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UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

UNIVERSAL ELECTRONICS INC., a Delaware Company,

Plaintiff,

v.

ROKU, INC., a Delaware Company,

Defendant.

Case No. 8:18-cv-01580

COMPLAINT FOR PATENT INFRINGMENT

DEMAND FOR JURY TRIAL

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Plaintiff Universal Electronics Inc. ("UEI") hereby brings its Complaint for patent infringement against Defendant Roku, Inc. ("Roku") and alleges as follows:

NATURE OF CASE

1. UEI is a 30-year old public company based in Santa Ana, California. It is the technology leader in home entertainment and home automation control, winning numerous awards related to universal entertainment control processes and technology. Throughout its 30-year history, UEI has consistently prioritized investments in research and development and technology acquisitions that have allowed it to pioneer, patent, and perfect key technologies in the area of entertainment interaction and control. As a result, UEI holds over 350 U.S. patents related to TV, home entertainment, and home control technologies and has many additional patent applications pending in the United States and jurisdictions throughout the world. Many of the world's leading consumer electronics OEM brands and subscription broadcasting operators purchase or license UEI's control technologies.

2. Roku is a relative newcomer to home entertainment control. Despite a mutually successful previous business relationship with UEI, Roku decided to forgo licensing key UEI technologies that are prevalent in a number of Roku's home entertainment products. After failing to reach an acceptable business solution, UEI brings this suit to secure appropriate relief and ensure adequate compensation for Roku's use of UEI technology.

3. In this Complaint, UEI asserts nine counts of patent infringement against Roku. The nine patents are in four patent families and two general technology categories: remote control set-up and touchscreen remotes.

PARTIES

4. Plaintiff UEI is a Delaware corporation that has a principal place of business located at 201 E. Sandpointe Ave., Santa Ana, CA 92707.

5. Defendant Roku is a Delaware corporation with a principal place of business located at 150 Winchester Circle, Los Gatos, CA 95032. It has offices in the judicial

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district at 2450 Colorado Ave., Santa Monica, CA 90404.

6. Roku manufactures and sells streaming players and components therefor, enabling users to stream free or paid programming services. Roku offers a Roku App for download to a smartphone or tablet to access streaming content. The Roku App works with the devices at issue in this action, like the Roku TV, Roku Ultra, Roku Express, Roku Streaming Stick, and Roku Streaming Stick + and others.

PATENTS IN-SUIT

7. UEI owns and has standing to sue for infringement of U.S. Patent No. 7,589,642 (the "642 Patent"), entitled "Relaying Key Code Signals Through a Remote Control Device," which was duly and lawfully issued on September 15, 2009. A true and correct copy of the 642 Patent is attached to this Complaint as Exhibit A.

8. UEI owns and has standing to sue for infringement of U.S. Patent No. 8,004,389 (the "389 Patent"), entitled "Relaying Key Code Signals Through a Remote Control Device," which was duly and lawfully issued on August 23, 2011. A true and correct copy of the 389 Patent is attached to this Complaint as Exhibit B.

9. UEI owns and has standing to sue for infringement of U.S. Patent No. 9,911,325 (the "325 Patent"), entitled "Relaying Key Code Signals Through a Remote Control Device," which was duly and lawfully issued on March 6, 2018. A true and correct copy of the 325 Patent is attached to this Complaint as Exhibit C.

10. UEI owns and has standing to sue for infringement of U.S. Patent No. 9,716,853 (the "853 Patent"), entitled "System and Method for Optimized Appliance Control," which was duly and lawfully issued on July 25, 2017. A true and correct copy of the 853 Patent is attached to this Complaint as Exhibit D.

11. UEI owns and has standing to sue for infringement of U.S. Patent No. 7,782,309 (the "309 Patent"), entitled "Controlling Device with Dual-Mode, Touch-Sensitive Display," which was duly and lawfully issued on August 24, 2010. A true and correct copy of the 309 Patent is attached to this Complaint as Exhibit E.

12. UEI owns and has standing to sue for infringement of U.S. Patent No.

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7,821,504 (the "504 Patent"), entitled "Controlling Device with Dual-Mode, Touch-Sensitive Display," which was duly and lawfully issued on October 26, 2010. A true and correct copy of the 504 Patent is attached to this Complaint as Exhibit F.

13. UEI owns and has standing to sue for infringement of U.S. Patent No. 7,821,505 (the "505 Patent"), entitled "Controlling Device with Dual-Mode, Touch-Sensitive Display," which was duly and lawfully issued on October 26, 2010. A true and correct copy of the 505 Patent is attached to this Complaint as Exhibit G.

14. UEI owns and has standing to sue for infringement of U.S. Patent No. 7,895,532 (the "532 Patent"), entitled "User Interface for a Remote Control Application," which was duly and lawfully issued on February 22, 2011. A true and correct copy of the 532 Patent is attached to this Complaint as Exhibit H.

15. UEI owns and has standing to sue for infringement of U.S. Patent No. 8,015,446 (the "446 Patent"), entitled "User Interface for a Remote Control Application," which was duly and lawfully issued on September 6, 2011. A true and correct copy of the 446 Patent is attached to this Complaint as Exhibit I.

JURISDICTION AND VENUE

16. This Court has jurisdiction over the subject matter of this action under 28 U.S.C. §§ 1331 and 1338(a).

17. This Court has personal jurisdiction over Roku pursuant to the laws of the State of California, including California's Long Arm Statute, California Code of Civil Procedure § 410.10. Roku's principal place of business is in the state of California, and, as a result, Roku is subject to general jurisdiction here. Roku has committed acts of infringement in California infringing UEI's asserted patents in California, and, as a result, Roku is subject to specific jurisdiction here. In particular, Roku sells and offers to sell hardware and software relating to remote control devices that infringe UEI's patents in California, and specifically in this judicial district. Roku does business in this judicial district relating to Roku's accused products, and has an office located in this district at 2450 Colorado Ave., Santa Monica, CA 90404. Roku is subject to personal jurisdiction

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because it has a regular and established place in this district and it sells, distributes, and licenses its products in this District, such that it should reasonably and fairly anticipate being brought into this Court.

18. Venue is proper in this District under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). Roku has committed acts of infringement in this judicial district and has a regular and established place of business in this judicial district at 2450 Colorado Ave., Santa Monica, CA 90404. It occupies commercial office space at that address and employs numerous employees at this address, including its General Counsel.

FACTUAL BACKGROUND

19. UEI is a pioneer in the TV industry, particularly in the realm of remote controls. UEI is the owner of hundreds of patents in this technology area ranging from remote controls to software to systems of networked devices. UEI was the first to create the pre-programmed universal remote control, which allows one remote control to command numerous devices. Back when infrared (IR) technology was the dominant method of controlling televisions and accessories, UEI invested significant time and resources to develop a device control database that correlated certain IR control codes with certain brands and devices. As other forms of communication and control were implemented with TVs and accessories, such as HDMI and WiFi, UEI continued to innovate and improve how remote controls could interface with a range of devices.

20. One of UEI's flagship technologies is QuickSet®, a product family dedicated to simplifying and automating the configuration and control of remote controls and home entertainment devices. QuickSet® is a widely deployed technology already in over 250 million devices around the world including set-top boxes, televisions, game consoles, smartphones, and tablets to enable effortless configuration and control of nearly any connected home entertainment device. The 642, 389, 325, and 853 Patents relate to features incorporated into versions of UEI's QuickSet® product family. Roku has incorporated these patented technologies into its products and services without authorization.

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21. UEI was also a pioneer in using touch screens and graphical user interfaces ("GUIs") in remote control applications. Well before smartphones made touchscreen technology ubiquitous, UEI patented devices and methods for using touchscreens and GUIs for remote control applications. The 309, 504, 505, 446, and 532 Patents relate to UEI's touchscreen GUI technology. Roku also has incorporated these additional patented technologies into its products and services without authorization.

COUNT ONE

INFRINGEMENT OF U.S. PATENT 7,582,642

22. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

23. UEI is the owner of all rights, title, and interest in the 642 Patent, including the right to bring this suit for injunctive relief and damages.

24. The 642 Patent generally relates to methods and devices allowing remote control devices to control one or more electronic consumer devices. At the time of the 642 Patent, existing consumer electronic devices would often be packaged with their own remote control device which were dedicated to operating only the particular device with which they were packaged, requiring owners of multiple devices to own multiple remote control devices. Each such remote control device would contain data relating only to the functions of its associated consumer electronic device. Memory limitations in these remote control devices would limit the amount of consumer electronic devices that a single remote control could control. The invention of the 642 Patent overcame these limitations in several ways including with a method and system for relaying a key code through a remote control device to an electronic consumer device allowing the electronic consumer device to be controlled without storing the associated code set on the remote control device.

25. The 642 Patent is valid and enforceable. The claims of the 642 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or

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conventional to those in the field at the time of invention. In particular, it was not well-understood, routine or conventional at the time of invention for a system to receive a keystroke indicator signal from a remote control device based on a user selecting a key on a remote control, generate a key code within a key code generator device using the keystroke indicator signal, modulate the key code onto a carrier signal, thereby generating a key code signal, and transmitting said key code signal from said key code generator device to an electronic consumer device. This was previously recognized by the Patent Trademark and Appeals Board (PTAB) in its denial of an institution of an IPR proceeding related to the 642 Patent. In particular, the PTAB determined that none of the 20+ cited combinations of references included at least the step of modulating the key code onto a carrier signal of claim 2.

26. UEI has provided notice to the public of the 642 Patent via marking the patent number on UEI's NevoSmart App on its "About" screen.

27. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 642 Patent, including but not limited to claim 2, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to the "Roku Ultra," the "Roku Streaming Stick," the "Roku Streaming Stick+," the "Roku Express," the "Roku Express+," the "Roku Premiere," the "Roku Premiere+," the "Roku 4," the "Roku 3," the "Roku 2," the "Roku TV," the "Roku Enhanced Remote," and any other Roku product that provides for the remote control of an external device such as a TV, audiovisual receiver, sound bar or "Roku TV Wireless Speakers" via a Roku remote through IR, RF and/or HDMI as directed by a Roku box or TV (the "642 Patent Accused Products").

28. For purposes of example only, and without limitation, the 642 Patent Accused Products perform every element of claim 2 of the 642 Patent when used as intended by Roku. Roku also has infringed and continues infringes at least one other claim of the 642 Patent.

29. In particular, the method of claim 2 involves "receiving a keystroke

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indicator signal from a remote control device, wherein the keystroke indicator signal indicates a key on said remote control device that a user has selected." The 642 Patent Accused Products receive a keystroke indicator signal from Roku's remote control, wherein the keystroke indicator signal indicates a key on Roku's remote that a user has pressed.

30. The method of claim 2 further involves "generating a key code within a key code generator device using the keystroke indictor signal." The 642 Patent Accused Products generate a key code, during at least the set-up process, in response to a keystroke indicator signal to enable a Roku remote to control other devices, and also based on certain Roku menu settings which provide for the control of other devices.

31. The method of claim 2 further involves "modulating said key code onto a carrier signal, thereby generating a key code signal." The 642 Patent Accused Products generate key code signals onto a carrier signal, such as Bluetooth, IR, Wi-Fi and Wi-Fi Direct to communicate with a remote control and over HDMI cables or RF to communicate with a TV and/or other consumer electronic devices like an audiovisual receiver, sound bar or "Roku TV Wireless Speakers."

32. The method of claim 2 further involves "transmitting said key code signal from said key code generator device to an electronic consumer device." The 642 Patent Accused Products transmit such key code signals to a consumer electronic device using various combinations of RF, IR and HDMI CEC signaling across the various 642 Patent Accused Products.

33. Roku has infringed and continues to infringe claims of the 642 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 642 Patent Accused Products.

34. Roku has performed each and every element of claim 2 of the 642 Patent during at least its own product development and testing of the 642 Patent Accused Products.

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35. Roku has indirectly infringed and continues to indirectly infringe at least claim 2 of the 642 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers, users, and retailers that offer for sale, sell, and use the 642 Patent Accused Devices.

36. Roku is on notice of the 642 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 642 Patent and its infringement prior to the filing of this Complaint. As stated above, UEI marked the 642 Patent via its NevoSmart App on its "About" screen. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 642 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 642 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 642 Patent. As such, Roku either knew or should have known about the existence of the 642 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 642 Patent Accused Products to infringe at least claim 2 of the 642 Patent within the meaning of 35 U.S.C. § 271(b).

37. Roku's acts of inducement include making, using, selling, and offering to sell the 642 Patent Accused Products, as well as Roku's creation and dissemination of promotional materials, marketing materials, and instruction guides that teach and encourage end users to use the 642 Patent Accused Products in an infringing manner. For example, the 642 Patent Accused Products provide step-by-step instruction on how an

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end user should use these products in a manner that directly infringes the 642 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku, has a webpage, https://support.roku.com/en-gb/article/115013019828-how-to-set-up-your-roku-enhanced-remote-to-control-your-tv, dedicated to instructing users how to set up Roku Enhanced Remotes via wireless and infrared (IR) technologies to seamlessly control Roku streaming players and aspects of users' TVs. Examples include, without limitation, Roku's instructions on how to connect Roku devices to control other devices through HDMI and IR.

38. Additionally, Roku has contributed to the infringement of claims of the 642 Patent within the meaning of 35 U.S.C. § 271(c). Specifically, Roku has contributed to the end users infringement of the 642 Patent by, among other things, making, selling, aiding, assisting, authorizing, advertising, marketing, promoting, providing for, and/or encouraging the offer for sale, sale, and use of the 642 Patent Accused Products, which Roku knew contain the software and features discussed above that are especially made or adapted by Roku for infringing uses of claims of the 642 Patent. The software and features discussed above are not staple articles of commerce suitable for substantial non-infringing use. The direct infringers for Roku's contributory infringement include, without limitation, its customers, users, and retailers that offer for sale, sell, and use the 642 Patent Accused Products.

39. Roku's direct and indirect infringement of the 642 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

40. Roku's infringement of the 642 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 642 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 642 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 642 Patent.

41. Roku's infringing activities will continue to injure UEI unless and until this

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Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 642 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT TWO

INFRINGEMENT OF U.S. PATENT 8,004,389

42. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

43. UEI is the owner of all rights, title, and interest in the 389 Patent, including the right to bring this suit for injunctive relief and damages.

44. The 389 Patent was filed as a continuation of the patent that issued as the 642 Patent, and its claims are inventive for many of the same reasons as described with respect to the 642 Patent.

45. The 389 Patent is valid and enforceable. The claims of the 389 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. The 389 Patent's claims share some similarities with the inventions claimed in the 642 Patent, but they include different or additional elements, each of which make the claims novel for the same or additional reasons as described above. For example, claim 2 of the 389 Patent includes the step of "identifying said codeset using input from a user of said remote control device, wherein said codeset is identified when said user stops pressing a key on said remote control device." For this reason as well, the combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention.

46. Roku has infringed and continues to infringe literally and/or through the

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doctrine of equivalents, one or more claims of the 389 Patent, including but not limited to claim 2, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to the "Roku Ultra", the "Roku Streaming Stick", the "Roku Streaming Stick+," the "Roku Premiere," the "Roku Premiere+," the "Roku 4," the "Roku TV," the "Roku Enhanced Remote," and any other Roku product that provides for the onscreen set-up of a remote control to control an external device, such as a TV, audiovisual receiver, sound bar or "Roku TV Wireless Speakers", where the Roku onscreen set-up process includes the step of the user indicating whether the sound on the target device was muted and stops pressing a key when it is muted (the "389 Patent Accused Products").

47. For purposes of example only, and without limitation, the 389 Patent Accused Products perform every element of claim 2 of the 389 Patent when used as intended by Roku. Roku also has infringed and continues infringes at least one other claim of the 389 Patent.

48. The method of claim 2 involves "receiving a keystroke indicator signal from a remote control device, wherein the keystroke indicator signal indicates a key on said remote control device that a user has selected." The 389 Patent Accused Products receive a keystroke indicator signal from Roku's remote control, wherein the keystroke indicator signal indicates a key on Roku's remote that a user has pressed.

49. The method of claim 2 further involves "generating a key code within a key code generator device using the keystroke indicator signal, wherein said key code is part of a codeset that controls an electronic consumer device." The 389 Patent Accused Products generate a key code during the set-up process, in response to keystroke indicator signal. This key code is part of a codeset that controls an electronic consumer device, such as the set of IR or CEC codes for control of a TV.

50. The method of claim 2 further involves "modulating said key code onto a carrier signal, thereby generating a key code signal." The 389 Patent Accused Products can generate key code signals onto a carrier signal, such as Bluetooth, Wi-Fi Direct, or IR

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to communicate with a remote.

51. The method of claim 2 further involves "transmitting said key code signal from said key code generator device." The 389 Patent Accused Products can transmit such key code signals to the remote control device, using Bluetooth, Wi-Fi Direct, or IR transmissions depending on the model of the device, or to a consumer electronic device using HDMI CEC.

52. The method of claim 2 further involves "identifying said codeset using input from a user of said remote control device, wherein said codeset is identified when said user stops pressing a key on said remote control device." The 389 Patent Accused Products can identify a codeset for a consumer electronic device via user input on the Roku remote in response to screen stating "Music is currently playing. Do you hear it?" and "Did the music stop playing?" When the user stops pressing a key, the codeset is identified.

53. Roku has infringed and continues to infringe claims of the 389 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 389 Patent Accused Products.

54. Roku has performed each and every element of claim 2 of the 389 Patent during at least its own product development and testing of the 389 Patent Accused Products.

55. Roku has indirectly infringed and continue to indirectly infringe at least claims of the 389 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers, users, and retailers that offer for sale, sell, and use the 389 Patent Accused Devices.

56. Roku is on notice of the 389 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 389 Patent and its infringement prior to the filing of this Complaint. At least as of September 2017, UEI

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informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 389 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 389 Patent. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 389 Patent and intended to induce infringement. As such, Roku either knew or should have known about the existence of the 389 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 389 Patent Accused Products to infringe at least claim 2 of the 389 Patent within the meaning of 35 U.S.C. § 271(b).

57. Roku's acts of inducement include making, using, selling, and offering to sell the 389 Patent Accused Products, as well as Roku's creation and dissemination of promotional materials, marketing materials, and instruction guides that teach and encourage end users to use the 389 Patent Accused Products in an infringing manner. For example, the 389 Patent Accused Products provide step-by-step instruction on how an end user should use these products in a manner that directly infringes the 389 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku, has a webpage, https://support.roku.com/en-gb/article/115013019828-how-to-set-up-your-roku-enhanced-remote-to-control-your-tv, dedicated to instructing users how to set up Roku Enhanced Remotes via wireless and infrared (IR) technologies to seamlessly control Roku streaming players and aspects of users' TV. Examples include, without limitation, Roku's instructions on how to connect Roku devices to control other devices through HDMI CEC or IR, including the "Did the music stop playing?" screen referenced above.

58. Additionally, Roku has contributed to the infringement of claims of the 389

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Patent within the meaning of 35 U.S.C. § 271(c). Specifically, Roku has contributed to the end users infringement of the 389 Patent by, among other things, making, selling, aiding, assisting, authorizing, advertising, marketing, promoting, providing for, and/or encouraging the offer for sale, sale, and use of the 389 Patent Accused Products, which Roku knew contains the software and features discussed above that are especially made or adapted by Roku for infringing uses of claims of the 389 Patent. The software and features discussed above are not staple articles of commerce suitable for substantial non-infringing use. The direct infringers for Roku's contributory infringement include, without limitation, its customers, users, and retailers that offer for sale, sell, and use the 389 Patent Accused Products.

59. Roku's direct and indirect infringement of the 389 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

60. Roku's infringement of the 389 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 389 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 389 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 389 Patent.

61. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 389 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

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COUNT THREE

INFRINGEMENT OF U.S. PATENT 9,911,325

62. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

63. UEI is the owner of all rights, title, and interest in the 325 Patent, including the right to bring this suit for injunctive relief and damages.

64. The 325 Patent arose from the same family as the 642 and 389 Patents, and its claims are inventive for many of the same reasons as described with respect to the 642 Patent.

65. The 325 Patent is valid and enforceable. The claims of the 325 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. The 325 Patent claims share some similarities with the inventions claimed in the 642 Patent, but they also include different or additional elements, each of which make the claims novel for the same or additional reasons as described above. For example, claim 1 of the 325 Patent includes is an apparatus claim and includes additional elements related to such physical devices, as well as additional limitations where the "codeset further comprises time information that describes how a digital one and/or digital zero within the selected one of the plurality of key code data is to be represented in the key code signal to be transmitted to the second device." For this reason as well, the combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention.

66. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 325 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to the "Roku Ultra", the "Roku Streaming Stick", the "Roku Streaming Stick+," the "Roku Express," the "Roku Express+," the "Roku Premiere," the "Roku Premiere+," the "Roku 4," the "Roku 3," the

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"Roku 2," the "Roku TV," and any other Roku product that provides for the remote control of an external device such as a TV and/or other consumer electronic devices like an audiovisual receiver, sound bar or "Roku TV Wireless Speakers" via a Roku remote via IR, HDMI or RF (the "325 Patent Accused Products").

67. For purposes of example only, and without limitation, the 325 Patent Accused Products perform every element of claim 1 of the 325 Patent when used as intended by Roku. Roku also has infringed and continues infringes at least one other claim of the 325 Patent.

68. Claim 1 involves "A first device for transmitting a command to control a functional operation of a second device." The 325 Patent Accused Products transmit a command to control a functional operation of a second device, such as a TV and/or other consumer electronic devices like an audiovisual receiver, sound bar or "Roku TV Wireless Speakers."

69. Claim 1 further involves the first device comprising "a receiver." The 325 Patent Accused Products contain a receiver that is used to communicate with the remote control and receive signals via Bluetooth, Wi-Fi Direct, or IR, depending on the particular device.

70. Claim 1 further involves the first device comprising "a transmitter." The 325 Patent Accused Products contain a transmitter in the form of at least the hardware used to send signals via RF or HDMI CEC.

71. Claim 1 further involves the first device comprising "a processing device coupled to the receiver and the transmitter." Each of the 325 Patent Accused Products contain a processor coupled to the device's receiver and transmitter.

72. Claim 1 further involves the first device comprising "a memory storing instructions executable by the processing device." Each of the 325 Accused Products contain memory storing instructions in the form of software that is executable by the processing device.

73. Claim 1 further involves the instructions causing the processing device to

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"generate a key code using a keystroke indicator received from a third device in communication with first device via use of the receiver, the keystroke indicator having data that indicates an input element of the third device that has been activated." The 325 Patent Accused Products generate a key code in response to a keystroke indicator signal pressed on the Roku's remote control. The products receive the keystroke indicator from the remote control via use of their receiver. The keystroke indicator signal has data indicating that an input element of the remote control has been activated.

74. Claim 1 further involves the instructions causing the processing device to "format the key code for transmission to the second device." The 325 Patent Accused Products format a key code for transmission to the second device, such as a TV or audiovisual receiver, via HDMI CEC.

75. Claim 1 further involves the instructions causing the processor to "transmit the formatted key code to the second device in a key code signal via use of the transmitter." The 325 Patent Accused Products transmit a CEC-formatted key code to a second device, such as a TV or audiovisual receiver, via HDMI link.

76. Claim 1 further involves "wherein the generated key code comprises a one of a plurality of key code data stored in a codeset." The key codes generated by the 325 Patent Accused Products comprise a one of a plurality of data that is stored in a codeset of CEC data.

77. Claim 1 further involves "wherein the one of the plurality of key code data is selected from the codeset as a function of the keystroke indicator received from the third device." The one of the plurality of key code data used by the 325 Patent Accused Products is selected from the codeset as a function of the keystroke indicator received from the remote control.

78. Claim 1 further involves "wherein each of the plurality of key code data stored in the codeset comprises a series of digital ones and/or digital zeros." The CEC data transmitted by the 325 Patent Accused Products is made up of a series of digital ones and/or digital zeros.

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79. Claim 1 further involves "wherein the codeset further comprises time information that describes how a digital one and/or a digital zero within the selected one of the plurality of key code data is to be represented in the key code signal to be transmitted to the second device." The CEC data transmitted by the 325 Patent Accused Products includes time information that describes how a digital one and/or a digital zero is to be represented in a signal transmitted to a second device, such as a TV or audiovisual receiver.

80. Roku has infringed and continues to infringe claims of the 325 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 325 Patent Accused Products.

81. Roku has indirectly infringed and continues to indirectly infringe claims of the 325 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers, users, and retailers that offer for sale, sell, and use the 325 Patent Accused Devices.

82. Roku is on notice of the 325 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 325 Patent and its infringement prior to the filing of this Complaint. At least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 325 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 325 Patent. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 325 Patent and intended to induce infringement. As such, Roku either knew or should have known about the existence of

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the 325 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 325 Patent Accused Products to infringe at least claim 1 of the 325 Patent within the meaning of 35 U.S.C. § 271(b).

83. Roku's acts of inducement include making, using, selling, and offering to sell the 325 Patent Accused Products, as well as Roku's creation and dissemination of promotional materials, marketing materials, and instruction guides that teach and encourage end users to use the 325 Patent Accused Products in an infringing manner. For example, the 325 Patent Accused Products provide step-by-step instruction on how an end user should use these products in a manner that directly infringes the 325 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku, has a webpage, https://support.roku.com/en-gb/article/115012968247-can-i-control-my-tv-with-the-remote-for-my-roku-streaming-player-, dedicated to instructing users how to control devices using CEC. Roku also promotes controlling devices' input via CEC as shown at the following webpage: https://support.roku.com/en-gb/article/115008012587-why-does-my-tv-switch-to-a-different-device-when-trying-to-use-my-roku-streaming-player-.

84. Additionally, Roku has contributed to the infringement of claims of the 325 Patent within the meaning of 35 U.S.C. § 271(c). Specifically, Roku has contributed to the end users infringement of the 325 Patent by, among other things, making, selling, aiding, assisting, authorizing, advertising, marketing, promoting, providing for, and/or encouraging the offer for sale, sale, and use of the 325 Patent Accused Products, which Roku knew contain the software and features discussed above that are especially made or adapted by Roku for infringing uses of claims of the 325 Patent. The software and features discussed above are not staple articles of commerce suitable for substantial non-infringing use. The direct infringers for Roku's contributory infringement include, without limitation, its customers, users, and retailers that offer for sale, sell, and use the 325 Patent Accused Products.

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85. Roku's direct and indirect infringement of the 325 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

86. Roku's infringement of the 325 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 325 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 325 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 325 Patent.

87. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 325 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT FOUR

INFRINGEMENT OF U.S. PATENT 9,716,853

88. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

89. UEI is the owner of all rights, title, and interest in the 853 Patent, including the right to bring this suit for injunctive relief and damages.

90. The 853 Patent generally relates to devices that can optimize control of multiple consumer electronic devices. At the time of the 853 Patent, a number of communication methods could be used between devices, including Wi-Fi, Bluetooth, and HDMI. However, many manufacturers were slow to adopt newer methods, resulting in situations where multiple devices in the same room or network could only be operated via different communication methods. The invention of the 853 Patent overcame these

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limitations by creating a device that is adapted to allow for multiple communication methods to facilitate communication across different communication mediums.

91. The 853 Patent is valid and enforceable. The claims of the 853 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. In particular, it was not well-understood, routine or conventional at the time of invention for a system utilize a universal control engine to respond to a detected presence of an intended target appliance, use an identity associated with the intended target appliance to create a listing of at least two different communications for use in controlling each of at least two functional operations of the intended target appliance and be capable of causing such control by a remote control.

92. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 853 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to the "Roku Ultra", the "Roku 4," the "Roku TV" and any other Roku product that allows control of an external device's volume or power via CEC or IR (the "853 Patent Accused Products").

93. For purposes of example only, and without limitation, the 853 Patent Accused Products perform every element of claim 1 of the 853 Patent when used as intended by Roku. Roku also has infringed and continues infringes at least one other claim of the 853 Patent.

94. Claim 1 involves "A universal control engine." The 853 Patent Accused Products are universal control engines that allow control of external devices.

95. Claim 1 further involves the universal control engine comprising "a processing device." The 853 Patent Accused Products contain a processor.

96. Claim 1 further involves the universal control engine comprising "a memory device having stored thereon instructions executable by the processing device." The 853

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Accused Products contain memory storing instructions in the form of software that is executable by the processing device.

97. Claim 1 further involves the instructions when executed by the processing device "causing the universal control engine to respond to a detected presence of an intended target appliance within a logical topography of controllable appliances which includes the universal control engine by using an identity associated with the intended target appliance to create a listing comprised of at least a first communication method and a second communication method different than the first communication method for use in controlling each of at least a first functional operation and a second functional operation of the intended target appliance and to respond to a received request from a controlling device intended to cause the intended target appliance to perform a one of the first and second functional operations by causing a one of the first and second communication methods in the listing of communication methods that has been associated with the requested one of the first and second functional operations to be used to transmit to the intended target appliance a command for controlling the requested one of the first and second functional operations of the intended target appliance." The 853 Patent Accused Products can detect and respond the presence of target devices connected to a logical topography that includes the Products via HDMI. The Products' software creates a listing of a first and second communication methods for controlling first and second functional operations of a target appliance because it has information on how to control at least volume and power of certain devices via IR or CEC. When a user presses the volume or power button on Roku's remote, it causes the target appliance, such as a TV or audiovisual receiver, to perform the requested functional operation using one of the first and second communication methods, e.g., either IR or CEC.

98. Roku has infringed and continue to infringe claims of the 853 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 853 Patent Accused Products.

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99. Roku has indirectly infringed and continue to indirectly infringe claims of the 853 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers, users, and retailers that offer for sale, sell, and use the 853 Patent Accused Devices.

100. Roku is on notice of the 853 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 853 Patent and its infringement prior to the filing of this Complaint. At least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 853 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 853 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 853 Patent. As such, Roku either knew or should have known about the existence of the 853 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 853 Patent Accused Products to infringe at least claim 1 of the 853 Patent within the meaning of 35 U.S.C. § 271(b).

101. Roku's acts of inducement include making, using, selling, and offering to sell the 853 Patent Accused Products, as well as Roku's creation and dissemination of promotional materials, marketing materials, and instruction guides that teach and encourage end users to use the 853 Patent Accused Products in an infringing manner. For example, the 853 Patent Accused Products provide step-by-step instruction on how an end user should use these products in a manner that directly infringes the 853 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its

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website. Roku has a webpage, https://support.roku.com/en-gb/article/115013019828-how-to-set-up-your-roku-enhanced-remote-to-control-your-tv, dedicated to instructing users how to set up Roku Enhanced Remotes via wireless and infrared (IR) technologies to seamlessly control Roku streaming players and aspects of users' TV. Roku also has a webpage, https://support.roku.com/en-gb/article/115012968247-can-i-control-my-tv-with-the-remote-for-my-roku-streaming-player-, dedicated to instructing users how to control devices using CEC.

102. Additionally, Roku has contributed to the infringement of claims of the 853 Patent within the meaning of 35 U.S.C. § 271(c). Specifically, Roku has contributed to the end users infringement of the 853 Patent by, among other things, making, selling, aiding, assisting, authorizing, advertising, marketing, promoting, providing for, and/or encouraging the offer for sale, sale, and use of the 853 Patent Accused Products, which Roku knew contain the software and features discussed above that are especially made or adapted by Roku for infringing uses of claims of the 853 Patent. The software and features discussed above are not staple articles of commerce suitable for substantial non-infringing use. The direct infringers for Roku's contributory infringement include, without limitation, its customers, users, and retailers that offer for sale, sell, and use the 853 Patent Accused Products.

103. Roku's direct and indirect infringement of the 853 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

104. Roku's infringement of the 853 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 853 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 853 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 853 Patent.

105. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining

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further direct and indirect infringement of the 853 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT FIVE

INFRINGEMENT OF U.S. PATENT 7,782,309

106. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

107. UEI is the owner of all rights, title, and interest in the 309 Patent, including the right to bring this suit for injunctive relief and damages

108. The 309 Patent generally relates to a method for using a remote control device with a dual-mode touch sensitive display. Prior art remote control devices used Graphical User Interfaces ("GUIs") to present multiple user interfaces on one controlling device in order to command functions on a target device. Prior art controlling devices, however, were limited to one mode of user interaction (such as pressing a button or soft key) in order to command target devices. The 309 Patent improves upon the prior art by providing two modes of user interaction via a touchscreen to better enable remote cursor control functionality on a target device.

109. The 309 Patent is valid and enforceable. The claims of the 309 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. Specifically, the use of graphical user interfaces on a remote control application, and dual-mode touch sensitive displays were not routine or conventional in the art at the time of invention.

110. UEI has provided notice to the public of the 309 Patent via marking it on UEI's NevoSmart App on its "About" screen.

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111. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 309 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to smartphones and tablets with the "Roku Mobile App" installed (the "309 Patent Accused Products").

112. For purposes of example only, and without limitation, the 309 Patent Accused Products perform every step of claim 1 of the 309 Patent, which relates to a method of using a remote control device with a dual-mode touch sensitive display. Roku also has infringed and continues infringes at least one other claim of the 309 Patent.

113. The method of claim 1 involves "using a universal controlling device comprised of a display having a touch-sensitive surface." The 309 Patent Accused Products include a universal controlling device with a display having a touch-sensitive surface.

114. The method of claim 1 further involves "causing one or more graphical user interfaces comprised of graphical user interface icons to be displayed in the display of the universal controlling device." The 309 Patent Accused Products include various graphical user interfaces that display on the user's smartphone. For example, the Roku Swipe Remote includes several graphical user interface icons, such a play button, a keyboard button, and a home button. The Swipe Remote also includes a field in the middle of the screen with the text "Swipe to move; Tap to select."

115. The method of claim 1 further involves "accepting via the touch-sensitive surface of the universal controlling device a first input type indicative of a selection of a displayed graphical user interface icon." Users select icons on the Swipe Remote GUI by using a tapping motion (a first input type). For example, users select the home icon at the top of the Swipe Remote to return to the home screen, or the play button to play selected content.

116. The method of claim 1 further involves "causing the universal controlling device to transmit to the one or more appliances first data representative of the displayed

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graphical user interface icon selected by the first input type." When a user taps the play button, for example, the play command is transmitted to the connected Roku device (such as a Roku TV, Roku Ultra, Roku Express, etc.) and the selected content will begin to play.

117. The method of claim 1 further involves "accepting via the touch-sensitive surface of the universal controlling device a second input type indicative of a motion made across the touch-sensitive surface." Users swipe (a second input type) on the Swipe Remote to browse content.

118. The method of claim 1 further involves "causing the universal controlling device to transmit to the one or more appliances second data representative of the motion made across the touch-sensitive surface provided by the second input type." When a user swipes on the Swipe Remote, the input is transmitted to the connected Roku device and moves through the content screens on the connected TV. For example, when the user is within the channel selection screen, a swipe on the Swipe Remote moves the onscreen cursor to the next channel, or moves to the next page of available channels.

119. The method of claim 1 further involves "causing the universal controlling device to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface." The 309 Patent Accused Products distinguish between the first input type received and the second input type received from the touch-sensitive surface, because tapping motions are used to select content while swiping motions are used to browse content on the Swipe Remote.

120. Roku has infringed and continues to infringe claims of the 309 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 309 Patent Accused Products.

121. Roku has performed each and every element of claim 1 of the 309 Patent during at least its own product development and testing of the 309 Patent Accused Products.

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122. Roku has indirectly infringed and continues to indirectly infringe at least claim 1 of the 309 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers and that offer for sale, sell, and use the 309 Patent Accused Products.

123. Roku is on notice of the 309 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 309 Patent and its infringement prior to the filing of this Complaint. As stated above, UEI has marked the 309 Patent via its NevoSmart App on its "About" screen. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 309 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 309 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 309 Patent. As such, Roku either knew or should have known about the existence of the 309 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 309 Patent Accused Products to infringe at least claim 1 of the 309 Patent within the meaning of 35 U.S.C. § 271(b).

124. Roku induces infringement by its customers and users by instructing an encouraging them to download and use the Roku Mobile App. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device, and on the Roku website at https://www.roku.com/mobile-app. For example, Roku provides step-by-step

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instruction on how an end user should use these products in a manner that directly infringes the 309 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku further has a webpage https://support.roku.com/article/115002681087-how-to-control-your-roku-streaming-device-using-the-roku-mobile-app dedicated to instructing users how to the swipe and touch functions of the Roku Mobile App. Examples include, without limitation, Roku's detailed instructions on the differences between controlling a Roku using the "traditional" and "Swipe" functionality.

125. Roku's direct and indirect infringement of the 309 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

126. Roku's infringement of the 309 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 309 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 309 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 309 Patent.

127. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 309 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT SIX

INFRINGEMENT OF U.S. PATENT 7,821,504

128. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

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129. UEI is the owner of all rights, title, and interest in the 504 Patent, including the right to bring this suit for injunctive relief and damages.

130. The 504 Patent generally relates to a method for using a remote control device with a dual-mode touch sensitive display. Prior art remote control devices used Graphical User Interfaces ("GUIs") to present multiple user interfaces on one controlling device in order to command functions on a target device. Prior art controlling devices, however, were limited to one mode of user interaction (such as pressing a button or soft key) in order to command target devices. The 504 Patent improves upon the prior art by providing two modes of user interaction via a touchscreen to better enable remote cursor control functionality on a target device.

131. The 504 Patent is valid and enforceable. The claims of the 504 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. Specifically, the use of graphical user interfaces on a remote control application, and dual-mode touch sensitive displays were not routine or conventional in the art at the time of invention

132. UEI has provided notice to the public of the 504 Patent via marking it on UEI's NevoSmart App on its "About" screen.

133. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 504 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to smartphones and tablets with the "Roku Mobile App" installed (the "504 Patent Accused Products").

134. For purposes of example only, and without limitation, the 504 Patent Accused Products perform every step of claim 1 of the 504 Patent, which relates to a method of using a remote control device with a dual-mode touch sensitive display. Roku also has infringed and continues infringes at least one other claim of the 504 Patent.

135. The method of claim 1 involves "using a universal controlling device

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comprised of a touch-sensitive surface." The 504 Patent Accused Products include a universal controlling device with a display having a touch-sensitive surface.

136. The method of claim 1 further involves "accepting via the touch-sensitive surface of the universal controlling device a first input type indicative of a static touch made upon the touch-sensitive surface." On the home screen of the Roku Mobile App, a user uses a static touch to select various options, such as one of the available channels or to select one of the icons at the bottom of the screen including "What's On"; "Channels"; "Remote"; "Photos+"; or "Settings."

137. The method of claim 1 further involves "causing the universal controlling device to transmit first data used to command at least a first functional operation of the one or more appliances, the first data being representative of the static touch made upon the touch-sensitive surface." When a user makes a tapping motion to make a selection on the Roku Mobile App home screen, data is transferred to the connected Roku device to command a functional operation of an appliance, for example, by playing the selected content on the appliance, changing menus or controlling power.

138. The method of claim 1 further involves "accepting via the touch-sensitive surface of the universal controlling device a second input type indicative of a moving touch made across the touch-sensitive surface." A user uses a swiping motion on the Roku Mobile App home screen to navigate content, such as available channels.

139. The method of claim 1 further involves "causing the universal controlling device to transmit second data used to command at least a second functional operation of the one or more appliances, the second data being representative of the moving touch made across the touch-sensitive surface." When a user swipes on the home screen of the Roku Mobile App, data is transmitted to the connected Roku device to move through the list of available channels on the screen of the TV.

140. The method of claim 1 further involves "causing the universal controlling device to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface." The 504 Patent Accused

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Products distinguish between the first input type received and the second input type received from the touch-sensitive surface, because tapping motions are used to select content while swiping motions are used to browse content on the Roku Mobile App home screen.

141. Roku has infringed and continues to infringe claims of the 504 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 504 Patent Accused Products.

142. Roku has performed each and every element of claim 1 of the 504 Patent during at least its own product development and testing of the 504 Patent Accused Products.

143. Roku has indirectly infringed and continues to indirectly infringe at least claim 1 of the 504 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers and that offer for sale, sell, and use the 504 Patent Accused Products.

144. Roku is on notice of the 504 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 504 Patent and its infringement prior to the filing of this Complaint. As stated above, UEI has marked the 504 Patent via its NevoSmart App on its "About" screen. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 504 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 504 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of

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infringement of the 504 Patent. As such, Roku either knew or should have known about the existence of the 504 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 504 Patent Accused Products to infringe at least claim 1 of the 504 Patent within the meaning of 35 U.S.C. § 271(b).

145. Roku induces infringement by its customers and users by instructing an encouraging them to download and use the Roku Mobile App. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device, and on the Roku website at https://www.roku.com/mobile-app. For example, Roku provides step-by-step instruction on how an end user should use these products in a manner that directly infringes the 504 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku further has a webpage https://support.roku.com/article/115002681087-how-to-control-your-roku-streaming-device-using-the-roku-mobile-app dedicated to instructing users how to the swipe and touch functions of the Roku Mobile App. Examples include, without limitation, Roku's detailed instructions on the differences between controlling a Roku using the "traditional" and "Swipe" functionality.

146. Roku's direct and indirect infringement of the 504 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

147. Roku's infringement of the 504 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 504 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 504 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 504 Patent.

148. Roku's infringing activities will continue to injure UEI unless and until this

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Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 504 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT SEVEN

INFRINGEMENT OF U.S. PATENT 7,821,505

149. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

150. UEI is the owner of all rights, title, and interest in the 505 Patent, including the right to bring this suit for injunctive relief and damages.

151. The 505 Patent generally relates to a universal controlling device with a dual-mode touch sensitive display. Prior art remote control devices used Graphical User Interfaces ("GUIs") to present multiple user interfaces on one controlling device in order to command functions on a target device. Prior art controlling devices, however, were limited to one mode of user interaction (such as pressing a button or soft key). The 505 Patent improves upon the prior art by providing two modes of user interaction via a touchscreen to better enable remote cursor control functionality on a target device.

152. The 505 Patent is valid and enforceable. The claims of the 505 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. Specifically, the use of graphical user interfaces on a remote control application, and dual-mode touch sensitive displays were not routine or conventional in the art at the time of invention.

153. UEI has provided notice to the public of the 505 Patent via marking it on UEI's NevoSmart App on its "About" screen.

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154. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 505 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to smartphones and tablets with the "Roku Mobile App" installed (the "505 Patent Accused Products").

155. For purposes of example only, and without limitation, the 505 Patent Accused Products include every element of claim 1 of the 505 Patent, which relates to a universal controlling device with a dual-mode touch sensitive display. Roku also has infringed and continues infringes at least one other claim of the 505 Patent.

156. Claim 1 involves a universal controlling device. The 505 Patent Accused Products are universal controlling devices capable of controlling various Roku devices (such as the Roku Ultra, Roku Express, and Roku TV) and other home entertainment appliances (like sound systems and Blu-Ray players).

157. The device of claim 1 further involves "a display having a touch-sensitive surface in which is displayed a plurality of graphical user interface icons." The 505 Patent Accused Products include a touch-sensitive surface (the smartphone screen), and plurality of GUI icons. The Roku Mobile App home screen includes several GUI icons, such as icons for different content channels, and icons at the bottom of the screen including "What's On"; "Channels"; "Remote"; "Photos+"; or "Settings." Users are further presented with options for static touch within the Swipe Remote GUI to select TV GUI interface elements when browsing menus on the TV GUI using the Roku Mobile App with Swipe Remote.

158. The device of claim 1 further involves "a transmitter for transmitting data for commanding functional operations of one or more appliances located remotely from the controlling device." The 505 Patent Accused Products contain a WiFi transmitter to control remote appliances, including at least various Roku boxes and Roku TVs, but also connected audio devices such as sound bars, AVRs and Roku TV Wireless Speakers.

159. The device of claim 1 further involves "a processing device for causing the

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transmitter to transmit data in response to input provided to the touch-sensitive surface." The 505 Patent Accused Products contain microprocessors for processing app data, such as data associated with input from a touchscreen.

160. The device of claim 1 further involves "in response to the touch-sensitive surface of the universal controlling device being provided a first input type indicative of a selection of a one of the plurality of displayed graphical user interface icons, the processing device causes the transmitter to transmit first data for commanding at least a first functional operation of the one or more appliances with the first data being representative of the one of the plurality of graphical user interface icon selected by the first input type." The home screen of the Roku Mobile App allows the user to use a static touch (a first input type) to select various options, such as one of the available channels or to select one of the icons at the bottom of the screen including "What's On"; "Channels"; "Remote"; "Photos+"; or "Settings." When a user makes a tapping motion to make a selection on the home screen, data is transferred to the connected Roku device to command a functional operation of an appliance by, for example, playing the selected content on the TV. Users are further presented with options for static touch within the Swipe Remote GUI to select TV GUI interface elements when browsing menus on the TV GUI using the Roku Mobile App with Swipe Remote.

161. The device of claim 1 further involves "in response to the touch-sensitive surface being provided a second input type indicative of a motion made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data for commanding at least a second functional operation of the one or more appliances with the second data being representative of the motion made across the touch-sensitive surface provided by the second input type." The Roku Mobile App allows a user to use a swiping motion (a second input type) on the home screen to navigate content, such as available channels. When a user swipes on the home screen of the Swipe Remote GUI of the Roku Mobile App, data is transmitted to the connected Roku device to move through the list of available channels and content on the screen of the TV. Users can

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similarly swipe through photos and music using a moving touch feature of the Photos+ function of the Roku Mobile App.

162. The device of claim 1 further involves "the processing device is programmed to distinguish the first input type provided to the touch-sensitive surface from the second input type provided to the touch-sensitive surface." The 505 Patent Accused Products can distinguish between the first input type received and the second input type received from the touch-sensitive surface, because tapping motions are used to select content while swiping motions are used to browse content on the Swipe Remote GUI, Photos+ feature, and Roku Mobile App home screen.

163. Roku has infringed and continues to infringe claims of the 505 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 505 Patent Accused Products.

164. Roku has performed each and every element of claim 1 of the 505 Patent during at least its own product development and testing of the 505 Patent Accused Products.

165. Roku has indirectly infringed and continues to indirectly infringe at least claim 1 of the 505 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers and that offer for sale, sell, and use the 505 Patent Accused Products.

166. Roku is on notice of the 505 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 505 Patent and its infringement prior to the filing of this Complaint. As stated above, UEI has marked the 505 Patent via its NevoSmart App on its "About" screen. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 505 Patent. Roku's own patents also have cited

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documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 505 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 505 Patent. As such, Roku either knew or should have known about the existence of the 505 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 505 Patent Accused Products to infringe at least claim 1 of the 505 Patent within the meaning of 35 U.S.C. § 271(b).

167. Roku induces infringement by its customers and users by instructing an encouraging them to download and use the Roku Mobile App. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device, and on the Roku website at https://www.roku.com/mobile-app. For example, Roku provides step-by-step instruction on how an end user should use these products in a manner that directly infringes the 505 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku further has a webpage https://support.roku.com/article/115002681087-how-to-control-your-roku-streaming-device-using-the-roku-mobile-app dedicated to instructing users how to the swipe and touch functions of the Roku Mobile App. Examples include, without limitation, Roku's detailed instructions on the differences between controlling a Roku using the "traditional" and "Swipe" functionality.

168. Roku's direct and indirect infringement of the 505 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

169. Roku's infringement of the 505 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced

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damages. More specifically, Roku knew or should have known about the 505 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 505 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 505 Patent.

170. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 505 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT EIGHT

INFRINGEMENT OF U.S. PATENT 7,895,532

171. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

172. UEI is the owner of all rights, title, and interest in the 532 Patent, including the right to bring this suit for injunctive relief and damages.

173. The 532 Patent generally relates to a user interface for a remote control application. Prior art universal remote controls relied on numerous hard keys for control, such that the control interface became more crowded and less user friendly on remotes able to control a greater number of appliances. The 532 Patent family relates to remote control applications with GUIs that allow for control of a large number of appliances while maintaining a simple user interface.

174. The 532 Patent is valid and enforceable. The claims of the 532 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or conventional to those in the field at the time of invention. Specifically, the use of GUIs

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on a remote control application was not routine or conventional in the art at the time of invention. In particular, the specific combination of claimed elements such as presenting representations of at least one appliance controllable by the controlling device, automatically creating a sequence of instructions on the controlling device for one or more interactions with at least one controllable appliance, and causing the sequence of instructions to be executed in response to selection of a user input element of the controlling device was not well-understood, routine, or conventional to those in the field at the time of invention.

175. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 532 Patent, including but not limited to claim 10, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to smartphones and tablets with the "Roku Mobile App" installed (the "532 Patent Accused Products").

176. For purposes of example only, and without limitation, the 532 Patent Accused Products perform every step of claim 10 of the 532 Patent, which relates to a method for using GUIs with a remote control application. Roku also has infringed and continues infringes at least one other claim of the 532 Patent.

177. The method of claim 10 involves "presenting to a user a graphical user interface including a representations of at least one appliance controllable by the controlling device." During at least the pairing process of the Roku Mobile App with a Roku device, a GUI on the 532 Patent Accused Products presents to the user a list of Roku devices controllable by the App such as the Roku TV, Roku Ultra, and others.

178. The method of claim 10 further involves "using a program to automatically create the sequence of instructions to be executed by the controlling device such that the sequence of instructions reflects one or more interactions by the user with the representations of the at least one appliance controllable by the controlling device presented via the graphical user interface." The Roku Mobile App includes a program that automatically creates a sequences of instructions based on a user's interaction with

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the representations of controllable devices, including the user selection of which Roku device to control with a 532 Patent Accused Product.

179. The method of claim 10 further involves "causing the automatically created sequence of instructions to be executed by the controlling device in response to a selection of a user input element of the controlling device." When a user of the Roku Mobile App selects one of the controllable devices from the list of representations, the Mobile App in response executes the sequence of instructions automatically connecting the 532 Patent Accused Products to the selected Roku device.

180. Roku has infringed and continues to infringe claims of the 532 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 532 Patent Accused Products.

181. Roku has performed each and every element of claim 1 of the 532 Patent during at least its own product development and testing of the 532 Patent Accused Products.

182. Roku has indirectly infringed and continues to indirectly infringe at least claim 1 of the 532 Patent under § 271(b) by knowingly and actively inducing infringement of those claims by its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers and that offer for sale, sell, and use the 532 Patent Accused Products.

183. Roku is on notice of the 532 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 532 Patent and its infringement prior to the filing of this Complaint. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 532 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's

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copying shows Roku knew or should have known of the 532 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 532 Patent. As such, Roku either knew or should have known about the existence of the 532 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 532 Patent Accused Products to infringe at least claim 10 of the 532 Patent within the meaning of 35 U.S.C. § 271(b).

184. Roku induces infringement by its customers and users by instructing an encouraging them to download and use the Roku Mobile App. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device, and on the Roku website at https://www.roku.com/mobile-app. For example, Roku provides step-by-step instruction on how an end user should use these products in a manner that directly infringes the 532 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku further has a webpage https://support.roku.com/article/217288467-how-to-install-the-roku-mobile-app dedicated to instructing users how to set up Roku Mobile App and connect it to Roku devices using the infringing process, explaining, "When the Roku mobile app launches it will discover any Roku devices on your network. Select the Roku device you wish to control using your Roku mobile app. You will then be taken to the home screen where you will be able to control your Roku device."

185. Roku's direct and indirect infringement of the 532 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

186. Roku's infringement of the 532 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 532 Patent and

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its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 532 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 532 Patent.

187. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further direct and indirect infringement of the 532 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

COUNT NINE

INFRINGEMENT OF U.S. PATENT 8,015,446

188. UEI incorporates the previous paragraphs of this Complaint as if fully set forth herein.

189. UEI is the owner of all rights, title, and interest in the 446 Patent, including the right to bring this suit for injunctive relief and damages.

190. The 446 Patent generally relates to a method for debugging a remote control application. Prior art universal remote control applications were not able to be properly debugged after the initial sale to consumers, leading to problems in the field that could not be corrected. The 446 Patent family relates to a remote control application that allows for debugging information from interactions with the remote control to be provided to a support team. The 446 Patent describes a method for debugging this remote control application by recording data associated with user interactions with the application and synchronizing that data with servers for access by a support team.

191. The 446 Patent is valid and enforceable. The claims of the 446 Patent are directed to an inventive application in the field of remote control of consumer electronic devices. The combination of claim elements was not well-understood, routine, or

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conventional to those in the field at the time of invention. Specifically, the use of GUIs on a remote control application, and capturing data associated with user interactions with that interface for use in debugging were not routine or conventional in the art at the time of invention.

192. Roku has infringed and continues to infringe literally and/or through the doctrine of equivalents, one or more claims of the 446 Patent, including but not limited to claim 1, by using, making, offering to sell, and/or selling without authority in the United States certain universal control devices, including but not limited to the "Roku Mobile App", and any other Roku product that stores data related to user interaction with remote control applications (the "446 Patent Accused Products").

193. For purposes of example only, and without limitation, the 446 Patent Accused Products include every element of claim 1 of the 446 Patent, which relates to a method for debugging a remote control application. Roku also has infringed and continues infringes at least one other claim of the 446 Patent.

194. The method of claim 1 involves "storing within a memory of the controlling device data captured during operation of the controlling device, the data being representative of a user interaction with a user interface element of the controlling device and an action occurring within the remote control application of the controlling device resulting from the user interaction with the user interface element of the controlling device." The 446 Patent Accused Products store numerous types of data captured during operation of the Roku remotes and Roku Mobile App. Section I.B.3 of the Roku Privacy Policy (available at https://docs.roku.com/doc/userprivacypolicy/en-us) states that "[w]e receive information about your interactions with the Roku Services, such as when you access the Roku Services, your search history, search results, audio information when you use voice-enabled features, channels you access (including usage statistics such as what channels you access, the time you access them, and how long you spend viewing them), interactions with content and advertisements, and settings and preferences." The "Roku Services" are defined to include the Roku Mobile App. The Privacy Policy

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further states that "[i[f you use Roku's mobile apps, in addition to the other usage information described in this section, we also log whether you use a feature called Play on Roku to play content stored on your mobile device (such as music, photos, or videos) through the Roku Device connected with Roku's mobile apps. To let you play videos, photos and music stored on your mobile device on your TV through the Roku Device, Roku's mobile apps may need permissions to access the content and other information stored on your mobile device." Thus, the 446 Patent Accused Products capture information relating to a user's interaction with the device, such as use of certain features, settings, and user preferences.

195. The method of claim 1 further involves "causing the controlling device to upload the captured data to a computer in communication with the controlling device whereby the uploaded captured data is available for use in debugging the remote control application of the controlling device." As described in the above-quoted Privacy Policy, Roku collects information about user activity, which it stores in "electronic databases of personal information." Thus, the 446 Patent Accused Products transmit the collected data to a server for access by Roku. The server is a computer in communication with the controlling device. The Privacy Policy explains in Section II (titled "Information Usage"), subsection A (titled "Use by or on Behalf of Roku") that the captured data is used "to provide and maintain the Roku Services" and to "to understand and analyze our user base and how you use the Roku Services, and to improve and enhance the Roku Services, and to develop new products, services, features and functionality." Improving and enhancing the Roku Services, and developing new features and functionality includes "debugging" as that term is commonly understood in the software industry. For example, the release notes for Roku OS 8 software (available at https://blog.roku.com/roku-os-8-release-notes) describes numerous examples of "bug fixes" contained in the software update, such as "[f]ixed multiple bugs that caused Roku devices to reboot intermittently when steaming specific channels"; "[f]ixed a bug in which color banding would appear on the screen for some Roku TV models when entering USB media player"; and "[f]ixed

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a bug in which audio would not mute immediately after some Roku TV models were turned off."

196. Roku has infringed and continues to infringe claims of the 446 Patent within the meaning of 35 U.S.C. § 271(a) through the foregoing activities, including at least making, using, selling, offering for sale, and/or importing the 446 Patent Accused Products.

197. Roku has performed each and every element of claim 1 of the 446 Patent during at least its own product development and testing of the 446 Patent Accused Products.

198. Roku has indirectly infringed and continues to indirectly infringe at least claim 1 of the 446 Patent under § 271(b) by knowingly and actively inducing infringement of those claims vis a vis its customers and end users of its products. The direct infringers that Roku has induced to infringe include, without limitation, Roku's customers and that offer for sale, sell, and use the 446 Patent Accused Products.

199. Roku is on notice of the 446 Patent at least as of the filing of this complaint. In addition, Roku has had actual or constructive knowledge of the 446 Patent and its infringement prior to the filing of this Complaint. Further, at least as of September 2017, UEI informed Roku that it had over 30 issued and pending patents covering its control solutions. It is believed that Roku investigated UEI's patents as a result and gained actual knowledge of the 446 Patent. Roku's own patents also have cited documents referring to UEI's patents over 290 times, which made Roku aware of UEI's patents. Furthermore, it is believed Roku copied various aspects of UEI's patented technology, and Roku's copying shows Roku knew or should have known of the 446 Patent and intended to induce infringement. As a result, Roku at least engaged in willful blindness by taking deliberate actions to avoid confirming a high probability of infringement of the 446 Patent. As such, Roku either knew or should have known about the existence of the 446 Patent and that creating features in its devices to practice that patent would induce infringement. Roku has induced and continue to induce end users of the 446 Patent

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Accused Products to infringe at least claim 1 of the 446 Patent within the meaning of 35 U.S.C. § 271(b).

200. Roku induces infringement by its customers and users by instructing an encouraging them to download and use the Roku Mobile App. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device. Encouragement and instructions to download the Roku Mobile App appear on the setup screen during the setup of a Roku Device, and on the Roku website at https://www.roku.com/mobile-app. For example, Roku provides step-by-step instruction on how an end user should use these products in a manner that directly infringes the 446 Patent, and Roku also provides further instruction in the "Setup and Troubleshooting" section of its website. Roku further has a webpage https://support.roku.com/article/217288467-how-to-install-the-roku-mobile-app dedicated to instructing users how to set up Roku Mobile App and connect it to Roku devices using the infringing process, explaining, "When the Roku mobile app launches it will discover any Roku devices on your network. Select the Roku device you wish to control using your Roku mobile app. You will then be taken to the home screen where you will be able to control your Roku device." The Privacy Policy further indicates that the data capture happens automatically by the Roku Mobile App after installation.

201. Roku's direct and indirect infringement of the 446 Patent has injured UEI, and UEI is entitled to recover damages adequate to compensate it for such infringement.

202. Roku's infringement of the 446 Patent has been willful, wanton, malicious, and/or deliberate and constitutes egregious behavior justifying an award of enhanced damages. More specifically, Roku knew or should have known about the 446 Patent and its infringement of that patent, as discussed above, but continued to engage in the using, making, offering to sell, and/or selling of the 446 Patent Accused Products despite an objectively high likelihood that this conduct would infringe the 446 Patent.

203. Roku's infringing activities will continue to injure UEI unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining

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further direct and indirect infringement of the 446 Patent. If Roku's conduct is not stopped, UEI will continue to suffer competitive harm, irreparable injury, and significant damages. Because UEI has no adequate remedy at law, UEI seeks, in addition to damages, preliminary and permanent injunctive relief. UEI competes to supply remote control technology to companies like Roku and will continue suffering irreparable harm absent injunctive relief.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff UEI respectfully requests relief and judgement against the Defendant, Roku, Inc., as follows:

1. An entry of judgement in favor of UEI and against Roku;

2. An award of damages adequate to compensate UEI for Roku's direct infringement and indirect infringement of U.S. Patent Nos. 7,589,642; 8,004,389; 9,911,325; 9,716,853; 7,782,309; 7,821,504; 7,821,505; 7,895,532; and 8,015,446;

3. A preliminary and permanent injunction against Roku and its officers, directors, employees, agents, consultants, contractors, suppliers, distributors, and all others acting in concert or privity with Roku from further infringement of the Patents-in-Suit;

4. If an injunction is denied, an award of an ongoing royalty;

5. An award of treble damages to UEI as a result of Roku's willful infringement;

6. An award of prejudgment interest;

7. A finding that, with respect to Roku, this case is exceptional and awarding to UEI its reasonable costs and attorney fees under 35 U.S.C. § 285;

8. All other costs and fees awardable by law; and

9. Such other relief that the Court sees as just and proper.

JURY DEMAND

10. UEI hereby demands a jury trial on all causes of action, claims, and issues so triable as a matter of right.

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Respectfully submitted this 5th day of September, 2018.

By: */s/ Ryan W. Koppelman*

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EXHIBIT A

US007589642B1

(12) **United States Patent**
Mui

(10) **Patent No.: US 7,589,642 B1**
(45) **Date of Patent: Sep. 15, 2009**

(54) **RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE**

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(73) Assignee: **UEI Cayman Inc.** (KY)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1076 days.

(21) Appl. No.: **10/737,029**

(22) Filed: **Dec. 16, 2003**

(51) **Int. Cl.**
G08C 19/00 (2006.01)

(52) **U.S. Cl.** **340/825.69**; 340/825.72; 340/825.22; 340/5.61; 340/5.64; 340/5.74; 340/825.29; 345/168

(58) **Field of Classification Search** 340/825.69, 340/825.72, 825.22, 5.61, 5.64, 5.74; 345/172, 345/168; 348/734
See application file for complete search history.

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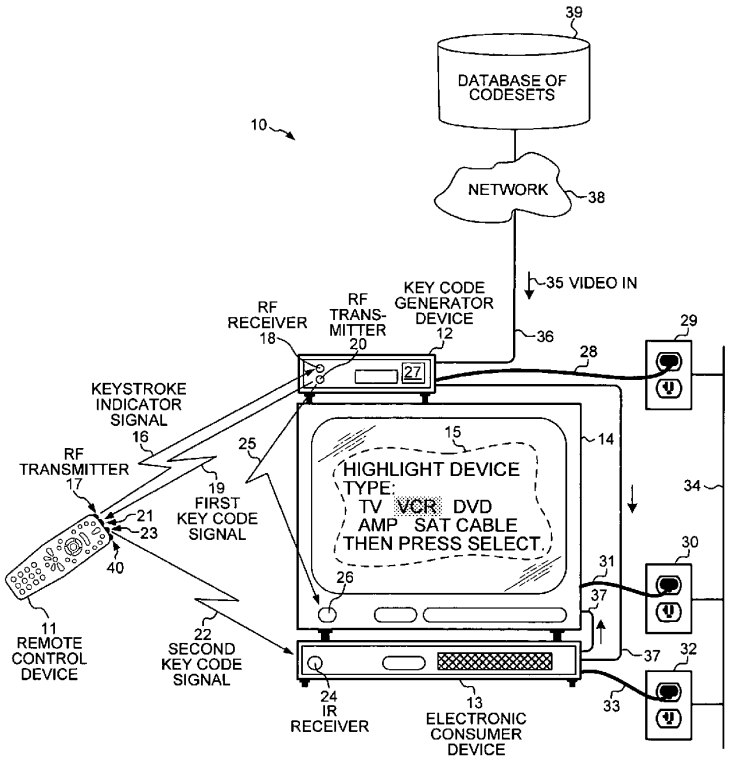
(57) **ABSTRACT**

Upon receiving a keystroke indicator signal from a remote control device, a key code generator device identifies a codeset usable to communicate with a selected consumer device. The keystroke indicator signal contains an indication of a pressed key, which corresponds to a function of the selected consumer device. Using the identified codeset and the key indication, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected consumer device in the second key code signal. The key code causes the selected consumer device to perform the desired function.

25 Claims, 4 Drawing Sheets



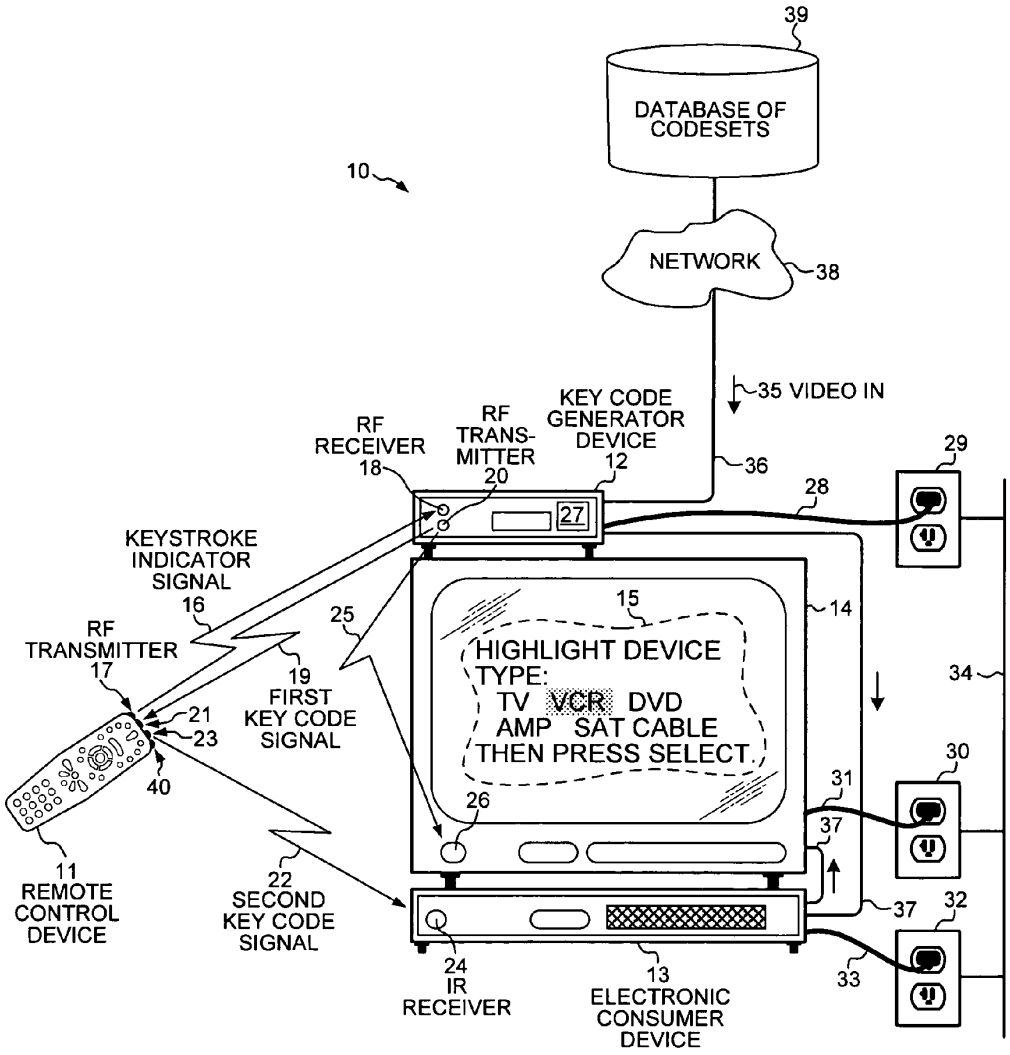

39
DATABASE OF CODESETS
10
NETWORK
38
35 VIDEO IN
RF RECEIVER
18
RF TRANS-MITTER
20
KEY CODE GENERATOR DEVICE
12
36
28
29
27
KEYSTROKE INDICATOR SIGNAL
16
RF TRANSMITTER
17
19
FIRST KEY CODE SIGNAL
25
15
14
HIGHLIGHT DEVICE TYPE:
TV VCR DVD
AMP SAT CABLE
THEN PRESS SELECT.
34
21
23
40
30
31
26
37
11
REMOTE CONTROL DEVICE
22
SECOND KEY CODE SIGNAL
37
32
24
IR RECEIVER
13
ELECTRONIC CONSUMER DEVICE
33

FIG. 1

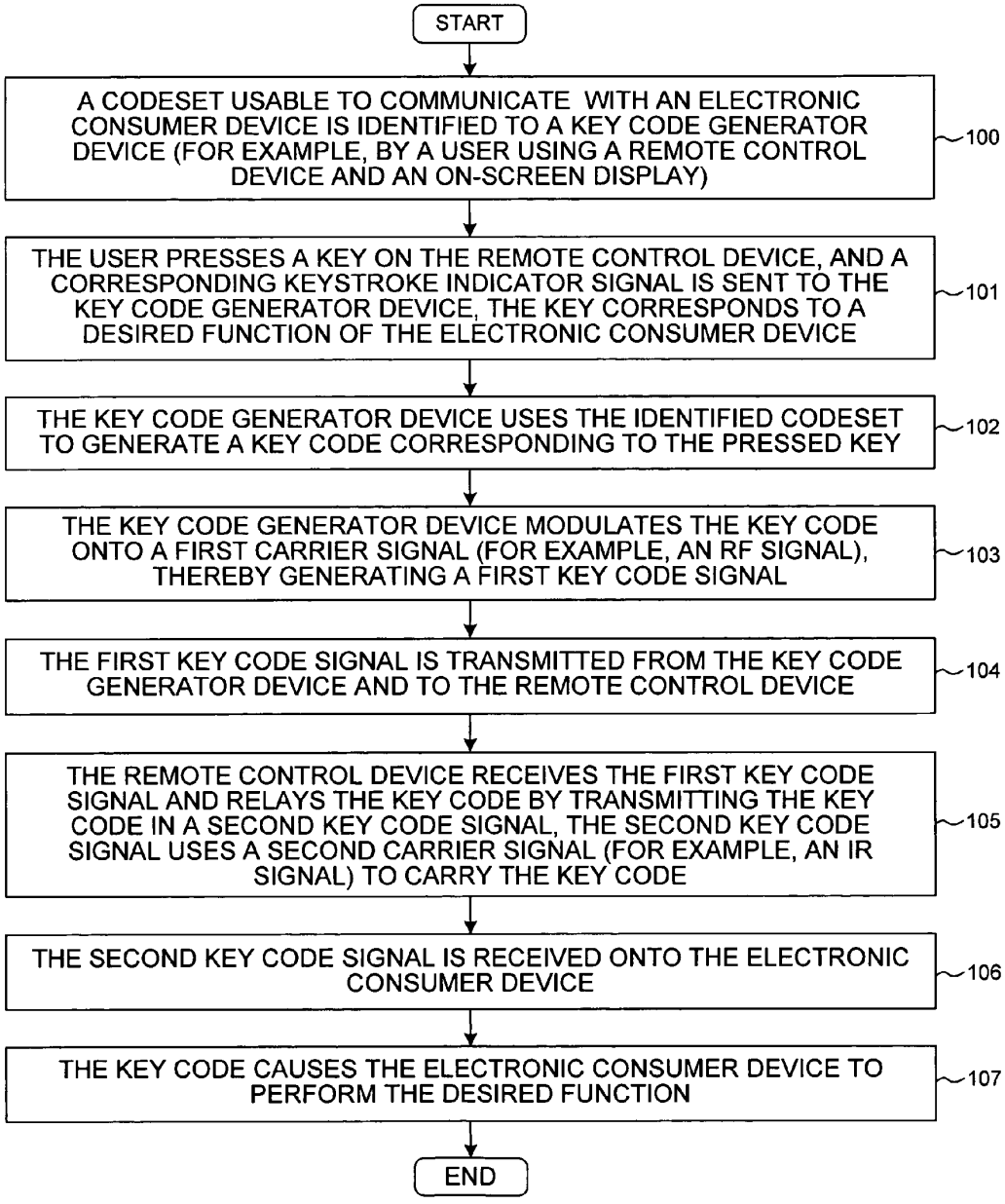
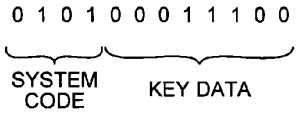

START
A CODESET USABLE TO COMMUNICATE WITH AN ELECTRONIC CONSUMER DEVICE IS IDENTIFIED TO A KEY CODE GENERATOR DEVICE (FOR EXAMPLE, BY A USER USING A REMOTE CONTROL DEVICE AND AN ON-SCREEN DISPLAY)
100
THE USER PRESSES A KEY ON THE REMOTE CONTROL DEVICE, AND A CORRESPONDING KEYSTROKE INDICATOR SIGNAL IS SENT TO THE KEY CODE GENERATOR DEVICE, THE KEY CORRESPONDS TO A DESIRED FUNCTION OF THE ELECTRONIC CONSUMER DEVICE
101
THE KEY CODE GENERATOR DEVICE USES THE IDENTIFIED CODESET TO GENERATE A KEY CODE CORRESPONDING TO THE PRESSED KEY
102
THE KEY CODE GENERATOR DEVICE MODULATES THE KEY CODE ONTO A FIRST CARRIER SIGNAL (FOR EXAMPLE, AN RF SIGNAL), THEREBY GENERATING A FIRST KEY CODE SIGNAL
103
THE FIRST KEY CODE SIGNAL IS TRANSMITTED FROM THE KEY CODE GENERATOR DEVICE AND TO THE REMOTE CONTROL DEVICE
104
THE REMOTE CONTROL DEVICE RECEIVES THE FIRST KEY CODE SIGNAL AND RELAYS THE KEY CODE BY TRANSMITTING THE KEY CODE IN A SECOND KEY CODE SIGNAL, THE SECOND KEY CODE SIGNAL USES A SECOND CARRIER SIGNAL (FOR EXAMPLE, AN IR SIGNAL) TO CARRY THE KEY CODE
105
THE SECOND KEY CODE SIGNAL IS RECEIVED ONTO THE ELECTRONIC CONSUMER DEVICE
106
THE KEY CODE CAUSES THE ELECTRONIC CONSUMER DEVICE TO PERFORM THE DESIRED FUNCTION
107
END

FIG. 2



KEY CODE

FIG. 3

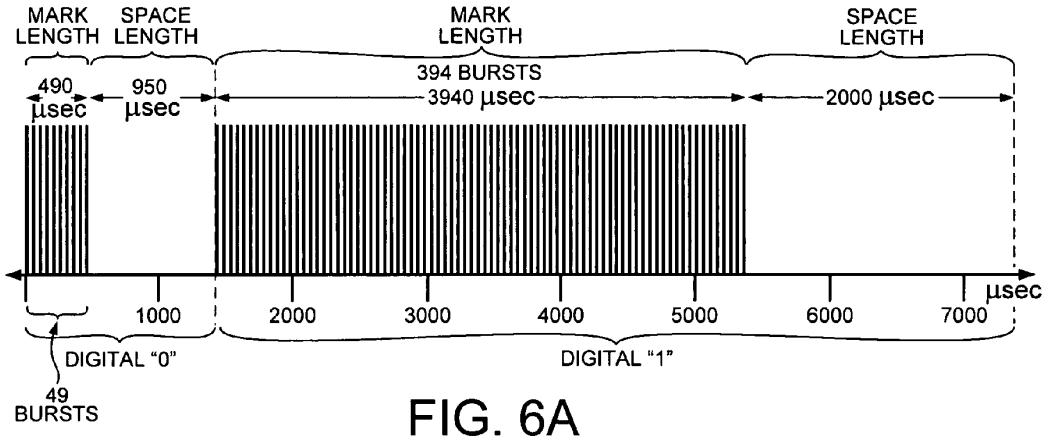


FIG. 6A

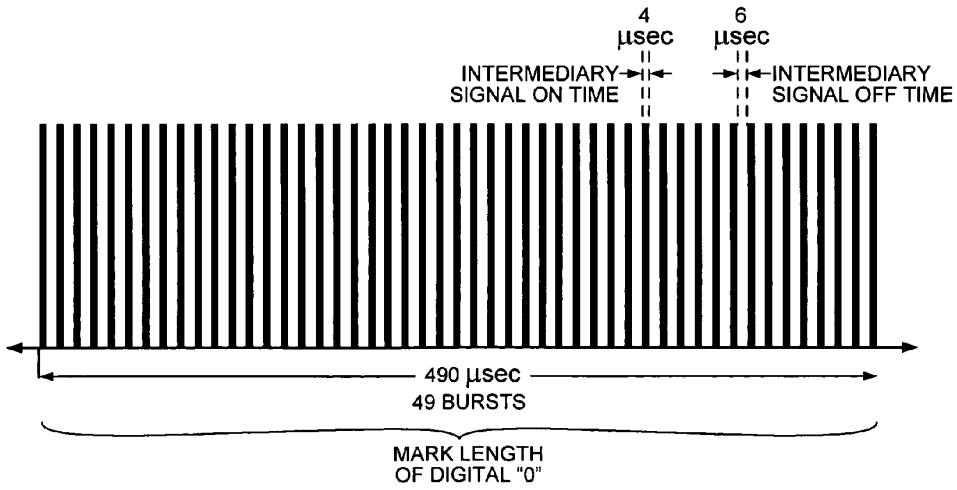


FIG. 6B

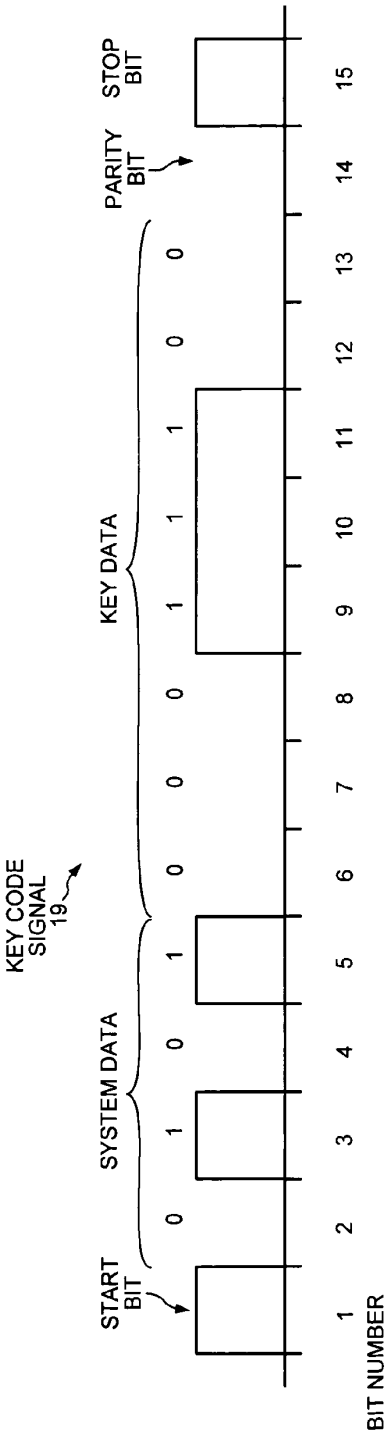


FIG. 4
BINARY TRANSMISSION

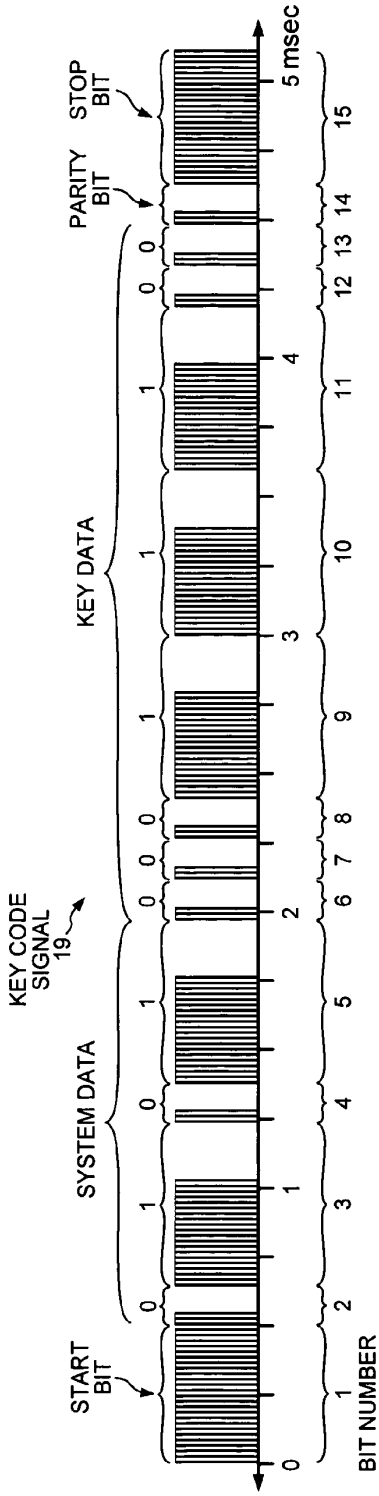


FIG. 5
PULSE WIDTH MODULATION

RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE

TECHNICAL FIELD

The present invention relates generally to remote control devices and, more specifically, to relaying key code signals through a remote control device to operate an electronic consumer device.

BACKGROUND

Most households today possess multiple types of electronic consumer devices, such as televisions, stereo radios, digital video disk players, video cassette recorders, set-top cable television boxes and set-top satellite boxes. Manufacturers of such electronic devices typically supply a remote control device along with each electronic device. It is, therefore, common for a consumer who has multiple electronic devices to have multiple remote control devices.

A remote control device typically controls a selected electronic consumer device by transmitting infrared key code signals to the selected electronic consumer device. The infrared signals contain key codes of a codeset associated with the selected electronic consumer device. Each key code corresponds to a function of the selected electronic device, such as power on, power off, volume up, volume down, play, stop, select, channel up, channel down, etc. In order to avoid the situation where a remote control device unintentionally operates an electronic consumer device that is associated with a different remote control device, manufacturers sometimes use distinct codesets for the communication between various electronic consumer devices and their associated remote control devices. The codesets can differ from each other not only by the bit patterns assigned to various functions of the associated electronic consumer device, but also by the timing information that describes how the key codes should be modulated onto carrier signals to generate key code signals.

Consumers may find it inconvenient to operate their electronic devices using multiple remote control devices. Thus, a consumer may wish to operate multiple electronic consumer devices using a single remote control device. A single remote control device can store many codesets so that the remote control device can control a corresponding large number of different electronic consumer devices. There are, however, thousands of codesets in use in electronic consumer devices today. Manufacturers of remote control devices, however, may wish to limit the memory on their remote control devices to a size that is insufficient to store the thousands of existing codesets.

A system is sought for enabling a remote control device to control a selected one of multiple different electronic consumer devices without requiring the codeset associated with the selected electronic consumer device to be stored on the remote control device.

SUMMARY

A system for relaying a key code through a remote control device to an electronic consumer device allows the electronic consumer device to be controlled without storing the associated codeset on the remote control device. Upon receiving a keystroke indicator signal from a remote control device, a key code generator device, such as a set-top box, identifies the particular codeset usable to communicate with the selected electronic consumer device. The keystroke indicator signal contains an indication of a key on the remote control device that was pressed, which corresponds to a function of the selected electronic consumer device. Using the identified codeset and the indication of the pressed key, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected electronic consumer device in the second key code signal. The key code causes the selected electronic consumer device to perform the desired function. The key code is not stored on the remote control device in a permanent manner, but rather the key code is relayed through the remote control device.

In another embodiment, a third key code signal (which may, for example, be a radio frequency signal) is communicated directly from the key code generator device to an electronic consumer device. A key code contained in the third key code signal causes the electronic consumer device to perform a desired function.

In yet another embodiment, the system automatically determines which codeset is usable to communicate with a selected electronic consumer device. The key code generator device sends key codes for one particular function from among a series of codesets one-by-one to the selected electronic consumer device. When the key code from one of the codesets causes the electronic consumer device to perform the desired function, electromagnetic noise is introduced into electrical power wiring through which both the electronic consumer device and the key code generator device receive power. When the key code generator device detects this noise on the electrical power wiring, the key code generator device identifies the codeset corresponding to the last transmitted key code to be the codeset usable to communicate with the selected electronic consumer device.

Other embodiments and advantages are described in the detailed description below. This summary does not purport to define the invention. The invention is defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, where like numerals indicate like components, illustrate embodiments of the invention.

FIG. **1** is a schematic diagram of a system for relaying key code signals through a remote control device.

FIG. **2** is a flowchart of a method for relaying key code signals through a remote control device.

FIG. **3** is an illustration of a key code transmitted within a key code signal.

FIG. **4** is a waveform diagram of a first example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **5** is a waveform diagram of a second example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **6**A is an illustration of a modulated digital zero and digital one within the key code signal of FIG. **5**.

FIG. **6**B is a more detailed illustration of a mark of a modulated digital zero within the key code signal of FIG. **5**.

DETAILED DESCRIPTION

Reference will now be made in detail to some embodiments of the invention, examples of which are illustrated in the accompanying drawings.

FIG. **1** is a diagram of a system **10** for relaying a key code through a remote control device **11** to an electronic consumer device in accordance with the present invention. FIG. **2** is a flowchart that illustrates a method of operation of system **10**. System **10** includes a key code generator device **12**, remote control device **11**, a first electronic consumer device **13** and a second electronic consumer device **14**. In this example, second electronic consumer device **14** is a television set.

In a first step (step **100**), key code generator device **12** determines the appropriate codeset that controls the type, brand and model of the particular electronic consumer device that is to be controlled. A user uses remote control device **11** to respond to an on-screen display **15** on the screen of television set **14** to step through a sequence of menu screens to identify the codeset corresponding to the device that is to be controlled. The user does this by identifying, on on-screen display **15**, the type, brand and model of the particular electronic consumer device. In this example, the user is identifying first electronic consumer device **13**, which is a video cassette recorder (VCR) manufactured by Sony with model number 8000. In FIG. **1**, the user is identifying the device type by highlighting the choice "VCR" on the on-screen display. In another example, subsequent to controlling VCR **13**, the user may wish to control television set **14**, which is a "Gold" model manufactured by RCA. In that case, the user begins identifying television set **14** by highlighting the choice "TV".

In the present example, key code generator device **12** is a set-top box. Key code generator device **12** generates the on-screen displays and communicates with television set **14** such that key code generator device **12** identifies one of a plurality of codesets that corresponds to one of the electronic consumer devices identified by the user, such as VCR **13** or television set **14**. System **10** uses the appropriate codeset to enable remote control device **11** to communicate with VCR **13** and television set **14**.

Next (step **101**), the user presses a key on remote control device **11**. This key is associated with a function that the user wants performed by an electronic consumer device. For example, the function may be to turn on the power of VCR **13**. When the user presses the "VCR power-on" key on remote control device **11**, remote control device **11** transmits a keystroke indicator signal **16** from a radio frequency (RF) transmitter **17** on remote control device **11**. Alternatively, two or more keys on remote control device **11** may be associated with a single function, such as turning on the power of VCR **13**. In that case, the user presses a "VCR" key and then a "power-on" key to cause remote control device **11** to transmit keystroke indicator signal **16**. Keystroke indicator signal **16** is transmitted as a signal in a radio frequency band to an RF receiver **18** on key code generator device **12**.

There are multiple forms in which an indication of the pressed key, as well as the identity of the electronic consumer device that is to perform the associated function, can be communicated in keystroke indicator signal **16** from remote control device **11** to key code generator device **12**. In one embodiment, the indication of the pressed key is a key code comprised of a standardized system code and standardized key data. In the present example, the standardized system code identifies the type of electronic consumer device that is to be controlled, such as a TV, a VCR, a DVD player, a stereo amplifier, a satellite receiver or a cable receiver. The standardized system code and key data are part of a commonly used codeset that is stored on remote control device **11**. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the system code and key data to form keystroke indicator signal **16**. For example, a microcontroller on remote control device **11** uses timing information associated with the commonly used codeset to generate a pulse width modulated keystroke indicator signal **16**.

In another embodiment, the indication of the pressed key includes a proprietary identification code identifying the pressed key, as well as a proprietary identification code corresponding to the type of the electronic consumer device that is to be controlled. The proprietary identification codes are understood by key code generator device **12**, but are not standardized codes that are understood by electronic consumer devices. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the proprietary identification codes onto keystroke indicator signal **16**.

Whether remote control device **11** communicates with key code generator device **12** through a standardized codeset or through proprietary identification codes, codes may be included that do not correspond to pressed keys or functions that are to be performed on electronic consumer devices. For example, in response to receiving any signal from remote control device **11**, key code generator device **12** may return a code to remote control device **11** causing a light emitting diode (LED) display on remote control device **11** to turn on.

Next (step **102**), key code generator device **12** determines which key code of the codeset previously identified in step **100** corresponds to the pressed key.

FIG. **3** illustrates one example of a key code from a commonly used codeset. The key code is comprised of a standardized system code and standardized key data. Both the system code and the key data are digital values. The 12-bit key code includes a 4-bit system code [0101] and 8-bit key data [00011100]. In the present example, the key code is the key code in the identified codeset that corresponds to the "VCR power-on" key of remote control device **11**.

Next (step **103**), key code generator device **12** modulates the key code for the power-on function of VCR **13** onto a first carrier signal, thereby generating a first key code signal **19**. In this example, the first carrier signal is an RF signal. An RF signal for purposes of this patent document is an electromagnetic signal having a frequency between thirty hertz and three hundred gigahertz.

FIG. **4** and FIG. **5** illustrate key code signal **19** in two specific embodiments. In both embodiments, the key code is transmitted as a stream of digital values 010100011100, where the system code is transmitted first immediately followed by the key data without any place holders between them. The standardized system code determined in step **102** need not identify the brand or model of VCR **13**, but only the fact that first electronic consumer device **13** is a VCR. The key code is modulated in step **103** using timing information associated with the codeset for VCR **13**. Thus, the particular brand and model of VCR **13** is able to understand the key code modulated using the appropriate timing information.

In the embodiment of FIG. **4**, key code signal **19** is a 15-bit binary transmission whose bit pattern appears as a universal asynchronous receiver and transmitter (UART) type communication. The binary transmission begins with a start bit and ends with a parity bit and a stop bit. The parity bit is calculated based on the 12-bit key code within the binary transmission. In this example, the value of the parity bit is a digital zero. An intermediary signal is transmitted over the first carrier signal at an intermediary frequency (for example, 100 kHz) to communicate a digital one. The absence of the intermediary signal indicates a digital zero. The intermediary signal has a lower frequency than the first carrier signal.

In the embodiment of FIG. **5**, the 12-bit key code is modulated onto key code signal **19** using pulse width modulation.

Digital ones and zeros are characterized by pairs of marks and spaces. The period between successive leading edges of the bursts in a mark is the period of an intermediary signal. The intermediary signal has an intermediary frequency. In a space, there are no bursts.

FIG. **6**A shows a digital zero and a digital one in key code signal **19** of FIG. **5** in more detail. A "mark/space" pair represents a digital zero and another "mark/space" pair represents a digital one. The marks and spaces of each pair have predetermined lengths. In the embodiment of FIG. **5**, the mark length of a digital zero is 490 microseconds, and the mark length of a digital one is 3940 microseconds. The space length of a digital zero is 950 microseconds, and the space length of a digital one is 2000 microseconds.

FIG. **6**B shows the bursts of the first carrier signal that comprise the intermediary signal in more detail. In the embodiment of FIG. **5**, the bursts that comprise the intermediary signal occur every ten microseconds, resulting in an intermediary frequency of 100 kilohertz. The duty cycle of the intermediary signal is characterized by an "on time" of four microseconds and an "off time" of six microseconds. There are forty-nine bursts of the carrier signal within each mark length of 490 microseconds.

Timing information other than that shown in the embodiment of FIG. **5** can also be used. For example, one common form of pulse width modulation uses an intermediary signal having a frequency of about 38.5 kilohertz. Each period of the intermediary signal has an "on time" of ten microseconds and an "off time" of sixteen microseconds. If such an intermediary signal were used to generate a 490 microsecond mark length of a digital zero shown in FIG. **6**A, there would be 19 bursts of the intermediary signal in the mark. Similarly, if such an intermediary signal were used to generate a 3940 microsecond mark length of a digital one shown in FIG. **6**A, there would be 151 bursts of the intermediary signal in the mark.

Next (step **104**), an RF transmitter **20** of key code generator device **12** transmits first key code signal **19** in the form of an RF transmission to an RF receiver **21** on remote control device **11**.

Next (step **105**), remote control device **11** receives first key code signal **19** and relays the key code communicated by first key code signal **19** to VCR **13** in the form of a second key code signal **22**. Remote control device **11** is a slave to key code generator device **12**. Remote control device **11** relays the key code by receiving first key code signal **19** in RF form and translating the communicated key code so that the key code is modulated onto a second carrier signal resulting in second key code signal **22**. In this example, the second carrier signal is an infrared signal with a frequency in the range between three hundred gigahertz and three hundred terahertz. Second key code signal **22** is transmitted by an IR transmitter **23** on remote control device **11** to VCR **13**. In the embodiment of FIG. **5**, key code signal **19** is converted into key code signal **22** by forming the bursts of the intermediary signal using the second carrier signal with an infrared frequency in the place of the first carrier signal with a radio frequency. For both key code signal **19** and key code signal **22**, digital ones and digital zeros are modulated using the same timing for "mark/space" pairs. The waveform diagram of key code signal **22** appears the same as the waveform diagram shown in FIG. **5** for key code signal **19**; only the frequency of the carrier signal that forms the bursts is different.

Next (step **106**), second key code signal **22** is received onto electronic consumer device (VCR) **13** by an IR receiver **24**.

Next (step **107**), IR receiver **24** on VCR **13** recovers the key code from second key code signal **22**. VCR **13** is thereby instructed to perform the function desired by the user. In this example, the function is to power on VCR **13**. Other key codes, however, correspond to other functions, such as power off, channel advance, channel back, volume up, volume down, cursor up, cursor down, cursor right, cursor left, select, play, record, stop, forward, rewind and pause.

In a second example, an electronic consumer device is controlled by an RF key code signal transmitted from key code generator device **12**. Subsequent to controlling VCR **13**, the user wishes to control second electronic consumer device **14**, which is a "Gold" model RCA television set. In the second example, the user uses the on-screen display **15** to identify the type (TV), brand (RCA) and model (Gold) of second electronic consumer device **14**. Key code generator device **12** determines the appropriate codeset that controls television set **14**. The user then presses a key on remote control device **11** associated with a function that the user wants performed by television set **14**. For example, the function is to advance the channel of television set **14**. When the user presses the channel advance key on remote control device **11**, an indication of the pressed key is transmitted in an RF keystroke indicator signal from remote control device **11** to key code generator device **12**.

Key code generator device **12** then determines which key code of the identified codeset corresponds to the pressed key. Key code generator device **12** modulates the key code for the channel advance function onto an RF carrier signal, thereby generating a third key code signal **25**. Key code generator device **12** uses the same modulation technique to generate both third key code signal **25** and first key code signal **19**. Third key code signal **25** is modulated using timing information associated with the codeset that controls RCA Gold television set **14**.

In this second example, television set **14** has an RF receiver **26** and is capable of receiving RF key code signals. RF transmitter **20** of key code generator device **12** transmits third key code signal **25** directly to television set **14**. Third key code signal **25** is received onto television set **14** by RF receiver **26**, and RF receiver **26** recovers the key code from third key code signal **25**. Television set **14** is thereby instructed to advance the channel.

Although remote control device **11** in the first example stores either a proprietary codeset or a standardized codeset and uses that codeset to generate keystroke indicator signal **16**, remote control device **11** stores only that single codeset. This codeset is the codeset used by key code generator device **12** to receive communications from remote control device **11**. Remote control device **11** can therefore be made inexpensively and may contain a relatively small amount of memory. The memory may, for example, be read only memory (ROM) on a microcontroller integrated circuit (for example, a Z8 microcontroller available from Zilog, Inc. of San Jose, Calif.)

Even though remote control device **11** stores only a single codeset, system **10** of FIG. **1** nevertheless allows remote control device **11** to control the desired electronic consumer device **13**, which may use any one of thousands of different codesets. Key code generator device **12** may, for example, include a hard disk or other mass storage device that stores thousands of possible codesets. The user may use remote control device **11** to select any one of those codesets for communication with the particular electronic consumer device **13**. In comparison to some conventional systems where codesets are downloaded into a universal remote control device from a personal computer or other device that is not normally part of an entertainment system, system **10** uses preexisting hardware of the entertainment system (such as the

on-screen display functionality, data storage capability, and wireless communication ability of the set-top box) to source and identify codesets.

