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(54) PLUG-AND-PLAY DEVICE AND METHOD OF USING THE SAME

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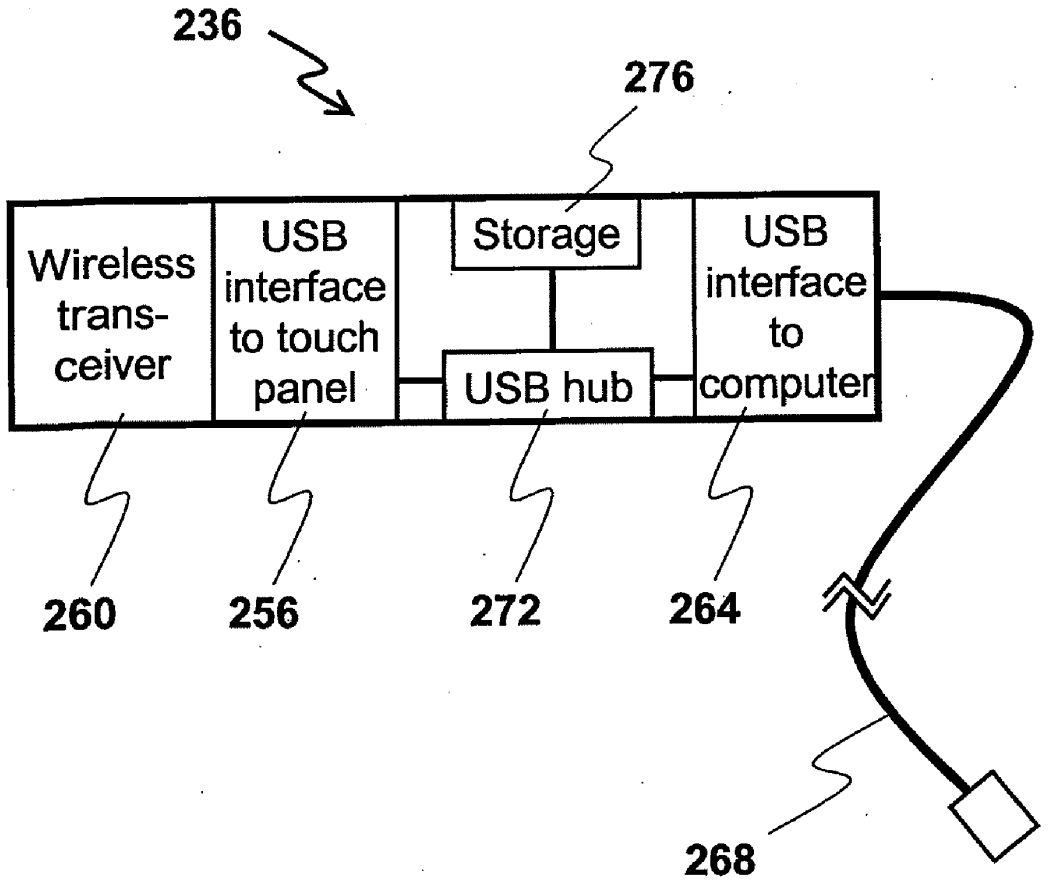
(52) **U.S. Cl.** **710/10**; 710/100

(57) **ABSTRACT**

A plug-and-play device comprises a first plug-and-play interface for establishing a connection with a first computing device and a second plug-and-play interface for establishing a connection with a second computing device. Storage stores code that is automatically executed by the second computing device when the plug-and-play device is connected to the second computing device via the second plug-and-play interface. The code when executed by the second computing device initiates a screen display data exchange between the first and second computing devices through the plug-and-play device. A controller controls the first plug-and-play interface, the second plug-and-play interface and the storage.



YEALINK EX. 1021

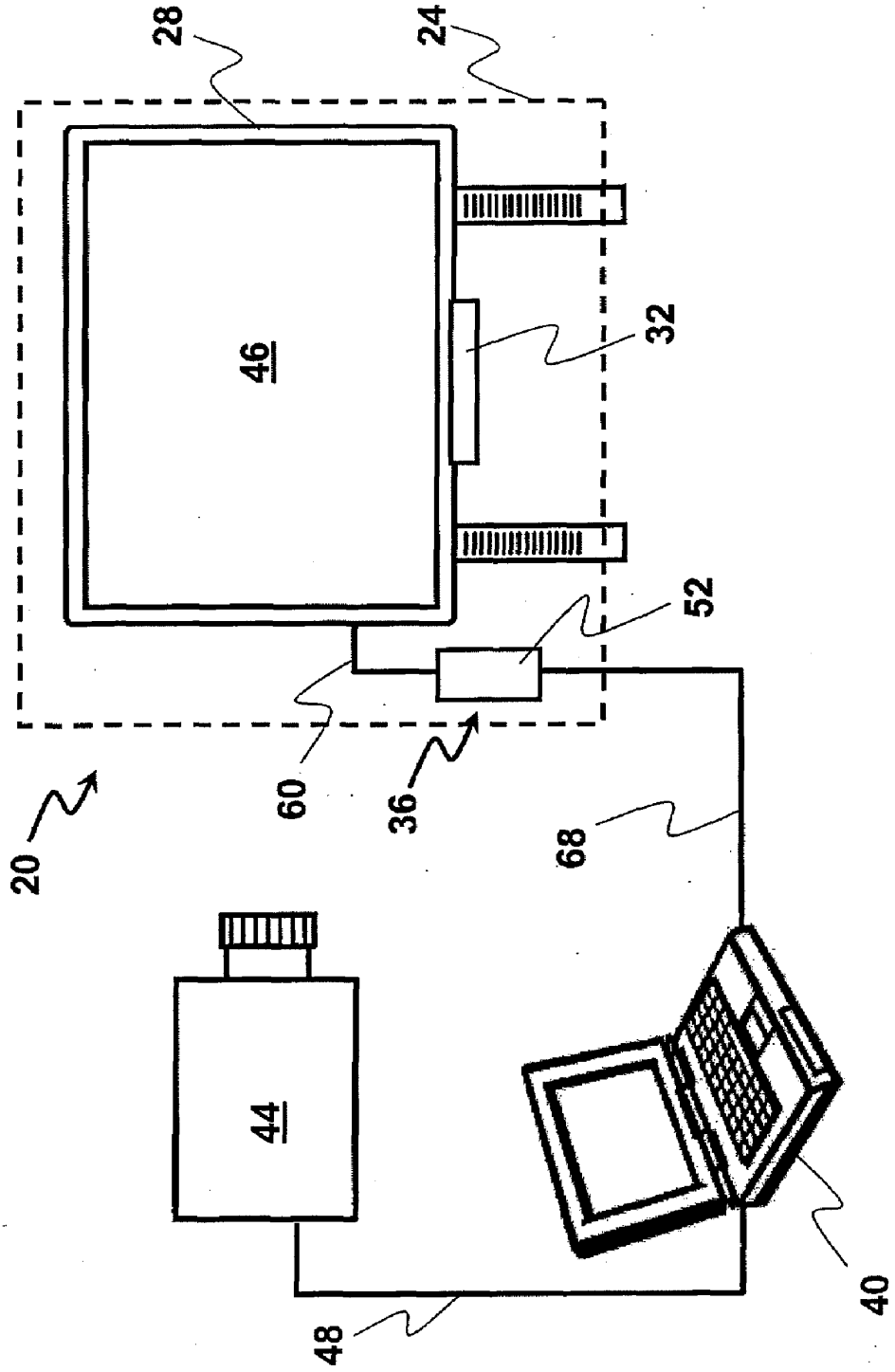


FIG. 1

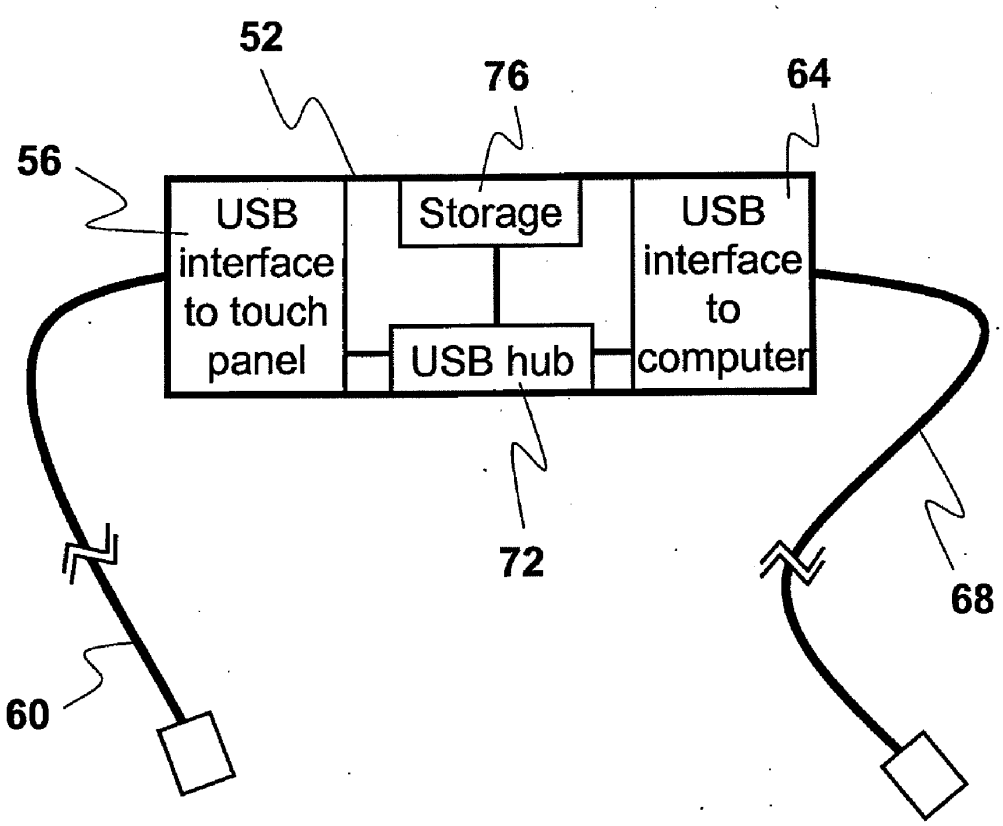

52
76
64
56
USB interface to touch panel
Storage
USB hub
USB interface to computer
72
68
60

