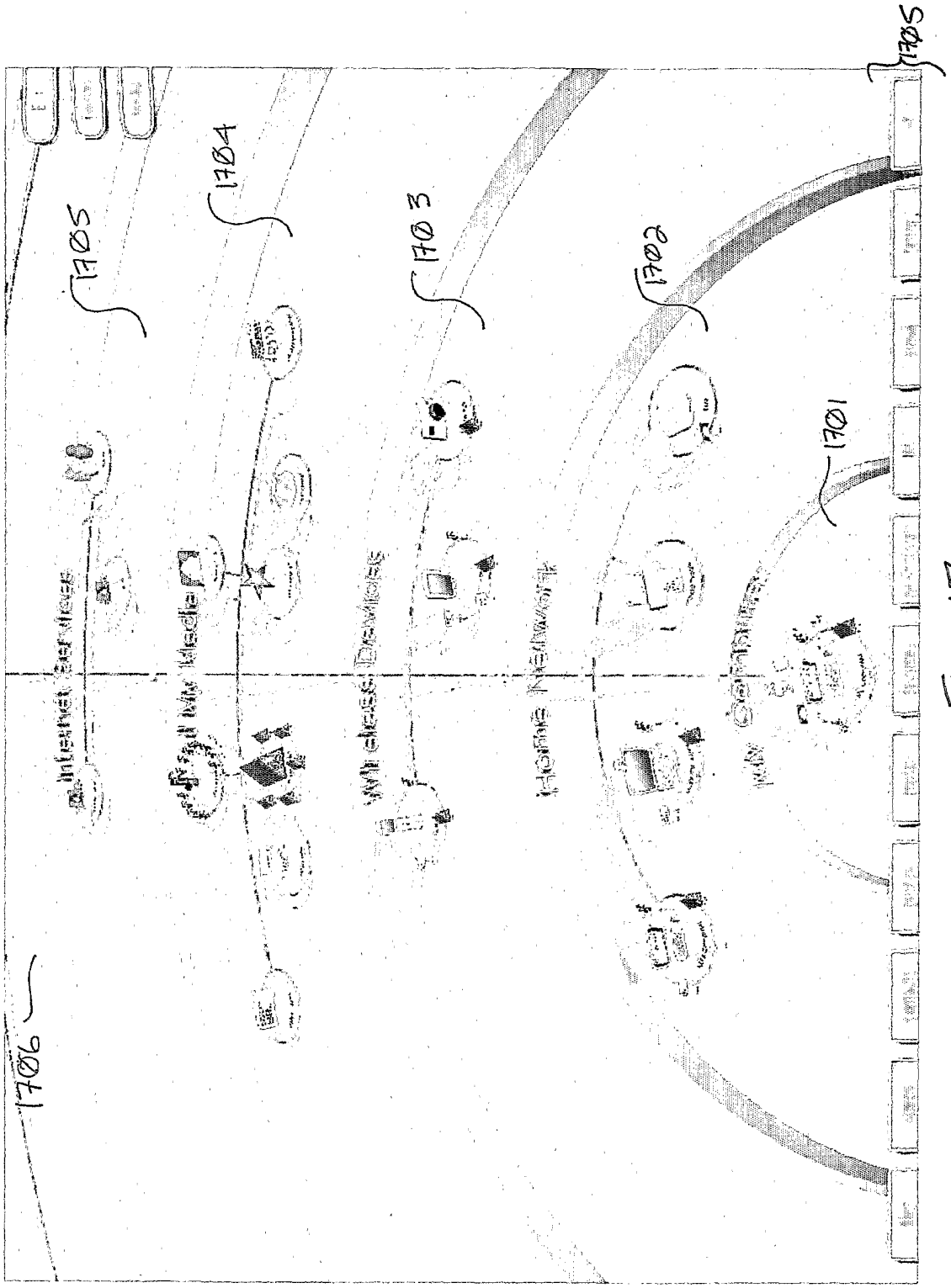
1705
1704
1703
1702
1701
1706
1705
Internet Services
Wireless Devices
Home Network

