SYSTEM AND METHOD FOR PORTABLE POWER SOURCE MANAGEMENT

BACKGROUND

[0001] As more computing power and new functions are added to mobile computing devices, new auxiliary devices are being attached to the mobile computing devices. The mobile computing devices may include, for example, laptop computers, personal digital assistants (PDAs), and mobile phones, among others. The auxiliary devices may include universal serial bus (USB) drives, digital video disk (DVD) drives, compact disk (CD) drives, and moving picture expert group (MPEG) based devices, among other current and future auxiliary devices.

[0002] A mobile computing device is normally configured with a portable power source such as a rechargeable battery. The portable power source of the mobile computing device supplies the power not only to the mobile computing device, but may also supply power to an attached auxiliary device. Because the portable power source has a limited amount of power, such as when no alternating current (AC) power is available, there may be a contention for power among the mobile computing device and the attached auxiliary devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] For a more complete understanding of this disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0004] FIG. 1 illustrates an embodiment of a computing complex with auxiliary devices.

[0005] FIG. 2 illustrates an embodiment of an exemplary user interface (UI).

[0006] FIG. 3 illustrates an embodiment of a process of power management.

[0007] FIG. 4 illustrates an exemplary general-purpose computer system suitable for implementing the several embodiments of the disclosure.

DETAILED DESCRIPTION

[0008] It should be understood at the outset that although an illustrative implementation of one or more embodiments are provided below, the disclosed systems and/or methods may be implemented using any number of techniques, whether currently known or in existence. The disclosure should in no way be limited to the illustrative implementations, drawings, and techniques illustrated below, including the exemplary designs and implementations illustrated and described herein, but may be modified within the scope of the appended claims along with their full scope of equivalents.

[0009] In an embodiment, a system is provided that includes a host system configured with a portable power source and a host power manager. The host power manager is configured to monitor an available power level of the portable power source and at least one power usage by one or more auxiliary devices. The host power manager is further configured to promote less than a full power usage by at least one of the auxiliary devices.

[0010] In one embodiment, a method for power management is provided. The method includes monitoring an available power level of a portable power source, and

monitoring at least one power usage by one or more auxiliary devices. The method provides for promoting less than a full power usage by the one or more auxiliary devices.

[0011] In an embodiment, an auxiliary device is provided that includes a first component and a second component. The first component has a first power usage which is of a non-high-priority category, and the second component has a second power usage which is of a high-priority category. The auxiliary devices also includes an auxiliary power manager configured to report to a host system a status of the power usages and to support less than a full power usage by stopping the first power usage.

[0012] As mentioned above, the portable power source of the mobile computing device supplies the power not only to the mobile computing device itself, but also to the attached auxiliary devices. This may create a contention for the portable power source between the mobile computing device and the attached auxiliary devices. A sudden loss of power source may result in data loss, application interruption or other undesirable consequences, not only for the mobile computing device, but for the attached auxiliary devices as well. To address this, a user may unplug an auxiliary device to discontinue its power usage or leave the device plugged in and allow it to continue consuming power. The present disclosure provides for managing auxiliary device power and promotes no power or less than a full power usage by some devices and components in order to extend battery life and usage by higher priority devices and/or components.

[0013] FIG. 1 illustrates an embodiment of a computing complex 100. The computing complex 100 comprise a host system 110 and a set of auxiliary devices 111 (111a and 111b). The host system 110 in turn comprises a user interface (UI) 200, a host processor 121, and a battery power source 113. The host processor 121 supports a set of

components 103 and a host power manager (H-PM) 151. The auxiliary devices 111a and 111b each include an auxiliary power manager (A-PM) 153 and a set of components 103.

[0014] The host system 110 may be a mobile computing device that uses the portable power source 113. The example of the host system 110 may include a laptop, a PDA, and other hand-held computing devices that are configured with computing power to host other components and auxiliary devices. The host system 110 may communicate with or use some of the auxiliary devices. For example, if the auxiliary device 111 is a portable USB drive, the host system may use the USB drive to store data or run a program from the USB drive. The auxiliary devices 111 may depend on the host system 110 to function. For example, the host system 110 may host a USB driver for the portable USB drive to run properly. The host processor 121 may obtain its power from the portable power source 113 in order to provide the computing power for the host system 110, and to host the components 103, the H-PM 151, and other components for the host system to function properly.

