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(54) Title: DETERMINING RELIABILITY OF A COMPUTER CARD

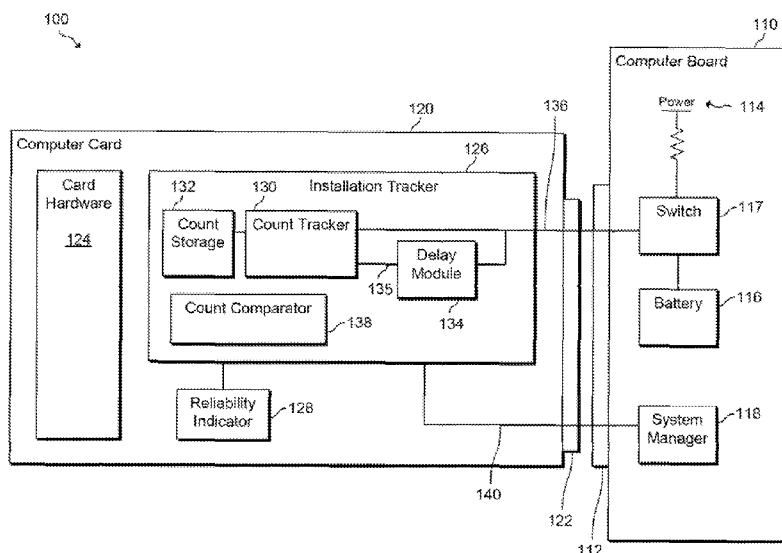


FIG. 1

(57) Abstract: In one example in accordance with the present disclosure, a computer assembly includes a computer card that allows for determining its reliability. The computer card may have an installation tracker that increments a count when the computer card is plugged into to a computer board. The installation tracker does not require a power source prior to the computer card being plugged into the computer board in order to increment the count. The computer assembly includes the computer board, which may have a power source that connects to the installation tracker only upon the computer card being plugged into the board.

DETERMINING RELIABILITY OF A COMPUTER CARD

BACKGROUND

[0001] In various modern computing system, a computer card or module (e.g., a printed circuit assembly, or "PCA" for short) may be installed on (e.g., plugged into) a computer board (e.g., a main motherboard or other system board, which may also be a type of PCA). These computer cards may provide additional or upgraded functionality to the computing system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The following detailed description references the drawings, wherein:

[0003] FIG. 1 is a block diagram of an example circuit assembly that allows for determining reliability of a computer card;

[0004] FIG. 2 is a block diagram of an example circuit assembly that allows for determining reliability of a computer card;

[0005] FIG. 3 is a flowchart of an example method for determining the reliability of a computer card; and

[0006] FIG. 4 is a flowchart of an example method for determining the reliability of a computer card.

DETAILED DESCRIPTION

[0007] As mentioned above, a computer card (e.g., a printed circuit assembly or "PCA") may be installed on (e.g., plugged into) a computer board (e.g., a main motherboard or other system board, which may also be a type of PCA). In some situations, such a computer card may install on a computer board via a connector on the card that engages a connector on the board. Such connectors may have a number of metal contacts (e.g., with metal plating such as gold) such that metal contacts on the card connector can make electrical contact with metal contacts on the board connector. In some situations, a computer card will be installed and uninstalled many times over the life of the card, and each time the card is installed or uninstalled (e.g., plugged or unplugged), the metal contacts on the card connector may rub or scrape against the board connector. After multiple installs, the connector of the card may degrade. For example, the metal contacts or plating on the card connector may wear or scrape away. This may cause reliability issues regarding the computer card making a good electrical or communicative connection with the computer board. Therefore, it may be desirable for a user (e.g., system administrator, system assembler, etc.) of a computer card to be able to determine the reliability of the card.

[0008] In some situations, a computer card may come (e.g., from the manufacturer) with a specification that indicates a rough estimate of how many times the card can be installed before it may have reliability issues. However, in such situations, the user of the card is left to keep track of the number of installations, and there is no automated way to record or track the number of times the card has been installed. Additionally, a user may be unaware of the installation guidelines in the specification, and thus the user may experience reliability issues without knowing why or having any direct indication that there may be connectivity problems. Furthermore, if a computer card that is having reliability issues is to be analyzed after problems arise to determine what the issue may be, complex tools

(e.g., a microscope) and expert analysis may need to be used to check the plating on the connector of the card. Thus, a card that is having issues may need to be sent back to the manufacturer for such analysis.