Although the specific embodiments of FIGS. **1** and **2** are explained above in connection with the codesets being identified to the key code generator device **12** using an on-screen display, the codeset usable to communicate with an electronic consumer device may be identified to key code generator device **12** in other ways in other embodiments. In one embodiment, for example, the key code generator device includes autoscan functionality. Key code generator device **12** includes an EMI detector **27** that detects electromagnetic interference (EMI) or noise on power cord **28**. Power cord **28** is a power cord through which key code generator device **12** receives electrical power from a wall socket **29**. Similarly, television set **14** receives power from another wall socket **30** via a power cord **31**. VCR **13** receives power from a wall socket **32** via another power cord **33**. In accordance with the autoscan functionality, key code generator device **12** identifies the codeset used to communicate with a particular electronic consumer device by generating and transmitting a sequence of key code signals relayed through remote control device **11** to the electronic consumer device to be controlled (in this case VCR **13**). Each of these key code signals contains a different key code corresponding to the same desired function on different device types, brands and models.

In one example, the desired function is the function of powering on VCR **13**. The key code generator device **12** sends the power-on key codes for each of a series of codesets one-by-one to VCR **13**. When the key code for one of the codesets causes VCR **13** to perform the desired function (in this case, to power on), VCR **13** introduces noise or other electromagnetic interference via cord **33** into wall socket **32**. The power terminal within wall socket **32** is connected through wiring **34** to the power terminal in wall socket **29**. The noise generated by VCR **13** is therefore communicated through wiring **34**, the power terminal of wall socket **29** and power cord **28** to EMI detector **27** on key code generator device **12**. When key code generator device **12** detects the electromagnetic interference on power cord **28**, key code generator device **12** automatically identifies the codeset used by VCR **13** as the codeset used to communicate the last key code signal for the power-on function.

Multiple electronic consumer devices may have the same key data for a particular function, for example, the power-on function. A key code, however, also contains a system code (see FIG. **3**) that corresponds to a particular type of electronic consumer device. For example, the system code used for a television set will typically be different than the system code used for a video cassette recorder. Thus, different device types that use the same key data for the power-on function will not respond to a key code containing an incorrect system code. Each of the power-on key codes transmitted in this example by key code generator device **12** contains the system code for a video cassette recorder, so television set **14** does not recognize the key codes. Because key code generator device **12** is aware of the system code communicated, key code generator device **12** determines that it was VCR **13** that was powered on and not television **14**.

In another example, the codeset usable to communicate with VCR **13** is identified to key code generator device **12** using autoscan functionality that does not involve key code generator device **12** having a specialized EMI detection circuit. In that case, the user may be prompted by successive screens of on screen display **15** to push the power-on key on remote control device **11** multiple times. Each time the power-on key is pressed, keystroke indicator signal **16** communicates this to key code generator device **12**. Key code generator device **12** in turn generates and transmits a key code signal containing a power-on key code using a different codeset. Each key code signal is relayed through remote control device **11** to the particular electronic consumer device to be controlled. One by one the user is prompted to push the power-on key, and key code generator device **12** in turn generates key codes using different codesets until the electronic consumer device performs a desired function. In this case, first electronic consumer device **13** turns on. The user is prompted not to press the power-on key once the user sees the desired function being performed by first electronic consumer device **13**. In the present example, light emitting diodes (LEDs) on the face of VCR **13** may be illuminated to indicate to the user that VCR **13** has powered on. When the user stops pressing the power-on key, then the key code generator device **12** identifies the codeset of the last transmitted key code to be the codeset used by the electronic consumer device.

In another example, the user presses keys on remote control device **11** to communicate to key code generator device **12** a 3-digit codeset identification number identifying the codeset. The user may determine this codeset identification number by looking up the codeset identification number in a booklet supplied along with the electronic consumer device to be controlled. Alternatively, a table of manufacturers, model numbers and their associated codesets may be used to lookup the codeset identification number.

In an embodiment where key code generator device **12** is a set-top box, the set-top box receives a video input signal **35** from a cable television coaxial cable **36**. Video input signal **35** is ultimately delivered to television set **14** through cables **37**. Coaxial cable **36** is also used to provide networking connectivity between the set-top box and a network **38**. Network **38** may, for example, be or include the Internet. A database of codesets **39** is maintained at a remote location. As new electronic consumer devices are introduced onto the market, new codesets may be necessary to communicate with these new devices. So that one such new codeset can be distributed from database of codesets **39** when a new electronic consumer device is introduced into the market, this new codeset is communicated via network **38** and coaxial cable **36** to key code generator device **12**. The new codeset is then stored on a mass storage hard disk within the set-top box. In this way, the pre-existing and inexpensive remote control device **11** can be used to control a new electronic consumer device whose required codeset did not exist at the time remote control device **11** and key code generator device **12** were delivered to the user.

In yet another embodiment, remote control device **11** is a learning remote control device that includes an IR detector **40**. In accordance with one method, the learning remote control device **11** is placed so that IR detector **40** can receive an IR transmission from an IR transmitter of another remote control device. Keys corresponding to key codes to be learned are pressed on the other remote control device such that successive key code signals are transmitted from the IR transmitter of the other remote control device to IR detector **40** of the learning remote control device **11**. Learning remote control device **11** detects when the envelope of the bursts of the received IR signal changes from low to high and high to low. The time duration between each successive transition is stored such that a key code signal is recorded as timing information for a series of mark lengths and space lengths. As the various keys of the remote control device to be learned are pressed, learning remote control device **11** records successive strings of timing information. The resulting strings of timing information, once collected on learning remote control device

11, are automatically transmitted from learning remote control device 11 in the form of RF signals to key code generator device 12. Key code generator device 12 in turn communicates the captured strings of timing information through coaxial cable 36 and network 38 to database of codesets 39. Personnel maintaining database of codesets 39 then analyze the timing information and generate a codeset that describes the key codes captured by learning remote control device 11. In this way, a new codeset containing key data, systems codes and timing information is added to database of codesets 39. Rather than storing the information as a new codeset that includes separate key codes and timing information, the information for each keystroke can be stored in database of codesets 39 in the form of interval times.

A single system 10 is therefore described that can support numerous different types of electronic consumer devices that can use multiple different codesets. The remote control device 11 of the system need not include a large memory and stored many codesets. Rather, the remote control device 11 need only relay individual key codes. Remote control device 11 can therefore be a relatively inexpensive device that includes only a small amount of memory. In addition to requiring only a small amount of memory, the very same remote control device 11 can control an electronic consumer device that uses a codeset or protocol that was not in existence at the time the remote control device 11 was delivered to the user. The amount of writable memory (for example, random access memory (RAM) or flash memory) on the remote control device 11 may be so little that it may not be adequate to store a conventional codeset. The bulk of the memory of the remote control device 11 may be relatively inexpensive mask-programmable read only memory (ROM). By reducing the amount of writable memory on remote control device 11, the cost of remote control device 11 is reduced.

Although the present invention has been described in connection with certain specific embodiments for instructional purposes, the present invention is not limited thereto. Although the method is described above in connection with an inexpensive remote control device whose primary purpose is to control an electronic consumer device, the method can be employed in connection with other types of devices. Due to the limited amount of memory and intelligence required of the remote control device in the present method, the functionality of remote control device 11 can be incorporated into an RF-enabled device (such as a cell phone or RF-enabled personal digital assistant (PDA) or RF-enabled wrist watch or RF-enabled keyboard) without significantly increasing the cost of the device. The first carrier signal used to communicate between the remote control device and the key code generator device need not be an RF signal, and the second carrier signal used to communicate between the remote control device and the electronic consumer device need not be an IR signal. Both the first and second carrier signals can be the same type of signals, for example IR signals. The key code generator device can transmit key codes to the electronic consumer device to be controlled via a hardwired connection rather than a wireless link. The type of key code signal relayed through the remote control device is not limited to any particular protocol.

Although key code generator device 12 is a set-top box in the embodiment of FIG. 1 above, in other embodiments the key code generator device 12 is another type of electronic consumer device such as, for example, a television, a stereo radio, a digital video disk player, a video cassette recorder, a personal computer, a set-top cable television box or a set-top satellite box. Although the keystroke indicator signal can be an indication of a pressed key where there is a one-to-one relationship between the key and a function to be performed, in other embodiments a keystroke indicator signal indicates a selected function that is not associated with a specific key on the remote control device. For example, a function can be selected choosing a function from a menu that is displayed on the remote control device. Accordingly, various modifications, adaptations, and combinations of various features of the described embodiments can be practiced without departing from the scope of the invention as set forth in the claims.

What is claimed is:

1. A method comprising:
(a) receiving a keystroke indicator signal from a remote control device, wherein the keystroke indicator signal indicates a key on said remote control device that a user has selected;
(b) generating a key code within a key code generator device using the keystroke indictor signal;
(c) modulating said key code onto a carrier signal, thereby generating a key code signal; and
(d) transmitting said key code signal from said key code generator device to said remote control device.

2. A method comprising:
(a) receiving a keystroke indicator signal from a remote control device, wherein the keystroke indicator signal indicates a keV on said remote control device that a user has selected;
(b) generating a key code within a key code generator device using the keystroke indictor signal;
(c) modulating said key code onto a carrier signal, thereby generating a key code signal; and
(d) transmitting said key code signal from said key code generator device to an electronic consumer device.

3. The method of claim 1, wherein said key code consists of a binary number.

4. The method of claim 1, wherein said key code comprises a binary number and timing information, and wherein said timing information defines how said binary number is modulated in (c) onto said carrier signal.

5. The method of claim 2, further comprising:
(e) pressing a power-on key of said remote control device causing said remote control device to transmit said keystroke indicator signal that is received in (a), wherein said key code signal transmitted in (d) is received onto said electronic consumer device, and wherein said pressing in (e) causes said electronic consumer device to turn on.

6. The method of claim 1, wherein said carrier signal is in a radio frequency band, wherein said key code signal is received by said remote control device, and wherein said method further comprises:
(e) modulating said key code onto a second carrier signal, thereby generating a second key code signal, said modulating being performed on said remote control device wherein said second carrier signal is in an infrared frequency band; and
(f) transmitting said second key code signal from said remote control device to an electronic consumer device.

7. The method of claim 6, further comprising:
(g) pressing a power-on key of said remote control device causing said remote control device to transmit said keystroke indicator signal that is received in (a), wherein the pressing in (g) causes said electronic consumer device to turn on.

8. The method of claim 1, wherein said key code generated in (b) is part of a codeset, and wherein said remote control device does not store said codeset.

9. The method of claim 8, wherein said codeset comprises timing information and a plurality of key codes, and wherein said timing information describes a digital one and a digital zero.

10. A method comprising:

(a) receiving a keystroke indicator signal from a remote control device;

(b) generating a key code within a key code generator device;

(c) modulating said key code onto a carrier signal, thereby generating a key code signal; and

(d) transmitting said key code signal from said key code generator device, wherein a codeset comprises a plurality of key codes, each one of said plurality of key codes corresponding to a function of an electronic consumer device, and wherein no more than a single one of said plurality of key codes is present on said remote control device at any given time.

11. The method of claim 10, wherein said function of said electronic consumer device is taken from the group consisting of: power on, power off, channel advance, channel back, volume up, volume down, cursor up, cursor down, cursor right, cursor left, select, play, record, stop, forward, back and pause.

12. A remote control device comprising:

a receiver that receives a first key code signal, wherein said first key code signal is generated by modulating a key code onto a first carrier signal, said first carrier signal falling within a radio frequency band;

a transmitter that transmits a second key code signal, wherein said second key code signal is generated by modulating said key code onto a second carrier signal, said second carrier signal falling within an infrared frequency band; and

a keypad that includes a key that corresponds to said key code, wherein said key code corresponds to a function of an electronic consumer device, and wherein said key code corresponds to a second function of a second electronic consumer device, as well as to said function of said electronic consumer device.

13. The device of claim 12, wherein said transmitter transmits a third key code signal, and wherein said third key code signal is generated by modulating said key code onto a third carrier signal.

14. The device of claim 12, wherein said key code comprises a first binary number and a second binary number, said first binary number corresponding to said function, and said second binary number corresponding to said second function.

15. A device comprising:

a receiver that receives a first key code signal, wherein said first key code signal is generated by modulating a key code onto a first carrier signal, said first carrier signal falling within a radio frequency band;

a transmitter that transmits a second key code signal, wherein said second key code signal is generated by modulating said key code onto a second carrier signal, said second carrier signal falling within an infrared frequency band; and

a keypad that includes a key that corresponds to said key code, wherein said key code corresponds to a function of an electronic consumer device, wherein said keypad includes a second key that corresponds to a second key code, wherein a third key code signal is generated by modulating said second key code onto a third carrier signal, wherein said third key code signal is received by said receiver, and wherein both said first key code and said second key code are not both stored in said device at the same time.

16. A system comprising:

a key code generator device that generates a first key code and a second key code, wherein a codeset is stored on said key code generator device, said codeset including said first key code and said second key code, wherein said first key code corresponds to a selected function of a first electronic consumer device, and wherein said second key code corresponds to said selected function of a second electronic consumer device; and

means for relaying said first key code and said second key code from said key code generator device through a remote control device to said first electronic consumer device and to said second electronic consumer device without simultaneously storing both said first key code and said second key code on said remote control device.

17. The system of claim 16, wherein said selected function is taken from the group consisting of: power on, power off, channel advance, channel back, volume up, volume down, cursor up, cursor down, cursor right, cursor left, select, play, record, stop, forward, back and pause.

18. The system of claim 16, wherein said selected function is power on, and wherein said system automatically determines when said first electronic consumer device powers on.

19. A remote control device, comprising:

a keypad;

an RF receiver;

an IR transmitter; and

means for receiving a key code from said RF receiver and for sending said key code to said IR transmitter such that said key code is modulated onto an IR carrier signal, said IR carrier signal with said key code modulated thereon being transmitted from said remote control device by said IR transmitter, wherein said means is a microcontroller.

20. A method comprising:

(a) receiving a keystroke indicator signal from a remote control device;

(b) using said keystroke indicator signal to generate a key code, wherein a key code generator device generates said key code;

(c) modulating said key code onto a carrier signal and thereby generating a key code signal; and

(d) transmitting said key code signal from said key code generator device to said remote control device, wherein said remote control device transmits said key code signal to an electronic consumer device.

21. The method of claim 20, wherein said key code generated in (b) is part of a codeset, and wherein said codeset is not stored on said remote control device.

22. The method of claim 2, wherein said key code consists of a binary number.

23. The method of claim 2, wherein said key code comprises a binary number and timing information, and wherein said timing information defines how said binary number is modulated in (c) onto said carrier signal.

24. The method of claim 2, wherein said key code generated in (b) is part of a codeset, and wherein said remote control device does not store said codeset.

25. The method of claim 24, wherein said codeset comprises timing information and a plurality of key codes, and wherein said timing information describes a digital one and a digital zero.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,589,642 B1
APPLICATION NO. : 10/737029
DATED : September 15, 2009
INVENTOR(S) : Daniel SauFu Mui

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 10, line 25, the words "indicates a keV on said" should be changed to --indicates a key on said--.

Signed and Sealed this

Twenty-seventh Day of October, 2009

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

EXHIBIT B

US008004389B1

(12) **United States Patent**
Mui

(10) **Patent No.: US 8,004,389 B1**
(45) **Date of Patent: *Aug. 23, 2011**

(54) **RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE**

(75) Inventor: **Daniel SauFu Mui**, San Jose, CA (US)

(73) Assignee: **UEI Cayman Inc.** (KY)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 16 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/462,526**

(22) Filed: **Aug. 4, 2009**

Related U.S. Application Data

(63) Continuation of application No. 10/737,029, filed on Dec. 16, 2003, now Pat. No. 7,589,642.

(51) **Int. Cl.**
G08C 19/02 (2006.01)

(52) **U.S. Cl.** **340/13.24**; 340/4.62; 340/5.61

(58) **Field of Classification Search** 340/825.69, 340/825.22, 5.61, 4.62; 341/176, 174
See application file for complete search history.

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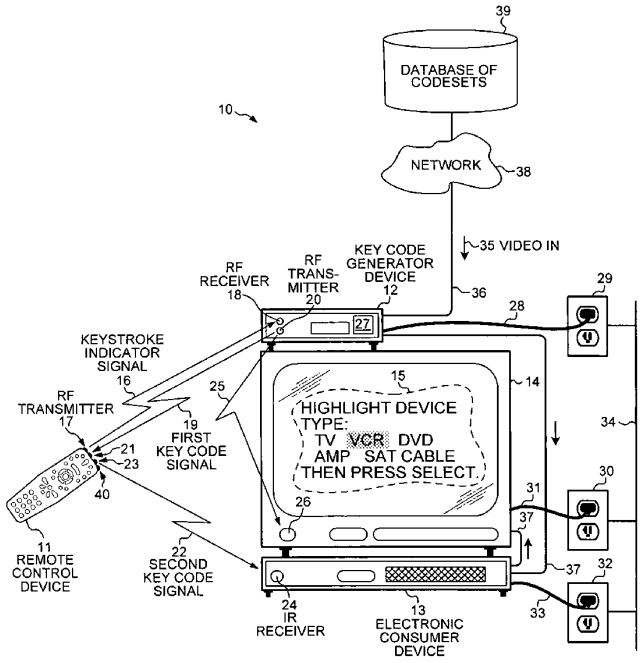
Primary Examiner — Vernal Brown
(74) *Attorney, Agent, or Firm* — Imperium Patent Works; Darien K. Wallace

(57) **ABSTRACT**

Upon receiving a keystroke indicator signal from a remote control device, a key code generator device identifies a codeset usable to communicate with a selected consumer device. The keystroke indicator signal contains an indication of a pressed key, which corresponds to a function of the selected consumer device. Using the identified codeset and the key indication, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected consumer device in the second key code signal. The key code causes the selected consumer device to perform the desired function.

16 Claims, 4 Drawing Sheets



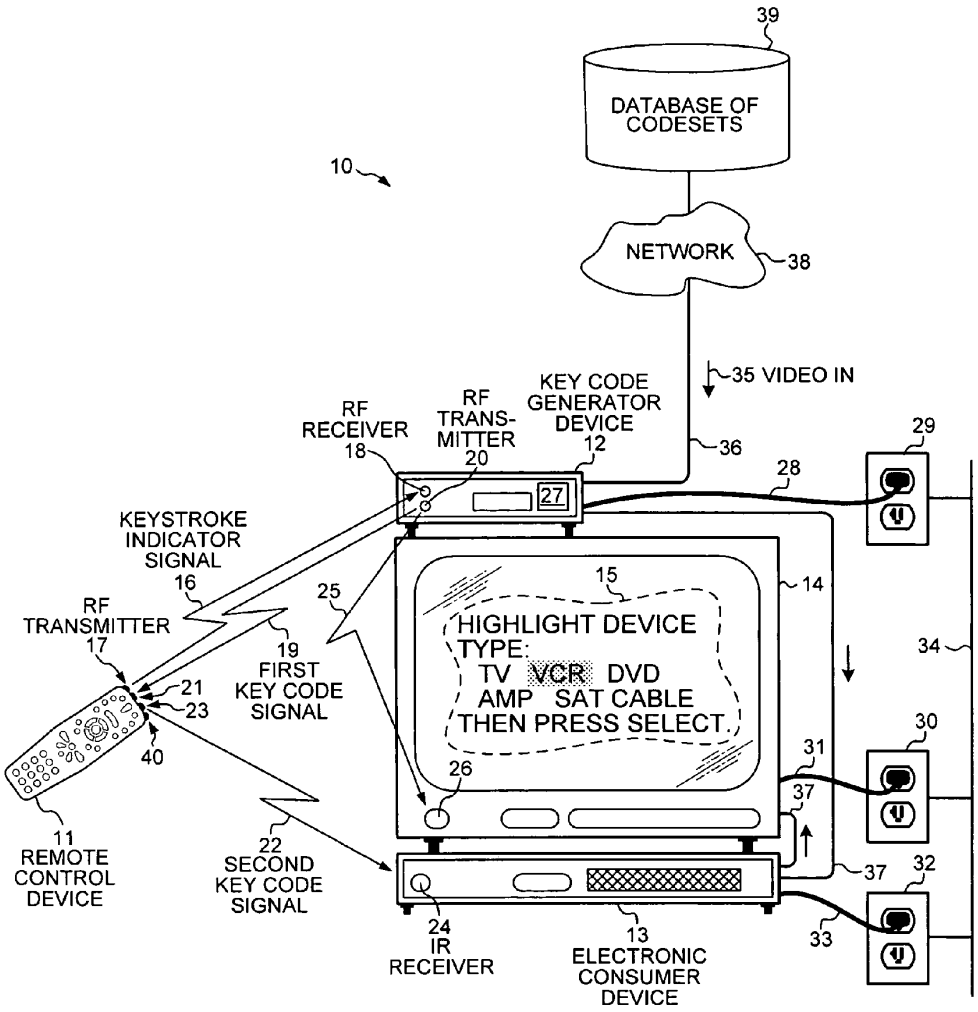

39
DATABASE OF CODESETS
10
NETWORK
38
35 VIDEO IN
KEY CODE GENERATOR DEVICE
12
RF RECEIVER
18
RF TRANS-MITTER
20
36
29
28
27
KEYSTROKE INDICATOR SIGNAL
16
RF TRANSMITTER
17
19
FIRST KEY CODE SIGNAL
25
15
14
HIGHLIGHT DEVICE TYPE:
TV VCR DVD
AMP SAT CABLE
THEN PRESS SELECT.
34
21
23
40
26
30
31
37
11
REMOTE CONTROL DEVICE
22
SECOND KEY CODE SIGNAL
37
32
24
IR RECEIVER
13
ELECTRONIC CONSUMER DEVICE
33

FIG. 1

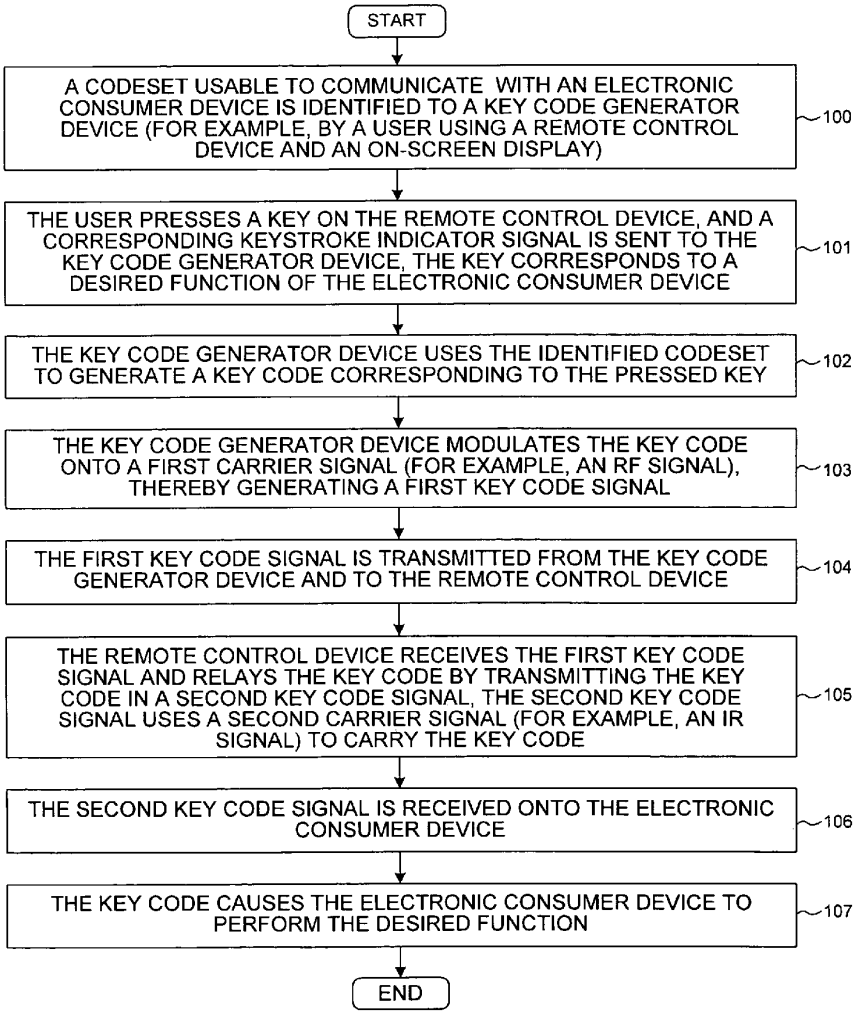
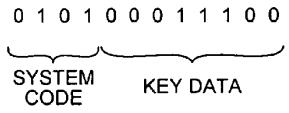

START
A CODESET USABLE TO COMMUNICATE WITH AN ELECTRONIC CONSUMER DEVICE IS IDENTIFIED TO A KEY CODE GENERATOR DEVICE (FOR EXAMPLE, BY A USER USING A REMOTE CONTROL DEVICE AND AN ON-SCREEN DISPLAY)
100
THE USER PRESSES A KEY ON THE REMOTE CONTROL DEVICE, AND A CORRESPONDING KEYSTROKE INDICATOR SIGNAL IS SENT TO THE KEY CODE GENERATOR DEVICE, THE KEY CORRESPONDS TO A DESIRED FUNCTION OF THE ELECTRONIC CONSUMER DEVICE
101
THE KEY CODE GENERATOR DEVICE USES THE IDENTIFIED CODESET TO GENERATE A KEY CODE CORRESPONDING TO THE PRESSED KEY
102
THE KEY CODE GENERATOR DEVICE MODULATES THE KEY CODE ONTO A FIRST CARRIER SIGNAL (FOR EXAMPLE, AN RF SIGNAL), THEREBY GENERATING A FIRST KEY CODE SIGNAL
103
THE FIRST KEY CODE SIGNAL IS TRANSMITTED FROM THE KEY CODE GENERATOR DEVICE AND TO THE REMOTE CONTROL DEVICE
104
THE REMOTE CONTROL DEVICE RECEIVES THE FIRST KEY CODE SIGNAL AND RELAYS THE KEY CODE BY TRANSMITTING THE KEY CODE IN A SECOND KEY CODE SIGNAL, THE SECOND KEY CODE SIGNAL USES A SECOND CARRIER SIGNAL (FOR EXAMPLE, AN IR SIGNAL) TO CARRY THE KEY CODE
105
THE SECOND KEY CODE SIGNAL IS RECEIVED ONTO THE ELECTRONIC CONSUMER DEVICE
106
THE KEY CODE CAUSES THE ELECTRONIC CONSUMER DEVICE TO PERFORM THE DESIRED FUNCTION
107
END

FIG. 2



KEY CODE
FIG. 3

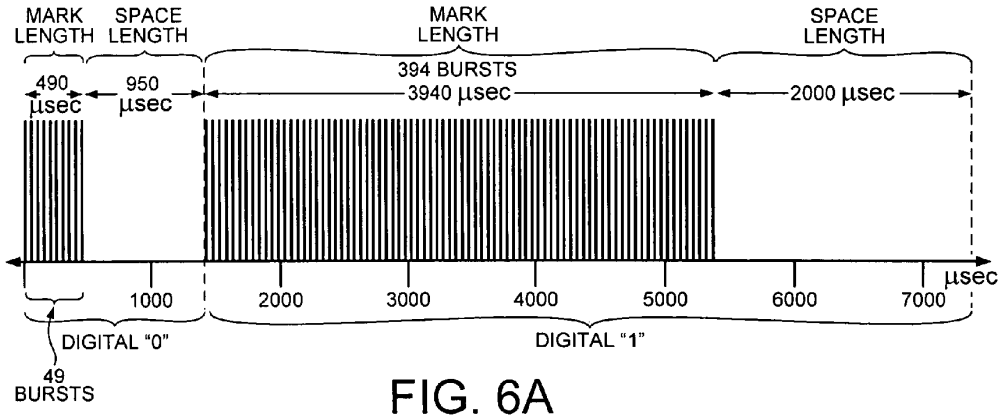


FIG. 6A

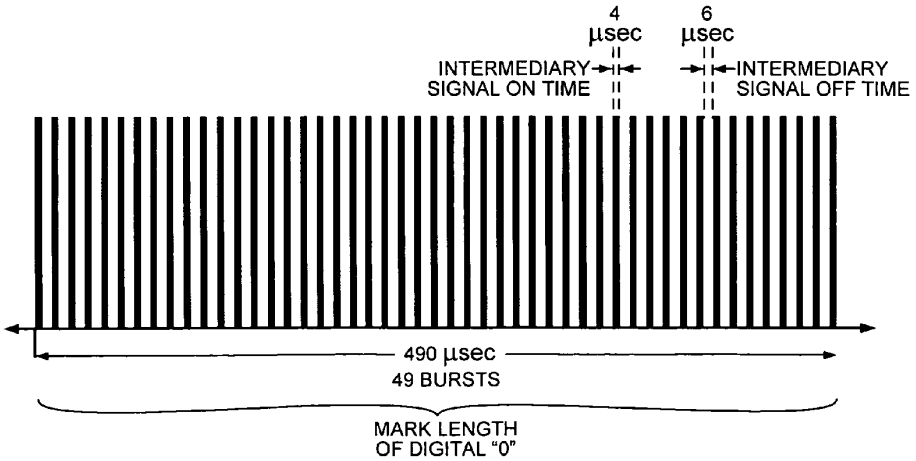


FIG. 6B

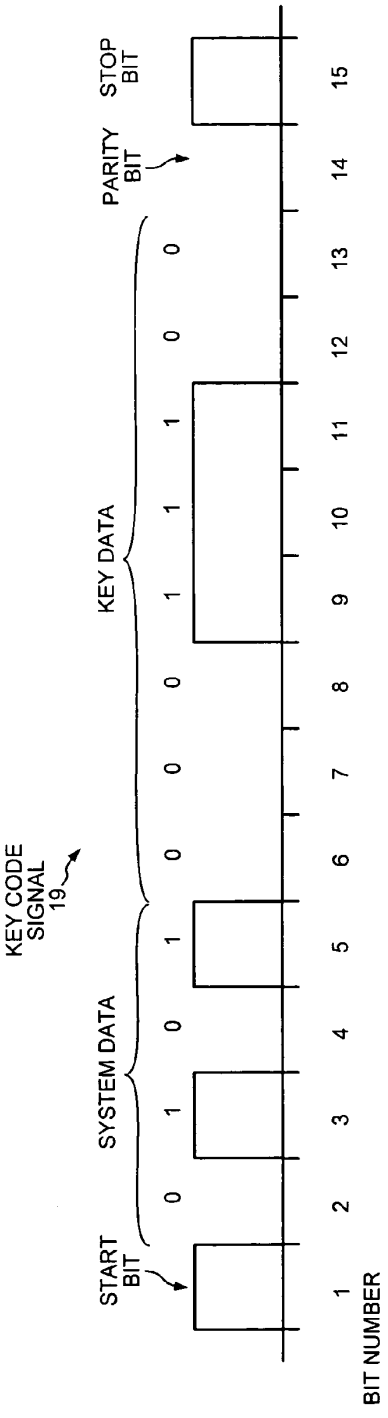


FIG. 4
BINARY TRANSMISSION

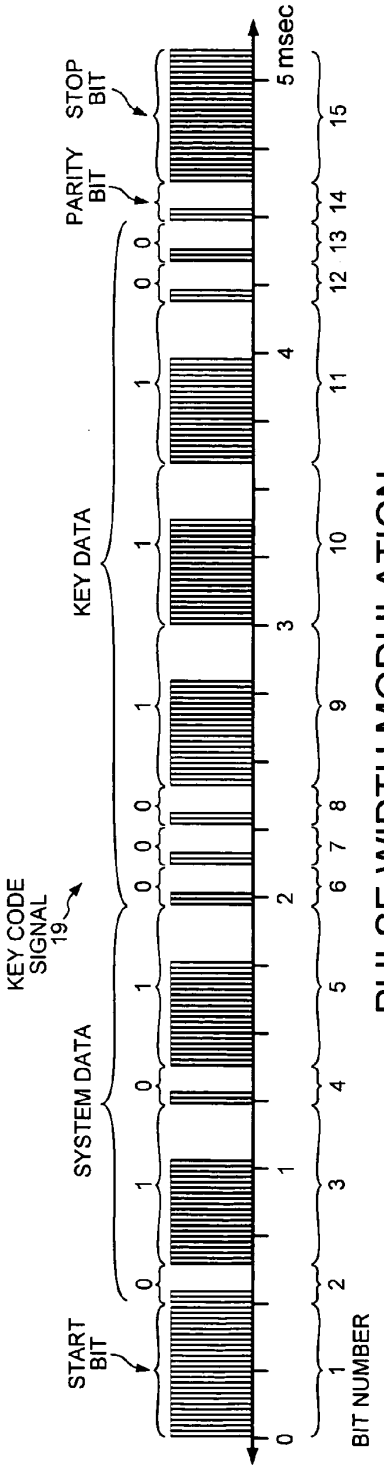


FIG. 5
PULSE WIDTH MODULATION

RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of, and claims priority under 35,U.S.C. §120 from, nonprovisional U.S. patent application Ser. No. 10/737,029 entitled "Relaying Key Code Signals Through a Remote Control Device," filed on Dec. 16, 2003, now U.S. Pat. No. 7,589,642, the subject matter of which is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates generally to remote control devices and, more specifically, to relaying key code signals through a remote control device to operate an electronic consumer device.

BACKGROUND

Most households today possess multiple types of electronic consumer devices, such as televisions, stereo radios, digital video disk players, video cassette recorders, set-top cable television boxes and set-top satellite boxes. Manufacturers of such electronic devices typically supply a remote control device along with each electronic device. It is, therefore, common for a consumer who has multiple electronic devices to have multiple remote control devices.

A remote control device typically controls a selected electronic consumer device by transmitting infrared key code signals to the selected electronic consumer device. The infrared signals contain key codes of a codeset associated with the selected electronic consumer device. Each key code corresponds to a function of the selected electronic device, such as power on, power off, volume up, volume down, play, stop, select, channel up, channel down, etc. In order to avoid the situation where a remote control device unintentionally operates an electronic consumer device that is associated with a different remote control device, manufacturers sometimes use distinct codesets for the communication between various electronic consumer devices and their associated remote control devices. The codesets can differ from each other not only by the bit patterns assigned to various functions of the associated electronic consumer device, but also by the timing information that describes how the key codes should be modulated onto carrier signals to generate key code signals.

Consumers may find it inconvenient to operate their electronic devices using multiple remote control devices. Thus, a consumer may wish to operate multiple electronic consumer devices using a single remote control device. A single remote control device can store many codesets so that the remote control device can control a corresponding large number of different electronic consumer devices. There are, however, thousands of codesets in use in electronic consumer devices today. Manufacturers of remote control devices, however, may wish to limit the memory on their remote control devices to a size that is insufficient to store the thousands of existing codesets.

A system is sought for enabling a remote control device to control a selected one of multiple different electronic consumer devices without requiring the codeset associated with the selected electronic consumer device to be stored on the remote control device.

SUMMARY

A system for relaying a key code through a remote control device to an electronic consumer device allows the electronic consumer device to be controlled without storing the associated codeset on the remote control device. Upon receiving a keystroke indicator signal from a remote control device, a key code generator device, such as a set-top box, identifies the particular codeset usable to communicate with the selected electronic consumer device. The keystroke indicator signal contains an indication of a key on the remote control device that was pressed, which corresponds to a function of the selected electronic consumer device. Using the identified codeset and the indication of the pressed key, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected electronic consumer device in the second key code signal. The key code causes the selected electronic consumer device to perform the desired function. The key code is not stored on the remote control device in a permanent manner, but rather the key code is relayed through the remote control device.

In another embodiment, a third key code signal (which may, for example, be a radio frequency signal) is communicated directly from the key code generator device to an electronic consumer device. A key code contained in the third key code signal causes the electronic consumer device to perform a desired function.

In yet another embodiment, the system automatically determines which codeset is usable to communicate with a selected electronic consumer device. The key code generator device sends key codes for one particular function from among a series of codesets one-by-one to the selected electronic consumer device. When the key code from one of the codesets causes the electronic consumer device to perform the desired function, electromagnetic noise is introduced into electrical power wiring through which both the electronic consumer device and the key code generator device receive power. When the key code generator device detects this noise on the electrical power wiring, the key code generator device identifies the codeset corresponding to the last transmitted key code to be the codeset usable to communicate with the selected electronic consumer device.

Other embodiments and advantages are described in the detailed description below. This summary does not purport to define the invention. The invention is defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, where like numerals indicate like components, illustrate embodiments of the invention.

FIG. **1** is a schematic diagram of a system for relaying key code signals through a remote control device.

FIG. **2** is a flowchart of a method for relaying key code signals through a remote control device.

FIG. **3** is an illustration of a key code transmitted within a key code signal.

FIG. **4** is a waveform diagram of a first example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **5** is a waveform diagram of a second example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **6**A is an illustration of a modulated digital zero and digital one within the key code signal of FIG. **5**.

FIG. **6**B is a more detailed illustration of a mark of a modulated digital zero within the key code signal of FIG. **5**.

DETAILED DESCRIPTION

Reference will now be made in detail to some embodiments of the invention, examples of which are illustrated in the accompanying drawings.

FIG. **1** is a diagram of a system **10** for relaying a key code through a remote control device **11** to an electronic consumer device in accordance with the present invention. FIG. **2** is a flowchart that illustrates a method of operation of system **10**. System **10** includes a key code generator device **12**, remote control device **11**, a first electronic consumer device **13** and a second electronic consumer device **14**. In this example, second electronic consumer device **14** is a television set.

In a first step (step **100**), key code generator device **12** determines the appropriate codeset that controls the type, brand and model of the particular electronic consumer device that is to be controlled. A user uses remote control device **11** to respond to an on-screen display **15** on the screen of television set **14** to step through a sequence of menu screens to identify the codeset corresponding to the device that is to be controlled. The user does this by identifying, on on-screen display **15**, the type, brand and model of the particular electronic consumer device. In this example, the user is identifying first electronic consumer device **13**, which is a video cassette recorder (VCR) manufactured by Sony with model number 8000. In FIG. **1**, the user is identifying the device type by highlighting the choice "VCR" on the on-screen display. In another example, subsequent to controlling VCR **13**, the user may wish to control television set **14**, which is a "Gold" model manufactured by RCA. In that case, the user begins identifying television set **14** by highlighting the choice "TV".

In the present example, key code generator device **12** is a set-top box. Key code generator device **12** generates the on-screen displays and communicates with television set **14** such that key code generator device **12** identifies one of a plurality of codesets that corresponds to one of the electronic consumer devices identified by the user, such as VCR **13** or television set **14**. System **10** uses the appropriate codeset to enable remote control device **11** to communicate with VCR **13** and television set **14**.

Next (step **101**), the user presses a key on remote control device **11**. This key is associated with a function that the user wants performed by an electronic consumer device. For example, the function may be to turn on the power of VCR **13**. When the user presses the "VCR power-on" key on remote control device **11**, remote control device **11** transmits a keystroke indicator signal **16** from a radio frequency (RF) transmitter **17** on remote control device **11**. Alternatively, two or more keys on remote control device **11** may be associated with a single function, such as turning on the power of VCR **13**. In that case, the user presses a "VCR" key and then a "power-on" key to cause remote control device **11** to transmit keystroke indicator signal **16**. Keystroke indicator signal **16** is transmitted as a signal in a radio frequency band to an RF receiver **18** on key code generator device **12**.

There are multiple forms in which an indication of the pressed key, as well as the identity of the electronic consumer device that is to perform the associated function, can be communicated in keystroke indicator signal **16** from remote control device **11** to key code generator device **12**. In one embodiment, the indication of the pressed key is a key code comprised of a standardized system code and standardized key data. In the present example, the standardized system code identifies the type of electronic consumer device that is to be controlled, such as a TV, a VCR, a DVD player, a stereo amplifier, a satellite receiver or a cable receiver. The standardized system code and key data are part of a commonly used codeset that is stored on remote control device **11**. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the system code and key data to form keystroke indicator signal **16**. For example, a microcontroller on remote control device **11** uses timing information associated with the commonly used codeset to generate a pulse width modulated keystroke indicator signal **16**.

In another embodiment, the indication of the pressed key includes a proprietary identification code identifying the pressed key, as well as a proprietary identification code corresponding to the type of the electronic consumer device that is to be controlled. The proprietary identification codes are understood by key code generator device **12**, but are not standardized codes that are understood by electronic consumer devices. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the proprietary identification codes onto keystroke indicator signal **16**.

Whether remote control device **11** communicates with key code generator device **12** through a standardized codeset or through proprietary identification codes, codes may be included that do not correspond to pressed keys or functions that are to be performed on electronic consumer devices. For example, in response to receiving any signal from remote control device **11**, key code generator device **12** may return a code to remote control device **11** causing a light emitting diode (LED) display on remote control device **11** to turn on.

Next (step **102**), key code generator device **12** determines which key code of the codeset previously identified in step **100** corresponds to the pressed key.

FIG. **3** illustrates one example of a key code from a commonly used codeset. The key code is comprised of a standardized system code and standardized key data. Both the system code and the key data are digital values. The 12-bit key code includes a 4-bit system code [0101] and 8-bit key data [00011100]. In the present example, the key code is the key code in the identified codeset that corresponds to the "VCR power-on" key of remote control device **11**.

Next (step **103**), key code generator device **12** modulates the key code for the power-on function of VCR **13** onto a first carrier signal, thereby generating a first key code signal **19**. In this example, the first carrier signal is an RF signal. An RF signal for purposes of this patent document is an electromagnetic signal having a frequency between thirty hertz and three hundred gigahertz.

FIG. **4** and FIG. **5** illustrate key code signal **19** in two specific embodiments. In both embodiments, the key code is transmitted as a stream of digital values 010100011100, where the system code is transmitted first immediately followed by the key data without any place holders between them. The standardized system code determined in step **102** need not identify the brand or model of VCR **13**, but only the fact that first electronic consumer device **13** is a VCR. The key code is modulated in step **103** using timing information associated with the codeset for VCR **13**. Thus, the particular brand and model of VCR **13** is able to understand the key code modulated using the appropriate timing information.

In the embodiment of FIG. **4**, key code signal **19** is a 15-bit binary transmission whose bit pattern appears as a universal asynchronous receiver and transmitter (UART) type communication. The binary transmission begins with a start bit and ends with a parity bit and a stop bit. The parity bit is calculated based on the 12-bit key code within the binary transmission.

In this example, the value of the parity bit is a digital zero. An intermediary signal is transmitted over the first carrier signal at an intermediary frequency (for example, 100 kHz) to communicate a digital one. The absence of the intermediary signal indicates a digital zero. The intermediary signal has a lower frequency than the first carrier signal.

In the embodiment of FIG. **5**, the 12-bit key code is modulated onto key code signal **19** using pulse width modulation. Digital ones and zeros are characterized by pairs of marks and spaces. The period between successive leading edges of the bursts in a mark is the period of an intermediary signal. The intermediary signal has an intermediary frequency. In a space, there are no bursts.

FIG. **6**A shows a digital zero and a digital one in key code signal **19** of FIG. **5** in more detail. A "mark/space" pair represents a digital zero and another "mark/space" pair represents a digital one. The marks and spaces of each pair have predetermined lengths. In the embodiment of FIG. **5**, the mark length of a digital zero is 490 microseconds, and the mark length of a digital one is 3940 microseconds. The space length of a digital zero is 950 microseconds, and the space length of a digital one is 2000 microseconds.

FIG. **6**B shows the bursts of the first carrier signal that comprise the intermediary signal in more detail. In the embodiment of FIG. **5**, the bursts that comprise the intermediary signal occur every ten microseconds, resulting in an intermediary frequency of 100 kilohertz. The duty cycle of the intermediary signal is characterized by an "on time" of four microseconds and an "off time" of six microseconds. There are forty-nine bursts of the carrier signal within each mark length of 490 microseconds.

Timing information other than that shown in the embodiment of FIG. **5** can also be used. For example, one common form of pulse width modulation uses an intermediary signal having a frequency of about 38.5 kilohertz. Each period of the intermediary signal has an "on time" of ten microseconds and an "off time" of sixteen microseconds. If such an intermediary signal were used to generate a 490 microsecond mark length of a digital zero shown in FIG. **6**A, there would be 19 bursts of the intermediary signal in the mark. Similarly, if such an intermediary signal were used to generate a 3940 microsecond mark length of a digital one shown in FIG. **6**A, there would be 151 bursts of the intermediary signal in the mark.

Next (step **104**), an RF transmitter **20** of key code generator device **12** transmits first key code signal **19** in the form of an RF transmission to an RF receiver **21** on remote control device **11**.

Next (step **105**), remote control device **11** receives first key code signal **19** and relays the key code communicated by first key code signal **19** to VCR **13** in the form of a second key code signal **22**. Remote control device **11** is a slave to key code generator device **12**. Remote control device **11** relays the key code by receiving first key code signal **19** in RF form and translating the communicated key code so that the key code is modulated onto a second carrier signal resulting in second key code signal **22**. In this example, the second carrier signal is an infrared signal with a frequency in the range between three hundred gigahertz and three hundred terahertz. Second key code signal **22** is transmitted by an IR transmitter **23** on remote control device **11** to VCR **13**. In the embodiment of FIG. **5**, key code signal **19** is converted into key code signal **22** by forming the bursts of the intermediary signal using the second carrier signal with an infrared frequency in the place of the first carrier signal with a radio frequency. For both key code signal **19** and key Code signal **22**, digital ones and digital zeros are modulated using the same timing for "mark/space" pairs. The waveform diagram of key code signal **22** appears the same as the waveform diagram shown in FIG. **5** for key code signal **19**; only the frequency of the carrier signal that forms the bursts is different.

Next (step **106**), second key code signal **22** is received onto electronic consumer device (VCR) **13** by an IR receiver **24**.

Next (step **107**), IR receiver **24** on VCR **13** recovers the key code from second key code signal **22**. VCR **13** is thereby instructed to perform the function desired by the user. In this example, the function is to power on VCR **13**. Other key codes, however, correspond to other functions, such as power off, channel advance, channel back, volume up, volume down, cursor up, cursor down, cursor right, cursor left, select, play, record, stop, forward, rewind and pause.

In a second example, an electronic consumer device is controlled by an RF key code signal transmitted from key code generator device **12**. Subsequent to controlling VCR **13**, the user wishes to control second electronic consumer device **14**, which is a "Gold" model RCA television set. In the second example, the user uses the on-screen display **15** to identify the type (TV), brand (RCA) and model (Gold) of second electronic consumer device **14**. Key code generator device **12** determines the appropriate codeset that controls television set **14**. The user then presses a key on remote control device **11** associated with a function that the user wants performed by television set **14**. For example, the function is to advance the channel of television set **14**. When the user presses the channel advance key on remote control device **11**, an indication of the pressed key is transmitted in an RF keystroke indicator signal from remote control device **11** to key code generator device **12**.

Key code generator device **12** then determines which key code of the identified codeset corresponds to the pressed key. Key code generator device **12** modulates the key code for the channel advance function onto an RF carrier signal, thereby generating a third key code signal **25**. Key code generator device **12** uses the same modulation technique to generate both third key code signal **25** and first key code signal **19**. Third key code signal **25** is modulated using timing information associated with the codeset that controls RCA Gold television set **14**.

In this second example, television set **14** has an RF receiver **26** and is capable of receiving RF key code signals. RF transmitter **20** of key code generator device **12** transmits third key code signal **25** directly to television set **14**. Third key code signal **25** is received onto television set **14** by RF receiver **26**, and RF receiver **26** recovers the key code from third key code signal **25**. Television set **14** is thereby instructed to advance the channel.

Although remote control device **11** in the first example stores either a proprietary codeset or a standardized codeset and uses that codeset to generate keystroke indicator signal **16**, remote control device **11** stores only that single codeset. This codeset is the codeset used by key code generator device **12** to receive communications from remote control device **11**. Remote control device **11** can therefore be made inexpensively and may contain a relatively small amount of memory. The memory may, for example, be read only memory (ROM) on a microcontroller integrated circuit (for example, a Z8 microcontroller available from Zilog, Inc. of San Jose, Calif.)

Even though remote control device **11** stores only a single codeset, system **10** of FIG. **1** nevertheless allows remote control device **11** to control the desired electronic consumer device **13**, which may use any one of thousands of different codesets. Key code generator device **12** may, for example, include a hard disk or other mass storage device that stores thousands of possible codesets. The user may use remote

control device **11** to select any one of those codesets for communication with the particular electronic consumer device **13**. In comparison to some conventional systems where codesets are downloaded into a universal remote control device from a personal computer or other device that is not normally part of an entertainment system, system **10** uses preexisting hardware of the entertainment system (such as the on-screen display functionality, data storage capability, and wireless communication ability of the set-top box) to source and identify codesets.

Although the specific embodiments of FIGS. **1** and **2** are explained above in connection with the codesets being identified to the key code generator device **12** using an on-screen display, the codeset usable to communicate with an electronic consumer device may be identified to key code generator device **12** in other ways in other embodiments. In one embodiment, for example, the key code generator device includes autoscan functionality. Key code generator device **12** includes an EMI detector **27** that detects electromagnetic interference (EMI) or noise on power cord **28**. Power cord **28** is a power cord through which key code generator device **12** receives electrical power from a wall socket **29**. Similarly, television set **14** receives power from another wall socket **30** via a power cord **31**. VCR **13** receives power from a wall socket **32** via another power cord **33**. In accordance with the autoscan functionality, key code generator device **12** identifies the codeset used to communicate with a particular electronic consumer device by generating and transmitting a sequence of key code signals relayed through remote control device **11** to the electronic consumer device to be controlled (in this case VCR **13**). Each of these key code signals contains a different key code corresponding to the same desired function on different device types, brands and models.

In one example, the desired function is the function of powering on VCR **13**. The key code generator device **12** sends the power-on key codes for each of a series of codesets one-by-one to VCR **13**. When the key code for one of the codesets causes VCR **13** to perform the desired function (in this case, to power on), VCR **13** introduces noise or other electromagnetic interference via cord **33** into wall socket **32**. The power terminal within wall socket **32** is connected through wiring **34** to the power terminal in wall socket **29**. The noise generated by VCR **13** is therefore communicated through wiring **34**, the power terminal of wall socket **29** and power cord **28** to EMI detector **27** on key code generator device **12**. When key code generator device **12** detects the electromagnetic interference on power cord **28**, key code generator device **12** automatically identifies the codeset used by VCR **13** as the codeset used to communicate the last key code signal for the power-on function.

Multiple electronic consumer devices may have the same key data for a particular function, for example, the power-on function. A key code, however, also contains a system code (see FIG. **3**) that corresponds to a particular type of electronic consumer device. For example, the system code used for a television set will typically be different than the system code used for a video cassette recorder. Thus, different device types that use the same key data for the power-on function will not respond to a key code containing an incorrect system code. Each of the power-on key codes transmitted in this example by key code generator device **12** contains the system code for a video cassette recorder, so television set **14** does not recognize the key codes. Because key code generator device **12** is aware of the system code communicated, key code generator device **12** determines that it was VCR **13** that was powered on and not television **14**.

In another example, the codeset usable to communicate with VCR **13** is identified to key code generator device **12** using autoscan functionality that does not involve key code generator device **12** having a specialized EMI detection circuit. In that case, the user may be prompted by successive screens of on screen display **15** to push the power-on key on remote control device **11** multiple times. Each time the power-on key is pressed, keystroke indicator signal **16** communicates this to key code generator device **12**. Key code generator device **12** in turn generates and transmits a key code signal containing a power-on key code using a different codeset. Each key code signal is relayed through remote control device **11** to the particular electronic consumer device to be controlled. One by one the user is prompted to push the power-on key, and key code generator device **12** in turn generates key codes using different codesets until the electronic consumer device performs a desired function. In this case, first electronic consumer device **13** turns on. The user is prompted not to press the power-on key once the user sees the desired function being performed by first electronic consumer device **13**. In the present example, light emitting diodes (LEDs) on the face of VCR **13** may be illuminated to indicate to the user that VCR **13** has powered on. When the user stops pressing the power-on key, then the key code generator device **12** identifies the codeset of the last transmitted key code to be the codeset used by the electronic consumer device.

In another example, the user presses keys on remote control device **11** to communicate to key code generator device **12** a 3-digit codeset identification number identifying the codeset. The user may determine this codeset identification number by looking up the codeset identification number in a booklet supplied along with the electronic consumer device to be controlled. Alternatively, a table of manufacturers, model numbers and their associated codesets may be used to lookup the codeset identification number.

In an embodiment where key code generator device **12** is a set-top box, the set-top box receives a video input signal **35** from a cable television coaxial cable **36**. Video input signal **35** is ultimately delivered to television set **14** through cables **37**. Coaxial cable **36** is also used to provide networking connectivity between the set-top box and a network **38**. Network **38** may, for example, be or include the Internet. A database of codesets **39** is maintained at a remote location. As new electronic consumer devices are introduced onto the market, new codesets may be necessary to communicate with these new devices. So that one such new codeset can be distributed from database of codesets **39** when a new electronic consumer device is introduced into the market, this new codeset is communicated via network **38** and coaxial cable **36** to key code generator device **12**. The new codeset is then stored on a mass storage hard disk within the set-top box. In this way, the pre-existing and inexpensive remote control device **11** can be used to control a new electronic consumer device whose required codeset did not exist at the time remote control device **11** and key code generator device **12** were delivered to the user.

In yet another embodiment, remote control device **11** is a learning remote control device that includes an IR detector **40**. In accordance with one method, the learning remote control device **11** is placed so that IR detector **40** can receive an IR transmission from an IR transmitter of another remote control device. Keys corresponding to key codes to be learned are pressed on the other remote control device such that successive key code signals are transmitted from the IR transmitter of the other remote control device to IR detector **40** of the learning remote control device **11**. Learning remote control device **11** detects when the envelope of the bursts of the

received IR signal changes from low to high and high to low. The time duration between each successive transition is stored such that a key code signal is recorded as timing information for a series of mark lengths and space lengths. As the various keys of the remote control device to be learned are pressed, learning remote control device **11** records successive strings of timing information. The resulting strings of timing information, once collected on learning remote control device **11**, are automatically transmitted from learning remote control device **11** in the form of RF signals to key code generator device **12**. Key code generator device **12** in turn communicates the captured strings of timing information through coaxial cable **36** and network **38** to database of codesets **39**. Personnel maintaining database of codesets **39** then analyze the timing information and generate a codeset that describes the key codes captured by learning remote control device **11**. In this way, a new codeset containing key data, systems codes and timing information is added to database of codesets **39**. Rather than storing the information as a new codeset that includes separate key codes and timing information, the information for each keystroke can be stored in database of codesets **39** in the form of interval times.

A single system **10** is therefore described that can support numerous different types of electronic consumer devices that can use multiple different codesets. The remote control device **11** of the system need not include a large memory and stored many codesets. Rather, the remote control device **11** need only relay individual key codes. Remote control device **11** can therefore be a relatively inexpensive device that includes only a small amount of memory. In addition to requiring only a small amount of memory, the very same remote control device **11** can control an electronic consumer device that uses a codeset or protocol that was not in existence at the time the remote control device **11** was delivered to the user. The amount of writable memory (for example, random access memory (RAM) or flash memory) on the remote control device **11** may be so little that it may not be adequate, to store a conventional codeset. The bulk of the memory of the remote control device **11** may be relatively inexpensive mask-programmable read only memory (ROM). By reducing the amount of writable memory on remote control device **11**, the cost of remote control device **11** is reduced.

Although the present invention has been described in connection with certain specific embodiments for instructional purposes, the present invention is not limited thereto. Although the method is described above in connection with an inexpensive remote control device whose primary purpose is to control an electronic consumer device, the method can be employed in connection with other types of devices. Due to the limited amount of memory and intelligence required of the remote control device in the present method, the functionality of remote control device, **11** can be incorporated into an RF-enabled device (such as a cell phone or RF-enabled personal digital assistant (PDA) or RF-enabled wrist watch or RF-enabled keyboard) without significantly increasing the cost of the device. The first carrier signal used to communicate between the remote control device and the key code generator device need not be an RF signal, and the second carrier signal used to communicate between the remote control device and the electronic consumer device need not be an IR signal. Both the first and second carrier signals can be the same type of signals, for example IR signals. The key code generator device can transmit key codes to the electronic consumer device to be controlled via a hardwired connection rather than a wireless link. The type of key code signal relayed through the remote control device is not limited to any particular protocol.

Although key code generator device **12** is a set-top box in the embodiment of FIG. **1** above, in other embodiments the key code generator device **12** is another type of electronic consumer device such as, for example, a television, a stereo radio, a digital video disk player, a video cassette recorder, a personal computer, a set-top cable television box or a set-top satellite box. Although the keystroke indicator signal can be an indication of a pressed key where there is a one-to-one relationship between the key and a function to be performed, in other embodiments a keystroke indicator signal indicates a selected function that is not associated with a specific key on the remote control device. For example, a function can be selected choosing a function from a menu that is displayed on the remote control device. Accordingly, various modifications, adaptations, and combinations of various features of the described embodiments can be practiced without departing from the scope of the invention as set forth in the claims.

What is claimed is:

1. A method comprising:

(a) receiving a keystroke indicator signal from a remote control device, wherein the keystroke indicator signal indicates a key on said remote control device that a user has selected;

(b) generating a key code within a key code generator device using the keystroke indicator signal, wherein said key code is part of a codeset that controls an electronic consumer device;

(c) modulating said key code onto a carrier signal, thereby generating a key code signal;

(d) transmitting said key code signal from said key code generator device; and

(e) identifying said codeset by detecting electromagnetic interference on a power cord of said key code generator device.

2. A method comprising:

(a) receiving a keystroke indicator signal from a remote control device, wherein the keystroke indicator signal indicates a key on said remote control device that a user has selected;

(b) generating a key code within a key code generator device using the keystroke indicator signal, wherein said key code is part of a codeset that controls an electronic consumer device;

(c) modulating said key code onto a carrier signal, thereby generating a key code signal;

(d) transmitting said key code signal from said key code generator device; and

(e) identifying said codeset using input from a user of said remote control device, wherein said codeset is identified when said user stops pressing a key on said remote control device.

3. The method of claim **2**, wherein said user is prompted by autoscan functionality to press said key on said remote control device.

4. A remote control device comprising:

a receiver that receives a first key code signal, wherein said first key code signal is generated by modulating a key code onto a first carrier signal, said first carrier signal falling within a radio frequency band;

a transmitter that transmits a second key code signal, wherein said second key code signal is generated by modulating said key code onto a second carrier signal, said second carrier signal falling within an infrared frequency band; and

a keypad that includes a key that corresponds to said key code, wherein said key code corresponds to a function of

an electronic consumer device, and wherein said remote control device is contained within a single structure.

5. The remote control device of claim **4**, wherein said remote control device is taken from the group consisting of: a learning remote control device, a cell phone, an RF-enabled personal digital assistant (PDA), an RF-enabled wrist watch, and an RF-enabled keyboard.

6. The remote control device of claim **4**, wherein a codeset comprises timing information and a plurality of key codes, wherein each of said plurality of key codes corresponds to a different function of said electronic consumer device, wherein said key code is a binary number, and wherein said timing information defines how said binary number is modulated onto said first carrier signal.

7. The remote control device of claim **4**, wherein said key code is part of a codeset, and wherein said codeset is not stored on said remote control device.

8. The remote control device of claim **4**, wherein said modulating to generate said first key code signal is performed according to a first codeset, and wherein said remote control device stores no codeset other than said first codeset.

9. The remote control device of claim **4**, wherein said key code is part of a codeset that includes a plurality of key codes, wherein each one of said plurality of key codes corresponds to a different function of the electronic consumer device, and wherein no more than a single one of said plurality of key codes is present on said remote control device at any given time.

10. The remote control device of claim **4**, further comprising:

a microcontroller that determines that a user of said remote control device has selected said key and that modulates said key code onto said second carrier signal.

11. The remote control device of claim **4**, wherein said modulating said key code onto said first carrier signal is performed by an electronic consumer device taken from the group consisting of: a television, a stereo radio, a digital video disk player, a video cassette recorder, a personal computer, a set-top cable television box and a set-top satellite box.

12. A remote control device, comprising:

a keypad;

an RF receiver;

an IR transmitter; and

means for receiving a key code from said RF receiver and for sending said key code to said IR transmitter such that said key code is modulated onto an IR carrier signal, said IR carrier signal with said key code modulated thereon being transmitted from said remote control device by said IR transmitter, wherein said remote control device is contained within a single structure.

13. The remote control device of claim **12**, wherein said key code is not stored on said remote control device immediately prior to said means receiving the key code.

14. The remote control device of claim **12**, wherein said key code is part of a codeset, and wherein said codeset is not stored on said remote control device.

15. The remote control device of claim **12**, wherein said means is a microcontroller.

16. The remote control device of claim **12**, wherein said means is for sending said key code to said IR transmitter and for sending a second key code to said IR transmitter without simultaneously storing both said key code and said second key code on said means, wherein said key code corresponds to a selected function of a first electronic consumer device, and wherein said second key code corresponds to said selected function of a second electronic consumer device.

* * * * *

EXHIBIT C

US009911325B2

(12) **United States Patent**
Mui

(10) **Patent No.: US 9,911,325 B2**
(45) **Date of Patent: Mar. 6, 2018**

(54) **RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/153,905**

(22) Filed: **May 13, 2016**

(65) **Prior Publication Data**

US 2016/0253899 A1 Sep. 1, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/068,820, filed on May 21, 2011, now Pat. No. 9,355,553, which is a continuation of application No. 12/462,526, filed on Aug. 4, 2009, now Pat. No. 8,004,389, which is a continuation of application No. 10/737,029, filed on Dec. 16, 2003, now Pat. No. 7,589,642.

(51) **Int. Cl.**

G08C 23/04	(2006.01)
G08C 17/00	(2006.01)
G08C 15/04	(2006.01)
G08C 17/02	(2006.01)
G08C 19/28	(2006.01)

(52) **U.S. Cl.**

CPC ***G08C 23/04*** (2013.01); ***G08C 15/04*** (2013.01); ***G08C 17/00*** (2013.01); ***G08C 17/02*** (2013.01); ***G08C 19/28*** (2013.01)

(58) **Field of Classification Search**

CPC G08C 15/04; G08C 17/02; G08C 23/04; G08C 19/28

USPC 340/13.24

See application file for complete search history.

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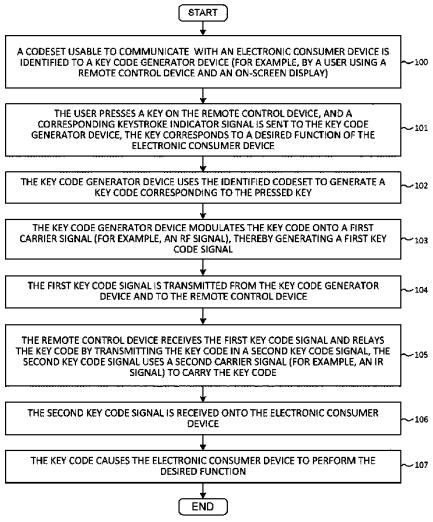
(57) **ABSTRACT**

Upon receiving a keystroke indicator signal from a remote control device, a key code generator device identifies a codeset usable to communicate with a selected consumer device. The keystroke indicator signal contains an indication of a pressed key, which corresponds to a function of the selected consumer device. Using the identified codeset and the key indication, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected consumer device in the second key code signal. The key code causes the selected consumer device to perform the desired function.

16 Claims, 4 Drawing Sheets



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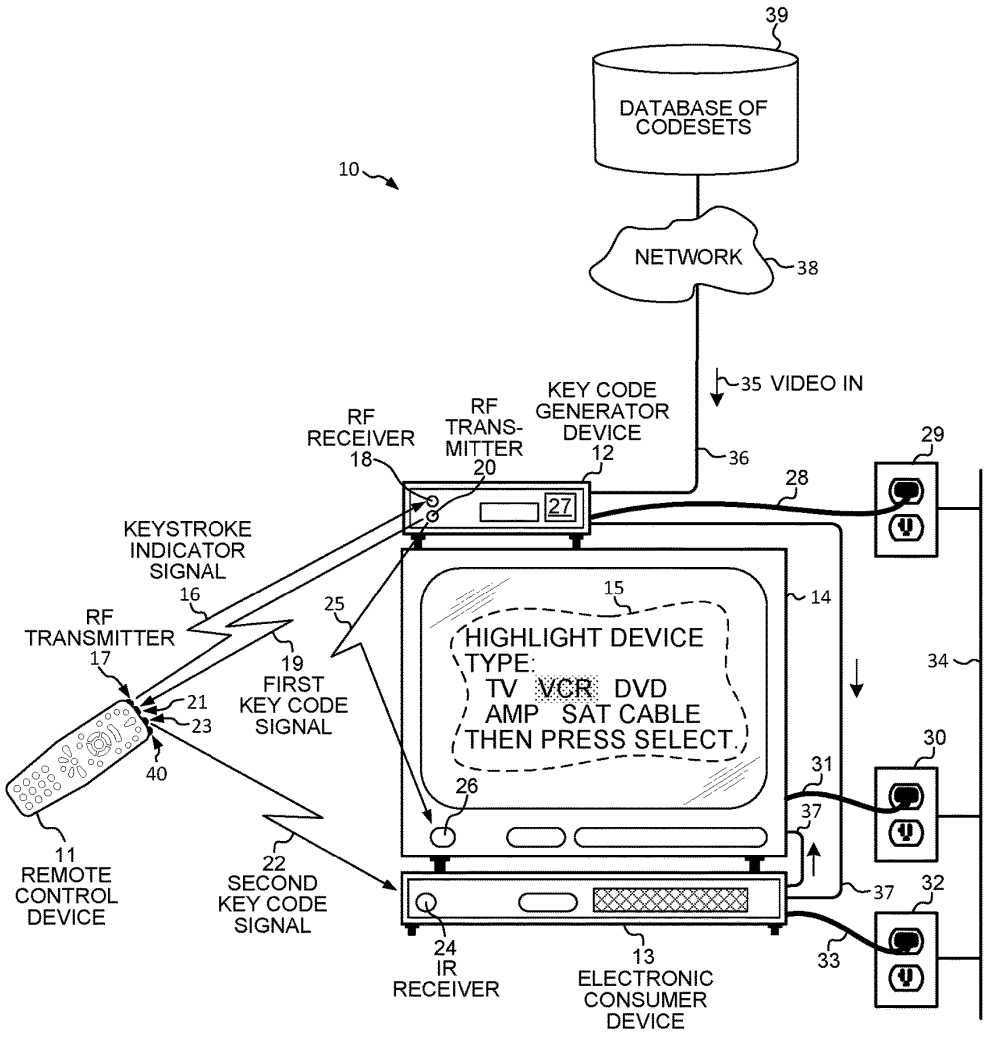

39
DATABASE OF CODESETS
10
NETWORK
38
35 VIDEO IN
RF RECEIVER 18
RF TRANS-MITTER 20
KEY CODE GENERATOR DEVICE 12
36
29
28
27
KEYSTROKE INDICATOR SIGNAL
16
RF TRANSMITTER 17
19 FIRST KEY CODE SIGNAL
25
15
14
HIGHLIGHT DEVICE TYPE:
TV VCR DVD
AMP SAT CABLE
THEN PRESS SELECT
34
21
23
40
26
31
30
37
11 REMOTE CONTROL DEVICE
22 SECOND KEY CODE SIGNAL
37
32
24 IR RECEIVER
13 ELECTRONIC CONSUMER DEVICE
33

FIG. 1

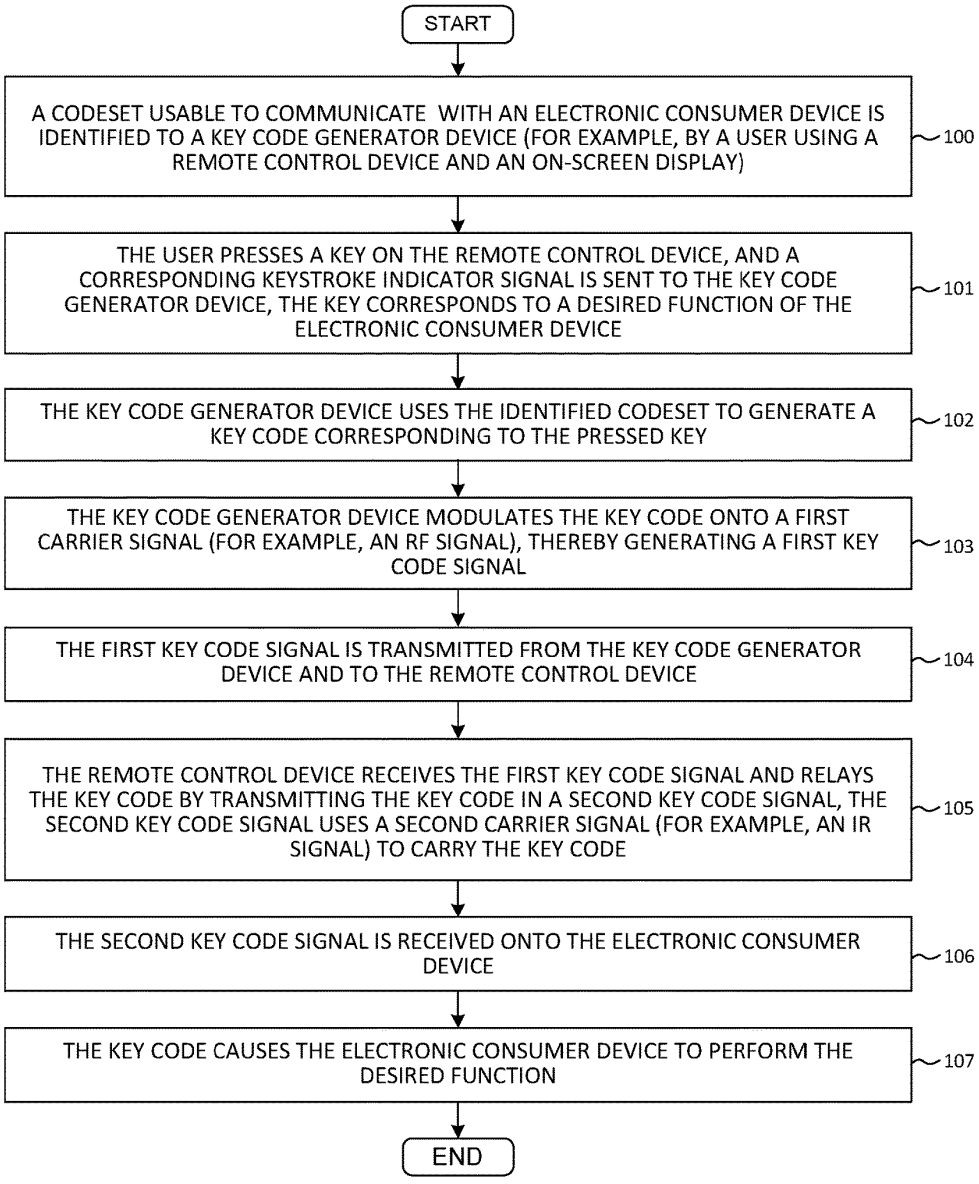
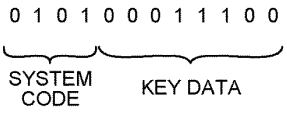

START
A CODESET USABLE TO COMMUNICATE WITH AN ELECTRONIC CONSUMER DEVICE IS IDENTIFIED TO A KEY CODE GENERATOR DEVICE (FOR EXAMPLE, BY A USER USING A REMOTE CONTROL DEVICE AND AN ON-SCREEN DISPLAY)
100
THE USER PRESSES A KEY ON THE REMOTE CONTROL DEVICE, AND A CORRESPONDING KEYSTROKE INDICATOR SIGNAL IS SENT TO THE KEY CODE GENERATOR DEVICE, THE KEY CORRESPONDS TO A DESIRED FUNCTION OF THE ELECTRONIC CONSUMER DEVICE
101
THE KEY CODE GENERATOR DEVICE USES THE IDENTIFIED CODESET TO GENERATE A KEY CODE CORRESPONDING TO THE PRESSED KEY
102
THE KEY CODE GENERATOR DEVICE MODULATES THE KEY CODE ONTO A FIRST CARRIER SIGNAL (FOR EXAMPLE, AN RF SIGNAL), THEREBY GENERATING A FIRST KEY CODE SIGNAL
103
THE FIRST KEY CODE SIGNAL IS TRANSMITTED FROM THE KEY CODE GENERATOR DEVICE AND TO THE REMOTE CONTROL DEVICE
104
THE REMOTE CONTROL DEVICE RECEIVES THE FIRST KEY CODE SIGNAL AND RELAYS THE KEY CODE BY TRANSMITTING THE KEY CODE IN A SECOND KEY CODE SIGNAL, THE SECOND KEY CODE SIGNAL USES A SECOND CARRIER SIGNAL (FOR EXAMPLE, AN IR SIGNAL) TO CARRY THE KEY CODE
105
THE SECOND KEY CODE SIGNAL IS RECEIVED ONTO THE ELECTRONIC CONSUMER DEVICE
106
THE KEY CODE CAUSES THE ELECTRONIC CONSUMER DEVICE TO PERFORM THE DESIRED FUNCTION
107
END

FIG. 2



KEY CODE
FIG. 3

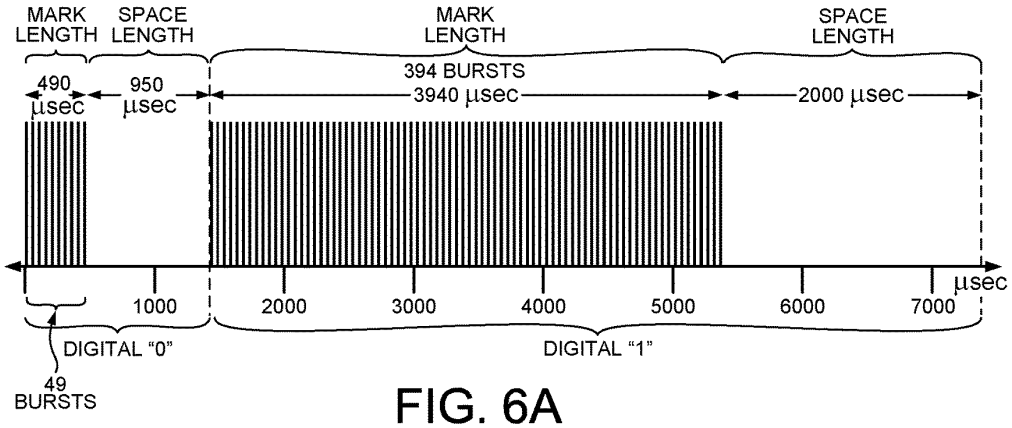


FIG. 6A

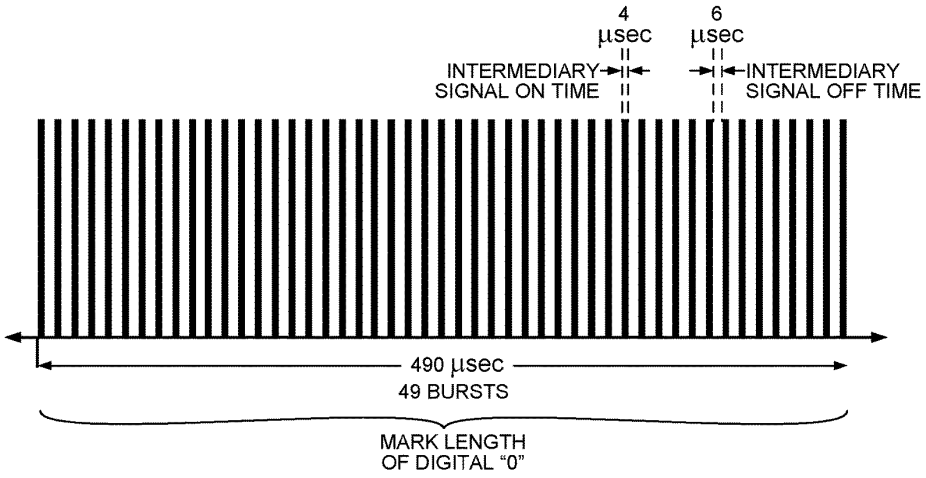


FIG. 6B

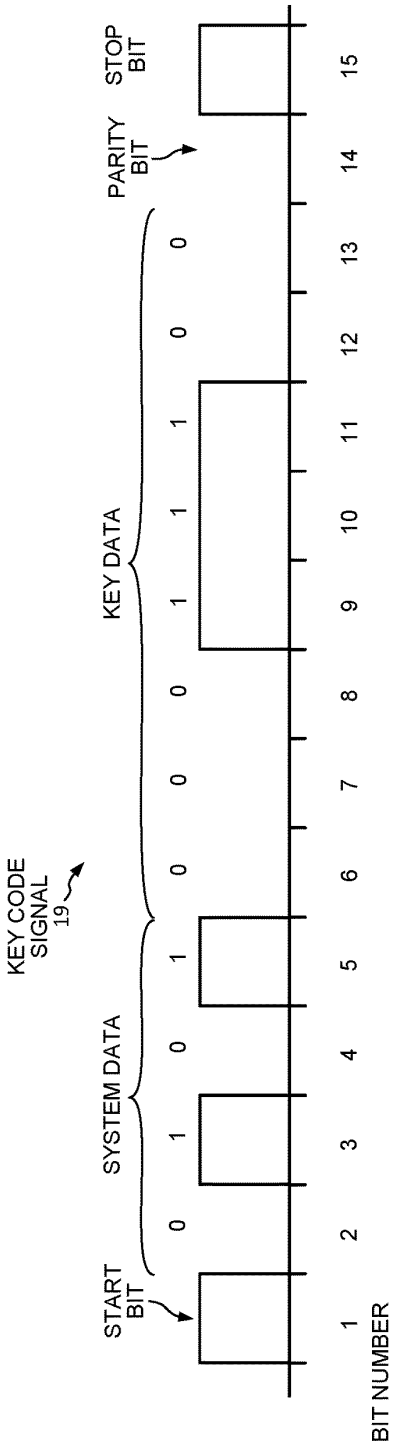


FIG. 4
BINARY TRANSMISSION

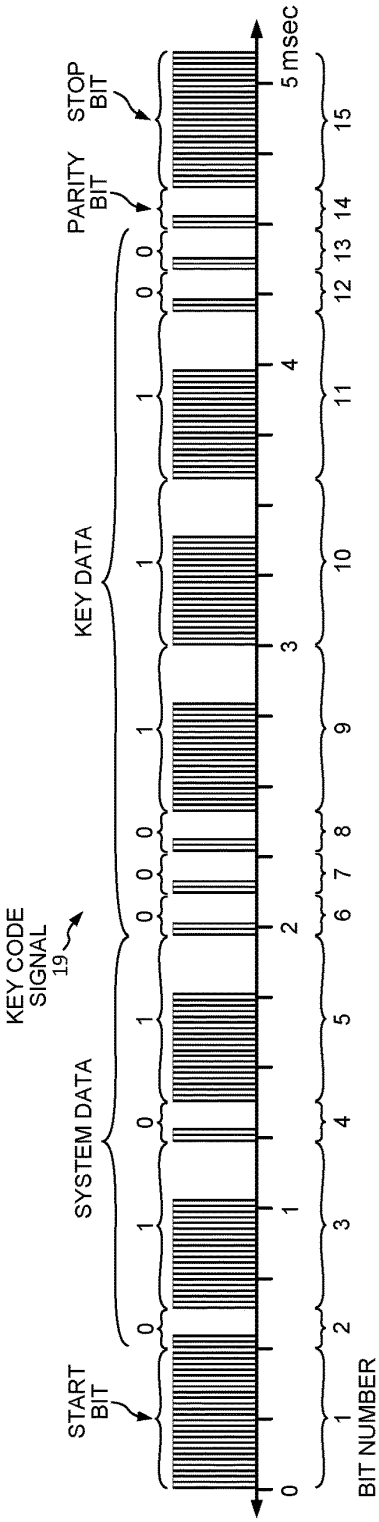


FIG. 5
PULSE WIDTH MODULATION

RELAYING KEY CODE SIGNALS THROUGH A REMOTE CONTROL DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of and claims the benefit of U.S. application Ser. No. 13/068,820, filed on May 21, 2011, which application is a continuation of and claims the benefit of U.S. application Ser. No. 12/462,526, filed on Aug. 4, 2009, which application is a continuation of and claims the benefit of U.S. application Ser. No. 10/737,029, filed on Dec. 16, 2003, each of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present invention relates generally to remote control devices and, more specifically, to relaying key code signals through a remote control device to operate an electronic consumer device.

BACKGROUND

Most households today possess multiple types of electronic consumer devices, such as televisions, stereo radios, digital video disk players, video cassette recorders, set-top cable television boxes and set-top satellite boxes. Manufacturers of such electronic devices typically supply a remote control device along with each electronic device. It is, therefore, common for a consumer who has multiple electronic devices to have multiple remote control devices.

A remote control device typically controls a selected electronic consumer device by transmitting infrared key code signals to the selected electronic consumer device. The infrared signals contain key codes of a codeset associated with the selected electronic consumer device. Each key code corresponds to a function of the selected electronic device, such as power on, power off, volume up, volume down, play, stop, select, channel up, channel down, etc. In order to avoid the situation where a remote control device unintentionally operates an electronic consumer device that is associated with a different remote control device, manufacturers sometimes use distinct codesets for the communication between various electronic consumer devices and their associated remote control devices. The codesets can differ from each other not only by the bit patterns assigned to various functions of the associated electronic consumer device, but also by the timing information that describes how the key codes should be modulated onto carrier signals to generate key code signals.

Consumers may find it inconvenient to operate their electronic devices using multiple remote control devices. Thus, a consumer may wish to operate multiple electronic consumer devices using a single remote control device. A single remote control device can store many codesets so that the remote control device can control a corresponding large number of different electronic consumer devices. There are, however, thousands of codesets in use in electronic consumer devices today. Manufacturers of remote control devices, however, may wish to limit the memory on their remote control devices to a size that is insufficient to store the thousands of existing codesets.

A system is sought for enabling a remote control device to control a selected one of multiple different electronic consumer devices without requiring the codeset associated with the selected electronic consumer device to be stored on the remote control device.

SUMMARY

A system for relaying a key code through a remote control device to an electronic consumer device allows the electronic consumer device to be controlled without storing the associated codeset on the remote control device. Upon receiving a keystroke indicator signal from a remote control device, a key code generator device, such as a set-top box, identifies the particular codeset usable to communicate with the selected electronic consumer device. The keystroke indicator signal contains an indication of a key on the remote control device that was pressed, which corresponds to a function of the selected electronic consumer device. Using the identified codeset and the indication of the pressed key, the key code generator device generates a key code and modulates that key code onto a radio frequency carrier signal, thereby generating a first key code signal. The remote control device receives the first key code signal from the key code generator device and modulates the key code onto an infrared frequency carrier signal, thereby generating a second key code signal. The remote control device relays the key code to the selected electronic consumer device in the second key code signal. The key code causes the selected electronic consumer device to perform the desired function. The key code is not stored on the remote control device in a permanent manner, but rather the key code is relayed through the remote control device.

In another embodiment, a third key code signal (which may, for example, be a radio frequency signal) is communicated directly from the key code generator device to an electronic consumer device. A key code contained in the third key code signal causes the electronic consumer device to perform a desired function.

In yet another embodiment, the system automatically determines which codeset is usable to communicate with a selected electronic consumer device. The key code generator device sends key codes for one particular function from among a series of codesets one-by-one to the selected electronic consumer device. When the key code from one of the codesets causes the electronic consumer device to perform the desired function, electromagnetic noise is introduced into electrical power wiring through which both the electronic consumer device and the key code generator device receive power. When the key code generator device detects this noise on the electrical power wiring, the key code generator device identifies the codeset corresponding to the last transmitted key code to be the codeset usable to communicate with the selected electronic consumer device.

Other embodiments and advantages are described in the detailed description below. This summary does not purport to define the invention. The invention is defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, where like numerals indicate like components, illustrate embodiments of the invention.

FIG. **1** is a schematic diagram of a system for relaying key code signals through a remote control device.

FIG. **2** is a flowchart of a method for relaying key code signals through a remote control device.

FIG. **3** is an illustration of a key code transmitted within a key code signal.

FIG. **4** is a waveform diagram of a first example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **5** is a waveform diagram of a second example of a key code signal transmitted by a remote control device in the system of FIG. **1**.

FIG. **6**A is an illustration of a modulated digital zero and digital one within the key code signal of FIG. **5**.

FIG. **6**B is a more detailed illustration of a mark of a modulated digital zero within the key code signal of FIG. **5**.

DETAILED DESCRIPTION

Reference will now be made in detail to some embodiments of the invention, examples of which are illustrated in the accompanying drawings.

FIG. **1** is a diagram of a system **10** for relaying a key code through a remote control device **11** to an electronic consumer device in accordance with the present invention. FIG. **2** is a flowchart that illustrates a method of operation of system **10**. System **10** includes a key code generator device **12**, remote control device **11**, a first electronic consumer device **13** and a second electronic consumer device **14**. In this example, second electronic consumer device **14** is a television set.

In a first step (step **100**), key code generator device **12** determines the appropriate codeset that controls the type, brand and model of the particular electronic consumer device that is to be controlled. A user uses remote control device **11** to respond to an on-screen display **15** on the screen of television set **14** to step through a sequence of menu screens to identify the codeset corresponding to the device that is to be controlled. The user does this by identifying, on on-screen display **15**, the type, brand and model of the particular electronic consumer device. In this example, the user is identifying first electronic consumer device **13**, which is a video cassette recorder (VCR) manufactured by Sony with model number 8000. In FIG. **1**, the user is identifying the device type by highlighting the choice "VCR" on the on-screen display. In another example, subsequent to controlling VCR **13**, the user may wish to control television set **14**, which is a "Gold" model manufactured by RCA. In that case, the user begins identifying television set **14** by highlighting the choice "TV".

In the present example, key code generator device **12** is a set-top box. Key code generator device **12** generates the on-screen displays and communicates with television set **14** such that key code generator device **12** identifies one of a plurality of codesets that corresponds to one of the electronic consumer devices identified by the user, such as VCR **13** or television set **14**. System **10** uses the appropriate codeset to enable remote control device **11** to communicate with VCR **13** and television set **14**.

Next (step **101**), the user presses a key on remote control device **11**. This key is associated with a function that the user wants performed by an electronic consumer device. For example, the function may be to turn on the power of VCR **13**. When the user presses the "VCR power-on" key on remote control device **11**, remote control device **11** transmits a keystroke indicator signal **16** from a radio frequency (RF) transmitter **17** on remote control device **11**. Alternatively, two or more keys on remote control device **11** may be associated with a single function, such as turning on the power of VCR **13**. In that case, the user presses a "VCR" key and then a "power-on" key to cause remote control device **11** to transmit keystroke indicator signal **16**. Keystroke indicator signal **16** is transmitted as a signal in a radio frequency band to an RF receiver **18** on key code generator device **12**.

There are multiple forms in which an indication of the pressed key, as well as the identity of the electronic consumer device that is to perform the associated function, can be communicated in keystroke indicator signal **16** from remote control device **11** to key code generator device **12**. In one embodiment, the indication of the pressed key is a key code comprised of a standardized system code and standardized key data. In the present example, the standardized system code identifies the type of electronic consumer device that is to be controlled, such as a TV, a VCR, a DVD player, a stereo amplifier, a satellite receiver or a cable receiver. The standardized system code and key data are part of a commonly used codeset that is stored on remote control device **11**. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the system code and key data to form keystroke indicator signal **16**. For example, a microcontroller on remote control device **11** uses timing information associated with the commonly used codeset to generate a pulse width modulated keystroke indicator signal **16**.

In another embodiment, the indication of the pressed key includes a proprietary identification code identifying the pressed key, as well as a proprietary identification code corresponding to the type of the electronic consumer device that is to be controlled. The proprietary identification codes are understood by key code generator device **12**, but are not standardized codes that are understood by electronic consumer devices. Remote control device **11** uses any one of a number of commonly used modulation techniques to modulate the proprietary identification codes onto keystroke indicator signal **16**.

Whether remote control device **11** communicates with key code generator device **12** through a standardized codeset or through proprietary identification codes, codes may be included that do not correspond to pressed keys or functions that are to be performed on electronic consumer devices. For example, in response to receiving any signal from remote control device **11**, key code generator device **12** may return a code to remote control device **11** causing a light emitting diode (LED) display on remote control device **11** to turn on.

Next (step **102**), key code generator device **12** determines which key code of the codeset previously identified in step **100** corresponds to the pressed key.

FIG. **3** illustrates one example of a key code from a commonly used codeset. The key code is comprised of a standardized system code and standardized key data. Both the system code and the key data are digital values. The 12-bit key code includes a 4-bit system code [0101] and 8-bit key data [00011100]. In the present example, the key code is the key code in the identified codeset that corresponds to the "VCR power-on" key of remote control device **11**.

Next (step **103**), key code generator device **12** modulates the key code for the power-on function of VCR **13** onto a first carrier signal, thereby generating a first key code signal **19**. In this example, the first carrier signal is an RF signal. An RF signal for purposes of this patent document is an electromagnetic signal having a frequency between thirty hertz and three hundred gigahertz.

FIG. **4** and FIG. **5** illustrate key code signal **19** in two specific embodiments. In both embodiments, the key code is transmitted as a stream of digital values 010100011100, where the system code is transmitted first immediately followed by the key data without any place holders between

them. The standardized system code determined in step **102** need not identify the brand or model of VCR **13**, but only the fact that first electronic consumer device **13** is a VCR. The key code is modulated in step **103** using timing information associated with the codeset for VCR **13**. Thus, the particular brand and model of VCR **13** is able to understand the key code modulated using the appropriate timing information.

In the embodiment of FIG. **4**, key code signal **19** is a 15-bit binary transmission whose bit pattern appears as a universal asynchronous receiver and transmitter (UART) type communication. The binary transmission begins with a start bit and ends with a parity bit and a stop bit. The parity bit is calculated based on the 12-bit key code within the binary transmission. In this example, the value of the parity bit is a digital zero. An intermediary signal is transmitted over the first carrier signal at an intermediary frequency (for example, 100 kHz) to communicate a digital one. The absence of the intermediary signal indicates a digital zero. The intermediary signal has a lower frequency than the first carrier signal.

In the embodiment of FIG. **5**, the 12-bit key code is modulated onto key code signal **19** using pulse width modulation. Digital ones and zeros are characterized by pairs of marks and spaces. The period between successive leading edges of the bursts in a mark is the period of an intermediary signal. The intermediary signal has an intermediary frequency. In a space, there are no bursts.

FIG. **6**A shows a digital zero and a digital one in key code signal **19** of FIG. **5** in more detail. A "mark/space" pair represents a digital zero and another "mark/space" pair represents a digital one. The marks and spaces of each pair have predetermined lengths. In the embodiment of FIG. **5**, the mark length of a digital zero is 490 microseconds, and the mark length of a digital one is 3940 microseconds. The space length of a digital zero is 950 microseconds, and the space length of a digital one is 2000 microseconds.

FIG. **6**B shows the bursts of the first carrier signal that comprise the intermediary signal in more detail. In the embodiment of FIG. **5**, the bursts that comprise the intermediary signal occur every ten microseconds, resulting in an intermediary frequency of 100 kilohertz. The duty cycle of the intermediary signal is characterized by an "on time" of four microseconds and an "off time" of six microseconds. There are forty-nine bursts of the carrier signal within each mark length of 490 microseconds.

Timing information other than that shown in the embodiment of FIG. **5** can also be used. For example, one common form of pulse width modulation uses an intermediary signal having a frequency of about 38.5 kilohertz. Each period of the intermediary signal has an "on time" of ten microseconds and an "off time" of sixteen microseconds. If such an intermediary signal were used to generate a 490 microsecond mark length of a digital zero shown in FIG. **6**A, there would be 19 bursts of the intermediary signal in the mark. Similarly, if such an intermediary signal were used to generate a 3940 microsecond mark length of a digital one shown in FIG. **6**A, there would be 151 bursts of the intermediary signal in the mark.

Next (step **104**), an RF transmitter **20** of key code generator device **12** transmits first key code signal **19** in the form of an RF transmission to an RF receiver **21** on remote control device **11**.

Next (step **105**), remote control device **11** receives first key code signal **19** and relays the key code communicated by first key code signal **19** to VCR **13** in the form of a second key code signal **22**. Remote control device **11** is a slave to key code generator device **12**. Remote control device **11** relays the key code by receiving first key code signal **19** in RF form and translating the communicated key code so that the key code is modulated onto a second carrier signal resulting in second key code signal **22**. In this example, the second carrier signal is an infrared signal with a frequency in the range between three hundred gigahertz and three hundred terahertz. Second key code signal **22** is transmitted by an IR transmitter **23** on remote control device **11** to VCR **13**. In the embodiment of FIG. **5**, key code signal **19** is converted into key code signal **22** by forming the bursts of the intermediary signal using the second carrier signal with an infrared frequency in the place of the first carrier signal with a radio frequency. For both key code signal **19** and key code signal **22**, digital ones and digital zeros are modulated using the same timing for "mark/space" pairs. The waveform diagram of key code signal **22** appears the same as the waveform diagram shown in FIG. **5** for key code signal **19**; only the frequency of the carrier signal that forms the bursts is different.

Next (step **106**), second key code signal **22** is received onto electronic consumer device (VCR) **13** by an IR receiver **24**.

Next (step **107**), IR receiver **24** on VCR **13** recovers the key code from second key code signal **22**. VCR **13** is thereby instructed to perform the function desired by the user. In this example, the function is to power on VCR **13**. Other key codes, however, correspond to other functions, such as power off, channel advance, channel back, volume up, volume down, cursor up, cursor down, cursor right, cursor left, select, play, record, stop, forward, rewind and pause.

In a second example, an electronic consumer device is controlled by an RF key code signal transmitted from key code generator device **12**. Subsequent to controlling VCR **13**, the user wishes to control second electronic consumer device **14**, which is a "Gold" model RCA television set. In the second example, the user uses the on-screen display **15** to identify the type (TV), brand (RCA) and model (Gold) of second electronic consumer device **14**. Key code generator device **12** determines the appropriate codeset that controls television set **14**. The user then presses a key on remote control device **11** associated with a function that the user wants performed by television set **14**. For example, the function is to advance the channel of television set **14**. When the user presses the channel advance key on remote control device **11**, an indication of the pressed key is transmitted in an RF keystroke indicator signal from remote control device **11** to key code generator device **12**.

Key code generator device **12** then determines which key code of the identified codeset corresponds to the pressed key. Key code generator device **12** modulates the key code for the channel advance function onto an RF carrier signal, thereby generating a third key code signal **25**. Key code generator device **12** uses the same modulation technique to generate both third key code signal **25** and first key code signal **19**. Third key code signal **25** is modulated using timing information associated with the codeset that controls RCA Gold television set **14**.

In this second example, television set **14** has an RF receiver **26** and is capable of receiving RF key code signals. RF transmitter **20** of key code generator device **12** transmits third key code signal **25** directly to television set **14**. Third key code signal **25** is received onto television set **14** by RF receiver **26**, and RF receiver **26** recovers the key code from third key code signal **25**. Television set **14** is thereby instructed to advance the channel.

Although remote control device **11** in the first example stores either a proprietary codeset or a standardized codeset

and uses that codeset to generate keystroke indicator signal **16**, remote control device **11** stores only that single codeset. This codeset is the codeset used by key code generator device **12** to receive communications from remote control device **11**. Remote control device **11** can therefore be made inexpensively and may contain a relatively small amount of memory. The memory may, for example, be read only memory (ROM) on a microcontroller integrated circuit (for example, a Z8 microcontroller available from Zilog, Inc. of San Jose, Calif.)