[0015] The portable power source 113 supplies the power to the host system 110 and the attached auxiliary devices 111. Batteries are a common choice of the portable power source 113. Irrespective of the types of the batteries and whether the batteries are rechargeable, the battery power sources have a limited power supply, in absence of any AC power supply. Some may last longer than others, depending on the material out of which the batteries are made. For example, the older types of zinc chloride or carbon zinc, alkaline, or Nickel-Cadmium (NiCad) batteries may not last as long as the newer types of batteries such as Nickel-Metal Hydride, lithium, or fuel-cell based batteries. Multiple components or devices may draw power from the portable power source 113 at

the same time. The more auxiliary devices 111 and components 103 that draw power from the power source 113, the faster the power supply would be drained.

[0016] The auxiliary device 111 are the devices that either don't have their own power or have very limited power, and depend on devices such as the host system 110 for power supply, in absence of any AC power supply. Examples of the auxiliary devices 111 may include: DVD drive, USB drive, MPEG-based devices, and CD drive, among others. Some of the auxiliary devices such as the device 111b may have an auxiliary power (AP) (not shown). One example of an auxiliary device with its own limited power supply is a CD player that may have its own limited battery power supply. Some auxiliary devices 111 may have their own interface (not shown), such as some of MP3 players, and thus may display the available power level of the AP. The auxiliary devices 111 are not a fixed part of the host system 110, because an auxiliary device 111 may be removed and added at any time. There may be a fixed number of the auxiliary devices 111 that can be attached to the host system 110, because of limited number of ports available on the host system 110. An auxiliary device 111 may host a number of components 103. Because of a lack of or a limited amount of computing power of its own, some auxiliary devices 111 may depend on the host processor 121 to run its component. Some auxiliary devices 111 may draw more power than others, depending on the type of the auxiliary device 111.

[0017] The components 103 may be a software application or a hardware component that may use various resources, including the portable power source 113. The component 103 may be located on an auxiliary device 111 or the host system 110. The host system 110 may include host components 104 which may use some resources of an auxiliary device 111. For example, a word processor on the host system 110 may use files stored

on a USB drive. The host components 104 may be various hardware or software systems. Components 103 on auxiliary devices may use the host processor 121 on the host system to run. For example, a game on a USB drive may use the host system 110 to run. Other examples of the components 103 may include a display screen or a battery or battery charging system on an auxiliary device 111, a music player for playing songs stored on an auxiliary device 111 or on the host system 110, among many others.

[0018] The host power manager (H-PM) 151 is an application running on the host processor 121. The responsibilities of the H-PM 151 include monitoring the power usages of various components 103 on the host processor 121, and the auxiliary devices 111 by communicating with the auxiliary power manager (A-PM) 153 on the auxiliary devices 111 to get the status of power usages by each of the auxiliary devices 111. The H-PM 151 also keeps track of the available power level of the host power source 113. The H-PM 151 also interfaces with the UI 131 to display to a user the power usage status and the available power level and to receive power usage control commands from the user. The H-PM 151 may collaborate with other components of the host system 110 such as an operating system or H-PM 151 in taking a power usage control action. One example of the control actions may be stopping one or more components 103 or an auxiliary device 111.

[0019] The auxiliary power manager (A-PM) 153 may be a light-weight application residing on at least some of the auxiliary devices 111. The responsibilities of the A-PM 153 may include monitoring the power usages by various components on the auxiliary device 111, reporting the power usages to the H-PM 151, and collaborating with the H-PM 151 and other components on the auxiliary device in carrying out a power usage

control action such as stopping a power usage of a particular component 103 of the auxiliary device 111. In addition, the A-PM 153 on the auxiliary device 111b that has an auxiliary power (not shown), may collaborate with the onboard UI (not shown) to display the device power usage status and charging status. In other embodiments, the functions of the A-PM 153 might be performed by the H-PM 151.