[0009] Some solutions allow for automatically determining whether a computer card is reliably connected to a computer board. However, such solutions do not indicate what the problem may be if the connection is not good. Other solutions allow for detecting the number of times that a circuit board has been inserted into and extracted from another circuit board. However, for these solutions, the circuit board that performs the insertion/extraction counting requires a persistent power source to be present before the insertion/extraction occurs, e.g., so that a monitoring circuit has power to detect the insertion/extraction. For example, in some of these solutions, the circuit board for which the number of insertions/extractions is being monitored needs to have its own power supply (e.g., from an AC power converter). This power requirement limits the practical utility of such solutions because many computer cards do not have their own persistent power supply.

[0010] The present disclosure describes determining the reliability of a computer card. The computer card may have an installation tracker that increments a count when the computer card is plugged into to a computer board. The installation tracker does not require a power source prior to the computer card being plugged into the computer board in order to increment the count. The installation tracker may use a single conductive line to both power the installation tracker and to initiate increments of the count. The computer board may have a power source (e.g., a coin battery) that connects to the installation tracker (e.g., via the single conductive line) only upon the computer card being plugged into the board. The computer card of the present disclosure may count the number of times the computer card is installed on the computer board or any other computer board. The computer card may provide an indication (e.g., visible indication on the card or indication to a system manager) of the count and/or how close the count is

to a defined maximum count. Users of the card (e.g., system administrators) can use this indication to be aware of the lifespan of the card and to be aware of any potential reliability issues. Suppliers of the card can use this indication to determine, in a reliable way, the wear on the card. For example, suppliers could base a limited warranty on the number of times the card has been installed.

[0011] FIG. 1 is a block diagram of an example circuit assembly 100 that allows for determining reliability of a computer card. Circuit assembly 100 includes a computer board 110 and a computer card 120. Computer card 120 may be installed on and uninstalled from (e.g., plugged into or unplugged from) computer board 110. In some situations, computer card 120 may be installed and uninstalled many times, for example, with respect to computer board 110 and/or various other computer boards. Computer card 120 may include a connector 122, which may engage with connector 112 of computer board 110 to facilitate installation of computer card 120 on computer board 110. For example, connector 122 may slide, at least partially, inside of connector 112.

[0012] Computer board 110 may be any type of computer board, for example, a main motherboard of a computer or server, or any other type of system board. Computer board 110 may be a printed circuit assembly (PCA), and may include a processor, system memory, I/O chipset, etc.

[0013] Computer board 110 may include a main board power source 114. This power source 114 may power most or all of the circuitry on computer board 110. This power source 114 may be, for example, a 3V or 5V direct current (DC) power source, where the power originates from an external power supply. Computer board 110 may include at least one battery, for example, battery 116. Battery 116 may power at least one circuit component of computer board 110, or battery 116 may power no components of computer board 110. Battery 116 may provide power to computer card 120 (e.g., to provide power and a count increment signal to installation tracker 126), as described in more detail herein. In some examples, battery 116 may be a coin battery. Battery 116 may allow computer

board 110 to continue to function (e.g., with limited functionality) when computer board 110 has no main board power (e.g., from an external power supply).

[0014] Computer board 110 may include a switch 117, which may select between multiple power sources (e.g., between main board power 114 and battery 116) to determine which power source is to provide power to computer card 120 (e.g., to installation tracker 126). In some examples, switch 117 may route power from battery 116 when computer board 110 is not powered on, and then may route power from main board power source 114 once computer board 110 is powered on. Such examples may allow for the life of battery 116 to be extended because battery 116 will not be drained when computer board 110 is powered on. In some examples, computer board 110 may not include switch 117, in which case a power source (e.g., either power 114 or battery 116) may be routed directly to computer card 120.

[0015] In some examples, computer board 110 may include a system manager 118, which may allow a system administrator to perform various functions on computer board 110, e.g., from a remote location. For example, a system administrator may access system manager 118 to view various pieces of status information about computer board 110 and/or about the board's attached components. In some examples, system manager 118 is an iLO (Integrated Lights-Out) chip, but various other types of server management technology may be used.

[0016] Computer board 110 may include connector 112. Connector 112 may engage with connector 122 of computer card 120 to facilitate installation of computer card 120 on computer board 110. Connector 112 may be any type of conductive or communicative connector. For example, connector 112 may be a PCIE (Peripheral Component Interconnect Express) connector. A PCIE connector may be designed to accept golden finger type connectors of computer cards. A PCIE connector may accept other types of connectors as well. Connector 112 may be any other type of connector appropriate for installation of computer cards.

