An information handling apparatus includes a chassis installed a plurality of electric parts of the information handling apparatus, having a pair of openings on opposite sides for allowing an incoming and outgoing air flow for cooling down an inside of the information handling apparatus, a pair of temperature detectors for detecting temperature at each of the openings, a fan installed in the housing for generating airflow between the openings, the fan being capable of reversibly switching airflow direction, and a controller for performing switching of the airflow direction by the fan so that the fan generates the airflow from one of the openings at which a detected with lower temperature is detected as compared with the other of the openings.
**FIG. 3**

1. **START**
2. **NO**
   - **S101** POWERED ON?
   - **YES**
     - **S102** ACQUIRE AMBIENT ENVIRONMENTAL INFORMATION
     - **S103** DETERMINE THE DIRECTION OF AIR FLOW
     - **S104** START FANS
     - **NO**
     - **S105** POWERED OFF?
     - **YES**
       - **S106** STOP FANS
       - **END**
FIG. 4

INFORMATION PROCESSING APPARATUS

DIRECTION OF AIRFLOW (1) (FORWARD)

DIRECTION OF AIRFLOW (2) (REVERSE)

ELECTRONIC PARTS

21
FIG. 9

FLOOR 34

FLOOR-MOUNTED AIR CONDITIONING SYSTEM 1

FLOOR-MOUNTED AIR CONDITIONING SYSTEM 2
FIG. 13

EXHAUST PARTITION 44
HINGE 45

AUTOMATICALLY

FIG. 14

GAS-LIQUID HEAT EXCHANGE SYSTEM 50

IT-APPARATUS RACK ROW 30
INFORMATION HANDLING APPARATUS, CONTROL APPARATUS, AND INSTALLATION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2009-123480, filed on 21 May, 2009, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The embodiments discussed herein are related to an information handling apparatus, a fan control apparatus, and installation an installation.

BACKGROUND

[0003] Hitherto, in a space called a data center or machine room as illustrated in FIG. 15, there are information communication apparatuses such as servers, storage systems and network equipment and an information-communication-apparatus housing rack in which such apparatuses are stacked. FIG. 15 is a diagram illustrating a data center. Hereinafter, an information communication apparatus is referred to as an IT (information technology) apparatus 20, and an information-communication-apparatus housing rack 30 may be called a rack.

[0004] Since IT apparatuses 20 include many electronic parts such as a central processing unit (CPU), the IT apparatuses 20 generate (or dissipate) heat while consuming power. When some IT apparatuses 20 run at a high temperature, it may be difficult to perform normal operations. Accordingly, an IT apparatus 20 has an air flow generation part such as a fan 22, as illustrated in FIG. 16 and is forcibly cooled. Thus, the apparatus can be kept at a constant temperature, and reliability and operability can be secured. Generally, an IT apparatus having an air inlet on the front face is used. Through the air inlet, air at a predetermined temperature is taken in by a fan 22. FIG. 16 is a diagram for explaining an air-cooling function of an IT apparatus.

[0005] However, in such a space, since many IT apparatuses 20 and racks are arranged, the temperature of the entire space increases. As a result, the IT apparatuses 20 take in air at a high temperature with a fan 22 and it is difficult to cool the apparatuses. In order to solve the problem, an air-conditioning system is generally used which emits the air at a high temperature within the space to the outside and supplies air at a low temperature into the space to lower the temperature within the space.

[0006] The use of the air-conditioning system causes air circulation within the space. Thus, the IT apparatuses 20 take in the air at a lower temperature to cool the internal electronic parts and exhaust the air at a high temperature after the use for cooling. Then, the air-conditioning system quickly takes in the air at a high temperature exhausted from the IT apparatuses 20, releases the air to the outside and supplies air at a low temperature into the space. Thus, since the IT apparatuses 20 can typically take in the air at a lower temperature and cool the electronic parts included in the IT apparatuses 20, the reliability of the IT apparatuses 20 themselves can improve.

[0007] The air-conditioning system may be, for example, of an air-conditioning type having an indoor unit and an outdoor unit or a water-cooling type using water cooled by an external turbo refrigerator, for example, to cool air at a high temperature taken into the space. Any type of air-conditioning system has electronic devices in the indoor unit for cooling the air by heat exchange, such as a blower, a compressor that circulates water for cooling air and a blower that releases heat to the outside. In other words, the air-conditioning system uses power to operate the electronic devices such as the blowers and compressor for air circulation. Such an air-conditioning system is disclosed in Japanese Laid-open Patent Publications No. 5-26839 and 2007-300037.