[0020] FIG. 2 illustrates one example of the UI 200. However other UIs with other features and options may be used and are within the spirit and scope of the present disclosure. The UI 200 is a user interface that is coupled with the host processor 121. The UI 200 may have an available power field 205 to provide a warning or a notification to a user on the available power level of the power source 113. The UI 200 may also have power usage fields 203 corresponding to each of the components 103 that are attached to the host system 110. The power usage fields 203 show the power usage of each component 103 of each auxiliary device 111. In this illustrative figure, auxiliary device 111a is shown having two components 103 (Comp1 and Comp2). These components 103 represent power consuming sub-systems of the auxiliary device 111a. For example, if the auxiliary device 111a were a digital audio player, Comp 1 might be a display or rechargeable battery of the auxiliary device 111a, and Comp 2 might be a storage medium or drive where media is stored on the auxiliary device 111a. To conserve the power of the power source 113, the auxiliary device 111a might enable shutting down (Comp 1) the display or preventing recharging of the rechargeable battery, but still promote use of (Comp 2) the storage device. This would allow a user of the host system 110 to continue to access media from the auxiliary device 111a, but conserve power by reducing or eliminating power consumption by Comp 1 of auxiliary device 111a. A myriad

of other auxiliary devices 111 may be configured with any combination of components for these purposes, which will readily suggest themselves to one skilled in the art.

[0021] Auxiliary device 111b is shown having only one component. Therefore the only alternative to reducing the power consumption of auxiliary device 111b is to disable or shut-down the device completely. In some embodiments, the UI 200 might provide features to enable the user to selectively shut-down or otherwise prevent auxiliary device 111b from consuming power from the power source 113. The UI 200 might also have the capability to selectively re-initiate supplying power the auxiliary device 111b, such as when AC power is restored to the host system 110. The UI 200 may allow the user to enter a command at the control command field 207 for the H-PM 151 to help carry out various features and functionality. For example, the user may issue a command or select a button to go into a power conservation mode, and in response, the H-PM 151 may shut down certain components 103 on a priority basis in collaboration with other components of the host system 110.

[0022] The user may select sequences or prioritize the auxiliary devices 111 and/or components 103 so that when a low priority situation arises the H-PM 151 might automatically begin shutting down or promoting reducing power to the devices, such as in conjunction with the A-PM 153. In some embodiments, this process might be accomplished manually by the user via the UI 200. The UI 200 may also allow the user to zoom in on a particular auxiliary device 111 and query for the power usage status of one or more of its component 103. The UI 200 might also provide for entry of a threshold power level of the power source 113, which when reached would prompt notification of the user. The UI 200 may allow the user to set a threshold that would trigger certain

control actions on the portable power source 113. For example, if a threshold of 20% is set for the available power level, then the H-PM 151 may start promoting less than a full power usage by the auxiliary devices 111, when the threshold is reached.

[0023] FIG. 3 illustrates an embodiment of a process 300 of portable power source management. The process 300 may comprise supplying full power to a plurality of components and auxiliary devices at block 303, monitoring an available power level and power usages at block 305, determining a priority for each power usage at block 307, promoting less than a full power usage at block 309, and reporting the available power level and the power usages to a user at block 311.

[0024] The block 303 illustrates the step of supplying full power to the components and the attached auxiliary devices 111. In a normal case where a host portable power source 113 has sufficient power, full power is provided to all components 103 on the host system 110 and to all attached auxiliary devices 111. Supplying full power may continue until a change in the status of available power occurs. One such event is that a minimum threshold for the available host power level is reached. In some embodiments, the power conservation by providing less than full power to an auxiliary device 111 might be initiated even before a threshold is reached, such as in situations when the user knows the AC power may be unavailable for some time.

[0025] The block 305 illustrates the step of monitoring the available power level and the power usages. Specifically, this step may include collecting power usage data of the auxiliary devices 111 and various components 103, aggregating power usages by various auxiliary devices 111 and the host components 110 into an aggregate usage, checking and calculating the available power level, and determining whether a predefined threshold

for the available power level is reached. Part of this step may also include storing the collected power usage data for a specified duration, if a user so desires. This step may also include keeping track of the status of the auxiliary devices 111, because an existing device may be removed and a new one added at any time.

[0026] The block 307 illustrates the step of determining a priority for each power usage. Specifically, this step may include categorizing the power usages by the auxiliary devices 111 and components 103 into categories such as high or low power usage priority, based on a number of criteria. One example criterion may be based on whether stopping the power usage of an auxiliary device or a component would result in a data loss. For example, stopping a read-only component such as music player may not result in any data loss. On the other hand, stopping an online session that has an in-progress transaction may result in some data loss. Some other usages by components such as a DVD player may consume more power. The user may categorize those power usages as high-priority if the usage might result in data loss, and those power usages, low or other priorities, that are unlikely to result in data loss. The power usages may also be categorized into low-power-consuming category and high-power-consuming category, according to the amount of power resource the component and the auxiliary device may use. Some power usages by components such as a word processor may be low-power-consuming. The criterion and categories may be modified by the user, depending on specific circumstances and the design choice.