[0017] Computer card 120 may be any type of computer card, for example, riser/interposer card, option card, expansion card, mezzanine card, memory module (e.g., DIMM) or the like. Computer card 120 may be a printed circuit assembly (PCA). Computer card 120 may, once installed, expand or add functionality to computer board 110. Computer card 120 may include card hardware 124, which may include circuitry, hardware, processor, machine-readable storage medium, executable instructions and any other components necessary to perform the main functional purpose of computer card 120.

[0018] Computer card 120 may also include an installation tracker 126 and a reliability indicator 128. Installation tracker 126 and reliability indicator 128 may allow for determining the reliability of computer card 120 and may allow for a user of the card to be able to easily identify when there may be a reliability issue. Installation tracker 126 and reliability indicator 128 are described in more detail herein.

[0019] Computer card 120 may include connector 122. Connector 122 may engage with connector 112 of computer card 110 to facilitate installation of computer card 120 on computer board 110. Connector 122 may be any type of conductive or communicative connector. For example, connector 122 may be a golden finger connector. A golden finger connector is a thin, long connector that extends from the edge of a computer card. The connector includes multiple thin metal-plated (e.g., gold plated) strips in a row across the length of the connector. Golden finger connectors may be used on, for example, riser/interposer cards, option cards, expansion cards, mezzanine cards, memory modules (e.g., DIMMs) or the like.

[0001] Installation tracker 126 may track the number of times that computer card 120 has been installed, either on computer board 110 or on any other computer board. Installation tracker 126 may include a count tracker 130, count storage 132, a delay module 134 and a count comparator 138. Count tracker 130 may maintain a count of the number of times that computer card 120 has been

installed, and when appropriate, may advance or increment the count. Count storage 132 may store the most recent count of the number of times that computer card 120 has been installed. Count tracker 130 may, at various times, read the current count from count storage 132, advance or increment the count (e.g., add one), and then cause the new count to be stored back in count storage 132. Count storage 132 may be a machine-readable storage medium, for example, any electronic, magnetic, optical, or other physical storage device that stores digital information. In some examples, count storage 132 may be a non-volatile memory such as NVRAM (Non-Volatile Random Access Memory), flash, a storage drive or the like.

[0020] Installation tracker 126 may use a single conductive line 136 to both power installation tracker 126 and to initiate increments of the count of the number of times that computer card 120 has been installed. As can be seen in FIG. 1, line 136 routes directly to count tracker 130, to power count tracker 130. Additionally, line 136 routes to delay module 134, and line 135 exits delay module 134 and routes into count tracker 130. Line 135 indicates to count tracker 130 that it should advance or increment the count (i.e., line 135 acts like a trigger signal). Thus, by using a single conductive line 136 to both power installation tracker 126 and to initiate increments of the count, installation tracker 126 does not require a power source prior to computer card 120 being plugged into computer board 110 in order to increment the count. Instead, at the time card 120 is plugged into board 110, line 136 delivers power to count tracker 130, and a short time later (when count tracker is powered up), a signal is delivered to count tracker via line 135, where that signal is a delayed version of the power signal that traveled on line 136 when the card was plugged.

[0021] In addition to the benefit of a single conductive line 136 both providing power to installation tracker 126 and initiating increments of the count, the single conductive line can also be powered by battery 116, which may be a

coin battery. In this respect, installation tracker 126 may be powered on and may advance the count even if computer board 110 is without main board power.

[0022] Count comparator 138 may determine whether the number of times that computer card 120 has been installed is more than a defined maximum count. For example, count storage 132 may, along with the current count, store a maximum count. Count comparator 138 may then read this maximum count and the current count (e.g., read from count storage 132 or from count tracker 130) and may compare these values to determine whether the current count is greater than the maximum count. When the current count is greater than the maximum count, computer card 120 may start to have reliability issues in some situations. Thus, it may be appropriate to notify users of this potential problem.

[0023] Count comparator 138 may communicate with reliability indicator 128. For example, when count comparator 138 determines that the current count is greater than the maximum count, count comparator 138 may send a signal to reliability indicator 128 to activate the indicator. In some examples, when reliability indicator is activated, it may produce a visual indication such that users can easily see by looking at the computer card that reliability issues may occur. In some examples, count comparator 138 may communicate with reliability indicator 128 to indicate more than one state related to the reliability of card 120. For example, count comparator 138 may compare the current count against multiple defined count values, for example, to track how close the current count is getting to the maximum count. In this example, count storage 132 may store these multiple defined count values.

