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(54) EMBEDDING WEB ACCESS FUNCTIONALITY INTO A DEVICE FOR USER INTERFACE FUNCTIONS

(76) Inventors: **Chandrasekar Venkatraman**, Fremont, CA (US); **Jeffrey A. Morgan**, Cupertino, CA (US)

Correspondence Address:
HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, CO 80528-9599 (US)

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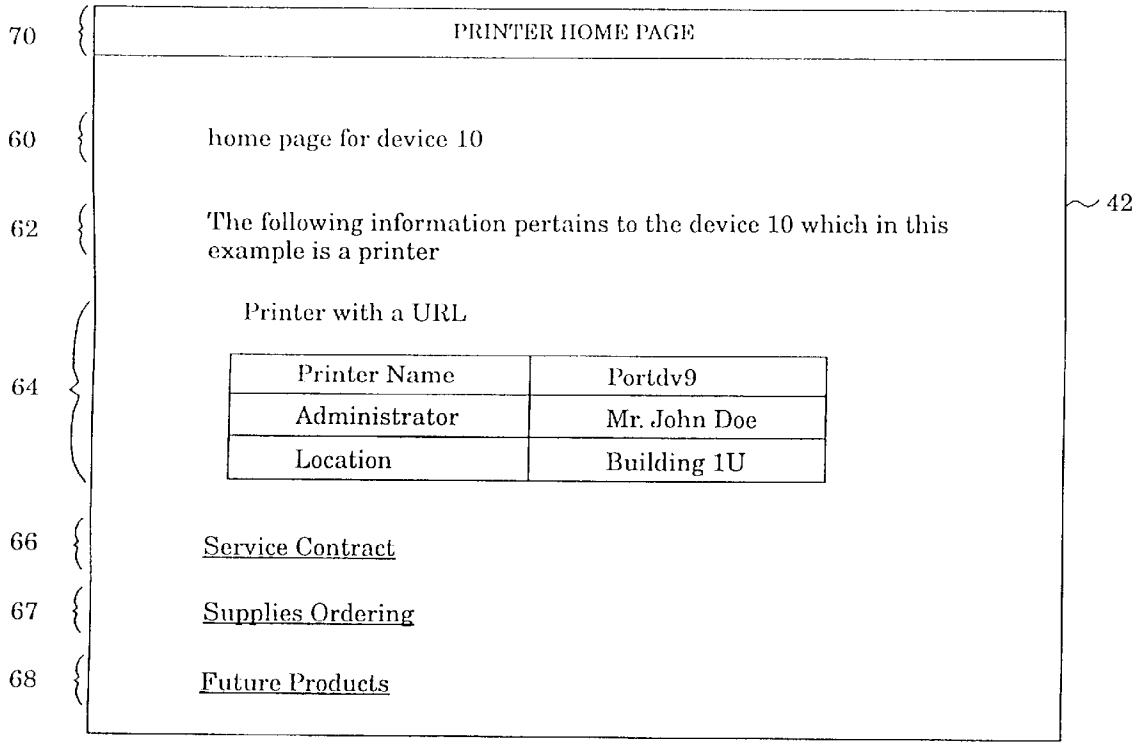
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(57) **ABSTRACT**

Web access functionality is embedded in a device to enable low cost widely accessible and enhanced user interface functions for the device. A web server in the device provides access to the user interface functions for the device through a device web page. A network interface in the device enables access to the web page by a web browser such that a user of the web browser accesses the user interface functions for the device through the web page.