Fig. 17

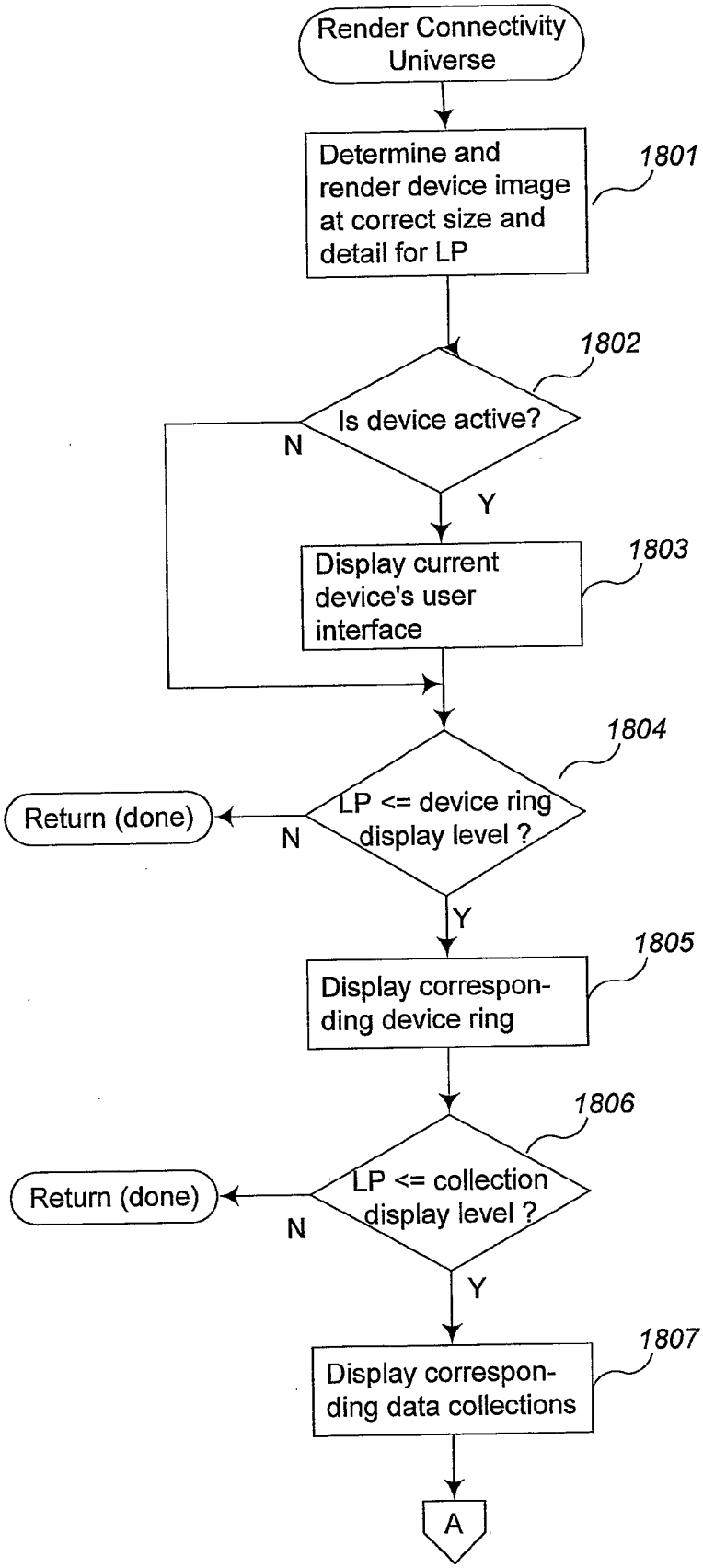
Render Connectivity Universe
Determine and render device image at correct size and detail for LP
1801
1802
Is device active?
N
Y
Display current device's user interface
1803
1804
LP <= device ring display level ?
Return (done)
N
Y
1805
Display correspon-ding device ring
1806
LP <= collection display level ?
Return (done)
N
Y
1807
Display correspon-ding data collections
A