Even though remote control device **11** stores only a single codeset, system **10** of FIG. **1** nevertheless allows remote control device **11** to control the desired electronic consumer device **13**, which may use any one of thousands of different codesets. Key code generator device **12** may, for example, include a hard disk or other mass storage device that stores thousands of possible codesets. The user may use remote control device **11** to select any one of those codesets for communication with the particular electronic consumer device **13**. In comparison to some conventional systems where codesets are downloaded into a universal remote control device from a personal computer or other device that is not normally part of an entertainment system, system **10** uses preexisting hardware of the entertainment system (such as the on-screen display functionality, data storage capability, and wireless communication ability of the set-top box) to source and identify codesets.

Although the specific embodiments of FIGS. **1** and **2** are explained above in connection with the codesets being identified to the key code generator device **12** using an on-screen display, the codeset usable to communicate with an electronic consumer device may be identified to key code generator device **12** in other ways in other embodiments. In one embodiment, for example, the key code generator device includes autoscan functionality. Key code generator device **12** includes an EMI detector **27** that detects electromagnetic interference (EMI) or noise on power cord **28**. Power cord **28** is a power cord through which key code generator device **12** receives electrical power from a wall socket **29**. Similarly, television set **14** receives power from another wall socket **30** via a power cord **31**. VCR **13** receives power from a wall socket **32** via another power cord **33**. In accordance with the autoscan functionality, key code generator device **12** identifies the codeset used to communicate with a particular electronic consumer device by generating and transmitting a sequence of key code signals relayed through remote control device **11** to the electronic consumer device to be controlled (in this case VCR **13**). Each of these key code signals contains a different key code corresponding to the same desired function on different device types, brands and models.

In one example, the desired function is the function of powering on VCR **13**. The key code generator device **12** sends the power-on key codes for each of a series of codesets one-by-one to VCR **13**. When the key code for one of the codesets causes VCR **13** to perform the desired function (in this case, to power on), VCR **13** introduces noise or other electromagnetic interference via cord **33** into wall socket **32**. The power terminal within wall socket **32** is connected through wiring **34** to the power terminal in wall socket **29**. The noise generated by VCR **13** is therefore communicated through wiring **34**, the power terminal of wall socket **29** and power cord **28** to EMI detector **27** on key code generator device **12**. When key code generator device **12** detects the electromagnetic interference on power cord **28**, key code generator device **12** automatically identifies the codeset used by VCR **13** as the codeset used to communicate the last key code signal for the power-on function.

Multiple electronic consumer devices may have the same key data for a particular function, for example, the power-on function. A key code, however, also contains a system code (see FIG. **3**) that corresponds to a particular type of electronic consumer device. For example, the system code used for a television set will typically be different than the system code used for a video cassette recorder. Thus, different device types that use the same key data for the power-on function will not respond to a key code containing an incorrect system code. Each of the power-on key codes transmitted in this example by key code generator device **12** contains the system code for a video cassette recorder, so television set **14** does not recognize the key codes. Because key code generator device **12** is aware of the system code communicated, key code generator device **12** determines that it was VCR **13** that was powered on and not television **14**.

In another example, the codeset usable to communicate with VCR **13** is identified to key code generator device **12** using autoscan functionality that does not involve key code generator device **12** having a specialized EMI detection circuit. In that case, the user may be prompted by successive screens of on screen display **15** to push the power-on key on remote control device **11** multiple times. Each time the power-on key is pressed, keystroke indicator signal **16** communicates this to key code generator device **12**. Key code generator device **12** in turn generates and transmits a key code signal containing a power-on key code using a different codeset. Each key code signal is relayed through remote control device **11** to the particular electronic consumer device to be controlled. One by one the user is prompted to push the power-on key, and key code generator device **12** in turn generates key codes using different codesets until the electronic consumer device performs a desired function. In this case, first electronic consumer device **13** turns on. The user is prompted not to press the power-on key once the user sees the desired function being performed by first electronic consumer device **13**. In the present example, light emitting diodes (LEDs) on the face of VCR **13** may be illuminated to indicate to the user that VCR **13** has powered on. When the user stops pressing the power-on key, then the key code generator device **12** identifies the codeset of the last transmitted key code to be the codeset used by the electronic consumer device.

In another example, the user presses keys on remote control device **11** to communicate to key code generator device **12** a 3-digit codeset identification number identifying the codeset. The user may determine this codeset identification number by looking up the codeset identification number in a booklet supplied along with the electronic consumer device to be controlled. Alternatively, a table of manufacturers, model numbers and their associated codesets may be used to lookup the codeset identification number.

In an embodiment where key code generator device **12** is a set-top box, the set-top box receives a video input signal **35** from a cable television coaxial cable **36**. Video input signal **35** is ultimately delivered to television set **14** through cables **37**. Coaxial cable **36** is also used to provide networking connectivity between the set-top box and a network **38**. Network **38** may, for example, be or include the Internet. A database of codesets **39** is maintained at a remote location. As new electronic consumer devices are introduced onto the market, new codesets may be necessary to communicate with these new devices. So that one such new codeset can be distributed from database of codesets **39** when a new elec-

tronic consumer device is introduced into the market, this new codeset is communicated via network **38** and coaxial cable **36** to key code generator device **12**. The new codeset is then stored on a mass storage hard disk within the set-top box. In this way, the pre-existing and inexpensive remote control device **11** can be used to control a new electronic consumer device whose required codeset did not exist at the time remote control device **11** and key code generator device **12** were delivered to the user.

In yet another embodiment, remote control device **11** is a learning remote control device that includes an IR detector **40**. In accordance with one method, the learning remote control device **11** is placed so that IR detector **40** can receive an IR transmission from an IR transmitter of another remote control device. Keys corresponding to key codes to be learned are pressed on the other remote control device such that successive key code signals are transmitted from the IR transmitter of the other remote control device to IR detector **40** of the learning remote control device **11**. Learning remote control device **11** detects when the envelope of the bursts of the received IR signal changes from low to high and high to low. The time duration between each successive transition is stored such that a key code signal is recorded as timing information for a series of mark lengths and space lengths. As the various keys of the remote control device to be learned are pressed, learning remote control device **11** records successive strings of timing information. The resulting strings of timing information, once collected on learning remote control device **11**, are automatically transmitted from learning remote control device **11** in the form of RF signals to key code generator device **12**. Key code generator device **12** in turn communicates the captured strings of timing information through coaxial cable **36** and network **38** to database of codesets **39**. Personnel maintaining database of codesets **39** then analyze the timing information and generate a codeset that describes the key codes captured by learning remote control device **11**. In this way, a new codeset containing key data, systems codes and timing information is added to database of codesets **39**.

Rather than storing the information as a new codeset that includes separate key codes and timing information, the information for each keystroke can be stored in database of codesets **39** in the form of interval times.

A single system **10** is therefore described that can support numerous different types of electronic consumer devices that can use multiple different codesets. The remote control device **11** of the system need not include a large memory and stored many codesets. Rather, the remote control device **11** need only relay individual key codes. Remote control device **11** can therefore be a relatively inexpensive device that includes only a small amount of memory. In addition to requiring only a small amount of memory, the very same remote control device **11** can control an electronic consumer device that uses a codeset or protocol that was not in existence at the time the remote control device **11** was delivered to the user. The amount of writable memory (for example, random access memory (RAM) or flash memory) on the remote control device **11** may be so little that it may not be adequate to store a conventional codeset. The bulk of the memory of the remote control device **11** may be relatively inexpensive mask-programmable read only memory (ROM). By reducing the amount of writable memory on remote control device **11**, the cost of remote control device **11** is reduced.

Although the present invention has been described in connection with certain specific embodiments for instructional purposes, the present invention is not limited thereto. Although the method is described above in connection with an inexpensive remote control device whose primary purpose is to control an electronic consumer device, the method can be employed in connection with other types of devices. Due to the limited amount of memory and intelligence required of the remote control device in the present method, the functionality of remote control device **11** can be incorporated into an RF-enabled device (such as a cell phone or RF-enabled personal digital assistant (PDA) or RF-enabled wrist watch or RF-enabled keyboard) without significantly increasing the cost of the device. The first carrier signal used to communicate between the remote control device and the key code generator device need not be an RF signal, and the second carrier signal used to communicate between the remote control device and the electronic consumer device need not be an IR signal. Both the first and second carrier signals can be the same type of signals, for example IR signals. The key code generator device can transmit key codes to the electronic consumer device to be controlled via a hardwired connection rather than a wireless link. The type of key code signal relayed through the remote control device is not limited to any particular protocol.

Although key code generator device **12** is a set-top box in the embodiment of FIG. **1** above, in other embodiments the key code generator device **12** is another type of electronic consumer device such as, for example, a television, a stereo radio, a digital video disk player, a video cassette recorder, a personal computer, a set-top cable television box or a set-top satellite box. Although the keystroke indicator signal can be an indication of a pressed key where there is a one-to-one relationship between the key and a function to be performed, in other embodiments a keystroke indicator signal indicates a selected function that is not associated with a specific key on the remote control device. For example, a function can be selected choosing a function from a menu that is displayed on the remote control device. Accordingly, various modifications, adaptations, and combinations of various features of the described embodiments can be practiced without departing from the scope of the invention as set forth in the claims.

What is claimed is:

1. A first device for transmitting a command to control a functional operation of a second device, the first device comprising:

a receiver;

a transmitter;

a processing device coupled to the receiver and the transmitter; and

a memory storing instructions executable by the processing device, the instructions causing the processing device to:

generate a key code using a keystroke indicator received from a third device in communication with first device via use of the receiver, the keystroke indicator having data that indicates an input element of the third device that has been activated;

format the key code for transmission to the second device; and

transmit the formatted key code to the second device in a key code signal via use of the transmitter;

wherein the generated key code comprises a one of a plurality of key code data stored in a codeset, wherein the one of the plurality of key code data is selected from the codeset as a function of the keystroke indicator received from the third device, wherein each of the plurality of key code data stored in the codeset comprises a series of digital ones and/or digital zeros, and

wherein the codeset further comprises time information that describes how a digital one and/or a digital zero within the selected one of the plurality of key code data is to be represented in the key code signal to be transmitted to the second device.

2. The first device as recited in claim **1**, wherein the receiver comprises an RF receiver.

3. The first device as recited in claim **1**, wherein the transmitter comprises an IR transmitter.

4. The first device as recited in claim **1**, wherein the formatted key code is transmitted from the first device to the second device via a wired connection between the first device and the second device.

5. The first device as recited in claim **1**, wherein the formatted key code is transmitted from the first device to the second device via a wireless connection between the first device and the second device.

6. The first device as recited in claim **1**, wherein the first device comprises a further receiver for receiving a media from a fourth device in communication with the first device and wherein the first device is coupled to the second device to provide the media to the second device for display on a display device associated with the second device.

7. The first device as recited in claim **1**, wherein the generated key code controls at least one of a power on, power off, volume up, and volume down functional operation of the second device.

8. The first device as recited in claim **1**, wherein the first device comprises a further receiver for receiving the codeset from a fourth device in communication with the first device.

9. A first device for transmitting a command to control a functional operation of a second device, the first device comprising:

a receiver;

a first transmitter;

a second transmitter;

a processing device coupled to the receiver, the first transmitter, and the second transmitter; and

a memory storing instructions executable by the processing device, the instructions causing the processing device to:

generate a key code using a keystroke indicator received from a third device in communication with first device via use of the receiver, the keystroke indicator having data that indicates an input element of the third device that has been activated;

format the key code for transmission to the second device;

transmit the formatted key code to the second device in a key code signal via use of the first transmitter and a first communication protocol; and

transmit the formatted key code to the second device in a keycode signal via use of the second transmitter and a second communication protocol when it is determined that the second device is not responsive to the key code signal transmitted via use of the first transmitter and the first communication protocol.

10. The first device as recited in claim **9**, wherein one of the first and second transmitters comprises an IR transmitter and wherein the other of the first and second transmitter comprises an RF transmitter.

11. The first device as recited in claim **9**, wherein one of the first and second communication protocols comprises a wired communication protocol and the other of the first and second communication protocols comprises a wireless communication protocol.

12. The first device as recited in claim **9**, wherein the formatted key code is transmitted from the first device to the second device via a wired connection between the first device and the second device.

13. The first device as recited in claim **9**, wherein the receiver comprises an RF receiver.

14. The first device as recited in claim **9**, wherein the first device comprises a further receiver for receiving a media from a fourth device in communication with the first device and wherein the first device is coupled to the second device to provide the media to the second device for display on a display device associated with the second device.

15. The first device as recited in claim **9**, wherein the generated key code controls at least one of a power on, power off, volume up, and volume down functional operation of the second device.

16. The first device as recited in claim **1**, wherein the first device comprises a further receiver for receiving at least one codeset from a fourth device in communication with the first device and wherein the at least one codeset is used to generate the key code.

* * * * *

EXHIBIT D

US009716853B2

(12) **United States Patent**
Arling et al.

(10) **Patent No.: US 9,716,853 B2**
(45) **Date of Patent: *Jul. 25, 2017**

(54) **SYSTEM AND METHOD FOR OPTIMIZED APPLIANCE CONTROL**

(71) Applicant: **Universal Electronics Inc.**, Santa Ana, CA (US)

(72) Inventors: **Paul D. Arling**, Irvine, CA (US); **Ramzi Ammari**, Newport Coast, CA (US); **Arsham Hatambeiki**, Irvine, CA (US); **Graham Williams**, Corona Del Mar, CA (US)

(73) Assignee: **Universal Electronics Inc.**, Santa Ana, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/948,927**

(22) Filed: **Nov. 23, 2015**

(65) **Prior Publication Data**

US 2016/0080679 A1 Mar. 17, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/933,877, filed on Jul. 2, 2013, now Pat. No. 9,219,874, which is a (Continued)

(51) **Int. Cl.**
G05B 11/01 (2006.01)
H04N 5/44 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04N 5/4403*** (2013.01); ***G08C 17/02*** (2013.01); ***G08C 23/04*** (2013.01); ***H04B 1/205*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G08C 2201/20; G08C 2201/21; G08C 2201/33; G08C 2201/40; G08C 2201/41;
(Continued)

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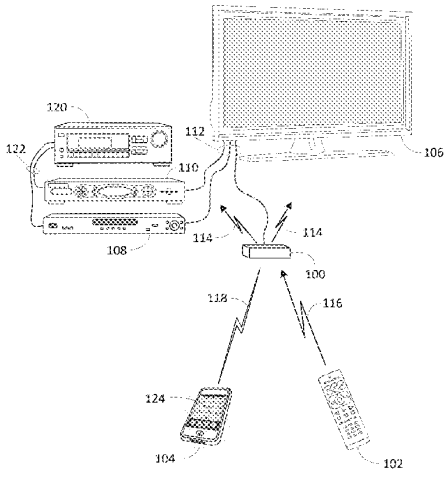
Primary Examiner — Firmin Backer
Assistant Examiner — Adnan Aziz
(74) *Attorney, Agent, or Firm* — Greenberg Traurig, LLP

(57) **ABSTRACT**

A device receives a request from a controlling device, such as a remote control, smart phone, or the like, where the request is intended to have one or more target devices perform one or more functional operations. The device responds to the request by applying the optimum methodology to propagate one or more commands to each intended target appliance to cause each intended target appliance to perform the intended one or more functional operations.

8 Claims, 13 Drawing Sheets



Related U.S. Application Data

continuation of application No. 13/657,176, filed on Oct. 22, 2012, now Pat. No. 9,215,394.

(60) Provisional application No. 61/552,857, filed on Oct. 28, 2011, provisional application No. 61/680,876, filed on Aug. 8, 2012.

(51) **Int. Cl.**

G08C 17/02	(2006.01)
G08C 23/04	(2006.01)
H04B 1/20	(2006.01)
H04N 21/422	(2011.01)
H04N 21/436	(2011.01)
H04N 5/60	(2006.01)

(52) **U.S. Cl.**

CPC ***H04N 5/60*** (2013.01); ***H04N 21/4222*** (2013.01); ***H04N 21/42204*** (2013.01); ***H04N 21/43615*** (2013.01); *G08C 2201/40* (2013.01); *G08C 2201/92* (2013.01); *H04N 2005/4426* (2013.01); *H04N 2005/4435* (2013.01); *H04N 2005/4442* (2013.01)

(58) **Field of Classification Search**

CPC . G08C 2201/91; H04L 12/281; H04L 12/282; H04L 12/2814; H04L 12/2818; H04L 12/2803; H04L 12/2809

See application file for complete search history.

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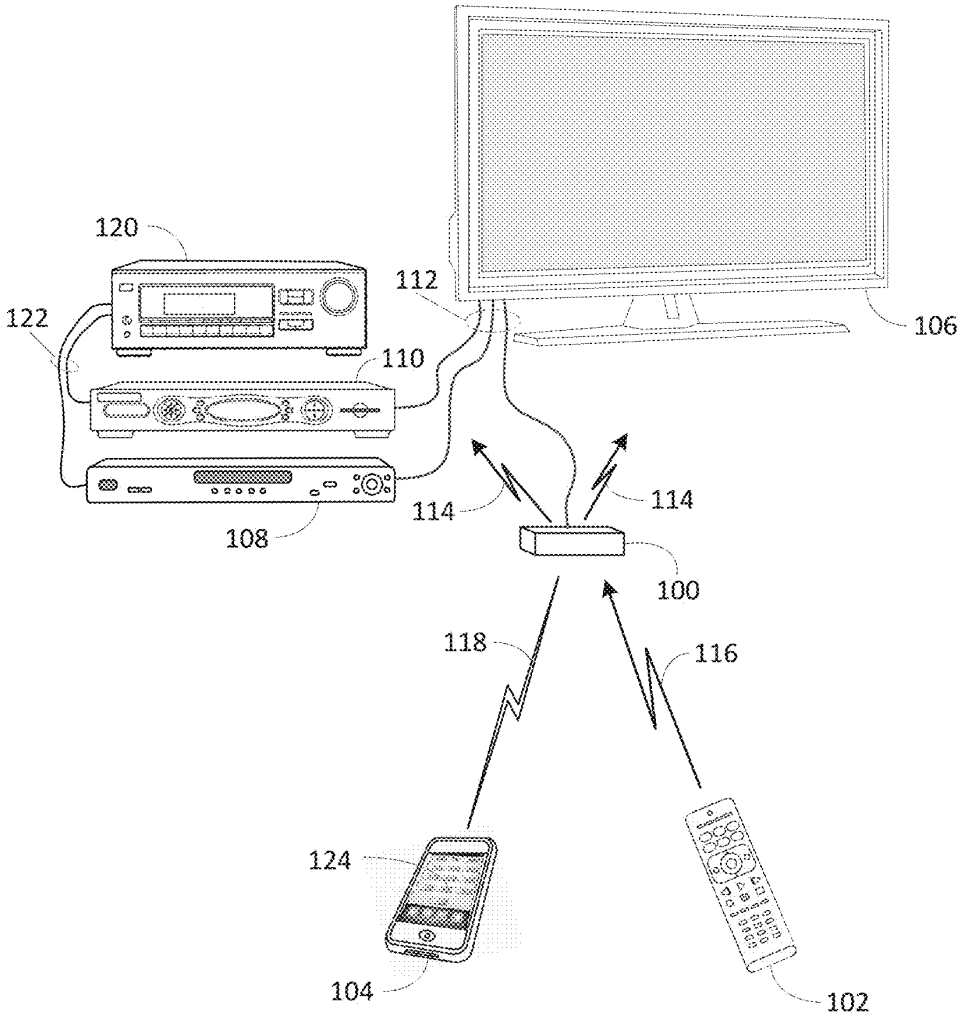
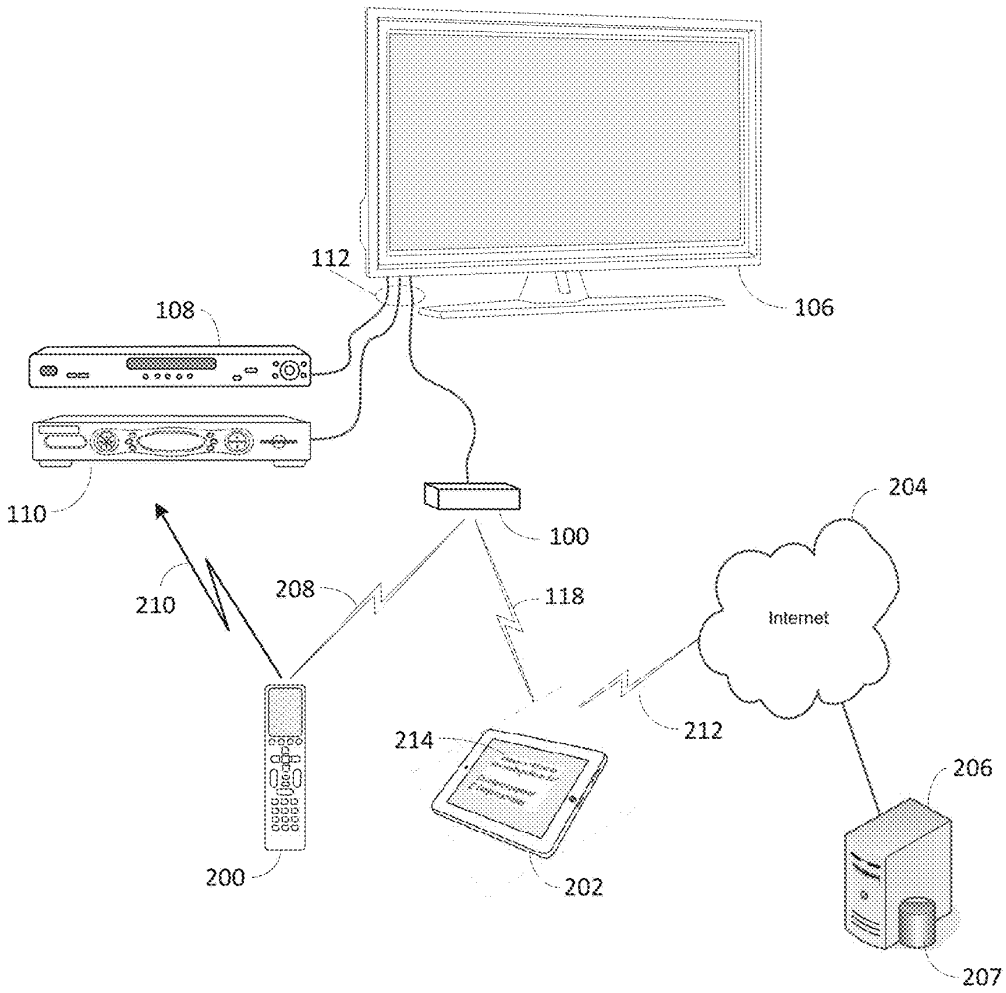


Figure 1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108
106
110
100
204
210
208
118
Internet
214
212
206
200
202
207

Figure 2

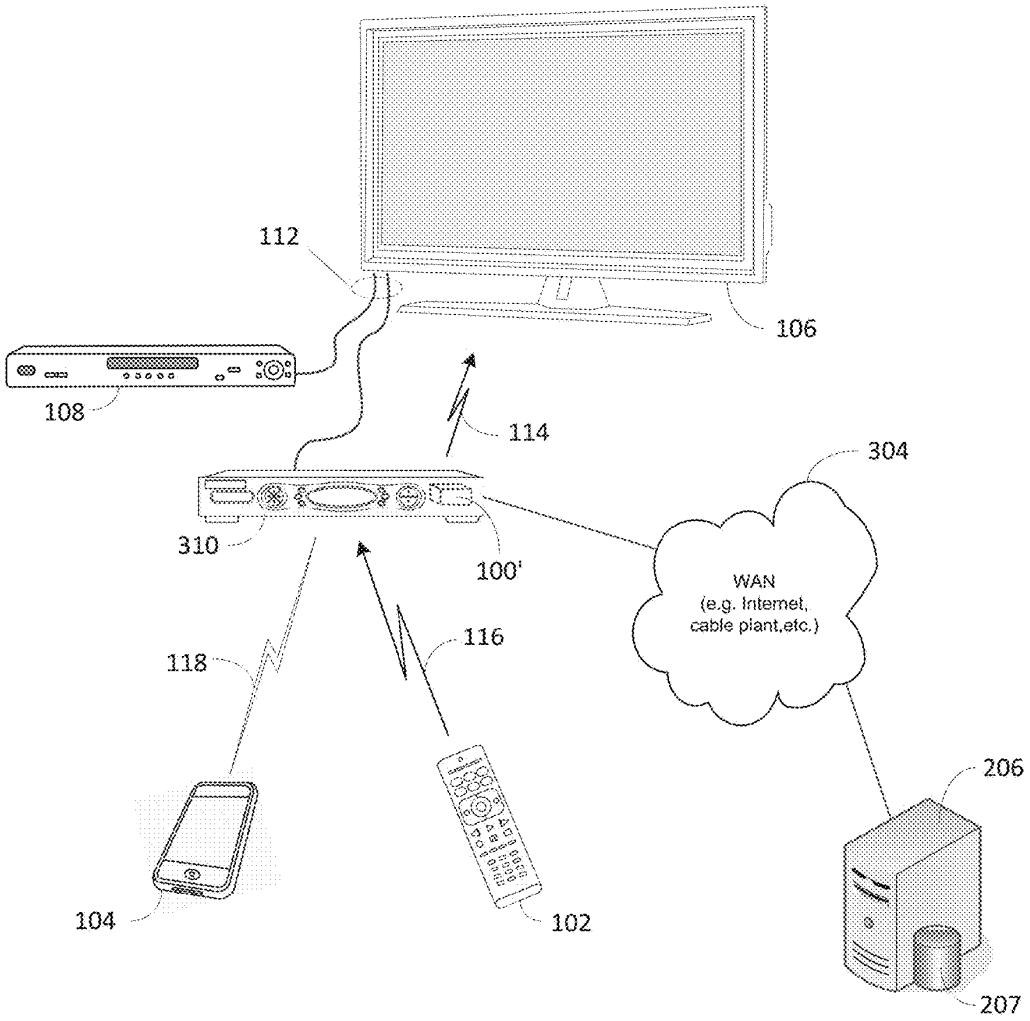
112
106
108
114
304
310
100'
WAN
(e.g. Internet,
cable plant,etc.)
118
116
206
104
102
207

Figure 3

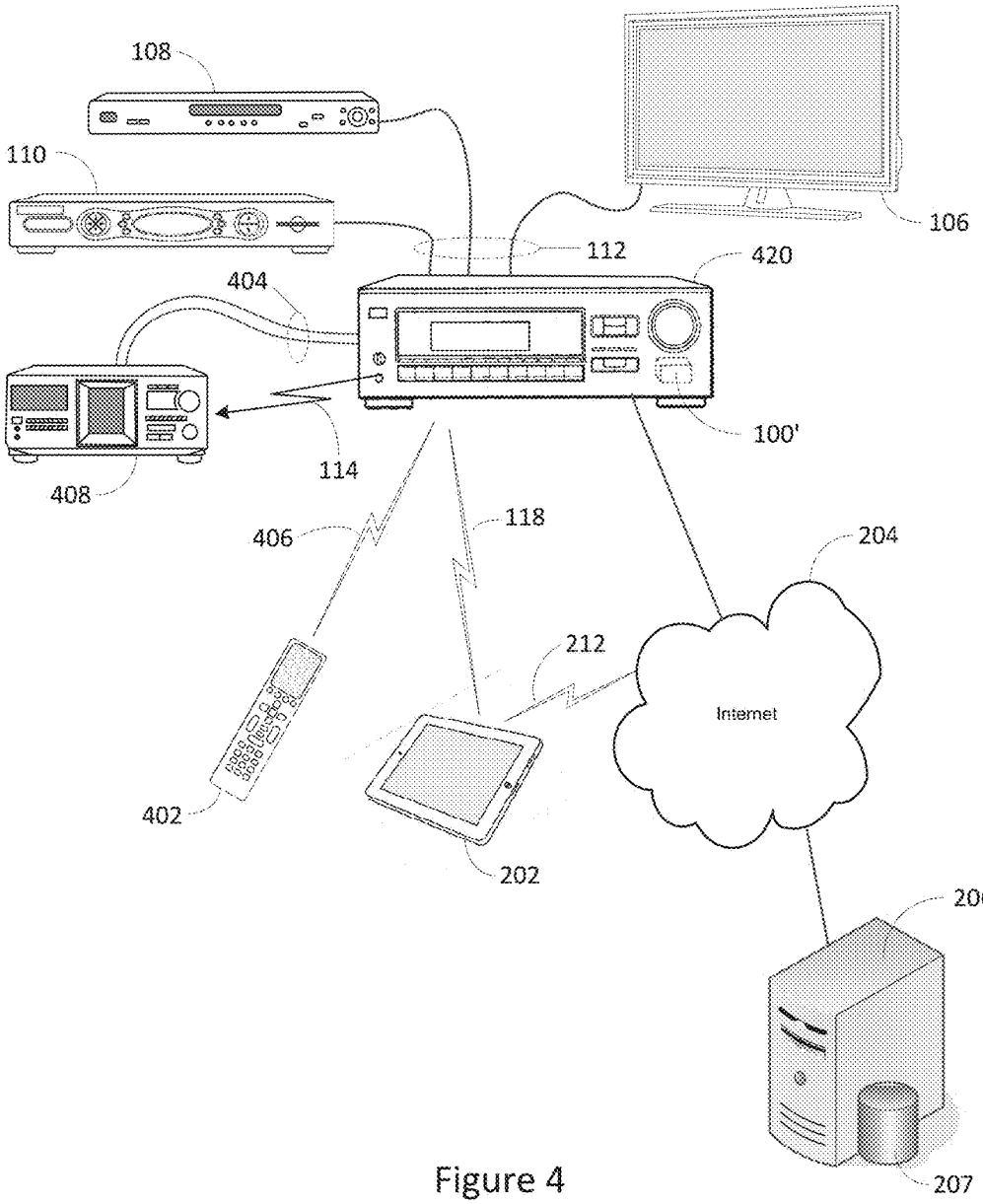
108
110
106
112
420
404
100'
114
408
406
118
204
212
Internet
402
202
206
207

Figure 4

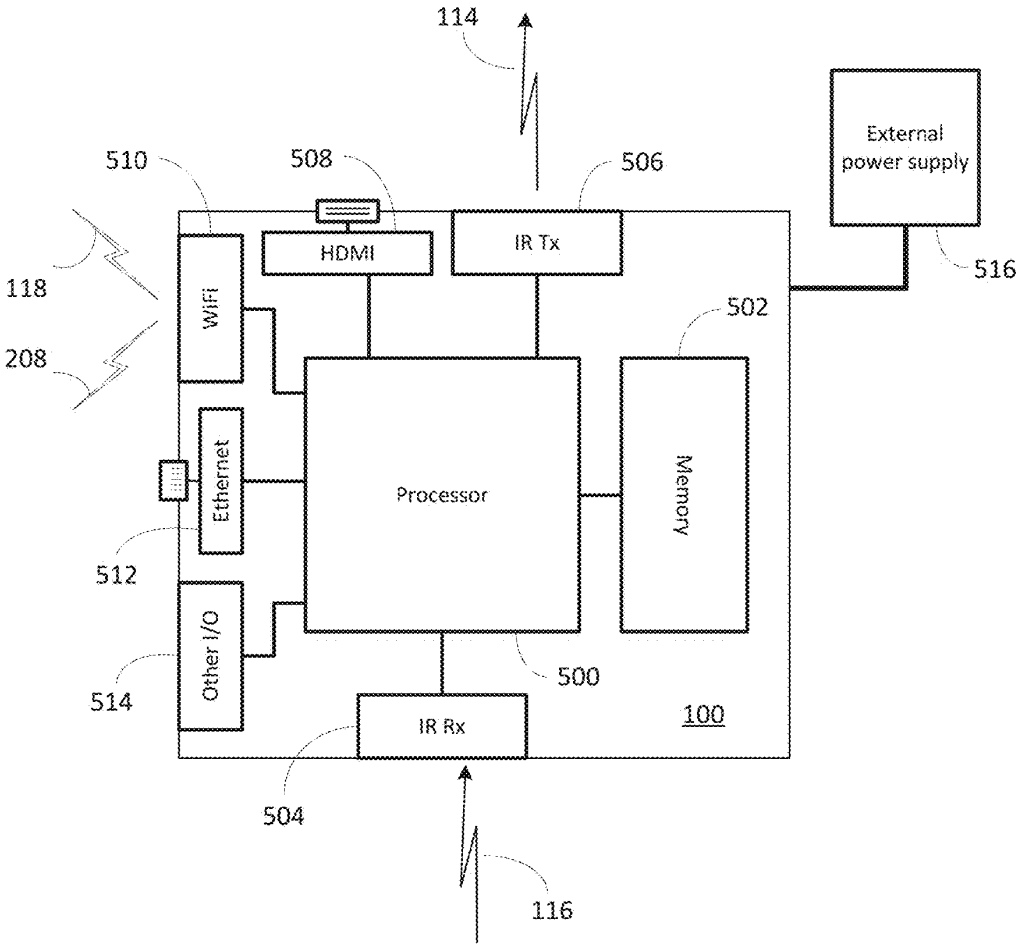
114
External power supply
510
508
506
516
HDMI
IR Tx
118
WiFi
502
208
Ethernet
Processor
Memory
512
Other I/O
514
500
100
IR Rx
504
116

Figure 5

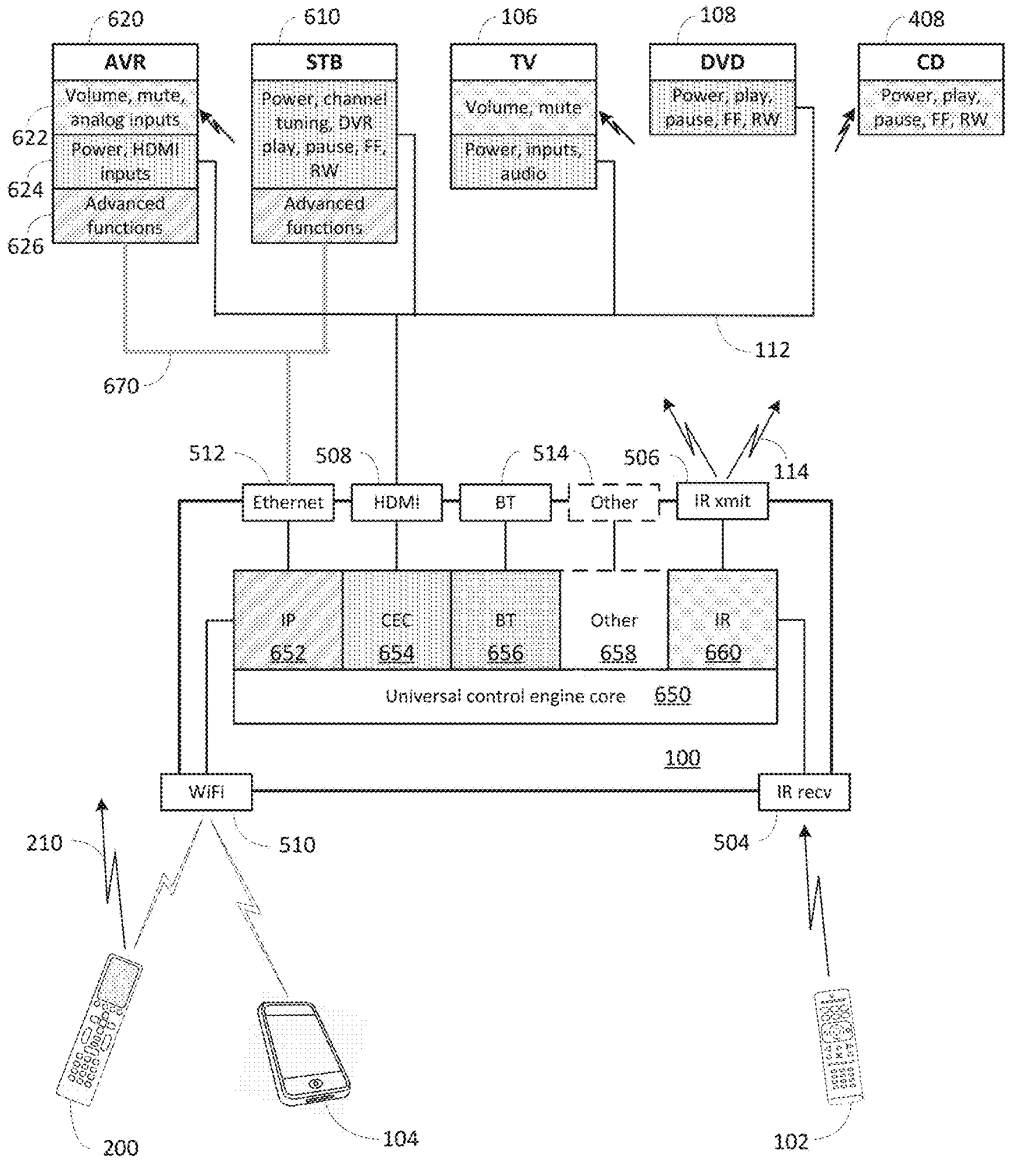
620
AVR
Volume, mute, analog inputs
622
Power, HDMI inputs
624
Advanced functions
626
610
STB
Power, channel tuning, DVR play, pause, FF, RW
Advanced functions
106
TV
Volume, mute
Power, inputs, audio
108
DVD
Power, play, pause, FF, RW
408
CD
Power, play, pause, FF, RW
112
670
512
508
514
506
114
Ethernet
HDMI
BT
Other
IR xmit
IP 652
CEC 654
BT 656
Other 658
IR 660
Universal control engine core 650
100
WiFi
IR recv
210
510
504
200
104
102

Figure 6

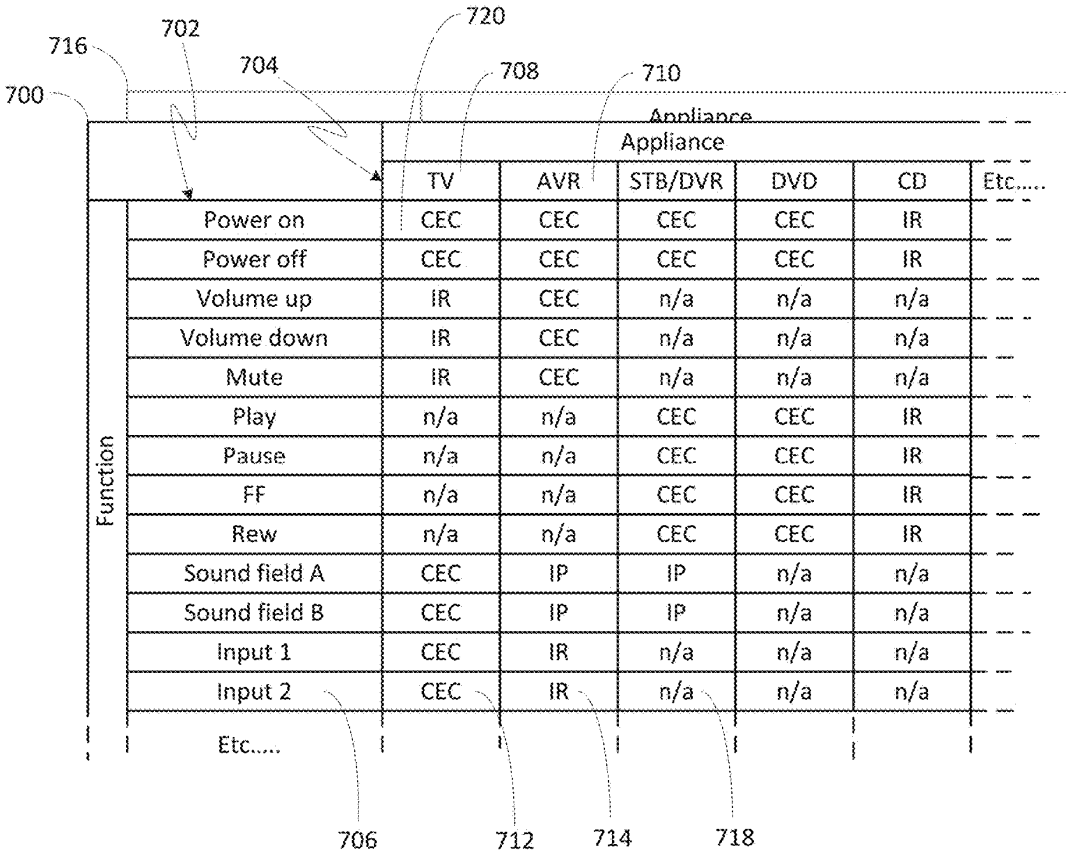
716
702
720
704
708
710
700
Appliance
Appliance
TV
AVR
STB/DVR
DVD
CD
Etc.....
Function
Power on
Power off
Volume up
Volume down
Mute
Play
Pause
FF
Rew
Sound field A
Sound field B
Input 1
Input 2
Etc.....
CEC
IR
IP
n/a
706
712
714
718

Figure 7

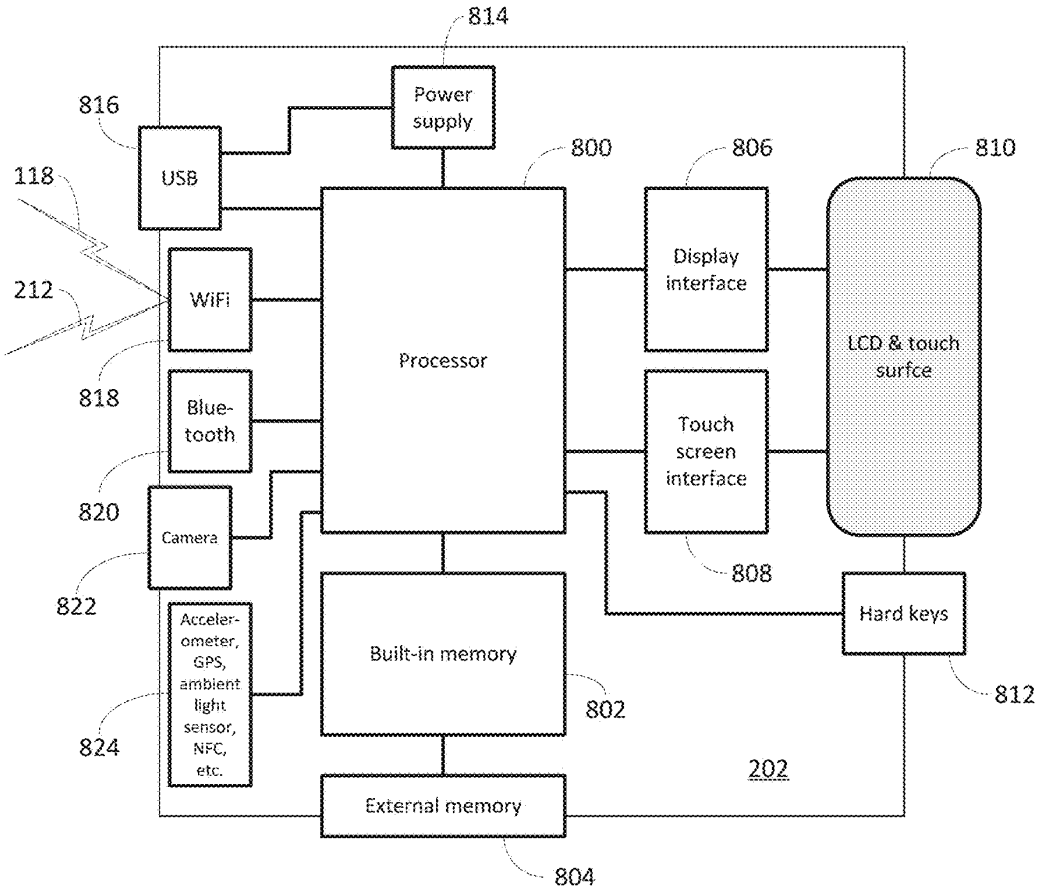
814
Power supply
816
USB
800
806
810
118
212
WiFi
Processor
Display interface
LCD & touch surfce
818
Blue-tooth
Touch screen interface
820
Camera
808
822
Acceler-ometer, GPS, ambient light sensor, NFC, etc.
Built-in memory
Hard keys
812
802
824
202
External memory
804

Figure 8

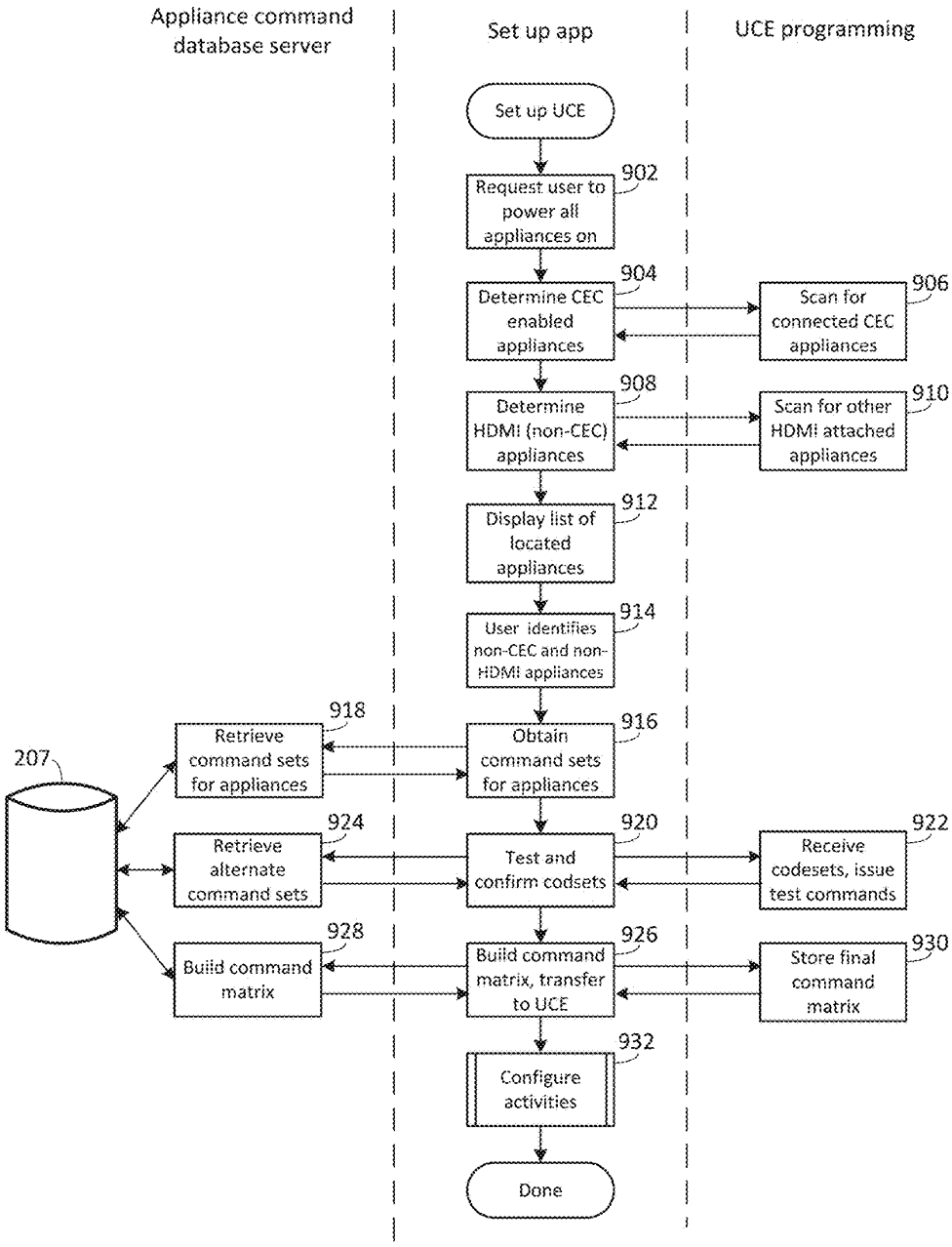
Appliance command database server
Set up app
UCE programming
Set up UCE
Request user to power all appliances on
902
Determine CEC enabled appliances
904
Scan for connected CEC appliances
906
Determine HDMI (non-CEC) appliances
908
Scan for other HDMI attached appliances
910
Display list of located appliances
912
User identifies non-CEC and non-HDMI appliances
914
207
Retrieve command sets for appliances
918
Obtain command sets for appliances
916
Retrieve alternate command sets
924
Test and confirm codsets
920
Receive codesets, issue test commands
922
Build command matrix
928
Build command matrix, transfer to UCE
926
Store final command matrix
930
Configure activities
932
Done

Figure 9

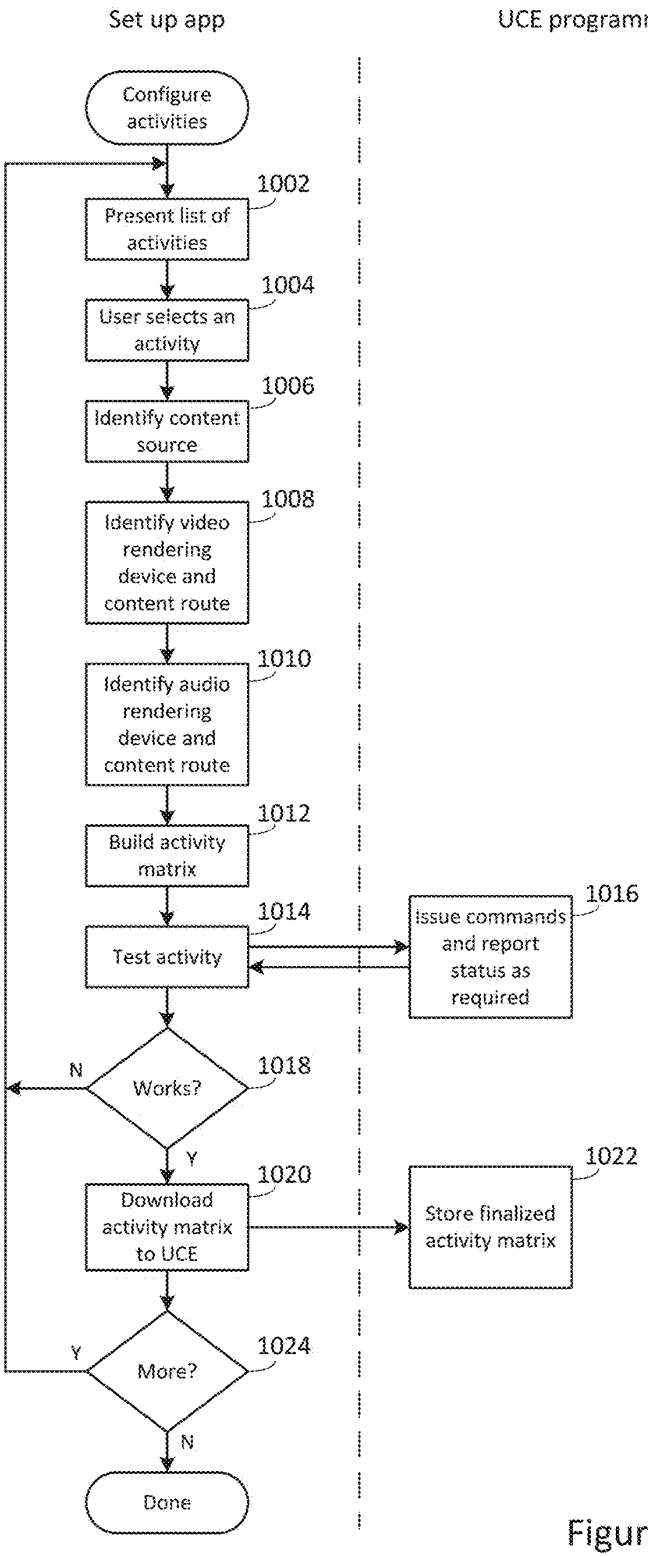
Set up app
UCE programming
Configure activities
1002
Present list of activities
1004
User selects an activity
1006
Identify content source
1008
Identify video rendering device and content route
1010
Identify audio rendering device and content route
1012
Build activity matrix
1014
Test activity
1016
Issue commands and report status as required
N
Works?
1018
Y
1020
Download activity matrix to UCE
1022
Store finalized activity matrix
Y
More?
1024
N
Done

Figure 10

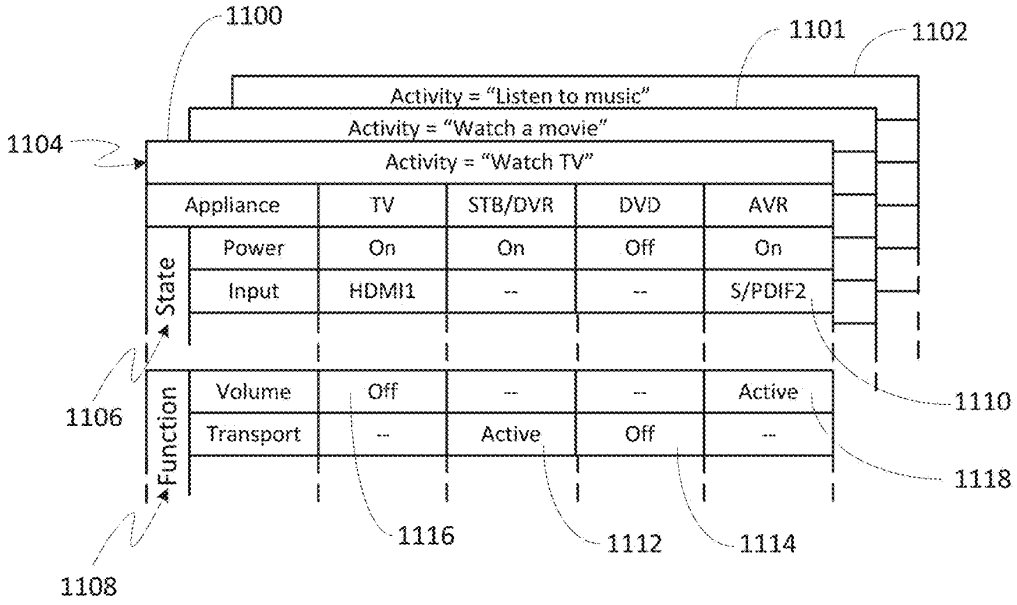

Figure 11

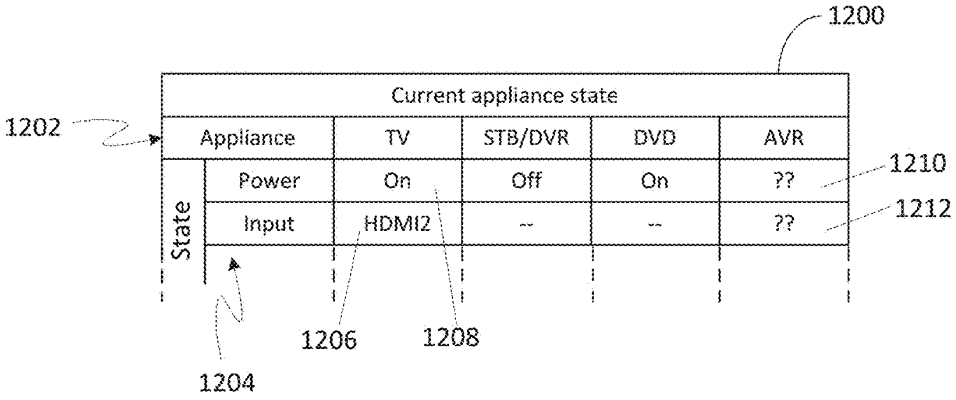

Figure 12

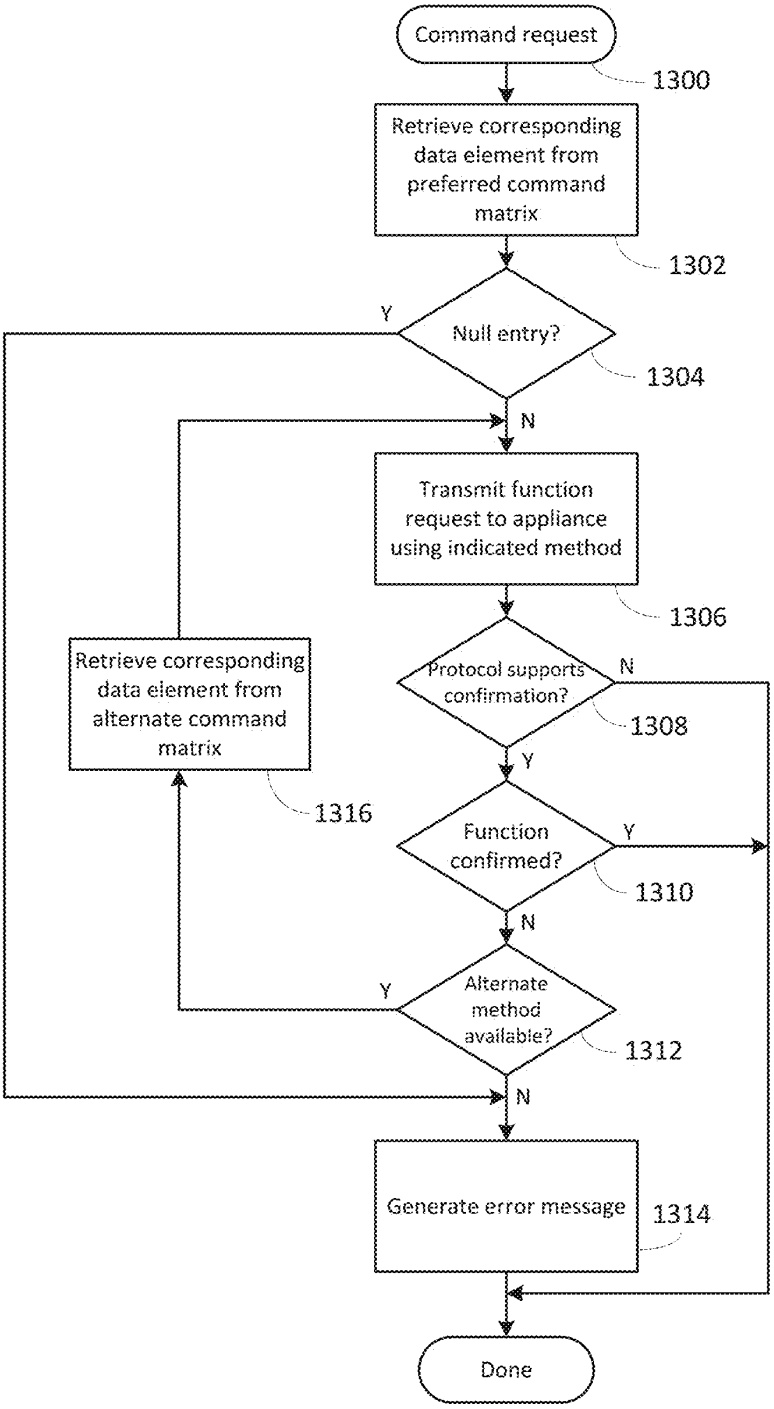
Command request
1300
Retrieve corresponding data element from preferred command matrix
1302
Null entry?
Y
1304
N
Transmit function request to appliance using indicated method
1306
Protocol supports confirmation?
N
1308
Y
Function confirmed?
Y
1310
N
Alternate method available?
Y
1312
N
Retrieve corresponding data element from alternate command matrix
1316
Generate error message
1314
Done

Figure 13

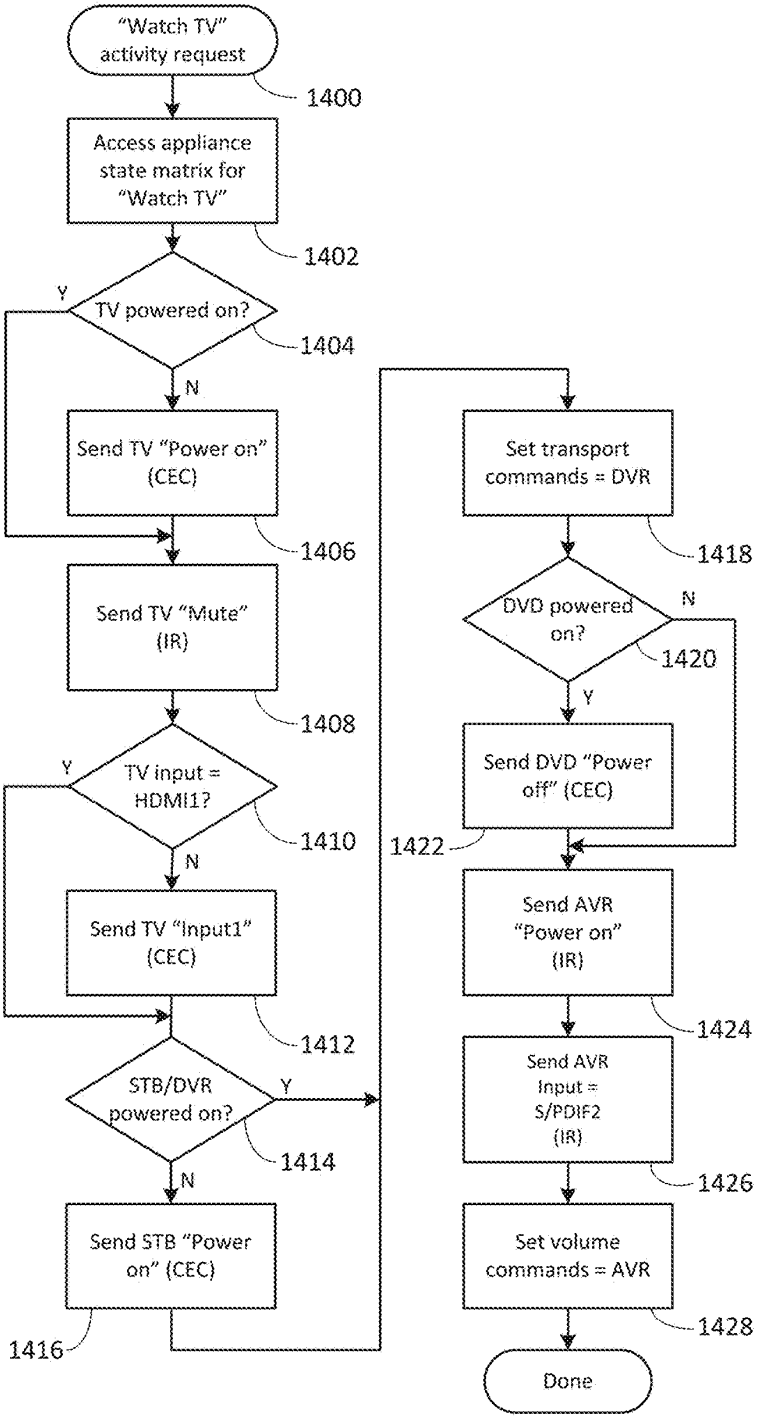
"Watch TV" activity request
1400
Access appliance state matrix for "Watch TV"
1402
TV powered on?
Y
N
1404
Send TV "Power on" (CEC)
1406
Send TV "Mute" (IR)
1408
TV input = HDMI1?
Y
N
1410
Send TV "Input1" (CEC)
1412
STB/DVR powered on?
Y
N
1414
Send STB "Power on" (CEC)
1416
Set transport commands = DVR
1418
DVD powered on?
N
Y
1420
Send DVD "Power off" (CEC)
1422
Send AVR "Power on" (IR)
1424
Send AVR Input = S/PDIF2 (IR)
1426
Set volume commands = AVR
1428
Done

Figure 14

SYSTEM AND METHOD FOR OPTIMIZED APPLIANCE CONTROL

RELATED APPLICATION INFORMATION

This application claims the benefit of and is a continuation of U.S. application Ser. No. 13/933,877, filed on Jul. 2, 2013, which application claims the benefit of and is a continuation of U.S. application Ser. No. 13/657,176, filed on Oct. 22, 2012, which application claims the benefit of U.S. Provisional Application No. 61/552,857, filed Oct. 28, 2011, and U.S. Provisional Application No. 61/680,876, filed Aug. 8, 2012, the disclosures of which are incorporated herein by reference in their entirety.

This application is also related to U.S. patent application Ser. No. 12/621,277, filed on Nov. 18, 2009 and entitled "System and Method for Reconfiguration of an Entertainment System Controlling Device," which in turn is a continuation-in-part of U.S. patent application Ser. No. 12/569,121 (now U.S. Pat. No. 8,243,207), filed on Sep. 29, 2009 and entitled "System and Method for Activity Based Configuration of an Entertainment System," the disclosures of which are incorporated herein by reference in their entirety.

This application is also related to U.S. patent application Ser. No. 13/198,072, filed on Aug. 4, 2011 and entitled "System and Method for Configuring the Remote Control Functionality of a Portable Device," the disclosure of which is incorporated herein by reference in its entirety.

This application is also related to U.S. patent application Ser. No. 13/240,604, filed on Sep. 22, 2011 and entitled "System and Method for Configuring Controlling Device Functionality," the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

Controlling devices, for example remote controls, for use in issuing commands to entertainment and other appliances, and the features and functionality provided by such controlling devices are well known in the art. In order to facilitate such functionality, various communication protocols, command formats, and interface methods have been implemented by appliance manufacturers to enable operational control of entertainment and other appliances, also as well known in the art. In particular, the recent proliferation of wireless and wired communication and/or digital interconnection methods such as WiFi, Bluetooth, HDMI, etc., amongst and between appliances has resulted in a corresponding proliferation of such communication protocols and command formats. While many of these newer methods may offer improved performance and/or reliability when compared to previous control protocols, appliance manufacturer adoption of such newer methods remains inconsistent and fragmented. This, together with the large installed base of prior generation appliances, may cause confusion, misoperation, or other problems when a user or manufacturer of a controlling device, such as a remote control, attempts to take advantage of the enhanced features and functionalities of these new control methods.

SUMMARY OF THE INVENTION

This invention relates generally to enhanced methods for appliance control via use of a controlling device, such as a remote control, smart phone, tablet computer, etc., and in particular to methods for taking advantage of improved appliance control communication methods and/or command formats in a reliable manner which is largely transparent to a user and/or seamlessly integrated with legacy appliance control technology.

To this end, the instant invention comprises a modular hardware and software solution, hereafter referred to as a Universal Control Engine (UCE), which is adapted to provide device control across a variety of available control methodologies and communication media, such as for example various infrared (IR) remote control protocols; Consumer Electronic Control (CEC) as may be implemented over a wired HDMI connection; internet protocol (IP), wired or wireless; RF4CE wireless; Bluetooth (BT) wireless personal area network(s); UPnP protocol utilizing wired USB connections; or any other available standard or proprietary appliance command methodology. Since each individual control paradigm may have its own strengths and weaknesses, the UCE may be adapted to combine various control methods in order to realize the best control option for each individual command for each individual device.

The UCE itself may be adapted to receive commands from a controlling device, for example a conventional remote control or a remote control app resident on a smart device such as a phone or tablet, etc., utilizing any convenient protocol and command structure (IR, RF4CE, BT, proprietary RF, etc.) As will become apparent, the controlling device may range from a very simple unidirectional IR device to a fully functional WiFi enabled smart phone or the like. The UCE may receive command requests from such a controlling device and apply the optimum methodology to propagate the command function(s) to each intended target appliance, such as for example a TV, AV receiver, DVD player, etc. In this manner the UCE may enable a single controlling device to command the operation of all appliances in a home theater system while coordinating available methods of controlling each particular appliance in order to select the best and most reliable method for issuing each command to each given device. By way of example without limitation, a UCE may utilize IR commands to power on an AV receiver appliance while CEC commands or another method may be used to select inputs or power down the same AV receiver appliance; or CEC commands may be used to power on and select inputs on a TV appliance while IR commands may be used to control the volume on the same TV appliance.

As will become apparent, a UCE may comprise modular hardware and software which may be embodied in a standalone device suitable for use in an existing home theater equipment configuration, or may be incorporated into any one of the appliances such as a STB, TV, AV receiver, HDMI switch etc. Further, when incorporated into an appliance, UCE functionality may be provisioned as a separate hardware module or may be incorporated together with other hardware functionality, e.g., as part of an HDMI interface IC or chip set, etc.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments and which are indicative of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the various aspects of the invention, reference may be had to preferred embodiments shown in the attached drawings in which:

FIGS. **1** and **2** illustrate exemplary systems in which a standalone UEC device may be utilized to command operation of several appliances;

FIGS. **3** and **4** illustrate exemplary systems in which UEC functionality may be incorporated into an appliance which is part of a home entertainment system;

FIG. **5** illustrates a block diagram of an exemplary UEC device;

FIG. **6** illustrates a graphical representation of an exemplary UCE-based control environment;

FIG. **7** illustrates an exemplary preferred command matrix for use in a UCE-based control environment, for example as illustrated in FIG. **6**;

FIG. **8** illustrates a block diagram of an exemplary smart device which may support a remote control app and a setup method for use in configuring a UCE;

FIG. **9** illustrates an exemplary series of steps which may be performed in order to set up and configure an exemplary UCE;

FIG. **10** illustrates an exemplary series of steps which may be performed in order to define to a UCE an appliance configuration which corresponds to a user activity;

FIG. **11** illustrates exemplary activity configuration matrices such as may be defined during the steps of FIG. **10**;

FIG. **12** illustrates an exemplary current appliance state matrix which may be maintained by a UCE for use in determining the commands necessary to invoke one of the states defined by the matrix of FIG. **11**;

FIG. **13** illustrates an exemplary series of steps which may be performed by a UCE in issuing a function command to an appliance; and

FIG. **14** illustrates an exemplary series of steps which may be performed by a UCE in establishing appliance states matching a desired activity defined in one of the matrices of FIG. **11**.

DETAILED DESCRIPTION

With reference to FIG. **1**, there is illustrated an exemplary system in which a UCE device **100** may be used to issue commands to control various controllable appliances, such as a television **106**, a cable set top box combined with a digital video recorder ("STB/DVR") **110**, a DVD player **108**, and an AV receiver **120**. While illustrated in the context of a television **106**, STB/DVR **110**, a DVD player **108**, and an AV receiver **120**, it is to be understood that controllable appliances may include, but need not be limited to, televisions, VCRs, DVRs, DVD players, cable or satellite converter set-top boxes ("STBs"), amplifiers, CD players, game consoles, home lighting, drapery, fans, HVAC systems, thermostats, personal computers, etc. In the illustrative example of FIG. **1**, appliance commands may be issued by UCE **100** in response to infrared ("IR") request signals **116** received from a remote control device **102**, radio frequency ("RF") request signals **118** received from an app **124** resident on a smart device **104**, or any other device from which UCE **100** may be adapted to receive requests, using any appropriate communication method. As illustrated, transmission of the requested appliance commands from the UCE to appliances **106**,**108**,**112**,**120** may take the form of wireless IR signals **114** or CEC commands issued over a wired HDMI interface **112**, as appropriate to the capabilities of the particular appliance to which each command may be directed. In particular, in the exemplary system illustrated, AV receiver **120** may not support HDMI inputs, being connected to audio source appliances **108**,**110** via, for example S/PDIF interfaces **122**. Accordingly UCE **100** may be constrained to transmit all commands destined for AV receiver **120** exclusively as IR signals, while commands destined for the other appliances **106** through **110** may take the form of either CEC or IR signals as appropriate for each command. By way of example without limitation, certain TV manufacturers may elect not to support volume adjustment via CEC. If the illustrative TV **106** is of such manufacture, UCE **100** may relay volume adjustment requests to TV **106** as IR signals **114**, while other requests such as power on/off or input selections may be relayed in the form of CEC commands over HDMI connection **112**.

It will however be appreciated that while illustrated in the context of IR, RF, and wired CEC signal transmissions, in general, transmissions to and from UCE device **100** may take the form of any convenient IR, RF, hardwired, point-to-point, or networked protocol, as necessary for a particular embodiment. Further, while wireless communications **116**, **118**, etc., between exemplary devices are illustrated herein as direct links, it should be appreciated that in some instances such communication may take place via a local area network or personal area network, and as such may involve various intermediary devices such as routers, bridges, access points, etc. Since these items are not necessary for an understanding of the instant invention, they are omitted from this and subsequent Figures for the sake of clarity.

Since smart device remote control apps such as that contemplated in the illustrative device **104** are well known, for the sake of brevity the operation, features, and functions thereof will not be described in detail herein. Nevertheless, if a more complete understanding of the nature of such apps is desired, the interested reader may turn to, for example, the before mentioned U.S. patent application Ser. No. 12/406,601 or U.S. patent application Ser. No. 13/329,940, entitled "Graphical User Interface and Data Transfer Methods in a Controlling Device," both of common ownership and incorporated herein by reference in their entirety.

Turning now to FIG. **2**, in a further illustrative embodiment, UCE **100** may receive wireless request signals from a remote control **200** and/or an app resident on a tablet computer **202**. As before, command transmissions to appliances **106**,**108**,**110** may take the form of wired CEC commands or wireless IR commands. However, in this example remote control **200** may be in bi-directional communication **208** with UCE **100** and accordingly the UCE may delegate the transmission of IR commands **210** to the remote control device **200**, i.e., use remote control **200** as a relay device for those commands determined to be best executed via IR transmissions. As also generally illustrated in FIG. **2**, a setup app **214** executing on a smart device such as tablet computer **202** may be utilized in conjunction with an Internet (**212**, **204**) accessible server **206** and associated database **207** to initially configure UCE **100** for operation with the specific group of appliances to be controlled, i.e., to communicate to UCE **100** a matching command code set and capability profile for each particular appliance to be controlled, for example based on type, manufacture, model number, etc., as will be described in greater detail hereafter.

With reference to FIG. **3**, in a yet further illustrative embodiment UCE functionality **100'** may be embedded in an appliance, for example STB/DVR **310**. In this example, remote control **102** and/or smart device **104** may transmit wireless request signals directly to STB/DVR **310** for action by the built-in UCE function **100'**, which actions may, as before, comprise CEC command transmissions via HDMI connection **112** or IR command transmissions **114**, originating in this instance from an IR blaster provisioned to the

STB/DVR appliance **310**. In this configuration, a set up application resident in STB/DVR **310** may be utilized to configure UEC **100'**, using for example an Internet connection **304** accessible through a cable modem and/or cable distribution system headend.

In the further illustrative embodiment of FIG. **4**, UCE functionality **100'** may be embedded in an AV receiver **420** which may serve as an HDMI switch between various content sources such as a STB/DVR **110** or a DVD player **108** and a rendering device such as TV **106**. In addition to HDMI inputs, AV receiver **420** may also support various other input formats, for example analog inputs such as the illustrative **404** from CD player **408**; composite or component video; S/PDIF coaxial or fiberoptic; etc. In this embodiment, request signals **406** may be directed to AV receiver **420**, for example from remote control **402**, for action by UCE function **100'**. As before, resulting appliance commands may be transmitted using CEC signals transmitted over HDMI connections **112**, or via IR signals **114** transmitted from an associated IR blaster. As appropriate for a particular embodiment, initial configuration of UCE **100'** to match the equipment to be controlled may be performed by an Internet-connected app resident in AV receiver **420**, or by an app resident in tablet computer **202** or other smart device, as mentioned previously in conjunction with FIG. **2**.

As will be appreciated, various other configurations are also possible without departing from the underlying UCE concept, for example UCE function **100'** may be incorporated into an Internet-capable TV, an HDMI switch, a game console, etc.; appliance command set and capability database **207** may be located at a cable system headend, may be stored locally (in all or in part), which local storage may take the form of internal memory within the UCE itself or in an appliance such as a TV, STB or AV receiver, or may take the form of a memory stick or the like attachable to a smart device or appliance; etc.

With reference to FIG. **5**, an exemplary UCE device **100** (whether stand alone or an appliance supporting UCE functionality) may include, as needed for a particular application, a processor **500** coupled to a memory **502** which memory may comprise a combination of ROM memory, RAM memory, and/or non-volatile read/write memory and may take the form of a chip, a hard disk, a magnetic disk, an optical disk, a memory stick, etc., or any combination thereof. It will also be appreciated that some or all of the illustrated memory may be physically incorporated within the same IC chip as the processor **500** (a so called "microcontroller") and, as such, it is shown separately in FIG. **5** only for the sake of clarity. Interface hardware provisioned as part of the exemplary UCE platform may include IR receiver circuitry **504** and IR transmitter circuitry **506**; an HDMI interface **508**; a WiFi transceiver and interface **510**; an Ethernet interface **512**; and any other wired or wireless I/O interface(s) **514** as appropriate for a particular embodiment, by way of example without limitation Bluetooth, RF4CE, USB, Zigbee, Zensys, X10/Insteon, HomePlug, HomePNA, etc. The electronic components comprising the exemplary UCE device **100** may be powered by an external power source **516**. In the case of a standalone UCE device such as illustrated in FIG. **1** or **2**, this may comprise for example a compact AC adapter "wall wart," while integrated UCE devices such as illustrated in FIG. **3** or **4** may draw operating power from the appliance into which they are integrated. It will also be appreciated that in the latter case, in certain embodiments processor **500** and/or memory **502** and/or certain portions of interface hardware items **504** through **514** may be shared with other functionalities of the host appliance.

As will be understood by those skilled in the art, some or all of the memory **502** may include executable instructions that are intended to be executed by the processor **500** to control the operation of the UCE device **100** (collectively, the UCE programming) as well as data which serves to define the necessary control protocols and command values for use in transmitting command signals to controllable appliances (collectively, the command data). In this manner, the processor **500** may be programmed to control the various electronic components within the exemplary UCE device **100**, e.g., to monitor the communication means **504**,**510** for incoming request messages from controlling devices, to cause the transmission of appliance command signals, etc. To cause the UCE device **100** to perform an action, the UCE device **100** may be adapted to be responsive to events, such as a received request message from remote control **102** or smart device **104**, changes in connected appliance status reported over HDMI interface **508**, WiFi interface **510**, or Ethernet interface **512**, etc. In response to an event, appropriate instructions within the UCE programming may be executed. For example, when a command request is received from a smart phone **104**, the UCE device **100** may retrieve from the command data stored in memory **502** a preferred command transmission medium (e.g., IR, CEC over HDMI, IP over WiFi, etc.) and a corresponding command value and control protocol to be used in transmitting that command to an intended target appliance, e.g., TV **106**, in a format recognizable by that appliance to thereby control one or more functional operations of that appliance. By way of further example, the status of connected appliances, e.g., powered or not powered, currently selected input, playing or paused, etc., as may be discerned from interfaces **508** through **514**, may be monitored and/or tabulated by the UCE programming in order to facilitate adjustment of appliance settings to match user-defined activity profiles, e.g. "Watch TV", "View a movie", etc.

An overview of an exemplary UCE control environment is presented in FIG. **6**. The UCE programming of an exemplary UCE device **100** may comprise a universal control engine core **650** together with a series of scalable software modules **652** through **660**, each module supporting a particular appliance command protocol or method and provisioned as appropriate for a particular embodiment. By way of example, the illustrative embodiment of FIG. **6** may include an internet protocol (IP) module **652**, a CEC over HDMI module **654**, a Bluetooth module **656**, an IR module **660**, and other modules(s) **658**, as appropriate for the particular application. The appliances to be controlled may include an IP enabled AV receiver **620**, an IP enabled STB/DVR **610**, TV **106**, DVD player **108**, and CD player **408**. As illustrated, certain of these devices may be interconnected via HDMI **112** and/or Ethernet **670** interfaces. (In this regard, it should be appreciated that the illustrative interconnections **112** and **670** of FIG. **6** are intended to depict logical topography only, and accordingly details of exact physical cabling structure and/or the presence of any necessary switches, routers, hubs, repeaters, interconnections, etc., are omitted for the sake of clarity.)

The preferred method/protocol/medium for issuance of commands to the exemplary appliances of FIG. **6** may vary by both appliance and by the function to be performed. By way of example, volume control and analog input selection commands **622** targeted to AV receiver **620** may be required to be issued via IR transmissions, while power on/off and

HDMI input selection functionality commands **624** may be better communicated via CEC commands and advanced functionality commands **626** such as sound field configuration may be best communicated via an Ethernet connection. In a similar manner, the various operational functions of the other appliances may best commanded via a mixture of mediums, methods, and protocols, as illustrated. As will be appreciated, in some instances a particular appliance may support receipt of an operational command via more than one path, for example the power on/off function of AV receiver **620** may be available not only as a CEC command, but also via an IR command. In such instances, the UCE preferred command format may be that which has been determined to offer the greatest reliability, for example in the above instance the CEC command may be preferred since this form of command is not dependent on line-of-sight and also permits confirmation that the action has been performed by the target appliance.

In order to determine the optimum method for each configured appliance type and command, the exemplary UCE core program **650** may be provisioned with a preferred command matrix **700**, as illustrated in FIG. **7**. Exemplary preferred command matrix **700** may comprise a series of data cells or elements, e.g. cells **712**, each corresponding to a specific command **702** and a specific one of the appliances to be controlled **704**. The data content of such a cell or element may comprise identification of a form of command/transmission to be used and a pointer to the required data value and formatting information for the specific command. By way of example, the data element **712** corresponding to the "Input 2" command **706** for the configured TV appliance **708**, may comprise an indicator that a CEC command is to be used, i.e., an indicator of the transmission device that is to be used to communicate the command to the intended target appliance, together with a pointer to the appropriate command data value and HDMI-CEC bus address; while data element **714** corresponding to the same command function for the configured AV receiver **710** may comprise an indicator that an IR command is to be used, together with a pointer to appropriate command data and formatting information within an IR code library stored elsewhere in UCE memory **502** . In certain embodiments one or more secondary command matrices **716** may also be provisioned, allowing for the use of alternate command methods in the event it is determined by the UCE programming that a preferred command was unsuccessful. Command matrix **700** may also contain null entries, for example **718**, where a particular function is not available on or not supported by a specific appliance. In an exemplary embodiment, command matrix **700** may be created and loaded into the memory **502** of UCE **100** during an initialization and set-up process, as will now be described in further detail.

In order to perform initial configuration of a UCE device, a setup application may be provided. In some embodiments, such a set up application may take the form of programming to be executed on any convenient device with a suitable user interface and capable of establishing communication with the UCE, such as without limitation a smart phone, tablet computer, personal computer, set top box, TV, etc., as appropriate for a particular embodiment. In other embodiments such a set up application may be incorporated into the UCE programming itself, utilizing for example a connected TV screen and an associated controlling device as the user interface. Regardless of the exact form and location of the programming and user interface means, the series of steps which may be performed by a UCE set up application when configuring a UCE device for operation with a specific set of appliances remains similar. Accordingly, it will be appreciated that the methods comprising the illustrative UCE set up application presented below in conjunction with FIGS. **8** and **9** may be generally applied, mutatis mutandis, to various alternative set up application embodiments.

With reference to FIG. **8**, as known in the art a tablet computer such as the exemplary device **202** of FIG. **2** may comprise, as needed for a particular application, a processor **800** memory **802** which memory may comprise a combination of ROM memory, RAM memory, and/or non-volatile read/write memory and may take the form of a chip, a hard disk, a magnetic disk, an optical disk, a memory stick, etc., or any combination thereof. In some embodiments, provision may also be made for attachment of external memory **804** which may take the form of an SD card, memory stick, or the like. Hardware provisioned as part of an exemplary tablet computer platform may include an LCD touchscreen **810** with associated display driver **806** and touch interface **808**; hard keys **812** such as for example a power on/off key; a USB port **816**; WiFi transceiver and interface **818**; a Bluetooth transceiver and interface **820**; a camera **822**; and various other features **824** as appropriate for a particular embodiment, for example an accelerometer, GPS, ambient light sensor, near field communicator; etc. The electronic components comprising the exemplary tablet computer device **202** may be powered by a battery-based internal power source **814**, rechargeable for example via USB interface **816**.

Memory **802** may include executable instructions that are intended to be executed by the processor **800** to control the operation of the tablet computer device **202** and to implement various functionalities such as Web browsing, game playing, video streaming, etc. As is known in the art, programming comprising additional functionalities (referred to as "apps") may be downloaded into tablet computer **202** via, for example, WiFi interface **818**, USB **816**, external memory **804**, or any other convenient method. As discussed previously, one such app may comprise a remote control app, for example as that described in co-pending U.S. patent application Ser. No. 13/329,940 of like assignee and incorporated herein by reference in its entirety, which app may be for use in commanding the operation of appliances **106**, **108**, **110** and/or **120** via UCE device **100**. In order to initially configure UCE device **100** to match the appliances to be controlled and to establish an appropriate command matrix, tablet computer **202** may also be provisioned with a setup app **214**, either as part of a remote control app or as separately downloadable item.

With reference now to FIG. **9** such a setup app, upon being invoked at step **902** may initially request that the user place all of the appliances to be controlled into a known state, e.g., powered on, in order to enable the appliance detection and/or testing steps which follow. Next, at step **904** the setup app may determine the identity of those appliances which are CEC-enabled. This may be accomplished by communicating a request to the associated UCE, which at step **906** which may cause the UCE programming to scan connected HDMI devices for appliances which are CEC-enabled and/or identifiable via interaction over the HDMI interface, for example as described in co-pending U.S. patent application Ser. No. 13/198,072, of like assignee and incorporated herein by reference in its entirety, and communicate such appliance identities to the setup application. Thereafter, at step **904** the setup application may determine if additional non-CEC appliances are connected to the UCE device via the HDMI interface. This may be accomplished by requesting the UCE programming to scan for any further

HDMI connections at step **910** and communicate the findings back to the setup application. Though not illustrated, it will be appreciated that where appropriate for a particular embodiment the UCE programming may conduct similar scans to in order to discover appliances connected via Ethernet, USB, Bluetooth, RF4CE, WiFi etc., where such interfaces may be provisioned to a UCE.

Thereafter, at step **912** the setup application may display a listing of detected appliances (both identified and not yet identified) to the user. At step **914**, the user may be prompted to enter appliance identifying information for those HDMI or otherwise connected appliances which were detected but not identified, as well as identifying information regarding any additional appliances which may form part of the system to be controlled but are not discoverable as described above (for example appliances such as AV receiver **120** or CD player **408** which may be responsive only to unidirectional IR commands). Without limitation, such identifying information may take the form of user-entered data such as an appliance type, brand and model number, or a setup code from a listing in a user guide; or may take the form of scanned or electronic information such as a digital picture of the appliance itself or of a bar code, QR code, or the like associated with appliance; near field acquisition of RFID tag data; etc.; or any combination thereof as appropriate for a particular embodiment.

Once appropriate identifying information has been acquired, at step **916** the setup app may communicate that information to a database server, for example server **206**, for performance of step **918**, comprising identification of and retrieval of command codeset and capability data corresponding to the identified appliances from a database **207**, and provision of this data to the setup application for processing and ultimate transfer to the UCE device. As will be appreciated, the transferred codeset data may comprise complete command data values and formatting information, may comprise pointers to command data values and formatting information already stored in the memories **502** and/or **802**/**804** of the UCE or the device upon which the setup application is currently resident, or a combination thereof. Where necessary, for example when database **207** may contain alternate codesets for an identified appliance, or where uncertainty exists regarding a particular appliance model number, etc., at steps **920**, **922**, and **924** various control paradigms and/or command data sets may be tested against the appliances to be controlled. Such testing may take the form of soliciting user response to effects observable commands, monitoring of HDMI interface status changes as described for example in U.S. patent application Ser. No. 13/240,604, of like assignee and incorporated herein by reference in its entirety, or any other method as convenient for a particular application. Once appropriate codesets have been fully determined, at steps **926**,**928** and **930** a suitable preferred command matrix, for example as illustrated in FIG. **7**, may be constructed and stored into the memory **502** of exemplary UCE device **100**, the matrix being constructed by considering the communication capabilities and functionalities of the devices identified via the above-described processes.

In order to select the optimum command method for each function of each configured appliance any suitable method may be utilized, for example a system-wide prioritization of command media and methods by desirability (e.g. apply IP, CEC, IR in descending order); appliance-specific command maps by brand and/or model; function-specific preference and/or priority maps (e.g. all volume function commands via IR where available); etc.; or any combination thereof. The exact selection of command method priorities or mapping may take into account factors such connection reliability, e.g. wired versus wireless, bidirectional versus unidirectional communication, etc.; speed of command transmission or execution; internal priorities within an appliance, e.g. received IP received packets processed before CEC packets, etc.; type of protocol support (e.g. error correction versus error detection; ack/nak, etc.); or any other factors which may applied in order to achieve optimum performance of a particular embodiment.

As will be appreciated, the construction of said preferred command matrix may be performed at the database server or within the setup application, or a combination thereof, depending on the particular embodiment. Once a preferred command matrix has been finalized and stored in the UCE device, at step **932** a series of desired appliance configurations associated with specific user activities may be configured and stored into the UCE device, as will be now be described.

Upon completion and storage of a preferred command matrix, an exemplary setup application may subsequently guide a user through a series of steps in order to establish the desired appliance configurations for a series of possible activities. With reference to FIG. **10**, at step **1002**, the user may be presented with a list of possible activities, e.g., "Watch TV", "Watch a movie", "Listen to music", etc. In some embodiments, the user may also be able to edit activity titles and/or create additional user defined activities. At step **1004** a user may select a particular activity for configuration, for example "Watch TV". At step **1006**, the user may be prompted to identify the content source for the activity being configured, for example cable STB/DVR **110** for the exemplary "Watch TV" activity. Such a prompt may take the form of a listing of eligible appliances as determined during the foregoing appliance set up steps; explicit user entry of an appliance type; etc. Next, at steps **1008** the user may be prompted in a similar manner to select video and audio rendering appliances for use in this activity, for example TV **106** and AVR receiver **120** respectively. Depending upon the system topography and the interfaces in use (i.e. HDMI/CEC, IP, analog, etc.) the set up application in concert with UCE programming may be able to ascertain which input port of each rendering appliance is attached to the content source appliance identified for this activity and/or if any intermediate switching appliance is in use (for example AV receiver **420** of the system illustrated in FIG. **4**). Where such information is obtainable, the set up application may automatically create all or part of an appropriate rendering device input selection for the activity being configured. If not, at steps **1008** and **1010**, the user may be additionally requested to identify the applicable content route(s) to the rendering appliances, e.g., input port numbers, presence of intermediate switches, etc. During or upon conclusion of steps **1004** through **1010**, the set up application may construct an activity matrix, for example as illustrated in FIG. **11**. By way of example, activity matrix **1100** for a "Watch TV" activity may comprise a series of cells, for example **1110** or **1112**, each corresponding to a desired configuration of a particular state **1106** or function **1108** of a specific appliance **1104** during the specified activity. By way of example, cell **1110** may indicate that the input of AV receiver **120** is to be set to "S/PDIF2", while cells **1112** and **1114** may indicate that transport function commands (e.g., "play", "pause", "fast forward" etc.) are to be directed to STB/DVR **110** and not to DVD **114**. In this regard, it will be appreciated that while in some embodiments the assignment of functions such as, for example, volume control, to specific appliances

during a particular activity may be performed within an individual controlling device, i.e., the controlling device may determine the appliance to which volume control commands are to be directed, in a preferred embodiment this assignment may be performed within the UCE, thereby ensuring consistency across each activity when multiple controlling devices are present in an environment, for example devices **102** and **104** of the environment illustrated in FIG. **1**.

Returning now to FIG. **10**, at steps **1014** and **1016** the newly-constructed activity matrix **1100** may be tested by causing the UCE programming, utilizing preferred command matrix **700**, to issue the commands necessary to place the identified appliances into the desired state and thereafter receiving verification at step **1018** that the desired activity was successfully initiated. It will be appreciated that such verification may comprise, for example, detection and reporting of HDMI or other content streams and/or appliance status by UCE programming by directly monitoring CEC status or by using methods such as described for example in U.S. patent application Ser. No. 13/240,604; solicitation of user input confirming correct operation; monitoring for presence or absence of analog input signals; recording of appliance status or error messages; etc.; or any combination thereof as appropriate for a particular embodiment.

If testing is unsuccessful, at step **1018** the set up application may return to step **1002** to allow reconfiguration of that activity and/or definition of alternative activities. If testing was successful, at steps **1020** and **1022** the completed activity matrix, for example **1100** as illustrated in FIG. **11**, may be transferred to the UCE **100** for storage in UCE memory **502**. Thereafter, at step **1024** the user may be offered the opportunity to return to step **1002** to define additional activity configurations, for example **1101**,**1102** as illustrated in FIG. **11**, or to exit the activity configuration process.

With reference now to FIG. **13**, the series of steps performed by the UCE programming in order to convey a function command to an appliance in accordance with a command request **1300** received from a controlling device such as remote control **102** or **200**, smart device **104** or **202**, etc., or in accordance with an internally generated requirement resulting from receipt of an activity request (as will be described hereafter) may initially comprise retrieval from a preferred command matrix that data element which corresponds to the requested command and target appliance. By way of specific example, receipt of a "TV power on" request from remote control **102** or the like at a UEC provisioned with the preferred command matrices illustrated in FIG. **7** may cause retrieval of data element **720**, indicating that the command is to be communicated to the TV appliance, e.g., television **106**, using an HDMI CEC command. At step **1304**, the UCE programming may determine if the retrieved value constitutes a null element. If so, the referenced appliance does not support the requested command and accordingly at step **1314** an error message may be generated and the process thereafter terminated. As will be appreciated, the exact nature of such an error message may depend upon the particular embodiment and/or the requesting controlling device: for example, if the request originated from a controlling device which is in bidirectional communication with the UCE the error may be communicated back to the requesting device for action, i.e., display to the user, illuminate a LED, activate a buzzer, etc. as appropriate. Alternatively, in those embodiments where a UCE is incorporated into an appliance, that appliance's front panel display may be utilized.

If the retrieved preferred command matrix element data is valid, at step **1306** the UCE may communicate the corresponding function command to the target appliance using the indicated command value and transmission method, e.g., for the exemplary data element **720** this may comprise issuing a CEC "power on" command to CEC logical device address zero (TV) via the UCE HDMI interface **508**. Once the command has been issued, at step **1308** the UCE programming may determine if the communication interface and protocol used in issuing the command provides for any confirmation mechanism, i.e., explicit acknowledgement of receipt, monitoring of HDMI status on an interface, detection of a media stream or HDCP handshake, etc. If not, for example the command was issued using a unidirectional IR signal and no other confirmation means such as power or input signal monitoring is available, the UCE programming may simply assume that the command was successful and processing is complete. If however confirmation means exists, at step **1310** the UCE programming may wait to determine if the command was successfully executed. Once positive confirmation is received, processing is complete. If no confirmation or a negative confirmation is received, at step **1312** the UCE programming may determine if an alternative method is available to communicate the command to the target appliance. Returning to the specific example presented above this may comprise accessing a secondary command matrix **716** in order to determine if an alternative communication method is available for the specific function, e.g., "TV power on." If an alternative does exist, at step **1316** the substitute command value and transmission method may be retrieved and processing may return to step **1306** to initiate an alternative attempt. Returning again to the specific example, if the CEC "power on" command corresponding to data element **720** of matrix **700** issued to TV **106** cannot be confirmed, an IR "power on" command encoded according to SIRCS (Sony Infrared Control System) in correspondence with the equivalent data element in secondary matrix **716** may be attempted as a substitute.

In addition to relaying individual command requests as described above, an exemplary UCE may also support activity selection, whereby receipt of a single user request from a controlling device may cause a series of commands to be issued to various appliances in order to configure a system appropriately for a particular user activity, such as for example, watching television. To this end a set of matrices defining desired equipment states suitable to various activities, for example as illustrated at **1100** through **1102** of FIG. **11**, may be stored in UCE memory **502** for access by UCE programming when executing such a request. As illustrated in FIG. **12**, in some embodiments the programming of an exemplary UCE may maintain an additional matrix **1200** representative of the current state of the controlled appliances, arranged for example by appliance **1202** and by operational state **1204**. By way of example, data elements **1206** and **1208** in the illustrative table **1200** may indicate that TV **106** is currently powered on (**1208**) with HDMI port number 2 selected as the input (**1206**). The data contents of the elements in such a table may be maintained in any convenient manner as appropriate to a particular embodiment, for example without limitation retrieval of HDMI/CEC status; monitoring input media streams and/or HDCP status; measuring power consumption; construction of a simulated appliance state such as described for example

in U.S. Pat. No. 6,784,805; etc.; or any combination thereof. In the case of certain appliances, such as for example AV receiver **120** which may be controllable only via unidirectional IR, the current state of the appliance may not be discernible. In such cases, a null data element **1210** maybe entered into exemplary matrix **1200** to indicate that this appliance may require configuration using discrete commands only and/or user interaction. As will be appreciated, in some embodiments the data contents of the illustrative table may be maintained in memory **502** on an ongoing basis by UCE programming, while in other embodiments this data may be gathered "on the fly" at the time the activity request is being processed. Combinations of these methods may also be used, for example "on the fly" gathering for appliances connected via an HDMI bus combined with maintenance of a simulated state for appliances controlled via IR signals.