[0024] Reliability indicator 128 may include a visible indicator that a direct user of card 120 can see by looking at the card. For example, reliability indicator 128 may be an LED or other notification unit. Reliability indicator 128 may notify or warn the user that based on the number of times that computer card 120 has been installed the card may start to have some reliability issues. In some examples, reliability indicator 128 may notify the user how close the current count is getting to

the maximum count. For example, if the current count is 75% of the maximum count, an indicator LED may be orange. Then if the current count is 90% of the maximum count, the LED may be darker orange. Then, once the count is greater than the maximum count, the LED may be red. Thus, a user may be warned that a card is starting to wear out before it is completely spent. Various other visual indications of how close the count is getting to the maximum count may be used, for example, lighting up more and more adjacent LEDs as the count gets closer to the maximum count, or blinking at least one LED when the count gets closer to the maximum count.

[0025] Count comparator 138 (in installation tracker 126) may also communicate with a system manager (e.g., 118) of computer board 110. In a similar manner to how count comparator communicates with reliability indicator 128, count comparator 138 may indicate to system manager 118 when the current count is greater than a maximum count and/or how close the current count is getting to the maximum count. In some examples, count comparator 138 may report (e.g., on an ongoing or continuous basis) to system manager 118 the current count. In some examples, when the current count is greater than a maximum count, count comparator 138 may report a warning or informational message to system manager 118, warning of potential reliability issues. System manager 118 may keep track of and/or log various pieces of information related to the count of installation times and/or how close the current count is to the maximum count.

[0026] Installation tracker 126 may connect to system manager 118 via a signal or bus (e.g., 140). In some examples, this signal or bus may be a standard reporting interface, such as an I2C (Inter-Integrated Circuit) bus, SMBus (system management bus), or other signal or bus that follows an industrial serial bus protocol. Thus, this standard interface may already exist on various computer cards and installation tracker 126 may be able to tap into that standard interface without adding more pins or lines for such communication. In these examples,

because the reporting interface (140) already exists, the solutions described herein may only require unique, dedicated use of one total pin (e.g., pin 136).

[0027] Installation tracker 126 (and/or at least one of its components 130, 132, 134, 138) may, in some examples, be implemented in the form of electronic circuitry (e.g., hardware, circuit logic, programmable logic device, etc.). In these examples, installation tracker may include at least one electronic circuit comprising a number of electronic components for performing the functionality of installation tracker 126. In other examples, installation tracker 126 (and/or at least one of its components 130, 132, 134, 138) may include a type of controller or processor, for example, a microcontroller, microprocessors, and/or other hardware device suitable for retrieval and execution of instructions stored in a machine-readable storage medium. In these examples, the machine readable storage medium may be included on computer card 120 and may be part of installation tracker 126. In these examples, the controller or processor may fetch, decode, and execute instructions stored on the machine readable storage medium to perform the functionality of installation tracker 126.

[0028] FIG. 2 is a block diagram of an example circuit assembly 200 that allows for determining reliability of a computer card. Circuit assembly 200 may be similar to circuit assembly 100 and, in some examples, may include some or all of the components of circuit assembly 100 that are not shown in FIG. 2. Circuit assembly 200 includes a computer board 210 and a computer card 220. Computer card 220 may be installed on and uninstalled from (e.g., plugged into or unplugged from) computer board 210. In some situations, computer card 220 may be installed and uninstalled many times, for example, with respect to computer board 210 and/or various other computer boards. Computer board 210 may be similar to computer board 110, for example. Computer board 210 may include a power source 216. Power source 216 may be, for example, a battery (e.g., a coin battery), or a different power source such as from an external power supply.

Computer card 220 may be similar to computer card 120, for example. Computer card 220 may include an installation tracker 226.

[0029] Each time computer card 220 is installed on computer board 210, an electrical connection may be established between the computer card 220 and the computer board 210. More specifically, each time computer card 220 is installed on computer board 210, an electrical connection may be established across line 236 between installation tracker 226 and power source 216. Similar to the example described above, 236 may be a single conductive line and may both power installation tracker and also initiate increments of a count that indicates the number of installations of card 220. Each time computer card 220 is uninstalled from computer board 210, the electrical connection across line 236 is severed. Even though line 236 is shown as solid between card 220 and board 210, the electrical connection would in fact be severed when card 220 is unplugged from board 210.