Fig. 18A

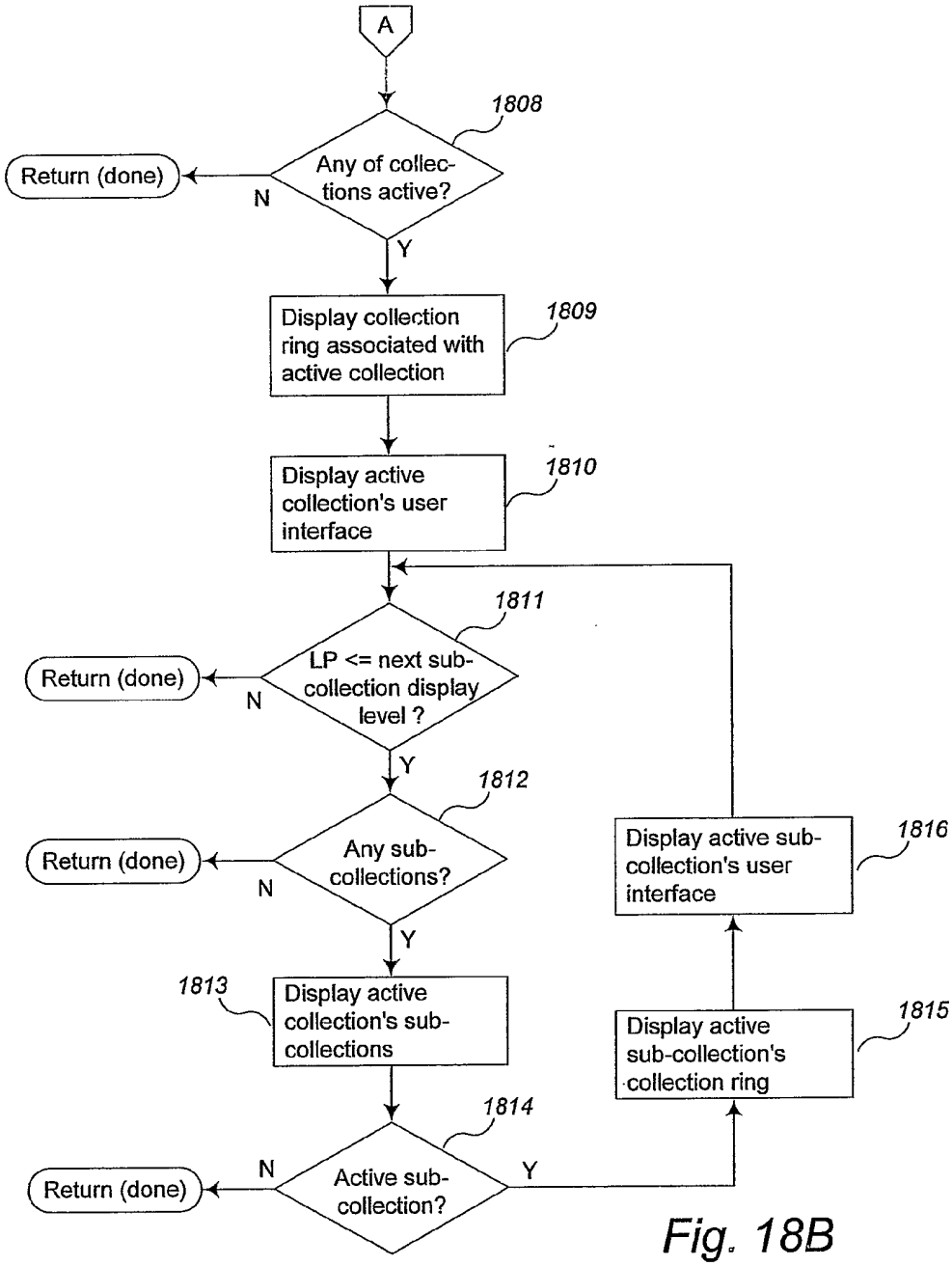
A
1808
Any of collections active?
N
Return (done)
Y
1809
Display collection ring associated with active collection
1810
Display active collection's user interface
1811
LP <= next sub-collection display level ?
N
Return (done)
Y
1812
Any sub-collections?
N
Return (done)
Y
1813
Display active collection's sub-collections
1814
Active sub-collection?
N
Return (done)
Y
1815
Display active sub-collection's collection ring
1816
Display active sub-collection's user interface