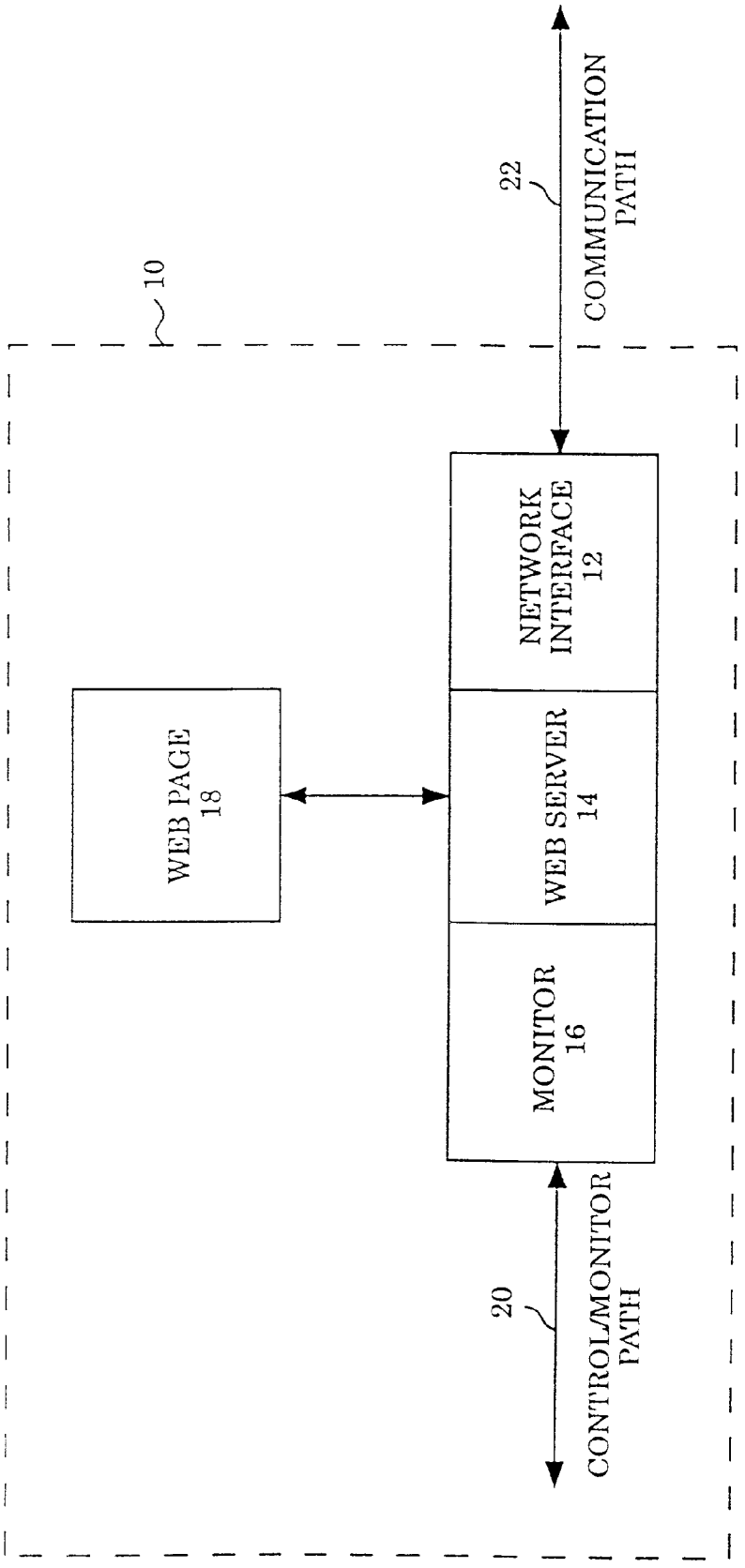
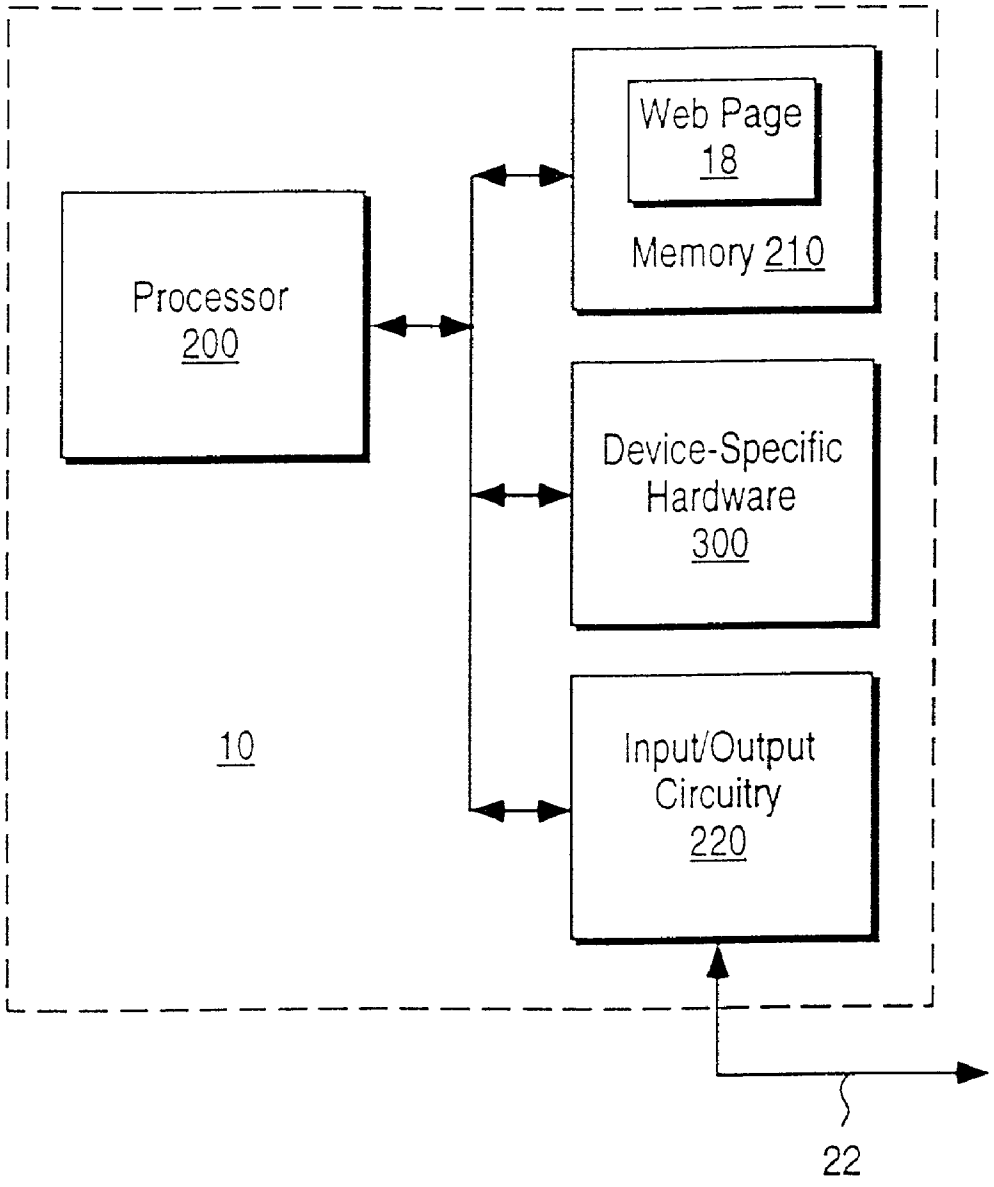

10
22
COMMUNICATION PATH
NETWORK INTERFACE 12
WEB PAGE 18
WEB SERVER 14
MONITOR 16
20
CONTROL/MONITOR PATH

Figure 1a

FIG. 1B


Web Page
18
Memory 210
Processor
200
Device-Specific
Hardware
300
10
Input/Output
Circuitry
220
22