FIG. 2

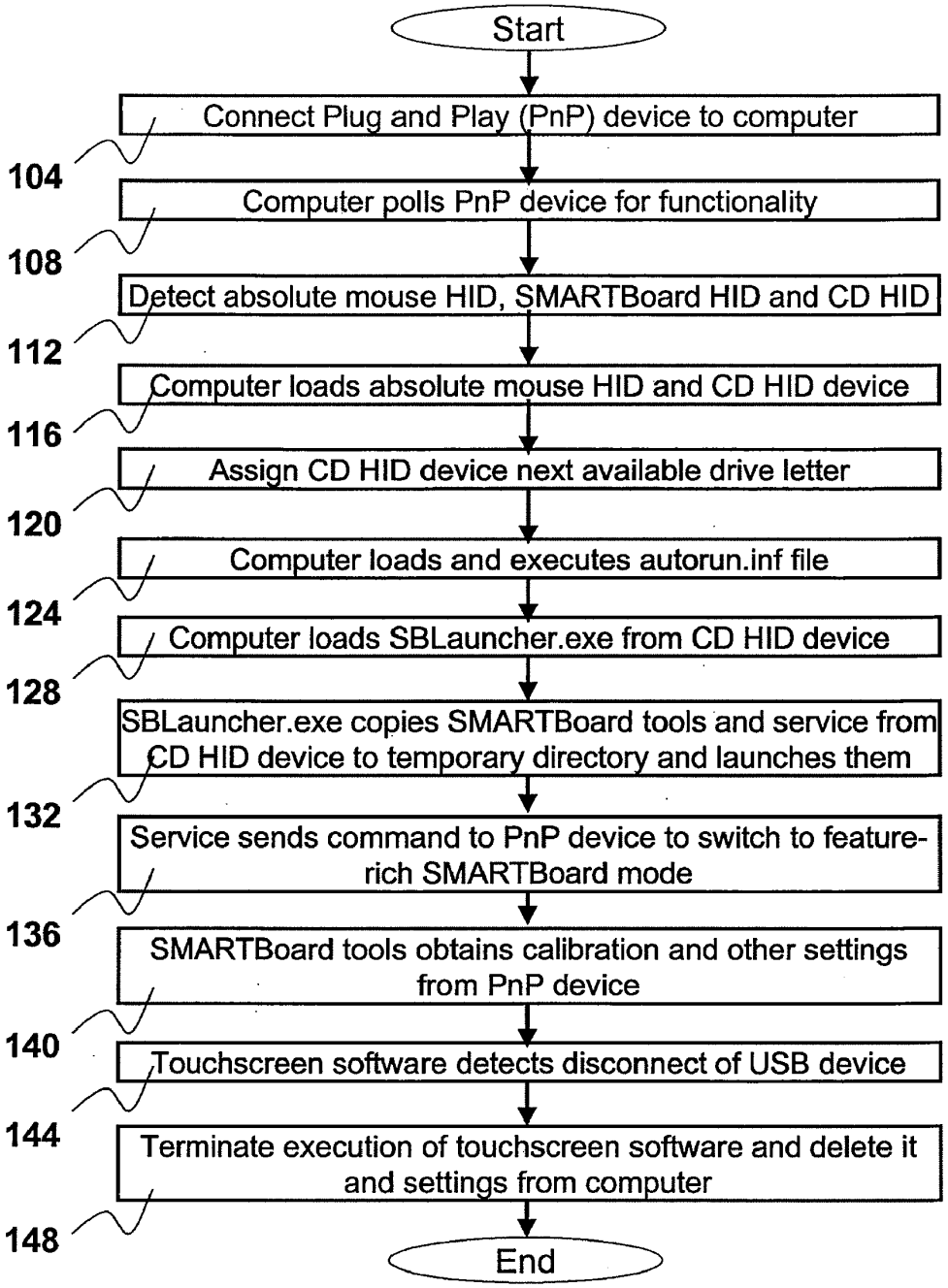

Start
Connect Plug and Play (PnP) device to computer
104
Computer polls PnP device for functionality
108
Detect absolute mouse HID, SMARTBoard HID and CD HID
112
Computer loads absolute mouse HID and CD HID device
116
Assign CD HID device next available drive letter
120
Computer loads and executes autorun.inf file
124
Computer loads SBLauncher.exe from CD HID device
128
SBLauncher.exe copies SMARTBoard tools and service from CD HID device to temporary directory and launches them
132
Service sends command to PnP device to switch to feature-rich SMARTBoard mode
136
SMARTBoard tools obtains calibration and other settings from PnP device
140
Touchscreen software detects disconnect of USB device
144
Terminate execution of touchscreen software and delete it and settings from computer
148
End

FIG. 3

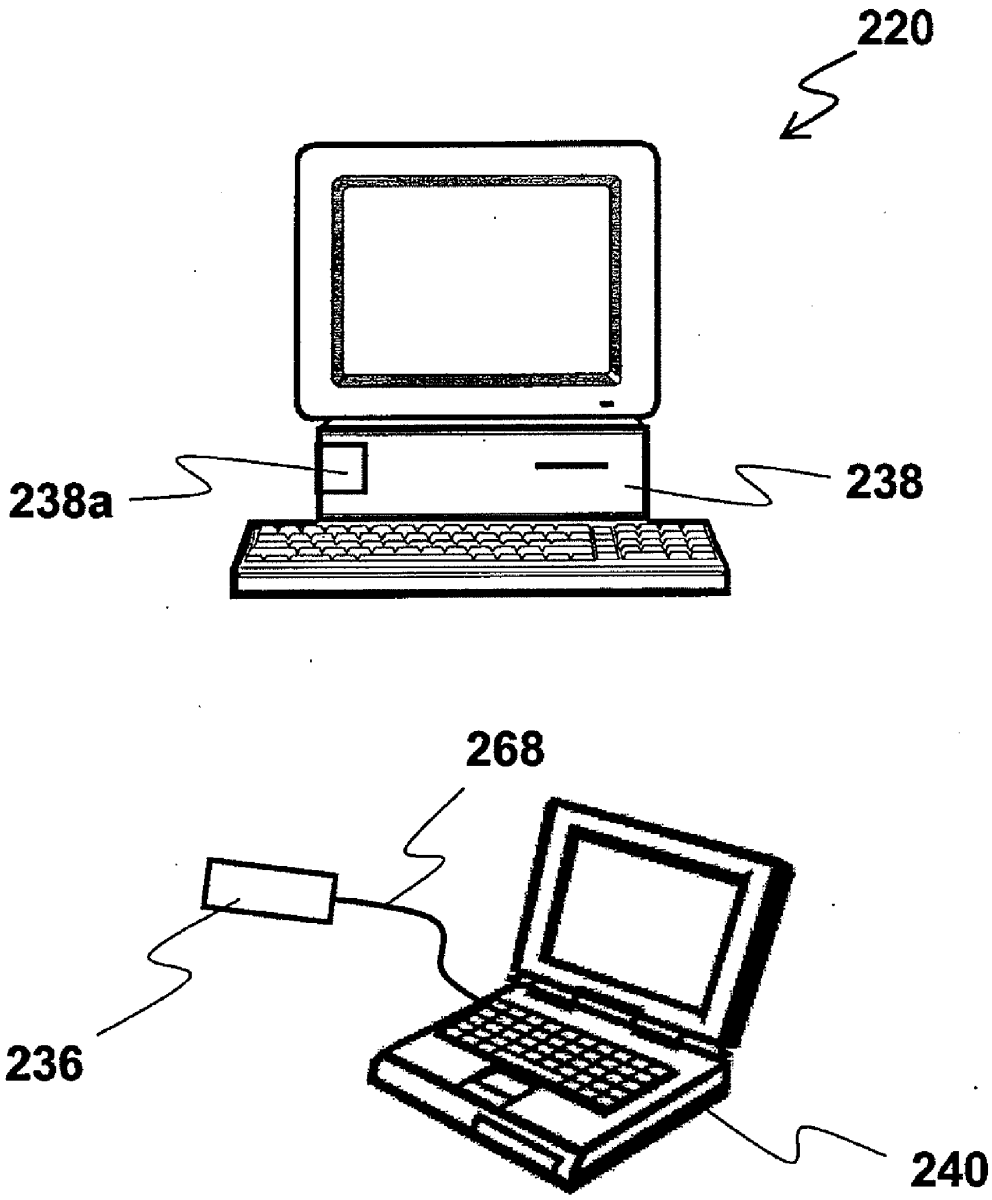


FIG. 4

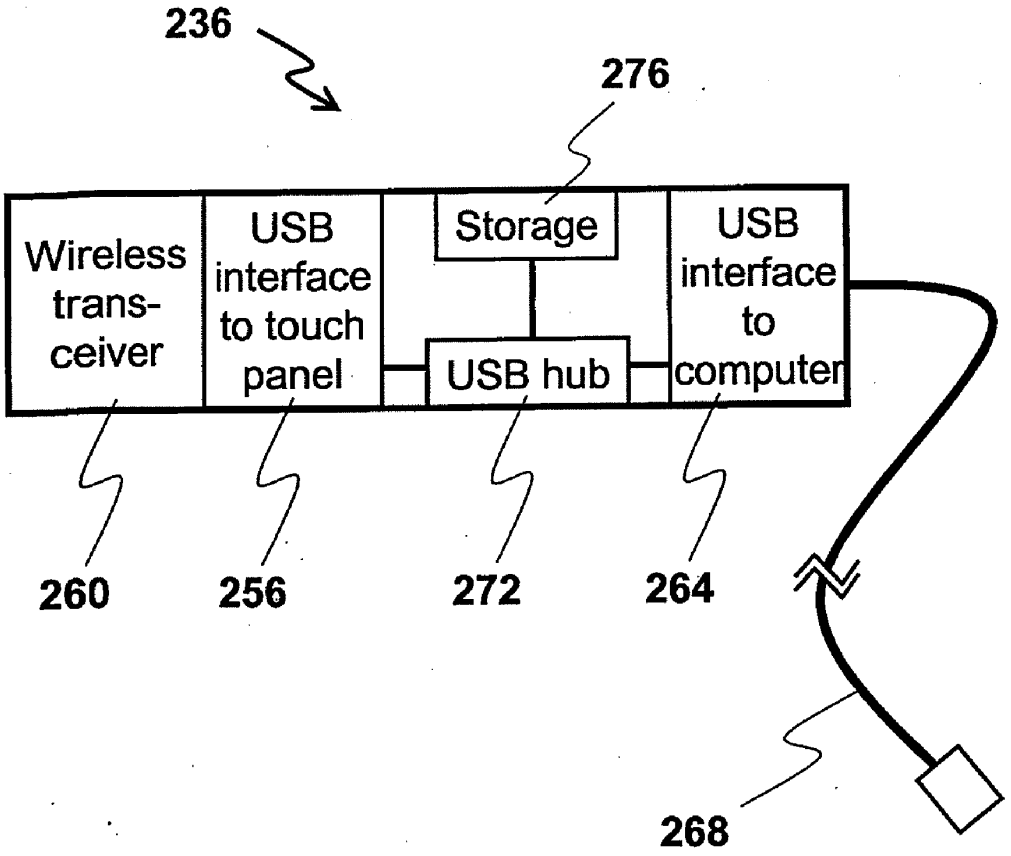

236
276
Wireless trans-ceiver
USB interface to touch panel
Storage
USB hub
USB interface to computer
260
256
272
264
268