[0008] However, since information communication apparatuses have come to perform advanced processing and/or complicated processing, information communication apparatuses generate more heat and/or have higher heat generation densities. As a result, even the use of the air-conditioning system according to the technology in the past may not cool such information communication apparatuses efficiently. Since the increases in heating value and/or heat generation densities of information communication apparatuses may increase the working amount of the air-conditioning system, the power consumption by the air-conditioning system may increase, which is not environmentally friendly.

SUMMARY

[0009] According to an aspect of the invention, an information handling apparatus includes a chassis installed a plurality of electric parts of the information handling apparatus, having a pair of openings on opposite sides for allowing an incoming and outgoing air flow for cooling down an inside of the information handling apparatus, a pair of temperature detectors for detecting temperature at each of the openings, a fan installed in the housing for generating airflow between the openings, the fan being capable of reversibly switching airflow direction, and a controller for performing switching of the air flow direction by the fan so that the fan generates the airflow from one of the openings at which a detected with lower temperature is detected as compared with the other of the openings.

[0010] The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0011] FIG. 1 is a diagram for explaining an information processing apparatus according to a first embodiment.

[0012] FIG. 2 is a diagram for explaining an information processing apparatus according to a second embodiment.

[0013] FIG. 3 is a flowchart illustrating a processing flow by the information processing apparatus according to the second embodiment.

[0014] FIG. 4 illustrates an information processing apparatus in which electronic parts having a symmetrical form about an air flow path are arranged.

[0015] FIG. 5 illustrates an information processing apparatus having electronic parts arranged symmetrically about an air flow path.

[0016] FIG. 6 illustrates a configuration of a rack having an air-conditioning control function.

[0017] FIGS. 7A and 7B are diagrams for explaining a case where a rack is to be relocated.
FIGS. 8A and 8B illustrate an example of the case using an under floor-outlet air-conditioning system.

FIG. 9 illustrates an example of the case using a 1:1 redundant air-conditioning system.

FIG. 10 illustrates an example of air-conditioning control on the entire space where information processing apparatuses and a rack there for is placed.

FIG. 11 illustrates another example of air-conditioning control on the entire space where information processing apparatuses and a rack there for is placed.

FIG. 12 illustrates another example of air-conditioning control on the entire space where information processing apparatuses and a rack there for is placed.

FIG. 13 is a diagram for explaining a configuration of an exhaust partition 44.

FIG. 14 illustrates a rack having a gas-liquid heat exchange system.

FIG. 15 illustrates a data center.

FIG. 16 is a diagram for explaining an air-cooling function of an IT apparatus.

DESCRIPTION OF EMBODIMENTS

There will be described in detail embodiments of the information processing apparatus, information-processing-apparatus housing rack and space control system disclosed by the present application with reference to drawings, below.

First Embodiment

The information processing apparatus disclosed by the present application is an IT apparatus such as a server and a computer that executes programs to perform the corresponding processing. Particularly, the information processing apparatus is environmentally friendly and can cool the internal electronic parts efficiently with a minimum amount of energy.

According to the first embodiment, there will be described a configuration of the information processing apparatus disclosed by the present application. FIG. 1 is a diagram for explaining an information processing apparatus according to the first embodiment.

As illustrated in FIG. 1, an information processing apparatus 10 includes electronic parts 11, air flow generation portions 12a and 12b, environmental-information acquiring portions 13a and 13b, and a direction-of-air-flow changing portion 14. The electronic parts 11 include a motherboard, a CPU, a memory, a ROM (read only memory) and, an LSI (large scale integration) that perform the corresponding processing.

The air flow generation portions 12a and 12b are connected to the direction-of-air-flow changing portion 14 and generate the air flow for cooling the electronic parts 11. More specifically, the air flow generation portions 12a and 12b take in air from the outside of the information processing apparatus 10, cause the air to pass through the inside of the information processing apparatus 10 and then exhaust the air to the outside.

The environmental-information acquiring portions 13a and 13b are connected to the direction-of-air-flow changing portion 14 and acquire ambient environmental information on the information processing apparatus 10. More specifically, the environmental-information acquiring portion 13a and 13b acquire environmental information such as temperature and humidity on the side (A) and side (B), respectively, in FIG. 1 and output the environmental information to the direction-of-air-flow changing portion 14.