Fig. 18B

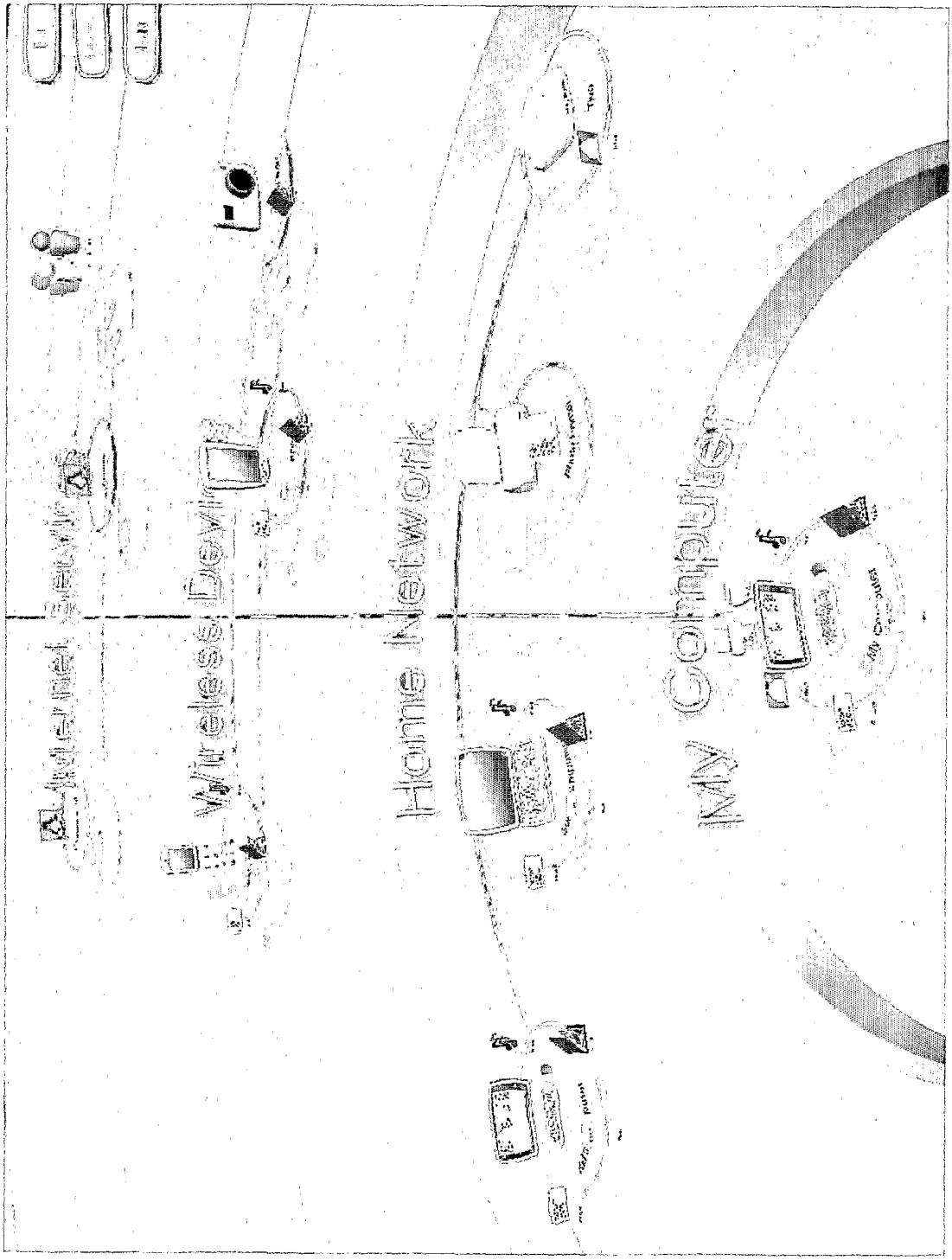

Fig. 19

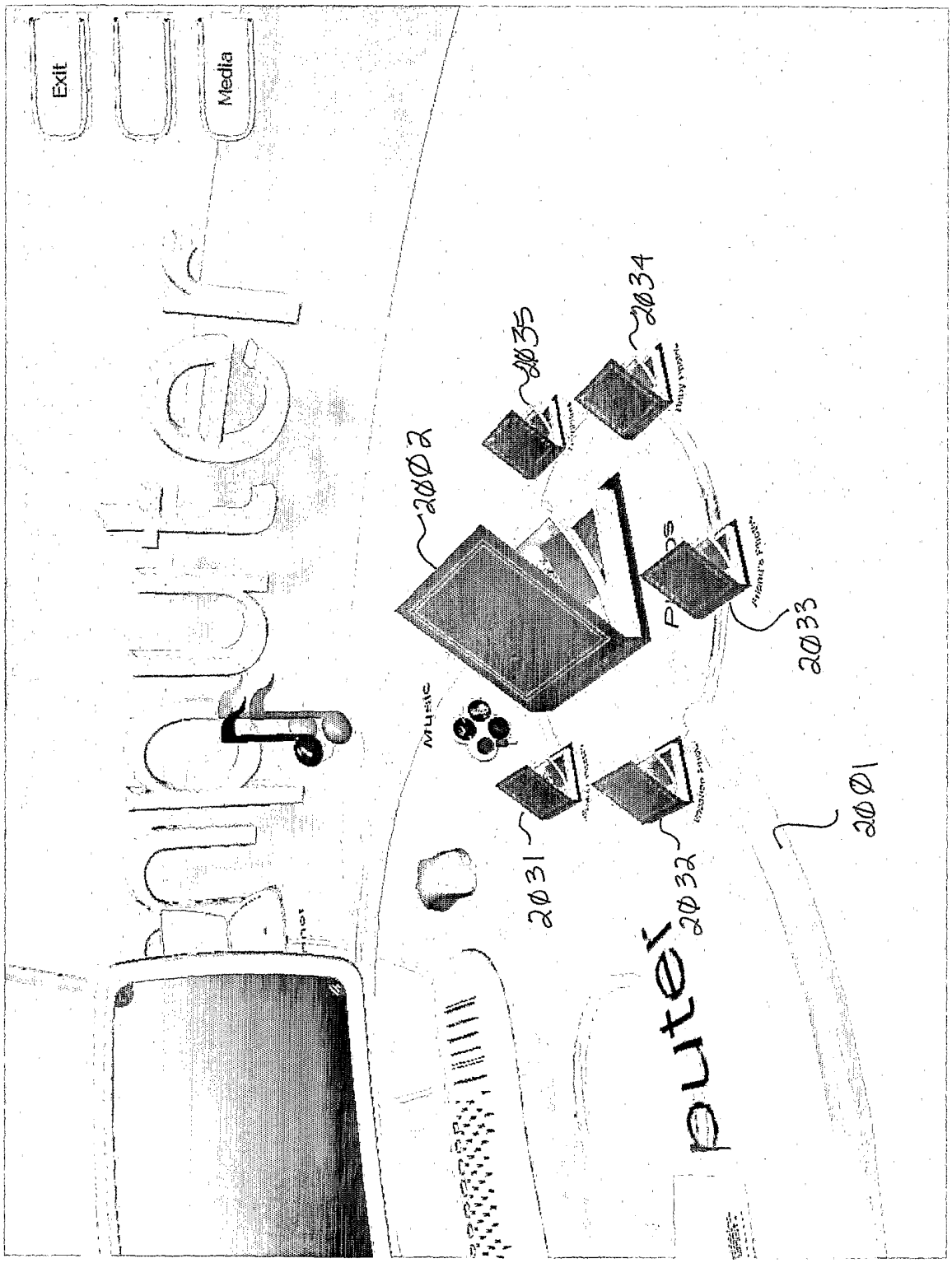