FIG. 5

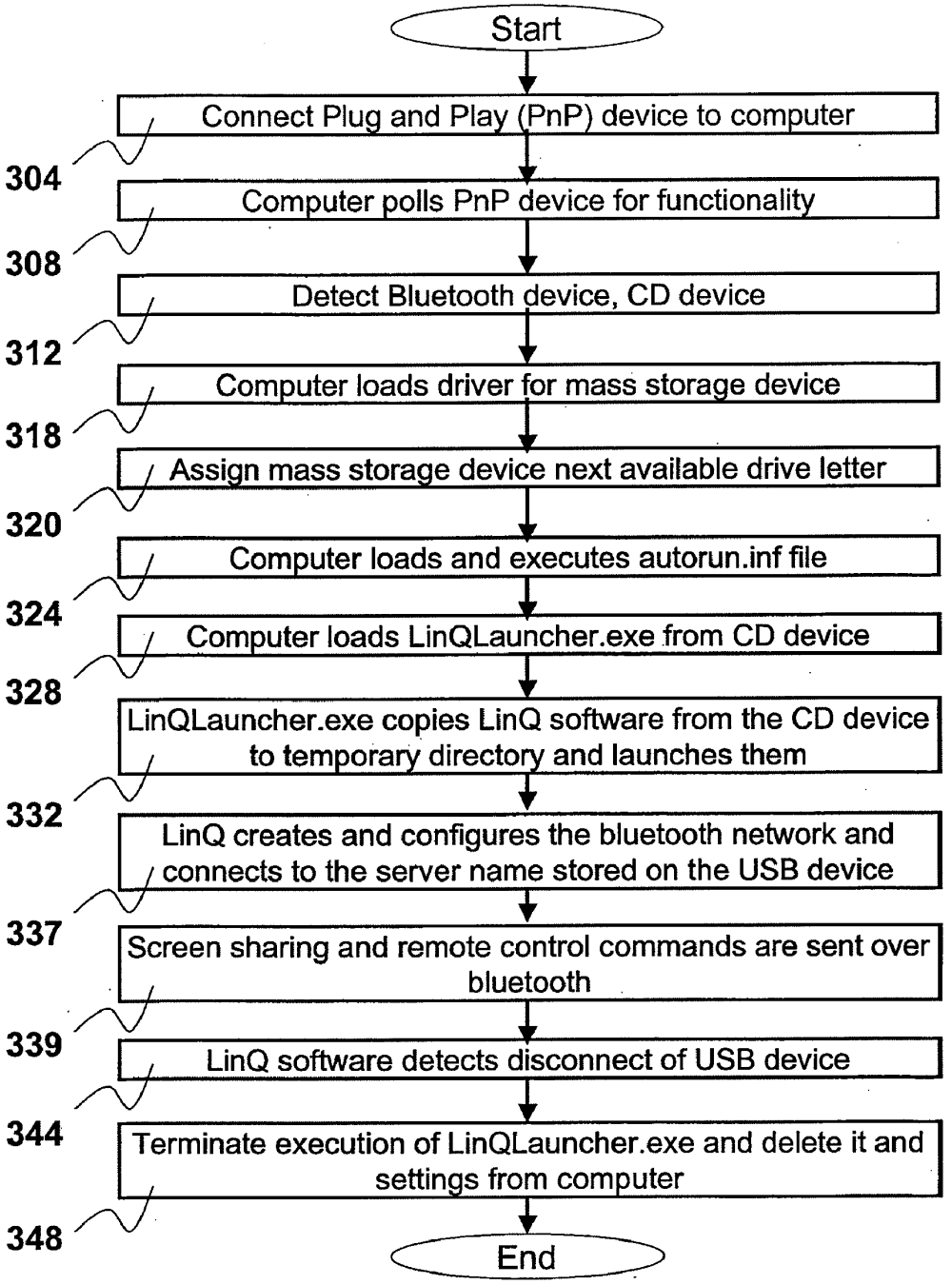

Start
Connect Plug and Play (PnP) device to computer
304
Computer polls PnP device for functionality
308
Detect Bluetooth device, CD device
312
Computer loads driver for mass storage device
318
Assign mass storage device next available drive letter
320
Computer loads and executes autorun.inf file
324
Computer loads LinQLauncher.exe from CD device
328
LinQLauncher.exe copies LinQ software from the CD device to temporary directory and launches them
332
LinQ creates and configures the bluetooth network and connects to the server name stored on the USB device
337
Screen sharing and remote control commands are sent over bluetooth
339
LinQ software detects disconnect of USB device
344
Terminate execution of LinQLauncher.exe and delete it and settings from computer
348
End