[0030] Similar to the example described above, line 236 routes directly to a count tracker inside installation tracker 226, to power the count tracker. Additionally, line 236 routes to a delay module inside installation tracker 226. A delayed version of line 236 then routes to the count tracker to initiate increment of a count that represents the number of times card 220 has been installed. Thus, line 236 both delivers power to installation tracker 226 so it can function, and also delivers a delayed trigger signal to indicate that the count tracker should increment the count.

[0031] Installation tracker 226 may, in some examples, be implemented in the form of electronic circuitry (e.g., hardware, circuit logic, programmable logic device, etc.). In these examples, installation tracker may include at least one electronic circuit comprising a number of electronic components for performing the functionality of installation tracker 226. In other examples, installation tracker 226 may include a type of controller or processor, for example, a microcontroller, microprocessors, and/or other hardware device suitable for retrieval and execution

of instructions stored in a machine-readable storage medium. In these examples, the machine readable storage medium may be included on computer card 220 and may be part of installation tracker 226. In these examples, the controller or processor may fetch, decode, and execute instructions stored on the machine readable storage medium to perform the functionality of installation tracker 226.

[0032] FIG. 3 is a flowchart of an example method 300 for determining the reliability of a computer card. Method 300 may be described below as being executed or performed by an installation tracker, for example, installation tracker 226 of FIG. 2 or installation tracker 126 of FIG. 1. Other suitable circuit modules, controllers, processors or the like may be used as well. Method 300 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of the installation tracker and executed by at least one processor of the installation tracker. Alternatively or in addition, method 300 may be implemented in the form of electronic circuitry (e.g., hardware). In alternate embodiments of the present disclosure, one or more steps of method 300 may be executed substantially concurrently or in a different order than shown in FIG. 3. In alternate embodiments of the present disclosure, method 300 may include more or less steps than are shown in FIG. 3. In some embodiments, one or more of the steps of method 300 may, at certain times, be ongoing and/or may repeat.

[0033] Method 300 may start at step 302 and continue to step 304, where the installation tracker may receive a power signal from a single conductive line when the computer card is plugged into a computer board. At step 306, the installation tracker may power up a count tracker using the single conductive line. At step 308, the installation tracker may delay the power signal and using the delayed power signal to trigger the count tracker to increment a count. At step 310, when the count is greater than a defined maximum count, the installation tracker may cause an indicator of the computer card to produce a visual indication. Method 300 may eventually continue to step 312, where method 300 may stop.

[0034] FIG. 4 is a flowchart of an example method 400 for determining the reliability of a computer card, for example, a computer card that is in communication with a system manager of a computer board. Method 400 may be described below as being executed or performed by an installation tracker, for example, installation tracker 226 of FIG. 2 or installation tracker 126 of FIG. 1. Other suitable circuit modules, controllers, processors or the like may be used as well. Method 400 may be implemented in the form of executable instructions stored on at least one machine-readable storage medium of the installation tracker and executed by at least one processor of the installation tracker. Alternatively or in addition, method 400 may be implemented in the form of electronic circuitry (e.g., hardware). In alternate embodiments of the present disclosure, one or more steps of method 400 may be executed substantially concurrently or in a different order than shown in FIG. 4. In alternate embodiments of the present disclosure, method 400 may include more or less steps than are shown in FIG. 4. In some embodiments, one or more of the steps of method 400 may, at certain times, be ongoing and/or may repeat.

[0035] Method 400 may start at step 402 and continue to step 404, where the installation tracker may receive a power signal from a single conductive line when the computer card is plugged into a computer board. At step 406, the installation tracker may power up a count tracker using the single conductive line. At step 408, the installation tracker may delay the power signal and using the delayed power signal to trigger the count tracker to increment a count. At step 410, the installation tracker may report (e.g., on an ongoing or continuous basis) to a system manager (e.g., similar to system manager 118) the current count. At step 412, when the count is greater than a defined maximum count, the installation tracker may cause an indicator of the computer card to produce a visual indication. At step 414, installation tracker may, when the current count is greater than the maximum count, report a warning or informational message to the system

manager, warning of potential reliability issues. Method 400 may eventually continue to step 416, where method 400 may stop.