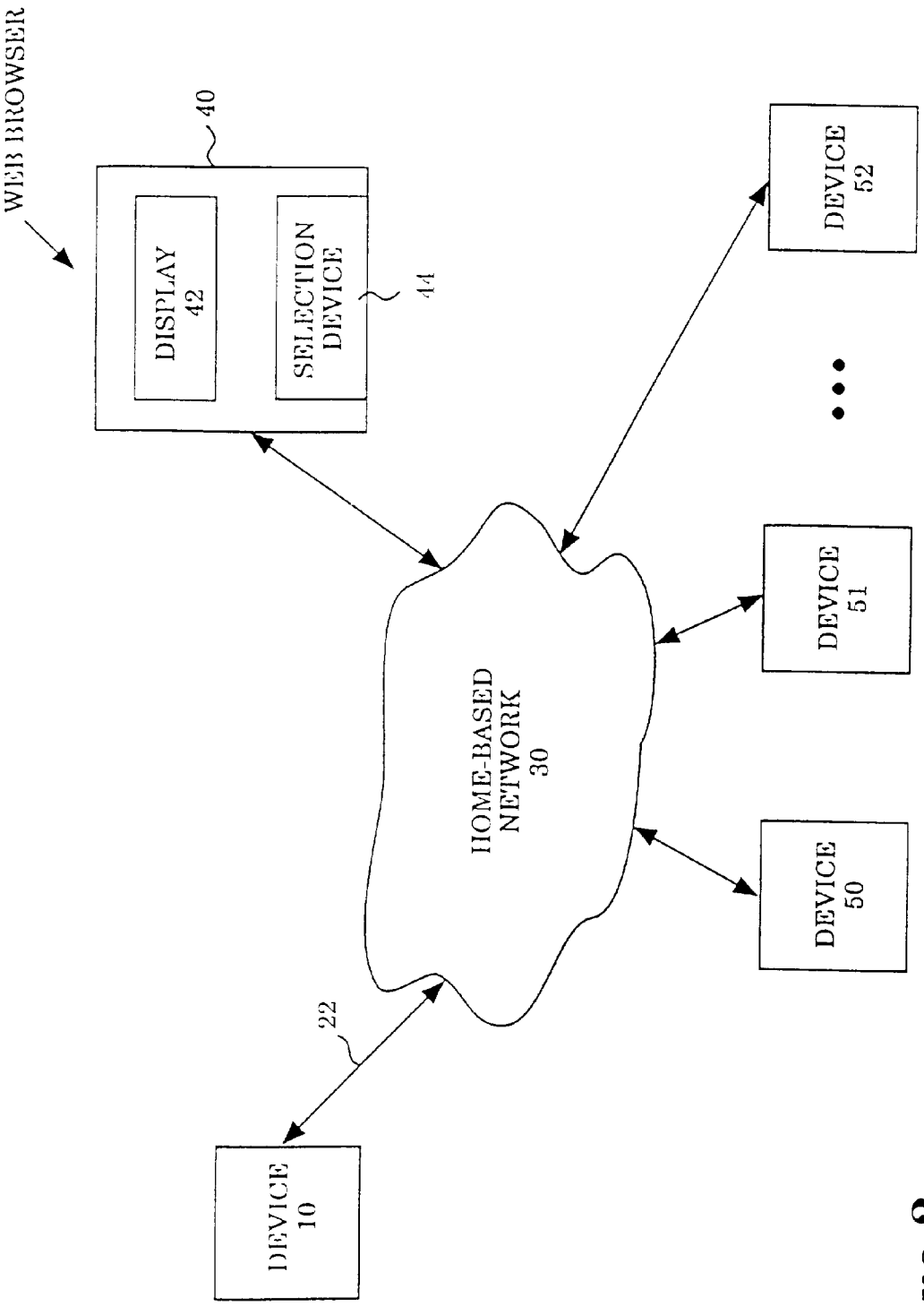

WEB BROWSER
40
DISPLAY
42
SELECTION
DEVICE
44
DEVICE
52
DEVICE
51
DEVICE
50
HOME-BASED
NETWORK
30
22
DEVICE
10

Figure 2

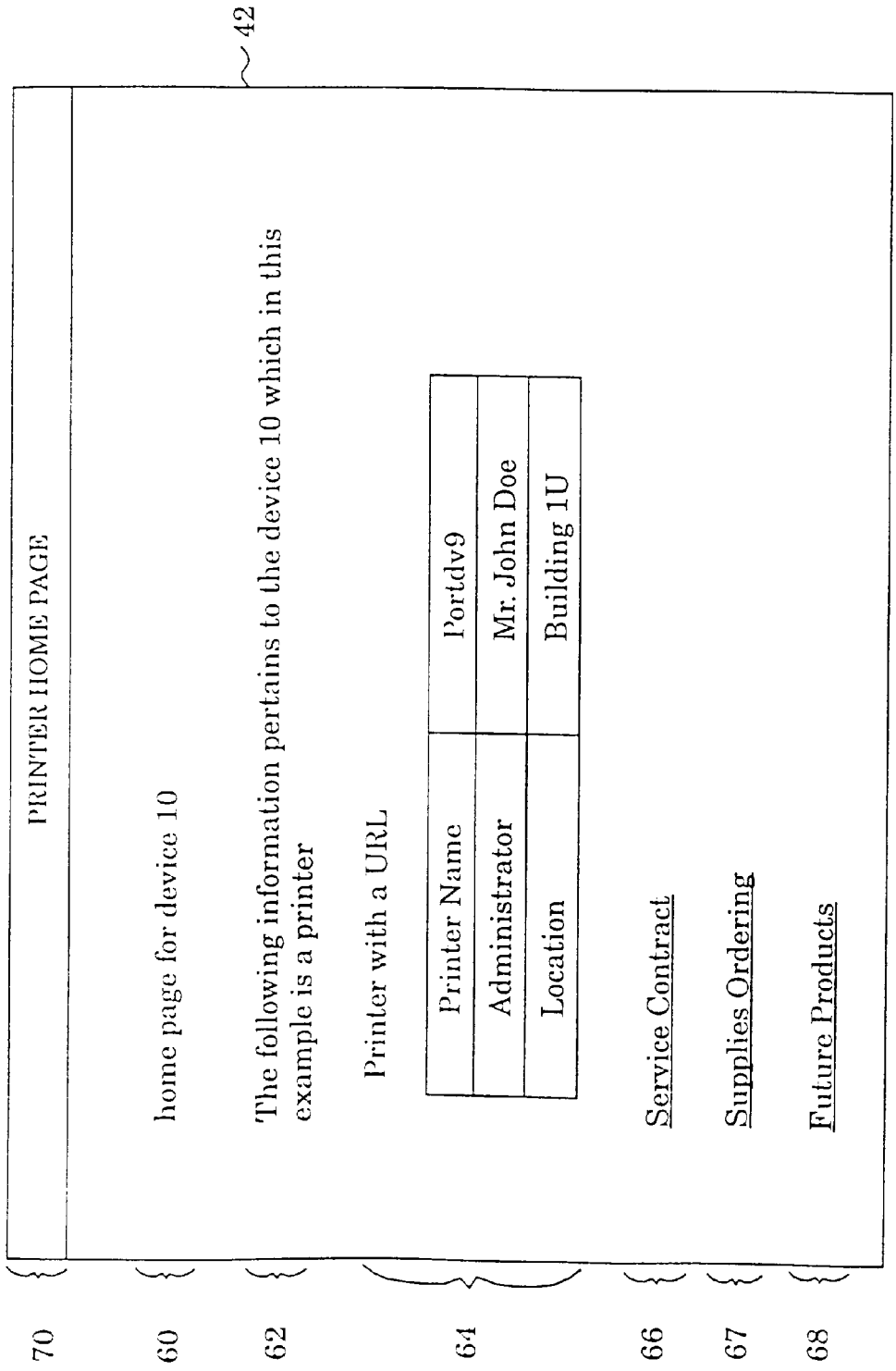

42
PRINTER HOME PAGE
home page for device 10
The following information pertains to the device 10 which in this example is a printer
Printer with a URL
Printer Name
Portdv9
Administrator
Mr. John Doe
Location
Building 1U
Service Contract
Supplies Ordering
Future Products
70
60
62
64
66
67
68