In order to configure a group of appliances for a desired activity, UCE programming may compare a desired state matrix, for example **1100**, to a current state matrix, for example **1200**, element by element, issuing commands as necessary to bring appliances to the desired state. By way of example, an exemplary series of steps which may be performed by the programming of a UCE in order to effect a "Watch TV" activity configuration will now be presented in conjunction with FIG. **14**. For the purposes of this example, the reader may also wish to reference the equipment configuration of FIG. **1** and the activity and current state matrices **1100** and **1200** of FIGS. **11** and **12**.

Upon receipt of a "Watch TV" request **1400**, at step **1402** the exemplary UCE programming may access an applicable appliance state matrix **1100**. Next, at step **1404** it may be determined by the UCE programming whether the present "power" state of TV **106** as indicated by current state matrix **1200** matches the desired state stored in the corresponding data element of matrix **1100**. If the states match, processing may continue at step **1408**. If the states do not match, at step **1406** a "power on" command may be communicated to TV **106**. As will be appreciated from the earlier discussion in conjunction with FIG. **13** and inspection of exemplary preferred command matrix **700**, in the illustrative system communication of the "power on" command to TV **106** may comprise a CEC command issued over HDMI connection **112**. Next, at step **1408** a "mute" command may be communicated to TV **106**, since element **1116** of illustrative matrix **1100** indicates that TV **106** is not the primary audio rendering appliance. In accordance with preferred command matrix **700**, communication of the "mute" command to TV **106** may comprise an IR transmission **114**. Thereafter, at steps **1410**,**1412** the active input of TV **106** may be set to "HDMI1" via a CEC command, and at steps **1414**,**1416** a CEC "power on" command may be communicated to STB/DVR **110** if that appliance is not already powered on. At step **1418**, the exemplary UCE programming may set an internal status to indicate that future transport command requests (e.g., play, pause, FF, etc.) should be routed to STB/DVR **110**, as indicated by element **1112** of matrix **1100**. Thereafter, at steps **1420**,**1422** a CEC "power off" command may be communicated to STB/DVR **108** if that appliance is not already powered off. Thereafter, at steps **1424** and **1426** "power on" and "input S/PDIF2" commands may be communicated to AV receiver **120** via IR signals. As will be appreciated, it may not be possible to determine the current status of AV receiver **120**, as indicated for example by elements **1210** and **1220** of matrix **1200**, and accordingly so-called "discrete," or explicit, function commands may be issued which may establish the desired status regardless of the current state of the appliance. Finally, at step **1428** the exemplary UCE programming may set an internal status to indicate that future volume control command requests (e.g. volume up/down, mute) should be routed to AV receiver **120**, as indicated by element **1118** of matrix **1100**, whereafter processing of the activity request is complete.

While various concepts have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those concepts could be developed in light of the overall teachings of the disclosure. For example, in an alternate embodiment of UCE functionality, in place of a preferred command matrix such as illustrated in FIG. **7**, the programming of an exemplary UCE may utilize a command prioritization list, for example a prioritization list "IP, CEC, IR" may cause the UCE programming to first determine if the requested command can be issued using Internet Protocol, only if not, then determine if the requested command can be issued using a CEC command over the HDMI interface, and only if not, then attempt to issue the requested command via an infrared signal. Such a prioritization reflects an exemplary preference of using bi-directional communication protocols over unidirectional communication protocols over line of sight communication protocols, e.g., IR, when supported by the intended target appliance.

Further, while described in the context of functional modules and illustrated using block diagram format, it is to be understood that, unless otherwise stated to the contrary, one or more of the described functions and/or features may be integrated in a single physical device and/or a software module, or one or more functions and/or features may be implemented in separate physical devices or software modules. It will also be appreciated that a detailed discussion of the actual implementation of each module is not necessary for an enabling understanding of the invention. Rather, the actual implementation of such modules would be well within the routine skill of an engineer, given the disclosure herein of the attributes, functionality, and inter-relationship of the various functional modules in the system. Therefore, a person skilled in the art, applying ordinary skill, will be able to practice the invention set forth in the claims without undue experimentation. It will be additionally appreciated that the particular concepts disclosed are meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

All patents cited within this document are hereby incorporated by reference in their entirety.

What is claimed is:

1. A universal control engine, comprising:

a processing device; and

a memory device having stored thereon instructions executable by the processing device, the instructions, when executed by the processing device, causing the universal control engine to respond to a detected presence of an intended target appliance within a logical topography of controllable appliances which includes the universal control engine by using an identity associated with the intended target appliance to create a listing comprised of at least a first communication method and a second communication method different than the first communication method for use in controlling each of at least a first functional operation and a second functional operation of the intended target appliance and to respond to a received request from a controlling device intended to cause the intended target appliance to perform a one of the first and second functional operations by causing a one of the first and

second communication methods in the listing of communication methods that has been associated with the requested one of the first and second functional operations to be used to transmit to the intended target appliance a command for controlling the requested one of the first and second functional operations of the intended target appliance.

2. The universal control engine as recited in claim **1**, wherein the instructions cause the universal control engine to respond to the request by causing a highest prioritized one of the first and second communication methods in the listing of communication methods that has been associated with the requested one of the first and second functional operations to be used to transmit to the intended target appliance a command for controlling the requested one of the first and second functional operations of the intended target appliance.

3. The universal control engine as recited in claim **1**, wherein the instructions cause the universal control engine to initiate a detection of the presence of the intended target appliance within the logical topography of controllable appliances.

4. The universal control engine as recited in claim **1**, wherein data obtained from a communication exchanged via use of a Bluetooth communication protocol is used by the universal control engine to detect the presence of the intended target appliance within the logical topography of controllable appliances.

5. The universal control engine as recited in claim **1**, wherein the instruction cause the universal control engine to cause a prompt to be displayed in a display associated with the universal control engine in response to a detected presence of the intended target appliance within a logical topography of controllable appliances, the prompt requesting a user to provide data indicative of the identity associated with the intended target appliance.

6. The universal control engine as recited in claim **2**, wherein the instructions cause the universal control engine to use at least one characteristic associated with each of the plurality of communication methods in the listing to prioritize the first and second communication methods in the listing.

7. The universal control engine as recited in claim **1**, wherein the instructions cause the universal control engine to initiate an interrogation of the intended target appliance to determine which of a plurality of communication methods are supported by the appliance for use in receiving a command for controlling at least one of the first and second functional operations and using results obtained from the interrogation to create the listing.

8. The universal control engine as recited in claim **1**, wherein the instructions cause the universal control engine to initiate a transmission of a test communication for controlling at least one of the first and second functional operations of the intended target appliance via use of at least one test communication method and to cause the universal control engine to omit the at least one test communication method from the listing of communication methods for use in controlling the at least one of the first and second plurality of functional operations of the intended target appliance when the at least one test communication method fails to elicit a performance by the intended target appliance of the at least one of the first and second functional operations.

* * * * *

EXHIBIT E

US007782309B2

(12) **United States Patent**
Janik

(10) **Patent No.: US 7,782,309 B2**
(45) **Date of Patent: *Aug. 24, 2010**

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

(75) Inventor: **Craig M. Janik**, Los Altos Hills, CA (US)

(73) Assignee: **Universal Electronics Inc.**, Cypress, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 155 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/103,895**

(22) Filed: **Apr. 16, 2008**

(65) **Prior Publication Data**

US 2008/0191898 A1 Aug. 14, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.** **345/173**; 348/734

(58) **Field of Classification Search** 345/173, 345/156, 169; 348/14.02, 14.03, 14.05, 734; 340/5.61, 825.22; 715/700, 717; 178/18.01; 341/176; 386/83
See application file for complete search history.

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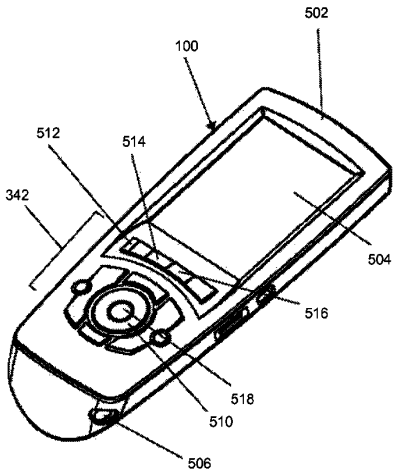
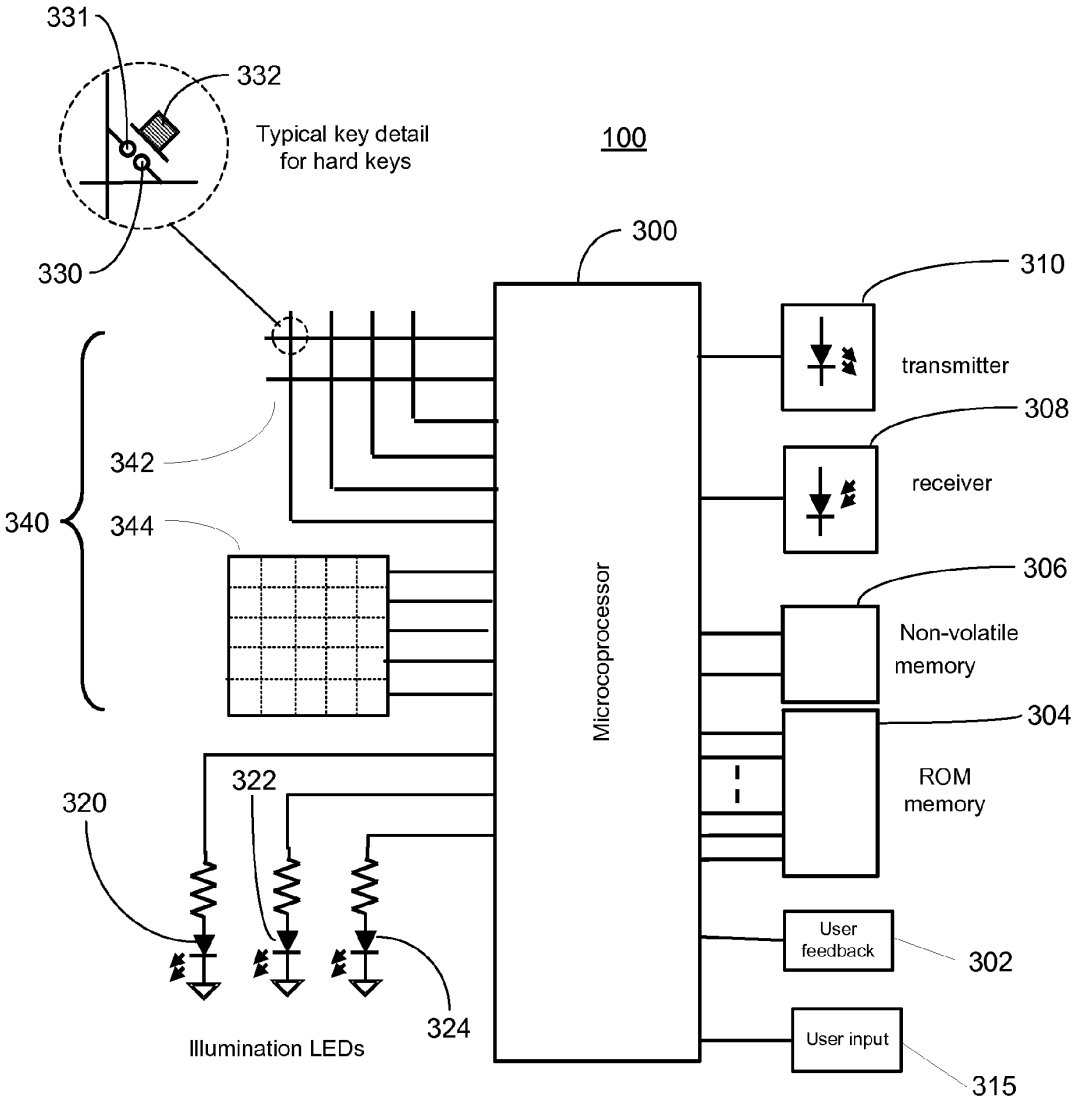
(57) **ABSTRACT**

A universal controlling device having a touch-sensitive display. The display provides one or more graphical user interfaces comprised of graphical user interface icons that are selectable via the touch-sensitive display and the display accepts motions made by a stylus or finger in contact with the touch-sensitive display. The different interactions with the touch-sensitive display are used to cause the transmission of respective data to one or more appliances.

8 Claims, 4 Drawing Sheets




331
332
Typical key detail
for hard keys
100
330
300
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transmitter
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receiver
342
340
344
306
Non-volatile
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ROM
memory
Microcoprocessor
322
320
User
feedback
302
User input
315
324
Illumination LEDs

FIGURE 1

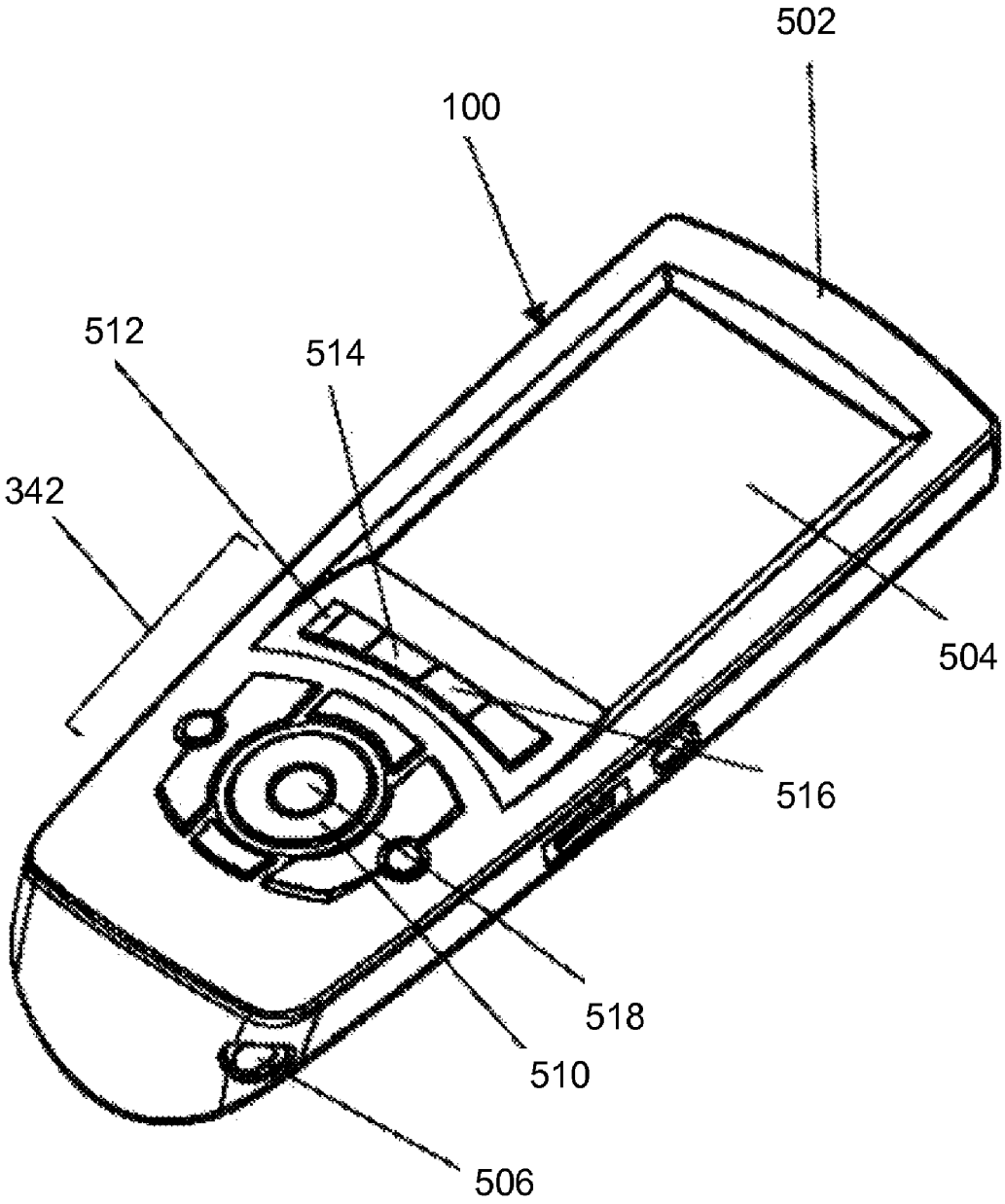


FIGURE 2

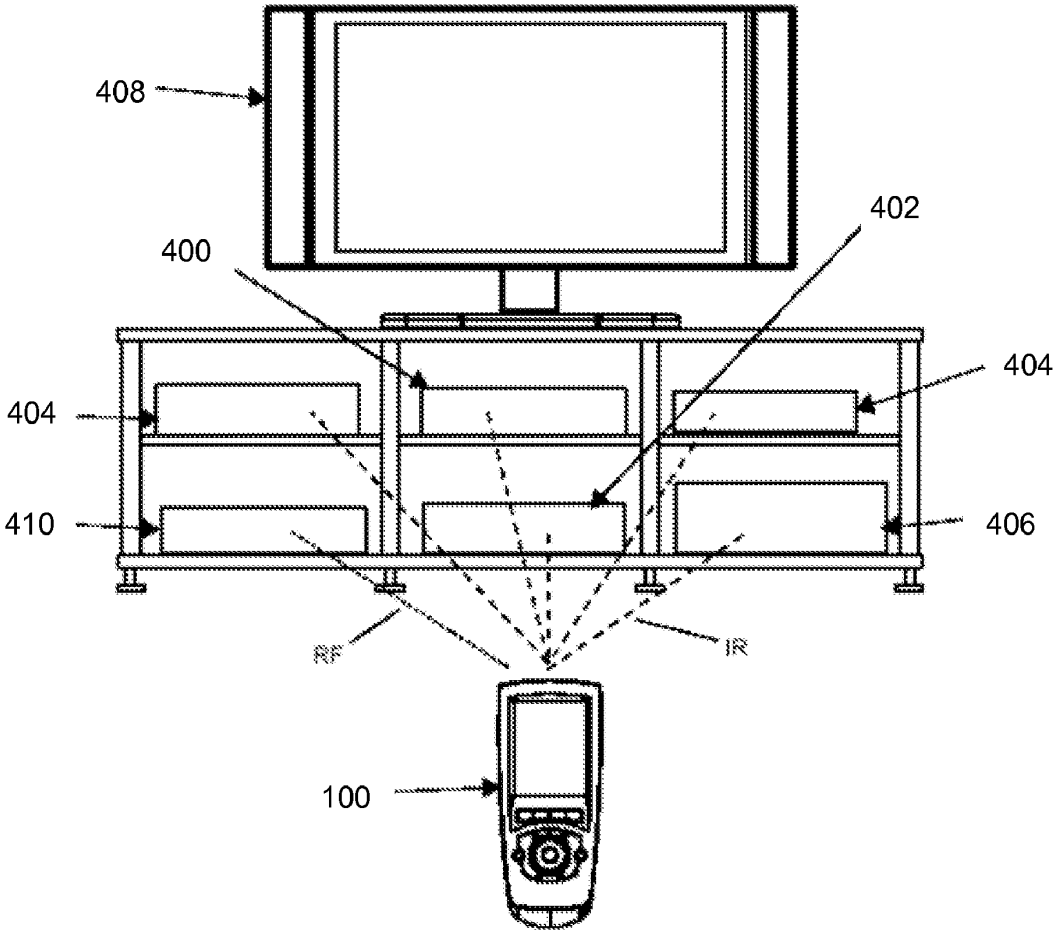


FIGURE 3

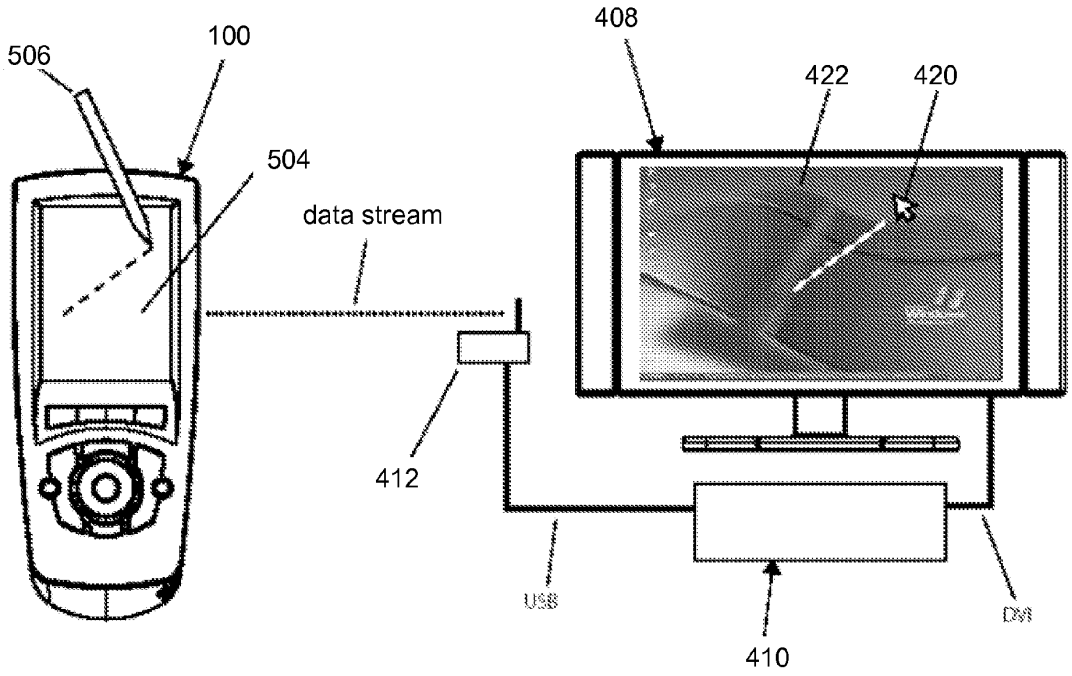


FIGURE 4

CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY

RELATED APPLICATION DATA

This application claims the benefit of and is a continuation of U.S. application Ser. No. 11/290,358, filed on Nov. 30, 2005, which, in turn, claims the benefit of U.S. Application No. 60/634,680, filed on Dec. 9, 2004.

BACKGROUND

The following relates generally to controlling devices and, more particularly, to a controlling device having a dual-mode, touch-sensitive display.

Manufacturers typically provide a controlling device with an appliance and, as such, different appliance types of different manufacturers are often commanded with different controlling devices, also referred to as "remote controls." To minimize the number of individual controlling devices a user requires, universal controlling devices have been developed. Accordingly, universal controlling devices for commanding various operational functions of various types of appliances of various manufacturers have become quite widespread. By way of example, universal controlling devices are described in commonly assigned U.S. Pat. Nos. 4,959,810, 5,255,313 and 5,552,917.

For selecting which of multiple appliances a universal controlling device is to command, a universal controlling device may allow a user to place, i.e., configure, the universal controlling device into an operational mode whereby the function keys will be used to transmit commands to a "primary" target appliance that has been associated with that operational mode. For example, a "TV" operational mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated television, a "VCR" mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated VCR, etc. A universal controlling device may also be provided with an ability to be configured in a "home theater" operational mode (i.e., one established to facilitate a particular activity), a "user" operational mode (i.e., one established for a particular user), a "room" operational mode (i.e., one established for a particular room), or the like (collectively referred to hereinafter as a "home theater" operational mode). In a "home theater" operation mode, the universal controlling device will generally be adapted to command multiple target appliances. For example, a "home theater" mode may be established whereby volume function keys are used to transmit volume control commands to an amplifier, transport function keys are used to transmit transport control commands to a VCR, channel function keys are used to transmit channel control commands to a cable box, picture control function keys are used to transmit picture control commands to a television, etc.

In the case of universal controlling device having a display, various function keys, such as those appropriate for the various operational modes, are typically presented to a user in multiple, different user interfaces each comprising one or more displayed soft keys. For example, commonly assigned U.S. Published Patent Application No. 2003/0103088 (Ser. No. 10/288,727) discloses a universal controlling device application for use in connection with a hand-held device having a display, e.g., a personal digital assistant ("PDA"), wherein the display is utilized to present the multiple, different user interfaces. While the use of a display advantageously allows a universal controlling device to present multiple, different user interfaces to allow for the command of operational functions of one or more appliances, what is needed is a universal controlling device wherein the display is further adapted to provide remote, cursor control functionality.

SUMMARY

In accordance with this and other needs, the following generally discloses a universal controlling device having a dual-mode, touch-sensitive display which is switchable between two operational modes. In one operational mode, the display provides one or more graphical user interfaces comprised of graphical user interface icons that are selectable to command operational functions of one or more appliances. In a second operational mode, the display provides pointer control where motions made by a stylus or finger in contact with the touch-sensitive display result in corresponding motions of a pointer on a display located remotely from the universal controlling device, such as a display connected with a personal computer, a TV, or the like.

A better appreciation of the objects, advantages, features, properties, and relationships of the disclosed controlling devices will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments which are indicative of the various ways in which the principles described hereinafter may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For use in better understanding the exemplary universal controlling device described hereinafter reference may be had to the following drawings in which:

FIG. **1** illustrates a block diagram of exemplary components of an exemplary universal controlling device;

FIG. **2** illustrates an isometric view of an exemplary universal controlling device constructed utilizing the components of FIG. **1**;

FIG. **3** illustrates an exemplary system environment in which the exemplary universal controlling device of FIG. **2** may be utilized; and

FIG. **4** illustrates an exemplary flow of data within the exemplary system environment of FIG. **3**.

DETAILED DESCRIPTION

The following discloses a controlling device **100** having a dual-mode, touch-sensitive face panel. In one operational mode of the controlling device **100**, the face panel is utilized to accept input to cause a transmission of at least one command to at least one appliance. In a second operational mode of the controlling device **100**, the face panel is utilized to accept input for the purpose of controlling a cursor or pointer on a larger, second device, such as a personal computer, television, or the like.

To provide the dual modes of operation, the controlling devices **100** may include, as needed for a particular application, a processor **300** coupled to a ROM memory **304**, a key matrix **340** (e.g., a touch-sensitive surface **344** placed over a liquid crystal display (LCD) alone or in combination with hard keys **342** (LCD)), transmission circuit(s) **310**, receiver circuit(s) **308** and/or transceiver circuit(s) (e.g., IR and/or RF), a non-volatile read/write memory **306**, a means **302** to provide feedback to the user (e.g., LED, display, speaker, and/or the like), a means **315** (such as a microphone, etc.) for receiving additional non-keypress input from the user, and means for providing visual and/or audio cues to the user, as

illustrated in FIG. **1**. The means for providing visual and/or audio cues to the user, to disseminate information to the user, may be embodied as key illumination means, a sound or voice synthesizer circuit, and/or a digital recording and playback circuit (e.g., to allow a user to playback sound or voice tags input via a microphone or otherwise downloaded into the controlling device). The key illumination means may be in the form of separate elements, such as LEDs **320**, **322**, and **324**, either directly associated with a hard key matrix **342**. In the case where the controlling device **100** includes hard keys, an exemplary molded-in key **332** is shown as operative with key matrix circuit **330**,**331**.

To control the operation of the controlling device **100**, the ROM memory **304** may include executable instructions that are intended to be executed by the processor **300**. In this manner, the processor **300** may be programmed to control the various electronic components within the remote control **100**, e.g., to monitor a power supply (not shown), to cause the transmission of signals, control the key illumination means **320**, **322**, and **324**, sound circuits, etc. The non-volatile read/write memory **306**, for example an EEPROM, battery-backed up RAM, Smart Card, memory stick, or the like, may be provided to store setup data and parameters as necessary. While the memory **304** is illustrated and described as a ROM memory, memory **304** can also be comprised of any type of readable media, such as ROM, RAM, SRAM, FLASH, EEPROM, or the like. Preferably, the memory **304** is non-volatile or battery-backed such that data is not required to be reloaded after battery changes. In addition, the memories **304** and **306** may take the form of a chip, a hard disk, a magnetic disk, and/or an optical disk.

To cause the controlling device **100** to perform an action, the controlling device **100** is adapted to be responsive to events, such as a sensed user interaction with the touch pad overlaying the key matrix **344**, interaction with the hard key matrix **342**, receipt of a transmission via receiver **308**, etc. In response to an event, appropriate instructions within the memory **304** may be executed. For example, when a function command key is activated on the controlling device **100**, the controlling device **100** may retrieve a command code corresponding to the activated function command key from memory **304** and transmit the command code to an intended target appliance in a format recognizable by that appliance.

It will be appreciated that the instructions within the memory **304** can be used not only to cause the transmission of command codes and/or data to the appliances, but also to perform local operations. While not limiting, local operations that may be performed by the controlling device **100** may include displaying information/data, favorite channel setup, macro key setup, function key relocation, user programming of favorite channel selections, etc. A further, local operation is the ability to "lock" function keys across device operational modes as described in previously referenced U.S. Published Patent Application No. 2003/0025840. Examples of still further local operations can be found in U.S. Pat. Nos. 5,481,256, 5,959,751, and 6,014,092.

For creating a correspondence between a command code and a function command key, data may be entered into the controlling device **100** that functions to identify an intended target appliances by its type and make (and sometimes model). Such data allows the controlling device **100** to transmit recognizable command codes in the format appropriate for such identified appliances. Typically, intended target appliances are identified for each operational mode of the controlling device **100**. Since methods for setting up a controlling device to command the operation of specific home appliances are well-known, such methods need not be described in greater detail herein. Nevertheless, for additional information pertaining to setup procedures, the reader may turn to U.S. Pat. Nos. 4,959,810, 5,614,906, and 6,225,938. It will also be appreciated that a controlling device **100** may be set up to command an appliance **102** by being taught the command codes needed to command such appliance as described in U.S. Pat. No. 4,623,887. Still further, it will be understood that command codes may be pre-stored in the controlling device **100** or the controlling device **100** may be upgradeable, for example via use of receiver **308**.

As illustrated in FIG. **3**, the universal controlling device **100** may be utilized to command functional operations of multiple appliances, such as those typically found in a home entertainment center. Thus, appliances controllable by the universal controlling device **100** may include VCRs **400**, DVD and CD players **402**, cable set-top boxes and satellite receivers **404**, AV receivers **406**, televisions **408**, as well as lighting, heating, etc. without limitation. Typically, commands are transmitted to such appliances using an IR protocol. The universal controlling device **100** may also be utilized to command functional operations of a home theater personal computer ("HTPC") **410**. An HTPC **410** is typically a PC that is set up at the home entertainment center and is used mainly for home entertainment functions such as for playing back music and video files, playing DVDs, and for viewing digital photos. The HTPC **410** may be connected to the Internet and may also be used for viewing Internet browser content, such as news, email, search results, and the like. Preferably, the universal controlling device **100** utilizes an RF protocol when communicating with the HTPC **410** which allows for communications beyond line-of-sight. In this regard, as illustrated in FIG. **4**, communications with the HTPC **410** may be made by means of a USB RF transceiver converter **412**. The USB converter device **412** includes a converting microcontroller and antenna for receiving and converting a data-stream transmitted in the RF domain by the universal controlling device **100** into USB messages for transmission to the HTPC **410**.

Turning to FIG. **2**, an exemplary embodiment of a universal controlling device **100** is illustrated. In the illustrated embodiment, the various components of FIG. **1** are encased within a housing **502** which also provides access to various of the hard keys **342** and the touch screen display in the form of a dual-mode touch-sensitive display **504**. By way of further example, the touch-sensitive display **504** may be 320×240 pixel LCD with a clear touch-sensitive digitizing layer covering the display. As will be well understood, the touch-sensitive display **504** is supported by circuitry which provides the position of a stylus **506** (storable within the housing **502**) or finger in contact with touch-sensitive digitizer layer to a microprocessor, i.e., a touch-sensitive digitizing sub-system that provides locations and motions of a stylus or finger in contact with touch-sensitive digitizing layer to the operating system and application software for the purpose of allowing the user to control the software application. As further illustrated in FIG. **2**, the universal controlling device **100** may also include a plurality of hard keys or mechanical buttons **342** or controlling various functions on target devices. It is to be understood that the function of the mechanical buttons **342** may change based on the mode of the universal controlling device **100** to thereby allow activations of the mechanical buttons to control various functions on various of the target devices.

For providing dual-mode functionality, the application software of the universal controlling device **100** preferably includes instructions which allow the touch-sensitive digitizer sub-system to switch between control of the local application software on the universal controlling device **100** and

control of a computer pointer **420** for the purpose of mousing, i.e., the process of moving a positionable pointer, such as the pointer on a Windows brand PC desktop **422**. To this end, the application software may also include a motion scaling function for use in the pointer control mode. Thus, the application software of the universal controlling device **100** will allow the universal controlling device **100** to operate in a first operational mode, in which the display presents a graphical user interface comprised of icons to control one or more of a plurality of audio-visual equipment (target devices), including a TV, VCR, DVD, satellite box, AV receiver and a HTPC, and a second operational mode, in which a pointer is controlled.

In the first operational mode, the universal controlling device **100** may be used to command various conventional operational functions of the home appliances. For example, the universal controlling device **100** may be used to select a specific media playback device, such as a DVD player **402**, as the input to the AV receiver **406**, resulting in the display of the DVD output on TV **408**. In such a process, 4-way navigation mechanical buttons **510** and center select button **518** would typically be used to navigate through selections and menus displayed on the TV **408**. Additionally, soft buttons displayed on display **504** as well as mechanical buttons **342** would typically be programmed to control operational functions of the DVD player **402**, AV receiver **406**, and the TV **408**, for example as part of a "home theater" mode. Thus, when operating within the first operational mode, when the user activates a mechanical button or soft button, an command code specific to an operational function on a specific target device is typically sent to target device.

Referring now to FIG. **4**, in the second operational mode, i.e., the pointer control mode, touch-sensitive digitizing subsystem on the universal controlling device **100** is used as a mousing (pointer control) input device for the HTPC **410**. In one embodiment, a pointer-mode activation button **512**, shown in FIG. **2**, allows the universal controlling device **100** to be toggled between the first operational mode and the second operational or pointer control mode. As will be appreciated, one or more of the feedback components of the universal controlling device may be utilized to inform the user as to which of the operational modes the universal controlling device **100** have been configured into as a result of actuation of the pointer-mode activation button **512**.

When the universal controlling device **100** is placed into the pointer control mode, position information output from touch-sensitive digitizer sub-system is converted into a data-stream and is sent via a (RF or IR) transmitter to the USB (RF or IR) receiver converter **412** that is connected to a USB port on the HTPC **410**. USB receiver converter **412** converts the received data-stream into mouse position messages that are sent to the Windows brand operating system of the HTPC **410** via the USB connection. The HTPC **410** may thus use the data provided by the touch-sensitive digitizing sub-system of the universal controlling device **100** identically to data received from a USB mouse, e.g., to control movement of a displayed pointer. This is illustrated in FIG. **4** which demonstrates that, when stylus **506** is moved across the dual-mode display **504**, displayed pointer **420** is moved in a corresponding direction on a HTPC desktop **422** displayed on TV **408**. Further, a scaling function in the software application may be provided to insure that motions made using a stylus or a finger correspond usably to motions of a PC pointer on the HTPC desktop especially in cases where the LCD on the universal controlling device **100** is in portrait orientation and HTPC GUI desktop **422** is in landscape orientation.

In the preferred embodiment, all of the user interface functions typically associated with mousing are included through use of the pointer control mode of the universal controlling device **100** such as: double-tapping to stick the pointer to a window bar, dragging the window across the desktop, and single tapping to release; double-tapping to open a window or start an application; etc. Additionally, with reference to FIG. **1**, when the universal controlling device **100** is in pointer control mode, two of the mechanical buttons **514**/**516** may be programmed to function as the left and right mouse buttons, as per the functions on such buttons on a mouse or on a laptop PC trackpad.

In a yet further embodiment, the universal controlling device **100** may be switched between the first operational mode and the pointer control mode is switched by actuation of a soft button located on LCD display **504**. Still further, the system may be provided with a media management and playback control application running on the HTPC **410** that provides media database browsing and media playback control whereby the advanced remote is used in the first operational mode to conventionally command functional operations of appliances, i.e., a mode wherein graphical user interface elements on the TV display are navigated by using the 4-way switch **510** and center select **518** mechanical buttons, and the second operational mode to command pointer operations. To this end, the system may be adapted wherein the HTPC **410** communicates to the universal controlling device **100** to allow the universal controlling device to toggle between the first operational mode and the pointer control operational mode when the media management and playback control application is entered and exited from the media management and playback control state. For example, when the media management and playback control application is exited, a message may be sent from the application to the universal controlling device **100** via a RF communications link where, upon receipt of this message, the universal controlling device **100** is switched to the pointer control operational mode. It will also be understood that, in cases where the universal controlling device **100** is utilized to command the HTPC **100** to enter and exit the media management and playback control state, the state of the HTPC **100** may be tracked internally within the universal controlling device **100**. For example, when a command is issued from the universal controlling device **100** for the purpose of causing the HTPC **100** to exit the media management and playback control application the universal controlling device **100** is also caused to switch to the pointer control operational mode.

While various concepts have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those concepts could be developed in light of the overall teachings of the disclosure. For example, the universal controlling device **100** may include a WLAN transceiver subsystem for communicating with and controlling devices connected to a WLAN, including the HTPC **410**. Additionally, while the embodiments presented above are described in the context of a universal controlling device (i.e. a controlling devices capable of commanding the operation of multiple classes of appliances devices from multiple manufacturers) as being most broadly representative of controlling devices in general, it will be appreciated that the teachings of this disclosure may be equally well applied to other controlling devices of narrower capability without departing from the spirit and scope of the present invention. As such, the particular concepts disclosed are meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

All documents cited within this application for patent are hereby incorporated by reference in their entirety.

What is claimed is:

1. A method for using a universal controlling device comprised of a display having a touch-sensitive surface to transmit data to one or more appliances located remotely from the controlling device, comprising:

causing one or more graphical user interfaces comprised of graphical user interface icons to be displayed in the display of the universal controlling device;

accepting via the touch-sensitive surface of the universal controlling device a first input type indicative of a selection of a displayed graphical user interface icon;

causing the universal controlling device to transmit to the one or more appliances first data representative of the displayed graphical user interface icon selected by the first input type;

accepting via the touch-sensitive surface of the universal controlling device a second input type indicative of a motion made across the touch-sensitive surface;

causing the universal controlling device to transmit to the one or more appliances second data representative of the motion made across the touch-sensitive surface provided by the second input type; and

causing the universal controlling device to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

2. The method as recited in claim **1**, wherein the universal controlling device supports a first operational mode and a second operational mode and the universal controlling device uses the first operational mode and the second operational mode to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

3. The method as recited in claim **2**, wherein the universal controlling device automatically toggles between the first operational mode and the second operational mode.

4. The method as recited in claim **3**, wherein the universal controlling device automatically toggles between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

5. The method as recited in claim **1**, wherein the first data comprises command data for commanding one or more operational functions of the one or more appliances.

6. The method as recited in claim **5**, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

7. The method as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

8. The method as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

* * * * *

US007782309C1

(12) INTER PARTES REEXAMINATION CERTIFICATE (977th)

United States Patent

Janik

(10) Number: US 7,782,309 C1
(45) Certificate Issued: *Oct. 24, 2014

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

(76) Inventor: **Craig M. Janik**, Los Altos Hills, CA (US)

Reexamination Request:
No. 95/001,759, Oct. 5, 2011

Reexamination Certificate for:
Patent No.: **7,782,309**
Issued: **Aug. 24, 2010**
Appl. No.: **12/103,895**
Filed: **Apr. 16, 2008**

(*) Notice: This patent is subject to a terminal disclaimer.

Related U.S. Application Data

(63) Continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**

G01N 33/48	(2006.01)
G01N 27/28	(2006.01)
G01N 33/487	(2006.01)

(52) **U.S. Cl.**
USPC **422/68.1**; 324/450; 324/403.02

(58) **Field of Classification Search**
None
See application file for complete search history.

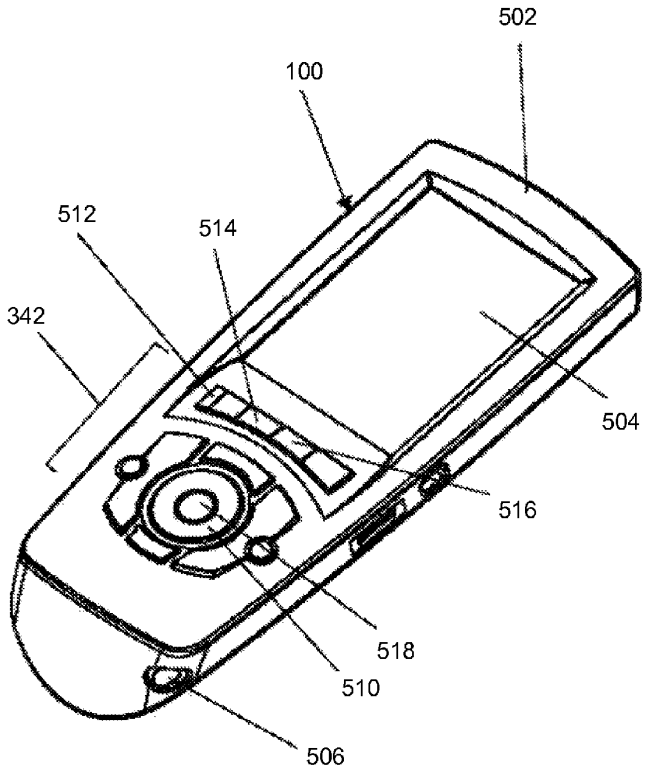
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 95/001,759, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Stephen J Ralis

(57) **ABSTRACT**

A universal controlling device having a touch-sensitive display. The display provides one or more graphical user interfaces comprised of graphical user interface icons that are selectable via the touch-sensitive display and the display accepts motions made by a stylus or finger in contact with the touch-sensitive display. The different interactions with the touch-sensitive display are used to cause the transmission of respective data to one or more appliances.



INTER PARTES REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 316

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-8** is confirmed.

New claims **9-37** are added and determined to be patentable.

9. The method as recited in claim 2, comprising causing the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causing the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

10. The method as recited in claim 9, wherein the data representative of a selection operation comprises data representative of a mouse button activation.

11. The method as recited in claim 3, comprising causing the universal controlling device to automatically toggle between the first operational mode and the second operational mode in response to a communication received from a controllable appliance.

12. The method as recited in claim 4, comprising causing the universal controlling device to internally track the state of the one or more appliances.

13. The method as recited in claim 1, wherein the display comprises an LCD display with a clear touch-sensitive layer covering the display.

14. The method as recited in claim 1, comprising causing information to be displayed in the display in response to a local operation of the universal controlling device being invoked.

15. The method as recited in claim 14, wherein the local operation comprises a favorite channel setup operation.

16. The method as recited in claim 14, wherein the local operation comprises a macro key setup operation.

17. The method as recited in claim 14, wherein the local operation comprises a function key relocation operation.

18. The method as recited in claim 1, comprising using a WLAN transceiver of the universal controlling device to transmit at least one of the first data and second data.

19. The method as recited in claim 1, wherein a single graphical user interface displayable in the display presents a plurality of graphical user interface icons for use in commanding operational functions of a plurality of different appliances in a home theater mode of the universal controlling device.

20. The method as recited in claim 1, comprising causing the universal controlling device to monitor a power supply of the universal controlling device.

21. The method as recited in claim 1, comprising causing the universal controlling device to initiate a playing of audio via a speaker of the universal controlling device in response to an input received into the universal controlling device.

22. The method as recited in claim 21, comprising causing the audio to be downloaded into the universal controlling device.

23. The method as recited in claim 1, comprising causing the universal controlling device to perform an operation in response to a sound input.

24. The method as recited in claim 1, comprising causing data to be received into the universal controlling device for upgrading an application of the universal controlling device that is used to transmit the first data.

25. The method as recited in claim 1, comprising causing data used to setup at least the graphical user interfaces to be stored in a memory of the controlling device.

26. The method as recited in claim 25, wherein the memory comprises a non-volatile read/write memory.

27. The method as recited in claim 1, comprising causing the graphical user interface icons displayed in the display of the universal controlling device to be changed as a function of an operational mode of the universal controlling device.

28. The method as recited in claim 1, comprising causing a cue indicative of an operational mode of the universal controlling device to be presented.

29. The method as recited in claim 28, wherein the cue is presented via a speaker of the universal controlling device.

30. The method as recited in claim 29, wherein the cue is presented via a LED of the universal controlling device.

31. The method as recited in claim 30, wherein the LED is disposed under a hard key of the universal controlling device.

32. The method as recited in claim 30, comprising causing the cue presented via use of the LED to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal controlling device.

33. The method as recited in claim 32, wherein the toggle element comprises a soft key displayed in the display.

34. The method as recited in claim 1, comprising causing the first data representative of the displayed graphical user interface icon selected by the first input type to be transmitted to a first appliance and causing the second data representative of the motion made across the touch-sensitive surface provided by the second input type to be transmitted to a second appliance different than the first appliance.

35. The method as recited in claim 1, comprising storing in a memory of the universal controlling device command codes for controlling functional operations of at least one appliance.

36. The method as recited in claim 1, comprising using a local operation of the universal controlling device to setup the one or more graphical user interfaces of the universal controlling device.

37. The method as recited in claim 1, comprising using a local operation of the universal controlling device to setup the universal controlling device to command functional operations of at least one appliance.

* * * * *

EXHIBIT F

US007821504B2

(12) **United States Patent**
Janik

(10) **Patent No.: US 7,821,504 B2**
(45) **Date of Patent: *Oct. 26, 2010**

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

(75) Inventor: **Craig M. Janik**, Los Altos Hills, CA (US)

(73) Assignee: **Universal Electronics Inc.**, Cypress, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/797,686**

(22) Filed: **Jun. 10, 2010**

(65) **Prior Publication Data**

US 2010/0245110 A1 Sep. 30, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/103,895, filed on Apr. 16, 2008, now Pat. No. 7,782,309, which is a continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.** **345/173**; 178/18.01; 348/14.04; 348/734

(58) **Field of Classification Search** 345/173, 345/156, 169; 178/18.01; 348/14.02, 14.03, 348/14.05, 734, 14.04; 340/5.61, 825.22; 715/700, 717; 341/176; 386/83
See application file for complete search history.

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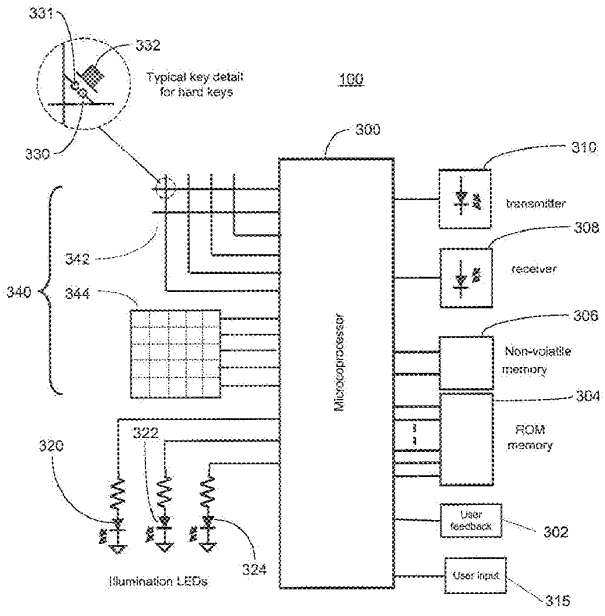
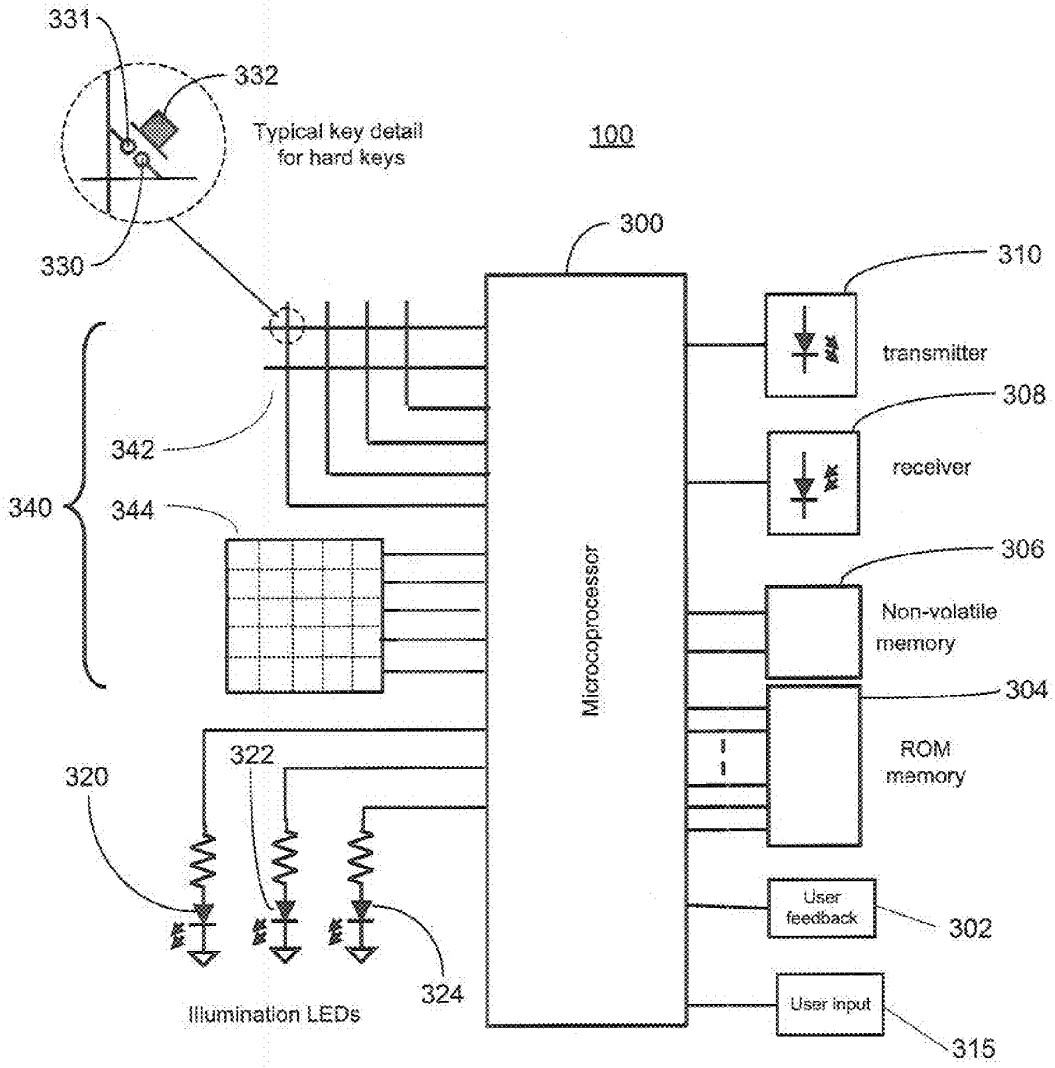
Primary Examiner—Abbas I Abdulselam
(74) *Attorney, Agent, or Firm*—Greenberg Traurig, LLP

(57) **ABSTRACT**

A processing device of a universal controlling device is programmed to distinguish between a first input type provided to a touch-sensitive surface and a second input type provided to the touch-sensitive surface. In response to the touch-sensitive surface being provided the first input type which is indicative of a static touch made upon the touch-sensitive surface the processing device causes a transmitter to transmit first data representative of the static touch made upon the touch-sensitive surface. In response to the touch-sensitive surface being provided the second input type which is indicative of a moving touch made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data being representative of the moving touch made across the touch-sensitive surface.

11 Claims, 4 Drawing Sheets




331
332
Typical key detail for hard keys
330
100
300
310
transmitter
308
receiver
342
340
344
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ROM memory
Microcoprocessor
322
320
User feedback
302
324
User input
315
Illumination LEDs

FIGURE 1

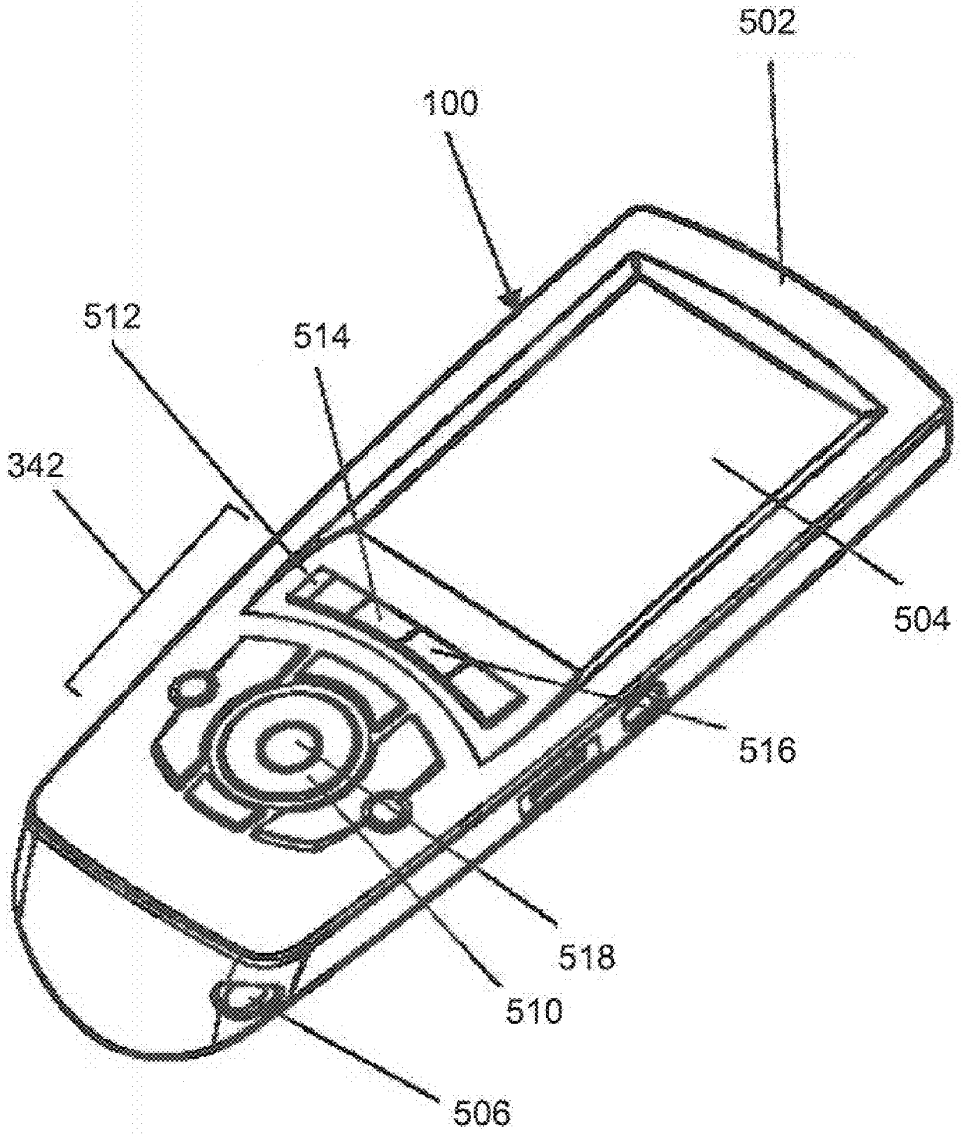

FIGURE 2

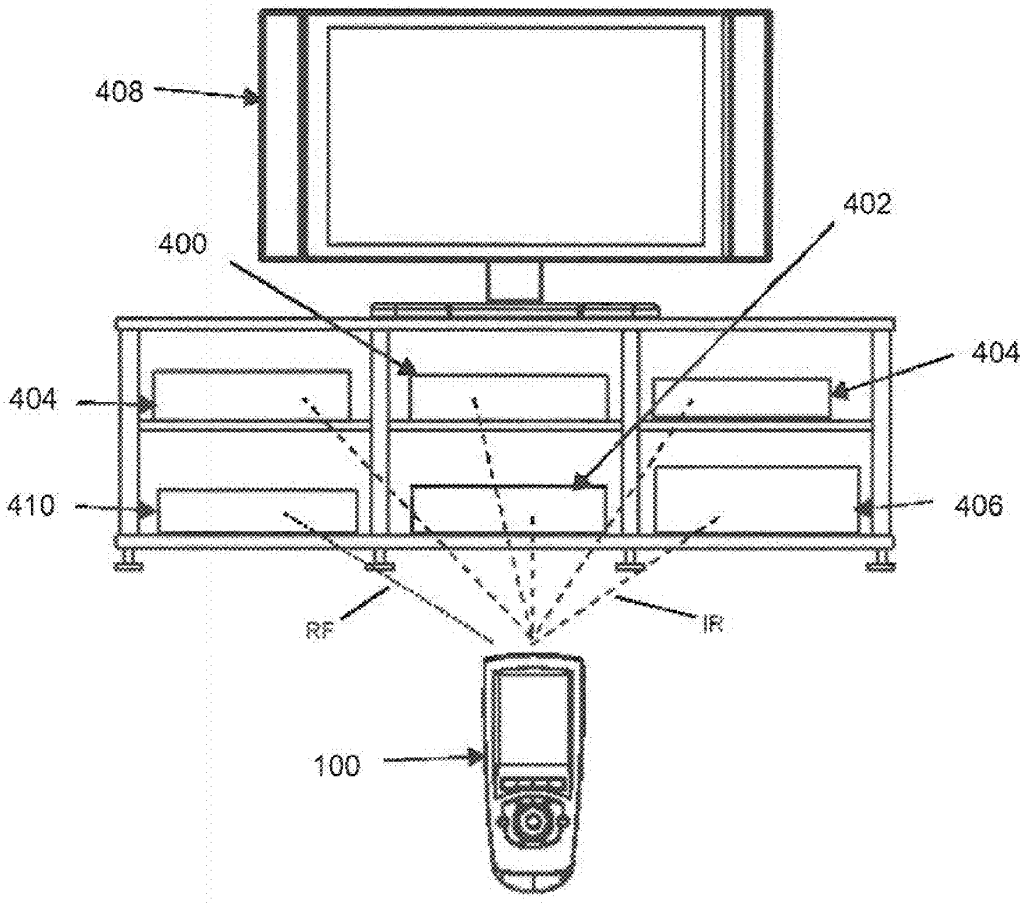

FIGURE 3

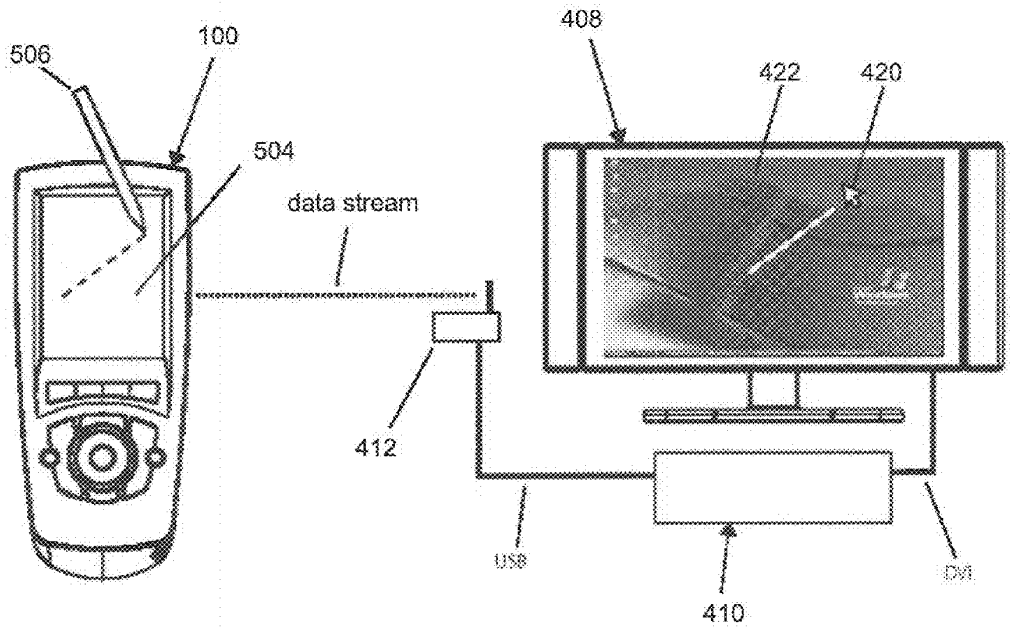

FIGURE 4

CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY

RELATED APPLICATION DATA

This application claims the benefit of and is a continuation of U.S. application Ser. No. 12/103,895, filed on Apr. 16, 2008, which claims the benefit of and is a continuation of U.S. application Ser. No. 11/290,358, filed on Nov. 30, 2005, which claims the benefit of U.S. Application No. 60/634,680, filed on Dec. 9, 2004, each of which is incorporated herein by reference in its entirety.

BACKGROUND

The following relates generally to controlling devices and, more particularly, to a controlling device having a dual-mode, touch-sensitive display.

Manufacturers typically provide a controlling device with an appliance and, as such, different appliance types of different manufacturers are often commanded with different controlling devices, also referred to as "remote controls." To minimize the number of individual controlling devices a user requires, universal controlling devices have been developed. Accordingly, universal controlling devices for commanding various operational functions of various types of appliances of various manufacturers have become quite widespread. By way of example, universal controlling devices are described in commonly assigned U.S. Pat. Nos. 4,959,810, 5,255,313 and 5,552,917.

For selecting which of multiple appliances a universal controlling device is to command, a universal controlling device may allow a user to place, i.e., configure, the universal controlling device into an operational mode whereby the function keys will be used to transmit commands to a "primary" target appliance that has been associated with that operational mode. For example, a "TV" operational mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated television, a "VCR" mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated VCR, etc. A universal controlling device may also be provided with an ability to be configured in a "home theater" operational mode (i.e., one established to facilitate a particular activity), a "user" operational mode (i.e., one established for a particular user), a "room" operational mode (i.e., one established for a particular room), or the like (collectively referred to hereinafter as a "home theater" operational mode). In a "home theater" operation mode, the universal controlling device will generally be adapted to command multiple target appliances. For example, a "home theater" mode may be established whereby volume function keys are used to transmit volume control commands to an amplifier, transport function keys are used to transmit transport control commands to a VCR, channel function keys are used to transmit channel control commands to a cable box, picture control function keys are used to transmit picture control commands to a television, etc.

In the case of universal controlling device having a display, various function keys, such as those appropriate for the various operational modes, are typically presented to a user in multiple, different user interfaces each comprising one or more displayed soft keys. For example, commonly assigned U.S. Published Patent Application No. 2003/0103088 (U.S. Ser. No. 10/288,727) discloses a universal controlling device application for use in connection with a hand-held device having a display, e.g., a personal digital assistant ("PDA"), wherein the display is utilized to present the multiple, different user interfaces. While the use of a display advantageously allows a universal controlling device to present multiple, different user interfaces to allow for the command of operational functions of one or more appliances, what is needed is a universal controlling device wherein the display is further adapted to provide remote, cursor control functionality.

SUMMARY

In accordance with this and other needs, the following generally discloses a universal controlling device having a dual-mode, touch-sensitive display which is switchable between two operational modes. In one operational mode, the display provides one or more graphical user interfaces comprised of graphical user interface icons that are selectable to command operational functions of one or more appliances. In a second operational mode, the display provides pointer control where motions made by a stylus or finger in contact with the touch-sensitive display result in corresponding motions of a pointer on a display located remotely from the universal controlling device, such as a display connected with a personal computer, a TV, or the like.

A better appreciation of the objects, advantages, features, properties, and relationships of the disclosed controlling devices will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments which are indicative of the various ways in which the principles described hereinafter may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For use in better understanding the exemplary universal controlling device described hereinafter reference may be had to the following drawings in which:

FIG. **1** illustrates a block diagram of exemplary components of an exemplary universal controlling device;

FIG. **2** illustrates an isometric view of an exemplary universal controlling device constructed utilizing the components of FIG. **1**;

FIG. **3** illustrates an exemplary system environment in which the exemplary universal controlling device of FIG. **2** may be utilized; and

FIG. **4** illustrates an exemplary flow of data within the exemplary system environment of FIG. **3**.

DETAILED DESCRIPTION

The following discloses a controlling device **100** having a dual-mode, touch-sensitive face panel. In one operational mode of the controlling device **100**, the face panel is utilized to accept input to cause a transmission of at least one command to at least one appliance. In a second operational mode of the controlling device **100**, the face panel is utilized to accept input for the purpose of controlling a cursor or pointer on a larger, second device, such as a personal computer, television, or the like.

To provide the dual modes of operation, the controlling devices **100** may include, as needed for a particular application, a processor **300** coupled to a ROM memory **304**, a key matrix **340** (e.g., a touch-sensitive surface **344** placed over a liquid crystal display (LCD) alone or in combination with hard keys **342** (LCD)), transmission circuit(s) **310**, receiver circuit(s) **308** and/or transceiver circuit(s) (e.g., IR and/or RF), a non-volatile read/write memory **306**, a means **302** to provide feedback to the user (e.g., LED, display, speaker,

and/or the like), a means **315** (such as a microphone, etc.) for receiving additional non-keypress input from the user, and means for providing visual and/or audio cues to the user, as illustrated in FIG. **1**. The means for providing visual and/or audio cues to the user, to disseminate information to the user, may be embodied as key illumination means, a sound or voice synthesizer circuit, and/or a digital recording and playback circuit (e.g., to allow a user to playback sound or voice tags input via a microphone or otherwise downloaded into the controlling device). The key illumination means may be in the form of separate elements, such as LEDs **320**, **322**, and **324**, either directly associated with a hard key matrix **342**. In the case where the controlling device **100** includes hard keys, an exemplary molded-in key **332** is shown as operative with key matrix circuit **330**,**331**.

To control the operation of the controlling device **100**, the ROM memory **304** may include executable instructions that are intended to be executed by the processor **300**. In this manner, the processor **300** may be programmed to control the various electronic components within the remote control **100**, e.g., to monitor a power supply (not shown), to cause the transmission of signals, control the key illumination means **320**, **322**, and **324**, sound circuits, etc. The non-volatile read/write memory **306**, for example an EEPROM, battery-backed up RAM, Smart Card, memory stick, or the like, may be provided to store setup data and parameters as necessary. While the memory **304** is illustrated and described as a ROM memory, memory **304** can also be comprised of any type of readable media, such as ROM, RAM, SRAM, FLASH, EEPROM, or the like. Preferably, the memory **304** is non-volatile or battery-backed such that data is not required to be reloaded after battery changes. In addition, the memories **304** and **306** may take the form of a chip, a hard disk, a magnetic disk, and/or an optical disk.

To cause the controlling device **100** to perform an action, the controlling device **100** is adapted to be responsive to events, such as a sensed user interaction with the touch pad overlaying the key matrix **344**, interaction with the hard key matrix **342**, receipt of a transmission via receiver **308**, etc. In response to an event, appropriate instructions within the memory **304** may be executed. For example, when a function command key is activated on the controlling device **100**, the controlling device **100** may retrieve a command code corresponding to the activated function command key from memory **304** and transmit the command code to an intended target appliance in a format recognizable by that appliance.

It will be appreciated that the instructions within the memory **304** can be used not only to cause the transmission of command codes and/or data to the appliances, but also to perform local operations. While not limiting, local operations that may be performed by the controlling device **100** may include displaying information/data, favorite channel setup, macro key setup, function key relocation, user programming of favorite channel selections, etc. A further, local operation is the ability to "lock" function keys across device operational modes as described in previously referenced U.S. Published Patent Application No. 2003/0025840. Examples of still further local operations can be found in U.S. Pat. Nos. 5,481,256, 5,959,751, and 6,014,092.

For creating a correspondence between a command code and a function command key, data may be entered into the controlling device **100** that functions to identify an intended target appliances by its type and make (and sometimes model). Such data allows the controlling device **100** to transmit recognizable command codes in the format appropriate for such identified appliances. Typically, intended target appliances are identified for each operational mode of the controlling device **100**. Since methods for setting up a controlling device to command the operation of specific home appliances are well-known, such methods need not be described in greater detail herein. Nevertheless, for additional information pertaining to setup procedures, the reader may turn to U.S. Pat. Nos. 4,959,810, 5,614,906, and 6,225,938. It will also be appreciated that a controlling device **100** may be set up to command an appliance **102** by being taught the command codes needed to command such appliance as described in U.S. Pat. No. 4,623,887. Still further, it will be understood that command codes may be pre-stored in the controlling device **100** or the controlling device **100** may be upgradeable, for example via use of receiver **308**.

As illustrated in FIG. **3**, the universal controlling device **100** may be utilized to command functional operations of multiple appliances, such as those typically found in a home entertainment center. Thus, appliances controllable by the universal controlling device **100** may include VCRs **400**, DVD and CD players **402**, cable set-top boxes and satellite receivers **404**, AV receivers **406**, televisions **408**, as well as lighting, heating, etc. without limitation. Typically, commands are transmitted to such appliances using an IR protocol. The universal controlling device **100** may also be utilized to command functional operations of a home theater personal computer ("HTPC") **410**. An HTPC **410** is typically a PC that is set up at the home entertainment center and is used mainly for home entertainment functions such as for playing back music and video files, playing DVDs, and for viewing digital photos. The HTPC **410** may be connected to the Internet and may also be used for viewing Internet browser content, such as news, email, search results, and the like. Preferably, the universal controlling device **100** utilizes an RF protocol when communicating with the HTPC **410** which allows for communications beyond line-of-sight. In this regard, as illustrated in FIG. **4**, communications with the HTPC **410** may be made by means of a USB RF transceiver converter **412**. The USB converter device **412** includes a converting microcontroller and antenna for receiving and converting a data-stream transmitted in the RF domain by the universal controlling device **100** into USB messages for transmission to the HTPC **410**.

Turning to FIG. **2**, an exemplary embodiment of a universal controlling device **100** is illustrated. In the illustrated embodiment, the various components of FIG. **1** are encased within a housing **502** which also provides access to various of the hard keys **342** and the touch screen display in the form of a dual-mode touch-sensitive display **504**. By way of further example, the touch-sensitive display **504** may be 320×240 pixel LCD with a clear touch-sensitive digitizing layer covering the display. As will be well understood, the touch-sensitive display **504** is supported by circuitry which provides the position of a stylus **506** (storable within the housing **502**) or finger in contact with touch-sensitive digitizer layer to a microprocessor, i.e., a touch-sensitive digitizing sub-system that provides locations and motions of a stylus or finger in contact with touch-sensitive digitizing layer to the operating system and application software for the purpose of allowing the user to control the software application. As further illustrated in FIG. **2**, the universal controlling device **100** may also include a plurality of hard keys or mechanical buttons **342** or controlling various functions on target devices. It is to be understood that the function of the mechanical buttons **342** may change based on the mode of the universal controlling device **100** to thereby allow activations of the mechanical buttons to control various functions on various of the target devices.

For providing dual-mode functionality, the application software of the universal controlling device **100** preferably

includes instructions which allow the touch-sensitive digitizer sub-system to switch between control of the local application software on the universal controlling device **100** and control of a computer pointer **420** for the purpose of mousing, i.e., the process of moving a positionable pointer, such as the pointer on a Windows brand PC desktop **422**. To this end, the application software may also include a motion scaling function for use in the pointer control mode. Thus, the application software of the universal controlling device **100** will allow the universal controlling device **100** to operate in a first operational mode, in which the display presents a graphical user interface comprised of icons to control one or more of a plurality of audio-visual equipment (target devices), including a TV, VCR, DVD, satellite box, AV receiver and a HTPC, and a second operational mode, in which a pointer is controlled.

In the first operational mode, the universal controlling device **100** may be used to command various conventional operational functions of the home appliances. For example, the universal controlling device **100** may be used to select a specific media playback device, such as a DVD player **402**, as the input to the AV receiver **406**, resulting in the display of the DVD output on TV **408**. In such a process, 4-way navigation mechanical buttons **510** and center select button **518** would typically be used to navigate through selections and menus displayed on the TV **408**. Additionally, soft buttons displayed on display **504** as well as mechanical buttons **342** would typically be programmed to control operational functions of the DVD player **402**, AV receiver **406**, and the TV **408**, for example as part of a "home theater" mode. Thus, when operating within the first operational mode, when the user activates a mechanical button or soft button, an command code specific to an operational function on a specific target device is typically sent to target device.

Referring now to FIG. **4**, in the second operational mode, i.e., the pointer control mode, touch-sensitive digitizing subsystem on the universal controlling device **100** is used as a mousing (pointer control) input device for the HTPC **410**. In one embodiment, a pointer-mode activation button **512**, shown in FIG. **2**, allows the universal controlling device **100** to be toggled between the first operational mode and the second operational or pointer control mode. As will be appreciated, one or more of the feedback components of the universal controlling device may be utilized to inform the user as to which of the operational modes the universal controlling device **100** have been configured into as a result of actuation of the pointer-mode activation button **512**.

When the universal controlling device **100** is placed into the pointer control mode, position information output from touch-sensitive digitizer sub-system is converted into a data-stream and is sent via a (RF or IR) transmitter to the USB (RF or IR) receiver converter **412** that is connected to a USB port on the HTPC **410**. USB receiver converter **412** converts the received data-stream into mouse position messages that are sent to the Windows brand operating system of the HTPC **410** via the USB connection. The HTPC **410** may thus use the data provided by the touch-sensitive digitizing sub-system of the universal controlling device **100** identically to data received from a USB mouse, e.g., to control movement of a displayed pointer. This is illustrated in FIG. **4** which demonstrates that, when stylus **506** is moved across the dual-mode display **504**, displayed pointer **420** is moved in a corresponding direction on a HTPC desktop **422** displayed on TV **408**. Further, a scaling function in the software application may be provided to insure that motions made using a stylus or a finger correspond usably to motions of a PC pointer on the HTPC desktop especially in cases where the LCD on the universal controlling device **100** is in portrait orientation and HTPC GUI desktop **422** is in landscape orientation.

In the preferred embodiment, all of the user interface functions typically associated with mousing are included through use of the pointer control mode of the universal controlling device **100** such as: double-tapping to stick the pointer to a window bar, dragging the window across the desktop, and single tapping to release; double-tapping to open a window or start an application; etc. Additionally, with reference to FIG. **1**, when the universal controlling device **100** is in pointer control mode, two of the mechanical buttons **514**/**516** may be programmed to function as the left and right mouse buttons, as per the functions on such buttons on a mouse or on a laptop PC trackpad.

In a yet further embodiment, the universal controlling device **100** may be switched between the first operational mode and the pointer control mode is switched by actuation of a soft button located on LCD display **504**. Still further, the system may be provided with a media management and playback control application running on the HTPC **410** that provides media database browsing and media playback control whereby the advanced remote is used in the first operational mode to conventionally command functional operations of appliances, i.e., a mode wherein graphical user interface elements on the TV display are navigated by using the 4-way switch **510** and center select **518** mechanical buttons, and the second operational mode to command pointer operations. To this end, the system may be adapted wherein the HTPC **410** communicates to the universal controlling device **100** to allow the universal controlling device to toggle between the first operational mode and the pointer control operational mode when the media management and playback control application is entered and exited from the media management and playback control state. For example, when the media management and playback control application is exited, a message may be sent from the application to the universal controlling device **100** via a RF communications link where, upon receipt of this message, the universal controlling device **100** is switched to the pointer control operational mode. It will also be understood that, in cases where the universal controlling device **100** is utilized to command the HTPC **100** to enter and exit the media management and playback control state, the state of the HTPC **100** may be tracked internally within the universal controlling device **100**. For example, when a command is issued from the universal controlling device **100** for the purpose of causing the HTPC **100** to exit the media management and playback control application the universal controlling device **100** is also caused to switch to the pointer control operational mode.

While various concepts have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those concepts could be developed in light of the overall teachings of the disclosure. For example, the universal controlling device **100** may include a WLAN transceiver subsystem for communicating with and controlling devices connected to a WLAN, including the HTPC **410**. Additionally, while the embodiments presented above are described in the context of a universal controlling device (i.e. a controlling devices capable of commanding the operation of multiple classes of appliances devices from multiple manufacturers) as being most broadly representative of controlling devices in general, it will be appreciated that the teachings of this disclosure may be equally well applied to other controlling devices of narrower capability without departing from the spirit and scope of the present invention. As such, the particular concepts disclosed are meant to be illustrative only and not limiting as to the

scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

All documents cited within this application for patent are hereby incorporated by reference in their entirety.

What is claimed is:

1. A method for using a universal controlling device comprised of a touch-sensitive surface to command functional operations of one or more appliances located remotely from the controlling device, comprising:

accepting via the touch-sensitive surface of the universal controlling device a first input type indicative of a static touch made upon the touch-sensitive surface;

causing the universal controlling device to transmit first data used to command at least a first functional operation of the one or more appliances, the first data being representative of the static touch made upon the touch-sensitive surface;

accepting via the touch-sensitive surface of the universal controlling device a second input type indicative of a moving touch made across the touch-sensitive surface;

causing the universal controlling device to transmit second data used to command at least a second functional operation of the one or more appliances, the second data being representative of the moving touch made across the touch-sensitive surface; and

causing the universal controlling device to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

2. The method as recited in claim **1**, wherein the universal controlling device supports a first operational mode and a second operational mode and the universal controlling device uses the first operational mode and the second operational mode to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

3. The method as recited in claim **2**, wherein the universal controlling device automatically toggles between the first operational mode and the second operational mode.

4. The method as recited in claim **3**, wherein the universal controlling device automatically toggles between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

5. The method as recited in claim **1**, wherein the second data comprises data for commanding movement of a displayed cursor associated with the one or more appliances.

6. The method as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

7. The method as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

8. A universal controlling device, comprising:

a touch-sensitive surface;

a transmitter for transmitting data for commanding functional operations of one or more appliances located remotely from the controlling device; and

a processing device for causing the transmitter to transmit data in response to input provided to the touch-sensitive surface;

wherein, in response to the touch-sensitive surface of the universal controlling device being provided a first input type indicative of a static touch made upon the touch-sensitive surface, the processing device causes the transmitter to transmit first data for commanding at least a first functional operation of the one or more appliances with the first data being representative of the static touch made upon the touch-sensitive surface and, in response to the touch-sensitive surface being provided a second input type indicative of a moving touch made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data for commanding at least a second functional operation of the one or more appliances with the second data being representative of the moving touch made across the touch-sensitive surface, and wherein the processing device is programmed to distinguish the first input type provided to the touch-sensitive surface from the second input type provided to the touch-sensitive surface.

9. The universal controlling device as recited in claim **8**, wherein the second data comprises data for commanding movement of a displayed cursor associated with the one or more appliances.

10. The universal controlling device as recited in claim **8**, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

11. The universal controlling device as recited in claim **8**, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

* * * * *

US007821504C1

(12) INTER PARTES REEXAMINATION CERTIFICATE (902nd)

United States Patent
Janik

(10) **Number: US 7,821,504 C1**
(45) **Certificate Issued: *Jul. 9, 2014**

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

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(73) Assignee: **Universal Electronics Inc.**, Cypress, CA (US)

Reexamination Request:
No. 95/001,760, Oct. 12, 2011

Reexamination Certificate for:
Patent No.: **7,821,504**
Issued: **Oct. 26, 2010**
Appl. No.: **12/797,686**
Filed: **Jun. 10, 2010**

(*) Notice: This patent is subject to a terminal disclaimer.

Related U.S. Application Data

(63) Continuation of application No. 12/103,895, filed on Apr. 16, 2008, now Pat. No. 7,782,309, which is a continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.**
USPC **345/173**; 178/18.01; 348/14.04; 348/734

(58) **Field of Classification Search**
None
See application file for complete search history.

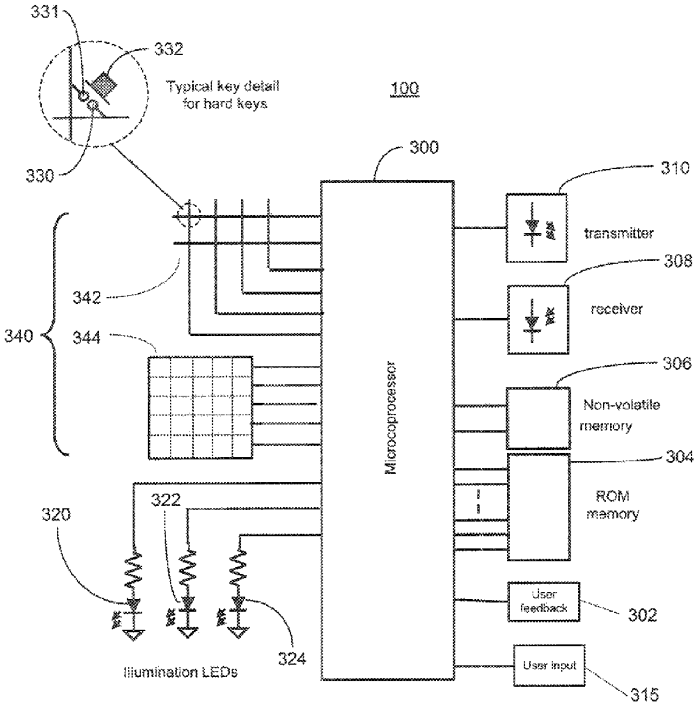
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 95/001,760, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Stephen J Ralis

(57) **ABSTRACT**

A processing device of a universal controlling device is programmed to distinguish between a first input type provided to a touch-sensitive surface and a second input type provided to the touch-sensitive surface. In response to the touch-sensitive surface being provided the first input type which is indicative of a static touch made upon the touch-sensitive surface the processing device causes a transmitter to transmit first data representative of the static touch made upon the touch-sensitive surface. In response to the touch-sensitive surface being provided the second input type which is indicative of a moving touch made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data being representative of the moving touch made across the touch-sensitive surface.



INTER PARTES REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 316

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-11** is confirmed.

New claims **12-53** are added and determined to be patentable.

12. The method as recited in claim 2, comprising causing the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causing the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

13. The method as recited in claim 12, wherein the data representative of a selection operation comprises data representative of a mouse button activation.

14. The method as recited in claim 3, comprising causing the universal controlling device to automatically toggle between the first operational mode and the second operational mode in response to a communication received from a controllable appliance.

15. The method as recited in claim 4, comprising causing the universal controlling device to internally track the state of the one or more appliances.

16. The method as recited in claim 1, comprising using a WLAN transceiver of the universal controlling device to transmit at least one of the first data and second data.

17. The method as recited in claim 1, comprising causing the universal controlling device to monitor a power supply of the universal controlling device.

18. The method as recited in claim 1, comprising causing the universal controlling device to initiate a playing of audio via a speaker of the universal controlling device in response to an input received into the universal controlling device.

19. The method as recited in claim 18, comprising causing the audio to be downloaded into the universal controlling device.

20. The method as recited in claim 1, comprising causing the universal controlling device to perform an operation in response to a sound input.

21. The method as recited in claim 1, comprising causing data to be received into the universal controlling device for upgrading an application of the universal controlling device that is used to transmit the first data.

22. The method as recited in claim 1, comprising causing a cue indicative of an operational mode of the universal controlling device to be presented.

23. The method as recited in claim 22, wherein the cue is presented via a speaker of the universal controlling device.

24. The method as recited in claim 22, wherein the cue is presented via a LED of the universal controlling device.

25. The method as recited in claim 24, wherein the LED is disposed under a hard key of the universal controlling device.

26. The method as recited in claim 25, comprising causing the cue presented via use of the LED to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal controlling device.

27. The method as recited in claim 1, comprising causing the first data to be transmitted to a first appliance and causing the second data to be transmitted to a second appliance different than the first appliance.

28. The method as recited in claim 1, comprising storing in a memory of the universal controlling device command codes for controlling functional operations of at least one appliance.

29. The method as recited in claim 1, comprising using a local operation of the universal controlling device to setup the universal controlling device to command functional operations of at least one appliance.

30. The universal controlling device as recited in claim 8, wherein the universal controlling device supports a first operational mode and a second operational mode and the processing device uses the first operational mode and the second operational mode to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

31. The universal controlling device as recited in claim 30, wherein the processing device causes the universal controlling device to automatically toggle between the first operational mode and the second operational mode.

32. The universal controlling device as recited in claim 31, wherein the processing device causes the universal controlling device to automatically toggle between the first operational mode and the second operational mode in response to a communication received from a controllable appliance.

33. The universal controlling device as recited in claim 31, wherein the processing device causes the universal controlling device to automatically toggle between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

34. The universal controlling device as recited in claim 33, wherein the processing device causes the universal controlling device to internally track the state of the one or more appliances.

35. The universal controlling device as recited in claim 30, wherein the first data comprises command data for commanding one or more operational functions of the one or more appliances.

36. The universal controlling device as recited in claim 35, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

37. The universal controlling device as recited in claim 30, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

38. The universal controlling device as recited in claim 30, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

39. The universal controlling device as recited in claim 38, comprising a WLAN transceiver for transmitting at least one of the first data and second data.

40. The universal controlling device as recited in claim 8, comprising a power supply for providing power to at least the

touch-sensitive surface, the processing device, and the transmitter and wherein the processing device monitors the power supply of the universal controlling device.

41. The universal controlling device as recited in claim 8, comprising a speaker coupled to the processing device for use in playing audio in response to an input received into the universal controlling device.

42. The universal controlling device as recited in claim 41, wherein the audio is downloaded into the universal controlling device.

43. The universal controlling device as recited in claim 8, comprising a microphone coupled to the processing device for allowing sound input to be processed by the processing device.

44. The universal controlling device as recited in claim 8, comprising a receiver and a memory for storing upgrade data usable by the processing device as received via the receiver.

45. The universal controlling device as recited in claim 8, comprising a feedback element coupled to the processing device for providing a cue indicative of an operational mode of the universal controlling device.

46. The universal controlling device as recited in claim 45, wherein the feedback element comprises a speaker.

47. The universal controlling device as recited in claim 45, wherein the feedback element comprises a LED.

48. The universal controlling device as recited in claim 47, wherein the LED is disposed under a hard key of the universal controlling device.

49. The universal controlling device as recited in claim 45, wherein the processing device causes the cue to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal controlling device.

50. The universal controlling device as recited in claim 8, wherein the processing device causes the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causes the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

51. The universal controlling device as recited in claim 50, wherein the data representative of a selection operation comprises data representative of a mouse button activation.

52. The universal controlling device as recited in claim 8, comprising a memory coupled to the processing device in which is stored codes for controlling functional operations of at least one appliance.

53. The universal controlling device as recited in claim 8, comprising a memory coupled to the processing device in which is stored a user created setup for commanding functional operations of at least one appliance.

* * * * *

EXHIBIT G

US007821505B2

(12) **United States Patent**
Janik

(10) **Patent No.: US 7,821,505 B2**
(45) **Date of Patent: Oct. 26, 2010**

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/797,695**

(22) Filed: **Jun. 10, 2010**

(65) **Prior Publication Data**

US 2010/0245281 A1 Sep. 30, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/103,895, filed on Apr. 16, 2008, now Pat. No. 7,782,309, which is a continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.** **345/173**; 345/169; 178/18.01; 348/14.04; 348/14.05

(58) **Field of Classification Search** 345/156, 345/169, 173; 348/14.02, 14.03, 14.05, 734, 348/14.04; 340/5.61, 825.22; 715/700, 717; 178/18.01; 341/176; 386/83
See application file for complete search history.

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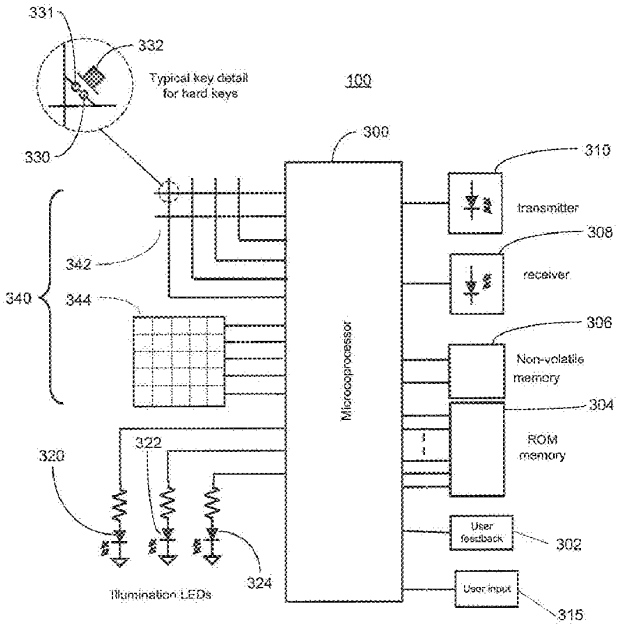
(57) **ABSTRACT**

A processing device of a universal controlling device is programmed to distinguish between a first input type provided to a touch-sensitive surface and a second input type provided to the touch-sensitive surface. In response to the touch-sensitive surface being provided the first input type which is indicative of an icon selection made upon the touch-sensitive surface the processing device causes a transmitter to transmit first data representative of the selected icon. In response to the touch-sensitive surface being provided the second input type which is indicative of a moving touch made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data being representative of the moving touch made across the touch-sensitive surface.