Fig. 20

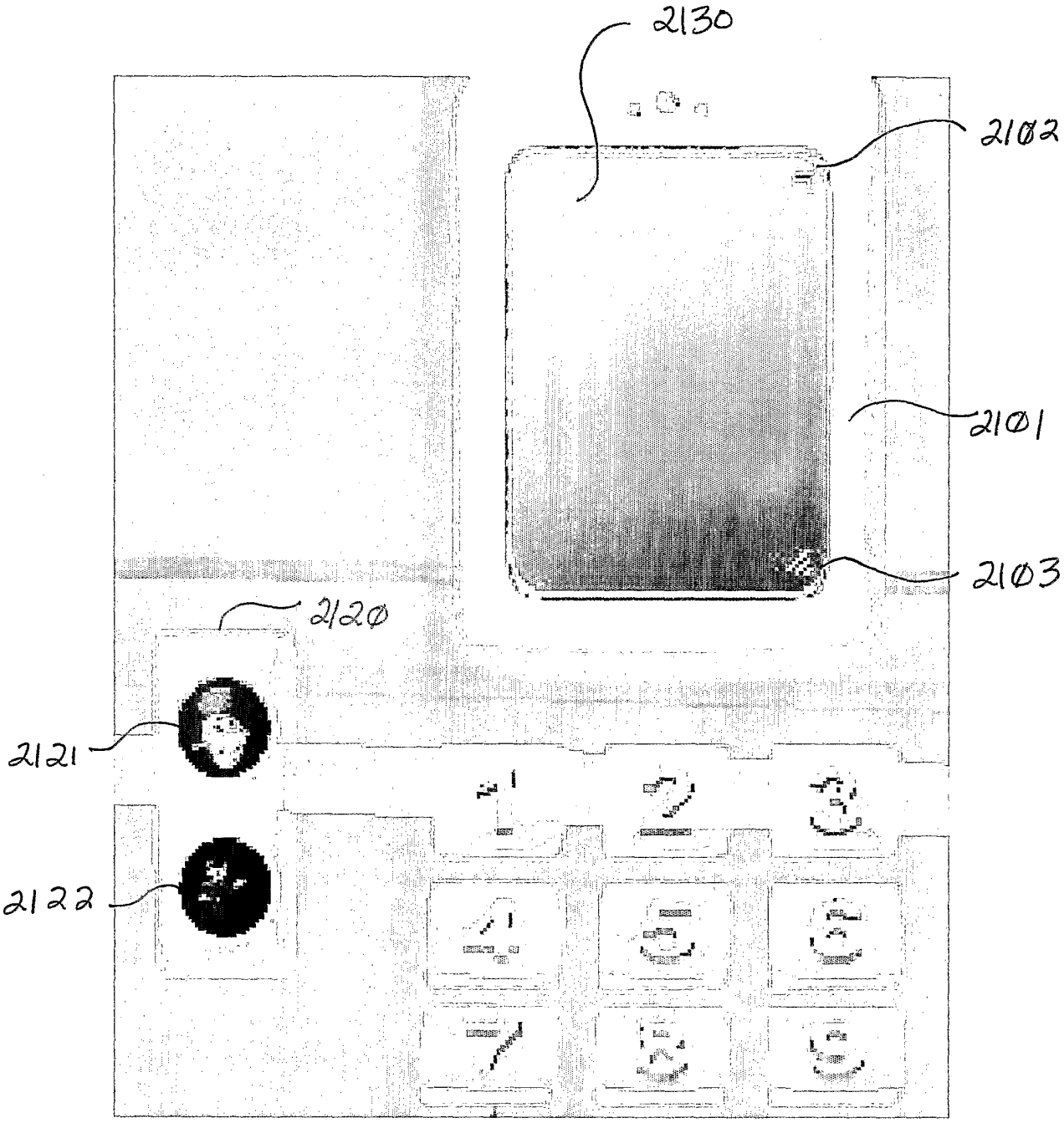

Fig. 21