On the basis of the environmental information acquired by the environmental-information acquiring portions 13a and 13b, the direction-of-air-flow changing portion 14 changes the operating conditions of the air flow generation portion 12a or 12b to change the direction of air flow. For example, if the temperature acquired by the environmental-information acquiring portion 13a is lower than the temperature acquired by the environmental-information acquiring portion 13b, the direction-of-air-flow changing portion 14 controls the air flow generation portion 12a and/or 12b so that the air can flow from the lower-temperature side to the higher-temperature side. In other words, if the temperature in the side (A) in FIG. 1 is lower than the side (B), the direction-of-air-flow changing portion 14 controls the air flow generation portion 12a and 12b so as to form the air flow path (1) in FIG. 1 on which air flows from the side (A) to the side (B).

For example, if the temperature acquired by the environmental-information acquiring portion 13b is lower than the temperature acquired by the environmental-information acquiring portion 13a, the direction-of-air-flow changing portion 14 controls the air flow generation portion 12a and 12b so that air can flow from the lower-temperature side to the higher-temperature side. In other words, if the temperature in the side (B) in FIG. 1 is lower than the side (A), the direction-of-air-flow changing portion 14 controls the air flow generation portion 12a and/or 12b so as to form the air flow path (2) in FIG. 1 on which air flows from the side (B) to the side (A).

In this way, the information processing apparatus 10 according to the first embodiment can automatically change the direction of suction/exhaust of the air for cooling the electronic parts 11 on the basis of the ambient environment of the information processing apparatus 10. As a result, the information processing apparatus 10 can be environmentally friendly and can cool internal electronic parts efficiently with a minimum amount of energy.

Second Embodiment

The information processing apparatus disclosed by the present application may have various function portions excluding the function portions according to the first embodiment. According to a second embodiment, there will be described an information processing apparatus having various function portions.

[Configuration of Information Processing Apparatus]

First of all, with reference to FIG. 2, there will be described an information processing apparatus according to the second embodiment. FIG. 2 is a diagram for explaining an information processing apparatus according to the second embodiment.

As illustrated in FIG. 2, an information processing apparatus 20 includes electronic parts 21, fans 22, a vent 23, a front sensor 24, a rear sensor 25, an environmental-information acquiring portion 26, and a direction-of-air-flow changing portion 27. These processing portions here are given for illustration purpose only, and the information processing apparatus may include other processing portions.

The electronic parts 21 perform the corresponding processing and may include a substrate 21a, an HDD 21c and an input/output portion 21f. The electronic parts represented...
by the electronic parts 21 are given for illustration purpose only, and the electronic parts 21 may include other various parts.

[0041] The substrate 21a may be an electronic circuit substrate (such as a motherboard) for configuring the electronic parts that implement the processing by the information processing apparatus 10 and may include a CPU 21b, a memory 21c, and an expansion slot 21d, for example.

[0042] The CPU 21b is a central processing unit that performs various numerical-value calculations, information processing and apparatus control based on programs. The memory 21c is a main storage device that stores data and programs directly accessible by the CPU 21b. The expansion slot 21d may be a slot for an expansion card for adding a function to the information processing apparatus 20 or a PC card such as a LAN (local area network) card and a flash memory card.

[0043] The HDD 21e is a hard disk drive (or storage device) that stores data to a magnetic disk and reads data from a magnetic disk. The input/output portion 21f is an input/output device driver that controls a display, a printer and a communication interface, for example, to provide interfaces to applications or the like.

[0044] The fans 22 are connected to the direction-of-airflow changing portion 27 and generate the air flow for cooling the electronic parts 21. More specifically, the fans 22 are blowers provided on the front face of the information processing apparatus 20. If the fans 22 receive an instruction to rotate from the direction-of-airflow changing portion 27, the fans 22 rotate in the direction instructed by the direction-of-airflow changing portion 27, take in the air from the outside and generate an air flow.

[0045] For example, if the fans 22 are instructed to rotate in the clockwise direction from the direction-of-airflow changing portion 27, the fans 22 rotate in the instructed clockwise direction and generate the air flow path (1) on which air is taken in from the front of the information processing apparatus 20 and is exhausted to the rear. If the fans 22 are instructed to rotate in the counterclockwise direction from the direction-of-airflow changing portion 27, the fans 22 rotate in the instructed counterclockwise direction and generate the air flow path (2) on which air is taken in from the rear of the information processing apparatus 20 and is exhausted to the front. The correspondence relationship between the direction of rotation and the direction of the air flow path are given for illustration purpose only and is not limited to the aforementioned relationship.

[0046] The vent 23 exhausts the air taken in from the front of the information processing apparatus 20 to the rear through the fans 22 and takes in the air from the rear of the information processing apparatus 20 to the inside of the information processing apparatus 20 through the fans 22.