12 Claims, 4 Drawing Sheets



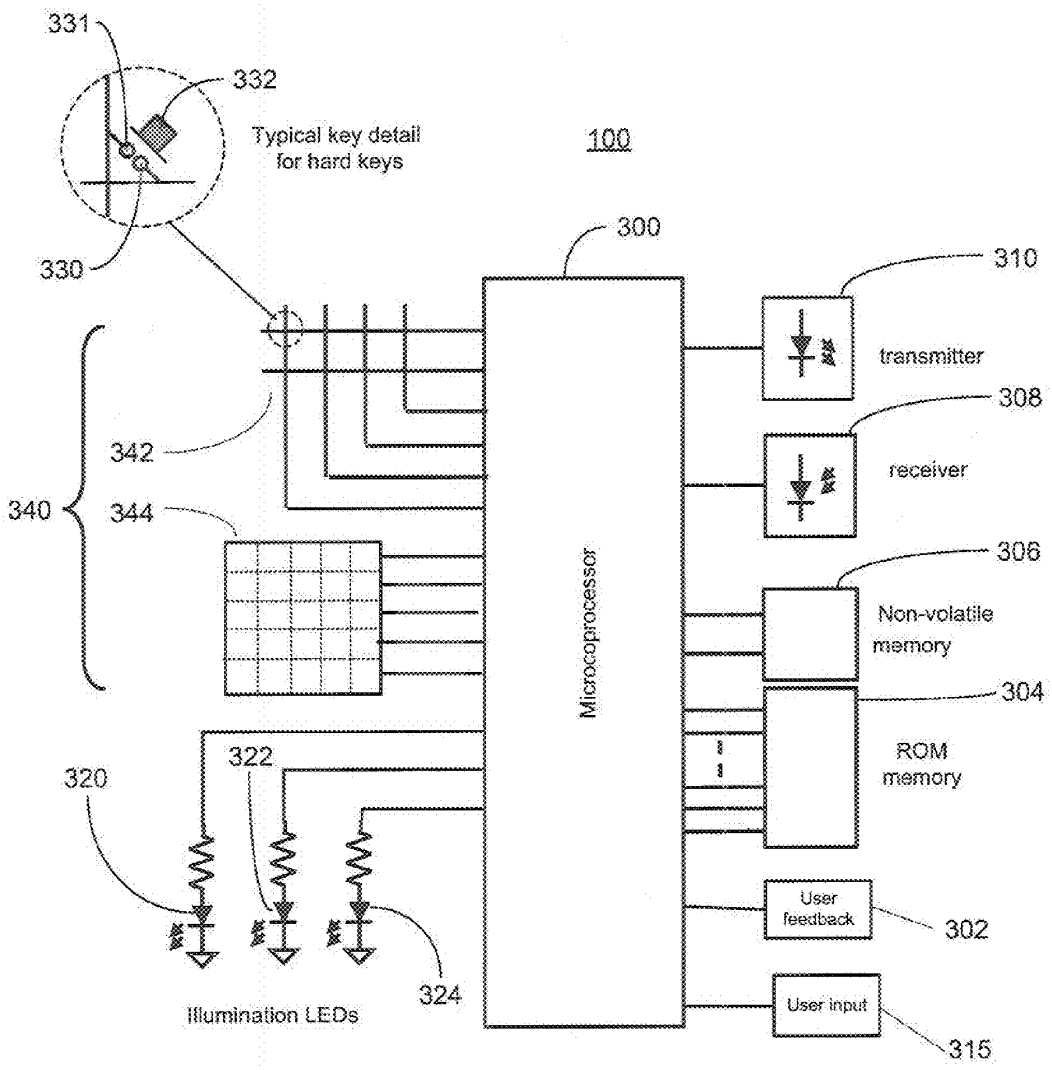

331
332
Typical key detail for hard keys
330
100
300
310
transmitter
308
receiver
342
340
344
306
Non-volatile memory
304
ROM memory
Microcoprocessor
322
320
User feedback
302
324
User input
315
Illumination LEDs

FIGURE 1

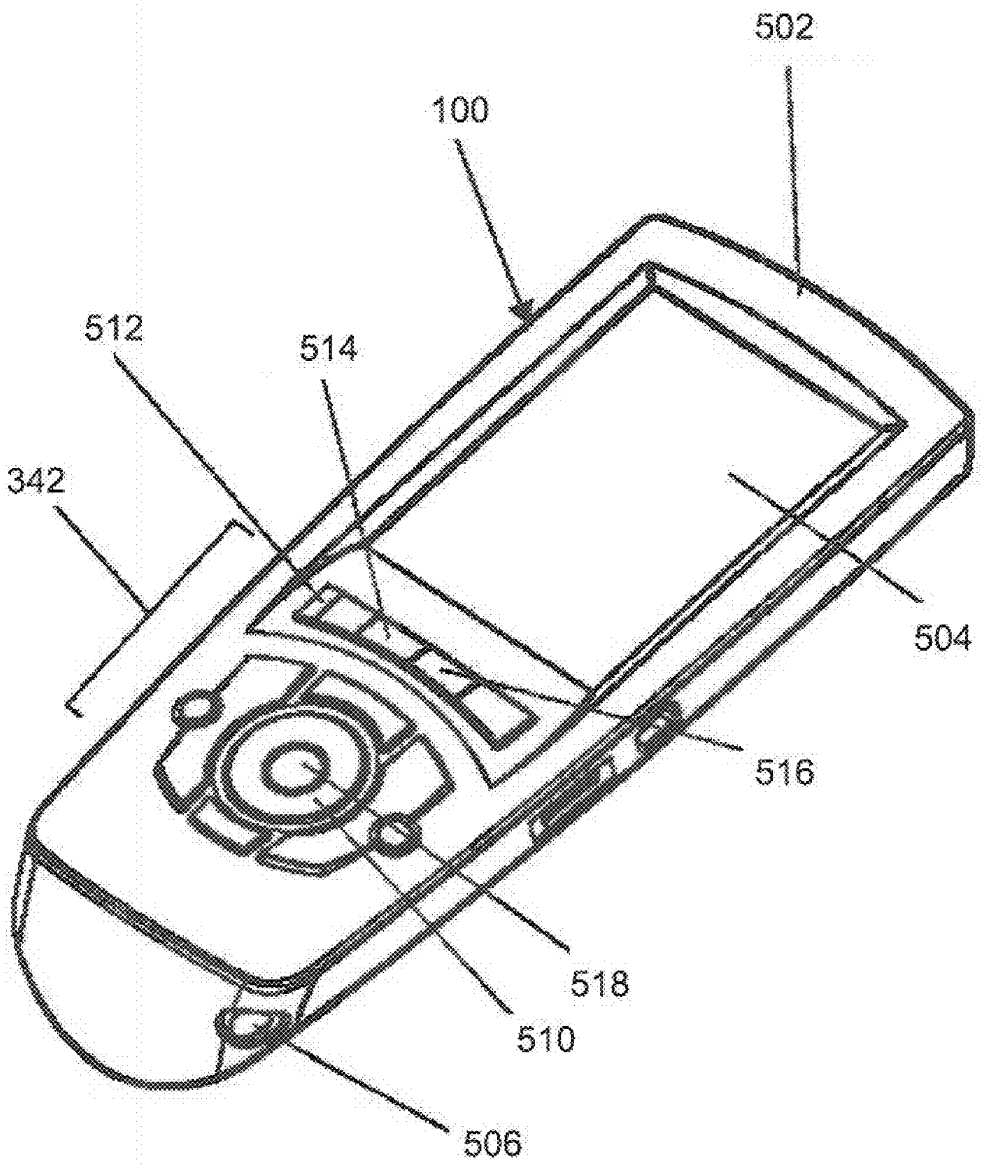


FIGURE 2

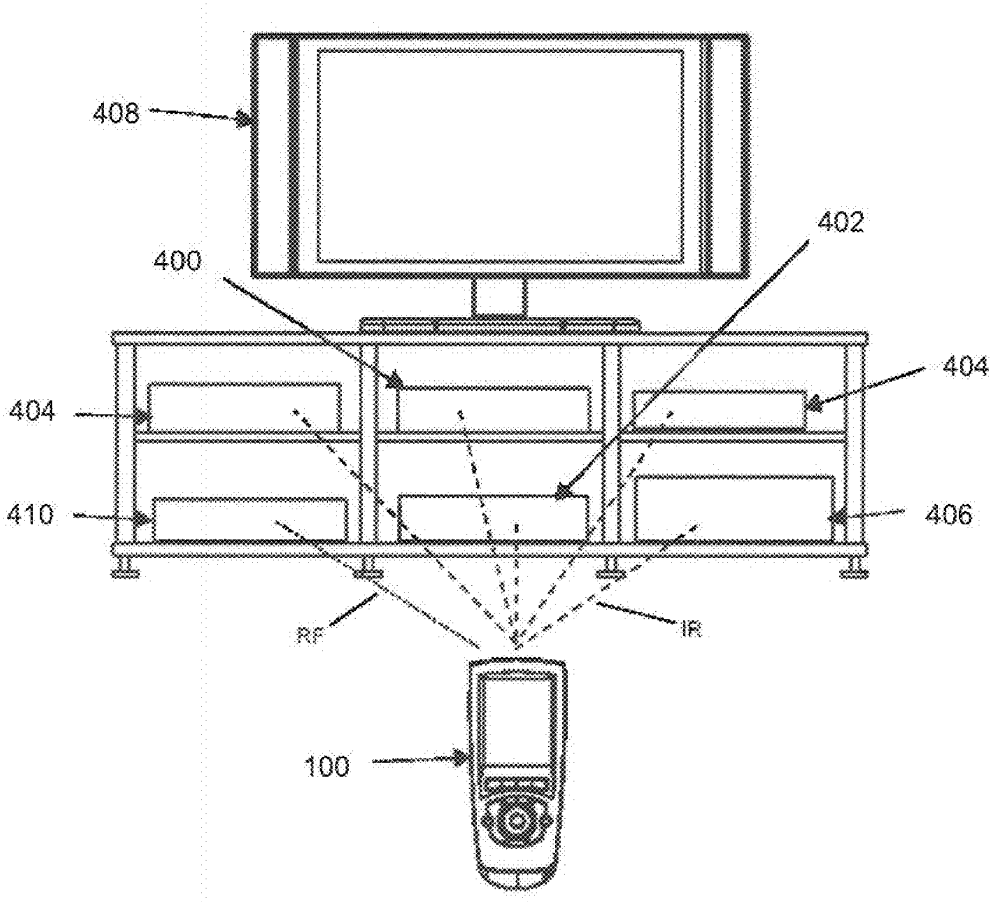


FIGURE 3

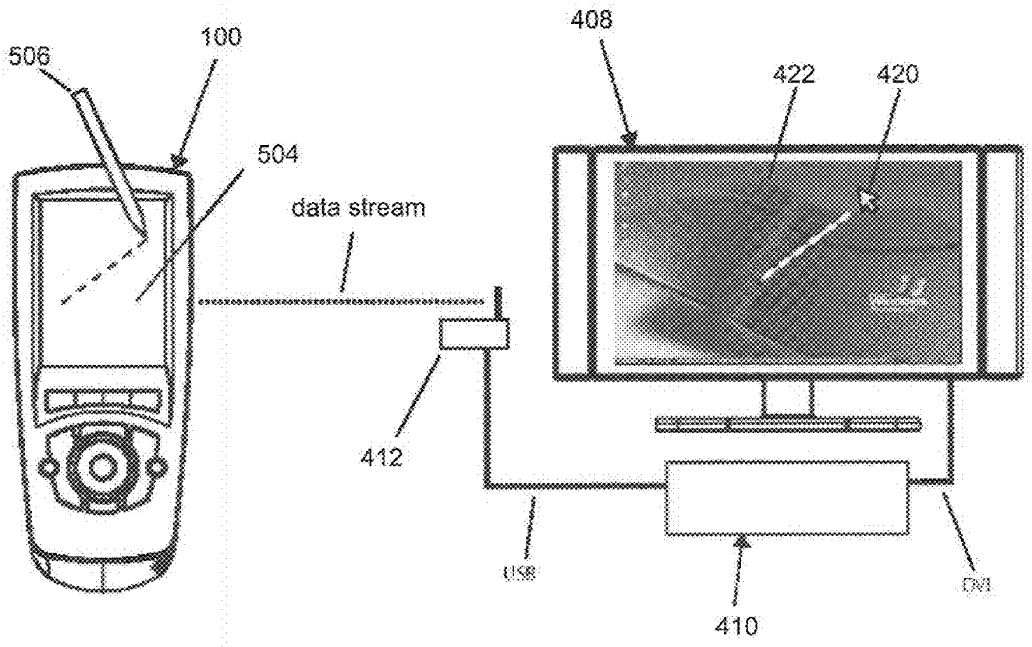


FIGURE 4

CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY

RELATED APPLICATION DATA

This application claims the benefit of and is a continuation of U.S. application Ser. No. 12/103,895, filed on Apr. 16, 2008, which claims the benefit of and is a continuation of U.S. application Ser. No. 11/290,358, filed on Nov. 30, 2005, which claims the benefit of U.S. Application No. 60/634,680, filed on Dec. 9, 2004, each of which is incorporated herein by reference in its entirety.

BACKGROUND

The following relates generally to controlling devices and, more particularly, to a controlling device having a dual-mode, touch-sensitive display.

Manufacturers typically provide a controlling device with an appliance and, as such, different appliance types of different manufacturers are often commanded with different controlling devices, also referred to as "remote controls." To minimize the number of individual controlling devices a user requires, universal controlling devices have been developed. Accordingly, universal controlling devices for commanding various operational functions of various types of appliances of various manufacturers have become quite widespread. By way of example, universal controlling devices are described in commonly assigned U.S. Pat. Nos. 4,959,810, 5,255,313 and 5,552,917.

For selecting which of multiple appliances a universal controlling device is to command, a universal controlling device may allow a user to place, i.e., configure, the universal controlling device into an operational mode whereby the function keys will be used to transmit commands to a "primary" target appliance that has been associated with that operational mode. For example, a "TV" operational mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated television, a "VCR" mode may be selected to place the universal controlling device into an operational mode whereby function keys are used to transmit commands primarily to a designated VCR, etc. A universal controlling device may also be provided with an ability to be configured in a "home theater" operational mode (i.e., one established to facilitate a particular activity), a "user" operational mode (i.e., one established for a particular user), a "room" operational mode (i.e., one established for a particular room), or the like (collectively referred to hereinafter as a "home theater" operational mode). In a "home theater" operation mode, the universal controlling device will generally be adapted to command multiple target appliances. For example, a "home theater" mode may be established whereby volume function keys are used to transmit volume control commands to an amplifier, transport function keys are used to transmit transport control commands to a VCR, channel function keys are used to transmit channel control commands to a cable box, picture control function keys are used to transmit picture control commands to a television, etc.

In the case of universal controlling device having a display, various function keys, such as those appropriate for the various operational modes, are typically presented to a user in multiple, different user interfaces each comprising one or more displayed soft keys. For example, commonly assigned U.S. Published Patent Application No. 2003/0103088 (Ser. No. 10/288,727) discloses a universal controlling device application for use in connection with a hand-held device having a display, e.g., a personal digital assistant ("PDA"), wherein the display is utilized to present the multiple, different user interfaces. While the use of a display advantageously allows a universal controlling device to present multiple, different user interfaces to allow for the command of operational functions of one or more appliances, what is needed is a universal controlling device wherein the display is further adapted to provide remote, cursor control functionality.

SUMMARY

In accordance with this and other needs, the following generally discloses a universal controlling device having a dual-mode, touch-sensitive display which is switchable between two operational modes. In one operational mode, the display provides one or more graphical user interfaces comprised of graphical user interface icons that are selectable to command operational functions of one or more appliances. In a second operational mode, the display provides pointer control where motions made by a stylus or finger in contact with the touch-sensitive display result in corresponding motions of a pointer on a display located remotely from the universal controlling device, such as a display connected with a personal computer, a TV, or the like.

A better appreciation of the objects, advantages, features, properties, and relationships of the disclosed controlling devices will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments which are indicative of the various ways in which the principles described hereinafter may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For use in better understanding the exemplary universal controlling device described hereinafter reference may be had to the following drawings in which:

FIG. **1** illustrates a block diagram of exemplary components of an exemplary universal controlling device;

FIG. **2** illustrates an isometric view of an exemplary universal controlling device constructed utilizing the components of FIG. **1**;

FIG. **3** illustrates an exemplary system environment in which the exemplary universal controlling device of FIG. **2** may be utilized; and

FIG. **4** illustrates an exemplary flow of data within the exemplary system environment of FIG. **3**.

DETAILED DESCRIPTION

The following discloses a controlling device **100** having a dual-mode, touch-sensitive face panel. In one operational mode of the controlling device **100**, the face panel is utilized to accept input to cause a transmission of at least one command to at least one appliance. In a second operational mode of the controlling device **100**, the face panel is utilized to accept input for the purpose of controlling a cursor or pointer on a larger, second device, such as a personal computer, television, or the like.

To provide the dual modes of operation, the controlling devices **100** may include, as needed for a particular application, a processor **300** coupled to a ROM memory **304**, a key matrix **340** (e.g., a touch-sensitive surface **344** placed over a liquid crystal display (LCD) alone or in combination with hard keys **342** (LCD)), transmission circuit(s) **310**, receiver circuit(s) **308** and/or transceiver circuit(s) (e.g., IR and/or RF), a non-volatile read/write memory **306**, a means **302** to provide feedback to the user (e.g., LED, display, speaker,

and/or the like), a means **315** (such as a microphone, etc.) for receiving additional non-keypress input from the user, and means for providing visual and/or audio cues to the user, as illustrated in FIG. **1**. The means for providing visual and/or audio cues to the user, to disseminate information to the user, may be embodied as key illumination means, a sound or voice synthesizer circuit, and/or a digital recording and playback circuit (e.g., to allow a user to playback sound or voice tags input via a microphone or otherwise downloaded into the controlling device). The key illumination means may be in the form of separate elements, such as LEDs **320**, **322**, and **324**, either directly associated with a hard key matrix **342**. In the case where the controlling device **100** includes hard keys, an exemplary molded-in key **332** is shown as operative with key matrix circuit **330**,**331**.

To control the operation of the controlling device **100**, the ROM memory **304** may include executable instructions that are intended to be executed by the processor **300**. In this manner, the processor **300** may be programmed to control the various electronic components within the remote control **100**, e.g., to monitor a power supply (not shown), to cause the transmission of signals, control the key illumination means **320**, **322**, and **324**, sound circuits, etc. The non-volatile read/write memory **306**, for example an EEPROM, battery-backed up RAM, Smart Card, memory stick, or the like, may be provided to store setup data and parameters as necessary. While the memory **304** is illustrated and described as a ROM memory, memory **304** can also be comprised of any type of readable media, such as ROM, RAM, SRAM, FLASH, EEPROM, or the like. Preferably, the memory **304** is non-volatile or battery-backed such that data is not required to be reloaded after battery changes. In addition, the memories **304** and **306** may take the form of a chip, a hard disk, a magnetic disk, and/or an optical disk.

To cause the controlling device **100** to perform an action, the controlling device **100** is adapted to be responsive to events, such as a sensed user interaction with the touch pad overlaying the key matrix **344**, interaction with the hard key matrix **342**, receipt of a transmission via receiver **308**, etc. In response to an event, appropriate instructions within the memory **304** may be executed. For example, when a function command key is activated on the controlling device **100**, the controlling device **100** may retrieve a command code corresponding to the activated function command key from memory **304** and transmit the command code to an intended target appliance in a format recognizable by that appliance.

It will be appreciated that the instructions within the memory **304** can be used not only to cause the transmission of command codes and/or data to the appliances, but also to perform local operations. While not limiting, local operations that may be performed by the controlling device **100** may include displaying information/data, favorite channel setup, macro key setup, function key relocation, user programming of favorite channel selections, etc. A further, local operation is the ability to "lock" function keys across device operational modes as described in previously referenced U.S. Published Patent Application No. 2003/0025840. Examples of still further local operations can be found in U.S. Pat. Nos. 5,481,256, 5,959,751, and 6,014,092.

For creating a correspondence between a command code and a function command key, data may be entered into the controlling device **100** that functions to identify an intended target appliances by its type and make (and sometimes model). Such data allows the controlling device **100** to transmit recognizable command codes in the format appropriate for such identified appliances. Typically, intended target appliances are identified for each operational mode of the controlling device **100**. Since methods for setting up a controlling device to command the operation of specific home appliances are well-known, such methods need not be described in greater detail herein. Nevertheless, for additional information pertaining to setup procedures, the reader may turn to U.S. Pat. Nos. 4,959,810, 5,614,906, and 6,225,938. It will also be appreciated that a controlling device **100** may be set up to command an appliance **102** by being taught the command codes needed to command such appliance as described in U.S. Pat. No. 4,623,887. Still further, it will be understood that command codes may be pre-stored in the controlling device **100** or the controlling device **100** may be upgradeable, for example via use of receiver **308**.

As illustrated in FIG. **3**, the universal controlling device **100** may be utilized to command functional operations of multiple appliances, such as those typically found in a home entertainment center. Thus, appliances controllable by the universal controlling device **100** may include VCRs **400**, DVD and CD players **402**, cable set-top boxes and satellite receivers **404**, AV receivers **406**, televisions **408**, as well as lighting, heating, etc. without limitation. Typically, commands are transmitted to such appliances using an IR protocol. The universal controlling device **100** may also be utilized to command functional operations of a home theater personal computer ("HTPC") **410**. An HTPC **410** is typically a PC that is set up at the home entertainment center and is used mainly for home entertainment functions such as for playing back music and video files, playing DVDs, and for viewing digital photos. The HTPC **410** may be connected to the Internet and may also be used for viewing Internet browser content, such as news, email, search results, and the like. Preferably, the universal controlling device **100** utilizes an RF protocol when communicating with the HTPC **410** which allows for communications beyond line-of-sight. In this regard, as illustrated in FIG. **4**, communications with the HTPC **410** may be made by means of a USB RF transceiver converter **412**. The USB converter device **412** includes a converting microcontroller and antenna for receiving and converting a data-stream transmitted in the RF domain by the universal controlling device **100** into USB messages for transmission to the HTPC **410**.

Turning to FIG. **2**, an exemplary embodiment of a universal controlling device **100** is illustrated. In the illustrated embodiment, the various components of FIG. **1** are encased within a housing **502** which also provides access to various of the hard keys **342** and the touch screen display in the form of a dual-mode touch-sensitive display **504**. By way of further example, the touch-sensitive display **504** may be 320×240 pixel LCD with a clear touch-sensitive digitizing layer covering the display. As will be well understood, the touch-sensitive display **504** is supported by circuitry which provides the position of a stylus **506** (storable within the housing **502**) or finger in contact with touch-sensitive digitizer layer to a microprocessor, i.e., a touch-sensitive digitizing sub-system that provides locations and motions of a stylus or finger in contact with touch-sensitive digitizing layer to the operating system and application software for the purpose of allowing the user to control the software application. As further illustrated in FIG. **2**, the universal controlling device **100** may also include a plurality of hard keys or mechanical buttons **342** or controlling various functions on target devices. It is to be understood that the function of the mechanical buttons **342** may change based on the mode of the universal controlling device **100** to thereby allow activations of the mechanical buttons to control various functions on various of the target devices.

For providing dual-mode functionality, the application software of the universal controlling device **100** preferably

includes instructions which allow the touch-sensitive digitizer sub-system to switch between control of the local application software on the universal controlling device **100** and control of a computer pointer **420** for the purpose of mousing, i.e., the process of moving a positionable pointer, such as the pointer on a Windows brand PC desktop **422**. To this end, the application software may also include a motion scaling function for use in the pointer control mode. Thus, the application software of the universal controlling device **100** will allow the universal controlling device **100** to operate in a first operational mode, in which the display presents a graphical user interface comprised of icons to control one or more of a plurality of audio-visual equipment (target devices), including a TV, VCR, DVD, satellite box, AV receiver and a HTPC, and a second operational mode, in which a pointer is controlled.

In the first operational mode, the universal controlling device **100** may be used to command various conventional operational functions of the home appliances. For example, the universal controlling device **100** may be used to select a specific media playback device, such as a DVD player **402**, as the input to the AV receiver **406**, resulting in the display of the DVD output on TV **408**. In such a process, 4-way navigation mechanical buttons **510** and center select button **518** would typically be used to navigate through selections and menus displayed on the TV **408**. Additionally, soft buttons displayed on display **504** as well as mechanical buttons **342** would typically be programmed to control operational functions of the DVD player **402**, AV receiver **406**, and the TV **408**, for example as part of a "home theater" mode. Thus, when operating within the first operational mode, when the user activates a mechanical button or soft button, an command code specific to an operational function on a specific target device is typically sent to target device.

Referring now to FIG. **4**, in the second operational mode, i.e., the pointer control mode, touch-sensitive digitizing subsystem on the universal controlling device **100** is used as a mousing (pointer control) input device for the HTPC **410**. In one embodiment, a pointer-mode activation button **512**, shown in FIG. **2**, allows the universal controlling device **100** to be toggled between the first operational mode and the second operational or pointer control mode. As will be appreciated, one or more of the feedback components of the universal controlling device may be utilized to inform the user as to which of the operational modes the universal controlling device **100** have been configured into as a result of actuation of the pointer-mode activation button **512**.

When the universal controlling device **100** is placed into the pointer control mode, position information output from touch-sensitive digitizer sub-system is converted into a data-stream and is sent via a (RF or IR) transmitter to the USB (RF or IR) receiver converter **412** that is connected to a USB port on the HTPC **410**. USB receiver converter **412** converts the received data-stream into mouse position messages that are sent to the Windows brand operating system of the HTPC **410** via the USB connection. The HTPC **410** may thus use the data provided by the touch-sensitive digitizing sub-system of the universal controlling device **100** identically to data received from a USB mouse, e.g., to control movement of a displayed pointer. This is illustrated in FIG. **4** which demonstrates that, when stylus **506** is moved across the dual-mode display **504**, displayed pointer **420** is moved in a corresponding direction on a HTPC desktop **422** displayed on TV **408**. Further, a scaling function in the software application may be provided to insure that motions made using a stylus or a finger correspond usably to motions of a PC pointer on the HTPC desktop especially in cases where the LCD on the universal controlling device **100** is in portrait orientation and HTPC GUI desktop **422** is in landscape orientation.

In the preferred embodiment, all of the user interface functions typically associated with mousing are included through use of the pointer control mode of the universal controlling device **100** such as: double-tapping to stick the pointer to a window bar, dragging the window across the desktop, and single tapping to release; double-tapping to open a window or start an application; etc. Additionally, with reference to FIG. **1**, when the universal controlling device **100** is in pointer control mode, two of the mechanical buttons **514**/**516** may be programmed to function as the left and right mouse buttons, as per the functions on such buttons on a mouse or on a laptop PC trackpad.

In a yet further embodiment, the universal controlling device **100** may be switched between the first operational mode and the pointer control mode is switched by actuation of a soft button located on LCD display **504**. Still further, the system may be provided with a media management and playback control application running on the HTPC **410** that provides media database browsing and media playback control whereby the advanced remote is used in the first operational mode to conventionally command functional operations of appliances, i.e., a mode wherein graphical user interface elements on the TV display are navigated by using the 4-way switch **510** and center select **518** mechanical buttons, and the second operational mode to command pointer operations. To this end, the system may be adapted wherein the HTPC **410** communicates to the universal controlling device **100** to allow the universal controlling device to toggle between the first operational mode and the pointer control operational mode when the media management and playback control application is entered and exited from the media management and playback control state. For example, when the media management and playback control application is exited, a message may be sent from the application to the universal controlling device **100** via a RF communications link where, upon receipt of this message, the universal controlling device **100** is switched to the pointer control operational mode. It will also be understood that, in cases where the universal controlling device **100** is utilized to command the HTPC **100** to enter and exit the media management and playback control state, the state of the HTPC **100** may be tracked internally within the universal controlling device **100**. For example, when a command is issued from the universal controlling device **100** for the purpose of causing the HTPC **100** to exit the media management and playback control application the universal controlling device **100** is also caused to switch to the pointer control operational mode.

While various concepts have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those concepts could be developed in light of the overall teachings of the disclosure. For example, the universal controlling device **100** may include a WLAN transceiver subsystem for communicating with and controlling devices connected to a WLAN, including the HTPC **410**. Additionally, while the embodiments presented above are described in the context of a universal controlling device (i.e. a controlling devices capable of commanding the operation of multiple classes of appliances devices from multiple manufacturers) as being most broadly representative of controlling devices in general, it will be appreciated that the teachings of this disclosure may be equally well applied to other controlling devices of narrower capability without departing from the spirit and scope of the present invention. As such, the particular concepts disclosed are meant to be illustrative only and not limiting as to the

scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

All documents cited within this application for patent are hereby incorporated by reference in their entirety.

What is claimed is:

1. A universal controlling device, comprising:

a display having a touch-sensitive surface in which is displayed a plurality of graphical user interface icons;

a transmitter for transmitting data for commanding functional operations of one or more appliances located remotely from the controlling device; and

a processing device for causing the transmitter to transmit data in response to input provided to the touch-sensitive surface;

wherein, in response to the touch-sensitive surface of the universal controlling device being provided a first input type indicative of a selection of a one of the plurality of displayed graphical user interface icons, the processing device causes the transmitter to transmit first data for commanding at least a first functional operation of the one or more appliances with the first data being representative of the one of the plurality of graphical user interface icon selected by the first input type and, in response to the touch-sensitive surface being provided a second input type indicative of a motion made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data for commanding at least a second functional operation of the one or more appliances with the second data being representative of the motion made across the touch-sensitive surface provided by the second input type, and wherein the processing device is programmed to distinguish the first input type provided to the touch-sensitive surface from the second input type provided to the touch-sensitive surface.

2. The universal controlling device as recited in claim **1**, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

3. The universal controlling device as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

4. The universal controlling device as recited in claim **1**, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

5. A non-transitory computer-readable media embodied in a physical memory device having stored thereon instructions for causing a universal controlling device comprised of a display having a touch-sensitive surface and adapted to transmit data to one or more appliances located remotely from the controlling device to perform steps comprising:

displaying in the display of the universal controlling device one or more graphical user interfaces comprised of graphical user interface icons;

accepting via the touch-sensitive surface of the universal controlling device a first input type indicative of a selection of a displayed graphical user interface icon;

initiating a transmission by the universal controlling device to the one or more appliances first data representative of the displayed graphical user interface icon selected by the first input type;

accepting via the touch-sensitive surface of the universal controlling device a second input type indicative of a motion made across the touch-sensitive surface;

initiating a transmission by the universal controlling device to the one or more appliances second data representative of the motion made across the touch-sensitive surface provided by the second input type; and

allowing the universal controlling device to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

6. The non-transitory computer-readable media as recited in claim **5**, wherein the universal controlling device supports a first operational mode and a second operational mode and the instructions allow the universal controlling device to use the first operational mode and the second operational mode to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

7. The non-transitory computer-readable media as recited in claim **6**, wherein the instructions cause the universal controlling device to automatically toggle between the first operational mode and the second operational mode.

8. The non-transitory computer-readable media as recited in claim **7**, wherein the universal controlling device is caused to automatically toggle between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

9. The non-transitory computer-readable media as recited in claim **6**, wherein the first data comprises command data for commanding one or more operational functions of the one or more appliances.

10. The non-transitory computer-readable media as recited in claim **9**, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

11. The non-transitory computer-readable media as recited in claim **6**, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

12. The non-transitory computer-readable media as recited in claim **6**, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

* * * * *

US007821505C1

(12) INTER PARTES REEXAMINATION CERTIFICATE (898th)

United States Patent

Janik

(10) Number: US 7,821,505 C1
(45) Certificate Issued: Jun. 27, 2014

(54) **CONTROLLING DEVICE WITH DUAL-MODE, TOUCH-SENSITIVE DISPLAY**

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(73) Assignee: **Universal Electronics Inc.**, Cypress, CA (US)

Reexamination Request:
No. 95/001,761, Sep. 29, 2011

Reexamination Certificate for:
Patent No.: **7,821,505**
Issued: **Oct. 26, 2010**
Appl. No.: **12/797,695**
Filed: **Jun. 10, 2010**

Related U.S. Application Data

(63) Continuation of application No. 12/103,895, filed on Apr. 16, 2008, now Pat. No. 7,782,309, which is a continuation of application No. 11/290,358, filed on Nov. 30, 2005, now Pat. No. 7,432,916.

(60) Provisional application No. 60/634,680, filed on Dec. 9, 2004.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.**
USPC **345/173**; 345/169; 178/18.01; 348/14.04; 348/14.05

(58) **Field of Classification Search**
None
See application file for complete search history.

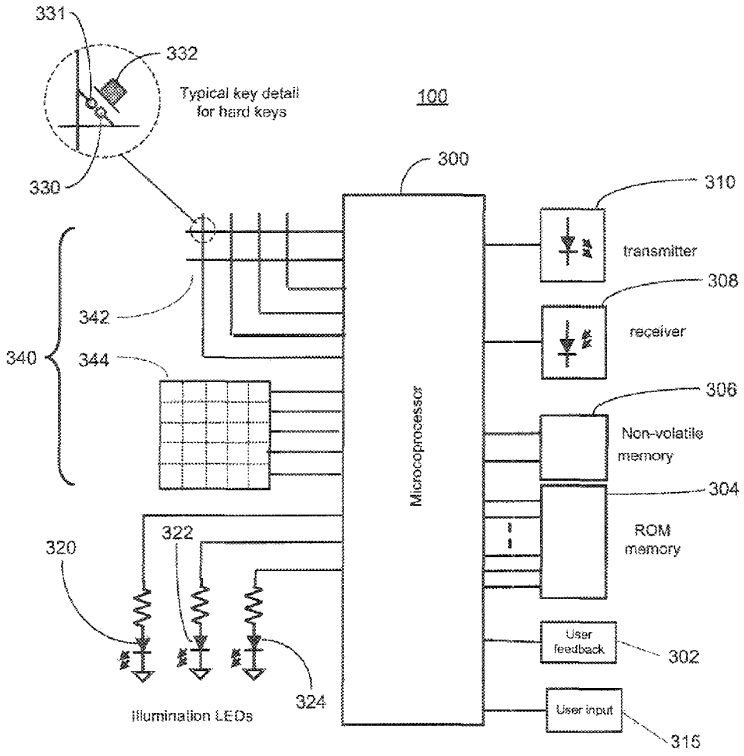
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 95/001,761, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Stephen J Ralis

(57) **ABSTRACT**

A processing device of a universal controlling device is programmed to distinguish between a first input type provided to a touch-sensitive surface and a second input type provided to the touch-sensitive surface. In response to the touch-sensitive surface being provided the first input type which is indicative of an icon selection made upon the touch-sensitive surface the processing device causes a transmitter to transmit first data representative of the selected icon. In response to the touch-sensitive surface being provided the second input type which is indicative of a moving touch made across the touch-sensitive surface, the processing device causes the transmitter to transmit second data being representative of the moving touch made across the touch-sensitive surface.



INTER PARTES REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 316

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-12** is confirmed.

New claims **13-93** are added and determined to be patentable.

13. The universal controlling device as recited in claim 1, wherein the first data comprises command data for commanding one or more operational functions of the one or more appliances.

14. The universal controlling device as recited in claim 13, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

15. The universal controlling device as recited in claim 14, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

16. The universal controlling device as recited in claim 14, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

17. The universal controlling device as recited in claim 1, comprising a WLAN transceiver for transmitting at least one of the first data and second data.

18. The universal controlling device as recited in claim 1, comprising a power supply for providing power to at least the touch-sensitive surface, the processing device, and the transmitter and wherein the processing device monitors the power supply of the universal controlling device.

19. The universal controlling device as recited in claim 1, comprising a speaker coupled to the processing device for use in playing audio in response to an input received into the universal controlling device.

20. The universal controlling device as recited in claim 19, wherein the audio is downloaded into the universal controlling device.

21. The universal controlling device as recited in claim 1, comprising a microphone coupled to the processing device for allowing sound input to be processed by the processing device.

22. The universal controlling device as recited in claim 1, comprising a receiver and a memory for storing upgrade data usable by the processing device as received via the receiver.

23. The universal controlling device as recited in claim 1, comprising a feedback element coupled to the processing device for providing a cue indicative of an operational mode of the universal controlling device.

24. The universal controlling device as recited in claim 23, wherein the feedback element comprises a speaker.

25. The universal controlling device as recited in claim 23, wherein the feedback element comprises a LED.

26. The universal controlling device as recited in claim 25, wherein the LED is disposed under a hard key of the universal controlling device.

27. The universal controlling device as recited in claim 26, wherein the processing device causes the cue to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal controlling device.

28. The universal controlling device as recited in claim 1, wherein the processing device causes the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causes the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

29. The universal controlling device as recited in claim 28, wherein the data representative of a selection operation comprises data representative of a mouse button activation.

30. The universal controlling device as recited in claim 1, comprising a memory coupled to the processing device in which is stored codes for controlling functional operations of at least one appliance.

31. The universal controlling device as recited in claim 1, comprising a memory coupled to the processing device in which is stored a user created setup for commanding functional operations of at least one appliance.

32. The universal controlling device as recited in claim 1, wherein the display comprises an LCD display over which is positioned the touch-sensitive surface.

33. The universal controlling device as recited in claim 1, wherein the processing device causes information to be displayed in the display in response to a local operation of the universal controlling device being invoked.

34. The universal controlling device as recited in claim 33, wherein the local operation comprises a favorite channel setup operation.

35. The universal controlling device as recited in claim 33, wherein the local operation comprises a macro key setup operation.

36. The universal controlling device as recited in claim 33, wherein the local operation comprises a function key relocation operation.

37. The universal controlling device as recited in claim 1, wherein the processing device causes a single graphical user interface to be displayed in the display having a plurality of graphical user interface icons for use in commanding operational functions of a plurality of different appliances in a home theater mode of the universal controlling device.

38. The universal controlling device as recited in claim 1, wherein the universal controlling device supports a first operational mode and a second operational mode and the processing device uses the first operational mode and the second operational mode to distinguish the first input type received via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

39. The universal controlling device as recited in claim 38, wherein the processing device causes the universal controlling device to automatically toggle between the first operational mode and the second operational mode.

40. The universal controlling device as recited in claim 39, wherein the processing device causes the universal controlling device to automatically toggle between the first opera-

tional mode and the second operational mode in response to a communication received from a controllable appliance.

41. The universal controlling device as recited in claim 38, wherein the processing device causes the universal controlling device to automatically toggle between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

42. The universal controlling device as recited in claim 41, wherein the processing device causes the universal controlling device to internally track the state of the one or more appliances.

43. The non-transitory computer-readable media as recited in claim 6, wherein the instructions cause the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causing the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

44. The non-transitory computer-readable media as recited in claim 43, wherein the data indicative of a selection operation comprises data representative of a mouse button activation.

45. The non-transitory computer-readable media as recited in claim 7, wherein the instructions cause the universal controlling device to automatically toggle between the first operational mode and the second operational mode in response to a communication received from a controllable appliance.

46. The non-transitory computer-readable media as recited in claim 8, wherein the instructions cause the universal controlling device to internally track the state of the one or more appliances.

47. The non-transitory computer-readable media as recited in claim 5, wherein the instructions use a WLAN transceiver of the universal controlling device to transmit at least one of the first data and second data.

48. The non-transitory computer-readable media as recited in claim 5, wherein the instructions monitor a power supply of the universal controlling device.

49. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause the universal controlling device to initiate a playing of audio via a speaker of the universal controlling device in response to an input received into the universal controlling device.

50. The non-transitory computer-readable media as recited in claim 49, wherein the instructions cause audio to be downloaded into the universal controlling device.

51. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause the universal controlling device to perform an operation in response to a sound input.

52. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause updgrade data to be downloaded into the universal controlling device.

53. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause a cue indicative of an operational mode of the universal controlling device to be presented.

54. The non-transitory computer-readable media as recited in claim 53, wherein the cue is presented via a speaker of the universal controlling device.

55. The non-transitory computer-readable media as recited in claim 53, wherein the cue is presented via a LED of the universal controlling device.

56. The non-transitory computer-readable media as recited in claim 55, wherein the LED is disposed under a hard key of the universal controlling device.

57. The non-transitory computer-readable media as recited in claim 56, wherein the instructions cause the cue presented via use of the LED to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal controlling device.

58. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause the first data to be transmitted to a first appliance and cause the second data to be transmitted to a second appliance different than the first appliance.

59. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause command codes for controlling functional operations of at least one appliance to be read from a memory device of the universal controlling device.

60. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause invocation of a local operation of the universal controlling device to setup the universal controlling device to command functional operations of at least one appliance.

61. The non-transitory computer-readable media as recited in claim 5, wherein the display comprises an LCD display.

62. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause information to be displayed in the display in response to a local operation of the universal controlling device being invoked.

63. The non-transitory computer-readable media as recited in claim 62, wherein the local operation comprises a favorite channel setup operation.

64. The non-transitory computer-readable media as recited in claim 62, wherein the local operation comprises a macro key setup operation.

65. The non-transitory computer-readable media as recited in claim 62, wherein the local operation comprises a function key relocation operation.

66. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause a single graphical user interface to be displayed in the display having a plurality of graphical user interface icons for use in commanding operational functions of a plurality of different appliances in a home theater mode of the universal controlling device.

67. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause data used to setup at least the graphical user interfaces to be stored in a memory of the controlling device.

68. The non-transitory computer-readable media as recited in claim 67, wherein the memory comprises a non-volatile read/write memory.

69. The non-transitory computer-readable media as recited in claim 5, wherein the instructions cause the graphical user interface icons displayed in the display of the universal controlling device to be changed as a function of an operational mode of the universal controlling device.

70. The non-transitory computer-readable media as recited in claim 69, wherein the universal controlling device supports a first operational mode and a second operational mode and uses the first operational mode and the second operational mode to distinguish the first input type received

via the touch-sensitive surface from the second input type received via the touch-sensitive surface.

71. The non-transitory computer-readable media as recited in claim 70, wherein the instructions cause the universal controlling device to automatically toggle between the first operational mode and the second operational mode.

72. The non-transitory computer-readable media as recited in claim 71, wherein the instructions cause the universal controlling device to automatically toggle between the first operational mode and the second operational mode in response to a communication received from a controllable appliance.

73. The non-transitory computer-readable media as recited in claim 70, wherein the instructions cause the universal controlling device to automatically toggle between the first operational mode and the second operational mode as a function of a state of the one or more appliances.

74. The non-transitory computer-readable media as recited in claim 73, wherein the instructions cause the universal controlling device to internally track the state of the one or more appliances.

75. The non-transitory computer-readable media as recited in claim 69, wherein the first data comprises command data for commanding one or more operational functions of the one or more appliances.

76. The non-transitory computer-readable media as recited in claim 75, wherein the second data comprises data for causing movement of a displayed cursor associated with the one or more appliances.

77. The non-transitory computer-readable media as recited in claim 76, wherein at least one of the first data and the second data are transmitted from the universal controlling device utilizing an IR protocol.

78. The non-transitory computer-readable media as recited in claim 76, wherein at least one of the first data and the second data are transmitted from the universal controlling utilizing an RF protocol.

79. The non-transitory computer-readable media as recited in claim 76, wherein the instructions use a WLAN transceiver of the universal controlling device to transmit at least one of the first data and second data.

80. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause the universal controlling device to monitor a power supply of the universal controlling device.

81. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause the universal controlling device to initiate a playing of audio via a speaker of the universal controlling device in response to an input received into the universal controlling device.

82. The non-transitory computer-readable media as recited in claim 81, wherein the instructions cause the audio to be downloaded into the universal controlling device.

83. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause the universal controlling device to perform an operation in response to a sound input.

84. The non-transitory computer-readable media as recited in claim 69, wherein the instruction cause data to be received into the universal controlling device for upgrading the universal controlling device.

85. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause a cue indicative of an operational mode of the universal controlling device to be presented.

86. The non-transitory computer-readable media as recited in claim 85, wherein the cue is presented via a speaker of the universal controlling device.

87. The non-transitory computer-readable media as recited in claim 85, wherein the cue is presented via a LED of the universal controlling device.

88. The non-transitory computer-readable media as recited in claim 87, wherein the LED is disposed under a hard key of the universal controlling device.

89. The non-transitory computer-readable media as recited in claim 85, wherein the instructions cause the cue presented via use of the LED to be changed in response to the operational mode of the universal controlling device being changed as a result of an activation of a toggle element of the universal, controlling device.

90. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause the universal controlling device to transmit first data representative of a command to control a functional operation of at least one of the one or more appliances in response to activation of at least one hard key of the universal controlling device when the universal controlling device is in the first operational mode and causes the universal controlling device to transmit second data representative of a selection operation in response to activation of the at least one hard key of the universal controlling device when the universal controlling device is in the second operational mode.

91. The non-transitory computer-readable media as recited in claim 90, wherein the data representative of a selection operation comprises data representative of a mouse button activation.

92. The non-transitory computer-readable media as recited in claim 69, wherein command codes for controlling functional operations of at least one appliance are stored in a memory of the controlling device for use by the instructions.

93. The non-transitory computer-readable media as recited in claim 69, wherein the instructions cause invocation of an application used to setup the universal controlling devise to command functional operations of at least one appliance.

* * * * *

EXHIBIT H

US007895532B2

(12) **United States Patent**
Scott et al.

(10) **Patent No.: US 7,895,532 B2**
(45) **Date of Patent: Feb. 22, 2011**

(54) **USER INTERFACE FOR A REMOTE CONTROL APPLICATION**

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(73) Assignee: **Universal Electronics, Inc.**, Cypress, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1373 days.

(21) Appl. No.: **11/340,442**

(22) Filed: **Jan. 26, 2006**

(65) **Prior Publication Data**

US 2006/0161865 A1 Jul. 20, 2006

Related U.S. Application Data

(62) Division of application No. 10/288,727, filed on Nov. 6, 2002, now Pat. No. 7,831,930.

(60) Provisional application No. 60/344,020, filed on Dec. 20, 2001, provisional application No. 60/334,774, filed on Nov. 20, 2001.

(51) **Int. Cl.**
G06F 3/00 (2006.01)

(52) **U.S. Cl.** **715/810**

(58) **Field of Classification Search** 715/810
See application file for complete search history.

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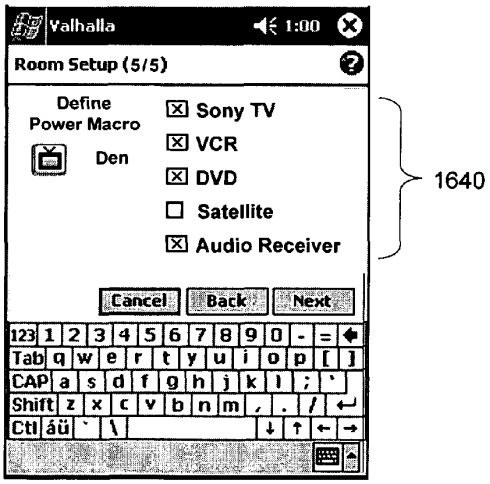
Primary Examiner—Ryan F Pitaro
(74) *Attorney, Agent, or Firm*—Greenberg Traurig, LLP

(57) **ABSTRACT**

A hand-held electronic device having a remote control application user interface that functions to displays operational mode information to a user. The graphical user interface may be used, for example, to setup the remote control application to control appliances for one or more users in one or more rooms, to perform activities, and to access favorites. The remote control application is also adapted to be upgradeable. Furthermore, the remote control application provides for the sharing of operational mode information.

14 Claims, 23 Drawing Sheets



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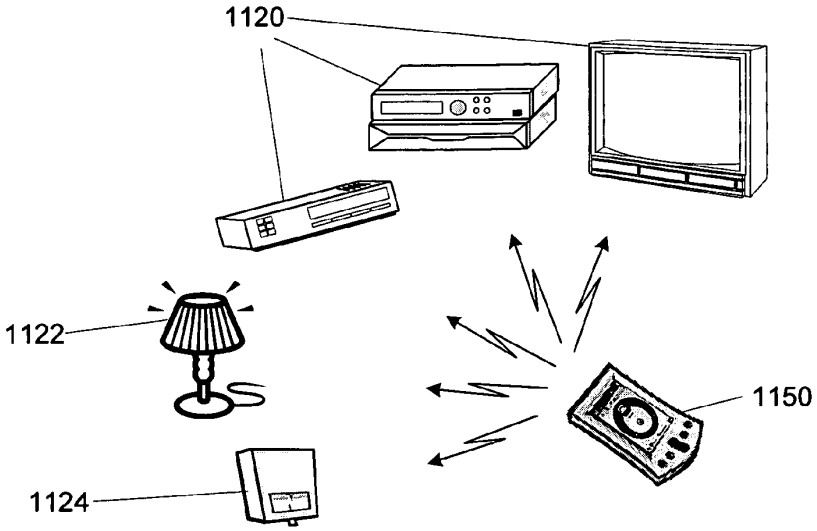


FIGURE 1

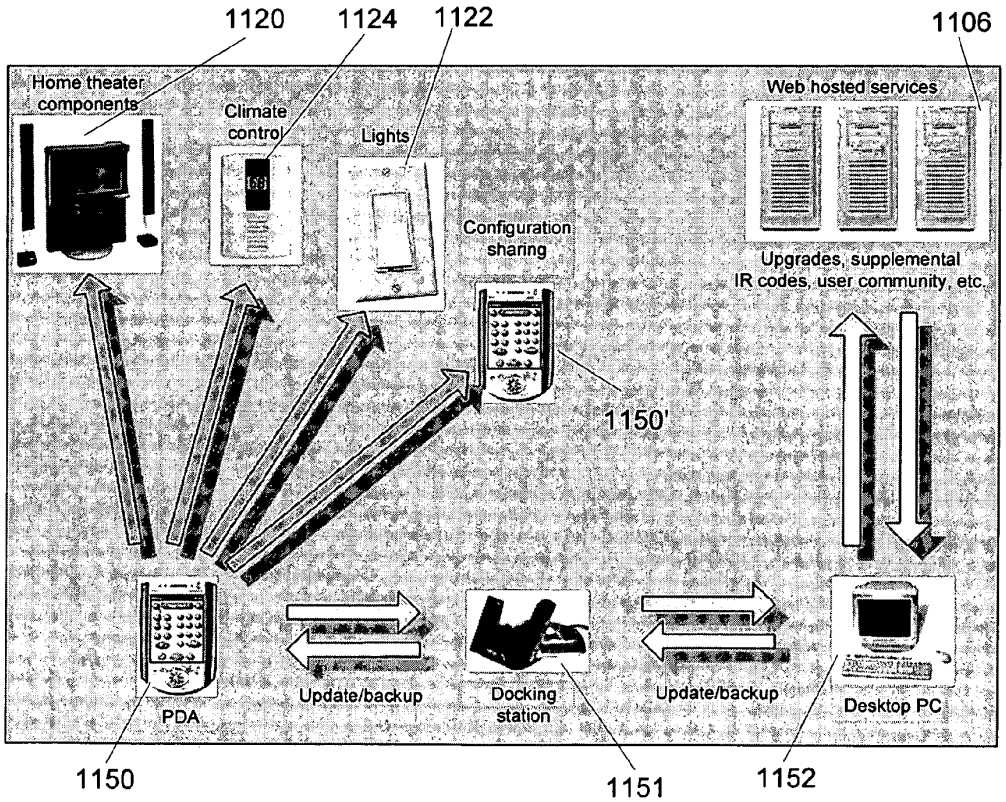
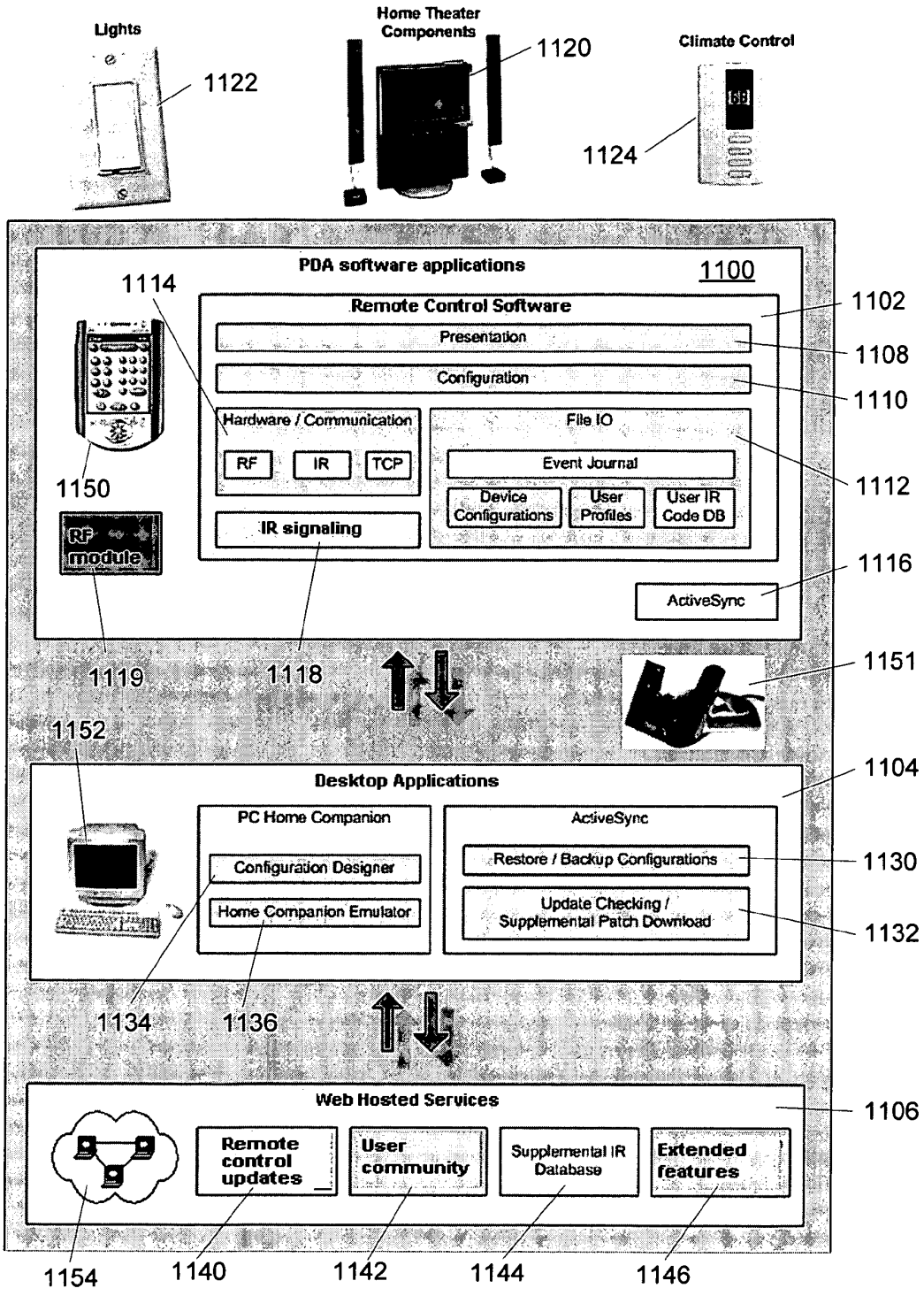


FIGURE 2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Home Theater Components
1120
Climate Control
1124
PDA software applications
1100
1114
Remote Control Software
1102
Presentation
1108
Configuration
1110
Hardware / Communication
RF
IR
TCP
File IO
Event Journal
Device Configurations
User Profiles
User IR Code DB
1112
1150
RF module
IR signaling
ActiveSync
1116
1119
1118
1151
1152
Desktop Applications
1104
PC Home Companion
Configuration Designer
Home Companion Emulator
ActiveSync
Restore / Backup Configurations
1130
Update Checking / Supplemental Patch Download
1132
1134
1136
Web Hosted Services
1106
Remote control updates
User community
Supplemental IR Database
Extended features
1154
1140
1142
1144
1146

FIGURE 3

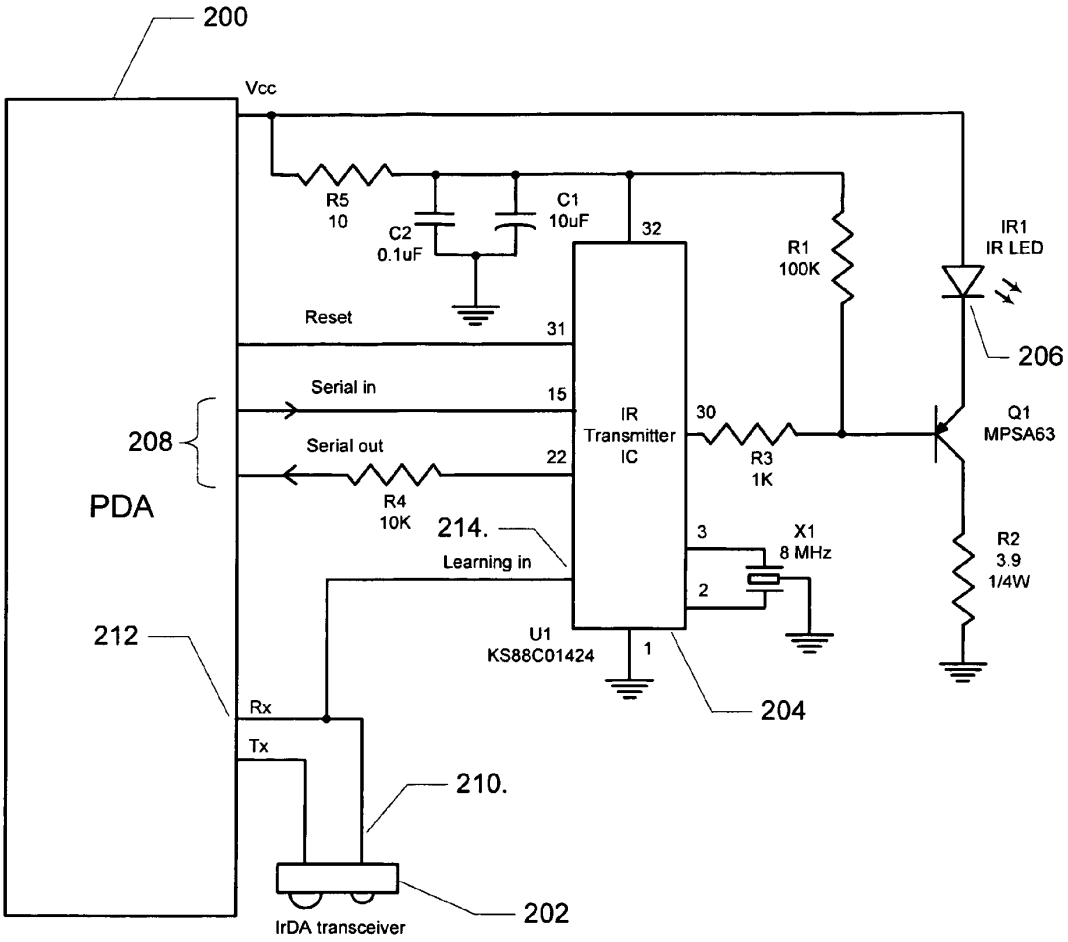
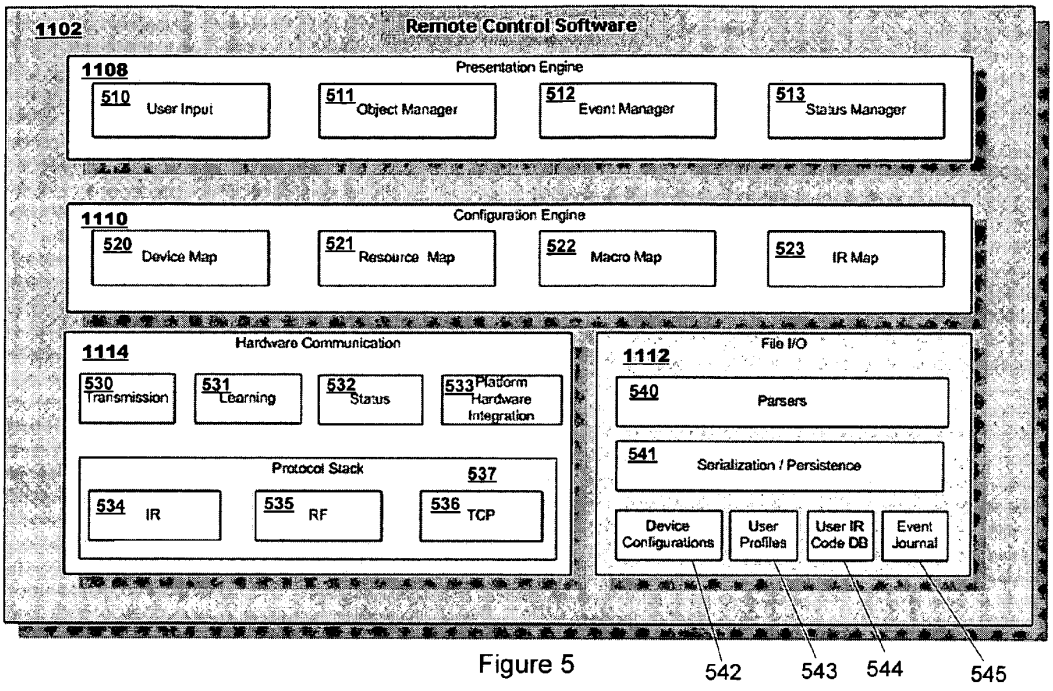

200
Vcc
R5
10
C2
0.1uF
C1
10uF
32
R1
100K
IR1
IR LED
206
Reset
31
Serial in
15
208
Serial out
22
PDA
R4
10K
IR
Transmitter
IC
30
R3
1K
Q1
MPSA63
214.
Learning in
3
X1
8 MHz
2
R2
3.9
1/4W
212
U1
KS88C01424
1
204
Rx
Tx
210.
202
IrDA transceiver

FIGURE 4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Remote Control Software
1108
Presentation Engine
510 User Input
511 Object Manager
512 Event Manager
513 Status Manager
1110
Configuration Engine
520 Device Map
521 Resource Map
522 Macro Map
523 IR Map
1114
Hardware Communication
530 Transmission
531 Learning
532 Status
533 Platform Hardware Integration
Protocol Stack
537
534 IR
535 RF
536 TCP
1112
File I/O
540 Parsers
541 Serialization / Persistence
Device Configurations
User Profiles
User IR Code DB
Event Journal
542
543
544
545

Figure 5

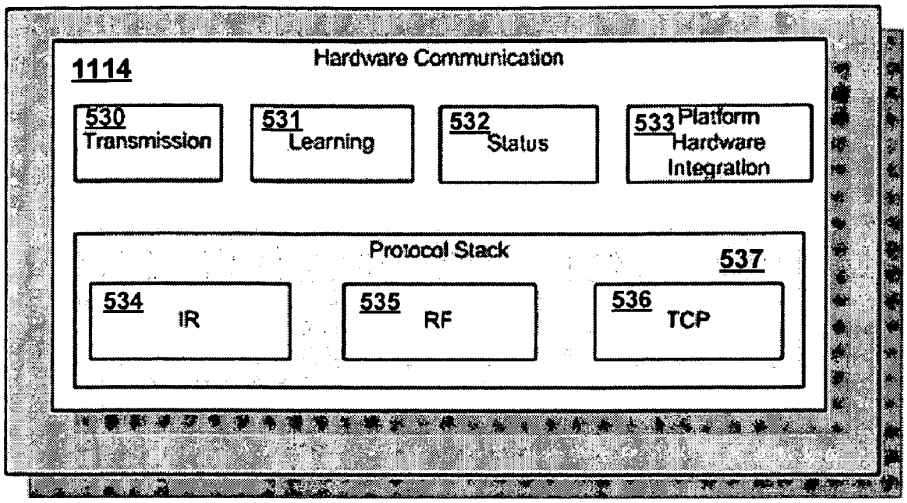

FIGURE 6

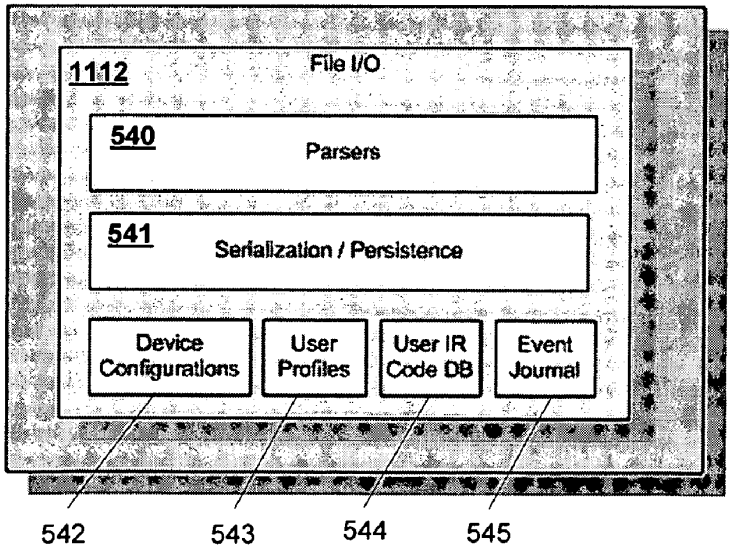

FIGURE 7

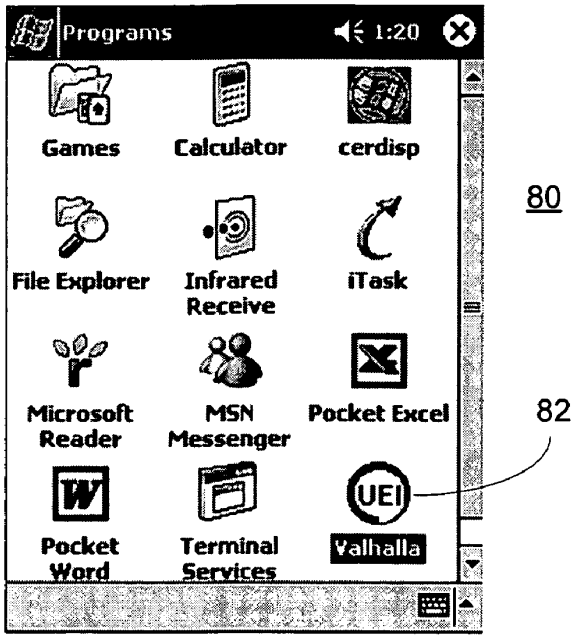

FIGURE 8

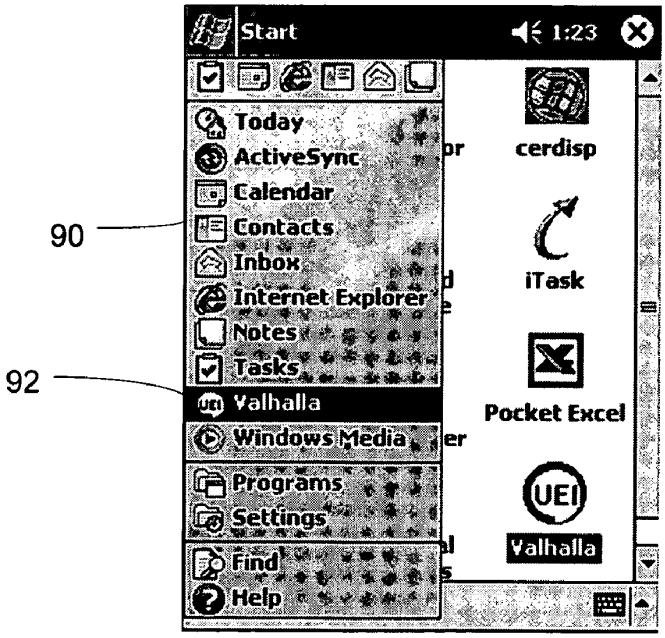

FIGURE 9

FIGURE 10

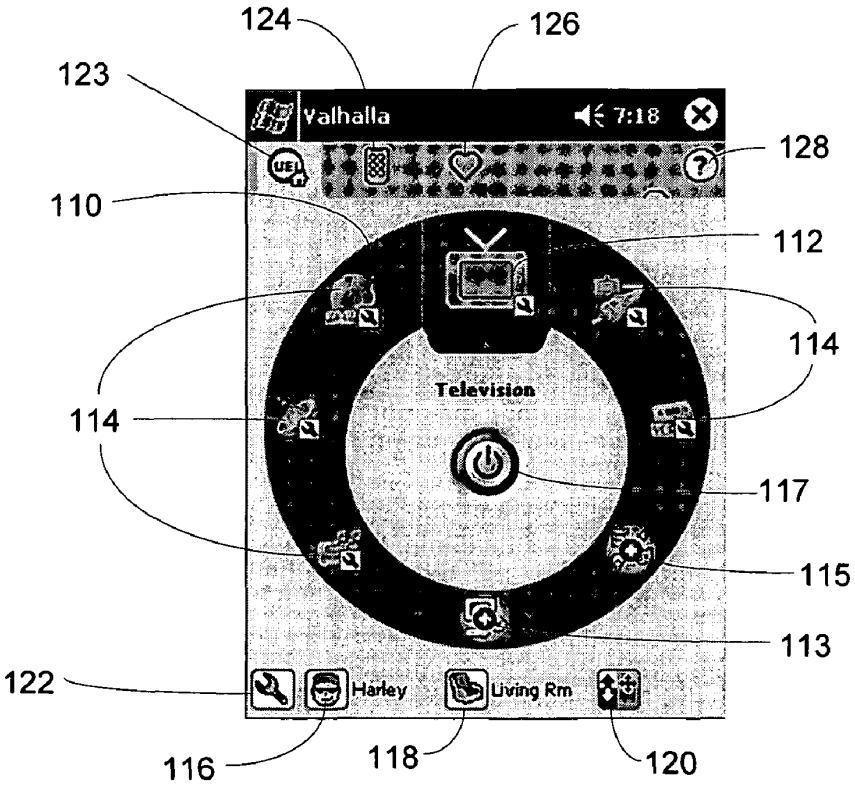

FIGURE 11

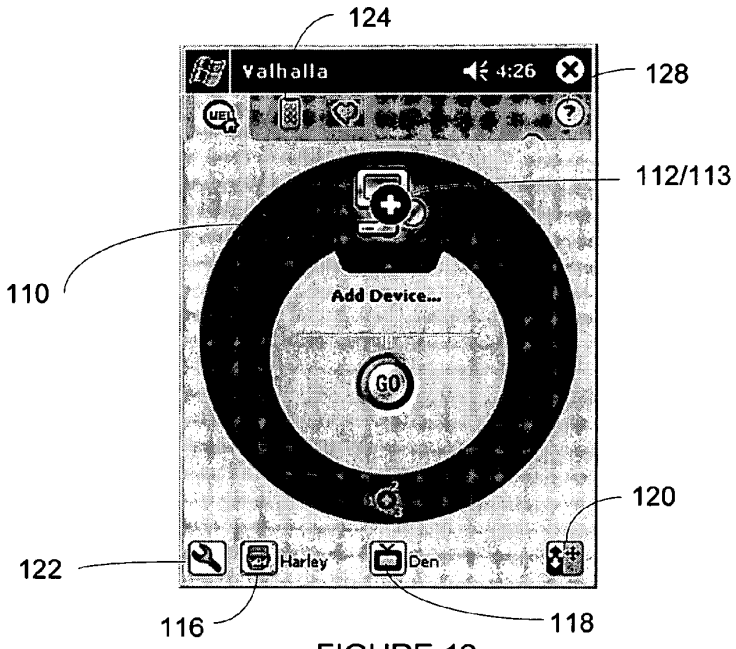

FIGURE 12

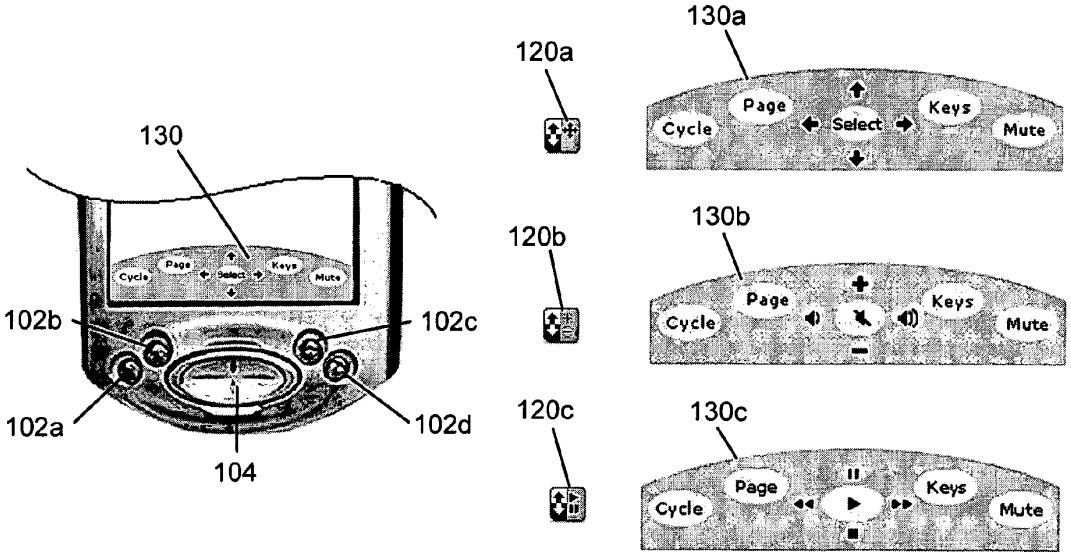

FIGURE 13

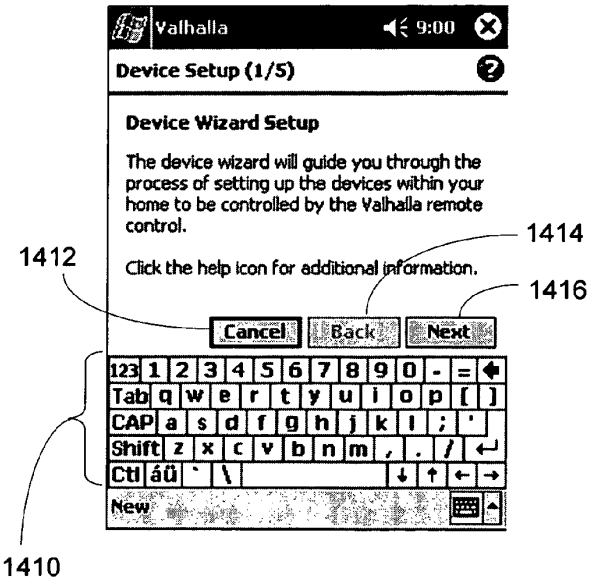

FIGURE 14a

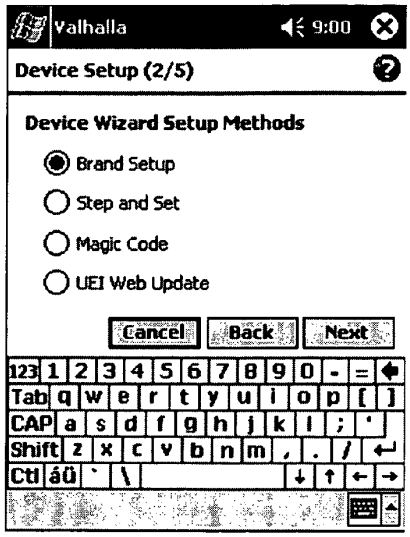

FIGURE 14b

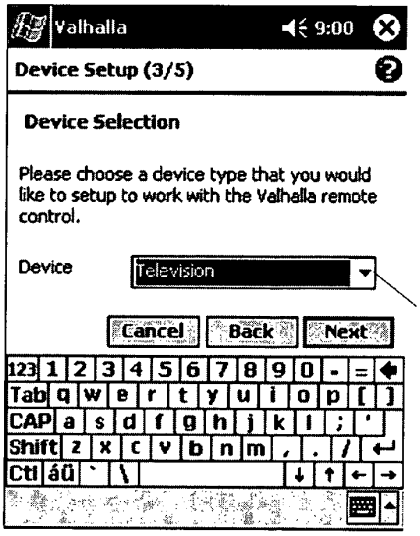

FIGURE 14c

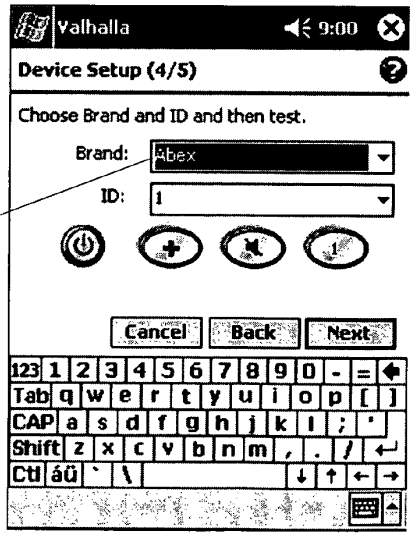

FIGURE 14d

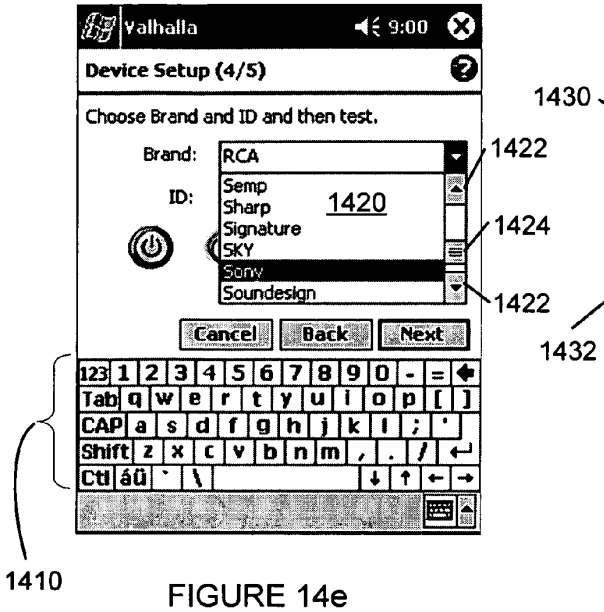

FIGURE 14e

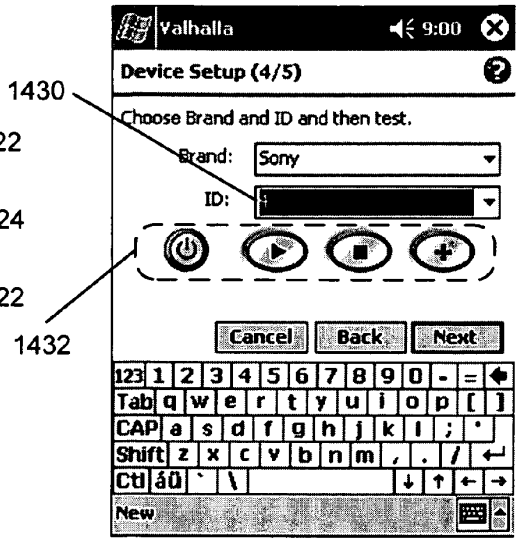

FIGURE 14f

FIGURE 14g

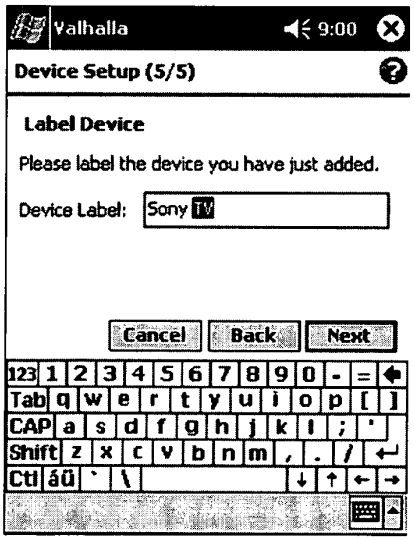

FIGURE 14h

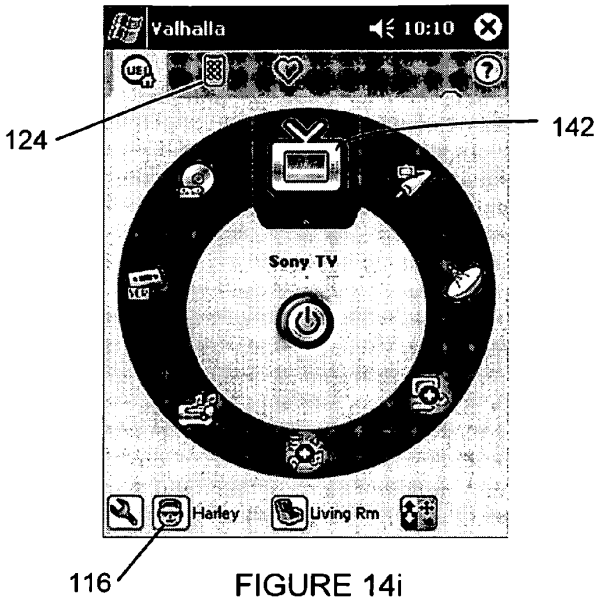

FIGURE 14i

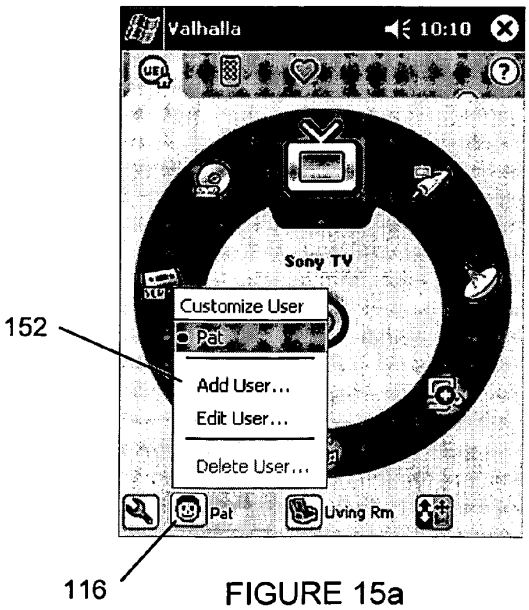

FIGURE 15a

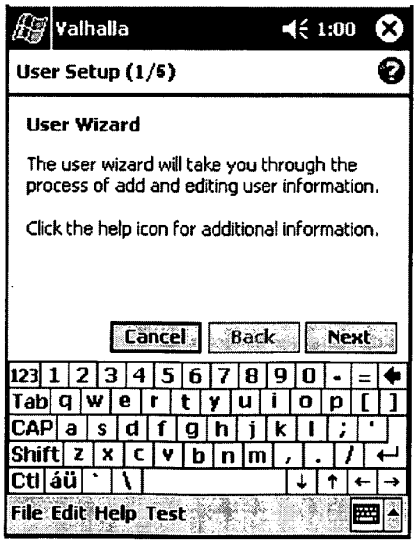

FIGURE 15b

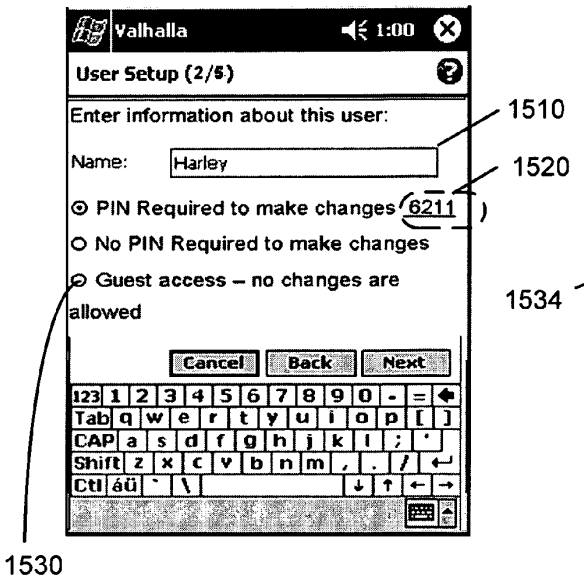

FIGURE 15c

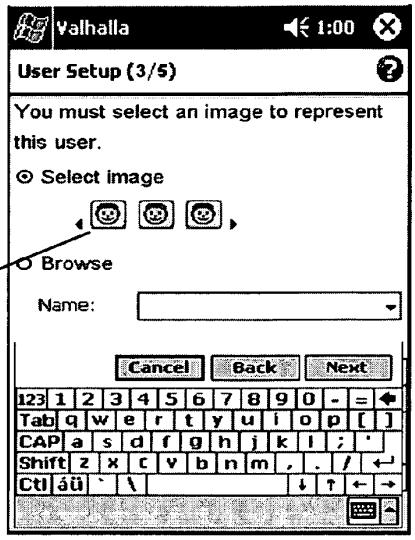

FIGURE 15d

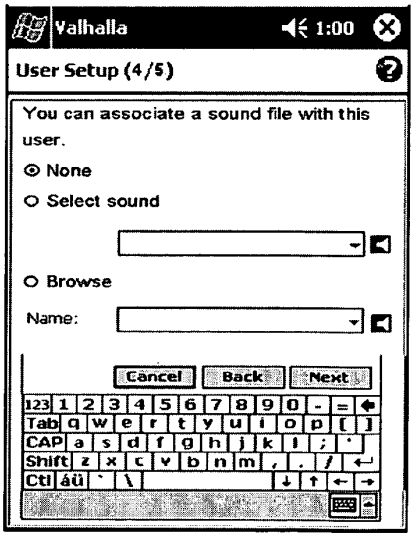

FIGURE 15e

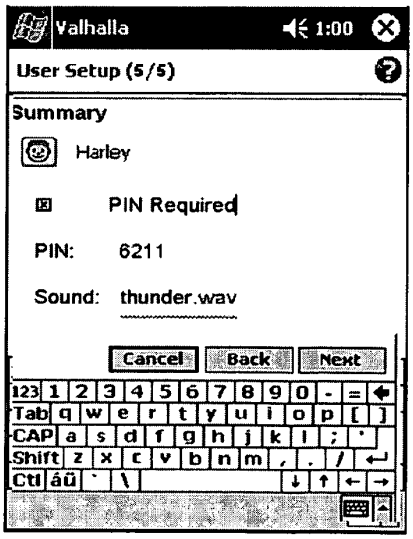

FIGURE 15f

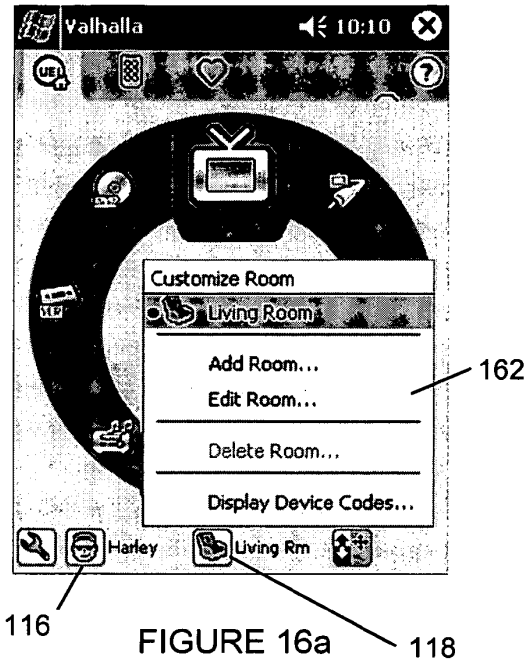

FIGURE 16a

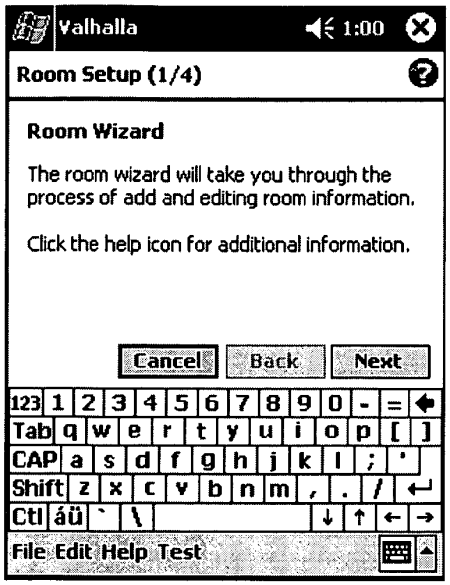

FIGURE 16b

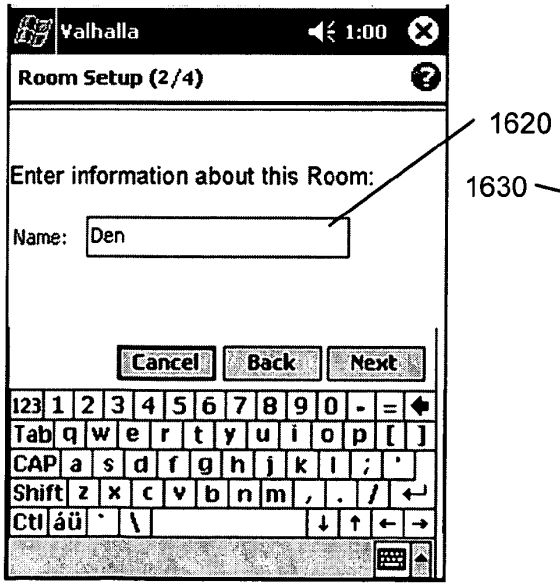

FIGURE 16c

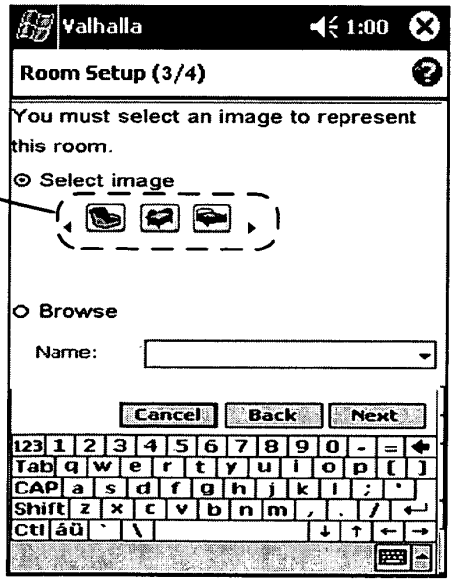

FIGURE 16d

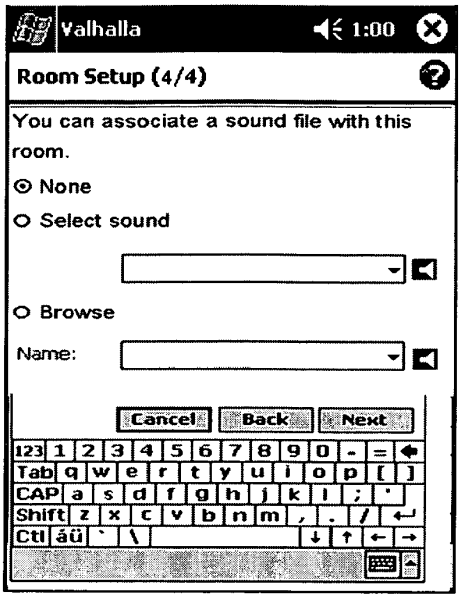

FIGURE 16e

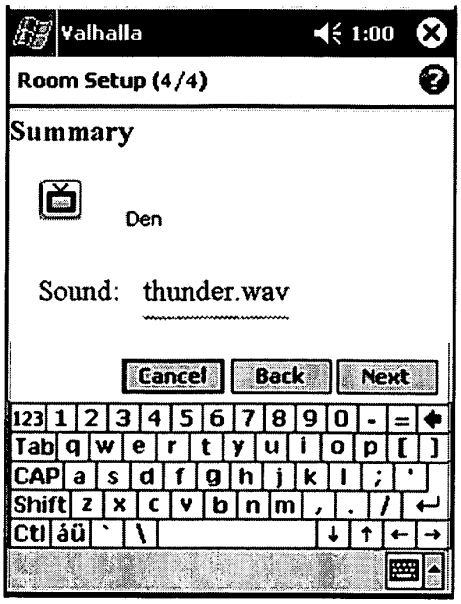

FIGURE 16f

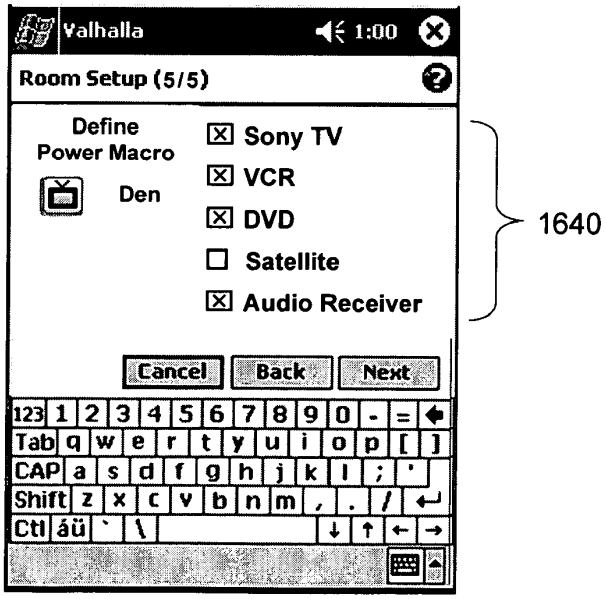

FIGURE 16g

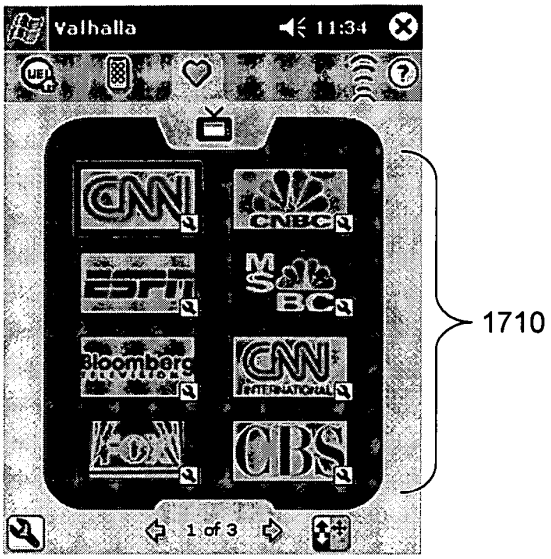

FIGURE 17a

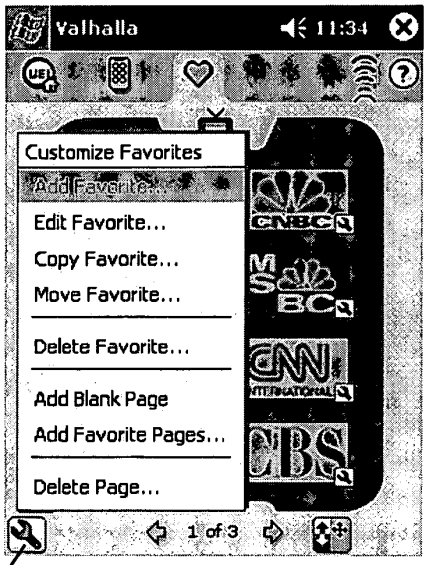

FIGURE 17b

FIGURE 17c

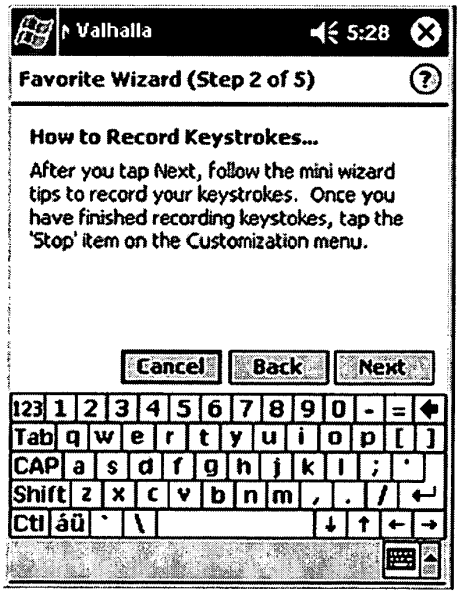

FIGURE 17d

FIGURE 17e

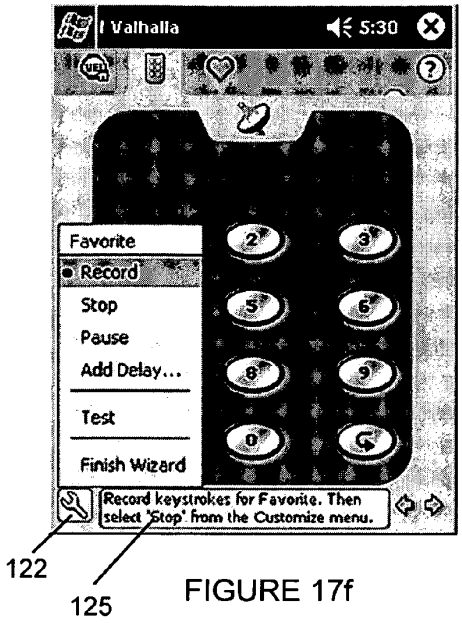

FIGURE 17f

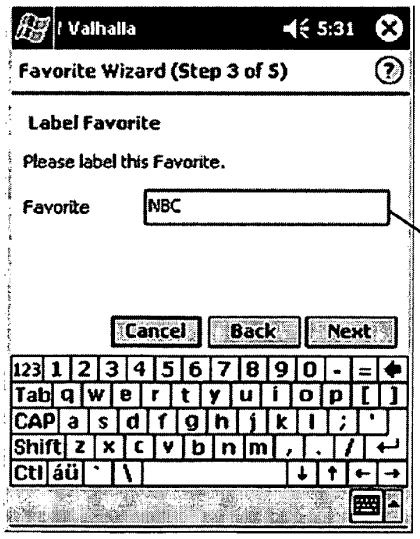

FIGURE 17g

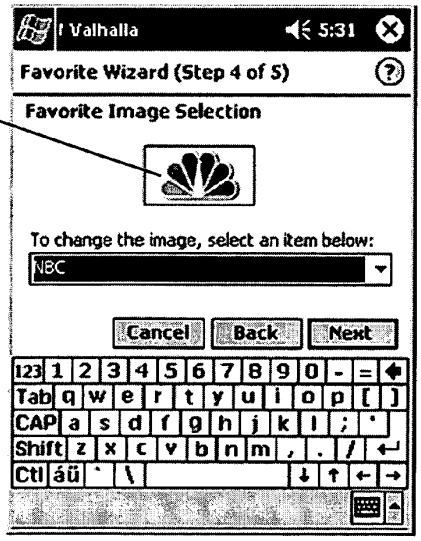

FIGURE 17h

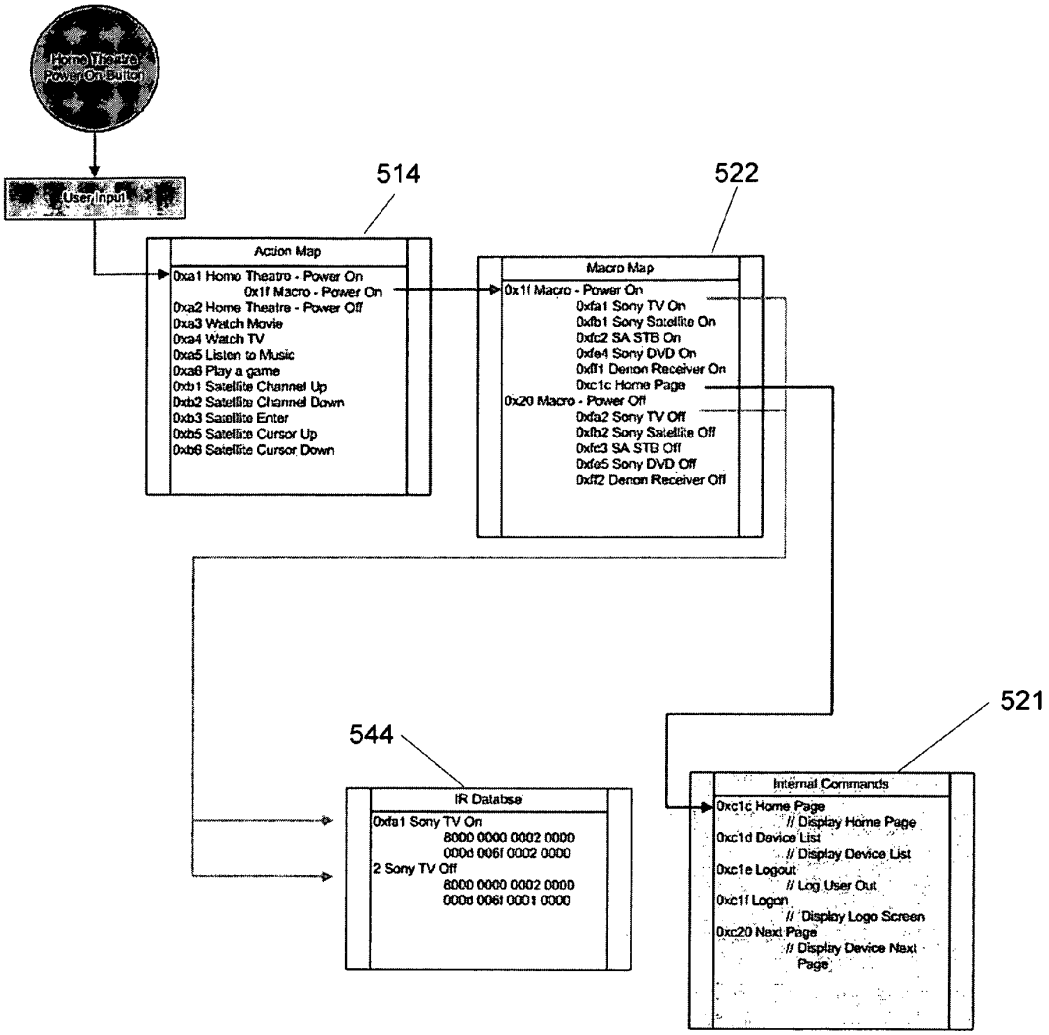
Home Theatre Power On Button
User Input
514
522
Action Map
0xa1 Home Theatre - Power On
0x1f Macro - Power On
0xa2 Home Theatre - Power Off
0xa3 Watch Movie
0xa4 Watch TV
0xa5 Listen to Music
0xa6 Play a game
0xb1 Satellite Channel Up
0xb2 Satellite Channel Down
0xb3 Satellite Enter
0xb5 Satellite Cursor Up
0xb6 Satellite Cursor Down
Macro Map
0x1f Macro - Power On
0xfa1 Sony TV On
0xfb1 Sony Satellite On
0xfc2 SA STB On
0xfe4 Sony DVD On
0xff1 Denon Receiver On
0xc1c Home Page
0x20 Macro - Power Off
0xfa2 Sony TV Off
0xfb2 Sony Satellite Off
0xfc3 SA STB Off
0xfe5 Sony DVD Off
0xff2 Denon Receiver Off
521
544
IR Database
0xfa1 Sony TV On
8000 0000 0002 0000
000d 006f 0002 0000
2 Sony TV Off
8000 0000 0002 0000
000d 006f 0001 0000
Internal Commands
0xc1c Home Page
// Display Home Page
0xc1d Device List
// Display Device List
0xc1e Logout
// Log User Out
0xc1f Logon
// Display Logo Screen
0xc20 Next Page
// Display Device Next Page