Figure 3

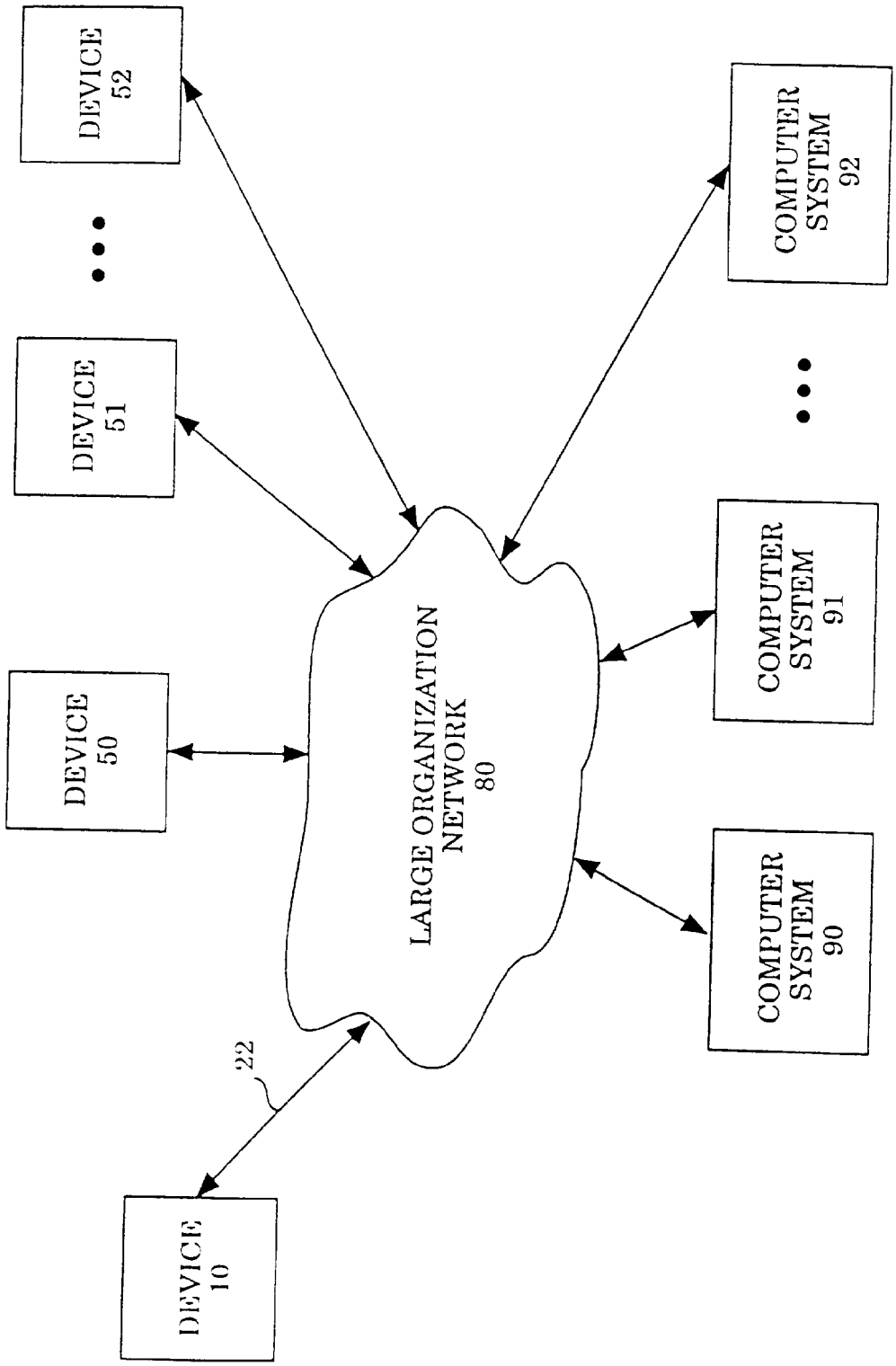

DEVICE 52
DEVICE 51
DEVICE 50
DEVICE 10
22
LARGE ORGANIZATION NETWORK 80
COMPUTER SYSTEM 92
COMPUTER SYSTEM 91
COMPUTER SYSTEM 90