FIG. 6

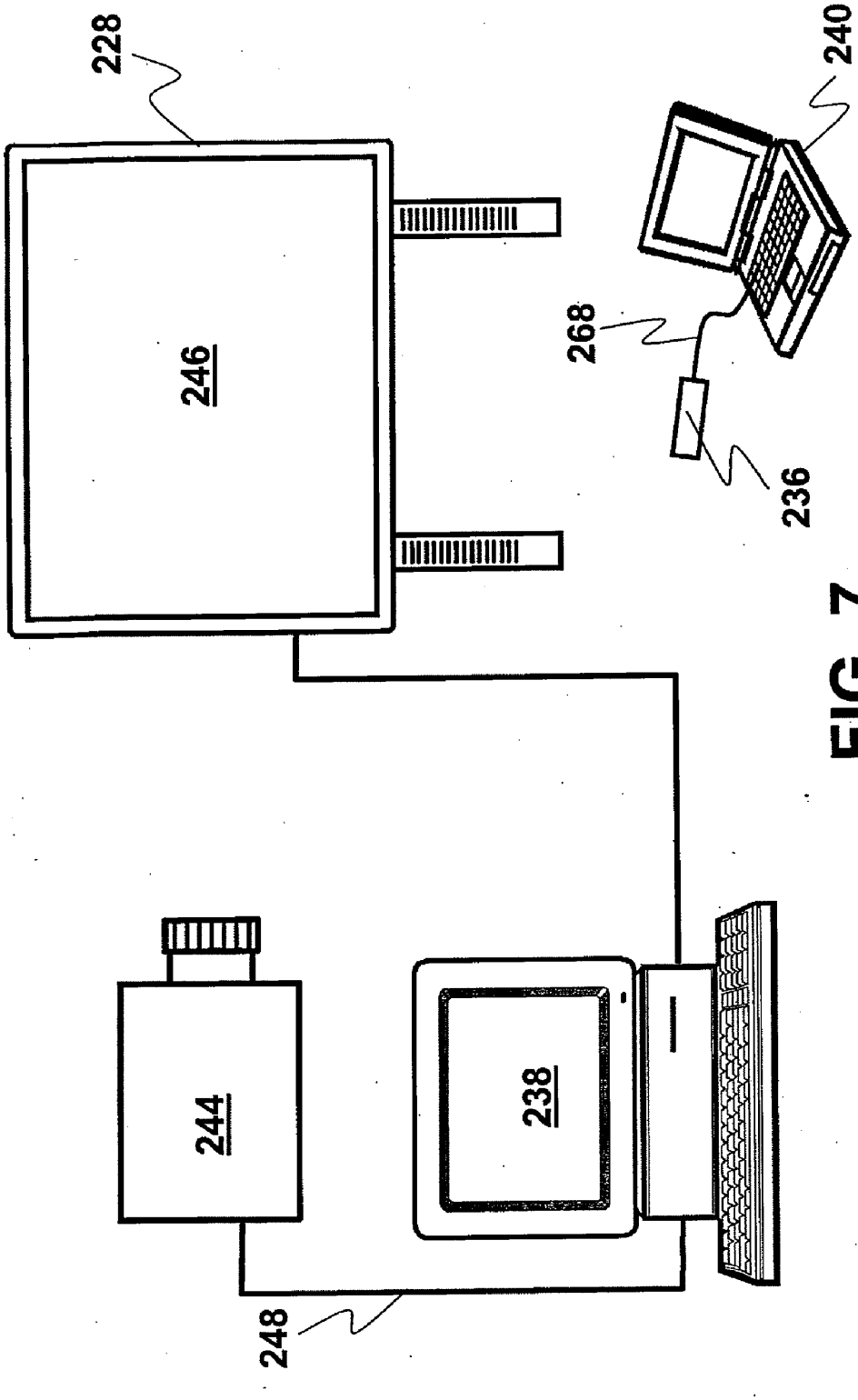


FIG. 7

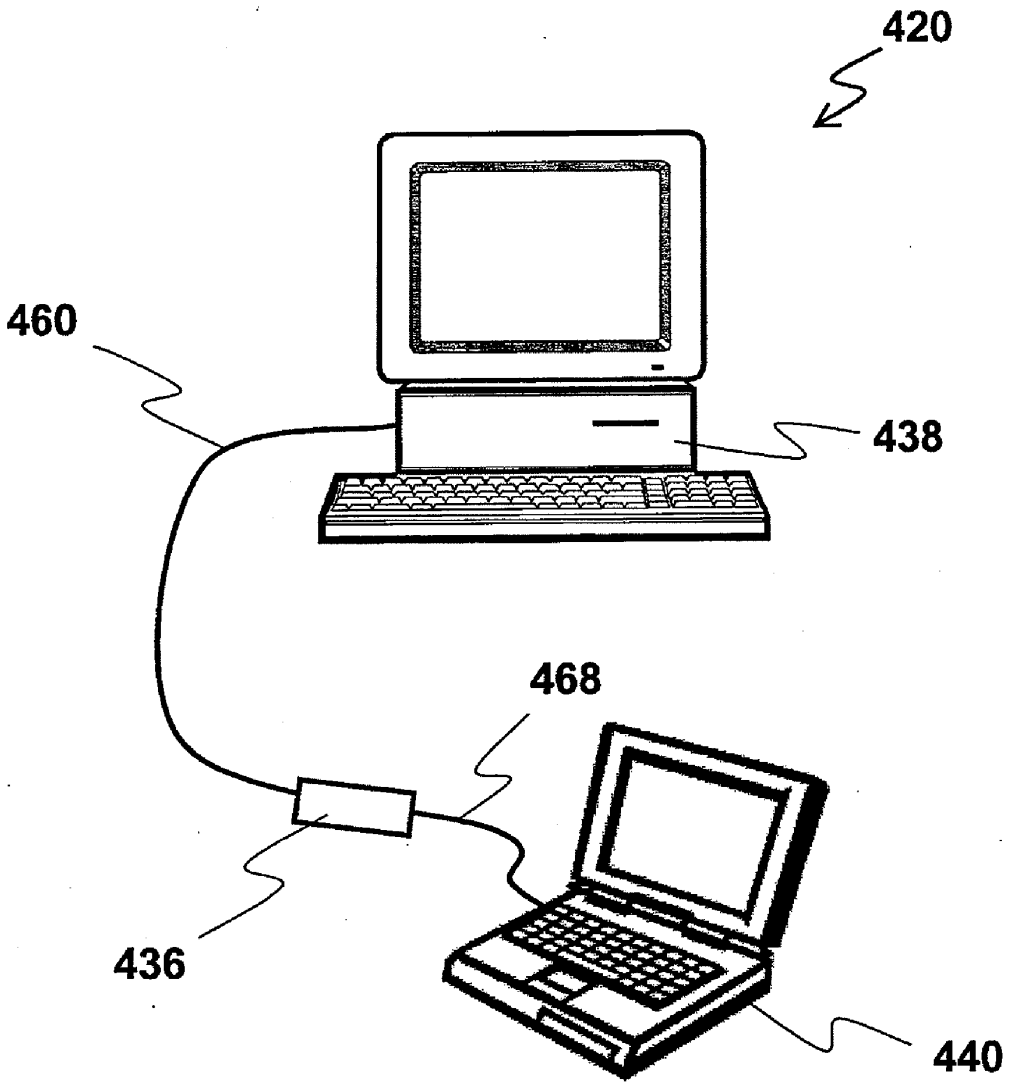


FIG. 8

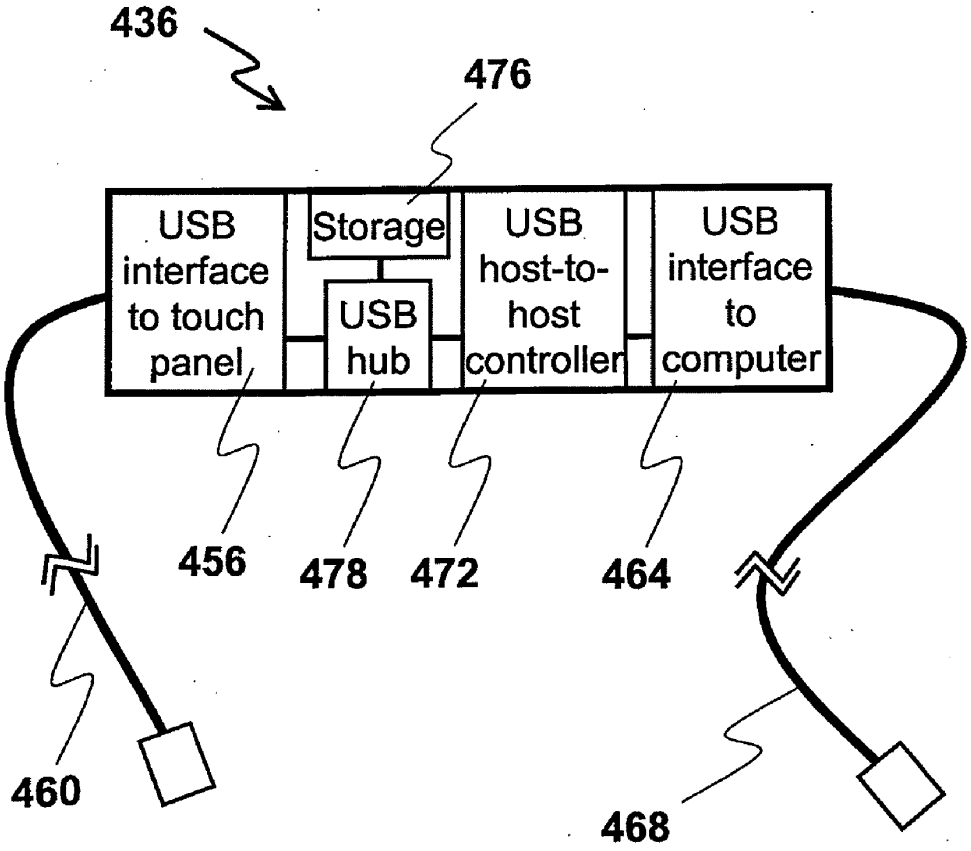

436
476
USB interface to touch panel
Storage
USB hub
USB host-to-host controller
USB interface to computer
456
478
472
464
460
468

FIG. 9

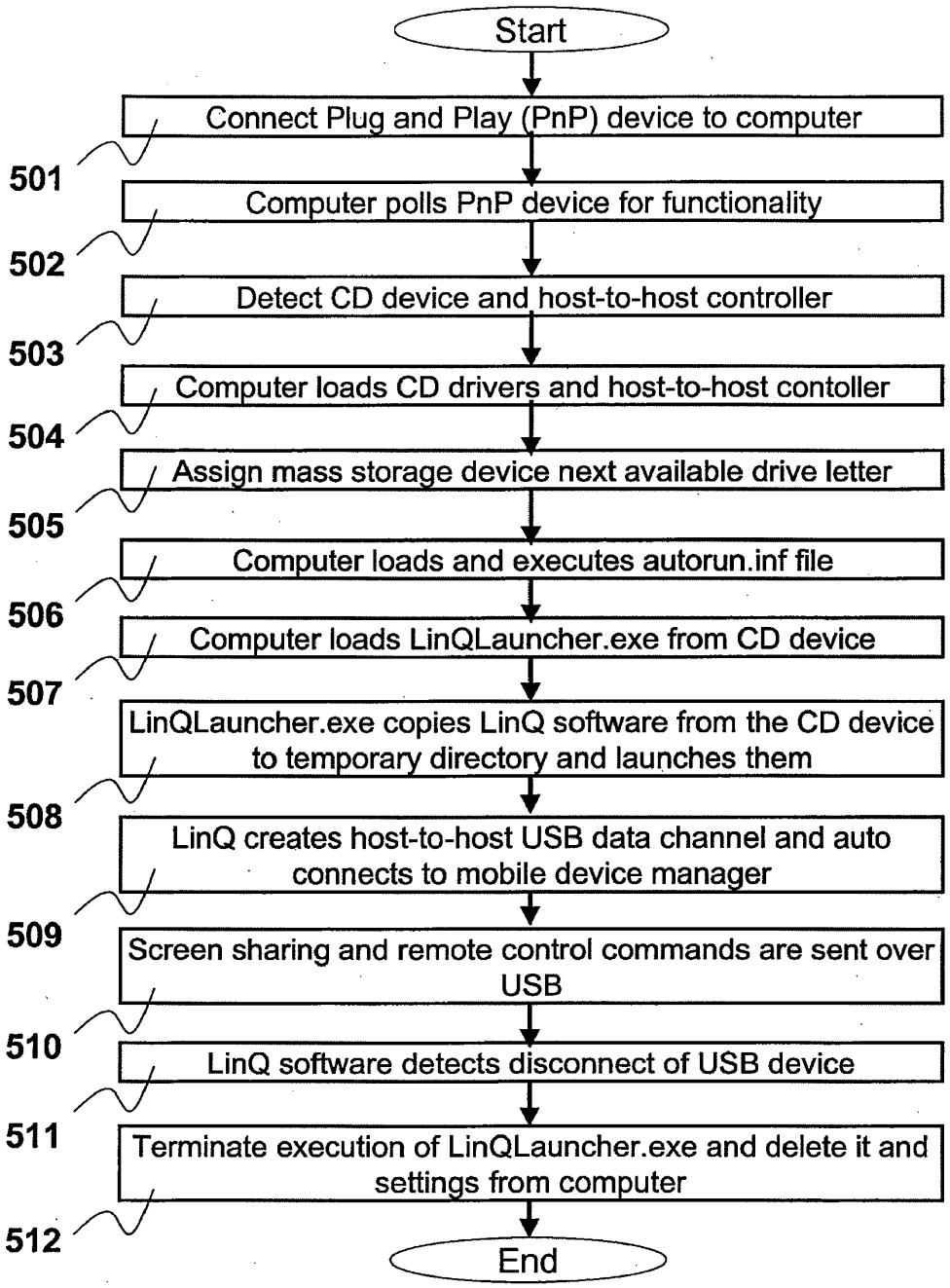

Start
Connect Plug and Play (PnP) device to computer
501
Computer polls PnP device for functionality
502
Detect CD device and host-to-host controller
503
Computer loads CD drivers and host-to-host contoller
504
Assign mass storage device next available drive letter
505
Computer loads and executes autorun.inf file
506
Computer loads LinQLauncher.exe from CD device
507
LinQLauncher.exe copies LinQ software from the CD device to temporary directory and launches them
508
LinQ creates host-to-host USB data channel and auto connects to mobile device manager
509
Screen sharing and remote control commands are sent over USB
510
LinQ software detects disconnect of USB device
511
Terminate execution of LinQLauncher.exe and delete it and settings from computer
512
End

FIG. 10

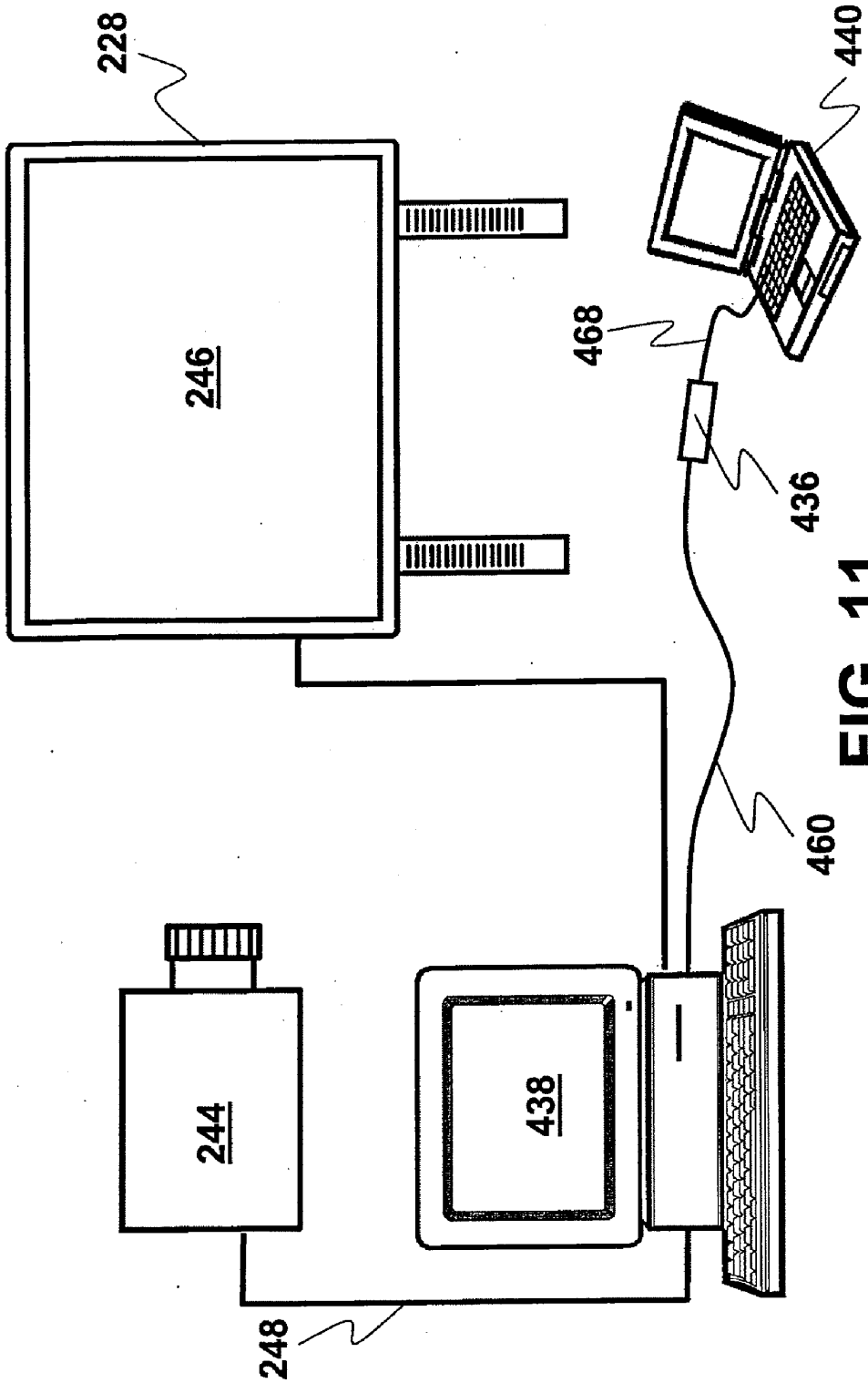


FIG. 11

PLUG-AND-PLAY DEVICE AND METHOD OF USING THE SAME

RELATED APPLICATION

[0001] The subject application is a continuation-in-part of U.S. patent application Ser. No. 11/420,600 to Hill et al. filed on May 26, 2006 for an invention entitled "Plug-And-Play Device And Method Of Using The Same", the contents of which are incorporated herein by reference.