Figure 18

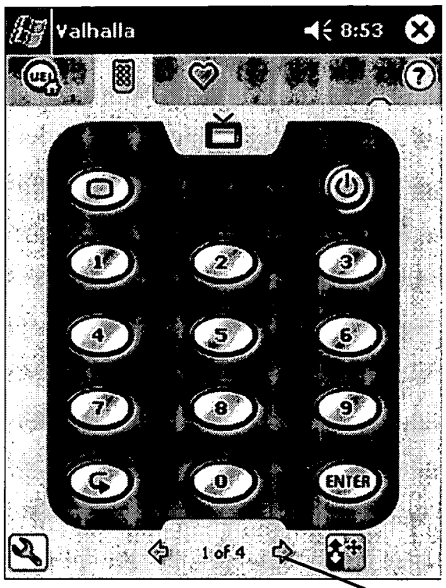

FIGURE 19a

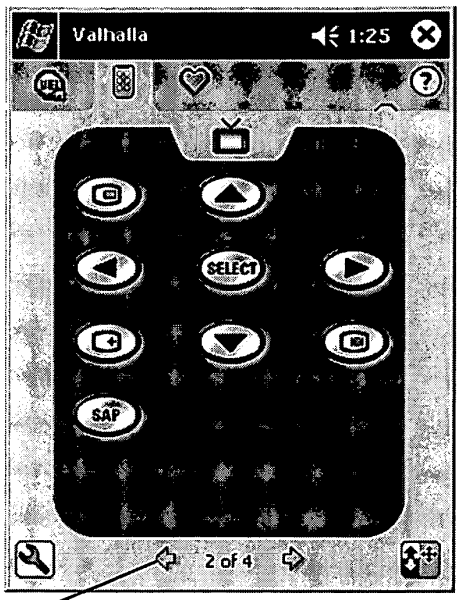

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FIGURE 19b

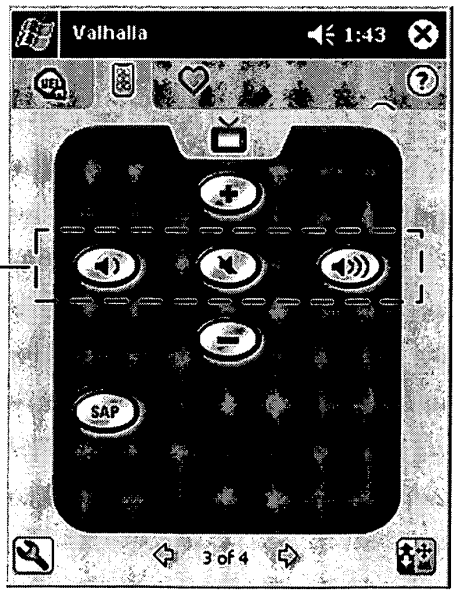

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FIGURE 19c

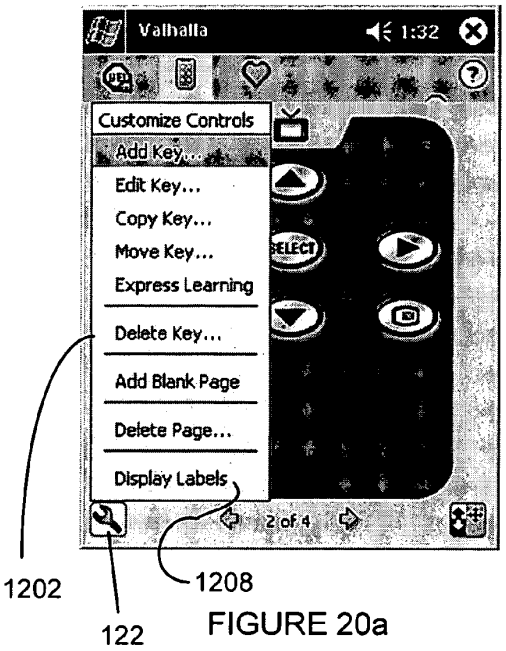

FIGURE 20a

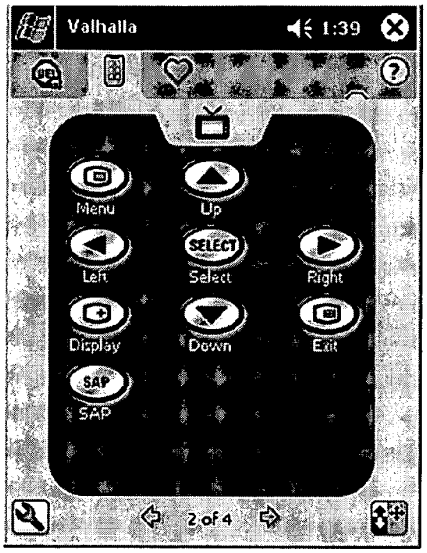

FIGURE 20b

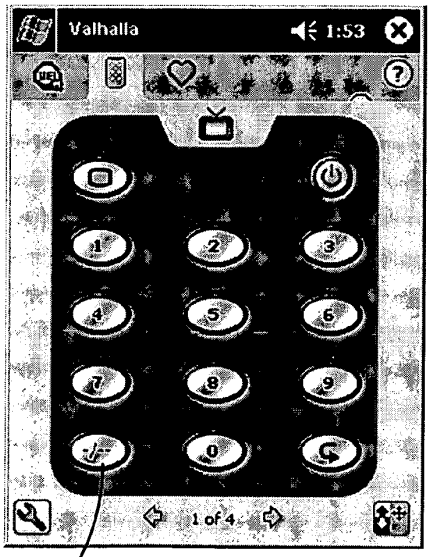

FIGURE 21a

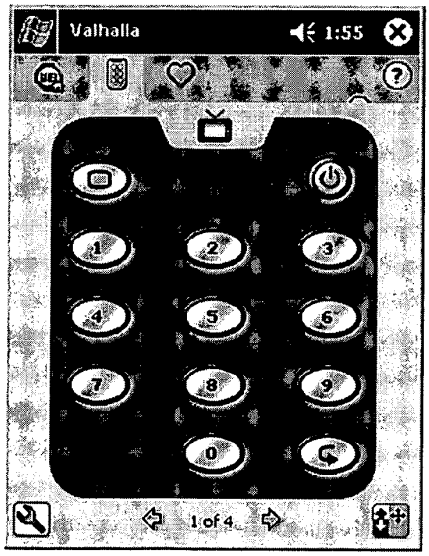

FIGURE 21b

FIGURE 22a

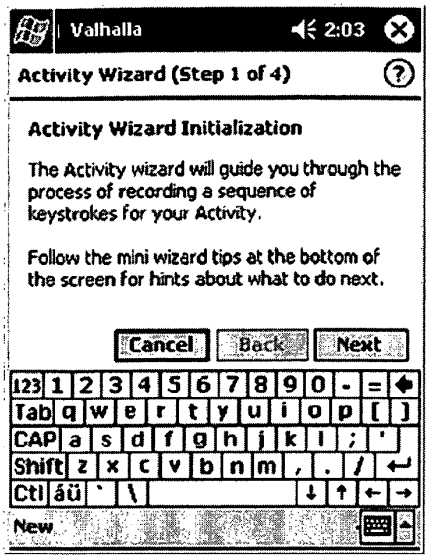

FIGURE 22b

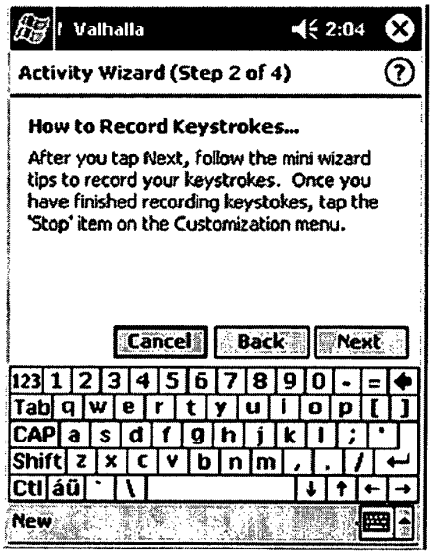

FIGURE 22c

FIGURE 22d

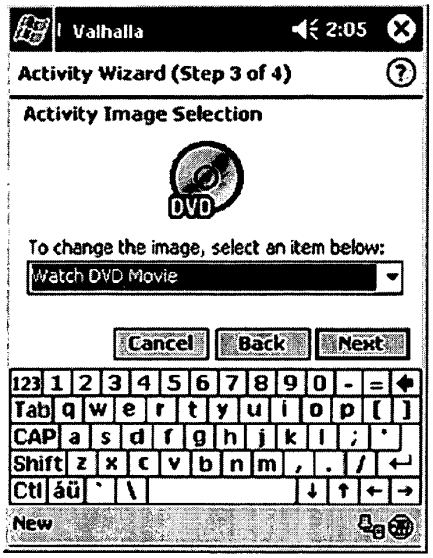

FIGURE 22e

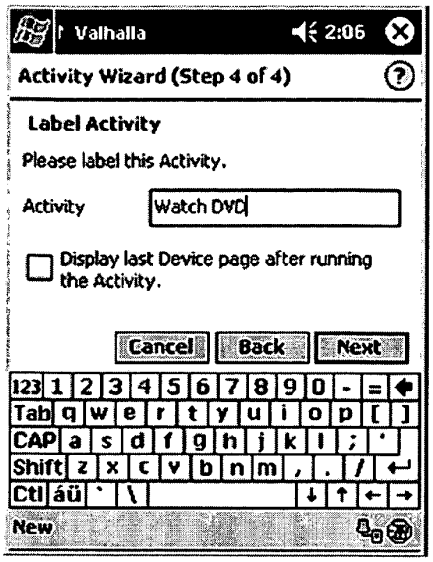

FIGURE 22f

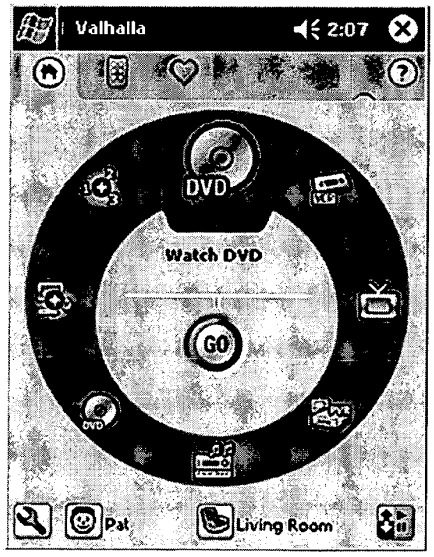

FIGURE 22g

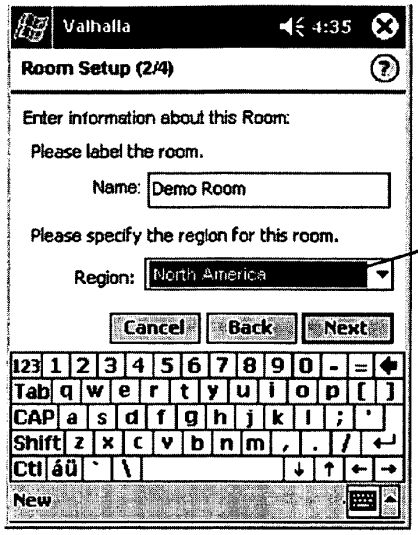

FIGURE 23a

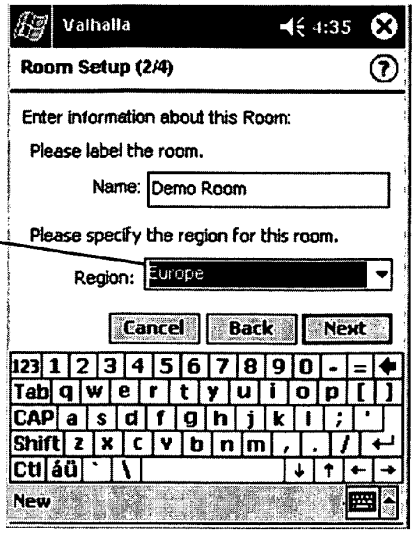

FIGURE 23b

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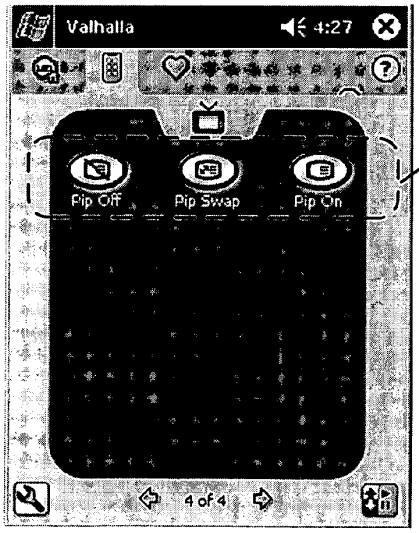

FIGURE 23c

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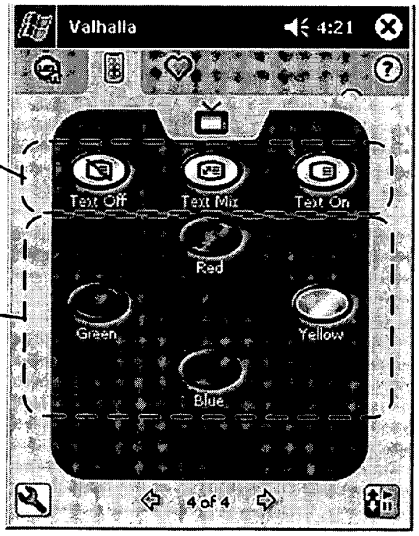

FIGURE 23d

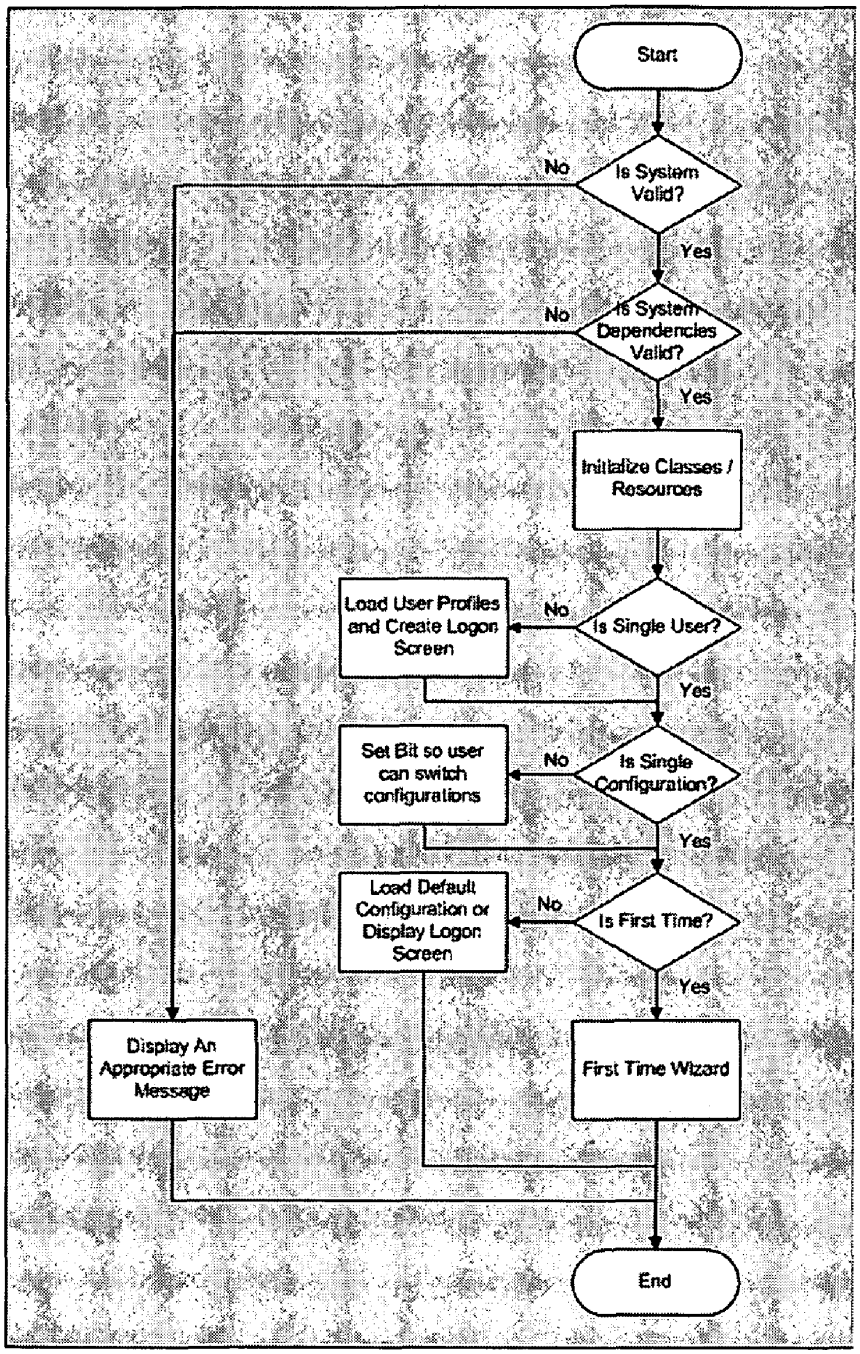
Start
Is System Valid?
No
Yes
Is System Dependencies Valid?
No
Yes
Initialize Classes / Resources
Is Single User?
No
Load User Profiles and Create Logon Screen
Yes
Is Single Configuration?
No
Set Bit so user can switch configurations
Yes
Is First Time?
No
Load Default Configuration or Display Logon Screen
Yes
Display An Appropriate Error Message
First Time Wizard
End

FIGURE 24

USER INTERFACE FOR A REMOTE CONTROL APPLICATION

RELATED APPLICATION INFORMATION

This application is a divisional of U.S. application Ser. No. 10/288,727 filed Nov. 6, 2003 which, in turn, claims the benefit of U.S. Provisional Patent Application Nos. 60/344,020 filed on Dec. 20, 2001 and 60/334,774 filed on Nov. 20, 2001.

BACKGROUND OF THE INVENTION

This invention relates generally to hand-held electronic devices and, more particularly, relates to a user interface for an universal remote control application resident on the hand-held electronic device.

Universal remote controls for controlling the operation of multiple, diverse home appliances are well known. In this regard, universal remote controls perform a valuable function by consolidating three, four, five, and more remote controls into one device. However, as more remotely controllable appliances enter the homes of consumers and the number of remotely controllable operations increase, the user interface of the universal remote control becomes increasingly more complex. This complexity arises from the need to provide more and more keys which are used to initiate the transmission of the control codes that control the increasing number of operations of the increasing number of home appliances. Disadvantageously, as the user interface of the universal remote control becomes more cluttered, the usability of the universal remote control diminishes. Accordingly, a need exists for a universal remote control having an improved user interface that simplifies the operation of the universal remote control and, as such, the remote operation of consumer appliances.

SUMMARY OF THE INVENTION

In accordance with these needs, the subject invention is directed to a hand-held electronic device having a remote control application user interface that functions to display operational mode information to a user. Representative platforms for the hand-held electronic device include, but are not limited to, devices such as personal digital assistants, Web tablets, lap-top computers, extended-functionality mobile phones, remote control devices, etc. which are collectively referred to hereinafter as "PDAs." An understanding of the objects, advantages, features, properties and relationships of the remote control application user interface will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments which are indicative of the various ways in which the principles of the remote control application user interface may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the remote control application user interface, reference may be had to various preferred embodiments shown in the following drawings in which:

FIG. **1** illustrates an exemplary system in which a PDA is adapted to control consumer appliances;

FIG. **2** illustrates an exemplary system in which a PDA receives updates and supplemental IR codes from a Web site;

FIG. **3** illustrates the internal topology of an exemplary system in which a PDA is adapted to control consumer appliances;

FIG. **4** illustrates an exemplary hardware circuit for enabling a PDA to transmit consumer appliance IR codes;

FIG. **5** illustrates an exemplary remote control application software architecture for a PDA;

FIG. **6** illustrates an exemplary hardware communication manager software architecture for a PDA;

FIG. **7** illustrates an exemplary file I/O manager software architecture for a PDA;

FIGS. **8** and **9** illustrate exemplary PDA display screens illustrating a resident or installed remote control application;

FIG. **10** illustrates an exemplary PDA physical appearance and layout;

FIG. **11** illustrates an exemplary remote control application home screen with the remote control application configured to control the operation of consumer appliances;

FIG. **12** illustrates an exemplary remote control application home screen prior to the remote control application being configured to control the operation of consumer appliances;

FIG. **13** illustrates exemplary remote control application hard key function assignments on a PDA together with corresponding informational displays;

FIG. **14** illustrates an exemplary series of steps to set up the remote control application to command the operation of a new consumer appliance;

FIG. **15** illustrates an exemplary series of steps to set up a new user of the remote control application;

FIG. **16** illustrates an exemplary series of steps to set up the remote control application to command the operation of consumer appliances in a designated room;

FIG. **17** illustrates an exemplary series of steps to set up a new remote control application favorite channel soft key;

FIG. **18** illustrates an exemplary set of data relationships for execution of a remote control application macro function;

FIG. **19** illustrates exemplary remote control application device control pages;

FIG. **20** illustrates an exemplary user customization of a remote control application device control page;

FIG. **21** illustrates an exemplary automatic customization of a remote control application device control page;

FIG. **22** illustrates an exemplary series of steps to program a remote control application activity or macro;

FIG. **23** illustrates an exemplary automatic adjustment of a remote control application device control page based on a geographical region;

FIG. **24** illustrates an exemplary start-up initialization sequence for the remote control application.

DETAILED DESCRIPTION

Exemplary embodiments of a user interface for an universal remote control application resident on the hand-held electronic device are illustrated and described which provide a next generation of home automation and consumer electronic controls. Representative platforms for the hand-held electronic device include devices supporting the Windows CE brand operating system or PocketPC type devices that include built-in support for transmitting consumer equipment IR remote control codes. Exemplary devices include, but are not limited to, devices such as the Compaq (now HP) iPAQ brand model 3950 or 3970 that include a hardware module to house the IR transmitter and an IR database of consumer electronics command codes, along with a remote control application that is used to control the operations of various consumer appliances. Other platform implementations using either built-in or add-on hardware to implement the IR transmit functionality are also possible, using other Windows CE brand class devices or other software systems such as, for example, the

Palm brand operating system. While the descriptions that follow are particularly illustrated using an iPAQ PocketPC brand platform, it will be appreciated by those of ordinary skill in the art that these teachings can be easily adapted to other platforms and software systems, for example, by making simple adjustments to display graphic sizes and layouts, file formats, etc., where needed to adapt to the different operating environment.

Turning to FIGS. **1** and **2** there is illustrated a system in which a PDA device **1150** is adapted to provide wireless control of consumer appliances such as home entertainment equipment **1120**, lighting **1122**, and temperature control **1124**. Control signals are provided, for example, by causing the PDA **1150** to emulate the wireless signals (IR, RF, etc.) used by the standard remote controls originally supplied with the respective appliances. The PDA **1150** is also preferably adapted to interact with Web-hosted services **1106**, such as IR code updates, graphics, software enhancements, electronic program guides (EPGs), etc., via a host desktop computer **1152** and docking station **1151** as particularly illustrated in FIG. **2**. It will be appreciated by those skilled in the art that the Web-hosted services may also be accessed directly, sans an intervening host desktop computer, in cases where the PDA **1150** is adapted to communicate directly to the Internet. Still further, the PDA **1150** may be adapted to share all or part of a user's programmed configuration settings with other compatible PD As **1150'**. An exemplary graphical representation of the topology of such an exemplary system is illustrated in FIG. **3** which depicts the major components of the remote control application and the environment in which it operates. Represented in FIG. **3** are the PDA **1150**, the host desktop PC **1152**, and Web Server(s) accessible through the Internet **1154**.

The PDA Software Application **1100** described hereinafter and shown graphically in FIG. **3** generally comprises four program segments that would typically be installed on the PDA **1150** in order to control, for example, home entertainment components **1120** and home automation components such as lights **1122** and climate control **1124**. By way of illustrative example, the four program segments comprise:

Remote Control Software **1102**: This application allows the user to control their consumer electronic devices. The application provides users with an easy and intuitive way to manage their home entertainment equipment as well as home automation devices (such as X10 type devices) within the home. The remote control application itself may comprise four major architectural subcomponents, although only the top level (referred to as the "presentation engine") is exposed to the end user. These four components, the presentation engine **1108**, the configuration engine **1110**, the hardware communication manager **1114**, and the file I/O manager **1112** will be described in more detail hereinafter.

ActiveSync Software **1116**: This application is used as a communications conduit to and from a remote control companion application that is installed on the host desktop PC **1152**.

IR Signaling Software **1118**: This application performs the IR signal generating functions to universally control appliances; supporting a database of IR codes and transmission protocols for use in conjunction with the IR hardware components described later with reference to FIG. **4**.

RF Module Software/Hardware **1119**: A Bluetooth or 802.11 RF module may optionally perform the RF signal generation to control RF devices and/or communicate wirelessly with a server or other applications resident on the host desktop PC **1152**. It will be appreciated that such an RF Module may be used either together with or in place of the above mentioned IR Signaling to effect control of home appliances.

As noted, the ActiveSync software **1116** cooperates with a remote control companion application **1104** installed on the host desktop PC **1152**. This combination of applications generally implements a standard Microsoft-based ActiveSync brand utility that functions as a communications conduit to/from the remote control application. Software supplemental to the ActiveSync brand applications may be required to ensure that data required for the remote control application is passed along the conduit in an appropriate fashion. Such supplemental software would be used to restore/backup configurations **1130** (e.g., which allows configuration files and event journals to be backed-up and restored) and to check updates/download supplemental patches **1132** (e.g., which reviews current version numbers of software, IR code databases, etc. and ensures that the latest versions are the ones available for download). It will be appreciated by those skilled in the art that these functions may be performed by software stored locally (e.g., on the PDA **1150** and/or host computer **1152**) or via the Web using, for example, Java applications. Optional desktop applications may also be used to edit **1134** and/or emulate **1136** the configuration and appearance of the PDA based remote control application on the desktop system **1152**.

Services and data that are located on a hosted site **1106** are represented by the remote control software services. The remote control software services may include remote control application software updates **1140**, supplemental IR database updates **1144** (including additional devices and/or key functions for download), and/or a remote control user community **1142** which, for example, might allow users to download additional graphics for interface customization, upload their configuration files to share with other users, etc. This user community **1142** is also where third party developed software extensions may be placed for download if desired. The hosted site **1106** may also be the source of data that is used in conjunction with extended features **1146** of the remote control application **1146**, for example downloadable electronic program guide ("EPG") information, cable channel lineups, movie schedules and the like.

The remote control application software **1102** may also include the following high level functions: setup wizards; consumer appliance control through IR and/or RF signal transmissions; customization features including the ability to learn IR codes, assign and playback macros, reassign keys, program favorites including rapid assignment of channel numbers to network logos, configure multiple user profiles, set restore points, configure a guest mode, customize the remote control application from the host or remote computer including the downloading of new IR codes and key functions, skins, additional network logos, software extensions; copying of configuration data from one PDA to another; journaling activity; and an API for third party developers to build extensions. These functions will be described in more detail in the following paragraphs.

Setup Wizards

The intent of a setup wizard is to get the PDA **1150** configured for use as quickly as possible. A setup wizard is normally a specialized part of an application program that functions to guide a user through a step-by-step setup or configuration process. Information utilized in connection with a setup wizard may be pre-populated so that there is an increased likelihood of a user successfully getting the desired results.

By way of example, a user setup wizard serves to setup the remote control application **1150** to identify one or more users and their preferences. For initial user setup, the user setup wizard may read data directly from the owner registration information file(s); no additional information would be required to use the remote control application. Alternatively, for initial user setup, the user setup wizard need not be invoked with the owner registration information file(s) being read and utilized by default.

By way of further example, a device setup wizard would be used to establish the list of devices that the remote control application is configured to control as well as how the devices should be controlled. To this end, the graphical user interface of the remote control application may start by displaying a small number of device buttons (e.g., buttons that would be activated to place the remote control application into a mode to control a device) that would initially be un-setup. Selection of an un-setup device button can be used to automatically invoke the device setup wizard. It is to be appreciated that the device setup wizard will be invoked each time the remote control application is setup to control a new device or when it is desired to add or change settings for an already setup device. Like the device setup wizard, the user setup wizard can be invoked multiple times to add more users. When invoking a setup wizard, the remote control application may be able to detect if a setup process has already been executed and may display the current settings to the user for confirmation or changing.

As will be described hereinafter, setup may prompt the user for the type of install to perform (typical or custom). For custom setup, the user may specify what level of device support is desired (standard, power, expanded). The setup wizard may chain together the functionality from different customization screens. Two major areas of customization are user setup and device setup. The user may be required to run the setup wizards sequentially from the beginning or may select a specific setup wizard or portion of a setup wizard to run after initial configuration of the remote control application. The remote control application may store user preferences in a configuration file and may recall configuration file preferences for inclusion in the setup wizard screens upon subsequent execution of those set wizards (e.g., in the performance of an edit of a setup).

Consumer Appliance Control

Once the PDA **1150** has been setup, via the remote control application, to control a device, the remote control application may be invoked to allow the PDA **1150** to be used as the primary Infrared (IR) remote control for the setup devices. In this regard, devices include conventional consumer appliances, such as televisions, VCRs, DVD players, PVRs, etc. Devices may also include home automation devices. While home automation devices may appear to be different from what might be viewed as convention consumer appliances (e.g., home theater equipment), from the standpoint of the remote control application, they are quite similar. As long as the home automation device can be controlled (e.g., via IR, RF, signals), the remote control application can cause the transmission of signals to the home automation device. Thus, the graphical user interface of the remote control application may support controls buttons, sliders, etc., e.g., via the use of bitmap images, to support operations unique to home automation devices (e.g., lights dim/brighter, curtains open/close, fan rotation speed, etc.).

Remote Control Application Customization

Remote control application customization allows a user to modify the graphical user interface, device and/or function control capabilities, etc, or the remote control application and/or PDA platform. Generally, any remote control application customization would be assisted by a setup wizard. Modifications achievable via customization include, by way of example, learning IR codes, assigning and playing back macros, specifying favorites (assigning channel numbers and/or the IR sequences necessary to cause entertainment appliances to switch channels to network logos), setting user security levels, etc. Before modifications are made, an automatic backup of the settings of one or more component parts of the remote control software application may be made so that the user can undo changes if they did not achieve the desired results.

Remote Control Application Customization from PC/External Updates

Settings usable in connection with the remote control application (e.g., skins, macros, etc.), remote control application updates, IR code updates, etc. may also be added, deleted, and/or modified based on information stored in external systems. The information may have originated on a Website, the host computer **1152**, etc.

Journal Activity

The system may be configured to journal (i.e., log) some or all of the activities of the user(s) and/or the system into a file that may be stored on the PDA **1150**. By way of example, some of the journal data may be accessed to determine the most recently viewed channels, may be used to generate and/or update favorites with an adaptive learning feature, etc. The journal data may also be made available for debugging purposes, for example by being synchronized with Web servers **1154** to accelerate the speed with which a support team can debug issues.

Extensible Through API for Third Party Developers

The system design may include an API that third party software developers can use to add functionality to the remote control application, communicate with remote control application, etc.

Electronic Program Guide ("EPG")

With an EPG application on the PDA **1150** the user can view upcoming shows and choose which shows to watch without distracting anyone else watching the TV. In addition, the remote control application may work in conjunction with the EPG application to prompt a user to watch a program, allow them to command tuning to a program, record a program, etc.

Operating Environment

It is anticipated that the major operating environment for the PDA **1150** would be the living room/home theater room in the home. However, the remote control application may be shipped with pre-configured lists of devices and device types associated with multiple rooms, including the office. The lists may be modified. Furthermore, a setup wizard can be used to configure the remote control application for one or more distinct rooms.

Hardware Components

The basic hardware components and architecture of a PDA that serves as a platform for the remote control application are well known in the art. Accordingly, for the sake of simplicity, only exemplary, select hardware features unique to the remote control functionality will be discussed in detail. Referring to FIG. **4**, a standard PDA **200** has an IrDA transceiver **202** used for short range communication with other PDAs and peripheral devices. In addition, since the controllable devices generally uses an IR wavelength different than that used by IrDA, the exemplary platform is also equipped with an IR transmitter IC **204** and separate LED **206** suitable for use with device IR control. In one embodiment, an IR signaling module **1118** communicates with the IR transmitter IC **204** through a serial

connection **208** (for example COM1/COM4). Methods and command protocols for communicating with such an IR transmitter IC **204** over a serial interface are well known and, therefore, need not be described further herein (for example, see co-pending application Ser. No. 09/905,432). It will also be appreciated by those skilled in the art that, while in the illustrated example the transmitter pulse timing is controlled by the specialized chip shown, in other embodiments it may be possible to implement these timing functions via software running in the main CPU itself which would serve as a substitute for the IR transmitter IC **204**. In addition, when adapted for use in connection with the remote control application, the IrDA receiver may also be used for learning IR codes from other devices such as originally supplied remote controls. The learning function would be made possible by paralleling the IrDA receiver output signal **210** to both the normal PDA connection **212** and the learning input **214** of the IR transmitter IC as shown.

The remote control application may also take advantage of any hard keys that are provided on the PDA **1150**. For example, the illustrated iPAQ brand PocketPC shown in FIG. **10** includes a navigation pad **104** and four additional keys **102** ("hotkeys") at the bottom of the unit which are normally used to facilitate rapid access to frequently used applications such as a calendar application, address book application, etc. In one exemplary embodiment, the remote control application may place appropriate calls to the underlying operating system API to override the default hotkey functions and replace them with commonly-used remote control functions (e.g., volume or channel adjust, etc.). Furthermore, key override may be configured to occur only when the remote control application is the active or in-focus application. In this manner, if the user changes to another application, e.g., the Excel brand spreadsheet application, while the remote control application is still running, the hardware hotkeys revert back to their previous setting until the remote control application is made active again. Additionally, the assignment of functionality to the hardware keys may be user configurable and/or automatically determined by the current mode of operation of the remote control application as described in more detail hereinafter.

The remote control application may also provide for the overriding of any default shut-off timing. In this manner, the shut-off timing of the display can be configured to be more appropriate for use in connection with a user's need to operate devices when the remote control application is the program with "focus." For example, by replacing the normal shut-off timeout with a two-stage process such as: after 15 seconds with no activity, switch to a splash screen then, after 5 additional seconds, power down. Alternatively, these timeout values may be made user-adjustable.

Software Components

Exemplary components of the remote control application **1102** are depicted in FIG. **5**. The illustrated components comprise a presentation engine **1108**, a configuration engine **1110**, a hardware communications manager **1114** and a file I/O manager **1112**. Each of these will be discussed in more detail in the following sections.

Presentation Engine

The presentation engine **1108** manages the user interface that users interact with to command the operation of the remote control application, for example, to cause the transmission of commands to devices. The presentation engine **1108** manages the mapping of the user configuration into the current hardware form factor—the iPAQ brand PDA in the exemplary embodiment, but in other embodiments this may be a WebPad or Tablet PC, a remote control software emulator, a remote control itself, etc.

User Input

The user input module **510** handles all input events generated by the user. This may include input from both the touch screen and hard keys. It may also handle input from a speech recognition software engine, for example the IBM ViaVoice brand software installed by default on the iPAQ **3950** brand PDA, or such other speech recognition applications as may be available. An action map **514** (see FIG. **18**) controls all of the actions the user can perform for each device type. Thus, user input events would be processed in terms of the action map **514**.

Object Manager

The object manager module **511** manages resources used to create display screens. The object manager may also manage intrinsic controls as well as controls developed by third parties.

Event Manager

The event manager module **512** may interface with an operating system calendaring function when events can be scheduled in the system.

Status Manager

The status manager module **513** may create a listening thread to capture any status broadcasts from devices. It may also track the current status of the remote control interface application, e.g., to determine if it is currently on a control page, a favorites page, running a setup Wizard, etc.

Configuration Engine

The configuration engine module **1110** manages the configuration resources and creates display screens using the presentation engine module. Resources for the configuration engine **1110** are generally stored in a configuration file.

Resource Map

The resource map **521** may contain any bitmaps, string literals, page layouts, and other resources utilized in the remote control application.

IR Map

The IR map **523** contains any user-defined IR codes to be used by the system. These codes may have been learned or downloaded. The IR map may also contain links to an IR database associated with the IR transmitter IC and/or the main or supplementary memory system of the PDA **1150**. IR map links may be created at runtime to account for a possible change in mapping between IR database revisions.

Macro Map

The macro map **522** contains a list of the macros available within the system. Each control that executes a macro may refer to the macro map.

Device Map

The device map **520** manages the links between the different types of information (resource map, IR map, and the macro map) for each appliance the remote control application has been configured to interact with. FIG. **18** is an example of how the various maps relate to each other as a user performs an action, in this case a macro (turning the power on for the home theater) as will be described in more detail hereinafter.

Hardware Communication Manager

The hardware communication manager module **1114** communicates with devices external to the system utilizing the IR, Bluetooth, and 80211.b RF hardware, and possibly others. As new hardware is developed, access to such hardware may be through a specified interface within the hardware communication manager. FIG. **6** depicts exemplary hardware communications interfaces. Each of the interface objects is discussed briefly below.

Transmission

The transmission object **530** is utilized to control the output of a byte sequence via the required protocol stack (e.g., IR, RF or TCP).

Learning

The learning object **531** is utilized to control the learning of a byte sequence via the required protocol stack, for example data acquired via the shared IR/IrDA input **214** to the IR transmitter IC **204**.

Status

The status object **532** is utilized to listen for broadcast messages on a particular protocol stack. This may be used for a two-way conversation between the PDA **1150** and other device hardware, e.g., hardware within home theatre and home automation systems.

Platform Hardware Integration

The platform hardware integration object **533** allows the remote control application to utilize the particular hardware capabilities of the PDA **1150** on which the remote control application is currently installed.

Protocol Stack

The protocol stack **537** is an abstraction layer between the different protocols used by the system to communicate with hardware within the home. A basic version of the remote control application may only use the IR protocol stack **534**, while more advanced (in capability) versions of the remote control application may use one or more additional protocol stacks (**535**, **536**) either in conjunction with or instead of the IR protocol stack.

IR

IR protocol **534** is used to communicate with any device using IR. The IR object may interface with an IR transmitter IC **204** for transmission and learning.

RF

RF protocol **535** is used to communicate with any devices using radio frequencies. The RF component may be used to abstract the communication between the remote control application and proprietary protocols, for example, Bluetooth, Zigbee, 802.11, or other RF signals.

TCP

TCP **536** may be used more and more as the home becomes wired and devices become connected via standard networking protocols such those used in conjunction with, for example, the IEEE 801.11b standard. The TCP stack may allow the remote control application to work with any wired device within the home, regardless of location. The TCP stack may also allow the user to communicate with the home from a remote location via the Internet or other conduit.

The File I/O Manager

The file I/O manager module **1112** allows data access to be managed and controlled from a single place within the remote control application. FIG. **7** depicts the file I/O manager objects, each will be discussed briefly below.

Parsers

The parsers **540** contain code to validate and parse the different file formats used by the remote control application. The parsers may be used mainly by the configuration engine **1110** to read and parse the different resources required to display information.

Serialization/Persistence

The serialization/persistence object **541** is used by the remote control application to read and write different file formats.

Device Configurations

The device configuration files **542** contain definitions of the devices the user has configured to be controlled via the remote control application. Each file may describe the contents and layout of various displayable pages for a device. These files may also contain any resources used to command the operation of such devices. Without limitation, the list of resources may include macros, IR codes, bitmaps, string literals and other data. A more detailed description of these file attributes are presented in later sections.

User Profiles

The user profiles **543** stores data about the different users of the remote control application which may include a user name, bitmap for a user avatar, user PIN, bit mask overlay and all preference settings. The results of adaptive learning (on a per-user basis) may be also stored in a user profile. Additionally, the user's favorite channel list (and associated network logos) may be stored here as well.

User IR Code Database

The user IR code database **544** is used to store supplemental IR codes downloaded from a Website or from some other source. The user IR code database may be separate from the standard IR code database shipped with the PDA **1150**. The user IR code database may also contain learned IR codes.

Event Journal

An event journal **545** may be provided to contain a log of user and system actions that have occurred within the remote control application. The event journal may also contain broadcast messages received from devices within the home. The event journal is a log of what the user has done as well as what is happening within the home. It is contemplated that a user may be able to switch between a verbose mode and an alert mode. The event journal may also be used for debugging purposes.

System Features and Functions

The following paragraphs present detailed descriptions of individual features of the remote control application. In some cases examples of typical use are presented showing user input or other external action(s) or event(s) together with the associated response. It should be appreciated that such examples of typical use are intended to be illustrative only and, therefore, are not to be considered as limiting.

Setup Wizards

Setup wizards are parts of the application logic that guide the user of the remote control application through the steps to add devices to be controlled, configure user preferences, etc. The results of using a setup wizard may be saved into configuration files **542**, **543** to be subsequently referenced by the remote control application when needed. In the discussions that follow, setup wizards will be divided into two general categories: user setup and device setup. A user setup wizard may be invoked to identify user(s) of the remote control application and their preferences. A device setup wizard may be invoked to establish the list of equipment that the remote control application may control and/or how the equipment should be controlled. A device setup wizard may also be used to gather information about which devices the remote control application may be operating. In this context, the overall initial setup process may be thought of as comprising four procedures:

(1) device identification;

(2) generation of macros (either via explicit entry or automatically);

(3) definition of favorites; and

(4) configuration of the home screen.

Setup wizards can be executed multiple times, for instance to add more users, add/change devices (to be controlled), add/change settings, etc. In an exemplary system, a setup wizard may detect if a particular setup has already been executed and display the current settings to the user for reference.

Platform Setup

Platform Setup—Device Identification.

To setup the remote control application platform, a device setup wizard may be invoked to setup the type(s) of devices the PDA **1150** is intended to operate (TV, DVD, DSS, AMP . . .). This information may also include the manufacturer of a target device. To this end the user may be presented with one or more selections of IR codes and given the opportunity to test the different IR codes (i.e., cause transmission of IR code signals) from a selected manufacturer in order to determine which IR codes cause a target device to respond. Once the user has found and tested a successful combination, the device may be added to a list of devices available to be controlled.

Four different and well-known methods of device setup may be supported, namely, brand setup (described above); step and set (where the user tests the next IR code in a sequence of IR codes); direct entry (where the user enters a pre-determine code for the manufacturer/device type that is the intended target) and downloaded Web codes (where the user directs the remote control application to apply new IR codes gained through internet access). In the event RF communications are utilized between the PDA **1150** and devices, these same setup procedures may be utilized without limitation.

Once the correct command code set has been established by one of the methods described above, the remote control application may expose different levels of functionality (i.e., keys to command device functions) depending on the current user of the remote control application. By way of example, the user interface may be implemented with up to three levels of complexity. The default level is to expose standard level functionality, (i.e., a representative set of the most commonly accessed command functions for the device type and model configured). Alternative levels may include a power level, which exposes all command functions available within the remote control application library for the device type and model configured, or a simplified level, in which only basic command functions are exposed to the user for the device type and model configured. These, or other levels, may be offered to a user based on pre-set user parameters (e.g., as entered during user setup described hereinafter.)

Platform Setup—Generation of Macros

The remote control application may analyze the remote control application environment (i.e., the system comprising the setup devices) and, based on the knowledge of the user and the devices, the remote control application may be used to create one or more macros to automate repetitive device functions. By way of example, two common appliance functions, "Power Macro for Home Theater" and "Audio/Video Routing" are described in more detail hereinafter, although it will be appreciated that many other such opportunities for automated or semi-automated tasks may exist.

Power Macro for Home Theater

If all the appliances in a home theater system have discrete on/off codes, the remote control application can offer a global (Home Theater) on and off function. To that end, the remote control application may display a list of all available appliances (i.e., all appliances for which the remote control application has been setup to control) and the user may select the one(s) to be involved in the Home Theater Power macro. For example, the remote control application may present a list comprising DSS, Cable Box, Amp, VCR, DVD and TV. The user may select only Amp, DVD and TV to be switched on and off in unison as part of a Home Theater Power macro since the VCR may be independently activated to receive an input signal from the DSS and Cable box to record a program.

Audio/Video Routing

If the user routes all audio output via an amplifier, the remote control application can assist the user by ensuring that the correct audio input signal is used when the user selects a device to be the device in focus. This form of macro setup may be accomplished by asking questions during setup that are utilized by the remote control application to associate inputs with devices. Alternatively, the macro setup may be accomplished by utilizing information previously stored in Device Map **520** regarding device interconnections and input/output configurations. The macro(s) created as a result of the question/answer session may be customizable by the user to handle special situations.

Platform Setup—Favorites

The user may be able to specify a list of favorite channels for a number of categories. The favorites lists may be synchronized with the channel lineup offered by a cable or satellite service provider. During the setup of personal favorites, a user may specify a group (of channels) that they always want to cycle through. The channels selected for personal favorites do not need to be in the same category (i.e., be available from the same device). For example, a news favorite might include local broadcast channels while a movie favorite might include a cable channel. A personal favorites group may include a unlimited number of channels or may be limited in number to, for example, no more than seven entries in order to balance the time consumed in stepping through the channel possibilities against the amount of program material offered.

Platform Setup—Home Screen

Another setup option may allow the user to customize the remote control application home screen, an example of which is illustrated in FIG. **11**. The remote control application home screen should not be confused with the initial (splash) screen that is loaded when the user starts the remote control application. In this regard, the remote control application home screen is the user's main portal to various device control screens or pages. During the setup of this home screen, the user may select whether to display control through a device-centric view, an activity-centric view or a mixture of the two, i.e., depending on the user's preference the home screen may list the devices, or it may list the activities that the user can perform, or it may list a combination of both. It is to be appreciated that an activity represents a desired configuration of one or more devices that is centered around a given pastime. By way of example, a "watch movies" activity might be setup to cause the transmission of commands to select the DVD player as the audio/video source, set the surround sound mode on the audio amplifier, switch the TV input to S-Video, etc.

Devices, activities, favorites, etc. that are not yet setup may be displayed on the remote control home page such that the iconic representation of the device, activity, favorite, etc. has an overlay, for example a wrench as illustrated in FIG. **11**. The overlay indicates to the user that setup is required. In this regard, the icons function as soft keys that may be selected to cause the performance of a further action, for example, to display a device control page, cause the transmission of commands, etc. Additionally, if desired, the iconic representation of an un-setup appliance, activity, favorite, etc. may also be displayed in a different color (e.g., "grayed" so as to be displayed fainter than normal as gray-scale image). The overlay and/or graying may be removed once a setup procedure has been completed.

Setup may be automatically initiated in response to a user selecting a device, activity, favorite, etc. that has not been previously setup, i.e. selecting an icon with an overlay as

described above may automatically invoke a setup wizard corresponding to the type of the selected icon. Initial execution of the remote control application may also detect that setup has never been performed and automatically invoke one or more of setup wizards (which may be chained one to the next in this instance) in order to establish a starting configuration for the remote control application. Still further, the remote control application may be pre-configured with a set of typical appliances, activities, etc. This set may, for example, be the most popular brand/model of each device type for the market or region in which the PDA **1150** was sold, may be a set of devices corresponding to a specific manufacturer or brand associated with the PDA **1150**, or some combination of the above or any other criteria deemed appropriate.

Remote Control Application Start-Up and Home Page.

FIGS. **8** and **9** illustrate exemplary display screens with programs installed on an exemplary PDA **1150** including the remote control application (labeled "Valhalla"). The user may initiate the remote control application by, for example, tapping the Valhalla icon **82** directly on the screen **80** or by selecting the Valhalla application **92** from a drop down start menu **90**. When the remote control application is started for the first time it may display a splash screen such as illustrated in FIG. **10**. The splash screen may include information such as product name and revision, company name, patent and copyright notices, etc. The splash screen may be OEM specific if desired. Alternatively, the remote control application, when staring from this initial state, may run a startup demo to show a quick overview of features of the remote control application. Once any splash screen display and/or demo are completed, the newly-started remote control application may load a default home screen with a suggested set of un-setup devices as illustrated in FIG. **11**. Alternatively, an empty home screen with only the set-up icon **112**/**113** shown in FIG. **12** may be displayed. Still further, the remote control application may be pre-configured to start with certain predetermined devices already setup to be controllable as noted previously, for example, those of a particular manufacturer.

Icons representing devices and/or activities may be displayed in a wheel **110** that rotates to bring the selected device or activity to the top of the wheel. The top (primary) icon **112** may be displayed larger (48×48 pixels in an exemplary embodiment) than the other icons **113**, **114**, **115** (24×24 pixels in said exemplary embodiment). Additionally, an intermediate size (36×36 pixels for example) may be provided for display of secondary devices. The spacing of the icons may be dynamically calculated based on number of icons, to provide even spacing around the wheel **110**.

In the example illustrated in FIG. **11**, indication is made to a user that devices are in need of being setup, for example, by overlaying a wrench symbol over the standard device icon. Devices that are set up may float (i.e., be moved so as to be positioned) near to the top of the wheel **110**. By interacting with the wheel **110**, the user may select a primary device **112** to initiate setup, or select another icon **114** to become the primary device. When another icon **114** is selected, the wheel may perform intelligent rotation turning in the direction that moves the desired device to the primary position—the wheel top—quickest.

The home page display shown by way of example in FIG. **11** or **12** may also include indication of the current user **116** and current room **118**. As will be described later, the icons representing the user and room may also be used to invoke configuration menus for these items. A default user name may be taken from the PDA **1150** owner information. In the example shown in FIG. **11** (i.e., with suggested devices to setup already displayed on the wheel, a default room is shown as the "Living Room" which includes the devices: TV, DVD, Cable Box, VCR, Satellite, Audio Receiver).

The home page display may also include a KeyGuide icon **120** which initiates a display of the current assignments of the hard keys of the PDA **1150** and/or allows altering these assignments, an icon **122** to initiate a customization menu, and icons **124** and **126** to switch to other display pages; all of which will be described in more detail hereinafter.

Device Setup

In order to control devices, the user may be required to first identify to the remote control application the manufacturer and IR code used by each device, as well as associating any desired special features (display name, macros, etc.) with the device. In general, device setup comprises performance of one or more of the following steps:

1) The user selects a device icon to set up.

2) The user selects a device type. (In some cases, this may comprise simply confirming that the device type desired matches the displayed icon that was selected.)

3) User specifies the device IR format and command set to be used to control the selected device. This, in general, may occur in one of several ways: the user may directly specify a desired setup code by number, the user may search through all codes available (local and/or downloaded from Web Hosted Services), the user may select a brand name from a list presented by the remote control application (and may test various versions of that manufacturer's IR codes if multiple possibilities exist), or may use such other technique as may be appropriate.

An exemplary setup process will be described in more detail in the paragraphs that follow.

Referring once again to FIG. **11**, the device wheel **110** is shown with all devices requiring setup. In addition, an add device icon **113** and add activity icon **115** are presented. The device wheel **110** of FIG. **11** represents an example of one starting view of the device wheel **110** when a user starts the remote control application for the first time. By way of example, the steps involved in setting up a TV using a brand name will be detailed. The user begins by touching the TV icon **112** (or pressing the power button **117** or selecting a hard key such as the navigation pad **104**, etc.). By way of explanation, during normal operation (i.e., after the remote application has been setup for the device), touching the device icon would cause the remote control application to display a page of control functions for that device (for example, see FIG. **19***a*). However, in this case, since the device has not yet been set up (as indicated by the small wrench icon overlaid on the main TV symbol), the setup wizard depicted in FIGS. **14***a* through **14***i* is invoked. As an alternative (for example in the case where a TV device has already been set up and the user wishes to add a second TV, or where the user wishes to add a device not shown on the default wheel) the user may select the add device icon **113**.

The device setup wizard for TV setup may begin with an introductory message as shown in FIG. **14***a*. Also, a keyboard **1401** and cancel **1412**, back **1414** and next **1416** buttons, for use in connection with the setup wizard, may be displayed. In general, the keyboard and buttons can be displayed throughout each setup wizard page and occupy the same position on all the screens for ease in use. Once the optional help message has been read, the user would press the next button **1416** which steps to the exemplary screen shown in FIG. **14***b*. The user may then select which setup method he wishes to use. In the example illustrated, the default setup method—brand setup—is already selected and the user simply presses the

next button **1416** to proceed to use this setup method. Other methods of device setup, for example, code searching, direct entry, etc., are also available and are well known in the art—see for example U.S. Pat. Nos. 4,959,810, 5,614,906 or 6,157,319 all of which are incorporated herein by reference in their entirety.

To perform device setup in accordance with the step illustrated in FIG. **14***c*, the user selects the device type (TV in this example) from a drop-down menu **1418** of all device types supported by the remote control application. Then, as illustrated in FIGS. **14***d* and **14***e*, the user may be presented with a drop down list of brand names **1420** which correspond to the device type selected. The user may navigate this list using the up and down arrows **1422**, slider **1424** displayed at side of the list, or any other conventional GUI device. Furthermore, for rapid positioning to a general area within the drop down list, the user may use the keyboard **1410** to type in the starting letter(s) of a brand name. Once the brand name has been highlighted (e.g., "Sony" in FIG. **14***e*), the user can indicate a desire to choose that brand by selecting (e.g., by tapping) the next button **1416**. Additional GUI techniques for choosing a brand of choice are also contemplated.

If multiple IR code set possibilities exist for the brand selected, the user may be presented with the opportunity to test each possible IR code set using a drop down menu **1430** in connection with a displayed set of test function keys **1432** as shown in FIG. **14***f*. Test functions **1432** may or may not be displayed with text labels indicating their designated functions—the example **1432** shown in FIG. **14***f* is without labels while the example shown in FIG. **20***b* includes keys with text function labels. The user may activate one or more of the test function keys **1432** to see if they function to control the device as desired (i.e., in response to their activation an IR command code from the selected set is transmitted to test if the target device responds). If the target device fails to respond as anticipated, the user can simply select a different code set number from the drop down list **1430** and repeat the test procedure (e.g., activate the test function keys again). When the correct setting is found (i.e., the device responds as expected), the user can press the next button **1416** to continue with the setup procedure.

Optional steps illustrated in FIGS. **14***g* and **14***h* allow the user to enter a tag name for the setup device. A default name, as shown in FIG. **14***g*, can be a simple concatenation of the brand name and the device type. The user may, however, elect to use a more descriptive name of their choosing, as shown in FIG. **14***h*. Tapping next button **1416** may then be used to complete the device setup wizard process. The resultant TV device icon **142** would then be displayed on the wheel **110** (sans wrench overlay) together with the user-entered device name as illustrated in FIG. **14***i*. Alternatively, an additional step may be included to allow the user to select a customized icon to represent the device.

User profiles

Exemplary steps for setting up a new user profile are illustrated in FIGS. **15***a* through **15***f*. With reference to FIG. **15***a*, user customization may be initiated by tapping the current user icon **116** which results in the display of a customize user menu **152**. The customize user menu **152** may be used to select a user—to place the remote control application in a mode to control devices, perform activities, etc. that have been associated with the selected user (in the example illustrated in FIG. **15** only one user, "Pat," is currently defined), to add/delete a user, or edit the profile of an existing user. By way of example, the steps involved in adding a user will be illustrated. It will be appreciated that process of editing the profile of an existing user could be very similar.

A user setup wizard could be invoked by selecting "add user" from the customize user menu **152**. The user setup wizard may commence by displaying an introductory message as illustrated in FIG. **15***b*. The user setup wizard may then prompt, as shown in FIG. **15***c*, for entry of a new username **1510** and, by way of example only, an optional password or personal identity number (PIN) **1520** which would be needed to authorize future changes to the profile being setup. In the example illustrated, this user setup wizard page also permits the new user to be defined as a "guest" via checkbox **1530**. If set, guest status preferably disables all setup and customization functions (device, user, room, favorites, etc.) within the remote control application while this user designated as a guest is active. Guest status may also be used to inhibit access to other applications of the PDA **1150** such as, by way of example, calendar, address book, spreadsheet, etc. The inhibit function may be implemented on a global basis—i.e., the guest user is prevented from exiting the remote control application—or may be on a per-application basis, depending on the level of support available within the PDA platform.

Once the name and any PIN or special status has been entered during user setup, an icon can be selected to represent the new user (as illustrated in FIG. **15***d*) and a sound may also be assigned to provide an audible indication when switching the remote control application for use by that user (as illustrated in FIG. **15***e*). To select an icon, the user may scroll through a list (for example presented as a strip **1534**) of predefined user images (which may alternatively be presented as a drop-down list, etc.), browse through bitmaps and select an image from a file folder within the PDA **1150**, download an image, etc. Similarly, the user may select a sound from a drop down list of predefined sounds, browse through all audio (e.g., .wav files) stored in the PDA **1150**, download an audio file, etc.

To conclude the user setup process, a confirmation screen may be presented, as illustrated in FIG. **15***f*. Tapping the next button **1416** on this confirmation screen may then return the remote control application to the home page display with the new user (e.g., the selected "Harley" icon shown, for example, FIG. **14***i* or **16***a*). The initialization of a new user in the manner described above can also result in the creation of a new, blank favorites page that would be assigned to this user. The purpose and configuration of the favorites page will be discussed in detail in a later section.

Room Profiles

An exemplary process for configuring a room profile is illustrated in FIGS. **16***a* through **16***f*. Room profile configuration may be commenced, with reference to FIG. **16***a*, by, for example, tapping the current room icon **118** which results in the display of a customize room menu **162**. The customize room menu **162** allows the selection of a different room—to place the remote control application in a mode to control devices, perform activities, etc. that have been associated with the selected room (in the example illustrated only one room, "Living Room," is currently defined), the addition/deletion of a new room, or editing the profile of an existing room. For configuration purposes, the customize room menu **162** also includes the option to display the device code setup numbers for all devices currently configured in the selected room. The device code setup information may be useful, for example, when accessing Web-based services which provide extended function codes for devices, and are not supported by automated or semi-automated processes. (For additional background regarding semi-automated Web-based services, the reader is directed to co-pending application Ser. No. 10/151,501 "System and Method for Upgrading the Remote

Control Functionality of a Device," which is incorporated herein by reference in its entirety.) By way of example, the steps involved in adding a room will be illustrated. It will be appreciated, however, that editing an existing room might be a similar process.

To invoke the room setup wizard, the "add room" item could be selected from the room customization menu **162**. Upon being invoked, the room setup wizard may begin by displaying an introductory message shown by way of example in FIG. **16***b*. The room setup wizard may then prompt for the entry of a name **1620** for the room, as illustrated in FIG. **16***c*, and an image to be associated with this room, as illustrated in FIG. **16***d*. To select an image, the user may scroll through a list (e.g., a strip as shown, a drop-down list, or other-like GUI selection device) of predefined room images **1630**, may browse through bitmap images in file folders within the PDA **1150**, download an image, etc. The user may also optionally associate a sound with switching to that room, as illustrated in FIG. **16***d*. Again, the user may select a sound from a drop down list of predefined sounds, may browse through sound files (e.g. .wav files) stored in the file system of the PDA **1150**, download an audio file, etc.

A confirmation screen may be presented to indicate that the room setup process is complete, as illustrated in FIG. **16***f*. Tapping the next button **1416** on this confirmation screen could then return the remote control application to a home page display with the new room "Den" selected and an empty wheel **110** ready to be configured for the devices and/or activities to be associated with the newly-defined room mode, as shown, for example, in FIG. **12**. The initialization of a new room in the manner described above may also results in the creation of a new, blank favorites page that would be assigned to that room (and user in that room if appropriate). The purpose and configuration of the favorites page will be discussed in detail in a later section.

Room Setup—Phase 2—Generation of Macros

The remote control application may also provide for the automatic or semi-automatic configuration of macros (pre-programmed sequences of command actions which may be played back by pressing a single key) for common activities. By way of example, an often needed sequence of commands may be the powering on (and off) of several appliances together, such as may be case with a home theater system. To facilitate creation of this type of exemplary macro, the remote control application may, as part of a setup wizard, display to the user a list of all currently configured devices **1640** accompanied by "checkboxes" in which the user may indicate which of these are to participate in an "all on" macro. This may be included as an additional step in the room setup wizard, as illustrated in FIG. **16***g*, since such macros will generally be associated with the devices available in a particular room.

By way of further example, another often needed sequence of commands may be those that perform input routing. To configure a macro to perform input routing, the user may answer a series of questions about the manner in which devices are hooked-up, may select a device hook-up configuration from a list (or from a list with visuals/diagrams), etc. Alternatively, where the underlying graphics capability of the device **1150** supports it, a drag and drop interface may be provided to match the inputs and outputs of different devices that is representative of the manner in which the devices are hooked-up. Each of these input/output pairs may then be used to establish a macro sequence to perform input routing so that, when a particular device is selected for use, all of the requisite audio/video controls are automatically selected or set to allow said use.

Customization of Home Screen

The system may allow the user to customize the appearance and functionality of the home page by, for example, adding a customized background, displaying only devices or only activities on the wheel **110** (the default may be to display both types, intermixed in the order in which they were set up), limiting access to setup functions, etc.

Initialization of the Remote Control Application and Interaction with Other Applications.

The remote control application may have basic behavior as it is turned on and off. By way of example, an initialization sequence may be performed when the remote control application is started. An overall view of a typical initialization sequence is shown in FIG. **24**. In the illustrated example, advantage is taken of the hardware and software provided by the iPAQ brand PDA to integrate seamlessly with the Windows Pocket PC **2002** brand software system. The basic initialization behaviors of this exemplary platform are described in the following paragraphs, together with the interactions with other parts of the PocketPC brand software system.

When a user selects the remote control application icon from the "programs" or "start" screen display (illustrated in FIGS. **8** and **9**), an internal consistency check is preferably performed to ensure that the files and resources needed to operate the remote control application are available. If a file is missing, for example, the user may be informed that they need to re-install the file or an application. If problems persist, a message may be displayed to inform a user that technical support should be contacted. A dependency check may also validate that the required hardware (e.g., an IR signaling module **1118** or transmitter IC **204**) is available and that it is the correct version for the remote control application and other software currently installed. In the Class Initialization, individual modules may be initialized to a default state before a configuration file is loaded. In the resource initialization, the base resources required to guide the user through the first time wizard may be loaded. The resources include the IR database, icons, bitmaps, dialogs, etc.

Thereafter, all required system resources are initialized, the remote control application selects the appropriate start-up user and room (if multiples are configured). The system may check to see if the system is multi-user or single user. If the system is single user, the multi user login may not be created. If the system is multi-user, the system may load the user profiles (including user name, user icon, user PIN and which configuration file the may use). If the system is single user, the system may check to see if the user has one or more configuration files. If there is only one configuration file, then that configuration file may be loaded. If the user has more than one configuration file on the system, the system may load the configuration file which is specified as the default. The default may be the last configuration file used on the system. The system may set a bit so the system can provide a method to allow the user to (choose from and) load any other configuration files. If the first time user wizard flag is set, the system may gather information about the user. If a configuration file is already on the PDA **1150**, then the user may be prompted to use that one or create a new one.

Upon successful initialization, a splash screen may also be displayed, an example of which can be seen in FIG. **10**. The splash screen may include information such as the product name, company name, legal information, including patent and copyright notices, etc. This splash screen may require user identification and/or log in or may simply switch to a home screen after a time out. In either case, on completion of the splash screen activity the remote control application would be the application in focus. While active, the remote

control application may temporarily override the standard assignments of any hotkeys—as described in more detail in other sections of this document.

When the remote control application is active, if the user performs no action within a timeout period (e.g., 20 seconds which time may be user settable) the system may turn off the display in order to conserve battery energy. However, even though the display is turned off, the application in focus may still be the remote control application. The display may be caused to briefly switch back from the home screen (or whatever other screen is currently being displayed) to the splash screen as warning that a time out is about to occur.

If the user selects another application supported by the PDA **1150**, for example, a Pocket Excel brand spreadsheet application, the remote control application may continue to execute in the background but would no longer be the application in focus. In this case, the remote control application may be reinstated as the application in focus by the user selecting a hotkey (e.g., the iTask button), which hotkey would again be active because the remote control application is not in focus, or by re-selecting the remote control application from the start menu or programs page. In the case where the remote control application is reinstated, the remote control application may not perform the complete initialization sequence described above. Rather, since the remote control application is already loaded and active, it may simply resume at the point at which it was suspended.

Favorites Page(s).

The remote control application may provide one or more favorites pages containing button icons which the user may configure for direct access to his favorite programming (e.g., example, to cause the transmissions of commands to cause a device to tune to a favorite channel), favorite device, etc. Access to such favorites pages may be, for example, via an icon **126** on the home screen page illustrated in FIG. **11**. An exemplary favorites page is illustrated in FIG. **17***a*. A favorites page may be optionally pre-populated with a selection **1710** of commonly requested content providers (e.g., using their logos) as shown in FIG. **17***a* or may initially be blank. Initialization of the default favorites page in either case preferably occurs on first start-up of the remote control application. Separate, additional favorites pages may be created when users and/or rooms are added as described earlier. It will also be appreciated that favorites pages may be specific to particular devices (e.g. a satellite STB or a CD jukebox) while in other instances favorites pages may span multiple devices in order to allow access to all of a user's favorite media content from a single point of access.

In the case where the initial favorites page is pre-populated, icons which have not yet been configured by the user may be displayed with an indicia that setup is necessary (e.g., using a wrench overlay as seen in FIG. **17***a*). In order to configure or add a favorites icon, the user may either invoke the customize favorites menu (instantiated, for example, by tapping the customize icon **122** while a favorites page is displayed) and selecting "Add Favorite" or "Edit Favorite," as illustrated in FIG. **17***b*, or may simply tap one of the default icons that is displaying the wrench overlay to indicate that it is not yet configured. In either case, a favorites setup wizard may be invoked to configure a favorites entry as described in the following paragraphs with reference to FIGS. **17***c* through **17***h*.

The favorite setup wizard may begin by displaying the introductory message shown in FIG. **17***c*. Next, the favorites setup wizard may instruct the user, as shown in FIG. **17***d*, to record a sequence of keystrokes or other actions which are to be associated with the favorites entry being configured. When the user taps the next button **1416**, the user may be presented with the normal set of device control pages such as, for example, the satellite device control page shown in FIG. **17***e*. The user may navigate amongst all the devices that have been configured using the home page wheel **110** (the home page is accessed via selecting icon **123**) to switch to individual device control pages using icon **124**. By this means the user may enter a series of keystrokes, for example, selecting the keys "0," "0," "4," and "Enter" to assign to a favorites button commands for switching the satellite receiver device shown in FIGS. **17***e* and **17***f* to channel four. In an exemplary system, a "mini-wizard" (evidenced by the guidance messages **125**) may continue to guide the user through the setup process while still providing full access to the soft key pages within the application interface of each device. When the user has completed entry of the desired sequence, tapping the customize icon **122** displays a menu which allows the user to complete the final steps of the favorites setup wizard. From this exemplary menu, the user also has the option of temporarily suspending and later resuming recording of keystrokes, inserting a delay into the playback sequence, or testing the sequence entered so far by playing it back. The final steps of the favorites setup wizard, illustrated in FIGS. **17***g* and **17***h*, allow a name **1720** and image **1730** to be assigned to the favorites entry. A sound may also be associated with selection of the favorite entry. Furthermore, where supported by the underlying PDA platform, additional data such as, for example, a URL to be loaded automatically into a concurrently running browser application, may be associated with the favorite entry. (For additional background regarding use of such data in conjunction with a user definable favorite key, the reader is directed to co-pending application Ser. No. 10/176,315 entitled "System and Method for Retrieving Information While Commanding Operation of an Appliance," which is incorporated herein by reference in its entirety.)

Navigation Model

The remote control application may take advantage of the hardware keys offered on the PDA **1150** by redefining functions associated with these keys while the remote control application is active. By way of example, referring to FIG. **10**, the exemplary iPAQ brand PocketPC devices offer four hard keys **102** plus a navigation pad **104** (up/down/left/right and select) arranged across the bottom of the unit. During normal operation these key would typically be assigned by default to perform various quick functions such as switching directly to a calendar or address book applications, displaying a list of currently active applications (sometimes referred to as using the "iTask button"), navigating directories or menus displayed on the screen, etc. When the remote control application is active, such hard keys may be defined to, among other things, cause the remote control application to perform actions that are related to commonly used device control functions. This functionally may be further enhanced by allowing the user to select between various groupings of hard key assignments based on their current activities. For example, optimum convenience during navigation of a menu on a PVR device may require that these keys be configured to cause the transmission of commands for direction control, menu, exit, and selection functions; while optimum convenience while watching a DVD may require that these keys be configured to cause the transmission of commands for transport control functions (play/pause/fast forward, etc.).

The various aspects of this hard key reassignment model and user control over it will be discussed in the following paragraphs in conjunction with FIG. **13**. These models include, but need not be limited to:

An exemplary application navigation model, which is driven by the four hard keys **102**;

Exemplary multiple navigation pad **104** key assignments, which can be navigational, control, or transport;

An exemplary method for displaying a key guide to indicate current key assignments; and

An exemplary method for selecting the active navigation pad key assignments.

Application Navigation

Button **102***a* can be used to cause the remote control application to cycle through each page type, e.g., home screen page, device control page (for a currently active device—the one at the top of the wheel), a favorites page, etc., as represented by the tab icons **123**, **124**, and **126**, respectively, across the top of the screen illustrated in FIG. **11**. If button **102***a* is pressed when the application is active, but in low power state, the current page may be displayed. In this instance a second press may cycle to the next page type. Button **102***b* can be used to cause the remote control application to display the next page for this page type (for example, control may be comprised of four pages, favorites comprised of three pages, etc.). If button **102***b* is pressed when the application is active, but in low power state, the current page may be displayed. In this instance a second press may cycle to the next page within the family of pages for this page type.

Button **102***d* can be used toggle mute (e.g., cause the transmission of a mute toggle command to an appliance in focus). This button may be made always available, regardless of the assignments selected for the other keys in the group.

Button **102***c* can be used to display a key guide **130** and allow a user to change key assignments for the navigation pad **104**. When pressed initially, the current key guide may be displayed, for example, overlaid over the bottom of whatever display page is currently active, as illustrated in FIG. **13**. Display of the key guide **130** may be for a fixed or user-settable period of time, e.g. five seconds. If button **102***c* is pressed again within this time window, i.e. while the key guide **130** display is visible, navigation pad key assignment configurations can be cycled through. By way of example, three possible selectable configurations **130***a*, **130***b* and **130***c* are shown. The significance of these assignments is discussed in more detail in the following paragraphs.

Navigation Pad Key Assignments

For user convenience, the five key functions present on the navigation pad **104** (up, down, left, right, and select) may be assigned to one of several groups of function according to an activity currently being performed. This assignment may be changed dynamically and automatically by the remote control application according to the device type currently selected or activity currently being performed, or it may be manually set by the user. In the illustrated example, three sets of functions are available: navigation **130***a* (for menu or guide operations on consumer appliances), control **130***b* (volume and channel up/down), and transport **130***c* (play, rewind, fast forward, etc.). It will be understood that activation of the navigation pad **104** would then result in the transmission of commands to control the appropriate operation of the intended target device.

An indication of the current setting of these keys is presented in the lower right corner of the screen by the key icon **120**. This icon may take different forms **120***a* (indicating navigation), **120***b* (indicating control) and **120***c* (indicating transport) depending on the current setting of the navigation pad hard keys. Tapping this icon **120** may invoke a menu from which the desired key assignment can be selected by the user. Alternatively, key assignments may be changed by use of the hard key **102***c* as described earlier.

In the case where a user attempts to change the hard keys to a mode that is not supported by the device selected for control, e.g., transport functions when the remote control application is in a mode to control the operation of a television, the remote control application can prohibit selection of that key assignment, can allow selection of that assignment with the resulting activation of the hard keys resulting in the no action being taken place by the system (or to cause transmission of signals in a format appropriate for a default device or last device capable of performing the actions—punch through which may be manually set or automatically set), etc.

When the remote control application is currently in a mode where it is displaying a configuration menu or when it is executing a setup wizard, the navigation key pad **104** may automatically revert to standard application functionality, i.e., menu up/down/left/right and select, for the duration of the setup wizard execution.

Control of Consumer Electronic Devices

The remote control application may be used to control the functionality of a large number of consumer electronic devices. While a TV will be used as a template device for the illustrative description that follows, it will however be appreciated that many other device types exist.

Operation of a TV device is as follows. Assuming that the TV has been setup as described earlier, the remote control application may be placed into a mode for controlling the TV, for example, by rotating the home page wheel **110** until the TV becomes the active (top) device icon—**142** in FIG. **14***i*—and then either tapping the TV icon **142** or the controls tab icon **124**, resulting in the display of the first page of device control page as illustrated in FIG. **19***a*. Depending on the device type, additional pages of control functions may be available as illustrated in FIGS. **19***b* and **19***c*. The user may navigate to these additional pages, if any, by using either the page hard key **102***b* or the control surface switching icons **192**. When the user selects a device as described above, the control page displayed may be the last one used, as opposed to always beginning at page one. For example, if the last action a user previously performed before switching to another device type, such as the VCR, was to command volume adjustment then, on re-selection of the TV, the third page (FIG. **19***c*) might be displayed since this page contains the (most recently used) TV volume control buttons **194**.

The soft keys displayed may be adjusted by the remote control application according to the specific device that has been setup. By way of example, FIG. **21***a* and **21***b* show a control page as it may appear for two different television models. Of note, the Panasonic brand television model shown in FIG. **21***b* supports a "-/--" key **1212**, while the Sony brand television model shown in FIG. **21***b* does not. In this example, the remote control application displays only those buttons for functions that actually exist on the device currently selected.

While a control page is active (i.e., displayed), the customize icon **122** may be used to invoke a menu **1202** which allows the user to make changes to key assignments and layout, learn new functions from another remote control or device, add and delete keys and pages, all of which will be discussed in further detail in sections to follow. Additionally, for convenience, from this menu **1202** the user may optionally enable a text display of key function labels as shown in FIG. **20***b*. By way of further explanation, the keys themselves are generally labeled using graphical icons wherever possible in order to eliminate language dependencies (as can be seen, for example, in FIGS. **20***a* and **20***b*), however, for users who are not familiar with the icon system, optional text labels may be provided.

Text labels may be generic functional names or may be the names assigned that function by the manufacturer of the device which is currently being controlled. By way of illustration, the remote control command function which returns a TV set (or other tuning device) to the channel that was previously being viewed is usually referred to generically as "last channel" or "previous channel." However, on Sony brand equipment this function is often labeled "Jump," on Panasonic brand equipment it is often labeled "R-Tune," etc. It will thus be appreciated that it may be advantageous in certain applications to offer the user key labeling in familiar terms.

As noted previously, the remote control application may display functions that support a standard level of functionality (i.e., those functions most commonly accessed), common power-related functions, or functions that are uncommon or extended functions that make device support 100% complete.

Control of Home Automation Devices

The remote control application is in general capable of controlling any device that can be controlled using IR or RF communications which includes home automation devices. In the case of home automation devices, the user may wish to have different button images to represent the functions and/or operation of these devices. Accordingly, additional button images may be made available to the user, either stored locally in the PDA **1150** or downloadable from, for example, a Web site or device, to help with the adoption and usage of the remote control application for controlling these devices. Such a list of optional button icons may include items such as on/off and open/closed icons for devices such as lights, curtains, blinds, air conditioning, heating, pool heater, spa, etc. The system may also have the ability to associate a function to an image, for example, to send a sequence of IR Codes to an X10 device.

Learning IR Codes

As new devices are introduced into the market, command sets to support such new devices can be added to the remote control application. This can be done one of three ways:

learning, downloading, or occasionally refreshing the database that is burned onto the non-volatile memory of the PDA **1150**. Detailed methods for learning IR codes are well known in the art (for example, see U.S. Pat. Nos. 4,626,848 and 6,097,309 which are incorporated herein by reference in their entirety) and the remote control application may be provided with the ability to learn IR codes from a new device-specific remote control using one or more of these or later-developed methods. To this end, the input signal to be learned may be provided to an IR receiver specifically provided for this purpose or may be derived from an output signal of an IR receiver **214** already built into the device **1150** as illustrated in FIG. **4**.

Generally, IR codes are learned for a single function at a time. The user may choose to learn every available function or may elect to learn select functions for that device type. The user can also choose to replace the codes for existing functions with new IR code sequences. Additionally, the user can add a function that is not normally exposed for this device type. When new functions are added, the user may add a button that is to be assigned the learned command code(s) and provide the button with an appropriate label.

Generally, when the remote control application detects that learning mode has been entered, the software listens for new codes to learn. The software may respond audibly and/or visibly when codes are learned. Furthermore, the software may respond with a different audible tone and/or visible indication when codes are not able to be learned.

Assign and Playback Macros

Macros provide a way for the user to perform a combination of tasks quickly. There may be two types of macros supported by the remote control application—system generated macros and user generated macros. System generated macros are generated automatically or semi-automatically by the remote control application to facilitate common tasks like turning on and off the power to a home theatre system. System generated macros were described earlier.

User generated macros allow the user to manually program a sequence of actions to be assigned to a single button such that that sequence can be repeated by a press of the single button. An example of a user generated macro might be a "Watch DVD Movie" macro, which: 1) turns on the DVD Player; 2) turns the AMP to the DVD input; 3) turns on the TV; 4) sets TV input to "Video 1;" and 5) plays the Movie. Such a user defined macro may be initiated in an exemplary embodiment via an activity icon on the home screen device wheel **110**.

With reference to FIGS. **22***a* through **22***g*, the user may initiate programming of a new macro sequence by rotating the add activity icon **115** to the uppermost position of the wheel, for example by selecting it, as shown in FIG. **22***a*. Selection of the add activity icon **115** may then cause an activity setup wizard to be invoked that guides the user through the programming process. The activity setup wizard may begin by displaying some informative messages as shown in FIGS. **22***b* and **22***c*. The activity setup wizard may then prompt the user to enter a sequence of keystrokes to be stored as a macro. This entry process is similar to that previously described in conjunction with FIGS. **17***e* and **17***f* (definition of a favorites key) and, therefore, need not be repeated here. Upon completion of the sequence entry, the user may select an image (FIG. **22***e*) and name (FIG. **22***f*) to associate with this programmed activity. The user may also be provided with an option, for example via a checkbox **224**, to have the macro playback, on completion, either remain at the home page (box unchecked) or switched to the device control page of the last device to be issued a command (box checked). This is useful where, for example, a user programming a "Watch DVD" macro may wish the sequence to end with the remote control switched to the DVD device control page (such as shown FIG. **22***d*) rather than the home screen page. When the macro definition is complete, the new activity ("Watch DVD" in this example) appears on the device wheel **110** as shown in FIG. **22***g*. Since similar images may be applicable to both devices and activities, activity icons may be displayed in a different color than device icons. In addition, the control button **117** in the center of the wheel may be changed to a green "GO" button in place of a red "Power" button.

It is to be appreciated, that the software may allow a macro to be assigned to any screen that controls devices. Furthermore, the software may allow macros to be added as punch-through commands for the hardware hotkeys as well as common user interface elements. Still further, the software may allow macros to be copied, linked, and/or edited. For use in editing, the software may allow a step-through capability to ensure that the macro functions as desired and provide a macro editor so that the user can fine-tune the macro. Macros can also be recorded with non-timed key strokes and/or with timed key strokes.

Customization and Reassignment of Keys

The remote control application may allow the user to expose functionality from one device on a control page that represents another device or simply rearrange the button layout of a given device control page. Customization and key reassignment may be accomplished by use of the copy key and move key functions accessible from the customization menu **1202** shown by way of example in FIG. **20***a*. Using the customization menu **1202**, the user may choose to override an

existing button or add a new button to the screen. For example, copying a key function creates a link to the underlying functionality so, if the underlying behavior of the linked to key is modified, all linked keys would be updated. Alternatively, the user may have the option to change the default state (a link) to become a copy of the original functionality. In this instance, modifying the functionality of the "original" key would not affect the other keys which were assigned the functionality of the "original" key.

In addition to redefining underlying key functionality as described above, the user may also be offered the option of adding new keys or editing existing keys. In this manner, key shapes and labels may be changed as needed. The remote control application may offer a selection of locally-stored key shapes and colors to choose from, others may be downloaded from the desktop **1104** or Web hosted services **1106**. By way of example, each button image may comprise two states, "Up" and "Down," to enable a user to differentiate between an incative button and a pressed or activated button. The remote control application may also support customization features such as are described in U.S. Pat. Nos. 5,959,751, 5,515,052, and 6,014,092 which are incorporated herein by reference in their entirety.

Manage Favorites

Since each user may have different viewing habits and favorite channels, the remote control application may allow the favorites to be global (for all users) or specific to a user. For example, in a household with several people the channel lineup will remain the same, however the favorites for an individual may vary. Furthermore, since favorites may actually perform several functions (associating a readily identifiable logo with a network channel and/or sending IR or other commands to direct a device to the proper channel), it may be of use for one individual to set up the entire network lineup as favorites, and allow other users to copy the entire set of favorites pages. Each user may then further customize their set of favorites pages by eliminating those that are not normally viewed, or re-arranging the favorites onto pages to their liking. This technique of eliminating favorites may also be used, for example, by a parent when configuring an acceptable channel lineup for a child. The child's user profile could be set up with a PIN that the child doesn't know (and thus has no ability to configure) and/or set up as a Guest so that other configuration changes may not be made. There may also be a setting in the interface to only allow (on a per-user basis) channel access through favorites (and not by channel up/down or numeric keypad entry) to further limit the channel lineup associated to particular individuals.

Assistance may be offered during the setup of favorites described earlier in conjunction with FIG. **17**. For example, a short list (seven entries, for example) may be maintained by the remote control application which represents a user's most frequently accessed channels. During execution of the favorites setup wizard, the current list of frequently accessed channels may appear thereby allowing rapid, semi-automatic programming of favorites buttons effected by picking channels from the displayed list. Optionally, the user may be able to create multiple such lists to cover a variety of genres or categories built into the favorites setup wizard.

When the remote control application is adapted to be used in connection with EPG functionality, the system may read extended channel information provided in the EPG to automatically group the channel into categories. Genre categories may also be supported, for example Personal, News, Sports, Movies, Music, etc. The user may be able to create additional categories with custom names. The user may be able to add a channel number (with device) to a category. The user may be to add a label to the channel. The user may be able to associate a logo with the channel. The system may handle favorite channels implemented across multiple input sources. For example, the movies list may contain one local cable channel and four channels supported by satellite. The remote control application may also monitor the EPG data periodically downloaded from the hosted services site **1106** for changes in a channel line-up to thereby adjust favorites channel programming sequences either automatically or by user option.

The favorites page display may also be adaptive. In this regard, the remote control application, on an user by user basis, may organize the display of the favorites page as a function of frequency of channel access. The most oft selected channels may be displayed on the top of the list. This display order may also change based on day of week and time of day, either automatically or by user request.

Extensible File Format

User IR Code DB

The user IR code database may be used to store supplemental IR Codes as they are downloaded from the website or from some other sources. This is separate from the standard IR code database shipped with the PDA **1150**. The user IR database may or may not contain learned codes. It is desired that all learned codes are accessible to all users of the remote control application.

Device Configuration File

The device configuration file contains the devices the user has configured to control with the remote control application. The device configuration file may also describe the contents and layout of the device control pages of the remote control application for each device. The device configuration file may additionally contain any resources required by the individual device. The list of resources include, but are not limited to, macros, IR codes, bitmaps, string literals and other required data.

Extensibility of Configuration Files

In order to manage the configuration and user set-up data associated with the remote control application as described in the preceding sections, it is advantageous to store this information in a file system which is designed to facilitate easy future extensions to the information stored as well as transfer of this information between like devices. An exemplary file structure which may be used to achieve these goals is presented in the following paragraphs and Tables 1 through 12 below.

Configuration Header

As illustrated in exemplary Table 1, the configuration header contains data fields for use in describing attributes of the file.

TABLE 1

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PageWidth	Width of a page	Short	
PageHeight	Height of a page	Short	
FileVersion	Version of this file format	BYTE	8
PlatformID__Key	ID to a record in the Platform Table	Long	
ArchiveFlag	Specifies when the document is to be archived.	Long	

Platform & Hardware Table

As illustrated in exemplary Table 2, the platform & hardware table contains data fields for use in describing attributes of the hardware platform on which the file was generated.

TABLE 2

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PlatformID__Key	Unique ID for this device	Long	
ScreenWidth	Screen Width	Short	
ScreenHeight	Screen Height	Short	
HardwareKeyMap__ID	Hardware Key Map	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Device Table

As illustrated in exemplary Table 3, the device table contains data fields for use in describing the attributes of each of the devices the user has setup the remote control application to control.

TABLE 3

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
DeviceID__Key	Unique ID for this device	Long	
LabelLength	Length of the string label	Short	
Label	String literal for this device	Char	variable
DeviceType	Class of device this device header refers to	UINT	
SetupCode	Code for this particular Device	UINT	
BrandNameLength	Length of the BrandName string	Short	
BrandName	String literal of this brand	Char	variable
ModelLength	Length of Model string	Short	
Model	String literal of this Model	Char	variable
DeviceSpecificDataSize	Size of the DeviceSpecificData	Short	
DeviceSpecificDataConfig	DeviceSpecificData	BYTE	variable
DownloadDeviceDataSize	Size of the downloaded data	Short	
DownloadDeviceData	Downloaded data	BYTE	variable
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

External downloaded data will be stored in DownloadDeviceData.

Page Table

As illustrated in exemplary Table 4, the page table contains data fields for use in describing the attributes of each display page of the remote control application.

TABLE 4

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PageID__Key	Unique ID for this page	Long	
DeviceID__Key	Parent Device ID	Long	
BackgroundID__Key	ID to a resource record	Long	
PageType	Describes what this page will contain - Home Page, Power, Home Theatre, Device Page, Favorite Page	UINT	
BackgroundFillRGB	RGB Fill Color	COLORREF	
OriginFlag	Who created this record	UINT	

TABLE 4-continued

Attribute	Description	Type	Size
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Page records are preferably grouped by device ID.

COLORREF is preferably a 32-bit value used to specify an RGB color.

Label Page Table

As illustrated in exemplary Table 5, the label page table contains data fields for use in describing the labels within a page.

TABLE 5

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
LabelID__Key	Unique ID for this Label	Long	
PageID__Key	Parent Page ID	Long	
LabelLength	Length of label string	Short	
Label	String Literal	Char	variable
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
Width	Width of Label	UINT	
Height	Height of Label	UINT	
Font	Font Type	UINT	
FontSize	Font Size	UCHAR	
FontAlignment	Font Alignment (Center/Left/Right)	UCHAR	
TextColor	RGB Color of the Text	COLORREF	

Border Table

As illustrated in exemplary Table 6, the border table contains data fields for use in describing page borders.

TABLE 6

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
BorderID__Key	ID to a resource record	Long	
PageID__Key	Parent Page ID	Long	
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
BorderFillRGB	RGB Color of the Fill	COLORREF	

Key Table

As illustrated in exemplary Table 7, the key table contains data fields for use in describing attributes of keys supported by the remote control application.

TABLE 7

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
KeyID__Key	Unique ID for this Key	Long	
PageID__Key	Parent Page ID	Long	
LabelLength	Length of key label string	Short	
Label	String Literal	Char	variable
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
ImageUpID__Key	ID to a resource record	Long	
ImageDownID__Key	ID to a resource record	Long	

TABLE 7-continued

Attribute	Description	Type	Size
ImageDisabledID_Key	ID to a resource record	Long	
SoundDownID_Key	ID to a resource record	Long	
SoundUPID_Key	ID to a resource record	Long	
Status	Status of key	UINT	
FunctionID_Key	ID to a Function record	Long	
MacroID_Key	ID to a set of macro records	Long	
FontType	Font Type	UINT	
FontSize	Font Size	UCHAR	
FontColor	Font Color	COLORREF	
FontAlignment	Font Alignment	UCHAR	
KeyType	Moveable Y/N	BOOL	
KeyPlacement	Hardkey/Softkey Y/N	BOOL	
ValidityDay	Days the key is valid	Long	
ValidityTime	Time the key is valid	Long	
OriginFlag	Who created this record (User, Dynamic, . . .)	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Key records are grouped and sorted by PageID_Key.

KeyType is a boolean to specify the key is movable or not.

Function Table

As illustrated in exemplary Table 8, the function table contains data fields for describing functions performed in response to activation of a key.

TABLE 8

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
FunctionID_Key	Unique ID for this page	Long	
FunctionNameLength	Length of FunctionName string	Short	
FunctionName	String Literal of the function Name	Char	variable
HardwareType	Hardware Type that implements this function	UINT	
DeviceType	Class of device this device header refers to.	UINT	
DeviceID	UEI ID for this Device	UINT	
DeviceID_Key	ID to Device	Long	
LearnedKeySize	Size of learned data	Short	
LearnedKey	Block of learned Key Data	BYTE	variable
MagicCode	UEI Magic Code	UINT	
KeyCode	ID to a resource record	Long	
HardwarePayloadSize	Size of HardwarePayload data	Short	
HardwarePayload	Hardware specific data stream	BYTE	variable
MacroID_Key	ID to a set of macro records	Long	
PageID_Key	Page to be jumped to	Long	
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

HardwareType may be, for example, RF or IR transmitter IC.

If the ID function is in the downloaded data, then Device-ID_Key is pointing to the device; otherwise, it's NULL.

Macro Table

As illustrated in exemplary Table 9, the macro table contains data fields for describing attributes of a macro function.

TABLE 9

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
MacroID_Key	ID for this macro set	Long	
FunctionID_Key	ID to a function record to execute	Long	
NextMacroID_Key	ID to a Next Macro Record to execute	Long	
KeyDownTime	The amount of time is milliseconds the key stays down	UINT	
InterKeyDelay	Delay amount after execution in milliseconds	UINT	
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Any nested macros will be copy entire functions from the macro list to the new macro list.

Resource Table

As illustrated in exemplary table 10, the resource table contains data fields for defining resources (e.g., image file, sound file, etc.)

TABLE 10

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
ResourceID_Key	Unique ID of a resource	Long	
ResourceType	Type of resource stored (Bitmap, Wave, . . . etc)	UINT	
ResourceDataSize	Size of the resource data	Long	
ResourceData	Byte stream of the resource	BYTE	variable
ResourceWidth	Width	UINT	
ResourceHeight	Height	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Event Journal File

As illustrated in exemplary Table 11, the event journal table contains data fields for describing events captured during the course of operation of the remote control application.

TABLE 11

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
EventID_Key	Unique ID of this Event	Long	
EventType	Type of Event, System or User	Long	
EventTime	Time of the event	Date/time	
EventDataSize	Size of EventData	Short	
EventData	Data of the event	BYTE	variable
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

User Profile File

As illustrated in exemplary Table 12, the user profile file contains data fields for use in describing user attributes.

TABLE 12

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
UserProfileID_Key	Unique ID of this User Profile	Long	
UserNameLength	Length of UserName	Short	
UserName	Name of the User	Char	variable

TABLE 12-continued

Attribute	Description	Type	Size
UserAvatarID_Key	ID to a resource ID	Long	
UserPin	4 digit PIN. (Or minimum password length as recommended/required by the operating system software.)	UINT	4
UserTimeOut	Time before the user is logged out		
UserRole	Role of the User		
UserRating	V-Chip Rating for the User		
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Room Profile File

As illustrated in exemplary Table 13, the room profile file contains data fields for use in describing room attributes.

TABLE 13

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
RoomID_Key	Unique ID of this Room Profile	Long	
RoomNameLength	Length of RoomName	Short	
RoomName	Name of the Room	Char	variable
Locale	Location of Room	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Functionally, it is to be appreciated that file formats may be versionable, file formats may be backwards compatible, file formats may be extensible to include new features, file formats may allow third party developers to use the storage mechanism, file formats may provide an efficient storage model, and files may reduce duplication of expensive resources like bitmaps.

Configuration Files to Support Multiple User Profiles

The remote control application is preferably designed to be used by multiple users. Accordingly, a user profile file may store data about a user of the system including the user name, bitmap for the user avatar, user PIN or password and all preference settings. In addition, the short list of most frequently accessed channels on a per-user basis may be stored in the user profile. The user's favorite channel list (and associated network logos) may be stored in the user profile as well.

In certain instances, it may be preferred to designate a primary user that controls the look and functionality of the remote control application. All the other user profiles may be derived from the primary user's user profile (the "master profile"). Any changes in the master profile may be updated in any of the profiles that are based from the master profile. Thus, the master profile may be fashioned after a template where any documents using the template may be updated if the template is modified.

Once the primary user has setup the main configuration, new configurations can be created based on the master profile. The primary user may choose which devices and which levels of functionality to expose. This can include backgrounds, specific favorites and other features. The primary user may also choose whether the profile is to be "locked down," which may be used to prevent any additional customization by other users of the profile. In this manner, the primary user can maintain complete control over the way other users (e.g., family members) interact with the remote control application.

All adaptive learning functions may be stored within each profile so that the individual users can access their favorite channels rather than anyone else's. Even if a profile is "locked down," favorites may be stored on a per-user basis. Additional facilities may be needed to give the primary user the ability to review the viewing habits of other family members.

For personalization, icons (or avatars) may represent each user. The avatar may be a 32×32 bitmap stored in the user profile. When the remote control applications starts, a splash screen may be generated with the bitmaps to allow the current user to select an appropriate user avatar and, thereby, gain access the remote control application configuration associated with the selected user.

User Profile

The following Table 14 contains exemplary attributes of the user profile object type.

TABLE 14

Attribute	Description
User Profile ID	Primary Key - Unique ID of this User Profile
User Name	Name of the User
User Avatar File Path	File location to the Avatar
User Avatar Bitmap Data	Avatar bitmap data
User Avatar Bitmap Data Size	Size of the Avatar bitmap data
User Avatar Width	Width of the Avatar Bitmap
User Avatar Height	Height of the Avatar Bitmap
User Nickname	Nickname for the user
User Pin	4 digit PIN

Favorite Map

The following tables contain exemplary attributes of the favorite map object type.