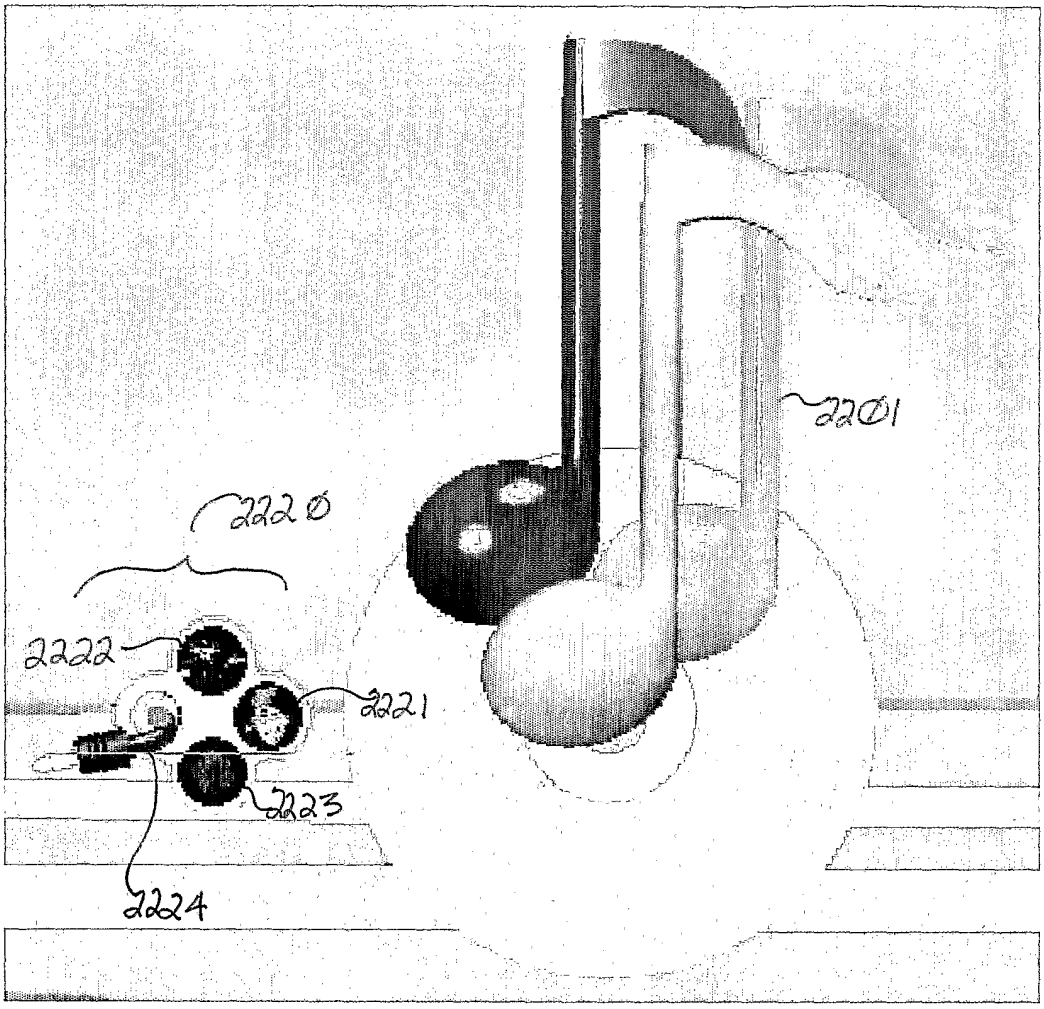

Fig. 22

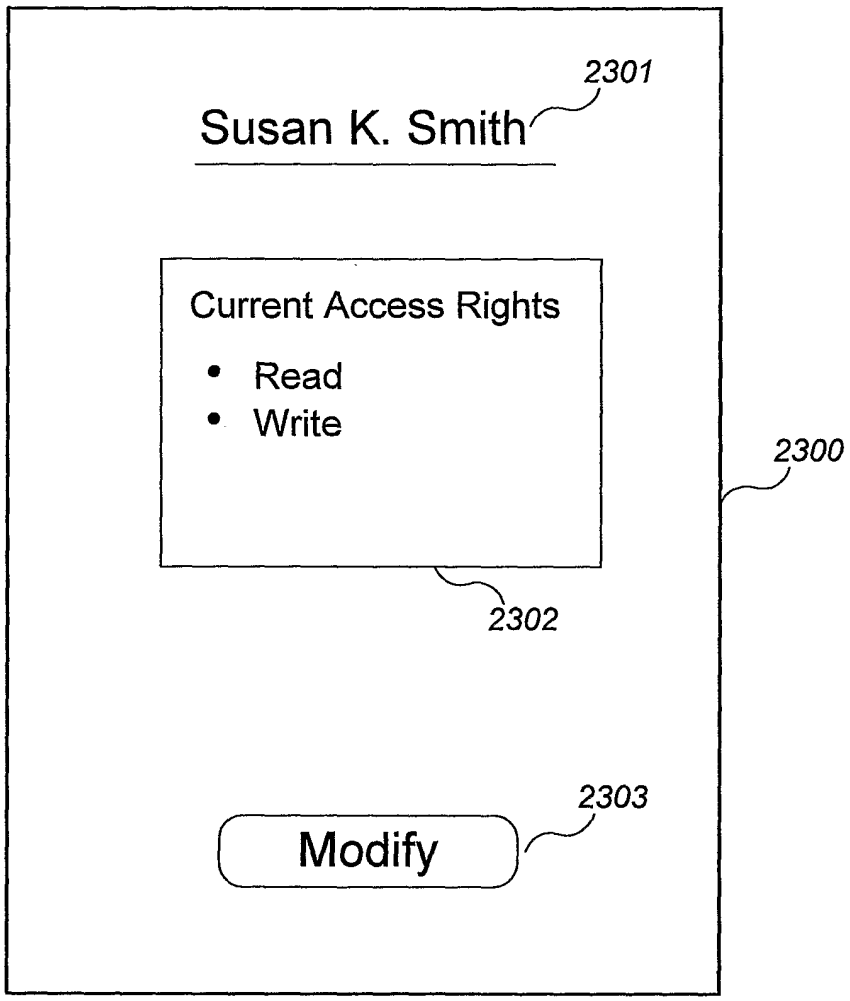
2301
Susan K. Smith
Current Access Rights
• Read
• Write
2300
2302
2303
Modify