[0027] The block 309 illustrates the step of promoting less than a full power usage. When the portable power source 113 runs low and, for example, a threshold of the available power level is crossed, actions prompted by the user or automatically may be

taken by the H-PM 151 to promote less than a full power usage by one or more components 103 and of one or more auxiliary devices 111a, in order to conserve power and avoid potential data or other loss because of a sudden power loss. One action may be to stop those components 103 and auxiliary devices 111 that are categorized as lower priority and high-power-consuming. For example, a component such as playing a movie on a DVD drive, which has a low risk of data loss and is high-power-consuming, may be stopped. Another option for action is to start an alternative component or device that is less power-consuming, in place of a high-power-consuming component or device at a cost of slower speed. For example, a more power-consuming flash drive may be stopped in favor of a slower, but less power-consuming internal disk drive. Another option of action may be to display to the user the power usages of each auxiliary device, component on the device, and each component, and the available power level, and allow the user to take control action manually such as stopping an auxiliary device 111 or a component 103.

[0028] The block 311 illustrates the step of reporting the available power level and the power usages to the user. Reporting the current available power level and the usages of the auxiliary devices 111 and the components 103 may take place during the whole period when the portable power source is available. The reporting may be on demand, at a fixed interval, or a combination of the two. The reporting may be through a GUI, a notification or other means.

[0029] The system described above may be implemented on any general-purpose computer with sufficient processing power, memory resources, and network throughput capability to handle the necessary workload placed upon it. FIG. 4 illustrates a typical,

general-purpose computer system suitable for implementing one or more embodiments disclosed herein. The computer system 480 includes a processor 482 (which may be referred to as a central processor unit or CPU) that is in communication with memory devices including secondary storage 484, read only memory (ROM) 486, random access memory (RAM) 488, input/output (I/O) devices 490, and network connectivity devices 492. The processor may be implemented as one or more CPU chips.

[0030] The secondary storage 484 is typically comprised of one or more disk drives or tape drives and is used for non-volatile storage of data and as an over-flow data storage device if RAM 488 is not large enough to hold all working data. Secondary storage 484 may be used to store programs which are loaded into RAM 488 when such programs are selected for execution. The ROM 486 is used to store instructions and perhaps data which are read during program execution. ROM 486 is a non-volatile memory device which typically has a small memory capacity relative to the larger memory capacity of secondary storage. The RAM 488 is used to store volatile data and perhaps to store instructions. Access to both ROM 486 and RAM 488 is typically faster than to secondary storage 484.

[0031] I/O devices 490 may include printers, video monitors, liquid crystal displays (LCDs), touch screen displays, keyboards, keypads, switches, dials, mice, track balls, voice recognizers, card readers, paper tape readers, or other well-known input devices.

[0032] The network connectivity devices 492 may take the form of modems, modem banks, ethernet cards, universal serial bus (USB) interface cards, serial interfaces, token ring cards, fiber distributed data interface (FDDI) cards, wireless local area network (WLAN) cards, radio transceiver cards such as code division multiple access (CDMA)

and/or global system for mobile communications (GSM) radio transceiver cards, and other well-known network devices. These network connectivity devices 492 may enable the processor 482 to communicate with an Internet or one or more intranets. With such a network connection, it is contemplated that the processor 482 might receive information from the network, or might output information to the network in the course of performing the above-described method steps. Such information, which is often represented as a sequence of instructions to be executed using processor 482, may be received from and outputted to the network, for example, in the form of a computer data signal embodied in a carrier wave

[0033] Such information, which may include data or instructions to be executed using processor 482 for example, may be received from and outputted to the network, for example, in the form of a computer data baseband signal or signal embodied in a carrier wave. The baseband signal or signal embodied in the carrier wave generated by the network connectivity devices 492 may propagate in or on the surface of electrical conductors, in coaxial cables, in waveguides, in optical media, for example optical fiber, or in the air or free space. The information contained in the baseband signal or signal embedded in the carrier wave may be ordered according to different sequences, as may be desirable for either processing or generating the information or transmitting or receiving the information. The baseband signal or signal embedded in the carrier wave, or other types of signals currently used or hereafter developed, referred to herein as the transmission medium, may be generated according to several methods well known to one skilled in the art.