CLAIMS

1. A computer assembly comprising:
a computer card that allows for determining its reliability, the computer card having an installation tracker that increments a count when the computer card is plugged into to a computer board, wherein the installation tracker does not require a power source prior to the computer card being plugged into the computer board in order to increment the count; and
the computer board, having a power source that connects to the installation tracker only upon the computer card being plugged into the board.
2. The computer assembly of claim 1, wherein the power source connects to the installation tracker via a single conductive line that both powers the installation tracker and also initiates increment of the count.
3. The computer assembly of claim 2, wherein the single conductive line routes directly to a count tracker in the installation tracker to power the count tracker, and also routes to a delay module in the installation tracker where the output of the delay module routes to the count tracker to initiate increment of the count.
4. The computer assembly of claim 2, wherein the single conductive line powers up circuitry that is responsible for incrementing the count, and wherein a delayed version of the single conductive line signals to the circuitry to increment the count.
5. The computer assembly of claim 1, wherein the power source is a coin battery.

6. The computer assembly of claim 4, wherein the computer board has a switch that selects between the coin battery and main board power of the computer board.

7. The computer assembly of claim 1, wherein the computer card has a golden finger connector to facilitate the computer card being plugged into the computer board.

8. The computer assembly of claim 1, wherein the computer card includes a reliability indicator that produces a visual indication when the count is greater than a defined maximum count.

9. The computer assembly of claim 1, wherein the computer board includes a system manager that connects to the installation tracker via a bus and wherein the installation tracker indicates to the system manager at least one of the following:

the count;

when the count is greater than a defined maximum count; and

how close the count is to the defined maximum count.

10. The computer assembly of claim 9, wherein the bus is a standard Inter-Integrated Circuit (i2C) bus, a system management bus (SMBus) or other bus that follows an industrial serial bus protocol.

11. A method for determining reliability of a computer card, the method comprising:

receiving a power signal from a single conductive line when the computer card is plugged into a computer board;

powering up a count tracker using the single conductive line;

delaying the power signal and using the delayed power signal to trigger the count tracker to increment a count; and

when the count is greater than a defined maximum count, causing an indicator of the computer card to produce a visual indication.

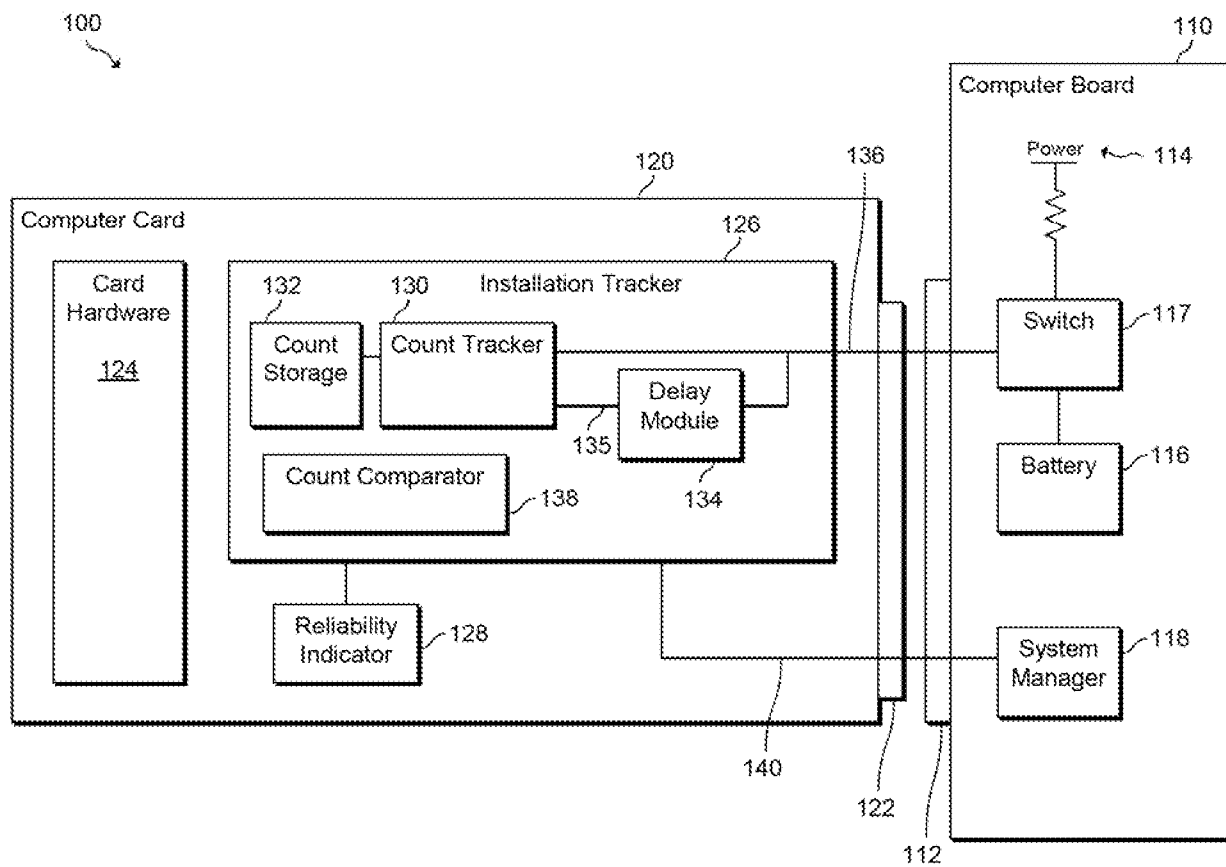
12. The method of claim 11, wherein the method further comprises, after powering up the count tracker but before incrementing the count, reading a current value of the count from a non-volatile memory of the computer card.