FIELD

[0002] The subject application relates generally to computer peripheral devices and, more specifically, to a plug-and-play device and a method of using the same.

BACKGROUND

[0003] Plug-and-play devices are well known and many types of plug-and-play standards exist, including for example universal serial bus ("USB"), IEEE1394 ("FireWire") and PCMCIA ("PC Card"), with the most common being USB. Such plug-and-play devices have a set of functionality that is accessible to a computer through a plug-and-play interface. The functionality of common plug-and-play devices can include, but is not limited to, storage, input registration, image capturing, audio input and output, etc. The sets of functionality available on common plug-and-play devices are pre-defined as device classes. Upon connection of a plug-and-play device to a computer, an electronic circuit is completed and the operating system of the computer is alerted to the connection. The operating system in response polls the plug-and-play device to determine what functionality is available on the plug-and-play device.

[0004] Many operating systems possess a number of pre-loaded drivers for generic plug-and-play device classes, such as USB mass storage, a two-button mouse, etc. If the operating system is in possession of a driver for the device class of the plug-and-play device connected to the computer, the computer loads the driver so that the functionality of the plug-and-play device can be accessed by the computer. If the operating system does not possess a driver corresponding to the device class of the plug-and-play device, the operating system typically prompts the user to install the appropriate software to enable the computer to access the functionality of the plug-and-play device.

[0005] U.S. Patent Application Publication No. 2004/0205778 to Wong et al. discloses a peripheral device that includes driver storage. The peripheral device connects to a computer via a plug-and-play interface and cycles through the emulation of a number of plug-and-play device classes recognized by the operating system until one is found that permits auto-execution of a driver installation program.

[0006] U.S. Patent Application Publication No. 2005/0038934 to Gotze et al. discloses a USB-based peripheral printer that can be conditioned between two modes. In a first mode, the printer emulates USB mass storage to permit installation of drivers stored in memory of the printer on a computer to which the printer is connected. Once the drivers are installed on the computer, the printer is conditioned to a second mode, in which the printer behaves as a printer.

[0007] The need to install software/drivers can be undesirable in a number of situations, such as where a user does not possess administrative rights for the computer or simply does not desire to install yet more software on the computer, especially where connection of the plug-and-play device to the computer is infrequent or a one-time affair. Installing software may also prove to be a difficult or complicated task. For example, the user may need to download software from the Internet or may need to locate media upon which the software/drivers are located.

[0008] When the plug-and-play device is a touch panel, calibration to map the coordinate system of the input field of the touch panel to the display coordinate system of the computer to which the plug-and-play device is connected is typically required in order to ensure proper registration of touch input. Following the calibration process, the calibration settings are registered and stored by the computer. Unfortunately, because the computer stores the calibration settings, when the touch panel is plugged into a computer to which it was not previously connected, the calibration process must be carried out again in order to establish the calibration settings on the new computer.

SUMMARY

[0009] Accordingly, in one aspect there is provided a plug-and-play device comprising: a first plug-and-play interface for establishing a connection with a first computing device; a second plug-and-play interface for establishing a connection with a second computing device; storage storing code that is automatically executed by the second computing device when said plug-and-play device is connected thereto via said second plug-and-play interface, said code when executed initiating a screen display data exchange between said first and second computing devices; and at least one controller controlling said first plug-and-play interface, said second plug-and-play interface and said storage.

[0010] In one embodiment, the first plug-and-play interface comprises a wireless transceiver and establishes a wireless connection with the first computing device. The wireless connection may be a secure wireless connection. In this case, the storage further stores at least one of at least one key, at least one biometric and at least one code that is used to establish the secure wireless connection. The plug-and-play device further comprises a physical connection to the second computing device. The physical connection may be in the form of a universal serial bus cable or the plug-and-play device may be configured as a dongle.

[0011] In another embodiment, the plug-and-play device comprises a physical connection to the first computing device and a physical connection to the second computing device. Each physical connection may be in the form of a universal serial bus cable.

[0012] The screen display data exchange may comprise transmission of second computing device display screen data to the first computing device. The second computing device display screen data is compressed prior to transmission to the first computing device. Differences between previously transmitted second computing device display screen data and current second computing device display screen data are transmitted. The code when executed may also permit file sharing between the first and second computing devices through the plug-and-play device.

[0013] The screen display data exchange alternatively may comprise transmission of first computing device display screen data to the second computing device. Similarly, the first computing device display screen data is compressed prior to transmission to the second computing device. Differ-

ences between previously transmitted first computing device display screen data and current first computing device display screen data are transmitted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Embodiments will now be described with reference to the accompanying drawings in which:

[0015] FIG. **1** shows a plug-and-play device comprising a touch panel, a controller and a cable, coupled to a computer;

[0016] FIG. **2** is a schematic diagram of the cable of FIG. **1**;

[0017] FIG. **3** is a flow chart of the general operation of the plug-and-play device of FIG. **1**;

[0018] FIG. **4** shows another plug-and-play device allowing for screen sharing between a master computer and a remote computer;

[0019] FIG. **5** is a schematic diagram of the plug-and-play device of FIG. **4**;

[0020] FIG. **6** is a flow chart of the general operation of the plug-and-play device of FIG. **4**;

[0021] FIG. **7** shows the plug-and-play device of FIG. **4** with a touch panel and projector communicating with the master computer;

[0022] FIG. **8** shows yet another plug-and-play device allowing for bi-direction screen sharing between a master computer and a remote computer;

[0023] FIG. **9** is a schematic diagram of the plug-and-play device of FIG. **8**;

[0024] FIG. **10** is a flow chart of the general operation of the plug-and-play device of FIG. **8**; and

[0025] FIG. **11** shows the plug-and-play device of FIG. **8** with a touch panel and projector communicating with the master computer.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] Turning now to FIG. **1**, a system or network **20** of operatively connected components is illustrated. As can be seen, system **20** comprises a plug-and-play (PnP) device **24** for receiving and digitizing input. In this embodiment, the plug-and-play device **24** comprises an interactive input system that includes a touch panel **28**, a controller **32** and a cable **36**. Touch panel **28** may be of the type employing analog resistive or machine vision technology to register pointer input such as those disclosed in U.S. Pat. Nos. 5,448,263; 6,141,000; 6,337,681; 6,747,636; 6,803,906; 7,232,986; 7,236,162; and 7,274,356 and in U.S. Patent Application Publication No. 2004/0179001 assigned to SMART Technologies ULC of Calgary, Alberta, Canada, assignee of the subject application, the contents of which are incorporated by reference. Alternatively, touch panel **28** may be of the type employing electromagnetic, capacitive, acoustic or other technologies to register pointer input. The controller **32** controls the operation of the touch panel **28** and is in communication with a computer **40** via the cable **36**. The computer **40** is also connected to a projection unit **44** such as for example, a liquid crystal display (LCD) projector, via a video graphics array (VGA) cable **48** and controls the LCD projector **44**. In response to image data received from the computer **40**, the LCD projector **44** projects images onto a touch surface **46** of the touch panel **28**. The LCD projector **44** may be positioned in front of or behind the touch panel **28**.

[0027] The touch panel **28** provides a user with the ability to interact with the image projected onto the touch surface **46** of the touch panel **28** and inject input into an application program running on the computer **40** using an active pointer (e.g. a pointer that emits light, sound or other signal) or a passive pointer (e.g. a finger, cylinder or other object). Although the touch panel **28** requires no extra software other than that provided by the operating system of the computer **40** in order to work as a mouse, the functionality of the touch panel **28** can be greatly enhanced by additional software not available on the operating system of the computer **40**, as will be described below.

[0028] The controller **32** comprises a processor (not shown) that executes firmware stored in non-volatile storage. Generally, the firmware causes the controller **32** to operate in one of two operational modes. In an initial mode, the controller **32** operates two USB profiles, namely an absolute mouse human interface device ("HID") profile and a SMARTBoard HID profile. The absolute mouse HID profile enables the controller **32** to relay absolute position information for a pointer contacting the touch surface **46** of the touch panel **28** along with basic mouse functions. The SMARTBoard HID profile is a device class that enables enhanced functionality for the touch panel **28**. The enhanced functionality comprises all of the functionality available in the absolute mouse HID device class as well as inking information, additional tool information (buttons, eraser, pen selection, etc.) and two-way communications with the controller **32**. In a "native" operating mode, the controller **32** terminates the absolute mouse HID profile and only operates the SMARTBoard HID profile.

[0029] The components of the cable **36** are better illustrated in FIG. **2**. As can be seen, the cable **36** comprises a USB hub component **52** having a USB interface **56** for connection to a USB cable segment **60** that extends to the touch panel **28**, and a USB interface **64** for connection to a USB cable segment **68** that extends to the computer **40**. Both USB interfaces **56**, **64** are in communication with a USB hub **72**. Also in communication with the USB hub **72** is storage **76**, namely flash memory, solid-state memory or other suitable computer memory. The storage **76** is configured to operate in accordance with a mass storage device and defines itself as compact disk read only memory (CD-ROM) according to the compact disk ("CD") HID profile. Storage **76** stores a set of software applications, including a user application (SMARTBoardTools.exe), a service application (SMARTBoardService.exe), a launcher application (SBLauncher.exe), a calibration application (SMARTBoardCalibrate.exe) and an autorun feature (autorun.inf) for a Windows® operating system file that references the launcher application. Further, the storage **76** stores calibration settings associated with the configuration of the system **20**. In particular, the calibration settings include data for mapping touch coordinates generated by the touch panel **28** in response to pointer contacts with the touch surface **46** to the display coordinate system of the computer **40**.

[0030] The SMARTBoardTools.exe user application permits a richer set of features than basic mouse functionality. In this embodiment, the SMARTBoardTools.exe user application contains a number of presentation applications, integration into popular drawing and presentation applications, and an application to allow users to ink over documents in any application or over the desktop of the graphical user interface of the computer **40** that is projected and displayed on the touch surface **46** of the touch panel **28**.

[0031] The method of operation of the plug-and-play device **24**, when the plug-and-play device **24** is connected to

a new computer **40** that has not been previously connected to the plug-and-play device, is shown in FIG. **3**. When a session is commenced and the plug-and-play device **24** is connected to the computer **40** (step **104**), and the connection of the plug-and-play device **24** to the computer **40** is detected by the operating system of the computer **40**, the computer **40** queries the plug-and-play device **24** to determine what functionality is provided by the plug-and-play device **24** (step **108**). As the USB hub **72** is connected to storage **76** as well as the controller **32**, the USB hub **72** queries both the storage **76** and the controller **32** to determine what profiles are available. In this embodiment, the storage **76** responds by indicating that it supports the CD HID profile. The controller **32**, in the initial mode, responds by indicating that it supports the absolute mouse HID profile and the SMARTBoard HID profile.

[0032] The computer **40**, upon receiving the available HID profiles, detects that functionality corresponding to the absolute mouse HID profile, the SMARTBoard HID profile and CD HID profile is available (step **112**). The computer **40** then loads the drivers for the devices recognized by the operating system for which the operating system has drivers, in this example the absolute mouse HID and CD HID (step **116**). As each of these sets of functionality is detected by the computer **40**, the computer **40** recognizes them as separate devices. The computer **40** does not load the SMARTBoard HID profile as the operating system of the computer **40** does not possess a corresponding driver. The computer **40** then assigns the plug-and-play device **24** which is recognized as a CD HID device, the next available drive letter (step **120**).