Fig. 23

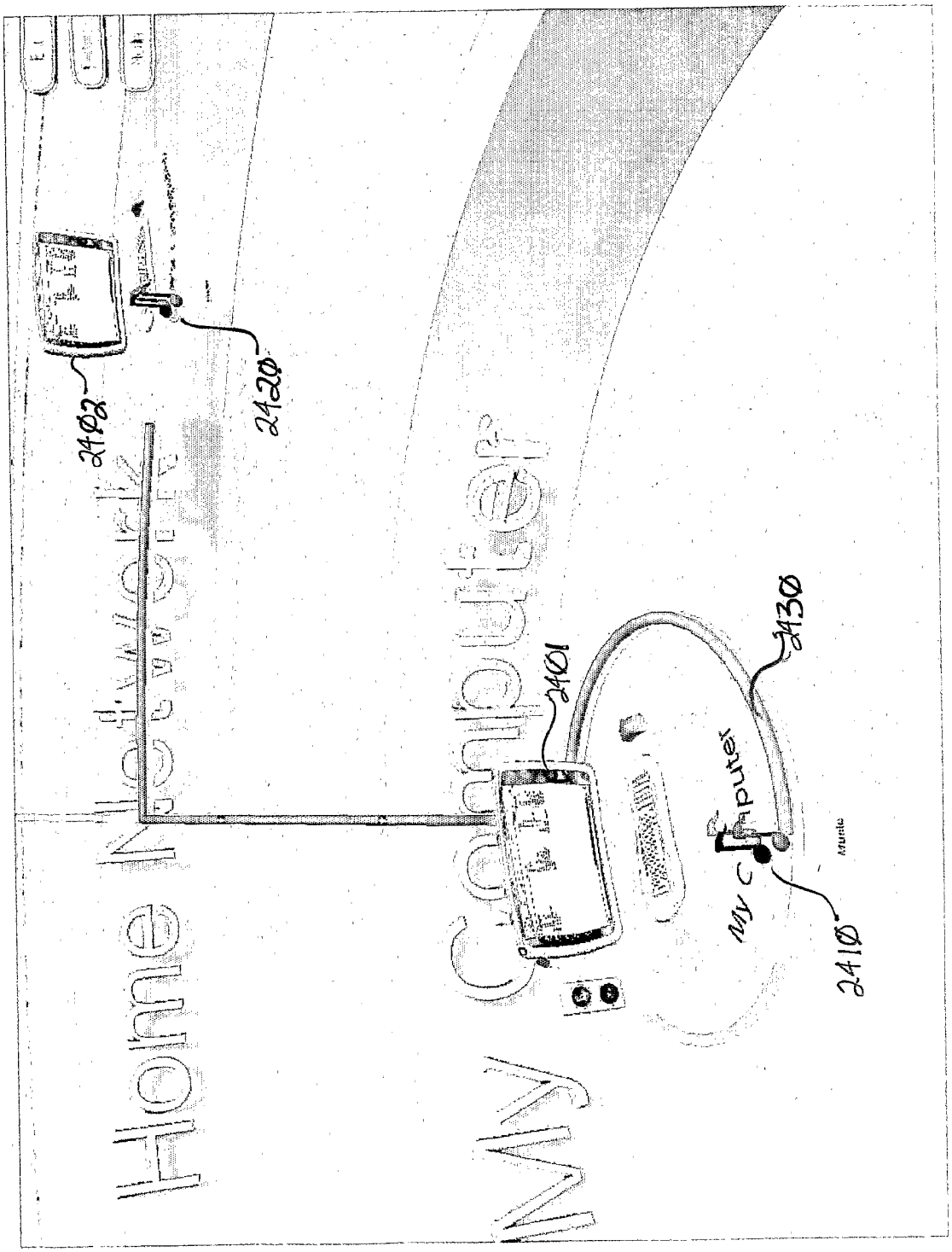

Fig. 24

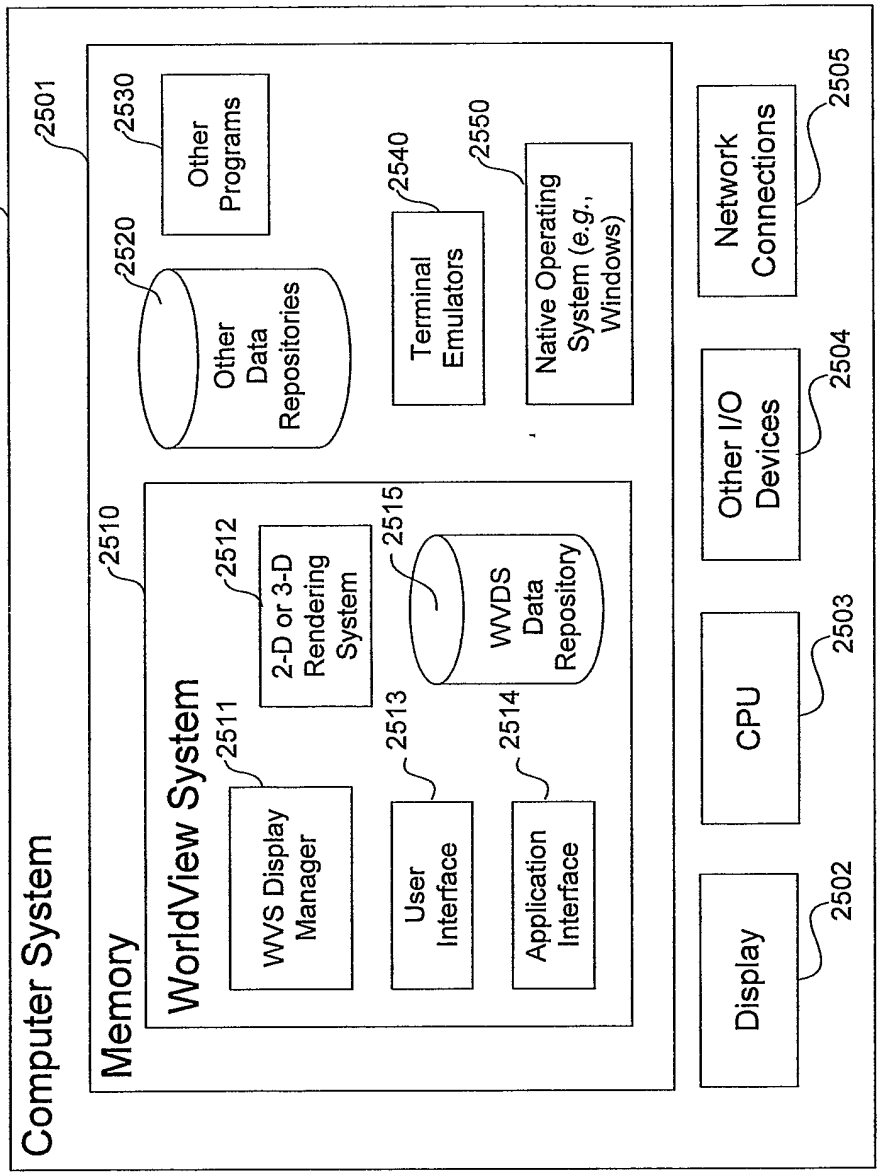
Computer System
2500
2501
Memory
2510
WorldView System
2511
WVS Display Manager
2512
2-D or 3-D Rendering System
2513
User Interface
2514
Application Interface
2515
WVDS Data Repository
2520
Other Data Repositories
2530
Other Programs
2540
Terminal Emulators
2550
Native Operating System (e.g., Windows)
Display
2502
CPU
2503
Other I/O Devices
2504
Network Connections
2505

Fig. 25