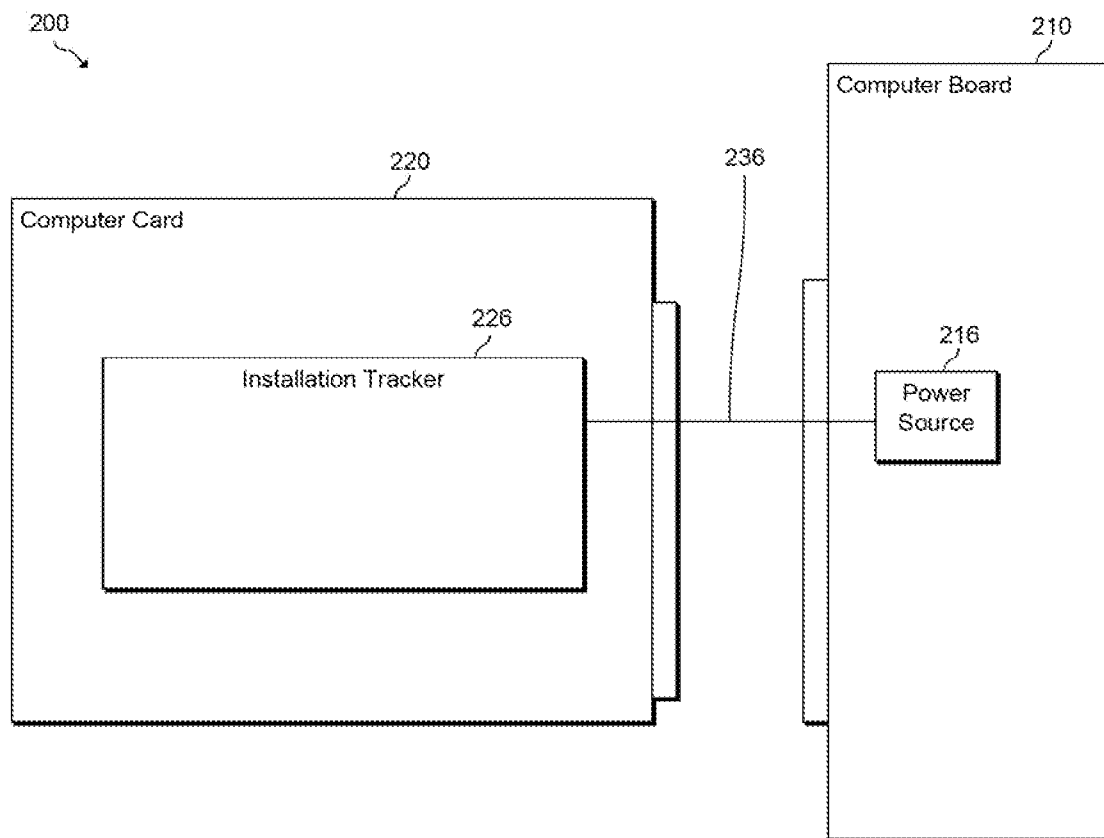
13. The method of claim 11, wherein the method further comprises, after incrementing the count, saving the count value to a non-volatile memory of the computer card.