Figure 4

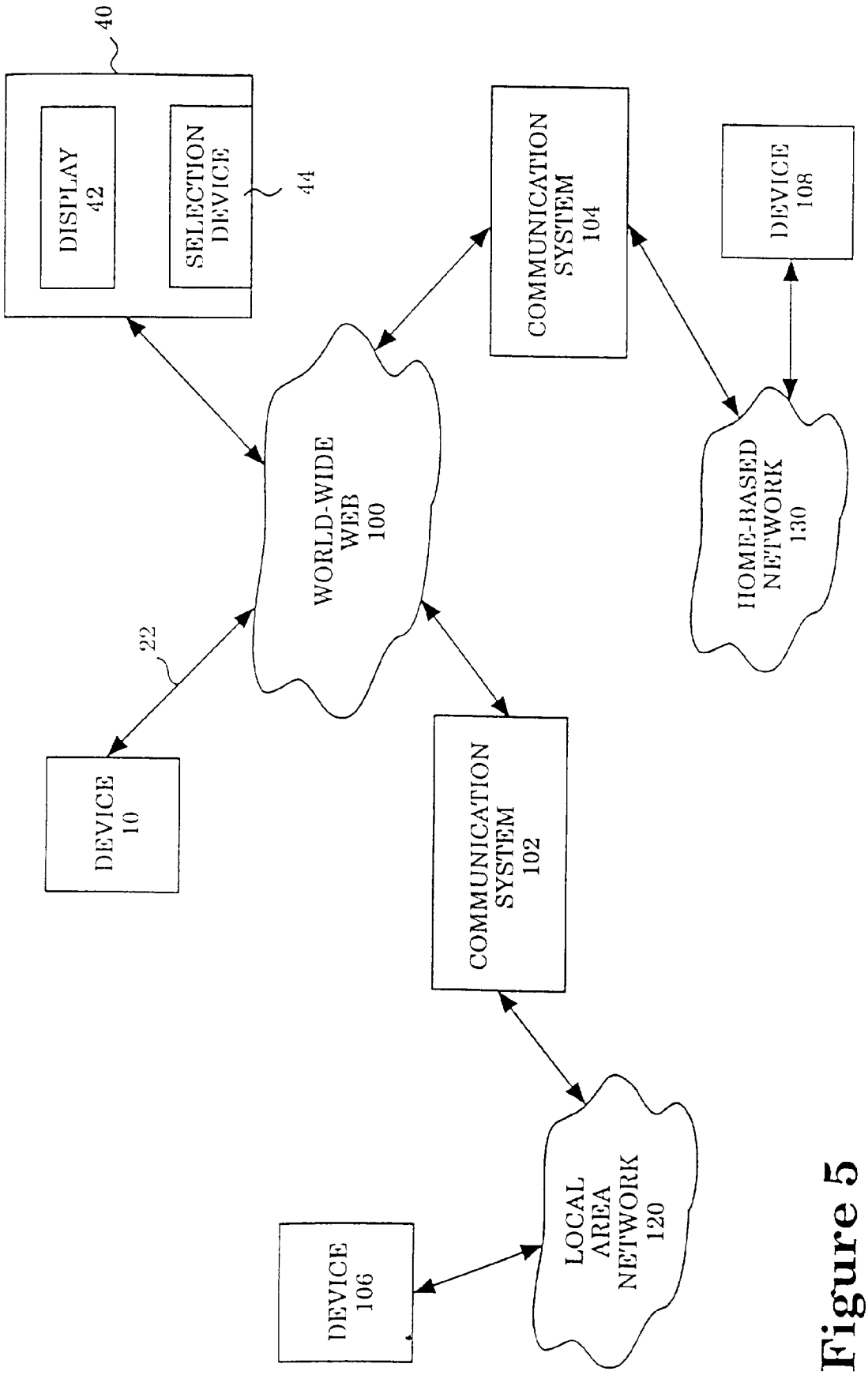

40
DISPLAY
42
SELECTION
DEVICE
44
COMMUNICATION
SYSTEM
104
DEVICE
108
WORLD-WIDE
WEB
100
HOME-BASED
NETWORK
130
22
DEVICE
10
COMMUNICATION
SYSTEM
102
LOCAL
AREA
NETWORK
120
DEVICE
106

Figure 5

EMBEDDING WEB ACCESS FUNCTIONALITY INTO A DEVICE FOR USER INTERFACE FUNCTIONS

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] The present invention pertains to the field of user interfaces for devices. More particularly, this invention relates to embedding web access functionality into devices to provide enhanced and widely accessible user interface functions.

[0003] 2. Art Background

[0004] A wide variety of devices including office equipment, home-based equipment, and lab equipment, as well as a variety of other types of devices commonly provide device specific user interface functions. Such devices may also be referred to as gadgets. Office equipment includes, for example, printers, fax machines, copiers, and various types of communication and telephony devices. Home-based devices include home entertainment equipment such as televisions and video and audio players and recorders as well as security systems, automobiles, appliances, thermostats, and hot tubs. Lab equipment includes measurement devices such as oscilloscopes, spectrum analyzers and other types of measurement equipment as well as networking equipment.

[0005] The user-interface mechanisms of such devices commonly include relatively simple and low cost user input and display mechanisms. Such simple mechanisms may include, for example, light emitting elements such as LED/LCD elements as well as various types of simple input buttons or switches. Such simple mechanisms are typically constructed to be low cost to minimize the overall cost of such devices. In addition, such mechanisms are usually compact and enable relatively small sizes for such devices. Unfortunately, such simple user interface mechanisms severely limit the range and flexibility of the user interface functions provided by such devices.

[0006] The user-interface functions of such a device may be enhanced by the implementation of a screen-based user interface mechanism within the device. For example, such a device may include a display screen, and a rendering processor along with appropriate software for generating a rich graphical user interface suitable for the particular type of device. However, such screen displays and rendering mechanisms are usually expensive and increase the overall cost of the device. Such high costs are typically unsuitable for lower cost devices targeted for a relatively large mass market. Moreover, display screens and associated hardware may be too bulky for the size constraints of many devices.

[0007] A screen-based user interface may be provided for a device using an external computer system. For example, the device may be connected to the computer system through either a standard connection such as a serial or parallel port connection or through a specialized hardware interface. The external computer system usually executes a set of software for communication and user interface to the device. The external computer system may implement a screen-based user interface for the device. The external computer system may also execute web server software that enables external web browsers to access the computer system and in turn the user interface of the device.

[0008] Unfortunately, such an external computer system greatly increases the cost of providing a screen-base user interface for a device. In addition, such prior computer system based solutions usually require the development of specialized software for each particular type of device. Moreover, such specialized software for a particular device from a particular manufacturer must typically be developed for differing types of computer system platforms. Such a variety of differing software for differing platforms greatly complicates the task of providing support for the devices. Furthermore, the development and support costs of such a variety of software usually increase the overall cost of providing a screen based user interface for such devices.

SUMMARY OF THE INVENTION

[0009] A solution for providing widely accessible, low cost, and enhanced user interface functions for a device is disclosed. The solution involves embedding web access functionality into the device including a web server that provides a device web page. The device includes an embedded network interface that enables access to the device web page by a web browser. A user of the web browser accesses the user interface functions for the device through the device web page. The web server functionality may be implemented with existing circuitry in a device, such as an exiting processor, memory, and input/output circuitry that normally perform device-specific functions, thereby avoiding the extra cost and space required for dedicated web server hardware for the device.

[0010] The web server functionality embedded in the device enables device user interface access via a variety of communication mechanisms including the world wide web portion of the Internet. The costs of providing screen based user interface mechanisms are exported away from the device and do not require an external computer to provide a device web server. The methods and mechanisms disclosed herein provide screen based user-friendly interfaces to a wide variety of devices without the necessity to develop expensive hardware and software applications for differing devices. The present methods and mechanisms employ web technology so that access to a device user interface is independent of the computer system platform employed and independent of the web browser software executed and independent of the location of the user.

[0011] The user interface information is packaged using the Hyper-Text Markup Language (HTML) and is transported according to the Hyper-Text Transfer Protocol (HTTP). The HTML and HTTP protocols enable communication with existing web browsers independent of the platform that executes the web browser. The present techniques avoid the need of an industry-wide Application Programming Interface (API) to unify the control and use of equipment.