[0033] Computer **40** is configured as the majority of computers are by default; that is, the computer **40** is configured to search CD HID devices for an autorun.inf file that will direct the computer **40** to automatically execute a specific application upon connection to a CD HID device. Accordingly, the computer **40** queries the plug-and-play device **24** that has been recognized as a CD HID device for an autorun.inf file and upon receiving the autorun.inf file, loads and executes the instructions contained therein (step **124**). The autorun.inf file is used by the Microsoft Windows® family of operating systems to execute, under certain conditions, the instructions contained therein upon detection of certain types of storage devices. For example, under certain conditions, the autorun.inf file is executed when a CD-ROM disk, containing the autorun.inf file, is inserted into the bay of a CD-ROM drive. Execution typically begins without delay after the information in the autorun.inf file becomes available to or is recognized by the computer operating system.

[0034] The autorun.inf file contains a pointer to the executable launcher application, SBLauncher.exe. Upon parsing the autorun.inf file, the computer **40** uses the pointer to obtain the SBLauncher.exe launcher application from the storage **76**, along with a set of corresponding dynamic link libraries ("DLLs"), and executes the SBLauncher.exe launcher application (step **128**). The SBLauncher.exe launcher application, when executed, directs the computer **40** to copy the SMARTBoardTools.exe user application and the SMARTBoardService.exe service application, along with some associated DLLs, from the storage **76** to a temporary directory on the computer **40** and then execute the SMARTBoardTools.exe user and SMARTBoardService.exe service applications (step **132**). Upon execution of the SMARTBoardService.exe service application, the SBLauncher.exe launcher application terminates execution and the SMARTBoardService.exe service application directs the computer **40** to send a command to the controller **32** to switch the controller to the SMARTBoard HID mode (step **136**).

[0035] Upon launch, the SMARTBoardTools.exe user application queries and obtains from storage **76** the calibration settings and other settings (step **140**). The calibration settings enable the SMARTBoardTools.exe user application to map touch input generated by the touch panel **28** in response to pointer contacts with the touch surface **46** to the display coordinate system of the computer **40**. The other settings include pen tray settings, COM port settings, contact filter settings and user settings for software applications. All of these settings are stored in a standard Windows® INI file. Further, several XML files are used to store layout and menu settings for various applets forming part of the SMARTBoardTools.exe user application. These applets provide a floating window of toolbuttons for accessing various functionality, an on-screen keyboard, etc. These layout and menu settings are stored in XML files in the storage **76** of the plug-and-play device **24**, and are loaded and saved in a directory ("C:\Documents and Settings\<user name>\Application Data\SMART Technologies\SMARTBoard Software\") during execution of the SMARTBoardTools.exe user application, where <user name> is the login name of the current user.

[0036] Upon obtaining the calibration settings, the SMARTBoardTools.exe user application maps touch input generated by the touch panel **28** in response to pointer contacts with the touch surface **46** to the display coordinate system of the computer **40**. In this manner, the user is able to interact effectively with the image projected onto the touch surface **46** of the touch panel **28** by the LCD projector **44**. During execution, some settings are stored in the "HKEY_CURRENT_USER" key of the registry and, in particular, in the "Software\SMART Technologies\SMARTBoard Software\" subkey. These settings include application window positions, user settings for each application and a list of recently used files. The "HKEY_CURRENT_USER" key is used as there are generally no restrictions on modifications made to this key. In addition, if there are no access restrictions on the "HKEY_LOCAL_MACHINE" key, spell checker settings are written there.

[0037] Upon termination of the session, the computer **40** can be unplugged from the plug-and-play device **24** and removed. When the plug-and-play device **24** is disconnected from the computer **40**, the computer **40** notifies the SBLauncher.exe launcher application (step **144**). The SBLauncher.exe launcher application in turn proceeds to terminate execution of and delete the SMARTBoardTools.exe user application, the SMARTBoardService.exe service application, the various related DLLs and settings from the temporary locations on the computer **40** and then does the same for itself (step **148**). Before termination of the SBLauncher.exe launcher application, the SBLauncher.exe launcher application writes the user settings stored in the "C\Documents and Settings\<user name>\Application Data\SMART Technologies Inc.\SMARTBoard Software\" directory to XML files which it then stores in storage **76** of the plug-and-play device **24**. The SBLauncher.exe launcher application then deletes the user settings from the directory and those stored in the registry. Once the settings and files are deleted from the computer **40**, the SBLauncher.exe launcher application places an entry in the HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run Once registry key which tells Windows to delete the SBLauncher.

exe launcher application when the user logs in next, and then terminates execution. If the user stops the SMARTBoard software by closing the SMARTBoardTools.exe user application, then the SBLauncher.exe launcher application executes the instance of itself found in the storage **76** of the plug-and-play device **24**. Upon execution of the SBLauncher.exe launcher application instance from the plug-and-play device **24**, the instance of the SBLauncher.exe launcher application stored on the computer **40** is deleted.

[0038] As noted above, in order for touch input generated by the touch panel **28** in response to pointer contacts with the touch surface **46** to be mapped to the display coordinate system of the computer **40**, the system **20** is calibrated. As the spatial relation between the image projected onto the touch surface **46** of the touch panel **28** by the LCD projector **44** and the touch panel **28** changes only when the LCD projector **44** and the touch panel **28** are moved relative to one another, calibration is generally performed after the touch panel **28** and LCD projector **44** are fixed at a location. In order to calibrate the system **20**, the SMARTBoardCalibrate.exe calibration application is launched. Once the SMARTBoardCalibrate.exe calibration application is launched, the user is prompted to touch a number of points on the image that is projected onto the touch surface **46** of the touch panel **28**. The resulting touch panel output is used to determine calibration settings which map the raw touch coordinates generated by the touch panel **28** in response to the pointer contacts on the touch surface **46** to the display coordinate system of the computer **40**. The calibration settings are then recorded in the Windows® INI file so that they can be used by other computers to map raw touch coordinates generated by the touch panel **28** in response to the pointer contacts on the touch surface **46** to the display coordinate system of the computer **40**. This process allows for calibration at system installation and subsequent use of the calibration settings by all users of the system **20**.

[0039] Turning now to FIG. **4**, another system or network **220** of operatively connected components is shown. As can be seen, system **220** comprises a plug-and-play device **236**, a master computer **238** and at least one remote computer **240**. The plug-and-play device **236** is physically connected to the remote computer **240** and communicates with the master computer **238** over a wireless communications link. In this embodiment, plug-and-play device **236** captures and compresses screen display data generated at the remote computer **240** and allows screen sharing between the remote computer **240** and the master computer **238** by automatically launching software stored on the plug-and-play device **236**.

[0040] In this embodiment, the master computer **238** comprises a wireless communication device **238***a,* for example a radio frequency (RF) communication device such as a Bluetooth™, WiFi or other RF adapter, or an infrared (IR) communication device. The master computer **238** also runs a mobile device manager software application to accept and manage connections from the remote computer **240**, provide screen sharing functionality, allow remote control from the remote computer **240**, and optionally, provide the remote computer **240** with Internet access.

[0041] The components of the plug-and-play device **236** are better illustrated in FIG. **5**. As can be seen, the plug-and-play device **236** comprises an interface **256** in the form of a USB interface to wireless communication device adapter connected to a wireless transceiver **260**. Similar to wireless communication device **238***a,* the wireless transceiver **260** is, for example, an RF communication device such as a Bluetooth™, WiFi or other RF adapter, or an infrared (IR) communication device. The wireless communication device **238***a* and wireless transceiver **260** are paired to enable a peer-to-peer wireless connection between the master computer **238** and the remote computer **240** to be established. The plug-and-play device **236** also comprises an interface **264** in the form of a USB interface to computing device adapter. The interface **264** comprises a port (not shown) to receive a cable segment **268** thereby to enable the physical connection to the remote computer **240** to be made. Both interfaces **256** and **264** are also in communication with a controller **272** in the form of a USB hub.

[0042] Controller **272** also communicates with storage **276** that is configured to store and automatically launch software applications thereon via an autorun feature that the operating system of the remote computer **240** supports. Similar to the previous embodiment, storage **276** is flash memory, solid-state memory or other non-volatile computer memory. The storage **276** is configured to operate in accordance with a mass storage device and defines itself as compact disk read only memory (CD-ROM). Storage **276** stores an executable launcher application, LinQLauncher.exe and may also store one or more access codes, biometrics or keys to automatically form a secure encrypted and authenticated wireless network connection with the master computer **238**.

[0043] The operation of the system **220**, when a peer-to-peer wireless connection between the master computer **238** and the remote computer **240** is established, will now be described with particular reference to FIG. **6**. When the plug-and-play device **236** is physically connected to the remote computer **240** via the cable segment **268** (step **304**) and the connection of the plug-and-play device **236** is detected by the operating system of the remote computer **240**, the remote computer **240** queries the plug-and-play device **236** to determine what functionality is provided by the plug-and-play device **236** (step **308**). In particular, the controller **272** queries the wireless transceiver **260** and the storage **276** to determine what profiles or connections are available. In this embodiment, the storage **276** responds by indicating that it supports the mass storage device and the wireless transceiver **260** responds by indicating its device type, interface profile and other parameters such as for example wireless network protocol, wireless network speed, encryption keys, biometrics, etc. The plug-and-play device **236** then returns the determined functionality information to the remote computer **240**.

[0044] The remote computer **240**, upon receiving the functionality information from the plug-and-play device **236**, determines that mass storage device and wireless communications functionality for the plug-and-play device **236** is available (step **312**). The remote computer **240** then loads at least the driver for the mass storage device recognized by its operating system and initializes the plug-and-play device **236** (step **316**). The remote computer **240** then assigns the plug-and-play device **236** which is recognized as a mass storage device the next available drive letter (step **320**).

[0045] The remote computer **240**, similar to the previous embodiment, is configured as the majority of computers are by default; that is, the remote computer **240** is configured to search mass storage devices for a file name that will direct the remote computer **240** to automatically execute instructions contained therein upon connection to a mass storage device. In this embodiment, the remote computer **240** queries the plug-and-play device **236** for the autorun.inf file and upon

receiving the autorun.inf file, loads and executes the instructions contained therein (step **324**).

[0046] The autorun.inf file contains a pointer to the executable launcher application, LinQLauncher.exe stored in the storage **276**. Upon parsing the autorun.inf file, the remote computer **240** uses the pointer to load a LinQ software application from the storage **276** (step **328**). The LinQLauncher.exe application directs the remote computer **240** to copy all necessary files of the LinQ software application from storage **276** to a temporary directory on the remote computer **240** and then start the LinQ software application (step **332**). The LinQ software application is used for setting up and managing the peer-to-peer wireless connection on the remote computer **240**, screen sharing and communications between the remote computer **240** and the master computer **238**.

[0047] Upon launch, the LinQ software application loads the necessary driver for the wireless transceiver **260**, configures the wireless transceiver **260**, finds the master computer **238** and establishes the peer-to-peer wireless connection between the LinQ software application and the mobile device manager application running on the master computer **238** (step **337**). The LinQ software application, which manages the peer-to-peer wireless connection on the remote computer **240**, then reads the access codes, biometrics or keys from the storage **276**. The access codes, biometrics or keys are in turn exchanged with the master computer **238** and used as a parameter to create a secure authenticated and encrypted peer-to-peer wireless connection. The mobile device manager application running on the master computer **238** manages the peer-to-peer wireless connection on the master computer **238**. In cases where multiple systems **220** may be operating, an ad-hoc network identifier may be necessary to allow the plug-and-play device **236** to determine the appropriate network to which to connect. In such cases, the ad-hoc network identifier is configured to be read from storage **276** in similar manner to the access codes, biometrics or keys.