14. A computer card that allows for determining its reliability, the computer card being connectable to a computer board, the computer card comprising:

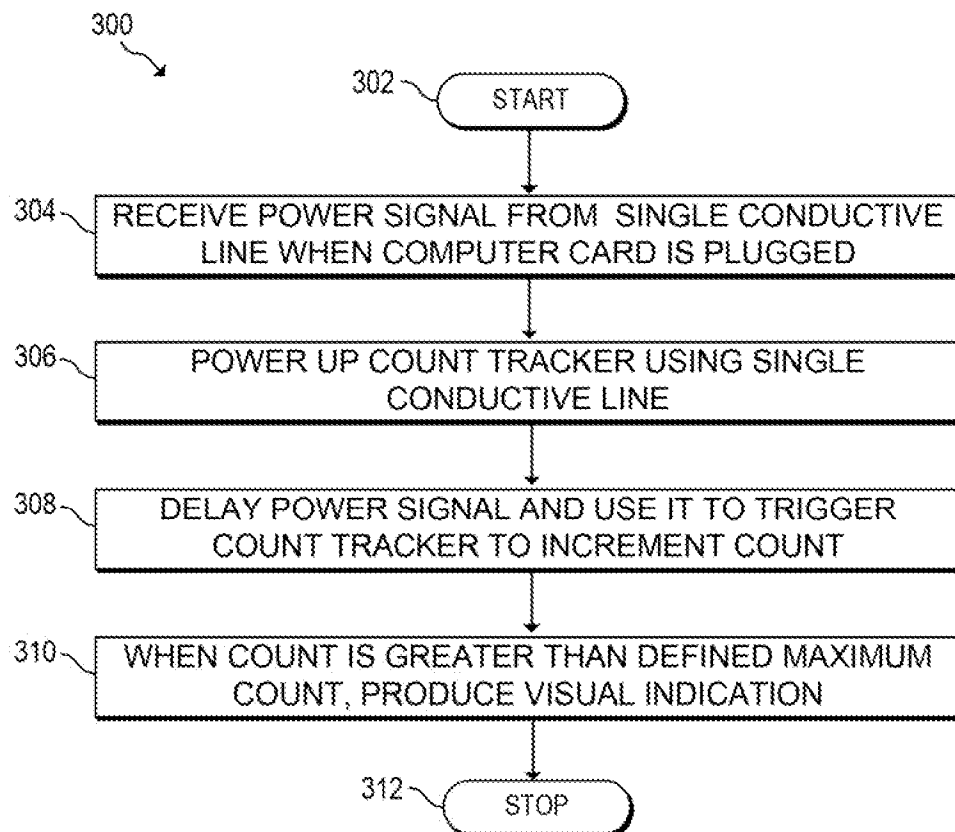
an installation tracker that increments a count when the computer card is electrically connected to the computer board, wherein the installation tracker uses a single conductive line to both power the installation tracker and to initiate increments of the count.

15. The computer card of claim 14, further comprising a golden finger connector to facilitate the computer card being plugged into the computer board.

**FIG. 1**

**FIG. 2**

3/3

**FIG. 3**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/063702**A. CLASSIFICATION OF SUBJECT MATTER****G06F 1/18(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F 1/18; G06F 1/28; G06F 19/00; G07C 3/00; G06F 15/00; E05B 47/00; G06F 17/40; H02H 3/05

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: computer card, computer board, installation tracker, count, plug, power source

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6662119 B1 (CRAIG G. MITCHELL) 09 December 2003 See column 6, line 62 - column 9, line 24; claims 1, 17; and figure 1.	1-15
A	US 2008-0285703 A1 (SLAVEK P. AKSAMIT et al.) 20 November 2008 See paragraphs [0012]-[0029]; and figures 2-3.	1-15
A	US 2003-0140267 A1 (ANTONIO ABBONDANZIO et al.) 24 July 2003 See paragraphs [0023]-[0027]; and figures 4-5.	1-15
A	US 2003-0069711 A1 (GEORGE HENRY AHRENS JR. et al.) 10 April 2003 See paragraphs [0046]-[0047]; and figure 4.	1-15
A	JP 05-069269 U (SHINKO MECHATROTECH CO., LTD.) 21 September 1993 See paragraphs [0010]-[0014]; claim 1; and figures 1-2.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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