[0012] Other features and advantages of the present invention will be apparent from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention is described with respect to particular exemplary embodiments thereof and reference is accordingly made to the drawings in which:

[0014] **FIGS. 1***a*-**1***b* illustrate a device with embedded web access functionality that provides device-specific user interface functions through a device web page;

[0015] **FIG. 2** shows a home-based network that enables a web browser to access the user interface functions through the device web page;

[0016] **FIG. 3** illustrates an example device web page for a printer device;

[0017] **FIG. 4** shows a large organization network or intranet that enables access to the device web pages of differing devices;

[0018] **FIG. 5** illustrates access to device web pages through the Internet world-wide web.

DETAILED DESCRIPTION

[0019] **FIG. 1***a* illustrates a device **10** with embedded web access functionality that provides device-specific user interface functions. The device **10** includes a network interface **12** and a web server **14** along with a monitor **16**. The network interface **12** enables communication via a communication path **22**. The monitor **16** controls various device-specific functions of the device **10** and monitors a set of information pertaining to the device **10** via a control/monitor path **20**. The web server **14** provides web server functions to web clients via the communication path **22**. The web server **14** provides web server functions according to the Hyper-Text Transfer Protocol (HTTP).

[0020] The web server **14** receives HTTP commands through the network interface **12** that specify a predetermined Universal Resource Locator (URL) for the device **10**. The HTTP commands may be used by web clients to read information from the device **10** such as device status information. The HTTP commands may also be used to transfer information to the device **10** such as information that controls the functions or operating states of the device **10**. Such HTTP commands include HTTP GET, HTTP POST, and HTTP PUT commands.

[0021] In response to an HTTP command targeted for the device **10**, the web server **14** generates a web page **18** that defines a set of user interface functions for the device **10**. The web page **18** is a Hypertext Markup Language (HTML) file. The network interface **12** transfers the web page **18** to a requesting HTTP client via the communication path **22**.

[0022] The web server **14** generates the web page **18** dynamically to reflect the updated state of the information pertaining to the device **10** that is maintained by the monitor **16**. The web page **18** may also define control buttons according to the HTTP protocol that enable various control functions for the device **10** to be initiated from a web client via the communication path **22**. The web page **18** may contain text, images, multimedia files, forms, tables or any object type supported by the HTTP and HTML protocols.

[0023] In addition, the web page **18** may contain one or more URLs that specify additional web pages located within the device **10**. The web page **18** may also contain one or more URLs that specify additional web pages located elsewhere, i.e. external to the device **10**. The additional web pages external to the device **10** may be located, for example, on a local communication network or on the Internet world wide web.

[0024] The device **10** represents a wide variety of devices including devices such as printers, fax machines, copiers, communication and telephony devices, home entertainment devices such as televisions, video and audio devices as well as appliances such as refrigerators and washing machines, security systems, automobiles, and hot tubs. The device **10** also represents a variety of measurement instruments including oscilloscopes, and spectrum analyzers and other types of measurement devices. In addition, the device **10** represents a variety of computer peripheral devices including mass storage units such as rotating media storage units.

[0025] The communication path **22** represents any communication means that is capable of transferring HTML files according to the HTTP web protocol. The communication path **22** may be realized by a wide variety of communication mechanisms including local area networks, telephone lines including cellular telephone links, serial communication links, parallel communication links, power line communication links, and radio and infrared communication links. The communication path **22** may also be a direct Internet connection to the world-wide web.

[0026] **FIG. 1***b* is a hardware block diagram of the device **10**. The device **10** includes a processor **200**, a memory **210**, a set of device-specific hardware **300** along with a set of input/output circuitry **220** that enables communication via the communication path **22**. The processor **200** performs device-specific functions for the device **10** in combination with the device-specific hardware **300**. The processor **200** is also employed to provide web server functionality in the device **10**. In one embodiment, the processor **200** stores the web page **18** in the memory **210** which may also be used to store information associated with normal device-specific functions.

[0027] In one embodiment, the device **10** is a printer device wherein the processor **200** and the memory **210** preform image rendering functions and the device-specific hardware **300** includes printer hardware and associated circuitry and wherein the input/output circuitry **220** provides network access to the printer device **10**. The web server functionality is embedded into the printer device **10** by providing software or firmware for the processor **200** and by utilizing space available in the memory **210** and by using the existing input/output circuitry **220** such as Ethernet circuitry to transfer HTML files.

[0028] In another embodiment, the device **10** is a video player/recorder wherein the processor **200** and the memory **210** perform functions for reading video and audio information from and writing video and audio information to a storage media such as magnetic tape or an optical storage media. The device-specific hardware **300** includes media actuation hardware such as motors and magnetic heads and associated circuitry for reading and imparting information onto the storage media. The web server functionality is embedded into the video device **10** by providing software or firmware for the processor **200** and by utilizing space available in the memory **210** and by adding the input/output circuitry **220** to the video device **10**.

[0029] In yet another embodiment, the device **10** is a washing machine wherein the processor **200** and the memory **210** preform functions for controlling wash cycles. The device-specific hardware **300** includes hardware such as motors, valves, sensors, and associated circuitry. The web

server functionality is embedded into the washing machine **10** by providing software or firmware for the processor **200** and by utilizing space available in the memory **210** and by adding the input/output circuitry to the video device **10**.

[**0030**] The web server functionality for the device **10** includes software executed by the processor **200** that services the HTTP protocol and that generates HTML formatted files. The web page **18** in one embodiment is stored in the memory **210** or may be generated on the fly. The processor **200** also executes communication software that drives the input/output circuitry **220** and provides the functionality of the network interface **12**. In addition, the processor **200** executes software that performs control and information monitoring an logging functions of the monitor **16**.

[**0031**] In another embodiment, the web server functions of the device **10** are implemented on a single integrated circuit chip including a processor and memory for holding software for servicing the HTTP protocol. In such an embodiment, the hardware portion of the network interface **12** may be implemented on the same integrated circuit chip as the processor or may be external to that chip.

[**0032**] In yet another embodiment, the web server functions of the device **10** are implemented with a state machine.

[**0033**] In another embodiment, the device **10** is a controller module or control computer contained in an automobile. The input/output circuitry **220** such as cellular transmitter/receiver circuitry enables a web browser to access control and status information for the automobile which is contained in the web page **18**.