TABLE 15

Attribute	Description
Favorite ID	Primary Key - ID to this Favorite
Device ID	Foreign Key - ID to the Device which supports this channel favorite - Satellite, Cable Box, Tivo or VCR.
Channel #	The channel # for the favorite
Channel Name	The channel name of the favorite
Network 4 Letter identifier	The channel 4 letter identifier.
Network Logo Bitmap ID	Foreign Key - ID to the Bitmap table stored in the configuration file
User Network Logo File Path	File location to the Network Logo
User Network Logo Bitmap Data	Network Logo bitmap data
User Network Logo Bitmap Data Size	Size of the Network Logo bitmap data
User Network Logo Width	Width of the Network Logo Bitmap
User Network Logo Height	Height of the Network Logo Bitmap

Thus, the remote control application may store information regarding a user's preferences in a configuration file. The user profile may store the user name, bitmap for the user avatar, user PIN and all preference settings, including favorites, network logos and the results of adaptive learning. Since the system may support multiple configuration files per user, the system may display content using (by default) the user's last used configuration file. The system may also allow the user to select a different configuration file to use. The system may allow multiple users to store their configuration files on the same PDA **1150**. The system may store the identity of last user that used remote control application. The system may require that one of the users be named as a primary user. The configurations set in the master profile for the primary user may be available for use in establishing configurations used

by other users. Any changes made to the master profile may be available to the configurations used by other users. The system may allow the primary user to determine the level of "lock down" associated with one or more user configurations which may, in turn, determine how secondary users can customize their settings.

Restore Point

Whenever the user performs an operation that may change the configuration of the remote control application, the remote control application may create a restore point just before making the change to the configuration. For example, the system may create a restore point when the user changes the configuration file, changes user settings, or changes the IR code database. Thus, the restore point maintains settings the remote control application may revert to if the user decides to return to a state prior to a change.

The restore point may be reset if the user chooses to save the new configuration and update the restore point, for example, by interacting with a check box in a save dialog. Preferably, the supplemental IR database is backed up using a restore point when the remote control application learns new IR codes. The supplemental IR database is also preferably backed up when the user applies a new IR database patch. Generally, the configuration file may be backed up on local storage. However, if no local storage is available, the configuration file can be uploaded to a PC the next time the device **1150** is docked. To this end, the user may be prompted to dock the device after making changes and the user may be continually prompted to dock upon startup of the remote control application until it is detected that the configuration file has been successfully backed up. When docked, the configuration file may be automatically backed up if anything has changed. A CRC may be stored in the file after changes. If the CRC changes between synchs, the file may be backed up (given that space is available).

Guest Mode

The primary user may elect to allow guest access (created as another user profile) which allows the guest user to operate the home system in a simple way, e.g., no learning functions are available, there is no access to other programs on the device **1150** without PIN confirmation, etc. Furthermore, guest access may override the ability to power down and reboot the system as a means to circumvent the guest mode. The guest profile may be based on the master profile as a base configuration and the guest may have no ability to change the configuration.

Security

For a user, the most sensitive information in remote control application (without support for E-Commerce transactions) is generally considered to be the data stored in the event journal. For the manufacturer, the most sensitive information is generally considered to be the IR code database. Therefore file encryption may be applied to the event journal and the IR code database as a measure of security.

The user may have other sensitive data stored on the PDA **1150**, including, but not limited to: schedules, contacts, financial information, notes, and email. The user needs to feel confident that the device **1150** used to hold this confidential information can sit on or near the coffee table for hours in the evening, with others around. This level of confidence may be provided by limiting access to only the remote control application functions when the remote control application is executing unless a PIN code is entered. Furthermore, the primary user may elect that no additional named users are allowed and that guest access is denied. The primary user may enter a PIN for secure transactions, including starting the remote control application. This puts the remote control application in a mode that no other programs can be accessed without a PIN code to thereby render all external data safe.

If the primary user elects to add secondary named users, they may also have PIN codes assigned. Secondary named users may be able to learn functions (if the primary user has not "locked down" the configuration) and store favorites. However, there may be no access by secondary users to other applications or files on the PDA **1150** without PIN confirmation.

Quick Assignment of Channel Number to Network Logo

Since the cable and satellite companies are constantly refining their channel line ups, the remote control application should provide a simple way to modify the channel numbers that the user assigned to favorites. Such channel number reassignment may be accomplished by, for example, the user holding down a channel logo (i.e., a button used to tune to a channel) for a given time (e.g., 3 seconds—as opposed to tapping it, which would normally execute the channel selection or other sequence assigned to the key) to invoke a setup wizard similar to that previously described in connection with FIGS. **17***a* through **17***h*.

Alternatively, the user may specify a channel number as a numeric variable instead of a series of keystrokes. This number is then converted by the remote control application into an appropriate sequence of IR command signals at time of execution. For additional background regarding methods for specifying and converting numeric variables into remote control IR signals, the reader is directed to co-pending application Ser. No. 10/287,389 entitled "System and Method for Interacting with a Program Guide Displayed on a Portable Electronic Device" of like assignee, which is incorporated herein by reference in its entirety.

Besides simplifying user definition of favorites, in the case of a remote control application that supports EPG functionality this approach can also keep the favorite channels (and perhaps others) in synch by monitoring the channel listings from the EPG. In this case, when an EPG is downloaded, typically on a periodic basis, the remote control application may compare the most recently downloaded EPG against a previously downloaded EPG to determine if any channel assignments have changed. If any channel assignments have changed, the remote control application may then check the favorites list to determine if any of the changed channels are listed therein. If so, the remote control application may update the favorites channel list to reflect the new channel number assigned to a favorite. By way of example, assume that an EPG comparison indicates that "ESPN" has changed from channel 29 to channel 45. If "ESPN" is in the favorites list, the favorites list will be updated to change the mapping of "ESPN" from channel 29 to channel 45 whereby subsequent activation by the user of the "ESPN" logo icon will cause the transmission of command(s) to tune the target device to the correct channel assignment.

It is also contemplated that the remote control application may store favorite channel assignments as broadcast channel identifiers and use the data in the EPG to dynamically convert these channel identifiers to absolute channel numbers each time the favorite is selected by the user. In this case, in keeping with the previous example, a favorite would be stored simply as "ESPN" which would be translated to channel 29 or channel 45, as appropriate, based on the EPG data currently loaded at the time the "ESPN" logo icon is activated (i.e., the channel the current EPG shows "ESPN" is being broadcast on). In this manner, there would be a late binding between the "ESPN" favorite and the channel on which "ESPN" is being broadcast.

When logo icons or other icons are activated, different states may be displayed to the user. For example, the system may support a network logo in the form of two bitmaps corresponding to a button up state and a button down state. Logo dimensions and color depth to be used may be supplier specified and may vary for the different platforms. The system may also store network logos in the user profile, since the favorite channel information may be there.

Download Skins

Skins are manufacturer or user developed bitmaps to represent buttons, backgrounds, etc. A button can have multiple states, up, down and disabled. The disabled state may be used to support functionality where two-way communication between the target device and the remote control is possible, where a particular user profile has no access to a function (for example, because it has been disabled by the primary user), etc.

Configuration files containing bitmap resources may be made available as part of vendor-supplied extended features offered on Web-hosted extended features service **1146** or may be uploaded by users themselves to a Web hosted user community **1142** for downloaded by other users. Such configuration files may be made available for specific devices or may represent generic keyshapes, etc., suitable for use with any device. By way of example, the system may look in a default named local directory for configuration files and in a default named directory on the host PC for configuration files to be updated during ActiveSync. When updated, the system may override bitmaps from previous configuration file.

Copy Configuration from One PDA to Another

The ability to share configuration files allows for growth in usage of the remote control application. A configuration file can be shared in a number of ways. It could be uploaded to an Internet site, sent via mail, or copied on to a floppy disk. The user who receives a configuration file may use the ActiveSync application to load it onto a PDA **1150**. Another method is that a user could transmit (referred to as "beaming") the configuration via the IRDA port on one PDA to another PDA. This method takes advantage of facilities available on the typical PDA hardware platforms.

The configuration file can be broken down into elements, for example devices, pages, themes, learned IR codes, network logo icons and favorites. The user may wish to share only a few elements or the whole configuration file.

The configuration files are preferred to have versioning, so that if a user shares a configuration file with a user who has an older version of the remote control application, the transferred configuration file is handled gracefully. If the configuration file has a dependency on a new version of an IR database module, then the user may be notified that the device may not function properly until the user updates their IR database. The system may be able to check version number of the software, version number of the IR Transmitter IC installed, and/or determine the form factor (PDA or WebPad) and the OEM of the platform.

The sending user may select from a list of options what they want to beam. The receiver may choose whether the received configuration file is merged with an existing configuration file or stored as a new configuration file. If the configuration file is merged, the remote control application may ask the user if the would like to update their home theatre mode settings. The receiving system may determine the destination location for the beamed or downloaded resources. Furthermore, users may be able to copy resources related to a configuration file to a hosted Website to enable sharing on a global basis. Thus, unlike most current home universal remote controls that only support a single configuration, the system may provide a mechanism to allow users to have multiple configurations to choose from.

Download Network Logos

A network logo is a graphical representation of a network station or channel. In its base form, it is a button with an up bitmap and a down bitmap. A disabled bitmap is not needed since the button does not have any state. The download network logos feature represents a set of resources that can be accessed through the Internet. To implement this feature, almost all of the architecture modules come into play: hosted remote control software services, desktop remote control software applications, and remote control software. Network logo sharing may allow users to transmit the network logo information button to another user, where the receiving user could chose to add it to the favorite list, channel lineup page, or the like. The system may operate in connection with a mechanism to establish access to network logo bitmaps from technology partners such as cable operators or EPG providers. Network logos may also be made available from a hosted Web site. The system may allow users to share network logos through IR beaming.

Journal Activity

The event journal may contain a list of user and system actions that have occurred within the remote control application. The event journal may also contain broadcast messages from devices within the home. The event journal is a log of what the user has done as well as what is happening within the home. The user may be able to switch between a verbose mode and an alert mode for the broadcast messages. The event journal may also be used for debugging purposes.

An exemplary event journal entry format is shown in Table 16.

TABLE 16

Attribute	Description
Event ID	Primary Key - Unique ID of this Event
Event Type	Type of Event, System or User
Event Title	Title of Event
Event Data	Data for the Event
Event Time	Time of the Event
Event User ID	Foreign Key - To the user who generated the event

The Event Journal may be uploaded to a PC with an ActiveSync application.

Application Programmer Interface (API) for Third Party Developers

Some users may be developers who wish to develop extensions to the remote control application. Thus, the remote control application may expose functionality to third party developers to build extensions. The support provided may be via custom configuration files that contain third party graphics and supplemental IR codes.

Exceptions

The remote control application running on a platform should exhibit graceful behavior under exception condition. Some examples of such conditions and appropriate responses for the remote control application are as follows:

Low power situation: A low power indication is generated by the underlying PDA operating hardware while the remote control application has focus. In this case the remote control application may issue an indication to the user and also take steps to minimize power consumption by, for example, disallowing certain actions. Since the remote control application should not lose any of setup and configuration information when the PDA **1150** runs out of power, the remote control

application may store this type of data in non-volatile memory (if available) and may inhibit any write activity (i.e., changes to that memory) during low power situations.

Low memory or low storage indication received: If the operating system of the platform issues a low memory or low storage indication while the remote control application has focus, the remote control application may issue an indication to the user, relinquish to the system any scratch memory it has in use, inhibit setup or other activities which may consume additional storage, suspend journaling activity, and take any other steps possible to minimize memory and storage requirements.

Installation of new (updated or extended) version of remote control application: If the user installs a new version of the remote control application this may detect that initial installation has already been configured for a previous version of the application and may use those configuration settings as the default settings during any new installation/customization process that occurs.

Additionally, the remote control application may behave gracefully if the user temporarily changes the allocation of storage and program memory while the remote control application is active. Installation of a supplemental version of the remote control application may gracefully use all of the configuration settings that currently exist.

Desktop Remote Control Software Applications

The desktop remote control applications **1104** are applications that are installed on the user's PC **1152** to support the remote control application on the PDA **1150**. Examples of PC remote control software applications include:

Configuration Designer

The configuration designer **1134** may allow a user to create a configuration file on the PC that can be loaded into remote control application.

Configuration Emulator

The configuration emulator **1136** may allow the user to review the configurations on the PC as if it were running on the target PDA.

Restore/Backup Configurations

This component **1130** may allow the user to backup and restore configuration files and event journals over the ActiveSync communications conduit to/from the PC and the PDA **1150**.

Update Checking/Supplemental Patch Download

This component **1132** may review current version numbers of remote control application and IR code databases, verify them against a Web hosted update service, and inform the user whenever later versions are available for download. Optionally, this component may also perform the updates automatically via the ActiveSync conduit.

Cultural and Political Requirements

The remote control application may be shipped with a world-wide IR code database and may be used in many international locations. The remote control application may thus support localization, for both language as well as key layout variations to support regional settings. With reference to FIGS. **23***a* through **23***d*, the room setup wizard input requirement at step **2** may be expanded from that shown in FIG. **16***c* to include a drop-down list **230** from which various regions may be selected. Based on this input, the behavior of the remote control application may be adjusted to more closely match the region in which it is being used. For example, the order in which IR device codes are presented to the user for testing in the drop-down menu **1430** (FIG. **14***f*) during device setup may be varied from region to region in order to place the most likely (i.e., most popular in that country or region) codes at the top of the list. Furthermore, even within the same IR code set, functionality and key assignments may also vary by region and may be automatically adjusted based upon the region selected.

By way of further illustration, control page 4 of the same television brand is shown in FIG. **23***c* as it appears with the region set to "North America," and in FIG. **23***d* as it appears with the region set to "Europe." By way of background explanation, in Europe some television broadcasts include a feature known as "Teletext" in which textual information such as news briefs, weather forecasts, etc. is encoded in the vertical blanking interval of the television signal. Many European market television sets thus may include the capability to decode and display this information under user control. Accordingly, with the region set to "Europe" the remote control application displays soft keys for the functions required to cause control **232** and navigate **234** signals to be transmitted to influence the Teletext data display. Further, as can be seen by comparing keys **232** in FIG. **23***c* versus **23***d*, manufacturers may offer different features in different markets which are invoked by similar control functions—in this instance "Picture in Picture" for the North American market versus Teletext for the European market.

It will also be appreciated that this region selection parameter may also be used internally by the remote control application for other purposes as well, for example it might be used to select one of several possible sets of "Help" data in different languages, either pre-loaded in the PDA **1150** or obtained via download from the desktop PC **1152** or Web hosted services **1106**. All string literals may be stored in the Windows brand OS resource file to provide a central location to perform localization work.

While specific embodiments of the present invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangement disclosed is meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

What is claimed is:

1. A hand-held device having instructions for displaying information to a user of the hand-held device, the instructions performing steps comprising:

displaying to the user a plurality of iconic representations to which are assigned a first set of actions whereby activation of an iconic representation causes the hand-held device to perform the action assigned to the activated iconic representation and wherein activation of at least some of the iconic representations causes the hand-held device to transmit command codes for controlling the operation of one or more home appliances;

accepting input which will change an action of the first set of actions which is assigned to at least one of the plurality of iconic representations;

in response to the input causing a representation of the assignment of the first set of actions to the plurality of iconic representations to be stored in a memory device; and

causing the representation of the assignment of first set of actions to the plurality of iconic representations to be retrieved from the memory device in response to a request to restore on the hand-held device the assignment of the first set of actions to the plurality of iconic representations.

2. The hand-held device as recited in claim **1**, wherein the step of accepting input comprises downloading command

codes to the hand-held device which are mapped to corresponding ones of the iconic representations.

3. The hand-held device as recited in claim **1**, wherein the step of accepting input comprises the user defining a macro to be assigned to the at least one of the iconic representations.

4. The hand-held device as recited in claim **1**, wherein the step of accepting input comprises the user setting up the hand-held device to control the operation of a specific type and brand of home appliance.

5. The hand-held device as recited in claim **1**, wherein the step of accepting input comprises a change to a configuration file of the hand-held device, the configuration file comprising:

a first set of data fields containing data indicative of attributes of a hardware platform for the hand-held device;

a second set of data fields containing data indicative of attributes of devices the hand-held device is configured to remotely control the operation of;

a third set of data fields containing data indicative of attributes of pages displayable by the hand-held device;

a fourth set of data fields containing data indicative of attributes of soft keys comprising at least a portion of the pages; and

a fifth set of data fields containing data indicative of attributes of functions performed by the hand-held device in response to activation of the soft keys.

6. The hand-held device as recited in claim **5**, wherein the configuration file further comprises a sixth set of data fields containing data descriptive of resources for use in display of the soft keys.

7. The hand-held device as recited in claim **5**, wherein the configuration file further comprises a sixth set of data fields containing data indicative of attributes of a user of the hand-held device.

8. The hand-held device as recited in claim **7**, wherein the configuration file further comprises a seventh set of data fields containing data indicative of a room in which the devices are found.

9. The hand-held device as recited in claim **1**, wherein data representative of the assignment of the first set of actions to the iconic representations is stored within an event journal.

10. A method for automatically creating a sequence of instructions to be executed by a controlling device, comprising:

presenting to a user a graphical user interface including a representations of at least one appliance controllable by the controlling device;

using a program to automatically create the sequence of instructions to be executed by the controlling device such that the sequence of instructions reflects one or more interactions by the user with the representations of the at least one appliance controllable by the controlling device presented via the graphical user interface; and

causing the automatically created sequence of instructions to be executed by the controlling device in response to a selection of a user input element of the controlling device.

11. The method as recited in claim **10**, comprising presenting the graphical user interface on the controlling device and using programming resident on the controlling device to automatically create the sequence of instructions.

12. The method as recited in claim **10**, comprising including within the graphical user interface representations of a plurality of appliances controllable by the controlling device and wherein the sequence of instructions to be executed by the controlling device are reflective of user interactions with the representations of the plurality of appliances presented via the graphical user interface and comprise instructions for causing the controlling device to transmit one or more commands to place at least one of the plurality of appliances represented within the graphical user interface into a desired state of operation.

13. The method as recited in claim **10**, comprising including within the graphical user interface representations of a plurality of appliances controllable by the controlling device and wherein the sequence of instructions to be executed by the controlling device are reflective of user interactions with the representations of the plurality of appliances presented via the graphical user interface and comprise instructions for causing the controlling device to transmit one or more commands to control audio/video input/output states of at least one of the plurality of appliances represented within the graphical user interface.

14. The method as recited in claim **13**, wherein the user interactions with the graphical user interface which result in automatic creation of the sequence of instructions to be executed by the controlling device comprises drag and drop interactions performed via the graphical user interface used to establish input/output pairings between selected ones of the plurality of appliances represented within the graphical user interface.

* * * * *

EXHIBIT I

US008015446B2

(12) **United States Patent**
Scott et al.

(10) **Patent No.: US 8,015,446 B2**
(45) **Date of Patent: Sep. 6, 2011**

(54) **USER INTERFACE FOR A REMOTE CONTROL APPLICATION**

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(73) Assignee: **Universal Electronics Inc.**, Cypress, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 240 days.

(21) Appl. No.: **12/421,065**

(22) Filed: **Apr. 9, 2009**

(65) **Prior Publication Data**

US 2009/0254778 A1 Oct. 8, 2009

Related U.S. Application Data

(62) Division of application No. 11/340,442, filed on Jan. 26, 2006, now Pat. No. 7,895,532, which is a division of application No. 10/288,727, filed on Nov. 6, 2002, now Pat. No. 7,831,930.

(60) Provisional application No. 60/344,020, filed on Dec. 20, 2001, provisional application No. 60/334,774, filed on Nov. 20, 2001.

(51) **Int. Cl.**
G06F 11/00 (2006.01)

(52) **U.S. Cl.** **714/25**

(58) **Field of Classification Search** 714/25
See application file for complete search history.

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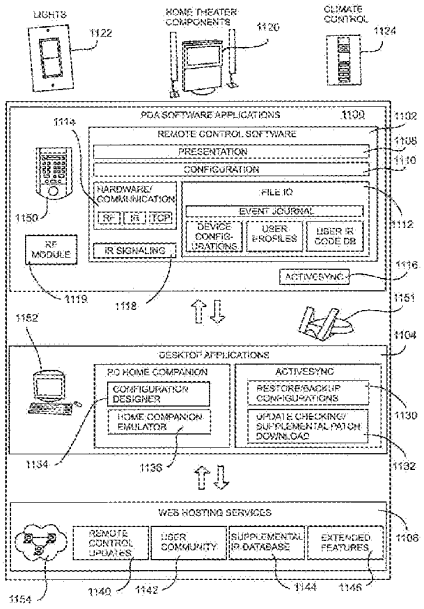
Primary Examiner — Bryce P Bonzo
(74) *Attorney, Agent, or Firm* — Greenberg Traurig, LLP

(57) **ABSTRACT**

A hand-held electronic device having a remote control application user interface that functions to displays operational mode information to a user. The graphical user interface may be used, for example, to setup the remote control application to control appliances for one or more users in one or more rooms, to perform activities, and to access favorites. The remote control application is also adapted to be upgradeable. Furthermore, the remote control application provides for the sharing of operational mode information.

14 Claims, 23 Drawing Sheets



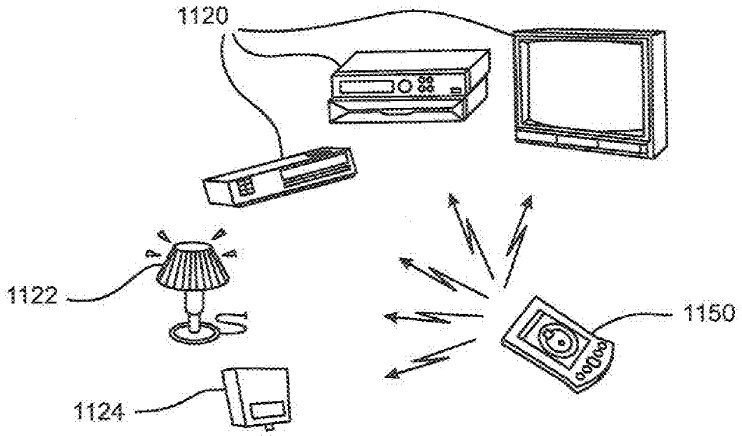

1120
1122
1124
1150

FIG. 1

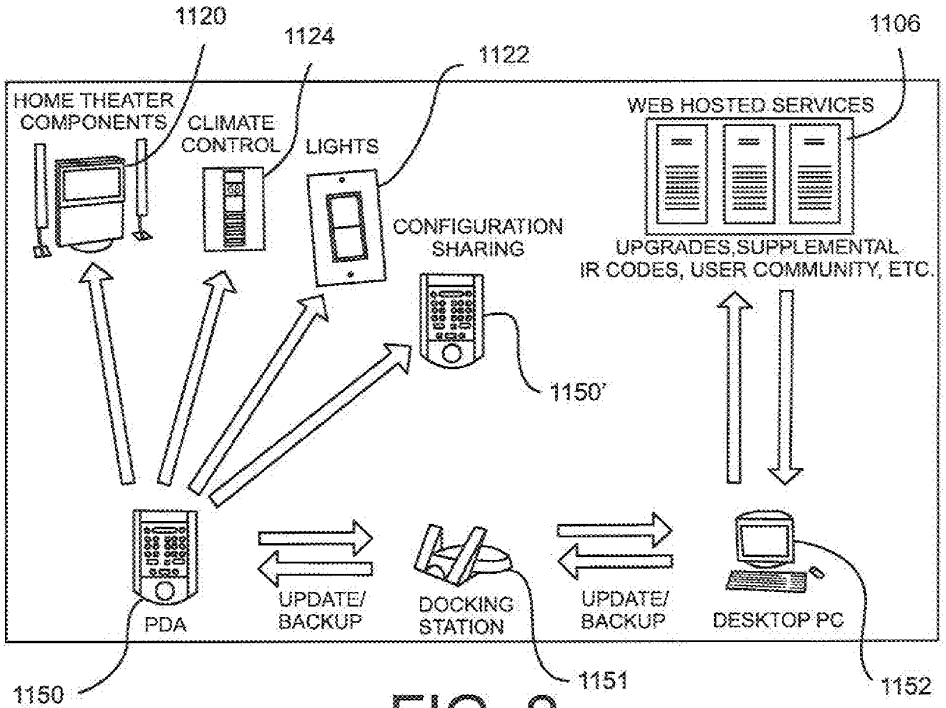

1120
1124
1122
1106
HOME THEATER COMPONENTS
CLIMATE CONTROL
LIGHTS
WEB HOSTED SERVICES
CONFIGURATION SHARING
UPGRADES, SUPPLEMENTAL IR CODES, USER COMMUNITY, ETC.
1150'
PDA
UPDATE/ BACKUP
DOCKING STATION
UPDATE/ BACKUP
DESKTOP PC
1150
1151
1152

FIG. 2

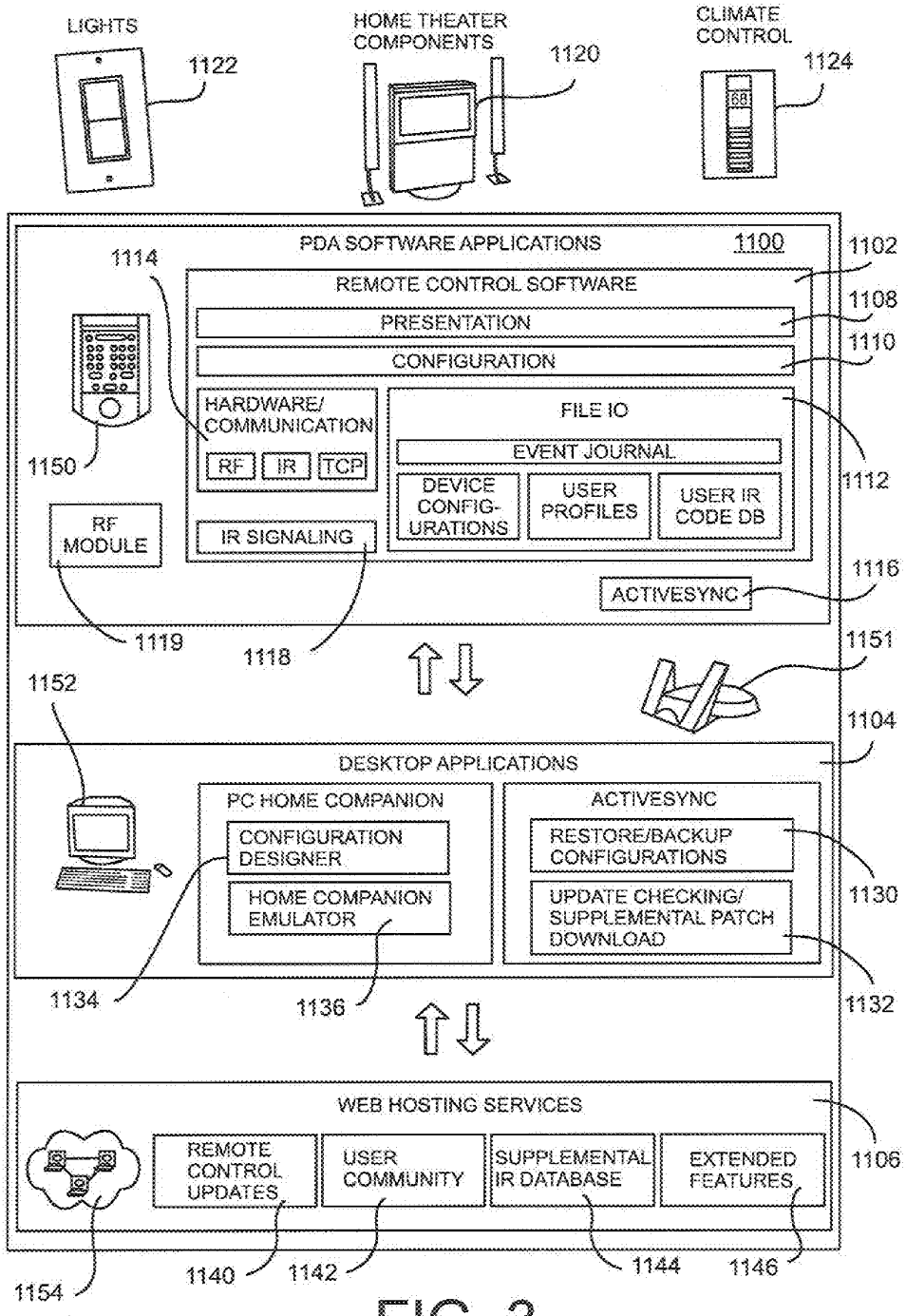

LIGHTS
1122
HOME THEATER COMPONENTS
1120
CLIMATE CONTROL
1124
PDA SOFTWARE APPLICATIONS
1100
1102
1114
REMOTE CONTROL SOFTWARE
1108
PRESENTATION
1110
CONFIGURATION
HARDWARE/ COMMUNICATION
RF
IR
TCP
FILE IO
EVENT JOURNAL
DEVICE CONFIG-URATIONS
USER PROFILES
USER IR CODE DB
1112
1150
RF MODULE
IR SIGNALING
1116
ACTIVESYNC
1119
1118
1151
1152
1104
DESKTOP APPLICATIONS
PC HOME COMPANION
CONFIGURATION DESIGNER
HOME COMPANION EMULATOR
ACTIVESYNC
RESTORE/BACKUP CONFIGURATIONS
UPDATE CHECKING/ SUPPLEMENTAL PATCH DOWNLOAD
1130
1134
1136
1132
WEB HOSTING SERVICES
1106
REMOTE CONTROL UPDATES
USER COMMUNITY
SUPPLEMENTAL IR DATABASE
EXTENDED FEATURES
1154
1140
1142
1144
1146

FIG. 3

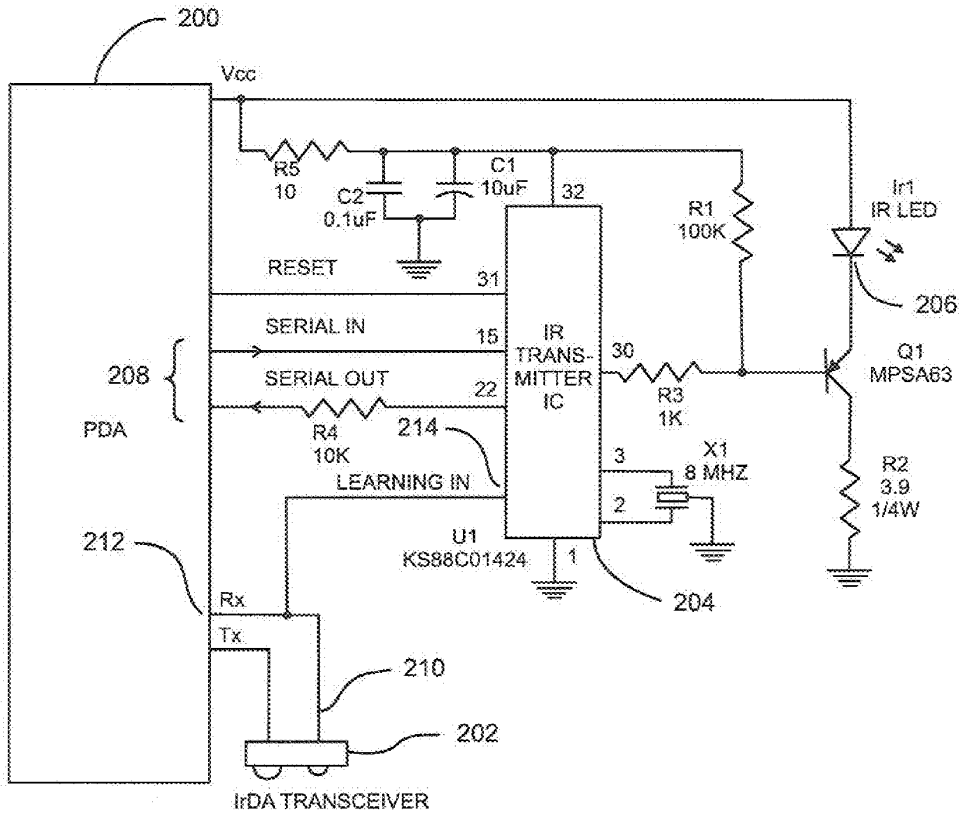

200
Vcc
R5
10
C2
0.1uF
C1
10uF
32
R1
100K
Ir1
IR LED
206
RESET
31
SERIAL IN
15
IR
TRANS-
MITTER
IC
30
Q1
MPSA63
208
SERIAL OUT
22
R3
1K
PDA
R4
10K
214
LEARNING IN
3
X1
8 MHZ
2
R2
3.9
1/4W
212
U1
KS88C01424
1
204
Rx
Tx
210
202
IrDA TRANSCEIVER

FIG. 4

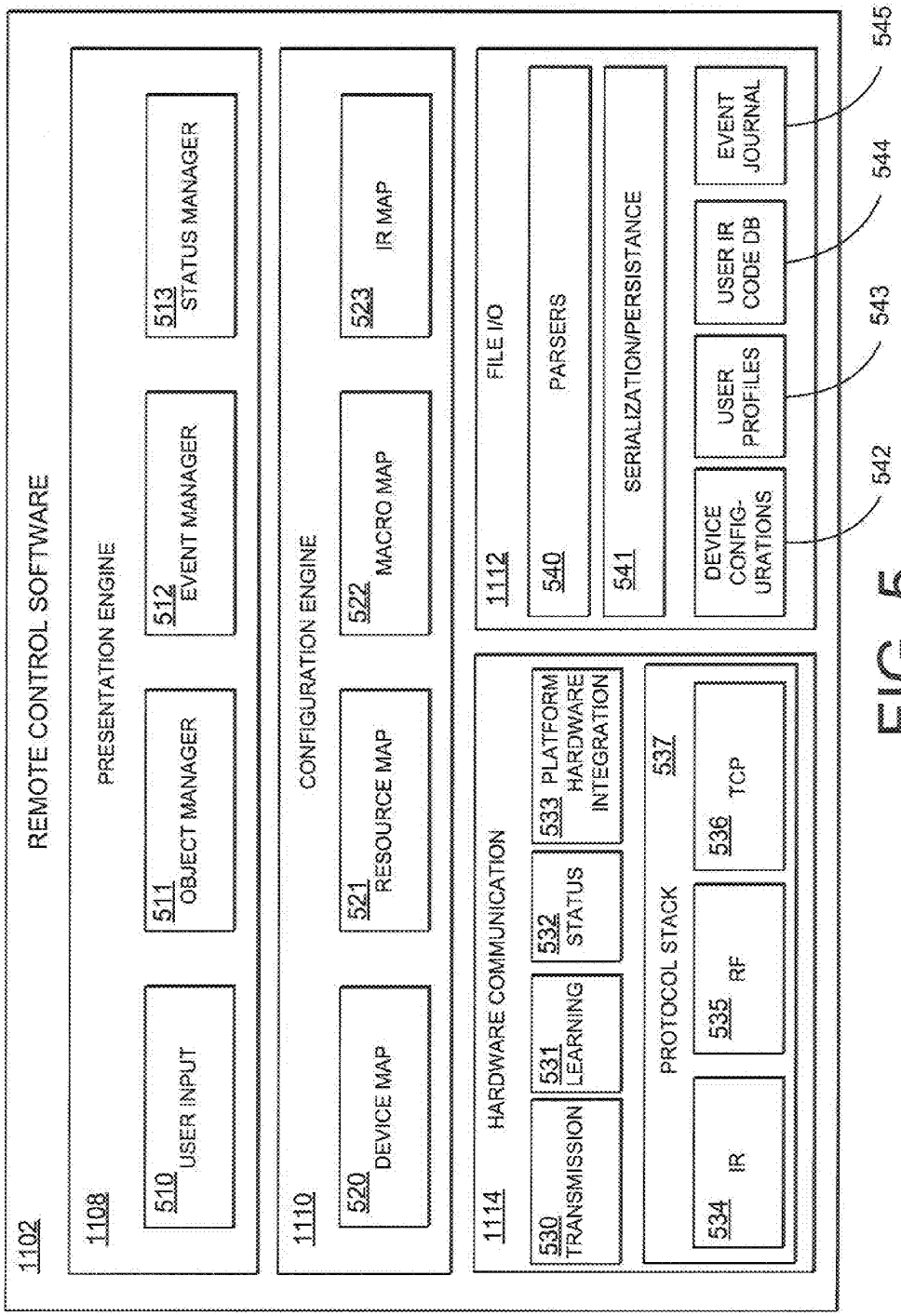

1102
REMOTE CONTROL SOFTWARE
1108
PRESENTATION ENGINE
510 USER INPUT
511 OBJECT MANAGER
512 EVENT MANAGER
513 STATUS MANAGER
1110
CONFIGURATION ENGINE
520 DEVICE MAP
521 RESOURCE MAP
522 MACRO MAP
523 IR MAP
1112
FILE I/O
540 PARSERS
541 SERIALIZATION/PERSISTANCE
DEVICE CONFIG-URATIONS
USER PROFILES
USER IR CODE DB
EVENT JOURNAL
542
543
544
545
1114
HARDWARE COMMUNICATION
530 TRANSMISSION
531 LEARNING
532 STATUS
533 PLATFORM HARDWARE INTEGRATION
537
PROTOCOL STACK
534 IR
535 RF
536 TCP

FIG. 5

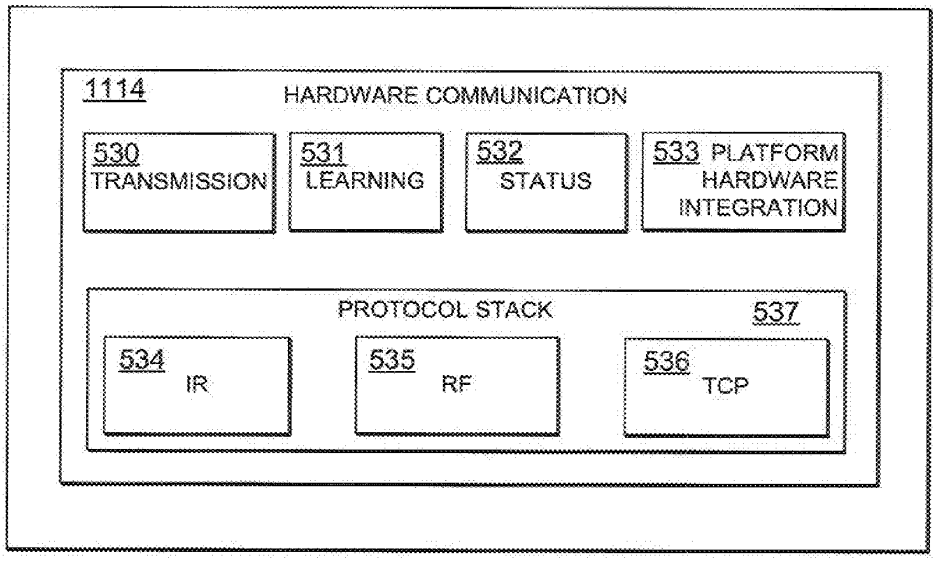

1114
HARDWARE COMMUNICATION
530
TRANSMISSION
531
LEARNING
532
STATUS
533 PLATFORM
HARDWARE
INTEGRATION
PROTOCOL STACK
537
534
IR
535
RF
536
TCP

FIG. 6

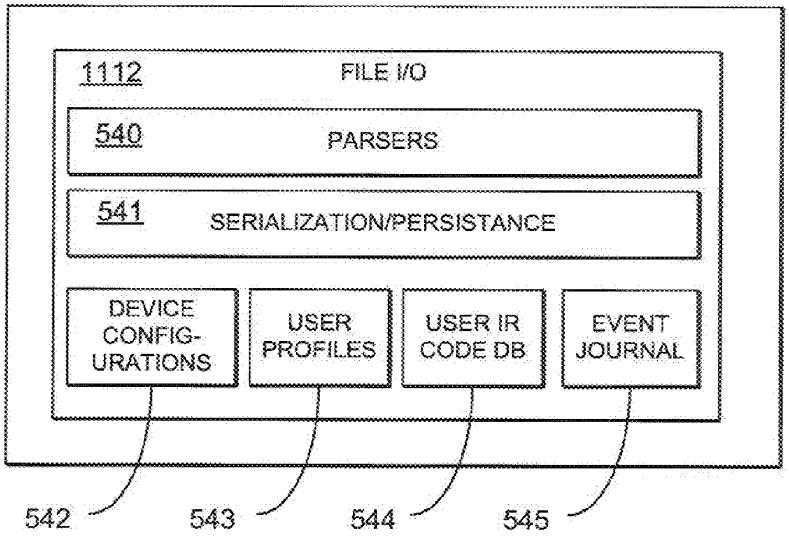

1112
FILE I/O
540
PARSERS
541
SERIALIZATION/PERSISTANCE
DEVICE
CONFIG-
URATIONS
USER
PROFILES
USER IR
CODE DB
EVENT
JOURNAL
542
543
544
545

FIG. 7

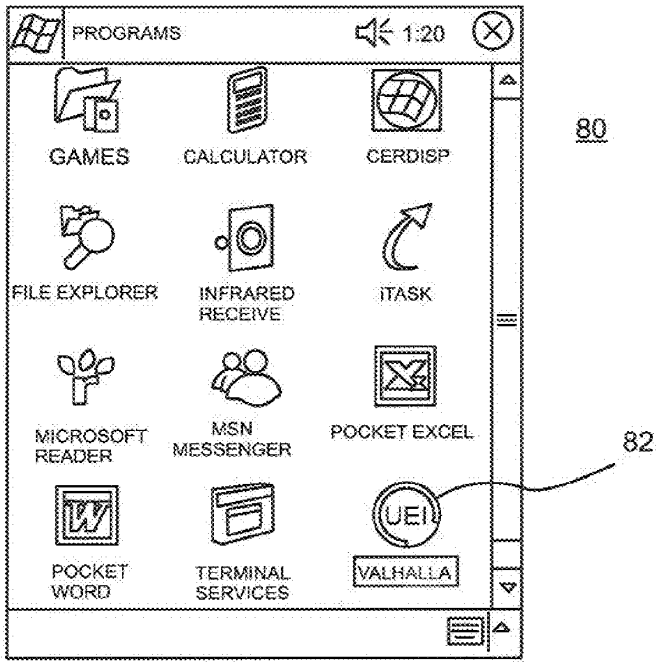

PROGRAMS
1:20
GAMES
CALCULATOR
CERDISP
FILE EXPLORER
INFRARED RECEIVE
iTASK
MICROSOFT READER
MSN MESSENGER
POCKET EXCEL
POCKET WORD
TERMINAL SERVICES
VALHALLA
80
82

FIG. 8

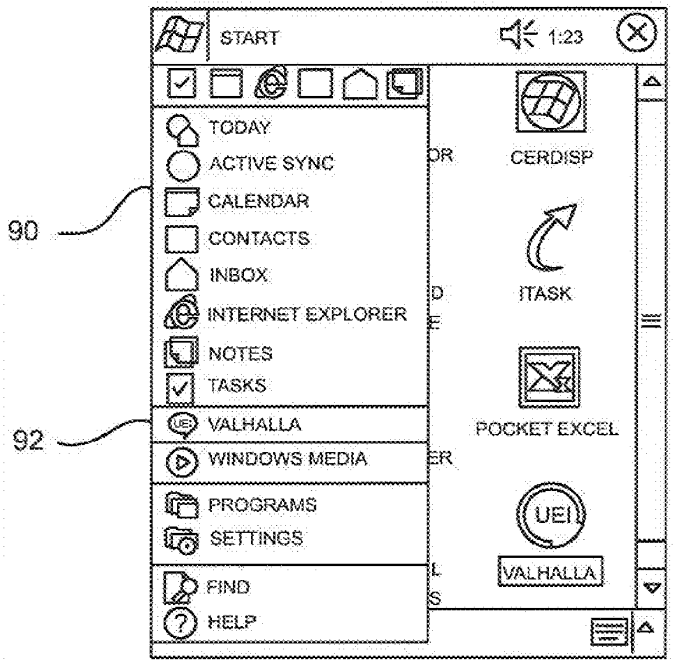

START
1:23
TODAY
ACTIVE SYNC
CALENDAR
CONTACTS
INBOX
INTERNET EXPLORER
NOTES
TASKS
VALHALLA
WINDOWS MEDIA
PROGRAMS
SETTINGS
FIND
HELP
CERDISP
iTASK
POCKET EXCEL
VALHALLA
90
92

FIG. 9

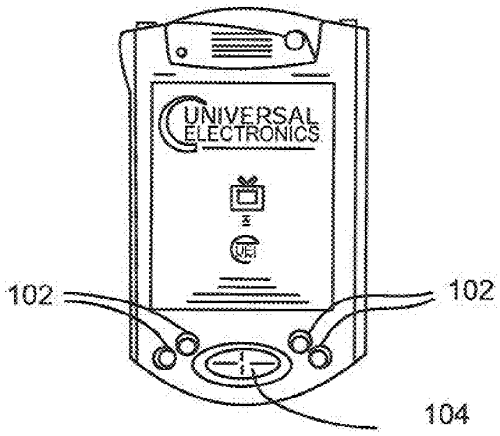

UNIVERSAL ELECTRONICS
102
102
104

FIG. 10

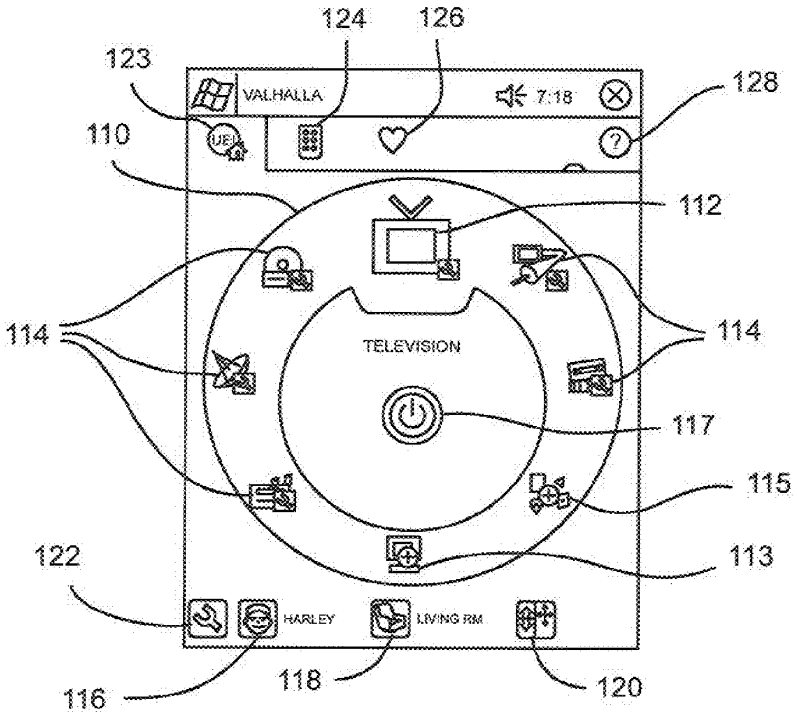

124
126
123
128
110
112
114
114
117
115
122
113
116
118
120
VALHALLA
7:18
TELEVISION
HARLEY
LIVING RM

FIG. 11

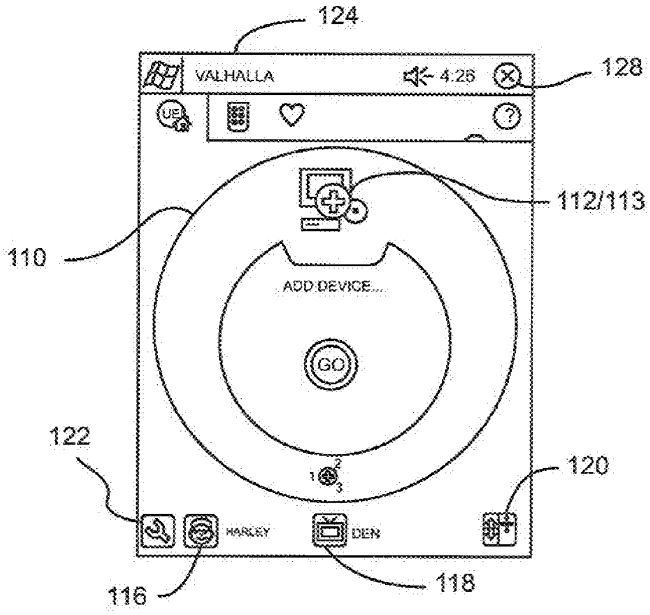

124
VALHALLA
4:28
128
112/113
110
ADD DEVICE...
GO
122
120
HARLEY
DEN
116
118

FIG. 12

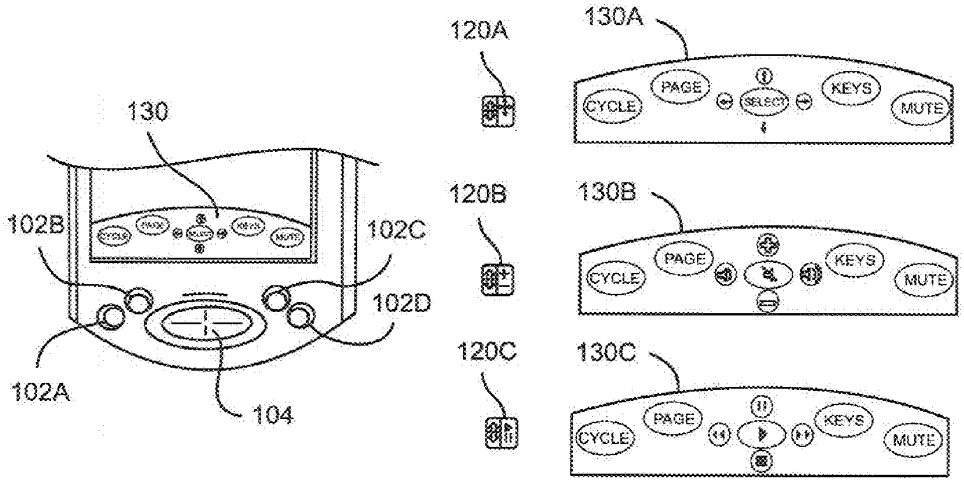

130
102B
102C
102D
102A
104
120A
130A
CYCLE
PAGE
SELECT
KEYS
MUTE
120B
130B
120C
130C

FIG. 13

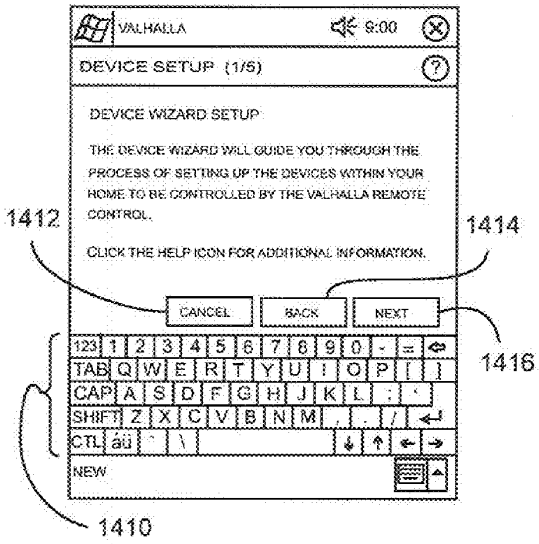


FIG. 14A

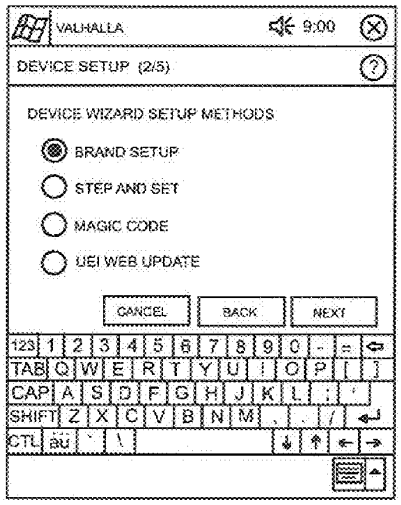


FIG. 14B

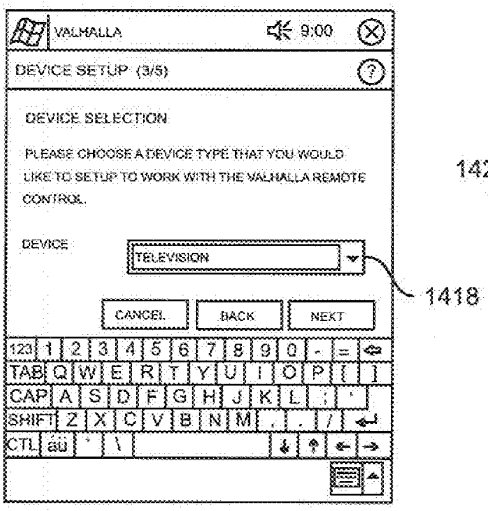


FIG. 14C

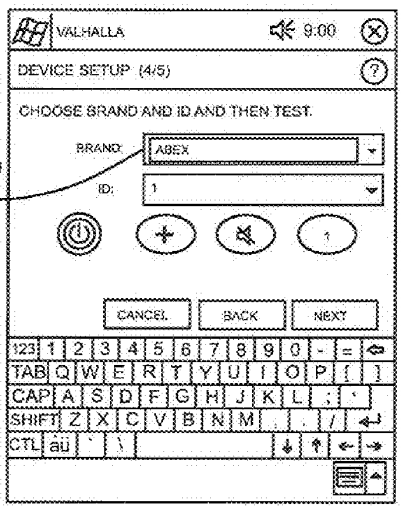


FIG. 14D

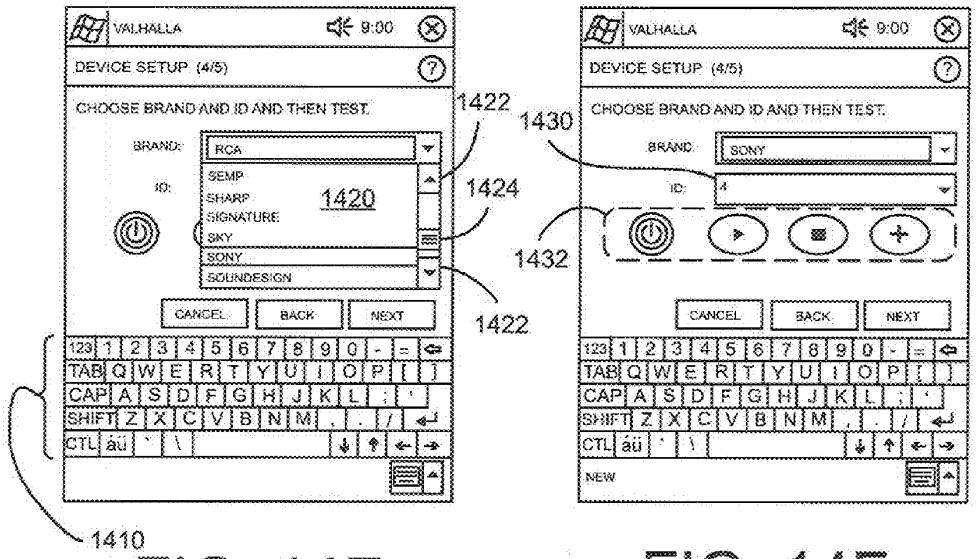


FIG. 14E

FIG. 14F

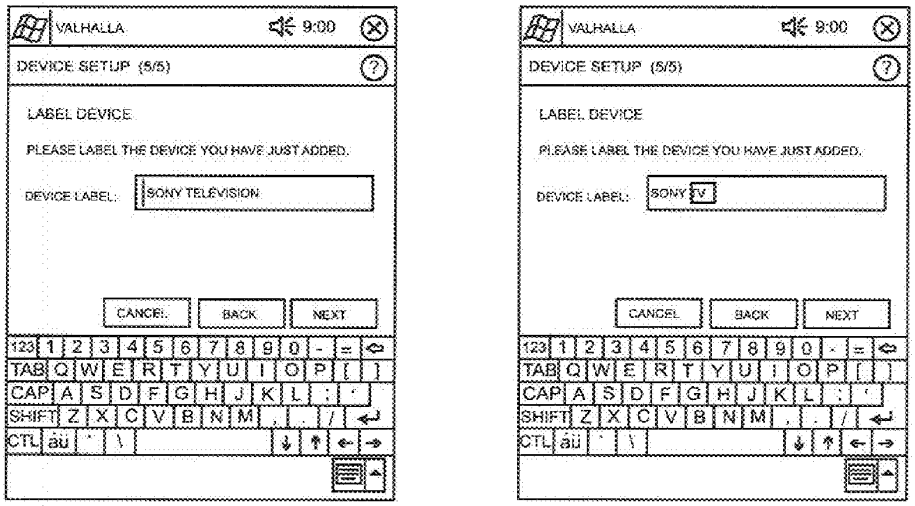


FIG. 14G

FIG. 14H

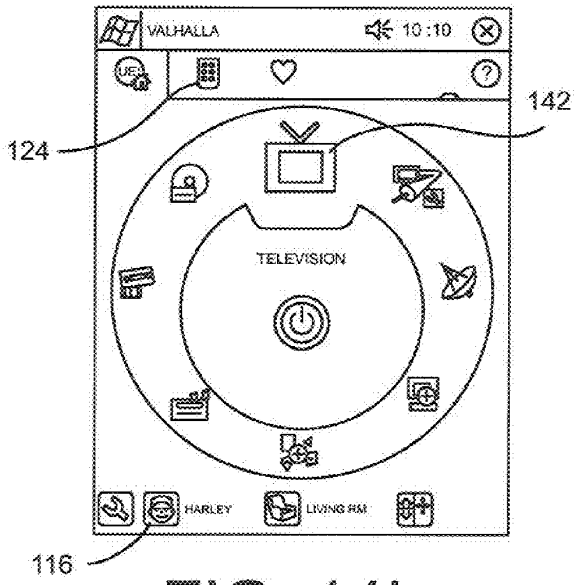


FIG. 14I

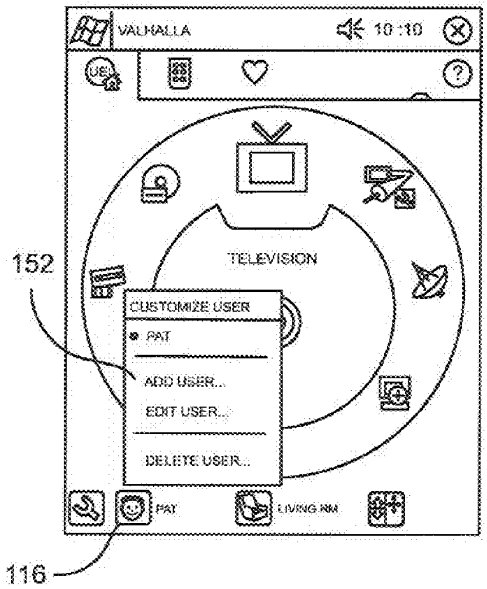


FIG. 15A

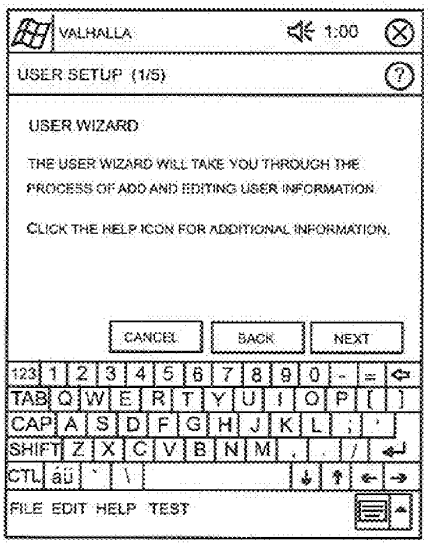


FIG. 15B

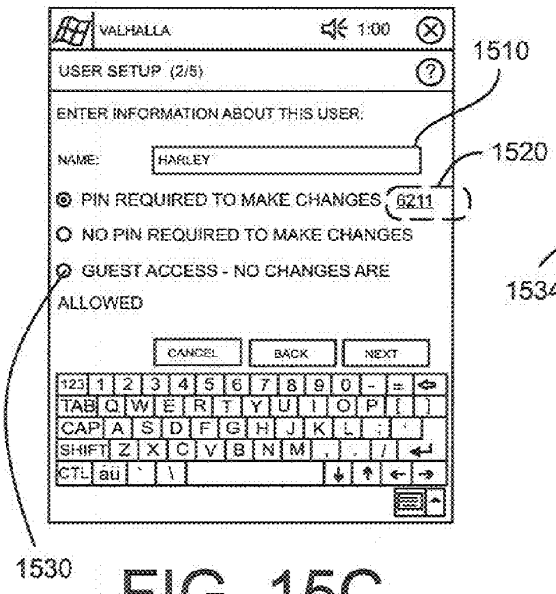


FIG. 15C

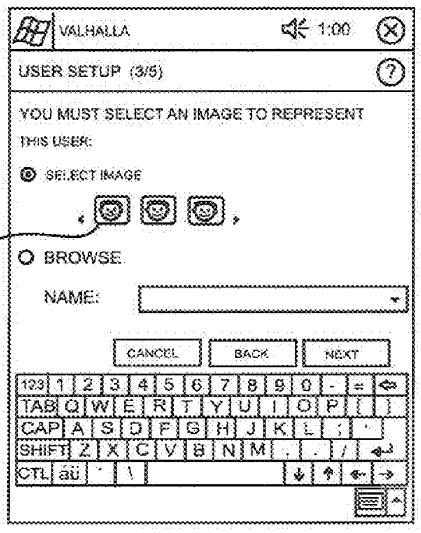


FIG. 15D

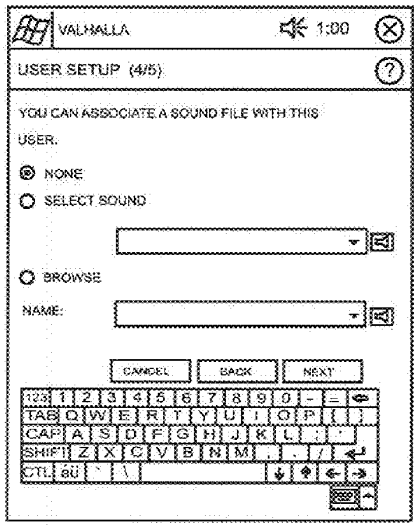


FIG. 15E

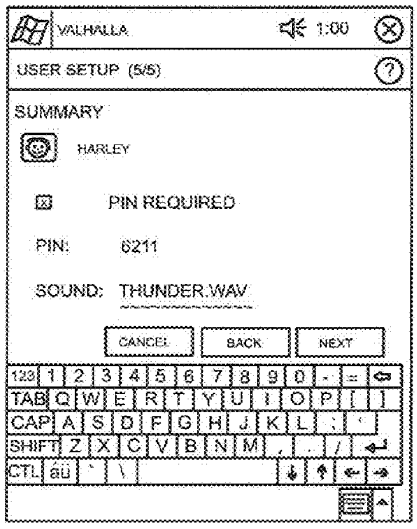


FIG. 15F

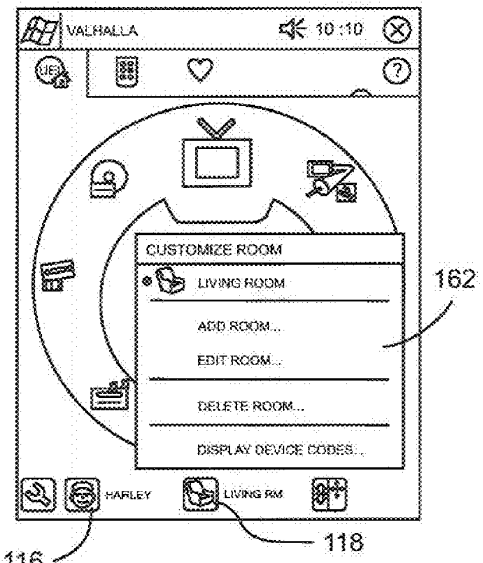


FIG. 16A

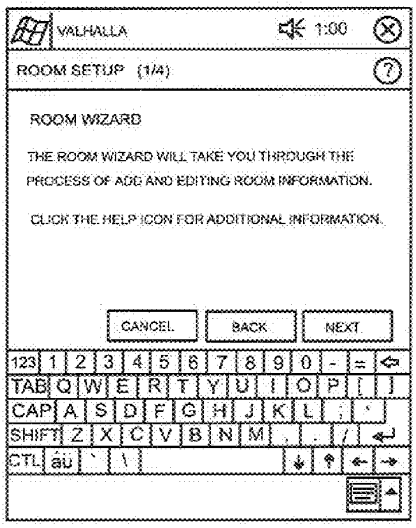


FIG. 16B

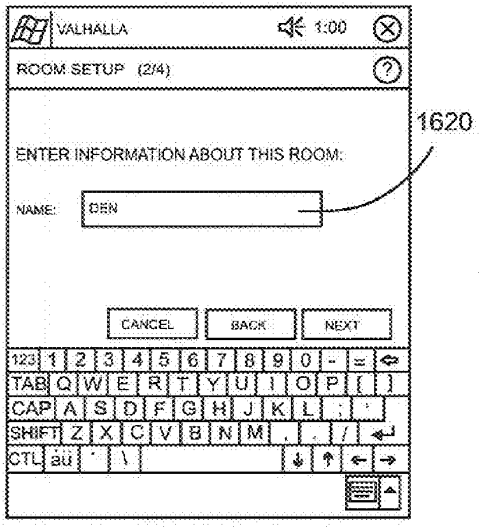


FIG. 16 C

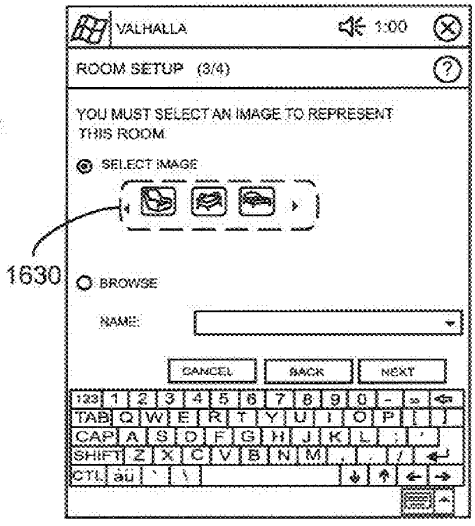


FIG. 16D

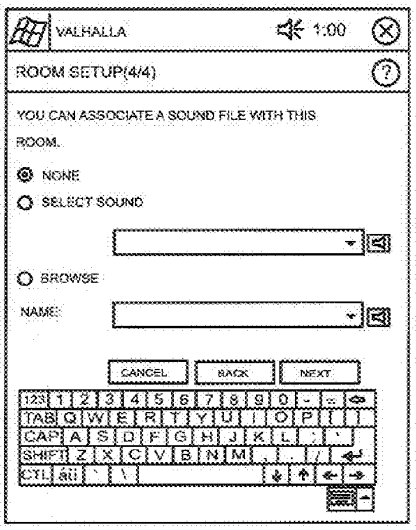


FIG. 16E

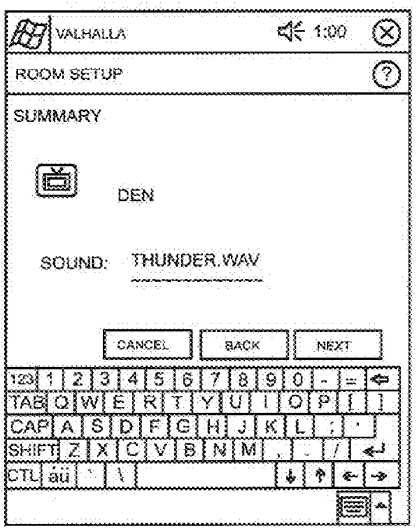


FIG. 16F

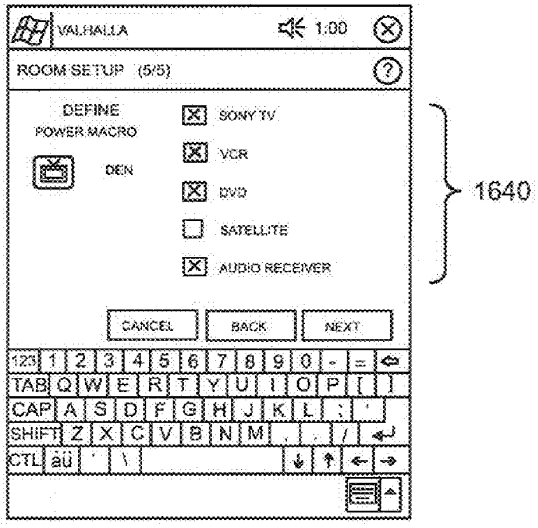


FIG. 16G

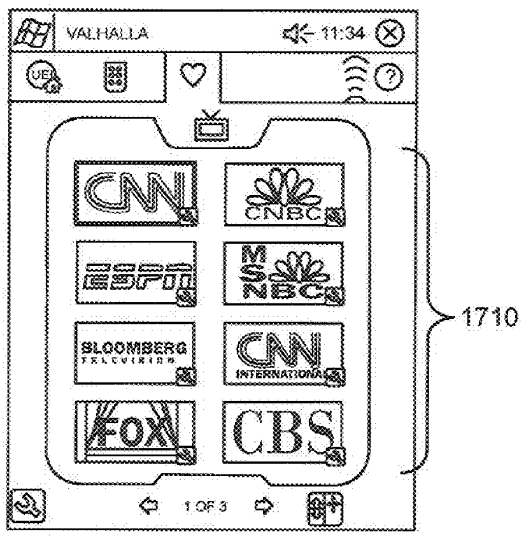


FIG. 17A

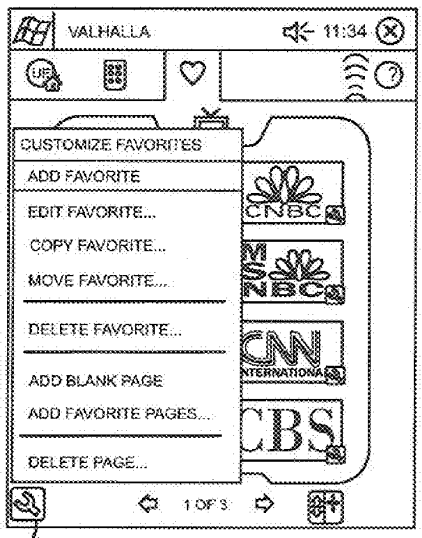


FIG. 17B

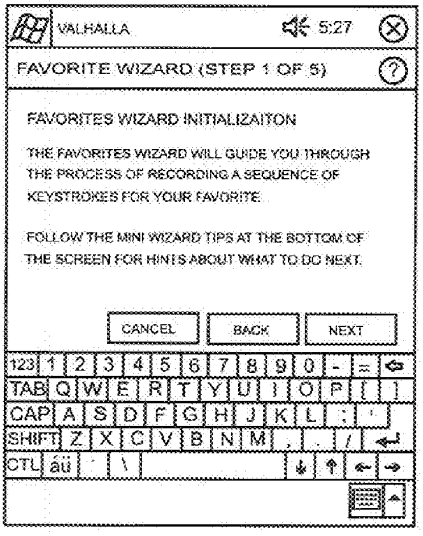


FIG. 17C

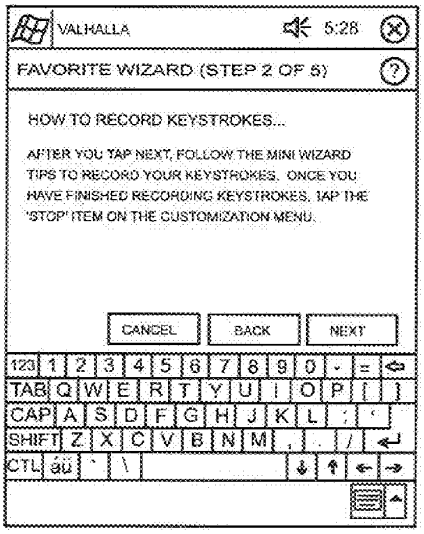


FIG. 17D

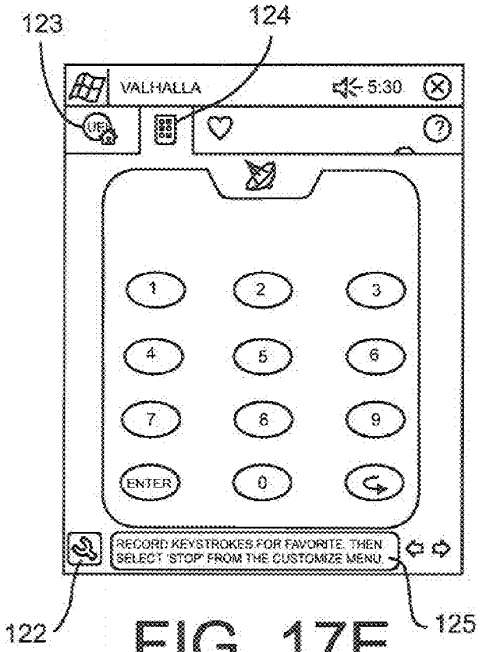


FIG. 17E

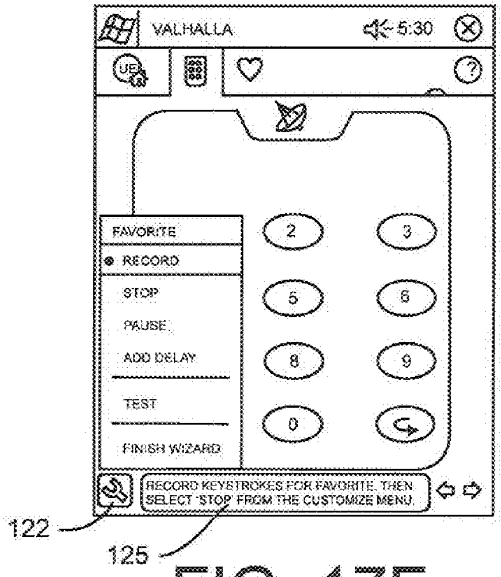


FIG. 17F

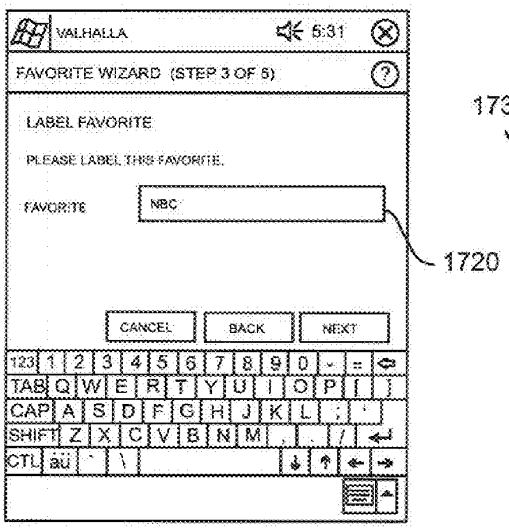


FIG. 17G

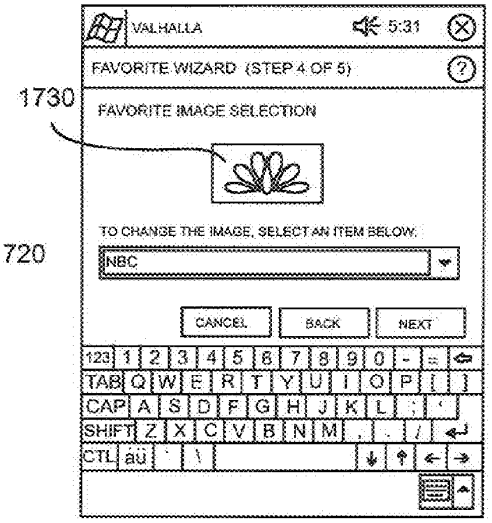


FIG. 17H

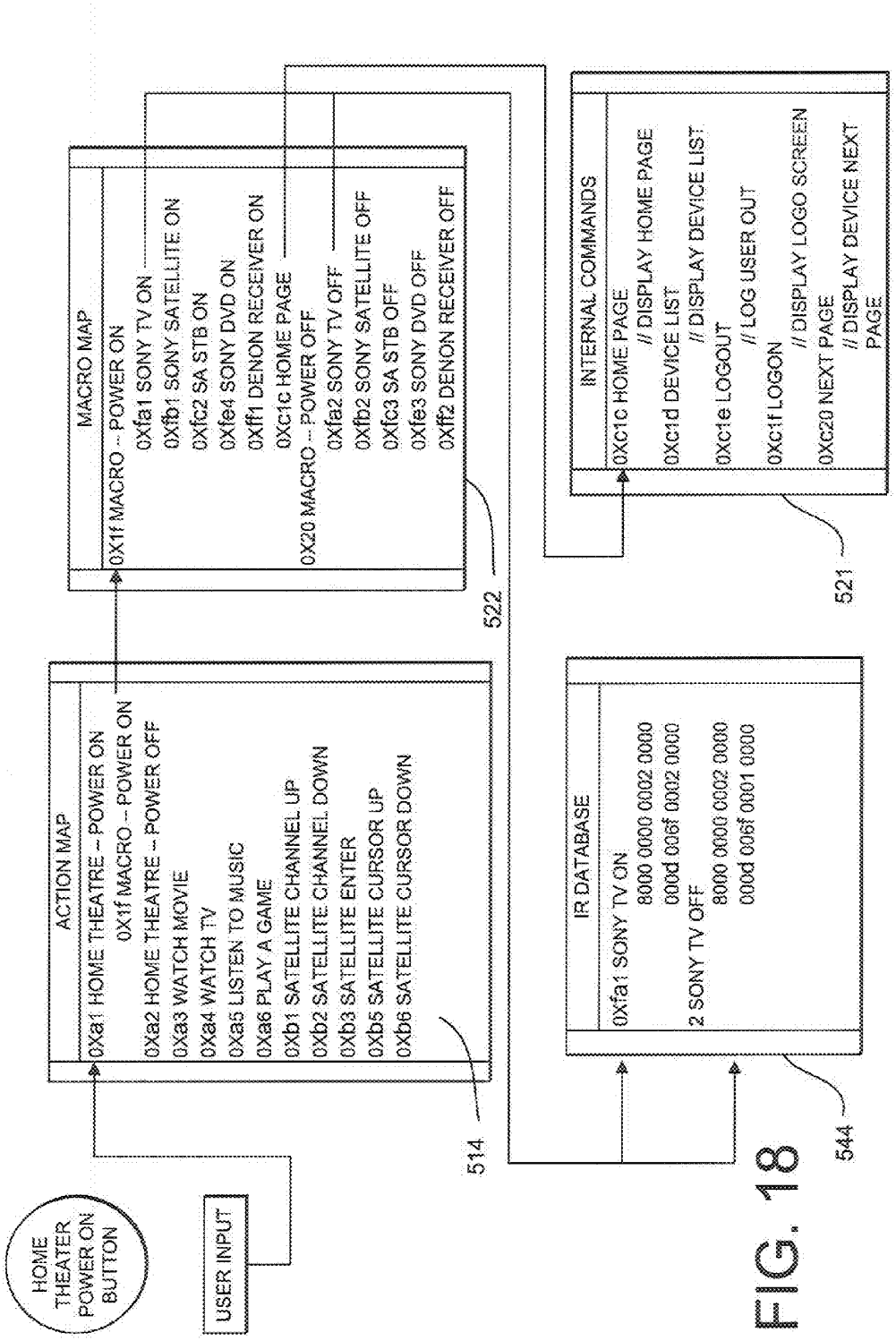

HOME THEATER POWER ON BUTTON
USER INPUT
ACTION MAP
0Xa1 HOME THEATRE -- POWER ON
0X1f MACRO -- POWER ON
0Xa2 HOME THEATRE -- POWER OFF
0Xa3 WATCH MOVIE
0Xa4 WATCH TV
0Xa5 LISTEN TO MUSIC
0Xa6 PLAY A GAME
0Xb1 SATELLITE CHANNEL UP
0Xb2 SATELLITE CHANNEL DOWN
0Xb3 SATELLITE ENTER
0Xb5 SATELLITE CURSOR UP
0Xb6 SATELLITE CURSOR DOWN
514
MACRO MAP
0X1f MACRO -- POWER ON
0Xfa1 SONY TV ON
0Xfb1 SONY SATELLITE ON
0Xfc2 SA STB ON
0Xfe4 SONY DVD ON
0Xff1 DENON RECEIVER ON
0Xc1c HOME PAGE
0X20 MACRO -- POWER OFF
0Xfa2 SONY TV OFF
0Xfb2 SONY SATELLITE OFF
0Xfc3 SA STB OFF
0Xfe3 SONY DVD OFF
0Xff2 DENON RECEIVER OFF
522
INTERNAL COMMANDS
0XC1C HOME PAGE
// DISPLAY HOME PAGE
0XC1d DEVICE LIST
// DISPLAY DEVICE LIST
0XC1e LOGOUT
// LOG USER OUT
0XC1f LOGON
// DISPLAY LOGO SCREEN
0XC20 NEXT PAGE
// DISPLAY DEVICE NEXT PAGE
521
IR DATABASE
0Xfa1 SONY TV ON
8000 0000 0002 0000
000d 006f 0002 0000
2 SONY TV OFF
8000 0000 0002 0000
000d 006f 0001 0000
544

FIG. 18

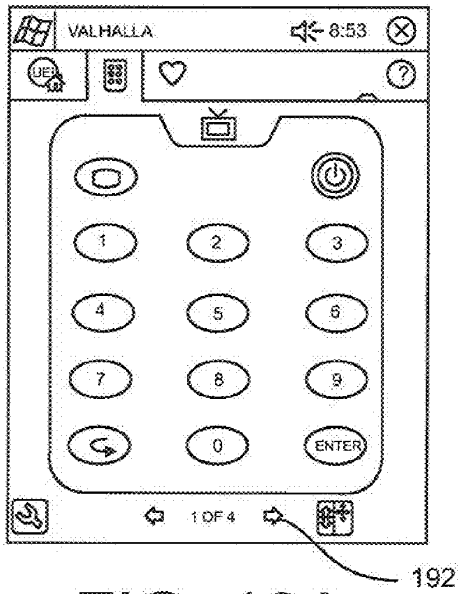


FIG. 19A

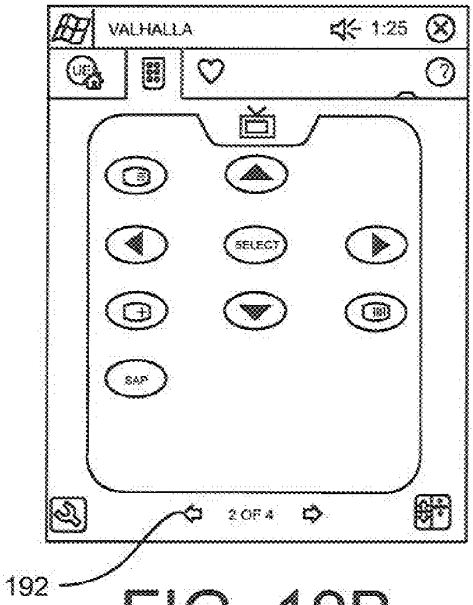


FIG. 19B

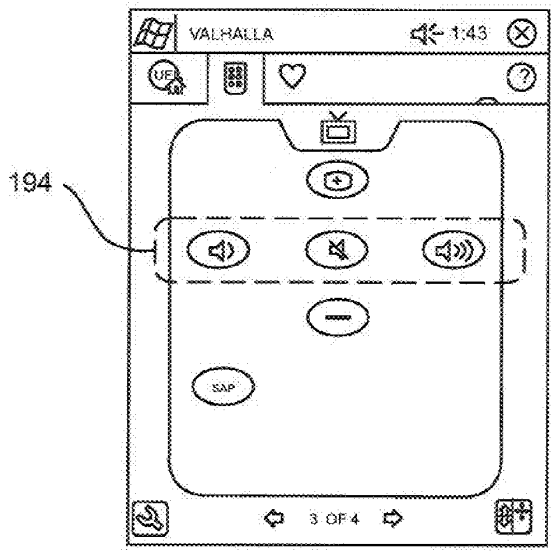


FIG. 19C

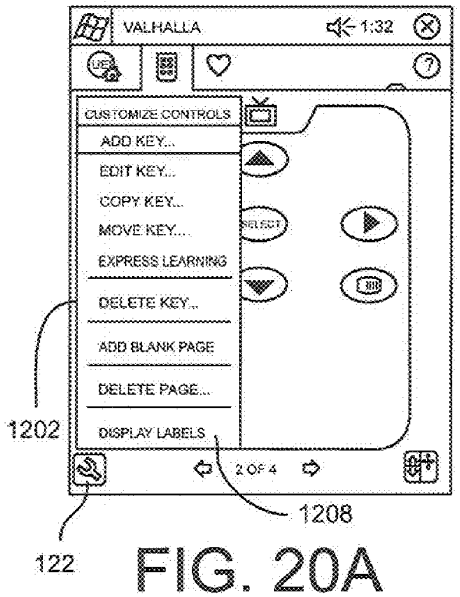


FIG. 20A

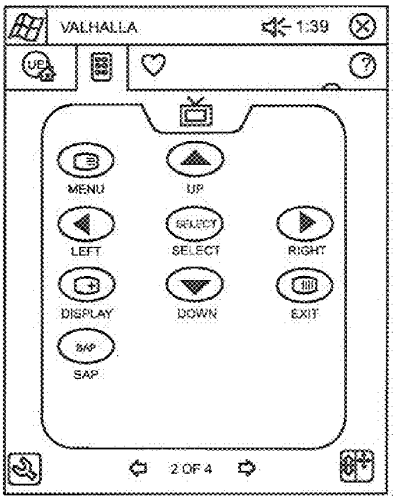


FIG. 20B

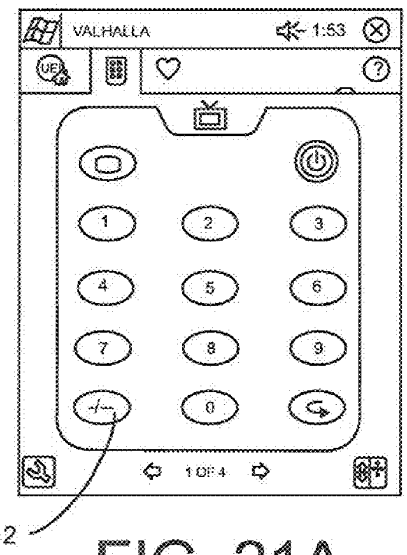


FIG. 21A

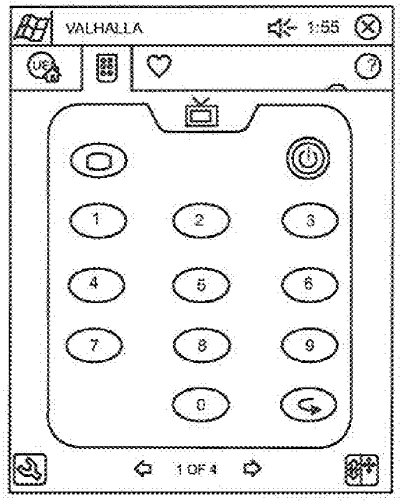


FIG. 21B

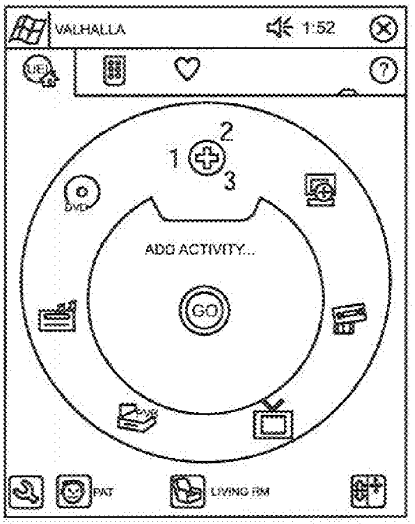


FIG. 22A

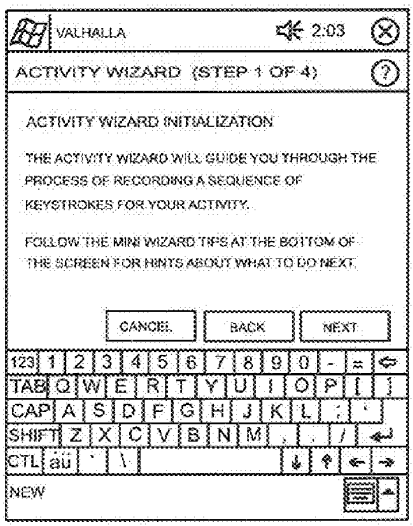


FIG. 22B

FIG. 22C

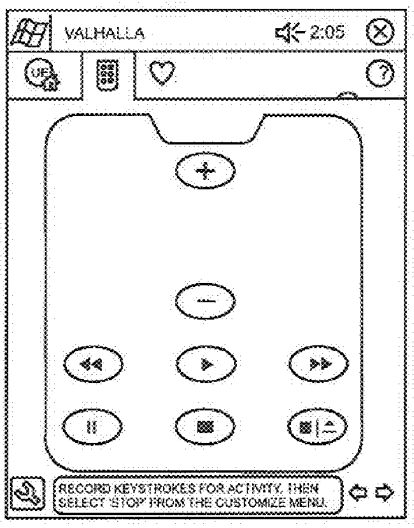


FIG. 22D

FIG. 22E

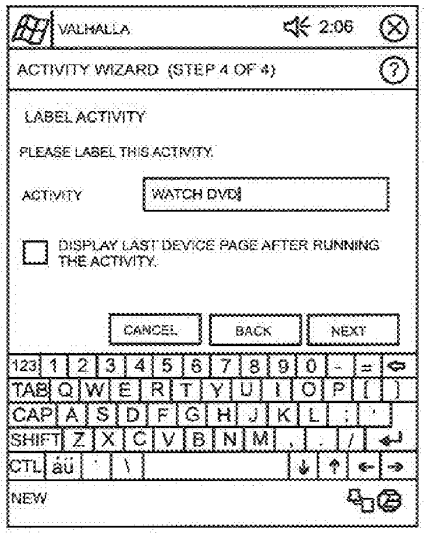


FIG. 22F

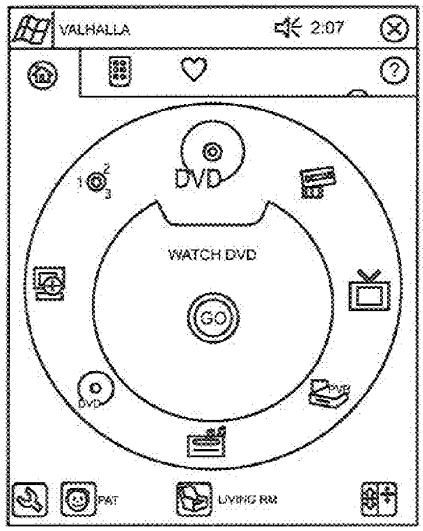


FIG. 22G

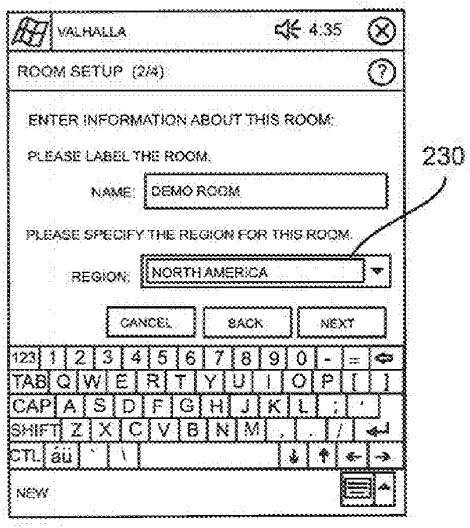


FIG. 23A

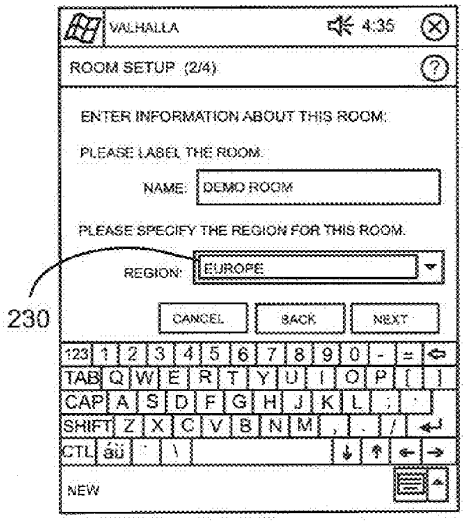


FIG. 23B

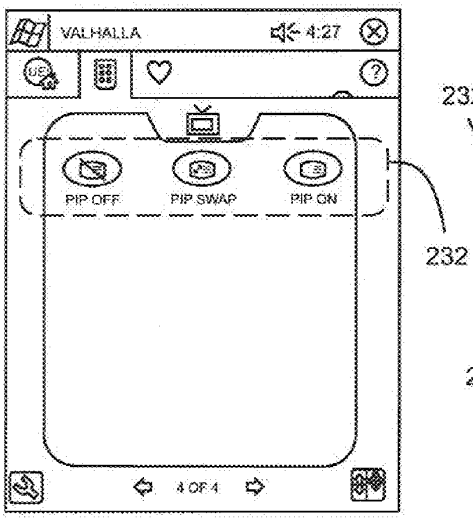


FIG. 23C

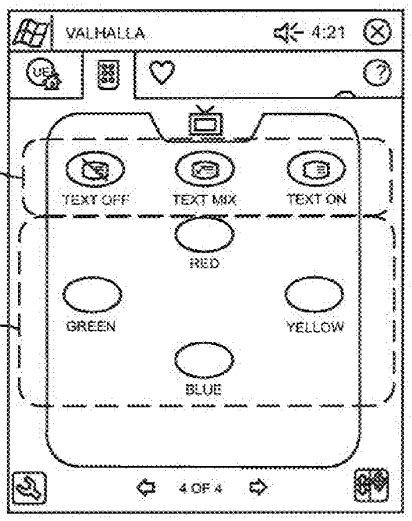


FIG. 23D

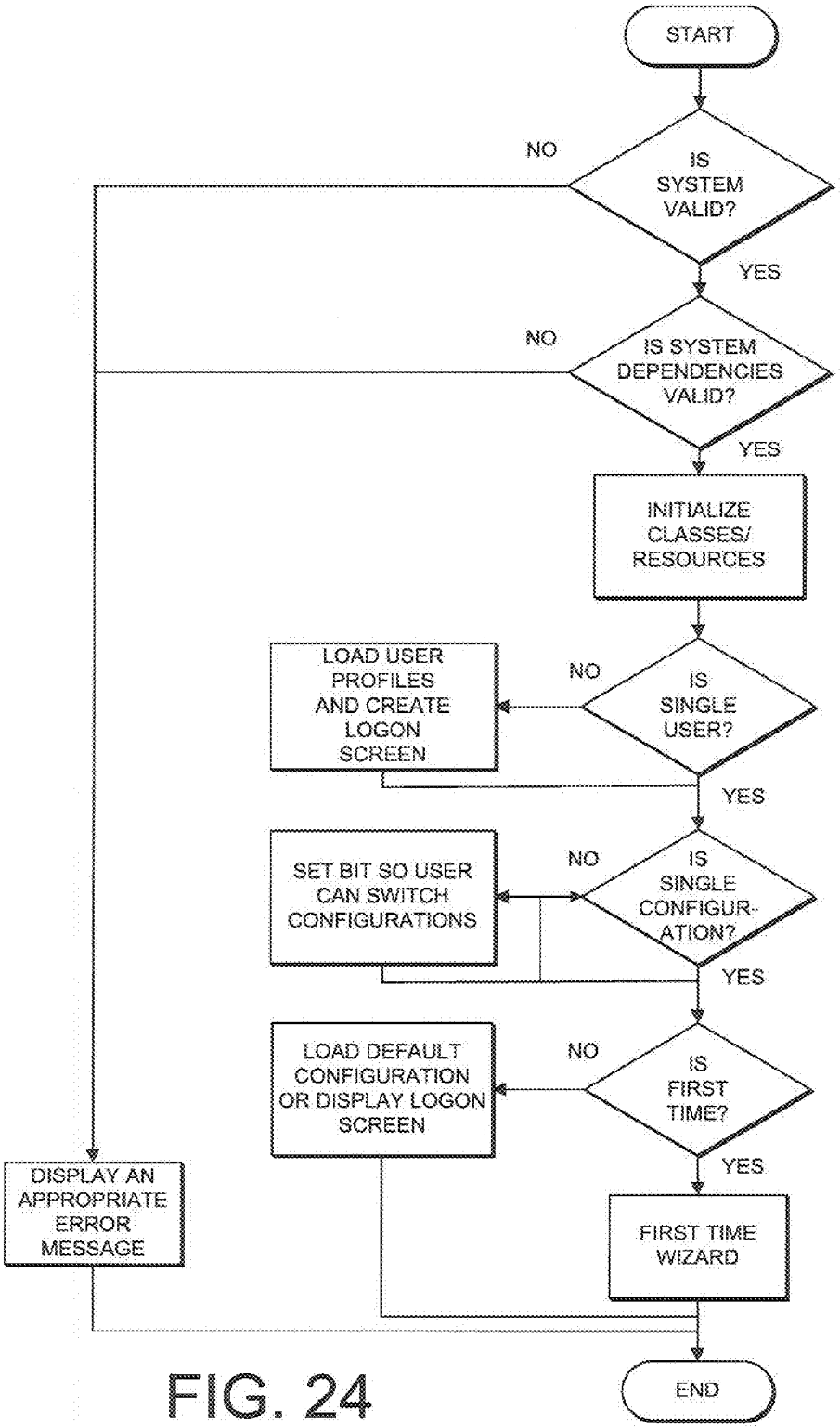

START
IS SYSTEM VALID?
NO
YES
IS SYSTEM DEPENDENCIES VALID?
NO
YES
INITIALIZE CLASSES/ RESOURCES
IS SINGLE USER?
NO
LOAD USER PROFILES AND CREATE LOGON SCREEN
YES
IS SINGLE CONFIGUR-ATION?
NO
SET BIT SO USER CAN SWITCH CONFIGURATIONS
YES
IS FIRST TIME?
NO
LOAD DEFAULT CONFIGURATION OR DISPLAY LOGON SCREEN
YES
FIRST TIME WIZARD
DISPLAY AN APPROPRIATE ERROR MESSAGE
END

FIG. 24

USER INTERFACE FOR A REMOTE CONTROL APPLICATION

RELATED APPLICATION INFORMATION

This application is a divisional of U.S. application Ser. No. 11/340,442, filed Jan. 26, 2006, which application was filed as a divisional of U.S. Application No. 10,288,727, filed Nov. 6, 2003, which, in turn, claims the benefit of U.S. Provisional Patent Application Nos. 60/344,020 filed on Dec. 20, 2001 and 60/334,774 filed on Nov. 20, 2001.