[0048] Once the remote computer **240** is connected to the master computer **238** over the peer-to-peer wireless connection, the remote computer **240** may send a request to share the screen display data of the remote computer **240** to the master computer **238**. If a request to share the screen display data is sent to the master computer **238** and accepted, the screen display data displayed on the remote computer **240** is compressed using a suitable compression algorithm such as for example MJPEG compression. The compressed screen display data is then compared with previous screen display data sent to the master computer **238** in the same peer-to-peer wireless connection session to detect differences in the screen display data. The detected differences are then sent to the master computer **238** via the peer-to-peer wireless connection and displayed on the screen of the master computer **238**. The master computer **238** passes input events, such as keyboard, mouse, trackball and/or pen-touch events, that it receives to the remote computer **240** thereby to remotely control the remote computer **240** (step **339**). As will be appreciated, by compressing the screen display data of the remote computer **240**, the time required to transmit the screen display data to the master computer **238** is reduced. Also, compressing the screen display data and only transmitting differences between screen display data, reduces the amount of screen display data that needs to be transmitted to the master computer **238** during screen sharing. This of course reduces the required transmission bandwidth required for screen sharing and thus, decreases latency.

[0049] When the peer-to-peer wireless connection is established between the master computer **238** and the remote computer **240**, those skilled in the art will appreciate that, besides sharing the screen display data of the remote computer **240**, file sharing between the master computer **238** and the remote computer **240** can also be carried out. To share files stored on the master computer **238**, one or more shared directories are set up on the master computer **238** with appropriate access right settings for the user of the remote computer **240**. The user of the remote computer **240** can then open the shared directories and access the files therein. Alternatively, shared directories can also be set up on the remote computer **240** with appropriate access right settings for the user of the master computer **238** and/or for users of other remote computers **240**. The user of the master computer **238** or other remote computer **240** can similarly open the shared directories and access the files therein. Further, the LinQLauncher.exe application can be configured to send files directly to and from the master and other remote computers **238** and **240** respectively.

[0050] With the peer-to-peer wireless connection established between the master computer **238** and the remote computer **240**, those skilled in the art will appreciate that the user of the remote computer **240** may also be allowed to access the Internet through the master computer **238**. To enable Internet access, the master computer **238** must be connected to the Internet via a wired or wireless local area network, dial-up network or other suitable type of network. With Internet access granted by the master computer **238**, Internet access requests initiated by the remote computer **240** are transmitted to the master computer **238** over the peer-to-peer wireless connection. The master computer **238** in response to received Internet access requests sends the received Internet access requests either directly to the Internet or indirectly to the Internet via a proxy server. Responses returned from the Internet that are received directly by the master computer **238** or indirectly by the master computer **238** from the proxy server are returned to the remote computer **240** over the peer-to-peer wireless connection.

[0051] Upon termination of the session between the remote computer **240** and the master computer **238**, the plug-and-play device **236** can be unplugged from the remote computer **240** and removed. When the plug-and-play device **236** is disconnected from the remote computer **240**, the remote computer **240** notifies the LinQLauncher.exe application (step **344**). The LinQLauncher.exe application in turn stops the screen sharing, disconnects the peer-to-peer wireless connection with the master computer **238**, terminates the execution of the LinQ software application, deletes the files in the temporary directory on the remote computer **240** that were copied from the storage **276**, and then terminates the execution of itself (step **348**). Those skilled in the art will appreciate that other clean up tasks, such as removing items in the system registry that were written by the LinQ software application when it was launched may also be performed upon the disconnection of the plug-and-play device **236** from the remote computer **240**.

[0052] Although FIG. **4** shows the master computer **238** communicating with a single remote computer **240** over a peer-to-peer wireless connection, those of skill in the art will appreciate that this is simply for ease of illustration and that the master computer **238** may communicate with a plurality of remote computers **240** over peer-to-peer wireless connections via respective plug-and-play interfaces **236**. In situations where the master computer **238** is communicating with

multiple remote computers **240** over peer-to-peer wireless connections, compressed screen display data transmitted by one remote computer **240** to the master computer **238** may also be shared by the master computer **238** with one or more other remote computers **240**. In addition, if a remote computer **240** establishes a connection to the master computer **238** over a peer-to-peer wireless connection and a peer-to-peer wireless connection between the master computer **238** and another remote computer **240** already exists over which screen display data is being shared, the master computer **238** can automatically share the screen display data with the newly connected remote computer **240**. Control commands initiated on the newly connected remote computer **240** that are sent to the master computer **238** may be sent to the remote computer that is sharing its screen display data to remotely manipulate its operation provided that remote computer has enabled remote control.

[0053] Although the remote computer **240** is described as loading the wireless transceiver driver at step **328** when the LinQLauncher.exe application is loaded from storage **276**, if desired, the driver for the wireless transceiver **260** may be loaded at step **318** when the driver for the plug-and-play device **236** which is recognized as a mass storage device is being loaded.

[0054] Similar to the embodiment of FIG. **3**, if desired, the master computer **238** can be connected to an interactive input system **228** of one of the types described previously as shown in FIG. **7**. In this case, shared screen display data received by the master computer **238** can be presented on the touch surface **246** of the interactive input system **228** via a projection device **244** that is connected to the master computer **238** by a physical cable **248** allowing a user to interact with the shared screen display data through pointer contacts with the touch surface **246**.

[0055] Those of skill in the art will appreciate that the physical form of the plug-and-play device **236** may be changed. For example, although the plug-and-play device **236** is shown as being connected to the remote computer **240** via cable segment **268**, the plug-and-play device **236** alternatively may take the form of a dongle similar to a USB flash drive or the like that plugs directly into the remote computer **240**.

[0056] In the above embodiment, rather than establishing a peer-to-peer wireless connection, alternatively, the LinQ software application may be configured to direct the remote computer **240** to use its wireless network card to establish a wireless connection between the remote computer **240** and the master computer **238** over existing network infrastructure.

[0057] FIG. **8** illustrates yet another embodiment of a system or network **420** of operatively connected components. Similar to the embodiment of FIG. **4**, system **420** comprises a plug-and-play device **436**, a master computer **438** and at least one remote computer **440**. The plug-and-play device **436** is physically connected to both the remote computer **440** and the master computer **438**. The plug-and-play device **436** enables bi-directional transmission of screen display and remote control data in real-time between the master computer **438** and remote computer **440** by automatically launching software stored on the plug-and-play device **436**.

[0058] The master computer **438**, similar to the previous embodiment, runs a mobile device manager application to accept and manage connections from the remote computer **440**, provide bidirectional screen sharing functionality, allow remote control from the remote computer **440**, and optionally, provide the remote computer **440** with Internet access.

[0059] The components of the plug-and-play device **436** are better illustrated in FIG. **9**. As can be seen, the plug-and-play device **436** comprises an interface **456** in the form of a USB interface to computing device adapter and an interface **464** also in the form of a USB interface to computing device adapter. The interface **456** comprises a port (not shown) to receive a cable segment **460** that extends and connects to the master computer **438**. The interface **464** also comprises a port (not shown) to receive a cable segment **468** that extends and connects to the remote computer **440**. The plug-and-play device **436** also comprises a controller **472** in the form of a USB host-to-host controller, and a USB hub **478**. The USB host-to-host controller **472** allows bi-direction screen data sharing in real-time between the remote computer **440** and the master computer **438**. The interface **456** is in communication with the USB hub **478** and the interface **464** is in communication with the USB host-to-host controller **472**. The USB hub **478** communicates with the USB host-to-host controller **472**.

[0060] Also in communication with the USB hub **478** is storage **476**, for example flash memory, solid-state memory or other suitable computer memory. The storage **476** is configured to store and automatically launch software applications thereon via an autorun feature that the operating system of the remote computer **440** supports. The storage **476** is configured to operate in accordance with a mass storage device that defines itself as a CD ROM. Similar to the previous embodiment, storage **476** stores the executable LinQLauncher.exe application.

[0061] The operation of the system **440** when a connection between the master computer **438** and the remote computer **440** via the plug-and-play device **436** is established will now be described with particular reference to FIG. **10**. When the plug-and-play device **436** is physically connected to the remote computer **440** via the cable segment **468** (step **501**) and the connection of the plug-and-play device **436** is detected by the operating system of the remote computer **440**, the remote computer **440** queries the plug-and-play device **436** to determine what functionality is provided by the plug-and-play device **436** (step **502**). In response to this query, the plug-and-play device **436** determines that it supports the mass storage device and USB host-to-host controller and returns this functionality information to the remote computer **440**.

[0062] The remote computer **440**, upon receiving the functionality information from the plug-and-play device **436**, determines that mass storage device and USB host-to-host controller functionality for the plug-and-play device **436** is available (step **503**). The remote computer **440** then loads at least the driver for the mass storage device recognized by its operating system and initializes the plug-and-play device **436** (step **504**). The remote computer **440** then assigns the plug-and-play device **436** which is recognized as a mass storage device, the next available drive letter (step **505**).

[0063] The remote computer **440**, similar to the previous embodiments, is configured as the majority of computers are by default; that is, the remote computer **440** is configured to search the mass storage devices for a file name that will direct the remote computer **440** to automatically execute instructions contained therein upon connection to the mass storage device. In this embodiment, the remote computer **440** queries the plug-and-play device **436** for the autorun.inf file and upon

receiving the autorun.inf file, loads and executes the instructions contained therein (step **506**).

[0064] The autorun.inf file contains a pointer to the executable launcher application, LinQLauncher.exe stored in storage **476**. Upon parsing the autorun.inf file, the remote computer **440** uses the pointer to load a LinQ software application from the storage **476** (step **507**). The LinQLauncher.exe application directs the remote computer **440** to copy all necessary files of the LinQ software application from storage **476** to a temporary directory on the remote computer **440** and then start the LinQ software application (step **508**). The LinQ software application is used for setting up and managing the connection on the remote computer **440**, screen sharing and other communications between the remote computer **440** and the master computer **438**.

[0065] In this embodiment, the mass storage device functionality of the plug-and-play device **436** is only exposed to the remote computer **440**. The mobile device manager software application running on the master computer **438** detects the insertion of cable segment **460** and communicates with it through a pre-installed driver on the master computer **438**.

[0066] Upon launch, the LinQ software application on the remote computer **440** finds the master computer **438** and establishes a USB host-to-host data channel between the remote computer **440** and master computer **438** and automatically connects to the mobile device manager software application running on the master computer **438** (step **509**). The mobile device manager software application running on the master computer **438** manages the connection on the master computer **438**.

[0067] Once the remote computer **440** is connected to the master computer **438**, the remote computer **440** may send a request to share the screen display data of the remote computer **440** with the master computer **438**. If a request to share the screen display data is sent to the master computer **438** and accepted, the screen display data of the remote computer **440** is compressed, sent to the master computer **438** and displayed on the screen of the master computer **438**. The master computer **438** passes input events, such as keyboard, mouse, trackball and/or pen-touch events, that it receives to the remote computer **440** thereby to remotely control the remote computer **440** (step **510**). As mentioned previously, the advantage of compressing the screen display data of the remote computer **440** before sending it to the master computer **438** is that the amount of data required to be transmitted to the master computer **438** is reduced. This of course reduces the transmission bandwidth and latency required for screen sharing.