[**0034**] In another embodiment, the device **10** is a mass storage device such as a disk drive or CD-ROM drive. The input/output circuitry **220** such as local area network interface circuitry enables a web browser to access control and status information for the mass storage device which is contained in the web page **18**.

[**0035**] In yet another embodiment, the device **10** is a home-entertainment device such as an audio system. The input/output circuitry **220** such as infrared communication circuitry or power line communication circuitry enables a web browser such as a home computer to access control and status information for the audio system which is contained in the web page **18**.

[**0036**] The memory **210** may be a static memory such as read-only memory, a flash memory, or a disk drive or may be a volatile memory such as a random access memory. The web page may be stored in the static memory or the random access memory in the HTML format or may be generated on the fly without being stored in the device **10**.

[**0037**] **FIG. 2** shows a home-based network **30** that enables a web browser **40** to access the user interface functions of the device **10**. The home-based network **30** may be implemented with a variety of communication mechanisms suitable for a home including power line communication links, twisted pair communication links, radio frequency communication links, and infrared communication links.

[**0038**] The web browser **40** includes a display **42** for generating visual objects including text, images, multimedia objects, and graphical user interface objects. The web browser **40** includes a selection device **44** that enables a user to select objects and URL links rendered on the display **42**. The web browser **40** may also include an audio capability that enables rendering of audio information to the user.

[**0039**] The home-based network **30** may also enable communication among a set of devices **50-52**. The devices **50-52** may include devices such as home appliances, home security systems, home entertainment devices, air-conditioning systems and hot-tubs. Any of the devices **50-52** that implement the device web page mechanisms disclosed herein may provide device specific user interface web pages to the web browser **40** via the home-based network **30**.

[**0040**] The web browser **40** may be embodied in a computer system that executes a set of web browser software. Such a computer system with web browser functionality may be realized by any one of a variety of available computer system platforms including Windows platforms, Macintosh platforms, Unix platforms as well as any other platform capable of executing web browser software that provides HTTP client functions and that renders HTML files.

[**0041**] The web browser **40** may-also be embodied in a variety of other devices that provide HTTP client functions and that render HTML files. Such devices include specialized hardware designed for television or telephone systems as well as low cost web browser devices and network computers.

[**0042**] A user accesses and controls the user interface functions of the device **10** using the web browser **40**. The user enters a URL corresponding to the device **10** into the web browser **40**. In response, the web browser **40** transfers an HTTP command which includes the entered URL over the home-based network **30**. The device **10** receives the HTTP command via the communication path **22** and recognizes the URL contained therein.

[**0043**] In one embodiment, the information for the web page **18** is periodically updated by the processor **200** and is stored in HTML format in the memory **210**. In such an embodiment, the processor **200** reads the web page **18** from the memory **210** in response to the HTTP command and transfers the web page **18** to the web browser **40** via the home based network **30**.

[**0044**] In an alternative embodiment, the processor **200** generates the web page **18** on the fly in response to the HTTP command from the web browser **40**. In such an embodiment, the processor **200** obtains information pertaining to the device from the device-specific hardware **300** after receiving the HTTP command and recognizing the URL contained therein. The processor **200** formats the information into the HTML format that defines the web page **18** and transfers the HTML formatted information to the web browser **40** via the home based network **30**.

[**0045**] The HTML file is transferred according to the HTTP protocol which specifies the URL corresponding to the web browser **40**. The web browser **40** receives the HTML file and renders the web page **18** on the display **42**.

[0046] The following is an example HTML file that defines the web page **18** in an embodiment wherein the device **10** is a printer device.

[0047] <TITLE>Printer Home Page</TITLE>

[0048] <H1>home page for device **10**</H1>

[0049] <HR>

[0050] The following information pertains to the device **10** which in this example is a printer

[0051] <table border>

[0052] <caption>Printer with a URL </caption>

[0053] <TR>

[0054] <TD>Printer Name</TD>Portdv9</TD>

[0055] </TR>

[0056] <TR>

[0057] <TD>Administrator</T1><TD>Mr. John Doe</TD>

[0058] <TR>

[0059] <TD>Location</TD><TD>Building 1U</TD>

[0060] </TR>

[0061] </TABLE>

[0062] <P>

[0063] <A HREF="http://www.hpsc.com">Service Contract</A>

[0064] <P>

[0065] <A HREF="http://www.hpsupl.com">Supplies ordering</A>

[0066] <P>

[0067] <A HREF="http://www.hpl.hp.com">Future Products</A>

[0068] <P>

[0069] <HR>

[0070] **FIG. 3** illustrates the web page **18** for the example HTML file shown above wherein the device **10** is a printer. The web page **18** is rendered on the display **42** by the web browser **40** in response to the example HTML code set forth above. The web page **18** includes a page title **70**, a header section **60**, a set of ASCII text **62**, a table section **64**, and a set of hyperlinks **66-68**.

[0071] The page title **70** is defined by the HTML <TITLE>Printer Home Page</TITLE> coding shown above. The header section **60** is defined by the HTML code <H1>Home Page for device **10**</H1> in the HTML file shown above. The ASCII text **62** is the ASCII text contained in the HTML file shown above. The table section **64** is defined with coding in the HTML file shown above and provides information pertaining to the printer including a printer name, an administrator, and a location for the printer.

[0072] The hyperlinks **66-68** defined in the HTML file shown above direct the web browser **40** to other web pages for various printer support functions. For example, the hyperlink **66**"Service Contract" may be selected by the user with the selection device **44** to direct the web browser **40** to the URL "http://www.hpsc.com" for information regarding printer service contracts. Similarly, hyperlinks **67** and **68** provide links to web pages for ordering printer supplies and obtaining information for future printer products from the manufacturer of the printer device **10**.

[0073] The web page **18** for the printer may also include manuals, parts lists, and other associated publications. These publication may be stored within the device **10** in, for example, a nonvolatile memory, or may be referenced elsewhere via hyperlinks contained in the web page **18**. These publications contain dynamic information such as updated manuals as well as new and updated software driver routines for the device **10**.

[0074] **FIG. 4** shows a large organization network **80** that enables access to the device web pages of the device **10** and the devices **50-52**. The large organization network **80** may be referred to as an Intranet and may be implemented with a variety of communication mechanisms including local area networks connected together by various types of communication links.

[0075] Any one or more of a set of computer systems **90-92** coupled to the large organization network **80** may access the device web pages of the devices **10** and **50-52**. The computer systems **90-92** may execute one or more of a variety of available web browser software or may have web browser functions built in.