These applications, from which priority is claimed, are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

This invention relates generally to hand-held electronic devices and, more particularly, relates to a user interface for an universal remote control application resident on the hand-held electronic device.

Universal remote controls for controlling the operation of multiple, diverse home appliances are well known. In this regard, universal remote controls perform a valuable function by consolidating three, four, five, and more remote controls into one device. However, as more remotely controllable appliances enter the homes of consumers and the number of remotely controllable operations increase, the user interface of the universal remote control becomes increasingly more complex. This complexity arises from the need to provide more and more keys which are used to initiate the transmission of the control codes that control the increasing number of operations of the increasing number of home appliances. Disadvantageously, as the user interface of the universal remote control becomes more cluttered, the usability of the universal remote control diminishes. Accordingly, a need exists for a universal remote control having an improved user interface that simplifies the operation of the universal remote control and, as such, the remote operation of consumer appliances.

SUMMARY OF THE INVENTION

In accordance with these needs, the subject invention is directed to a hand-held electronic device having a remote control application user interface that functions to display operational mode information to a user. Representative platforms for the hand-held electronic device include, but are not limited to, devices such as personal digital assistants, Web tablets, lap-top computers, extended-functionality mobile phones, remote control devices, etc. which are collectively referred to hereinafter as "PDAs." An understanding of the objects, advantages, features, properties and relationships of the remote control application user interface will be obtained from the following detailed description and accompanying drawings which set forth illustrative embodiments which are indicative of the various ways in which the principles of the remote control application user interface may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the remote control application user interface, reference may be had to various preferred embodiments shown in the following drawings in which:

FIG. **1** illustrates an exemplary system in which a PDA is adapted to control consumer appliances;

FIG. **2** illustrates an exemplary system in which a PDA receives updates and supplemental IR codes from a Web site;

FIG. **3** illustrates the internal topology of an exemplary system in which a PDA is adapted to control consumer appliances;

FIG. **4** illustrates an exemplary hardware circuit for enabling a PDA to transmit consumer appliance IR codes;

FIG. **5** illustrates an exemplary remote control application software architecture for a PDA;

FIG. **6** illustrates an exemplary hardware communication manager software architecture for a PDA;

FIG. **7** illustrates an exemplary file I/O manager software architecture for a PDA;

FIGS. **8** and **9** illustrate exemplary PDA display screens illustrating a resident or installed remote control application;

FIG. **10** illustrates an exemplary PDA physical appearance and layout;

FIG. **11** illustrates an exemplary remote control application home screen with the remote control application configured to control the operation of consumer appliances;

FIG. **12** illustrates an exemplary remote control application home screen prior to the remote control application being configured to control the operation of consumer appliances;

FIG. **13** illustrates exemplary remote control application hard key function assignments on a PDA together with corresponding informational displays;

FIG. **14** illustrates an exemplary series of steps to set up the remote control application to command the operation of a new consumer appliance;

FIG. **15** illustrates an exemplary series of steps to set up a new user of the remote control application;

FIG. **16** illustrates an exemplary series of steps to set up the remote control application to command the operation of consumer appliances in a designated room;

FIG. **17** illustrates an exemplary series of steps to set up a new remote control application favorite channel soft key;

FIG. **18** illustrates an exemplary set of data relationships for execution of a remote control application macro function;

FIG. **19** illustrates exemplary remote control application device control pages;

FIG. **20** illustrates an exemplary user customization of a remote control application device control page;

FIG. **21** illustrates an exemplary automatic customization of a remote control application device control page;

FIG. **22** illustrates an exemplary series of steps to program a remote control application activity or macro;

FIG. **23** illustrates an exemplary automatic adjustment of a remote control application device control page based on a geographical region;

FIG. **24** illustrates an exemplary start-up initialization sequence for the remote control application.

DETAILED DESCRIPTION

Exemplary embodiments of a user interface for an universal remote control application resident on the hand-held electronic device are illustrated and described which provide a next generation of home automation and consumer electronic controls. Representative platforms for the hand-held electronic device include devices supporting the Windows CE brand operating system or PocketPC type devices that include built-in support for transmitting consumer equipment IR remote control codes. Exemplary devices include, but are not limited to, devices such as the Compaq (now HP) iPAQ brand model 3950 or 3970 that include a hardware module to house the IR transmitter and an IR database of consumer electronics command codes, along with a remote control application that is used to control the operations of various consumer appliances. Other platform implementations using either built-in

or add-on hardware to implement the IR transmit functionality are also possible, using other Windows CE brand class devices or other software systems such as, for example, the Palm brand operating system. While the descriptions that follow are particularly illustrated using an iPAQ PocketPC brand platform, it will be appreciated by those of ordinary skill in the art that these teachings can be easily adapted to other platforms and software systems, for example, by making simple adjustments to display graphic sizes and layouts, file formats, etc., where needed to adapt to the different operating environment.

Turning to FIGS. **1** and **2** there is illustrated a system in which a PDA device **1150** is adapted to provide wireless control of consumer appliances such as home entertainment equipment **1120**, lighting **1122**, and temperature control **1124**. Control signals are provided, for example, by causing the PDA **1150** to emulate the wireless signals (IR, RF, etc.) used by the standard remote controls originally supplied with the respective appliances. The PDA **1150** is also preferably adapted to interact with Web-hosted services **1106**, such as IR code updates, graphics, software enhancements, electronic program guides (EPGs), etc., via a host desktop computer **1152** and docking station **1151** as particularly illustrated in FIG. **2**. It will be appreciated by those skilled in the art that the Web-hosted services may also be accessed directly, sans an intervening host desktop computer, in cases where the PDA **1150** is adapted to communicate directly to the Internet. Still further, the PDA **1150** may be adapted to share all or part of a user's programmed configuration settings with other compatible PDAs **1150'**. An exemplary graphical representation of the topology of such an exemplary system is illustrated in FIG. **3** which depicts the major components of the remote control application and the environment in which it operates. Represented in FIG. **3** are the PDA **1150**, the host desktop PC **1152**, and Web Server(s) accessible through the Internet **1154**.

The PDA Software Application **1100** described hereinafter and shown graphically in FIG. **3** generally comprises four program segments that would typically be installed on the PDA **1150** in order to control, for example, home entertainment components **1120** and home automation components such as lights **1122** and climate control **1124**. By way of illustrative example, the four program segments comprise:

Remote Control Software **1102**: This application allows the user to control their consumer electronic devices. The application provides users with an easy and intuitive way to manage their home entertainment equipment as well as home automation devices (such as X10 type devices) within the home. The remote control application itself may comprise four major architectural subcomponents, although only the top level (referred to as the "presentation engine") is exposed to the end user. These four components, the presentation engine **1108**, the configuration engine **1110**, the hardware communication manager **1114**, and the file I/O manager **1112** will be described in more detail hereinafter.

ActiveSync Software **1116**: This application is used as a communications conduit to and from a remote control companion application that is installed on the host desktop PC **1152**.

IR Signaling Software **1118**: This application performs the IR signal generating functions to universally control appliances; supporting a database of IR codes and transmission protocols for use in conjunction with the IR hardware components described later with reference to FIG. **4**.

RF Module Software/Hardware **1119**: A Bluetooth or 802.11 RF module may optionally perform the RF signal generation to control RF devices and/or communicate wirelessly with a server or other applications resident on the host desktop PC **1152**. It will be appreciated that such an RF Module may be used either together with or in place of the above mentioned IR Signaling to effect control of home appliances.

As noted, the ActiveSync software **1116** cooperates with a remote control companion application **1104** installed on the host desktop PC **1152**. This combination of applications generally implements a standard Microsoft-based ActiveSync brand utility that functions as a communications conduit to/from the remote control application. Software supplemental to the ActiveSync brand applications may be required to ensure that data required for the remote control application is passed along the conduit in an appropriate fashion. Such supplemental software would be used to restore/backup configurations **1130** (e.g., which allows configuration files and event journals to be backed-up and restored) and to check updates/download supplemental patches **1132** (e.g., which reviews current version numbers of software, IR code databases, etc. and ensures that the latest versions are the ones available for download). It will be appreciated by those skilled in the art that these functions may be performed by software stored locally (e.g., on the PDA **1150** and/or host computer **1152**) or via the Web using, for example, Java applications. Optional desktop applications may also be used to edit **1134** and/or emulate **1136** the configuration and appearance of the PDA based remote control application on the desktop system **1152**.

Services and data that are located on a hosted site **1106** are represented by the remote control software services. The remote control software services may include remote control application software updates **1140**, supplemental IR database updates **1144** (including additional devices and/or key functions for download), and/or a remote control user community **1142** which, for example, might allow users to download additional graphics for interface customization, upload their configuration files to share with other users, etc. This user community **1142** is also where third party developed software extensions may be placed for download if desired. The hosted site **1106** may also be the source of data that is used in conjunction with extended features **1146** of the remote control application **1146**, for example downloadable electronic program guide ("EPG") information, cable channel lineups, movie schedules and the like.

The remote control application software **1102** may also include the following high level functions: setup wizards; consumer appliance control through IR and/or RF signal transmissions; customization features including the ability to learn IR codes, assign and playback macros, reassign keys, program favorites including rapid assignment of channel numbers to network logos, configure multiple user profiles, set restore points, configure a guest mode, customize the remote control application from the host or remote computer including the downloading of new IR codes and key functions, skins, additional network logos, software extensions; copying of configuration data from one PDA to another; journaling activity; and an API for third party developers to build extensions. These functions will be described in more detail in the following paragraphs.

Setup Wizards

The intent of a setup wizard is to get the PDA **1150** configured for use as quickly as possible. A setup wizard is normally a specialized part of an application program that functions to guide a user through a step-by-step setup or configuration process. Information utilized in connection

with a setup wizard may be pre-populated so that there is an increased likelihood of a user successfully getting the desired results.

By way of example, a user setup wizard serves to setup the remote control application **1150** to identify one or more users and their preferences. For initial user setup, the user setup wizard may read data directly from the owner registration information file(s); no additional information would be required to use the remote control application. Alternatively, for initial user setup, the user setup wizard need not be invoked with the owner registration information file(s) being read and utilized by default.

By way of further example, a device setup wizard would be used to establish the list of devices that the remote control application is configured to control as well as how the devices should be controlled. To this end, the graphical user interface of the remote control application may start by displaying a small number of device buttons (e.g., buttons that would be activated to place the remote control application into a mode to control a device) that would initially be un-setup. Selection of an un-setup device button can be used to automatically invoke the device setup wizard. It is to be appreciated that the device setup wizard will be invoked each time the remote control application is setup to control a new device or when it is desired to add or change settings for an already setup device. Like the device setup wizard, the user setup wizard can be invoked multiple times to add more users. When invoking a setup wizard, the remote control application may be able to detect if a setup process has already been executed and may display the current settings to the user for confirmation or changing.

As will be described hereinafter, setup may prompt the user for the type of install to perform (typical or custom). For custom setup, the user may specify what level of device support is desired (standard, power, expanded). The setup wizard may chain together the functionality from different customization screens. Two major areas of customization are user setup and device setup. The user may be required to run the setup wizards sequentially from the beginning or may select a specific setup wizard or portion of a setup wizard to run after initial configuration of the remote control application. The remote control application may store user preferences in a configuration file and may recall configuration file preferences for inclusion in the setup wizard screens upon subsequent execution of those set wizards (e.g., in the performance of an edit of a setup).

Consumer Appliance Control

Once the PDA **1150** has been setup, via the remote control application, to control a device, the remote control application may be invoked to allow the PDA **1150** to be used as the primary Infrared (IR) remote control for the setup devices. In this regard, devices include conventional consumer appliances, such as televisions, VCRs, DVD players, PVRs, etc. Devices may also include home automation devices. While home automation devices may appear to be different from what might be viewed as convention consumer appliances (e.g., home theater equipment), from the standpoint of the remote control application, they are quite similar. As long as the home automation device can be controlled (e.g., via IR, RF, signals), the remote control application can cause the transmission of signals to the home automation device. Thus, the graphical user interface of the remote control application may support controls buttons, sliders, etc., e.g., via the use of bitmap images, to support operations unique to home automation devices (e.g., lights dim/brighter, curtains open/close, fan rotation speed, etc.).

Remote Control Application Customization

Remote control application customization allows a user to modify the graphical user interface, device and/or function control capabilities, etc, or the remote control application and/or PDA platform. Generally, any remote control application customization would be assisted by a setup wizard. Modifications achievable via customization include, by way of example, learning IR codes, assigning and playing back macros, specifying favorites (assigning channel numbers and/or the IR sequences necessary to cause entertainment appliances to switch channels to network logos), setting user security levels, etc. Before modifications are made, an automatic backup of the settings of one or more component parts of the remote control software application may be made so that the user can undo changes if they did not achieve the desired results.

Remote Control Application Customization From PC/External Updates

Settings usable in connection with the remote control application (e.g., skins, macros, etc.), remote control application updates, IR code updates, etc. may also be added, deleted, and/or modified based on information stored in external systems. The information may have originated on a Website, the host computer **1152**, etc.

Journal Activity

The system may be configured to journal (i.e., log) some or all of the activities of the user(s) and/or the system into a file that may be stored on the PDA **1150**. By way of example, some of the journal data may be accessed to determine the most recently viewed channels, may be used to generate and/or update favorites with an adaptive learning feature, etc. The journal data may also be made available for debugging purposes, for example by being synchronized with Web servers **1154** to accelerate the speed with which a support team can debug issues.

Extensible Through API For Third Party Developers

The system design may include an API that third party software developers can use to add functionality to the remote control application, communicate with remote control application, etc.

Electronic Program Guide ("EPG")

With an EPG application on the PDA **1150** the user can view upcoming shows and choose which shows to watch without distracting anyone else watching the TV. In addition, the remote control application may work in conjunction with the EPG application to prompt a user to watch a program, allow them to command tuning to a program, record a program, etc.

Operating Environment

It is anticipated that the major operating environment for the PDA **1150** would be the living room/home theater room in the home. However, the remote control application may be shipped with pre-configured lists of devices and device types associated with multiple rooms, including the office. The lists may be modified. Furthermore, a setup wizard can be used to configure the remote control application for one or more distinct rooms.

Hardware Components

The basic hardware components and architecture of a PDA that serves as a platform for the remote control application are well known in the art. Accordingly, for the sake of simplicity, only exemplary, select hardware features unique to the remote control functionality will be discussed in detail. Referring to FIG. **4**, a standard PDA **200** has an IrDA transceiver **202** used for short range communication with other PDAs and peripheral devices. In addition, since the controllable devices generally uses an IR wavelength different than that used by IrDA,

the exemplary platform is also equipped with an IR transmitter IC **204** and separate LED **206** suitable for use with device IR control. In one embodiment, an IR signaling module **1118** communicates with the IR transmitter IC **204** through a serial connection **208** (for example COM1/COM4). Methods and command protocols for communicating with such an IR transmitter IC **204** over a serial interface are well known and, therefore, need not be described further herein (for example, see co-pending application Ser. No. 09/905,432). It will also be appreciated by those skilled in the art that, while in the illustrated example the transmitter pulse timing is controlled by the specialized chip shown, in other embodiments it may be possible to implement these timing functions via software running in the main CPU itself which would serve as a substitute for the IR transmitter IC **204**. In addition, when adapted for use in connection with the remote control application, the IrDA receiver may also be used for learning IR codes from other devices such as originally supplied remote controls. The learning function would be made possible by paralleling the IrDA receiver output signal **210** to both the normal PDA connection **212** and the learning input **214** of the IR transmitter IC as shown.

The remote control application may also take advantage of any hard keys that are provided on the PDA **1150**. For example, the illustrated iPAQ brand PocketPC shown in FIG. **10** includes a navigation pad **104** and four additional keys **102** ("hotkeys") at the bottom of the unit which are normally used to facilitate rapid access to frequently used applications such as a calendar application, address book application, etc. In one exemplary embodiment, the remote control application may place appropriate calls to the underlying operating system API to override the default hotkey functions and replace them with commonly-used remote control functions (e.g., volume or channel adjust, etc.). Furthermore, key override may be configured to occur only when the remote control application is the active or in-focus application. In this manner, if the user changes to another application, e.g., the Excel brand spreadsheet application, while the remote control application is still running, the hardware hotkeys revert back to their previous setting until the remote control application is made active again. Additionally, the assignment of functionality to the hardware keys may be user configurable and/or automatically determined by the current mode of operation of the remote control application as described in more detail hereinafter.

The remote control application may also provide for the overriding of any default shut-off timing. In this manner, the shut-off timing of the display can be configured to be more appropriate for use in connection with a user's need to operate devices when the remote control application is the program with "focus." For example, by replacing the normal shut-off timeout with a two-stage process such as: after 15 seconds with no activity, switch to a splash screen then, after 5 additional seconds, power down. Alternatively, these timeout values may be made user-adjustable.

Software Components

Exemplary components of the remote control application **1102** are depicted in FIG. **5**. The illustrated components comprise a presentation engine **1108**, a configuration engine **1110**, a hardware communications manager **1114** and a file I/O manager **1112**. Each of these will be discussed in more detail in the following sections.

Presentation Engine

The presentation engine **1108** manages the user interface that users interact with to command the operation of the remote control application, for example, to cause the transmission of commands to devices. The presentation engine **1108** manages the mapping of the user configuration into the current hardware form factor—the iPAQ brand PDA in the exemplary embodiment, but in other embodiments this may be a WebPad or Tablet PC, a remote control software emulator, a remote control itself, etc.

User Input

The user input module **510** handles all input events generated by the user. This may include input from both the touch screen and hard keys. It may also handle input from a speech recognition software engine, for example the IBM ViaVoice brand software installed by default on the iPAQ 3950 brand PDA, or such other speech recognition applications as may be available. An action map **514** (see FIG. **18**) controls all of the actions the user can perform for each device type. Thus, user input events would be processed in terms of the action map **514**.

Object Manager

The object manager module **511** manages resources used to create display screens. The object manager may also manage intrinsic controls as well as controls developed by third parties.

Event Manager

The event manager module **512** may interface with an operating system calendaring function when events can be scheduled in the system.

Status Manager

The status manager module **513** may create a listening thread to capture any status broadcasts from devices. It may also track the current status of the remote control interface application, e.g., to determine if it is currently on a control page, a favorites page, running a setup Wizard, etc.

Configuration Engine

The configuration engine module **1110** manages the configuration resources and creates display screens using the presentation engine module. Resources for the configuration engine **1110** are generally stored in a configuration file.

Resource Map

The resource map **521** may contain any bitmaps, string literals, page layouts, and other resources utilized in the remote control application.

IR Map

The IR map **523** contains any user-defined IR codes to be used by the system. These codes may have been learned or downloaded. The IR map may also contain links to an IR database associated with the IR transmitter IC and/or the main or supplementary memory system of the PDA **1150**. IR map links may be created at runtime to account for a possible change in mapping between IR database revisions.

Macro Map

The macro map **522** contains a list of the macros available within the system. Each control that executes a macro may refer to the macro map.

Device Map

The device map **520** manages the links between the different types of information (resource map, IR map, and the macro map) for each appliance the remote control application has been configured to interact with. FIG. **18** is an example of how the various maps relate to each other as a user performs an action, in this case a macro (turning the power on for the home theater) as will be described in more detail hereinafter.

Hardware Communication Manager

The hardware communication manager module **1114** communicates with devices external to the system utilizing the IR, Bluetooth, and 80211.b RF hardware, and possibly others. As new hardware is developed, access to such hardware may be through a specified interface within the hardware communi-

cation manager. FIG. **6** depicts exemplary hardware communications interfaces. Each of the interface objects is discussed briefly below.

Transmission

The transmission object **530** is utilized to control the output of a byte sequence via the required protocol stack (e.g., IR, RF or TCP).

Learning

The learning object **531** is utilized to control the learning of a byte sequence via the required protocol stack, for example data acquired via the shared IR/IrDA input **214** to the IR transmitter IC **204**.

Status

The status object **532** is utilized to listen for broadcast messages on a particular protocol stack. This may be used for a two-way conversation between the PDA **1150** and other device hardware, e.g., hardware within home theatre and home automation systems.

Platform Hardware Integration

The platform hardware integration object **533** allows the remote control application to utilize the particular hardware capabilities of the PDA **1150** on which the remote control application is currently installed.

Protocol Stack

The protocol stack **537** is an abstraction layer between the different protocols used by the system to communicate with hardware within the home. A basic version of the remote control application may only use the IR protocol stack **534**, while more advanced (in capability) versions of the remote control application may use one or more additional protocol stacks (**535**, **536**) either in conjunction with or instead of the IR protocol stack.

IR

IR protocol **534** is used to communicate with any device using IR. The IR object may interface with an IR transmitter IC **204** for transmission and learning.

RF

RF protocol **535** is used to communicate with any devices using radio frequencies. The RF component may be used to abstract the communication between the remote control application and proprietary protocols, for example, Bluetooth, Zigbee, 802.11, or other RF signals.

TCP

TCP **536** may be used more and more as the home becomes wired and devices become connected via standard networking protocols such those used in conjunction with, for example, the IEEE 801.11b standard. The TCP stack may allow the remote control application to work with any wired device within the home, regardless of location. The TCP stack may also allow the user to communicate with the home from a remote location via the Internet or other conduit.

The File I/O Manager

The file I/O manager module **1112** allows data access to be managed and controlled from a single place within the remote control application. FIG. **7** depicts the file I/O manager objects, each will be discussed briefly below.

Parsers

The parsers **540** contain code to validate and parse the different file formats used by the remote control application. The parsers may be used mainly by the configuration engine **1110** to read and parse the different resources required to display information.

Serialization/Persistence

The serialization/persistence object **541** is used by the remote control application to read and write different file formats.

Device Configurations

The device configuration files **542** contain definitions of the devices the user has configured to be controlled via the remote control application. Each file may describe the contents and layout of various displayable pages for a device. These files may also contain any resources used to command the operation of such devices. Without limitation, the list of resources may include macros, IR codes, bitmaps, string literals and other data. A more detailed description of these file attributes are presented in later sections.

User Profiles

The user profiles **543** stores data about the different users of the remote control application which may include a user name, bitmap for a user avatar, user PIN, bit mask overlay and all preference settings. The results of adaptive learning (on a per-user basis) may be also stored in a user profile. Additionally, the user's favorite channel list (and associated network logos) may be stored here as well.

User IR Code Database

The user IR code database **544** is used to store supplemental IR codes downloaded from a Website or from some other source. The user IR code database may be separate from the standard IR code database shipped with the PDA **1150**. The user IR code database may also contain learned IR codes.

Event Journal

An event journal **545** may be provided to contain a log of user and system actions that have occurred within the remote control application. The event journal may also contain broadcast messages received from devices within the home. The event journal is a log of what the user has done as well as what is happening within the home. It is contemplated that a user may be able to switch between a verbose mode and an alert mode. The event journal may also be used for debugging purposes.

System Features and Functions

The following paragraphs present detailed descriptions of individual features of the remote control application. In some cases examples of typical use are presented showing user input or other external action(s) or event(s) together with the associated response. It should be appreciated that such examples of typical use are intended to be illustrative only and, therefore, are not to be considered as limiting.

Setup Wizards

Setup wizards are parts of the application logic that guide the user of the remote control application through the steps to add devices to be controlled, configure user preferences, etc. The results of using a setup wizard may be saved into configuration files **542**, **543** to be subsequently referenced by the remote control application when needed. In the discussions that follow, setup wizards will be divided into two general categories: user setup and device setup. A user setup wizard may be invoked to identify user(s) of the remote control application and their preferences. A device setup wizard may be invoked to establish the list of equipment that the remote control application may control and/or how the equipment should be controlled. A device setup wizard may also be used to gather information about which devices the remote control application may be operating. In this context, the overall initial setup process may be thought of as comprising four procedures:

(1) device identification;

(2) generation of macros (either via explicit entry or automatically);

(3) definition of favorites; and

(4) configuration of the home screen.

Setup wizards can be executed multiple times, for instance to add more users, add/change devices (to be controlled), add/

change settings, etc. In an exemplary system, a setup wizard may detect if a particular setup has already been executed and display the current settings to the user for reference.

Platform Setup

Platform Setup—Device Identification

To setup the remote control application platform, a device setup wizard may be invoked to setup the type(s) of devices the PDA **1150** is intended to operate (TV, DVD, DSS, AMP . . .). This information may also include the manufacturer of a target device. To this end the user may be presented with one or more selections of IR codes and given the opportunity to test the different IR codes (i.e., cause transmission of IR code signals) from a selected manufacturer in order to determine which IR codes cause a target device to respond. Once the user has found and tested a successful combination, the device may be added to a list of devices available to be controlled.

Four different and well-known methods of device setup may be supported, namely, brand setup (described above); step and set (where the user tests the next IR code in a sequence of IR codes); direct entry (where the user enters a pre-determine code for the manufacturer/device type that is the intended target) and downloaded Web codes (where the user directs the remote control application to apply new IR codes gained through internet access). In the event RF communications are utilized between the PDA **1150** and devices, these same setup procedures may be utilized without limitation.

Once the correct command code set has been established by one of the methods described above, the remote control application may expose different levels of functionality (i.e., keys to command device functions) depending on the current user of the remote control application. By way of example, the user interface may be implemented with up to three levels of complexity. The default level is to expose standard level functionality, (i.e., a representative set of the most commonly accessed command functions for the device type and model configured). Alternative levels may include a power level, which exposes all command functions available within the remote control application library for the device type and model configured, or a simplified level, in which only basic command functions are exposed to the user for the device type and model configured. These, or other levels, may be offered to a user based on pre-set user parameters (e.g., as entered during user setup described hereinafter.)

Platform Setup—Generation of Macros

The remote control application may analyze the remote control application environment (i.e., the system comprising the setup devices) and, based on the knowledge of the user and the devices, the remote control application may be used to create one or more macros to automate repetitive device functions. By way of example, two common appliance functions, "Power Macro for Home Theater" and "Audio/Video Routing" are described in more detail hereinafter, although it will be appreciated that many other such opportunities for automated or semi-automated tasks may exist.

Power Macro for Home Theater

If all the appliances in a home theater system have discrete on/off codes, the remote control application can offer a global (Home Theater) on and off function. To that end, the remote control application may display a list of all available appliances (i.e., all appliances for which the remote control application has been setup to control) and the user may select the one(s) to be involved in the Home Theater Power macro. For example, the remote control application may present a list comprising DSS, Cable Box, Amp, VCR, DVD and TV. The user may select only Amp, DVD and TV to be switched on and off in unison as part of a Home Theater Power macro since the VCR may be independently activated to receive an input signal from the DSS and Cable box to record a program.

Audio/Video Routing

If the user routes all audio output via an amplifier, the remote control application can assist the user by ensuring that the correct audio input signal is used when the user selects a device to be the device in focus. This form of macro setup may be accomplished by asking questions during setup that are utilized by the remote control application to associate inputs with devices. Alternatively, the macro setup may be accomplished by utilizing information previously stored in Device Map **520** regarding device interconnections and input/output configurations. The macro(s) created as a result of the question/answer session may be customizable by the user to handle special situations.

Platform Setup—Favorites

The user may be able to specify a list of favorite channels for a number of categories. The favorites lists may be synchronized with the channel lineup offered by a cable or satellite service provider. During the setup of personal favorites, a user may specify a group (of channels) that they always want to cycle through. The channels selected for personal favorites do not need to be in the same category (i.e., be available from the same device). For example, a news favorite might include local broadcast channels while a movie favorite might include a cable channel. A personal favorites group may include a unlimited number of channels or may be limited in number to, for example, no more than seven entries in order to balance the time consumed in stepping through the channel possibilities against the amount of program material offered.

Platform Setup—Home Screen

Another setup option may allow the user to customize the remote control application home screen, an example of which is illustrated in FIG. **11**. The remote control application home screen should not be confused with the initial (splash) screen that is loaded when the user starts the remote control application. In this regard, the remote control application home screen is the user's main portal to various device control screens or pages. During the setup of this home screen, the user may select whether to display control through a device-centric view, an activity-centric view or a mixture of the two, i.e., depending on the user's preference the home screen may list the devices, or it may list the activities that the user can perform, or it may list a combination of both. It is to be appreciated that an activity represents a desired configuration of one or more devices that is centered around a given pastime. By way of example, a "watch movies" activity might be setup to cause the transmission of commands to select the DVD player as the audio/video source, set the surround sound mode on the audio amplifier, switch the TV input to S-Video, etc.

Devices, activities, favorites, etc. that are not yet setup may be displayed on the remote control home page such that the iconic representation of the device, activity, favorite, etc. has an overlay, for example a wrench as illustrated in FIG. **11**. The overlay indicates to the user that setup is required. In this regard, the icons function as soft keys that may be selected to cause the performance of a further action, for example, to display a device control page, cause the transmission of commands, etc. Additionally, if desired, the iconic representation of an un-setup appliance, activity, favorite, etc. may also be displayed in a different color (e.g., "grayed" so as to be displayed fainter than normal as gray-scale image). The overlay and/or graying may be removed once a setup procedure has been completed.

Setup may be automatically initiated in response to a user selecting a device, activity, favorite, etc. that has not been previously setup, i.e. selecting an icon with an overlay as described above may automatically invoke a setup wizard corresponding to the type of the selected icon. Initial execution of the remote control application may also detect that setup has never been performed and automatically invoke one or more of setup wizards (which may be chained one to the next in this instance) in order to establish a starting configuration for the remote control application. Still further, the remote control application may be pre-configured with a set of typical appliances, activities, etc. This set may, for example, be the most popular brand/model of each device type for the market or region in which the PDA **1150** was sold, may be a set of devices corresponding to a specific manufacturer or brand associated with the PDA **1150**, or some combination of the above or any other criteria deemed appropriate.

Remote Control Application Start-Up and Home Page

FIGS. **8** and **9** illustrate exemplary display screens with programs installed on an exemplary PDA **1150** including the remote control application (labeled "Valhalla"). The user may initiate the remote control application by, for example, tapping the Valhalla icon **82** directly on the screen **80** or by selecting the Valhalla application **92** from a drop down start menu **90**. When the remote control application is started for the first time it may display a splash screen such as illustrated in FIG. **10**. The splash screen may include information such as product name and revision, company name, patent and copyright notices, etc. The splash screen may be OEM specific if desired. Alternatively, the remote control application, when staring from this initial state, may run a startup demo to show a quick overview of features of the remote control application. Once any splash screen display and/or demo are completed, the newly-started remote control application may load a default home screen with a suggested set of un-setup devices as illustrated in FIG. **11**. Alternatively, an empty home screen with only the set-up icon **112**/**113** shown in FIG. **12** may be displayed. Still further, the remote control application may be pre-configured to start with certain predetermined devices already setup to be controllable as noted previously, for example, those of a particular manufacturer.

Icons representing devices and/or activities may be displayed in a wheel **110** that rotates to bring the selected device or activity to the top of the wheel. The top (primary) icon **112** may be displayed larger (48×48 pixels in an exemplary embodiment) than the other icons **113**, **114**, **115** (24×24 pixels in said exemplary embodiment). Additionally, an intermediate size (36×36 pixels for example) may be provided for display of secondary devices. The spacing of the icons may be dynamically calculated based on number of icons, to provide even spacing around the wheel **110**.

In the example illustrated in FIG. **11**, indication is made to a user that devices are in need of being setup, for example, by overlaying a wrench symbol over the standard device icon. Devices that are set up may float (i.e., be moved so as to be positioned) near to the top of the wheel **110**. By interacting with the wheel **110**, the user may select a primary device **112** to initiate setup, or select another icon **114** to become the primary device. When another icon **114** is selected, the wheel may perform intelligent rotation turning in the direction that moves the desired device to the primary position—the wheel top—quickest.

The home page display shown by way of example in FIG. **11** or **12** may also include indication of the current user **116** and current room **118**. As will be described later, the icons representing the user and room may also be used to invoke configuration menus for these items. A default user name may be taken from the PDA **1150** owner information. In the example shown in FIG. **11** (i.e., with suggested devices to setup already displayed on the wheel, a default room is shown as the "Living Room" which includes the devices: TV, DVD, Cable Box, VCR, Satellite, Audio Receiver).

The home page display may also include a KeyGuide icon **120** which initiates a display of the current assignments of the hard keys of the PDA **1150** and/or allows altering these assignments, an icon **122** to initiate a customization menu, and icons **124** and **126** to switch to other display pages; all of which will be described in more detail hereinafter.

Device Setup

In order to control devices, the user may be required to first identify to the remote control application the manufacturer and IR code used by each device, as well as associating any desired special features (display name, macros, etc.) with the device. In general, device setup comprises performance of one or more of the following steps:

1) The user selects a device icon to set up.

2) The user selects a device type. (In some cases, this may comprise simply confirming that the device type desired matches the displayed icon that was selected.)

3) User specifies the device IR format and command set to be used to control the selected device. This, in general, may occur in one of several ways: the user may directly specify a desired setup code by number, the user may search through all codes available (local and/or downloaded from Web Hosted Services), the user may select a brand name from a list presented by the remote control application (and may test various versions of that manufacturer's IR codes if multiple possibilities exist), or may use such other technique as may be appropriate.

An exemplary setup process will be described in more detail in the paragraphs that follow.

Referring once again to FIG. **11**, the device wheel **110** is shown with all devices requiring setup. In addition, an add device icon **113** and add activity icon **115** are presented. The device wheel **110** of FIG. **11** represents an example of one starting view of the device wheel **110** when a user starts the remote control application for the first time. By way of example, the steps involved in setting up a TV using a brand name will be detailed. The user begins by touching the TV icon **112** (or pressing the power button **117** or selecting a hard key such as the navigation pad **104**, etc.). By way of explanation, during normal operation (i.e., after the remote application has been setup for the device), touching the device icon would cause the remote control application to display a page of control functions for that device (for example, see FIG. **19***a*). However, in this case, since the device has not yet been set up (as indicated by the small wrench icon overlaid on the main TV symbol), the setup wizard depicted in FIGS. **14***a* through **14***i* is invoked. As an alternative (for example in the case where a TV device has already been set up and the user wishes to add a second TV, or where the user wishes to add a device not shown on the default wheel) the user may select the add device icon **113**.

The device setup wizard for TV setup may begin with an introductory message as shown in FIG. **14***a*. Also, a keyboard **1401** and cancel **1412**, back **1414** and next **1416** buttons, for use in connection with the setup wizard, may be displayed. In general, the keyboard and buttons can be displayed throughout each setup wizard page and occupy the same position on all the screens for ease in use. Once the optional help message has been read, the user would press the next button **1416** which steps to the exemplary screen shown in FIG. **14***b*. The user may then select which setup method he wishes to use. In

the example illustrated, the default setup method—brand setup—is already selected and the user simply presses the next button **1416** to proceed to use this setup method. Other methods of device setup, for example, code searching, direct entry, etc., are also available and are well known in the art—see for example U.S. Pat. Nos. 4,959,810, 5,614,906 or 6,157,319 all of which are incorporated herein by reference in their entirety.

To perform device setup in accordance with the step illustrated in FIG. **14***c*, the user selects the device type (TV in this example) from a drop-down menu **1418** of all device types supported by the remote control application. Then, as illustrated in FIGS. **14***d* and **14***e*, the user may be presented with a drop down list of brand names **1420** which correspond to the device type selected. The user may navigate this list using the up and down arrows **1422**, slider **1424** displayed at side of the list, or any other conventional GUI device. Furthermore, for rapid positioning to a general area within the drop down list, the user may use the keyboard **1410** to type in the starting letter(s) of a brand name. Once the brand name has been highlighted (e.g., "Sony" in FIG. **14***e*), the user can indicate a desire to choose that brand by selecting (e.g., by tapping) the next button **1416**. Additional GUI techniques for choosing a brand of choice are also contemplated.

If multiple IR code set possibilities exist for the brand selected, the user may be presented with the opportunity to test each possible IR code set using a drop down menu **1430** in connection with a displayed set of test function keys **1432** as shown in FIG. **14***f*. Test functions **1432** may or may not be displayed with text labels indicating their designated functions—the example **1432** shown in FIG. **14***f* is without labels while the example shown in FIG. **20***b* includes keys with text function labels. The user may activate one or more of the test function keys **1432** to see if they function to control the device as desired (i.e., in response to their activation an IR command code from the selected set is transmitted to test if the target device responds). If the target device fails to respond as anticipated, the user can simply select a different code set number from the drop down list **1430** and repeat the test procedure (e.g., activate the test function keys again). When the correct setting is found (i.e., the device responds as expected), the user can press the next button **1416** to continue with the setup procedure.

Optional steps illustrated in FIGS. **14***g* and **14***h* allow the user to enter a tag name for the setup device. A default name, as shown in FIG. **14***g*, can be a simple concatenation of the brand name and the device type. The user may, however, elect to use a more descriptive name of their choosing, as shown in FIG. **14***h*. Tapping next button **1416** may then be used to complete the device setup wizard process. The resultant TV device icon **142** would then be displayed on the wheel **110** (sans wrench overlay) together with the user-entered device name as illustrated in FIG. **14***i*. Alternatively, an additional step may be included to allow the user to select a customized icon to represent the device.

User Profiles

Exemplary steps for setting up a new user profile are illustrated in FIGS. **15***a* through **15***f*. With reference to FIG. **15***a*, user customization may be initiated by tapping the current user icon **116** which results in the display of a customize user menu **152**. The customize user menu **152** may be used to select a user—to place the remote control application in a mode to control devices, perform activities, etc. that have been associated with the selected user (in the example illustrated in FIG. **15** only one user, "Pat," is currently defined), to add/delete a user, or edit the profile of an existing user. By way of example, the steps involved in adding a user will be illustrated. It will be appreciated that process of editing the profile of an existing user could be very similar.

A user setup wizard could be invoked by selecting "add user" from the customize user menu **152**. The user setup wizard may commence by displaying an introductory message as illustrated in FIG. **15***b*. The user setup wizard may then prompt, as shown in FIG. **15***c*, for entry of a new username **1510** and, by way of example only, an optional password or personal identity number (PIN) **1520** which would be needed to authorize future changes to the profile being setup. In the example illustrated, this user setup wizard page also permits the new user to be defined as a "guest" via checkbox **1530**. If set, guest status preferably disables all setup and customization functions (device, user, room, favorites, etc.) within the remote control application while this user designated as a guest is active. Guest status may also be used to inhibit access to other applications of the PDA **1150** such as, by way of example, calendar, address book, spreadsheet, etc. The inhibit function may be implemented on a global basis—i.e., the guest user is prevented from exiting the remote control application—or may be on a per-application basis, depending on the level of support available within the PDA platform.

Once the name and any PIN or special status has been entered during user setup, an icon can be selected to represent the new user (as illustrated in FIG. **15***d*) and a sound may also be assigned to provide an audible indication when switching the remote control application for use by that user (as illustrated in FIG. **15***e*). To select an icon, the user may scroll through a list (for example presented as a strip **1534**) of predefined user images (which may alternatively be presented as a drop-down list, etc.), browse through bitmaps and select an image from a file folder within the PDA **1150**, download an image, etc. Similarly, the user may select a sound from a drop down list of predefined sounds, browse through all audio (e.g., .wav files) stored in the PDA **1150**, download an audio file, etc.

To conclude the user setup process, a confirmation screen may be presented, as illustrated in FIG. **15***f*. Tapping the next button **1416** on this confirmation screen may then return the remote control application to the home page display with the new user (e.g., the selected "Harley" icon shown, for example, FIG. **14***i* or **16***a*). The initialization of a new user in the manner described above can also result in the creation of a new, blank favorites page that would be assigned to this user. The purpose and configuration of the favorites page will be discussed in detail in a later section.

Room Profiles

An exemplary process for configuring a room profile is illustrated in FIGS. **16***a* through **16***f*. Room profile configuration may be commenced, with reference to FIG. **16***a*, by, for example, tapping the current room icon **118** which results in the display of a customize room menu **162**. The customize room menu **162** allows the selection of a different room—to place the remote control application in a mode to control devices, perform activities, etc. that have been associated with the selected room (in the example illustrated only one room, "Living Room," is currently defined), the addition/deletion of a new room, or editing the profile of an existing room. For configuration purposes, the customize room menu **162** also includes the option to display the device code setup numbers for all devices currently configured in the selected room. The device code setup information may be useful, for example, when accessing Web-based services which provide extended function codes for devices, and are not supported by automated or semi-automated processes. (For additional background regarding semi-automated Web-based services,

the reader is directed to co-pending application Ser. No. 10/151,501 "System and Method for Upgrading the Remote Control Functionality of a Device," which is incorporated herein by reference in its entirety.) By way of example, the steps involved in adding a room will be illustrated. It will be appreciated, however, that editing an existing room might be a similar process.

To invoke the room setup wizard, the "add room" item could be selected from the room customization menu **162**. Upon being invoked, the room setup wizard may begin by displaying an introductory message shown by way of example in FIG. **16***b*. The room setup wizard may then prompt for the entry of a name **1620** for the room, as illustrated in FIG. **16***c*, and an image to be associated with this room, as illustrated in FIG. **16***d*. To select an image, the user may scroll through a list (e.g., a strip as shown, a drop-down list, or other-like GUI selection device) of predefined room images **1630**, may browse through bitmap images in file folders within the PDA **1150**, download an image, etc. The user may also optionally associate a sound with switching to that room, as illustrated in FIG. **16***d*. Again, the user may select a sound from a drop down list of predefined sounds, may browse through sound files (e.g. .wav files) stored in the file system of the PDA **1150**, download an audio file, etc.

A confirmation screen may be presented to indicate that the room setup process is complete, as illustrated in FIG. **16***f*. Tapping the next button **1416** on this confirmation screen could then return the remote control application to a home page display with the new room "Den" selected and an empty wheel **110** ready to be configured for the devices and/or activities to be associated with the newly-defined room mode, as shown, for example, in FIG. **12**. The initialization of a new room in the manner described above may also results in the creation of a new, blank favorites page that would be assigned to that room (and user in that room if appropriate). The purpose and configuration of the favorites page will be discussed in detail in a later section.

Room Setup—Phase **2**—Generation of Macros

The remote control application may also provide for the automatic or semi-automatic configuration of macros (pre-programmed sequences of command actions which may be played back by pressing a single key) for common activities. By way of example, an often needed sequence of commands may be the powering on (and off) of several appliances together, such as may be case with a home theater system. To facilitate creation of this type of exemplary macro, the remote control application may, as part of a setup wizard, display to the user a list of all currently configured devices **1640** accompanied by "checkboxes" in which the user may indicate which of these are to participate in an "all on" macro. This may be included as an additional step in the room setup wizard, as illustrated in FIG. **16***g*, since such macros will generally be associated with the devices available in a particular room.

By way of further example, another often needed sequence of commands may be those that perform input routing. To configure a macro to perform input routing, the user may answer a series of questions about the manner in which devices are hooked-up, may select a device hook-up configuration from a list (or from a list with visuals/diagrams), etc. Alternatively, where the underlying graphics capability of the device **1150** supports it, a drag and drop interface may be provided to match the inputs and outputs of different devices that is representative of the manner in which the devices are hooked-up. Each of these input/output pairs may then be used to establish a macro sequence to perform input routing so that, when a particular device is selected for use, all of the requisite audio/video controls are automatically selected or set to allow said use.

Customization of Home Screen

The system may allow the user to customize the appearance and functionality of the home page by, for example, adding a customized background, displaying only devices or only activities on the wheel **110** (the default may be to display both types, intermixed in the order in which they were set up), limiting access to setup functions, etc.

Initialization of the Remote Control Application and Interaction with Other Applications

The remote control application may have basic behavior as it is turned on and off. By way of example, an initialization sequence may be performed when the remote control application is started. An overall view of a typical initialization sequence is shown in FIG. **24**. In the illustrated example, advantage is taken of the hardware and software provided by the iPAQ brand PDA to integrate seamlessly with the Windows Pocket PC 2002 brand software system. The basic initialization behaviors of this exemplary platform are described in the following paragraphs, together with the interactions with other parts of the PocketPC brand software system.

When a user selects the remote control application icon from the "programs" or "start" screen display (illustrated in FIGS. **8** and **9**), an internal consistency check is preferably performed to ensure that the files and resources needed to operate the remote control application are available. If a file is missing, for example, the user may be informed that they need to re-install the file or an application. If problems persist, a message may be displayed to inform a user that technical support should be contacted. A dependency check may also validate that the required hardware (e.g., an IR signaling module **1118** or transmitter IC **204**) is available and that it is the correct version for the remote control application and other software currently installed. In the Class Initialization, individual modules may be initialized to a default state before a configuration file is loaded. In the resource initialization, the base resources required to guide the user through the first time wizard may be loaded. The resources include the IR database, icons, bitmaps, dialogs, etc.

Thereafter, all required system resources are initialized, the remote control application selects the appropriate start-up user and room (if multiples are configured). The system may check to see if the system is multi-user or single user. If the system is single user, the multi user login may not be created. If the system is multi-user, the system may load the user profiles (including user name, user icon, user PIN and which configuration file the may use). If the system is single user, the system may check to see if the user has one or more configuration files. If there is only one configuration file, then that configuration file may be loaded. If the user has more than one configuration file on the system, the system may load the configuration file which is specified as the default. The default may be the last configuration file used on the system. The system may set a bit so the system can provide a method to allow the user to (choose from and) load any other configuration files. If the first time user wizard flag is set, the system may gather information about the user. If a configuration file is already on the PDA **1150**, then the user may be prompted to use that one or create a new one.

Upon successful initialization, a splash screen may also be displayed, an example of which can be seen in FIG. **10**. The splash screen may include information such as the product name, company name, legal information, including patent and copyright notices, etc. This splash screen may require user identification and/or log in or may simply switch to a

home screen after a time out. In either case, on completion of the splash screen activity the remote control application would be the application in focus. While active, the remote control application may temporarily override the standard assignments of any hotkeys—as described in more detail in other sections of this document.

When the remote control application is active, if the user performs no action within a timeout period (e.g., 20 seconds which time may be user settable) the system may turn off the display in order to conserve battery energy. However, even though the display is turned off, the application in focus may still be the remote control application. The display may be caused to briefly switch back from the home screen (or whatever other screen is currently being displayed) to the splash screen as warning that a time out is about to occur.

If the user selects another application supported by the PDA **1150**, for example, a Pocket Excel brand spreadsheet application, the remote control application may continue to execute in the background but would no longer be the application in focus. In this case, the remote control application may be reinstated as the application in focus by the user selecting a hotkey (e.g., the iTask button), which hotkey would again be active because the remote control application is not in focus, or by re-selecting the remote control application from the start menu or programs page. In the case where the remote control application is reinstated, the remote control application may not perform the complete initialization sequence described above. Rather, since the remote control application is already loaded and active, it may simply resume at the point at which it was suspended.

Favorites Page(s)

The remote control application may provide one or more favorites pages containing button icons which the user may configure for direct access to his favorite programming (e.g., example, to cause the transmissions of commands to cause a device to tune to a favorite channel), favorite device, etc. Access to such favorites pages may be, for example, via an icon **126** on the home screen page illustrated in FIG. **11**. An exemplary favorites page is illustrated in FIG. **17***a*. A favorites page may be optionally pre-populated with a selection **1710** of commonly requested content providers (e.g., using their logos) as shown in FIG. **17***a* or may initially be blank. Initialization of the default favorites page in either case preferably occurs on first start-up of the remote control application. Separate, additional favorites pages may be created when users and/or rooms are added as described earlier. It will also be appreciated that favorites pages may be specific to particular devices (e.g. a satellite STB or a CD jukebox) while in other instances favorites pages may span multiple devices in order to allow access to all of a user's favorite media content from a single point of access.

In the case where the initial favorites page is pre-populated, icons which have not yet been configured by the user may be displayed with an indicia that setup is necessary (e.g., using a wrench overlay as seen in FIG. **17***a*). In order to configure or add a favorites icon, the user may either invoke the customize favorites menu (instantiated, for example, by tapping the customize icon **122** while a favorites page is displayed) and selecting "Add Favorite" or "Edit Favorite," as illustrated in FIG. **17***b*, or may simply tap one of the default icons that is displaying the wrench overlay to indicate that it is not yet configured. In either case, a favorites setup wizard may be invoked to configure a favorites entry as described in the following paragraphs with reference to FIGS. **17***c* through **17***h*.

The favorite setup wizard may begin by displaying the introductory message shown in FIG. **17***c*. Next, the favorites setup wizard may instruct the user, as shown in FIG. **17***d*, to record a sequence of keystrokes or other actions which are to be associated with the favorites entry being configured. When the user taps the next button **1416**, the user may be presented with the normal set of device control pages such as, for example, the satellite device control page shown in FIG. **17***e*. The user may navigate amongst all the devices that have been configured using the home page wheel **110** (the home page is accessed via selecting icon **123**) to switch to individual device control pages using icon **124**. By this means the user may enter a series of keystrokes, for example, selecting the keys "0," "0," "4," and "Enter" to assign to a favorites button commands for switching the satellite receiver device shown in FIGS. **17***e* and **17***f* to channel four. In an exemplary system, a "mini-wizard" (evidenced by the guidance messages **125**) may continue to guide the user through the setup process while still providing full access to the soft key pages within the application interface of each device. When the user has completed entry of the desired sequence, tapping the customize icon **122** displays a menu which allows the user to complete the final steps of the favorites setup wizard. From this exemplary menu, the user also has the option of temporarily suspending and later resuming recording of keystrokes, inserting a delay into the playback sequence, or testing the sequence entered so far by playing it back. The final steps of the favorites setup wizard, illustrated in FIGS. **17***g* and **17***h*, allow a name **1720** and image **1730** to be assigned to the favorites entry. A sound may also be associated with selection of the favorite entry. Furthermore, where supported by the underlying PDA platform, additional data such as, for example, a URL to be loaded automatically into a concurrently running browser application, may be associated with the favorite entry. (For additional background regarding use of such data in conjunction with a user definable favorite key, the reader is directed to co-pending application Ser. No. 10/176,315 entitled "System and Method for Retrieving Information While Commanding Operation of an Appliance," which is incorporated herein by reference in its entirety.)

Navigation Model

The remote control application may take advantage of the hardware keys offered on the PDA **1150** by redefining functions associated with these keys while the remote control application is active. By way of example, referring to FIG. **10**, the exemplary iPAQ brand PocketPC devices offer four hard keys **102** plus a navigation pad **104** (up/down/left/right and select) arranged across the bottom of the unit. During normal operation these key would typically be assigned by default to perform various quick functions such as switching directly to a calendar or address book applications, displaying a list of currently active applications (sometimes referred to as using the "iTask button"), navigating directories or menus displayed on the screen, etc. When the remote control application is active, such hard keys may be defined to, among other things, cause the remote control application to perform actions that are related to commonly used device control functions. This functionally may be further enhanced by allowing the user to select between various groupings of hard key assignments based on their current activities. For example, optimum convenience during navigation of a menu on a PVR device may require that these keys be configured to cause the transmission of commands for direction control, menu, exit, and selection functions; while optimum convenience while watching a DVD may require that these keys be configured to cause the transmission of commands for transport control functions (play/pause/fast forward, etc.).

The various aspects of this hard key reassignment model and user control over it will be discussed in the following

paragraphs in conjunction with FIG. **13**. These models include, but need not be limited to:

- An exemplary application navigation model, which is driven by the four hard keys **102**;
- Exemplary multiple navigation pad **104** key assignments, which can be navigational, control, or transport;
- An exemplary method for displaying a key guide to indicate current key assignments; and
- An exemplary method for selecting the active navigation pad key assignments.

Application Navigation

Button **102***a* can be used to cause the remote control application to cycle through each page type, e.g., home screen page, device control page (for a currently active device—the one at the top of the wheel), a favorites page, etc., as represented by the tab icons **123**, **124**, and **126**, respectively, across the top of the screen illustrated in FIG. **11**. If button **102***a* is pressed when the application is active, but in low power state, the current page may be displayed. In this instance a second press may cycle to the next page type. Button **102***b* can be used to cause the remote control application to display the next page for this page type (for example, control may be comprised of four pages, favorites comprised of three pages, etc.). If button **102***b* is pressed when the application is active, but in low power state, the current page may be displayed. In this instance a second press may cycle to the next page within the family of pages for this page type.

Button **102***d* can be used toggle mute (e.g., cause the transmission of a mute toggle command to an appliance in focus). This button may be made always available, regardless of the assignments selected for the other keys in the group.

Button **102***c* can be used to display a key guide **130** and allow a user to change key assignments for the navigation pad **104**. When pressed initially, the current key guide may be displayed, for example, overlaid over the bottom of whatever display page is currently active, as illustrated in FIG. **13**. Display of the key guide **130** may be for a fixed or user-settable period of time, e.g. five seconds. If button **102***c* is pressed again within this time window, i.e. while the key guide **130** display is visible, navigation pad key assignment configurations can be cycled through. By way of example, three possible selectable configurations **130***a*, **130***b* and **130***c* are shown. The significance of these assignments is discussed in more detail in the following paragraphs.

Navigation Pad Key Assignments

For user convenience, the five key functions present on the navigation pad **104** (up, down, left, right, and select) may be assigned to one of several groups of function according to an activity currently being performed. This assignment may be changed dynamically and automatically by the remote control application according to the device type currently selected or activity currently being performed, or it may be manually set by the user. In the illustrated example, three sets of functions are available: navigation **130***a* (for menu or guide operations on consumer appliances), control **130***b* (volume and channel up/down), and transport **130***c* (play, rewind, fast forward, etc.). It will be understood that activation of the navigation pad **104** would then result in the transmission of commands to control the appropriate operation of the intended target device.

An indication of the current setting of these keys is presented in the lower right corner of the screen by the key icon **120**. This icon may take different forms **120***a* (indicating navigation), **120***b* (indicating control) and **120***c* (indicating transport) depending on the current setting of the navigation pad hard keys. Tapping this icon **120** may invoke a menu from which the desired key assignment can be selected by the user. Alternatively, key assignments may be changed by use of the hard key **102***c* as described earlier.

In the case where a user attempts to change the hard keys to a mode that is not supported by the device selected for control, e.g., transport functions when the remote control application is in a mode to control the operation of a television, the remote control application can prohibit selection of that key assignment, can allow selection of that assignment with the resulting activation of the hard keys resulting in the no action being taken place by the system (or to cause transmission of signals in a format appropriate for a default device or last device capable of performing the actions—punch through which may be manually set or automatically set), etc.

When the remote control application is currently in a mode where it is displaying a configuration menu or when it is executing a setup wizard, the navigation key pad **104** may automatically revert to standard application functionality, i.e., menu up/down/left/right and select, for the duration of the setup wizard execution.

Control of Consumer Electronic Devices

The remote control application may be used to control the functionality of a large number of consumer electronic devices. While a TV will be used as a template device for the illustrative description that follows, it will however be appreciated that many other device types exist.

Operation of a TV device is as follows. Assuming that the TV has been setup as described earlier, the remote control application may be placed into a mode for controlling the TV, for example, by rotating the home page wheel **110** until the TV becomes the active (top) device icon—**142** in FIG. **14***i*—and then either tapping the TV icon **142** or the controls tab icon **124**, resulting in the display of the first page of device control page as illustrated in FIG. **19***a*. Depending on the device type, additional pages of control functions may be available as illustrated in FIGS. **19***b* and **19***c*. The user may navigate to these additional pages, if any, by using either the page hard key **102***b* or the control surface switching icons **192**. When the user selects a device as described above, the control page displayed may be the last one used, as opposed to always beginning at page one. For example, if the last action a user previously performed before switching to another device type, such as the VCR, was to command volume adjustment then, on re-selection of the TV, the third page (FIG. **19***c*) might be displayed since this page contains the (most recently used) TV volume control buttons **194**.

The soft keys displayed may be adjusted by the remote control application according to the specific device that has been setup. By way of example, FIGS. **21***a* and **21***b* show a control page as it may appear for two different television models. Of note, the Panasonic brand television model shown in FIG. **21***b* supports a "–/–" key **1212**, while the Sony brand television model shown in FIG. **21***b* does not. In this example, the remote control application displays only those buttons for functions that actually exist on the device currently selected.

While a control page is active (i.e., displayed), the customize icon **122** may be used to invoke a menu **1202** which allows the user to make changes to key assignments and layout, learn new functions from another remote control or device, add and delete keys and pages, all of which will be discussed in further detail in sections to follow. Additionally, for convenience, from this menu **1202** the user may optionally enable a text display of key function labels as shown in FIG. **20***b*. By way of further explanation, the keys themselves are generally labeled using graphical icons wherever possible in order to eliminate language dependencies (as can be seen, for

example, in FIGS. **20***a* and **20***b*), however, for users who are not familiar with the icon system, optional text labels may be provided.

Text labels may be generic functional names or may be the names assigned that function by the manufacturer of the device which is currently being controlled. By way of illustration, the remote control command function which returns a TV set (or other tuning device) to the channel that was previously being viewed is usually referred to generically as "last channel" or "previous channel." However, on Sony brand equipment this function is often labeled "Jump," on Panasonic brand equipment it is often labeled "R-Tune," etc. It will thus be appreciated that it may be advantageous in certain applications to offer the user key labeling in familiar terms.

As noted previously, the remote control application may display functions that support a standard level of functionality (i.e., those functions most commonly accessed), common power-related functions, or functions that are uncommon or extended functions that make device support 100% complete.

Control of Home Automation Devices

The remote control application is in general capable of controlling any device that can be controlled using IR or RF communications which includes home automation devices. In the case of home automation devices, the user may wish to have different button images to represent the functions and/or operation of these devices. Accordingly, additional button images may be made available to the user, either stored locally in the PDA **1150** or downloadable from, for example, a Web site or device, to help with the adoption and usage of the remote control application for controlling these devices. Such a list of optional button icons may include items such as on/off and open/closed icons for devices such as lights, curtains, blinds, air conditioning, heating, pool heater, spa, etc. The system may also have the ability to associate a function to an image, for example, to send a sequence of IR Codes to an X10 device.

Learning IR Codes

As new devices are introduced into the market, command sets to support such new devices can be added to the remote control application. This can be done one of three ways: learning, downloading, or occasionally refreshing the database that is burned onto the non-volatile memory of the PDA **1150**. Detailed methods for learning IR codes are well known in the art (for example, see U.S. Pat. Nos. 4,626,848 and 6,097,309 which are incorporated herein by reference in their entirety) and the remote control application may be provided with the ability to learn IR codes from a new device-specific remote control using one or more of these or later-developed methods. To this end, the input signal to be learned may be provided to an IR receiver specifically provided for this purpose or may be derived from an output signal of an IR receiver **214** already built into the device **1150** as illustrated in FIG. **4**.

Generally, IR codes are learned for a single function at a time. The user may choose to learn every available function or may elect to learn select functions for that device type. The user can also choose to replace the codes for existing functions with new IR code sequences. Additionally, the user can add a function that is not normally exposed for this device type. When new functions are added, the user may add a button that is to be assigned the learned command code(s) and provide the button with an appropriate label.

Generally, when the remote control application detects that learning mode has been entered, the software listens for new codes to learn. The software may respond audibly and/or visibly when codes are learned. Furthermore, the software may respond with a different audible tone and/or visible indication when codes are not able to be learned.

Assign and Playback Macros

Macros provide a way for the user to perform a combination of tasks quickly. There may be two types of macros supported by the remote control application—system generated macros and user generated macros. System generated macros are generated automatically or semi-automatically by the remote control application to facilitate common tasks like turning on and off the power to a home theatre system. System generated macros were described earlier.

User generated macros allow the user to manually program a sequence of actions to be assigned to a single button such that that sequence can be repeated by a press of the single button. An example of a user generated macro might be a "Watch DVD Movie" macro, which: 1) turns on the DVD Player; 2) turns the AMP to the DVD input; 3) turns on the TV; 4) sets TV input to "Video **1**;" and 5) plays the Movie. Such a user defined macro may be initiated in an exemplary embodiment via an activity icon on the home screen device wheel **110**.

With reference to FIGS. **22***a* through **22***g*, the user may initiate programming of a new macro sequence by rotating the add activity icon **115** to the uppermost position of the wheel, for example by selecting it, as shown in FIG. **22***a*. Selection of the add activity icon **115** may then cause an activity setup wizard to be invoked that guides the user through the programming process. The activity setup wizard may begin by displaying some informative messages as shown in FIGS. **22***b* and **22***c*. The activity setup wizard may then prompt the user to enter a sequence of keystrokes to be stored as a macro. This entry process is similar to that previously described in conjunction with FIGS. **17***e* and **17***f* (definition of a favorites key) and, therefore, need not be repeated here. Upon completion of the sequence entry, the user may select an image (FIG. **22***e*) and name (FIG. **22***f*) to associate with this programmed activity. The user may also be provided with an option, for example via a checkbox **224**, to have the macro playback, on completion, either remain at the home page (box unchecked) or switched to the device control page of the last device to be issued a command (box checked). This is useful where, for example, a user programming a "Watch DVD" macro may wish the sequence to end with the remote control switched to the DVD device control page (such as shown FIG. **22***d*) rather than the home screen page. When the macro definition is complete, the new activity ("Watch DVD" in this example) appears on the device wheel **110** as shown in FIG. **22***g*. Since similar images may be applicable to both devices and activities, activity icons may be displayed in a different color than device icons. In addition, the control button **117** in the center of the wheel may be changed to a green "GO" button in place of a red "Power" button.

It is to be appreciated, that the software may allow a macro to be assigned to any screen that controls devices. Furthermore, the software may allow macros to be added as punch-through commands for the hardware hotkeys as well as common user interface elements. Still further, the software may allow macros to be copied, linked, and/or edited. For use in editing, the software may allow a step-through capability to ensure that the macro functions as desired and provide a macro editor so that the user can fine-tune the macro. Macros can also be recorded with non-timed key strokes and/or with timed key strokes.

Customization and Reassignment of Keys

The remote control application may allow the user to expose functionality from one device on a control page that represents another device or simply rearrange the button layout of a given device control page. Customization and key reassignment may be accomplished by use of the copy key

and move key functions accessible from the customization menu **1202** shown by way of example in FIG. **20***a*. Using the customization menu **1202**, the user may choose to override an existing button or add a new button to the screen. For example, copying a key function creates a link to the underlying functionality so, if the underlying behavior of the linked to key is modified, all linked keys would be updated. Alternatively, the user may have the option to change the default state (a link) to become a copy of the original functionality. In this instance, modifying the functionality of the "original" key would not affect the other keys which were assigned the functionality of the "original" key.

In addition to redefining underlying key functionality as described above, the user may also be offered the option of adding new keys or editing existing keys. In this manner, key shapes and labels may be changed as needed. The remote control application may offer a selection of locally-stored key shapes and colors to choose from, others may be downloaded from the desktop **1104** or Web hosted services **1106**. By way of example, each button image may comprise two states, "Up" and "Down," to enable a user to differentiate between an inactive button and a pressed or activated button. The remote control application may also support customization features such as are described in U.S. Pat. Nos. 5,959,751, 5,515,052, and 6,014,092 which are incorporated herein by reference in their entirety.

Manage Favorites

Since each user may have different viewing habits and favorite channels, the remote control application may allow the favorites to be global (for all users) or specific to a user. For example, in a household with several people the channel lineup will remain the same, however the favorites for an individual may vary. Furthermore, since favorites may actually perform several functions (associating a readily identifiable logo with a network channel and/or sending IR or other commands to direct a device to the proper channel), it may be of use for one individual to set up the entire network lineup as favorites, and allow other users to copy the entire set of favorites pages. Each user may then further customize their set of favorites pages by eliminating those that are not normally viewed, or re-arranging the favorites onto pages to their liking. This technique of eliminating favorites may also be used, for example, by a parent when configuring an acceptable channel lineup for a child. The child's user profile could be set up with a PIN that the child doesn't know (and thus has no ability to configure) and/or set up as a Guest so that other configuration changes may not be made. There may also be a setting in the interface to only allow (on a per-user basis) channel access through favorites (and not by channel up/down or numeric keypad entry) to further limit the channel lineup associated to particular individuals.

Assistance may be offered during the setup of favorites described earlier in conjunction with FIG. **17**. For example, a short list (seven entries, for example) may be maintained by the remote control application which represents a user's most frequently accessed channels. During execution of the favorites setup wizard, the current list of frequently accessed channels may appear thereby allowing rapid, semi-automatic programming of favorites buttons effected by picking channels from the displayed list. Optionally, the user may be able to create multiple such lists to cover a variety of genres or categories built into the favorites setup wizard.

When the remote control application is adapted to be used in connection with EPG functionality, the system may read extended channel information provided in the EPG to automatically group the channel into categories. Genre categories may also be supported, for example Personal, News, Sports, Movies, Music, etc. The user may be able to create additional categories with custom names. The user may be able to add a channel number (with device) to a category. The user may be to add a label to the channel. The user may be able to associate a logo with the channel. The system may handle favorite channels implemented across multiple input sources. For example, the movies list may contain one local cable channel and four channels supported by satellite. The remote control application may also monitor the EPG data periodically downloaded from the hosted services site **1106** for changes in a channel line-up to thereby adjust favorites channel programming sequences either automatically or by user option.

The favorites page display may also be adaptive. In this regard, the remote control application, on an user by user basis, may organize the display of the favorites page as a function of frequency of channel access. The most oft selected channels may be displayed on the top of the list. This display order may also change based on day of week and time of day, either automatically or by user request.

Extensible File Format

User IR Code DB

The user IR code database may be used to store supplemental IR Codes as they are downloaded from the website or from some other sources. This is separate from the standard IR code database shipped with the PDA **1150**. The user IR database may or may not contain learned codes. It is desired that all learned codes are accessible to all users of the remote control application.

Device Configuration File

The device configuration file contains the devices the user has configured to control with the remote control application. The device configuration file may also describe the contents and layout of the device control pages of the remote control application for each device. The device configuration file may additionally contain any resources required by the individual device. The list of resources include, but are not limited to, macros, IR codes, bitmaps, string literals and other required data.

Extensibility of Configuration Files

In order to manage the configuration and user set-up data associated with the remote control application as described in the preceding sections, it is advantageous to store this information in a file system which is designed to facilitate easy future extensions to the information stored as well as transfer of this information between like devices. An exemplary file structure which may be used to achieve these goals is presented in the following paragraphs and Tables 1 through 12 below.

Configuration Header

As illustrated in exemplary Table 1, the configuration header contains data fields for use in describing attributes of the file.

TABLE 1

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PageWidth	Width of a page	Short	
PageHeight	Height of a page	Short	
FileVersion	Version of this file format	BYTE	8
PlatformID__Key	ID to a record in the Platform Table	Long	
ArchiveFlag	Specifies when the document is to be archived.	Long	

Platform & Hardware Table

As illustrated in exemplary Table 2, the platform & hardware table contains data fields for use in describing attributes of the hardware platform on which the file was generated.

TABLE 2

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PlatformID_Key	Unique ID for this device	Long	
ScreenWidth	Screen Width	Short	
ScreenHeight	Screen Height	Short	
HardwareKeyMap_ID	Hardware Key Map	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Device Table

As illustrated in exemplary Table 3, the device table contains data fields for use in describing the attributes of each of the devices the user has setup the remote control application to control.

TABLE 3

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
DeviceID_Key	Unique ID for this device	Long	
LabelLength	Length of the string label	Short	
Label	String literal for this device	Char	variable
DeviceType	Class of device this device header refers to	UINT	
SetupCode	Code for this particular Device	UINT	
BrandNameLength	Length of the BrandName string	Short	
BrandName	String literal of this brand	Char	variable
ModelLength	Length of Model string	Short	
Model	String literal of this Model	Char	variable
DeviceSpecificDataSize	Size of the DeviceSpecificData	Short	
DeviceSpecificDataConfig	DeviceSpecificData	BYTE	variable
DownloadDeviceDataSize	Size of the downloaded data	Short	
DownloadDeviceData	Downloaded data	BYTE	variable
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

External downloaded data will be stored in DownloadDeviceData.

Page Table

As illustrated in exemplary Table 4, the page table contains data fields for use in describing the attributes of each display page of the remote control application.

TABLE 4

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
PageID_Key	Unique ID for this page	Long	
DeviceID_Key	Parent Device ID	Long	
BackgroundID_Key	ID to a resource record	Long	
PageType	Describes what this page will contain - Home Page, Power, Home Theatre, Device Page, Favorite Page	UINT	
BackgroundFillRGB	RGB Fill Color	COLORREF	
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Page records are preferably grouped by device ID.

COLORREF is preferably a 32-bit value used to specify an RGB color.

Label Page Table

As illustrated in exemplary Table 5, the label page table contains data fields for use in describing the labels within a page.

TABLE 5

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
LabelID_Key	Unique ID for this Label	Long	
PageID_Key	Parent Page ID	Long	
LabelLength	Length of label string	Short	
Label	String Literal	Char	variable
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
Width	Width of Label	UINT	
Height	Height of Label	UINT	
Font	Font Type	UINT	
FontSize	Font Size	UCHAR	

TABLE 5-continued

Attribute	Description	Type	Size
FontAlignment	Font Alignment (Center/Left/Right)	UCHAR	
TextColor	RGB Color of the Text	COLORREF	

Border Table

As illustrated in exemplary Table 6, the border table contains data fields for use in describing page borders.

TABLE 6

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
BorderID_Key	ID to a resource record	Long	
PageID_Key	Parent Page ID	Long	
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
BorderFillRGB	RGB Color of the Fill	COLORREF	

Key Table

As illustrated in exemplary Table 7, the key table contains data fields for use in describing attributes of keys supported by the remote control application.

TABLE 7

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
KeyID_Key	Unique ID for this Key	Long	
PageID_Key	Parent Page ID	Long	
LabelLength	Length of key label string	Short	
Label	String Literal	Char	variable
LocationX	X Location	UINT	
LocationY	Y Location	UINT	
LocationZ	Z Location	UINT	
ImageUpID_Key	ID to a resource record	Long	
ImageDownID_Key	ID to a resource record	Long	
ImageDisabledID_Key	ID to a resource record	Long	
SoundDownID_Key	ID to a resource record	Long	
SoundUPID_Key	ID to a resource record	Long	
Status	Status of key	UINT	
FunctionID_Key	ID to a Function record	Long	
MacroID_Key	ID to a set of macro records	Long	
FontType	Font Type	UINT	
FontSize	Font Size	UCHAR	
FontColor	Font Color	COLORREF	
FontAlignment	Font Alignment	UCHAR	
KeyType	Moveable Y/N	BOOL	
KeyPlacement	Hardkey/Softkey Y/N	BOOL	
ValidityDay	Days the key is valid	Long	
ValidityTime	Time the key is valid	Long	
OriginFlag	Who created this record (User, Dynamic, . . .)	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Key records are grouped and sorted by PageID_Key.

KeyType is a boolean to specify the key is movable or not.

Function Table

As illustrated in exemplary Table 8, the function table contains data fields for describing functions performed in response to activation of a key.

TABLE 8

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
FunctionID_Key	Unique ID for this page	Long	
FunctionNameLength	Length of FunctionName string	Short	
FunctionName	String Literal of the function Name	Char	variable
HardwareType	Hardware Type that implements this function	UINT	
DeviceType	Class of device this device header refers to.	UINT	
DeviceID	UEI ID for this Device	UINT	
DeviceID_Key	ID to Device	Long	
LearnedKeySize	Size of learned data	Short	
LearnedKey	Block of learned Key Data	BYTE	variable
MagicCode	UEI Magic Code	UINT	
KeyCode	ID to a resource record	Long	
HardwarePayloadSize	Size of HardwarePayload data	Short	
HardwarePayload	Hardware specific data stream	BYTE	variable
MacroID_Key	ID to a set of macro records	Long	
PageID_Key	Page to be jumped to	Long	
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

HardwareType may be, for example, RF or IR transmitter IC.

If the ID function is in the downloaded data, then DeviceID_Key is pointing to the device; otherwise, it's NULL.

Macro Table

As illustrated in exemplary Table 9, the macro table contains data fields for describing attributes of a macro function.

TABLE 9

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
MacroID_Key	ID for this macro set	Long	
FunctionID_Key	ID to a function record to execute	Long	
NextMacroID_Key	ID to a Next Macro Record to execute	Long	
KeyDownTime	The amount of time is milliseconds the key stays down	UINT	
InterKeyDelay	Delay amount after execution in milliseconds	UINT	
OriginFlag	Who created this record	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Any nested macros will be copy entire functions from the macro list to the new macro list.

Resource Table

As illustrated in exemplary table 10, the resource table contains data fields for defining resources (e.g., image file, sound file, etc.)

TABLE 10

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
ResourceID_Key	Unique ID of a resource	Long	
ResourceType	Type of resource stored (Bitmap, Wave, . . . etc)	UINT	
ResourceDataSize	Size of the resource data	Long	
ResourceData	Byte stream of the resource	BYTE	variable
ResourceWidth	Width	UINT	
ResourceHeight	Height	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Event Journal File

As illustrated in exemplary Table 11, the event journal table contains data fields for describing events captured during the course of operation of the remote control application.

TABLE 11

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
EventID_Key	Unique ID of this Event	Long	
EventType	Type of Event, System or User	Long	
EventTime	Time of the event	Date/time	
EventDataSize	Size of EventData	Short	
EventData	Data of the event	BYTE	variable
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

User Profile File

As illustrated in exemplary Table 12, the user profile file contains data fields for use in describing user attributes.

TABLE 12

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
UserProfileID_Key	Unique ID of this User Profile	Long	
UserNameLength	Length of UserName	Short	

TABLE 12-continued

Attribute	Description	Type	Size
UserName	Name of the User	Char	variable
UserAvatarID__Key	ID to a resource ID	Long	
UserPin	4 digit PIN. (Or minimum password length as recommended/required by the operating system software.)	UINT	4
UserTimeOut	Time before the user is logged out		
UserRole	Role of the User		
UserRating	V-Chip Rating for the User		
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Room Profile File

As illustrated in exemplary Table 13, the room profile file contains data fields for use in describing room attributes.

TABLE 13

Attribute	Description	Type	Size
RecordSize	Size of this record	USHORT	
RoomID__Key	Unique ID of this Room Profile	Long	
RoomNameLength	Length of RoomName	Short	
RoomName	Name of the Room	Char	variable
Locale	Location of Room	UINT	
PADSize	Size of Paddings	Short	
PAD	Padding . . .	BYTE	variable

Functionally, it is to be appreciated that file formats may be versionable, file formats may be backwards compatible, file formats may be extensible to include new features, file formats may allow third party developers to use the storage mechanism, file formats may provide an efficient storage model, and files may reduce duplication of expensive resources like bitmaps.

Configuration Files to Support Multiple User Profiles

The remote control application is preferably designed to be used by multiple users. Accordingly, a user profile file may store data about a user of the system including the user name, bitmap for the user avatar, user PIN or password and all preference settings. In addition, the short list of most frequently accessed channels on a per-user basis may be stored in the user profile. The user's favorite channel list (and associated network logos) may be stored in the user profile as well.

In certain instances, it may be preferred to designate a primary user that controls the look and functionality of the remote control application. All the other user profiles may be derived from the primary user's user profile (the "master profile"). Any changes in the master profile may be updated in any of the profiles that are based from the master profile. Thus, the master profile may be fashioned after a template where any documents using the template may be updated if the template is modified.

Once the primary user has setup the main configuration, new configurations can be created based on the master profile. The primary user may choose which devices and which levels of functionality to expose. This can include backgrounds, specific favorites and other features. The primary user may also choose whether the profile is to be "locked down," which may be used to prevent any additional customization by other users of the profile. In this manner, the primary user can maintain complete control over the way other users (e.g., family members) interact with the remote control application.

All adaptive learning functions may be stored within each profile so that the individual users can access their favorite channels rather than anyone else's. Even if a profile is "locked down," favorites may be stored on a per-user basis. Additional facilities may be needed to give the primary user the ability to review the viewing habits of other family members.

For personalization, icons (or avatars) may represent each user. The avatar may be a 32×32 bitmap stored in the user profile. When the remote control applications starts, a splash screen may be generated with the bitmaps to allow the current user to select an appropriate user avatar and, thereby, gain access the remote control application configuration associated with the selected user.

User Profile

The following Table 14 contains exemplary attributes of the user profile object type.

TABLE 14

Attribute	Description
User Profile ID	Primary Key - Unique ID of this User Profile
User Name	Name of the User
User Avatar File Path	File location to the Avatar
User Avatar Bitmap Data	Avatar bitmap data
User Avatar Bitmap Data Size	Size of the Avatar bitmap data
User Avatar Width	Width of the Avatar Bitmap
User Avatar Height	Height of the Avatar Bitmap
User Nickname	Nickname for the user
User Pin	4 digit PIN

Favorite Map

The following tables contain exemplary attributes of the favorite map object type.

TABLE 15

Attribute	Description
Favorite ID	Primary Key - ID to this Favorite
Device ID	Foreign Key - ID to the Device which supports this channel favorite - Satellite, Cable Box, Tivo or VCR.
Channel #	The channel # for the favorite
Channel Name	The channel name of the favorite
Network 4 Letter identifier	The channel 4 letter identifier.
Network Logo Bitmap ID	Foreign Key - ID to the Bitmap table stored in the configuration file
User Network Logo File Path	File location to the Network Logo
User Network Logo Bitmap Data	Network Logo bitmap data
User Network Logo Bitmap Data Size	Size of the Network Logo bitmap data
User Network Logo Width	Width of the Network Logo Bitmap
User Network Logo Height	Height of the Network Logo Bitmap

Thus, the remote control application may store information regarding a user's preferences in a configuration file. The user profile may store the user name, bitmap for the user avatar, user PIN and all preference settings, including favorites, network logos and the results of adaptive learning. Since the system may support multiple configuration files per user, the system may display content using (by default) the user's last used configuration file. The system may also allow the user to select a different configuration file to use. The system may allow multiple users to store their configuration files on the same PDA **1150**. The system may store the identity of last user that used remote control application. The system may require that one of the users be named as a primary user. The configurations set in the master profile for the primary user

may be available for use in establishing configurations used by other users. Any changes made to the master profile may be available to the configurations used by other users. The system may allow the primary user to determine the level of "lock down" associated with one or more user configurations which may, in turn, determine how secondary users can customize their settings.

Restore Point

Whenever the user performs an operation that may change the configuration of the remote control application, the remote control application may create a restore point just before making the change to the configuration. For example, the system may create a restore point when the user changes the configuration file, changes user settings, or changes the IR code database. Thus, the restore point maintains settings the remote control application may revert to if the user decides to return to a state prior to a change.

The restore point may be reset if the user chooses to save the new configuration and update the restore point, for example, by interacting with a check box in a save dialog. Preferably, the supplemental IR database is backed up using a restore point when the remote control application learns new IR codes. The supplemental IR database is also preferably backed up when the user applies a new IR database patch. Generally, the configuration file may be backed up on local storage. However, if no local storage is available, the configuration file can be uploaded to a PC the next time the device **1150** is docked. To this end, the user may be prompted to dock the device after making changes and the user may be continually prompted to dock upon startup of the remote control application until it is detected that the configuration file has been successfully backed up. When docked, the configuration file may be automatically backed up if anything has changed. A CRC may be stored in the file after changes. If the CRC changes between synchs, the file may be backed up (given that space is available).

Guest Mode

The primary user may elect to allow guest access (created as another user profile) which allows the guest user to operate the home system in a simple way, e.g., no learning functions are available, there is no access to other programs on the device **1150** without PIN confirmation, etc. Furthermore, guest access may override the ability to power down and reboot the system as a means to circumvent the guest mode. The guest profile may be based on the master profile as a base configuration and the guest may have no ability to change the configuration.

Security

For a user, the most sensitive information in remote control application (without support for E-Commerce transactions) is generally considered to be the data stored in the event journal. For the manufacturer, the most sensitive information is generally considered to be the IR code database. Therefore file encryption may be applied to the event journal and the IR code database as a measure of security.

The user may have other sensitive data stored on the PDA **1150**, including, but not limited to: schedules, contacts, financial information, notes, and email. The user needs to feel confident that the device **1150** used to hold this confidential information can sit on or near the coffee table for hours in the evening, with others around. This level of confidence may be provided by limiting access to only the remote control application functions when the remote control application is executing unless a PIN code is entered. Furthermore, the primary user may elect that no additional named users are allowed and that guest access is denied. The primary user may enter a PIN for secure transactions, including starting the remote control application. This puts the remote control application in a mode that no other programs can be accessed without a PIN code to thereby render all external data safe.

If the primary user elects to add secondary named users, they may also have PIN codes assigned. Secondary named users may be able to learn functions (if the primary user has not "locked down" the configuration) and store favorites. However, there may be no access by secondary users to other applications or files on the PDA **1150** without PIN confirmation.

Quick Assignment of Channel Number to Network Logo

Since the cable and satellite companies are constantly refining their channel line ups, the remote control application should provide a simple way to modify the channel numbers that the user assigned to favorites. Such channel number reassignment may be accomplished by, for example, the user holding down a channel logo (i.e., a button used to tune to a channel) for a given time (e.g., 3 seconds—as opposed to tapping it, which would normally execute the channel selection or other sequence assigned to the key) to invoke a setup wizard similar to that previously described in connection with FIGS. **17***a* through **17***h*.

Alternatively, the user may specify a channel number as a numeric variable instead of a series of keystrokes. This number is then converted by the remote control application into an appropriate sequence of IR command signals at time of execution. For additional background regarding methods for specifying and converting numeric variables into remote control IR signals, the reader is directed to co-pending application Ser. No. 10/287,389 entitled "System and Method for Interacting with a Program Guide Displayed on a Portable Electronic Device" of like assignee, which is incorporated herein by reference in its entirety.

Besides simplifying user definition of favorites, in the case of a remote control application that supports EPG functionality this approach can also keep the favorite channels (and perhaps others) in synch by monitoring the channel listings from the EPG. In this case, when an EPG is downloaded, typically on a periodic basis, the remote control application may compare the most recently downloaded EPG against a previously downloaded EPG to determine if any channel assignments have changed. If any channel assignments have changed, the remote control application may then check the favorites list to determine if any of the changed channels are listed therein. If so, the remote control application may update the favorites channel list to reflect the new channel number assigned to a favorite. By way of example, assume that an EPG comparison indicates that "ESPN" has changed from channel **29** to channel **45**. If "ESPN" is in the favorites list, the favorites list will be updated to change the mapping of "ESPN" from channel **29** to channel **45** whereby subsequent activation by the user of the "ESPN" logo icon will cause the transmission of command(s) to tune the target device to the correct channel assignment.

It is also contemplated that the remote control application may store favorite channel assignments as broadcast channel identifiers and use the data in the EPG to dynamically convert these channel identifiers to absolute channel numbers each time the favorite is selected by the user. In this case, in keeping with the previous example, a favorite would be stored simply as "ESPN" which would be translated to channel **29** or channel **45**, as appropriate, based on the EPG data currently loaded at the time the "ESPN" logo icon is activated (i.e., the channel the current EPG shows "ESPN" is being broadcast on). In this manner, there would be a late binding between the "ESPN" favorite and the channel on which "ESPN" is being broadcast.

When logo icons or other icons are activated, different states may be displayed to the user. For example, the system may support a network logo in the form of two bitmaps corresponding to a button up state and a button down state. Logo dimensions and color depth to be used may be supplier specified and may vary for the different platforms. The system may also store network logos in the user profile, since the favorite channel information may be there.

Download Skins

Skins are manufacturer or user developed bitmaps to represent buttons, backgrounds, etc. A button can have multiple states, up, down and disabled. The disabled state may be used to support functionality where two-way communication between the target device and the remote control is possible, where a particular user profile has no access to a function (for example, because it has been disabled by the primary user), etc.

Configuration files containing bitmap resources may be made available as part of vendor-supplied extended features offered on Web-hosted extended features service **1146** or may be uploaded by users themselves to a Web hosted user community **1142** for downloaded by other users. Such configuration files may be made available for specific devices or may represent generic keyshapes, etc., suitable for use with any device. By way of example, the system may look in a default named local directory for configuration files and in a default named directory on the host PC for configuration files to be updated during ActiveSync. When updated, the system may override bitmaps from previous configuration file.

Copy Configuration from One PDA to Another

The ability to share configuration files allows for growth in usage of the remote control application. A configuration file can be shared in a number of ways. It could be uploaded to an Internet site, sent via mail, or copied on to a floppy disk. The user who receives a configuration file may use the ActiveSync application to load it onto a PDA **1150**. Another method is that a user could transmit (referred to as "beaming") the configuration via the IRDA port on one PDA to another PDA. This method takes advantage of facilities available on the typical PDA hardware platforms.

The configuration file can be broken down into elements, for example devices, pages, themes, learned IR codes, network logo icons and favorites. The user may wish to share only a few elements or the whole configuration file.

The configuration files are preferred to have versioning, so that if a user shares a configuration file with a user who has an older version of the remote control application, the transferred configuration file is handled gracefully. If the configuration file has a dependency on a new version of an IR database module, then the user may be notified that the device may not function properly until the user updates their IR database. The system may be able to check version number of the software, version number of the IR Transmitter IC installed, and/or determine the form factor (PDA or WebPad) and the OEM of the platform.

The sending user may select from a list of options what they want to beam. The receiver may choose whether the received configuration file is merged with an existing configuration file or stored as a new configuration file. If the configuration file is merged, the remote control application may ask the user if the would like to update their home theatre mode settings. The receiving system may determine the destination location for the beamed or downloaded resources. Furthermore, users may be able to copy resources related to a configuration file to a hosted Website to enable sharing on a global basis. Thus, unlike most current home universal remote controls that only support a single configuration, the system may provide a mechanism to allow users to have multiple configurations to choose from.

Download Network Logos

A network logo is a graphical representation of a network station or channel. In its base form, it is a button with an up bitmap and a down bitmap. A disabled bitmap is not needed since the button does not have any state. The download network logos feature represents a set of resources that can be accessed through the Internet. To implement this feature, almost all of the architecture modules come into play: hosted remote control software services, desktop remote control software applications, and remote control software. Network logo sharing may allow users to transmit the network logo information button to another user, where the receiving user could chose to add it to the favorite list, channel lineup page, or the like. The system may operate in connection with a mechanism to establish access to network logo bitmaps from technology partners such as cable operators or EPG providers. Network logos may also be made available from a hosted Web site. The system may allow users to share network logos through IR beaming.

Journal Activity

The event journal may contain a list of user and system actions that have occurred within the remote control application. The event journal may also contain broadcast messages from devices within the home. The event journal is a log of what the user has done as well as what is happening within the home. The user may be able to switch between a verbose mode and an alert mode for the broadcast messages. The event journal may also be used for debugging purposes.

An exemplary event journal entry format is shown in Table 16.

TABLE 16

Attribute	Description
Event ID	Primary Key - Unique ID of this Event
Event Type	Type of Event, System or User
Event Title	Title of Event
Event Data	Data for the Event
Event Time	Time of the Event
Event User ID	Foreign Key - To the user who generated the event

The Event Journal may be uploaded to a PC with an ActiveSync application.

Application Programmer Interface (API) for Third Party Developers

Some users may be developers who wish to develop extensions to the remote control application. Thus, the remote control application may expose functionality to third party developers to build extensions. The support provided may be via custom configuration files that contain third party graphics and supplemental IR codes.

Exceptions

The remote control application running on a platform should exhibit graceful behavior under exception condition. Some examples of such conditions and appropriate responses for the remote control application are as follows:

Low power situation: A low power indication is generated by the underlying PDA operating hardware while the remote control application has focus. In this case the remote control application may issue an indication to the user and also take steps to minimize power consumption by, for example, disallowing certain actions. Since the remote control application should not lose any of setup and configuration information when the PDA **1150** runs out of power, the remote control

application may store this type of data in non-volatile memory (if available) and may inhibit any write activity (i.e., changes to that memory) during low power situations.

Low memory or low storage indication received: If the operating system of the platform issues a low memory or low storage indication while the remote control application has focus, the remote control application may issue an indication to the user, relinquish to the system any scratch memory it has in use, inhibit setup or other activities which may consume additional storage, suspend journaling activity, and take any other steps possible to minimize memory and storage requirements.

Installation of new (updated or extended) version of remote control application: If the user installs a new version of the remote control application this may detect that initial installation has already been configured for a previous version of the application and may use those configuration settings as the default settings during any new installation/customization process that occurs.

Additionally, the remote control application may behave gracefully if the user temporarily changes the allocation of storage and program memory while the remote control application is active. Installation of a supplemental version of the remote control application may gracefully use all of the configuration settings that currently exist.

Desktop Remote Control Software Applications

The desktop remote control applications **1104** are applications that are installed on the user's PC **1152** to support the remote control application on the PDA **1150**. Examples of PC remote control software applications include:

Configuration Designer

The configuration designer **1134** may allow a user to create a configuration file on the PC that can be loaded into remote control application.

Configuration Emulator

The configuration emulator **1136** may allow the user to review the configurations on the PC as if it were running on the target PDA.

Restore/Backup Configurations

This component **1130** may allow the user to backup and restore configuration files and event journals over the ActiveSync communications conduit to/from the PC and the PDA **1150**.

Update Checking/Supplemental Patch Download

This component **1132** may review current version numbers of remote control application and IR code databases, verify them against a Web hosted update service, and inform the user whenever later versions are available for download. Optionally, this component may also perform the updates automatically via the ActiveSync conduit.

Cultural and Political Requirements

The remote control application may be shipped with a world-wide IR code database and may be used in many international locations. The remote control application may thus support localization, for both language as well as key layout variations to support regional settings. With reference to FIGS. **23***a* through **23***d*, the room setup wizard input requirement at step **2** may be expanded from that shown in FIG. **16***c* to include a drop-down list **230** from which various regions may be selected. Based on this input, the behavior of the remote control application may be adjusted to more closely match the region in which it is being used. For example, the order in which IR device codes are presented to the user for testing in the drop-down menu **1430** (FIG. **14***f*) during device setup may be varied from region to region in order to place the most likely (i.e., most popular in that country or region) codes at the top of the list. Furthermore, even within the same IR code set, functionality and key assignments may also vary by region and may be automatically adjusted based upon the region selected.

By way of further illustration, control page **4** of the same television brand is shown in FIG. **23***c* as it appears with the region set to "North America," and in FIG. **23***d* as it appears with the region set to "Europe." By way of background explanation, in Europe some television broadcasts include a feature known as "Teletext" in which textual information such as news briefs, weather forecasts, etc. is encoded in the vertical blanking interval of the television signal. Many European market television sets thus may include the capability to decode and display this information under user control. Accordingly, with the region set to "Europe" the remote control application displays soft keys for the functions required to cause control **232** and navigate **234** signals to be transmitted to influence the Teletext data display. Further, as can be seen by comparing keys **232** in FIG. **23***c* versus **23***d*, manufacturers may offer different features in different markets which are invoked by similar control functions—in this instance "Picture in Picture" for the North American market versus Teletext for the European market.

It will also be appreciated that this region selection parameter may also be used internally by the remote control application for other purposes as well, for example it might be used to select one of several possible sets of "Help" data in different languages, either pre-loaded in the PDA **1150** or obtained via download from the desktop PC **1152** or Web hosted services **1106**. All string literals may be stored in the Windows brand OS resource file to provide a central location to perform localization work.

While specific embodiments of the present invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangement disclosed is meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

What is claimed is:

1. A method for facilitating debugging of a remote control application of a controlling device, comprising:

storing within a memory of the controlling device data captured during operation of the controlling device, the data being representative of a user interaction with a user interface element of the controlling device and an action occurring within the remote control application of the controlling device resulting from the user interaction with the user interface element of the controlling device; and

causing the controlling device to upload the captured data to a computer in communication with the controlling device whereby the uploaded captured data is available for use in debugging the remote control application of the controlling device.

2. The method as recited in claim **1**, comprising storing the captured data within an event journal to be uploaded to the computer.

3. The method as recited in claim **2**, wherein the captured data comprises data representative of a time of occurrence of the action occurring within the remote control application of the controlling device resulting from the user interaction with the user interface element of the controlling device.

4. The method as recited in claim **2**, wherein the event journal is encrypted.

5. The method as recited in claim **2**, comprising storing within the event journal data representative of broadcast messages received from appliances controllable by the controlling device.

6. The method as recited in claim **1**, wherein the controlling device comprises a hand-held, universal remote control device.

7. A controlling device having a memory in which is stored instructions, executable by a processor, for facilitating debugging of the controlling device wherein the instructions cause the controlling device to perform steps comprising:

storing within the memory of the controlling device data captured during operation of the controlling device, the data being representative of a user interaction with a user interface element of the controlling device and an action occurring within a remote control application of the controlling device resulting from the user interaction with the user interface element of the controlling device controlling device; and

causing the controlling device to upload the captured data to a computer in communication with the controlling device whereby the uploaded captured data is available for use in debugging the remote control application of the controlling device.

8. The controlling device as recited in claim **7**, wherein the instructions perform the step of storing the captured data within an event journal to be uploaded to the computer.

9. The controlling device as recited in claim **8**, wherein the captured data comprises data representative of a time of occurrence of the action occurring within the remote control application of the controlling device resulting from the user interaction with the user interface element of the controlling device.

10. The controlling device as recited in claim **8**, wherein the event journal is encrypted.

11. The controlling device as recited in claim **8**, wherein the instructions store within the event journal data representative of broadcast messages received from appliances controllable by the controlling device.

12. The controlling device as recited in claim **7**, wherein the controlling device comprises a hand-held, universal remote control device.

13. The controlling device as recited in claim **8**, wherein the instructions store within the event journal data representative of a one of a plurality of users that provides the user interaction with the user interface element of the controlling device.

14. The controlling device as recited in claim **7**, wherein the data representative of a user interaction with a user interface element of the controlling device identifies a user activated key of the controlling device.

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