[0068] If at the time the remote computer **440** is connected to the master computer **438** and another remote computer **440** in the network is sharing its screen display data with the master computer **438**, the remote computer **440** automatically receives the compressed screen display data from the master computer **438**, decompresses it and displays it on its display screen. Also, control commands initiated on the other remote computer **440** may be sent to the master computer **438** and then to the remote computer **440** to enable operation of the remote computer **440** to be remotely controlled provided the remote computer has enabled remote control.

[0069] If desired, the remote computer **440** can be configured to display the master computer desktop image on its display screen and pass input events, such as keyboard, mouse, trackball and/or pen-touch events that it receives to the master computer **438** to remotely control the master computer **438** provided the master computer has enabled remote control.

[0070] When the connection is established between the master computer **438** and the remote computer **440**, those skilled in the art will appreciate that, besides sharing the screen display data of the remote computer **440**, file sharing between the master computer **438** and the remote computer **440** can also be carried out. To share files stored on the master computer **438**, one or more shared directories are set up on the master computer **438** with appropriate user access right settings for the user of the remote computer **440**. The user of the remote computer **440** can then open the shared directories and access the files therein. Alternatively, shared directories can also be set up on the remote computer **440** with appropriate access right settings for the user of the master computer **438** and/or for users of other remote computers **440**.

[0071] With the connection established between the master computer **438** and the remote computer **440**, those skilled in the art will appreciate that the user of the remote computer **440** may also be allowed to access Internet through the master computer **438**. To enable the Internet access, the master computer **438** must be connected to the Internet via a wired or wireless local area network, dial-up network or any other type of network. With the allowance of Internet access granted by the user of the master computer **438**, Internet access requests initiated by the remote computer **440** are transferred to the master computer **438**. Responses returned from the Internet that are received directly by the master computer **438** or indirectly by the master computer **438** from the proxy server are returned to the remote computer **440**.

[0072] Upon termination of the session between the remote computer **440** and the master computer **438**, the plug-and-play device **436** can be unplugged from the remote computer **440** and removed. When the plug-and-play device **436** is disconnected from the remote computer **440**, the remote computer **440** notifies the LinQLauncher.exe application (step **511**). The LinQLauncher.exe application in turn stops the screen sharing, disconnects the connection with the master computer **438**, terminates the execution of the LinQ software application, deletes the files in the temporary directory on the remote computer **440** that were copied from the storage **476**, and then terminates the execution of itself (step **512**). Those skilled in the art will appreciate that other clean up tasks, for example removing items in the system registry that were written by the LinQ software application when it was launched, may be performed upon the disconnection of the plug-and-play device **436** from the remote computer **440**.

[0073] In an alternative embodiment, the mass storage device functionality of the plug-and-play device **36** is exposed to both the master and remote computers **438** and **440** so that the LinQ software application is automatically launched on both the master and remote computers **438** and **440** respectively. Because the mobile device manager software application is running on the master computer **438**, the LinQ software application launched on the master computer **438** closes itself so the mobile device manager software can communicate with the USB host-to-host controller **472**. Upon launch of the LinQ software application on the remote computer **440**, the LinQ software application finds the master computer **438** and establishes the USB host-to-host data channel and automatically connects to the mobile device manager software application running on the master computer **438** (step **309**). The mobile device manager software

application running on the master computer **438** manages the connection on the master computer **438**.

[0074] Similar to the previous embodiments, if desired, the master computer **438** can be connected to an interactive input system **228** of one of the types described previously as shown in FIG. **11**. In this case, shared screen display data received by the master computer **438** can be presented on the touch surface **246** of the interactive input system **228** via a projection device **244** that is connected to the master computer **438** by a physical cable **248** allowing a user to interact with the shared screen display data through pointer contacts with the touch surface **246**.

[0075] In the embodiments described above, the computers are described as using the autorun.inf file to perform auto-execution. Those of skill in the art will appreciate that other auto-execution methods such as for example Autoplay may be employed.

[0076] In the embodiments where the plug-and-play devices use cable segments to connect to the remote computers and master computers, if desired, the cable segments may be retractably accommodated by the plug-and-play devices.

[0077] In the embodiments of FIGS. **4** to **11**, rather than carrying out Internet connections over the connections between the remote computers and master computers, if desired, the remote computers may be directed to use their wireless network cards to establish an Internet connection over existing network infrastructure.

[0078] While the systems have been described with specificity to USB, other types of plug-and-play architectures can be utilized. For example, those of skill in the art will readily understand how to adapt the systems described herein for use with FireWire and PCMCIA architectures and the like.

[0079] While embodiments have been described with reference to a touch panel, the system can be any one of a number of other devices, such as cameras, sound systems, mice, keyboards, printers, displays, etc. For example, where the plug-and-play device is a sound system, the settings can include the output volumes for each speaker that has been previously calibrated to desired levels for the set configuration.

[0080] While an LCD projector has been described as projecting image data on the touch panel, those of skill in the art will appreciate that other devices such as with an LCD displays, plasma displays, cathode ray tubes, or other display devices known to those of skill in the art may be used to generate images that are presented on the touch panel.

[0081] Although embodiments have been described with reference to the accompanying drawings, those of skill in the art will appreciate that modifications and variations may be made without departing from the spirit and scope thereof as defined by the appended claims.

What is claimed is:

1. A plug-and-play device comprising:

a first plug-and-play interface for establishing a connection with a first computing device;

a second plug-and-play interface for establishing a connection with a second computing device;

storage storing code that is automatically executed by the second computing device when said plug-and-play device is connected to said second computing device via said second plug-and-play interface, said code when executed by said second computing device initiating a screen display data exchange between said first and second computing devices through said plug-and-play device; and

at least one controller controlling said first plug-and-play interface, said second plug-and-play interface and said storage.

2. The plug-and-play device of claim **1** wherein the first plug-and-play interface comprises a wireless transceiver and wherein the first plug-and-play interface establishes a wireless connection with said first computing device.

3. The plug-and-play device of claim **2** wherein said wireless connection is a secure wireless connection.

4. The plug-and-play devive of claim **3** wherein said storage further stores at least one of at least one key, at least one biometric and at least one code used to establish said secure wireless connection.

5. The plug-and-play device of claim **2** wherein the second plug-and-play interface receives a physical connection extending to said second computing device.

6. The plug-and-play device of claim **5** wherein said physical connection is a universal serial bus (USB) cable.

7. The plug-and-play device of claim **2** further comprising a physical connection to said second computing device.

8. The plug-and-play device of claim **7** wherein said physical connection is a USB cable.

9. The plug-and-play device of claim **7** wherein said wireless connection is a secure wireless connection.

10. The plug-and-play device of claim **2** wherein the plug-and-play device is configured as a dongle to plug into a port of said second computing device.

11. The plug-and-play device of claim **10** wherein said wireless connection is a secure wireless connection.

12. The plug-and-play device of claim **2** wherein the storage is non-volatile memory.

13. The plug-and-play device of claim **2** wherein the at least one controller is a USB hub.

14. The plug-and-play device of claim **13** further comprising a physical connection to said second computing device.

15. The plug-and-play device of claim **14** wherein said wireless connection is a secure wireless connection.

16. The plug-and-play device of claim **13** wherein the plug-and-play device is configured as a dongle to plug into a port of said second computing device.

17. The plug-and-play device of claim **16** wherein said wireless connection is a secure wireless connection.

18. The plug-and-play device of claim **1** wherein said screen display data exchange comprises transmission of second computing device display screen data to said first computing device.

19. The plug-and-play device of claim **18** wherein the second computing device display screen data is compressed prior to transmission to said first computing device.

20. The plug-and-play device of claim **19** wherein differences between previously transmitted second computing device display screen data and current second computing device display screen data are transmitted.

21. The plug-and-play device of claim **1** wherein said screen display data exchange comprises transmission of first computing device display screen data to said second computing device.

22. The plug-and-play device of claim **21** wherein the first computing device display screen data is compressed prior to transmission to said second computing device.

23. The plug-and-play device of claim **24** wherein differences between previously transmitted first computing device display screen data and current first computing device display screen data are transmitted.

24. The plug-and-play device of claim **18** wherein the code when executed further permits file sharing between said first and second computing devices through said plug-and-play device.

25. The plug-and-play device of claim **21** wherein the code when executed further permits file sharing between said first and second computing devices through said plug-and-play device.

26. The plug-and-play device of claim **2** wherein said screen display data exchange comprises transmission of second computing device display screen data to said first computing device.

27. The plug-and-play device of claim **26** wherein the second computing device display screen data is compressed prior to transmission to said first computing device.

28. The plug-and-play device of claim **27** wherein differences between previously transmitted second computing device display screen data and current second computing device display screen data are transmitted.

29. The plug-and-play device of claim **2** wherein said screen display data exchange comprises transmission of first computing device display screen data to said second computing device.

30. The plug-and-play device of claim **29** wherein the first computing device display screen data is compressed prior to transmission to said second computing device.

31. The plug-and-play device of claim **30** wherein differences between previously transmitted first computing device display screen data and current first computing device display screen data are transmitted.

32. The plug-and-play device of claim **7** wherein said screen display data exchange comprises transmission of second computing device display screen data to said first computing device.

33. The plug-and-play device of claim **32** wherein compresses the second computing device display screen data is compressed prior to transmission to said first computing device.

34. The plug-and-play device of claim **33** wherein differences between previously transmitted second computing device display screen data and current second computing device display screen data are transmitted.

35. The plug-and-play device of claim **7** wherein said screen display data exchange comprises transmission of first computing device display screen data to said second computing device.

36. The plug-and-play device of claim **35** wherein the first computing device display screen data is compressed prior to transmission to said second computing device.

37. The plug-and-play device of claim **38** wherein differences between previously transmitted first computing device display screen data and current first computing device display screen data are transmitted.

38. The plug-and-play device of claim **1** wherein the first plug-and-play interface receives a physical connection extending to said first computing device and wherein the second plug-and-play interface receives a physical connection extending to the second computing device.

39. The plug-and-play device of claim **38** wherein each physical connection is a USB cable.

40. The plug-and-play device of claim **1** further comprising a physical connection to said first computing device and a physical connection to said second computing device.

41. The plug-and-play device of claim **40** wherein each physical connection is a USB cable.

42. The plug-and-play device of claim **40** wherein said screen display data exchange comprises transmission of second computing device display screen data to said first computing device.

43. The plug-and-play device of claim **42** wherein the second computing device display screen data is compressed prior to transmission to said first computing device.

44. The plug-and-play device of claim **43** wherein differences between previously transmitted second computing device display screen data and current second computing device display screen data are transmitted.

45. The plug-and-play device of claim **40** wherein said screen display data exchange comprises transmission of first computing device display screen data to said second computing device.

46. The plug-and-play device of claim **45** wherein the first computing device display screen data is compressed prior to transmission to said second computing device.

47. The plug-and-play device of claim **46** wherein differences between previously transmitted first computing device display screen data and current first computing device display screen data are transmitted.

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