[0076] A user of one of the computer systems **90-92** enters a URL corresponding to the desired one of the devices **10** and **50-52** into the corresponding web browser application. In response, the particular web browser application as an HTTP client transfers an HTTP command that specifies the desired URL over the large organization network **80**. The device specified by the HTTP command recognizes the URL contained therein. In response, the targeted device transfers an HTML file that defines its device web page via large organization network **80**. The transfer of the HTML file specifies the URL of the originating HTTP client computer system from among the computer systems **90-92**. The originating HTTP client computer system recognizes its URL and receives and then renders the device web page to the user.

[0077] **FIG. 5** illustrates access to device web pages through a direct Internet connection to the worldwide web **100**. The web page **18** of the device **10** may be accessed by any web client on the world-wide web **100** including the web browser **40**.

[0078] In addition, a communication system **102** functions as a communication bridge between the world-wide web **100** and a local area network **120** and a communication system **104** functions as a communication bridge between the world-wide web **100** and a home base network **130**. As a consequence, any other HTTP clients coupled to the local area network **120** or the home-base network **130** may access the device web pages in a device **108**, a device **106**, or the device **10**. In addition, the web browser **40** or any HTTP client on the world-wide web **100** may access the device web pages of the devices **106** and **108**.

[0079] The embedded web server functionality described herein enables a variety of widely accessible device interrogation and control functions for a particular device as well as for sets of devices. For example, a web page may be

embedded into each washing machine of a chain of Laundromats wherein an operator from an office computer can determine the machines that require servicing and schedule daily service routing to the Laundromats accordingly.

[0080] The foregoing detailed description of the present invention is provided for the purposes of illustration and is not intended to be exhaustive or to limit the invention to the precise embodiment disclosed. Accordingly, the scope of the present invention is defined by the appended claims.

What is claimed is:

1. A web access mechanism embedded in a device, comprising:

web server that generates a device web page wherein the device web page provides a set of user interface functions for the device;

network interface that enables access to the device web page by a web browser such that a user of the web browser accesses the user interface functions for the device through the device web page.

2. The web access mechanism of claim 1, wherein the web server receives an HTTP command via the network interface and then generates an HTML file that defines the device web page in response to the HTTP command.

3. The web access mechanism of claim 2, wherein the HTTP command specifies a URL corresponding to the device.

4. The web access mechanism of claim 3, wherein the HTML file contains a set of information pertaining to the device.

5. The web access mechanism of claim 3, wherein the HTML file contains a set of URLs that control a set of predetermined functions for the device wherein each URL may point to a web page located internal to the device or a web page located external to the device.

6. The web access mechanism of claim 3, wherein the HTML file contains a hyperlink to an external web page that specifies additional information pertaining to the device.

7. A device, comprising:

processor that generates a device web page wherein the device web page provides a set of user interface functions for the device and includes a set of information pertaining to the device;

memory for storing the device web page;

input/output circuitry that enables communication via a communication path such that a web browser accesses the device web page via the communication path.

8. The device of claim 7, wherein the processor receives an HTTP command via the input/output circuitry and then generates an HTML file that defines the device web page in response to the HTTP command.

9. The device of claim 8, wherein the HTTP command specifies a URL corresponding to the device.

10. The device of claim 8, wherein the HTML file contains a set of URLs that control a set of predetermined functions for the device wherein each URL may point to a web page located internal to the device or a web page located external to the device.

11. The device of claim 8, wherein the HTML file defines a set of graphical mechanisms for controlling a set of predetermined functions for the device.

12. The device of claim 8, wherein the HTML file contains a hyperlink to an external web page that specifies additional information pertaining to the device.

13. A user interface method for a device, comprising the steps of:

generating a device web page within the device wherein the device web page provides a set of user interface functions for the device;

providing access to the device web page from a web browser external to the device such that a user of the web browser accesses the user interface functions for the device through the device web page.

14. The method of claim 13, wherein the step of generating a device web page includes the step of generating an HTML file that defines the device web page in response to an HTTP command received from the web browser.

15. The method of claim 14, wherein the HTTP command specifies a URL corresponding to the device.

16. The method of claim 14, wherein the HTML file contains a set of information pertaining to the device.

17. The method of claim 14, wherein the HTML file contains a set of URLs that control a set of predetermined functions for the device wherein each URL may point to a web page located internal to the device or a web page located external to the device.

18. The method of claim 14, wherein the HTML file contains a hyperlink to an external web page that specifies additional information pertaining to the device.

19. A user interface apparatus embedded in a device, comprising:

means for generating a device web page within the device wherein the device web page provides a set of user interface functions for the device;

means for providing access to the device web page from a web browser external to the device such that a user of the web browser accesses the user interface functions for the device through the device web page.

20. The apparatus of claim 19, wherein the means for generating a device web page includes means for generating an HTML file that defines the device web page in response to an HTTP command generated by the web browser.

21. The apparatus of claim 20, wherein the HTTP command specifies a URL corresponding to the device.

22. The apparatus of claim 20, wherein the HTML file contains a set of information pertaining to the device.

23. The apparatus of claim 20, wherein the HTML file contains a set of URLs that control a set of predetermined functions for the device wherein each URL may point to a web page located internal to the device or a web page located external to the device.

24. The apparatus of claim 20, wherein the HTML file contains a hyperlink to an external web page that specifies additional information pertaining to the device.

25. A system, comprising:

device having an embedded web server that generates a device web page wherein the device web page provides a set of user interface functions for the device and includes a set of information pertaining to the device, the device also having a network interface that enables access to the device web page via a communication network;

web browser coupled to the communication network wherein a user of the web browser accesses the user interface functions for the device through the device web page.

26. The system of claim 25, wherein the web server in the device receives an HTTP command via the communication network and the network interface and then generates an HTML file that defines the device web page in response to the HTTP command.

27. The system of claim 26, wherein the HTTP command specifies a URL corresponding to the device.

28. The system of claim 26, wherein the HTML file contains a set of URLs that control a set of predetermined functions for the device such that the user of the web browser selects the URLs to control the predetermined functions of the device wherein each URL may point to a web page located internal to the device or a web page located external to the device.

29. The system of claim 26, wherein the HTML file contains a hyperlink to an external web page located elsewhere on the communication network that specifies additional information pertaining to the device.

30. The system of claim 25, wherein the communication network comprises a home-based communication network.

31. The system of claim 25, wherein the communication network comprises a large-organization communication network.

32. The system of claim 25, wherein the communication network comprises the world wide web of the Internet.

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