[0034] The processor 482 executes instructions, codes, computer programs, scripts which it accesses from hard disk, floppy disk, optical disk (these various disk based systems may all be considered secondary storage 484), ROM 486, RAM 488, or the network connectivity devices 492.

[0035] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[0036] In addition, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as coupled or directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component whether electrically, mechanically, or otherwise. Other examples of changes, substitutions, and alterations are ascertainable by one skilled in the art and could be made without departing from the spirit and scope disclosed herein.

What is claimed is:

1. A system, comprising:

a host system configured with a user interface (UI), a portable power source, and a host power manager, the user interface configured to allow a user to prioritize components of one or more auxiliary devices, the host power manager configured to monitor an available power level of the portable power source and at least one power usage by the one or more auxiliary devices, the host power manager further configured to provide less than a full power usage to at least one of the auxiliary devices by stopping providing power for at least one component of a non-high priority category of the at least one of the auxiliary devices while providing power to at least one component of a high priority category of the at least one of the auxiliary devices.

2. The system of claim 1, further comprising the one or more auxiliary devices communicating with the host power manager on a status of the at least some of the power usages by each of the auxiliary devices.

3. The system of claim 1, wherein the UI is further configured to report on the power usage by each of the auxiliary devices and the available power level to a user, the UI further configured to receive a control command from the user to manage the power level of the auxiliary devices.

4. The system of claim 1, wherein the host system comprises a plurality of host components, each of which use power from the portable power source and using at least some of the auxiliary devices.

5. The system of claim 1, wherein the host system is one of a laptop computer, a desk top computer, a mobile phone, and a personal digital assistant (PDA).

6. The system of claim 1, wherein each of the auxiliary devices is one of a universal serial bus (USB) drive, a disk drive, a digital versatile disk (DVD) drive, a moving picture expert group (MPEG) based device, a cell phone, and a compact disk (CD) drive.

7. The system of claim 1, wherein the portable power source is a rechargeable battery.

8. The system of claim 1, wherein a threshold for the available power level is settable by a user through a UI.

9. The system of claim 1, wherein a component is categorized as high priority if stopping usage of the component might result in data loss, and a component is categorized as non-high priority if stopping usage of the component is unlikely to result in data loss.

10. A method for power management, comprising:

prioritizing components of one or more auxiliary devices;

monitoring an available power level of a portable power source;

monitoring at least one power usage by one or more auxiliary devices; and

providing less than a full power usage by the one or more auxiliary devices by stopping providing power to at least one component of a non-high priority category of the at least one of the auxiliary devices while providing power to at least one component of a high priority category of the at least one of the auxiliary devices.

11. The method of claim 10, further comprising displaying the available power level and the power usage of the one or more auxiliary devices to a user.

12. The method of claim 10, wherein promoting less than the full power usage by at least some of the auxiliary devices comprises stopping a high-power-consuming usage.

13. The method of claim 10, wherein monitoring the at least one power usage by the one or more auxiliary devices comprises aggregating into an aggregate usage the at least one power usage by the one or more auxiliary devices.

14. The method of claim 10, wherein a component is categorized as high priority if stopping usage of the component might result in data loss, and a component is categorized as non-high priority if stopping usage of the component is unlikely to result in data loss.

15. An auxiliary device, comprising:

a first component with a first power usage which is of a non-high-priority category;

a second component with a second power usage which is of a high-priority category; and

an auxiliary power manager configured to report to an external host system a status of the power usages, and to support less than a full power usage by stopping the first power usage, the first and second power usage being provided by the external host system.

16. The device of claim 15, further comprising a user interface (UI) to display at least one of the power usages.

17. The device of claim 15, wherein the auxiliary device is one of a universal serial bus (USB) drive, a compact disk (CD) drive, an external hard disk, a cell phone, a moving picture experts group (MPEG) based device, and a personal digital assistant (PDA).

18. The device of claim 15, further comprising a rechargeable auxiliary power source.

19. The device of claim 18, wherein the first power usage is charging the rechargeable auxiliary power source.

20. The device of claim 15, wherein the auxiliary power manager is further configured to reinitiate power usage by the first component after the first power usage had previously been stopped.