[0047] The front sensor 24 is defined on the front face of the information processing apparatus 20 and acquires environmental information such as temperature and humidity of the front of the information processing apparatus 20 and outputs the information to the environmental-information acquiring portion 26. The rear sensor 25 is defined on the rear face of the information processing apparatus 20 and acquires environmental information such as temperature and humidity of the rear of the information processing apparatus 20 and outputs the information to the environmental-information acquiring portion 26.

[0048] The timing for detecting temperature or humidity by the front sensor 24 or rear sensor 25 may be defined arbitrarily such as detection upon notification to the environmental-information acquiring portion 26 of the occurrence of change in temperature or humidity that is measured at all times and detection at predetermined time intervals (such as every 30 minutes). Illustrating the example in which the sensors are provided at the two positions of the rear and front of the information processing apparatus 20, the positions are not limited thereto. The sensors may be provided on sides or at the four corners. The positions and number of the sensors may be defined arbitrarily.

[0049] The environmental-information acquiring portion 26 is connected to the direction-of-airflow changing portion 27 and acquires ambient environmental information of the information processing apparatus 20. More specifically, the environmental-information acquiring portion 26 acquires temperature or humidity of the front of the information processing apparatus 20 from the front sensor 24 and acquires temperature or humidity of the rear of the information processing apparatus 20 from the rear sensor 25 and outputs the acquired environmental information to the direction-of-airflow changing portion 27.

[0050] On the basis of the environmental information acquired by the environmental-information acquiring portion 26, the direction-of-airflow changing portion 27 changes the operating condition of the fans 22 to change the direction of air flow. More specifically, on the basis of the environmental information acquired by the environmental-information acquiring portion 26, the direction-of-airflow changing portion 27 changes the direction of rotations by the fans 22 to change the direction of air flow so that air can flow from the front to the rear or from the rear to the front of the information processing apparatus 20.

[0051] For example, on the basis of the temperature or humidity acquired by the environmental-information acquiring portion 26, the direction-of-airflow changing portion 27 may determine that the front of the information processing apparatus 20 has a higher temperature or humidity than the rear. In this case, the direction-of-airflow changing portion 27 instructs the fans 22 to rotate clockwise and generates the airflow path (1) on which air is take in from the front of the information processing apparatus 20 and is exhausted to the rear. On the basis of the temperature or humidity acquired by the environmental-information acquiring portion 26, the direction-of-airflow changing portion 27 may determine that the rear of the information processing apparatus 20 has a higher temperature or humidity than the front. In this case, the direction-of-airflow changing portion 27 instructs the fans 22 to rotate counterclockwise and generates the airflow path (2) on which air is taken in from the rear of the information processing apparatus 20 and is exhausted to the front.

[0052] [Processing Flow by Information Processing Apparatus]

[0053] Next, with reference to FIG. 3, there will be described a processing flow by the information processing apparatus. FIG. 3 is a flowchart illustrating a processing flow by the information processing apparatus according to the second embodiment.

[0054] As illustrated in FIG. 3, if the power is turned on (Yes in step S101), the environmental-information acquiring portion 26 of the information processing apparatus 20
acquires ambient environmental information on the information processing apparatus 20 through the front sensor 24 and rear sensor 25 (step S102).

[0055] Then, on the basis of the environmental information acquired by the environmental-information acquiring portion 26, the direction-of-air-flow changing portion 27 of the information processing apparatus 20 determines the direction of the air flow to be taken into the information processing apparatus 20 (step S103). The direction-of-air-flow changing portion 27 then controls the fans 22 so as to generate the determined air flow (step S104).

[0056] After that, until the power is turned off by a user, for example, (No in step S105), the information processing apparatus 20 repeats the processing in step S102 to step S104. If the power is turned off by a user, for example, (Yes in step S105), the information processing apparatus 20 stops the fans 22 (step S106).

Second Embodiment

[0057] In this way, according to the second embodiment, the air flow path for cooling the electronic parts 21 can be automatically changed on the basis of the ambient environment of the information processing apparatus 20. As a result, the internal electronic parts can be efficiently cooled environmentally friendly and with a minimum amount of energy. As described above, even in the information processing apparatus 20 having many electronic parts, the internal electronic parts can be efficiently cooled environmentally friendly and with a minimum amount of energy.

Third Embodiment

[0058] In the information processing apparatus disclosed by the present application, since the internal electronic parts are cooled by the air, the arrangement of the electronic parts in consideration of the air flow path allows efficient cooling with less energy. According to a third embodiment, there will be described an example of the efficient arrangement of the internal electronic parts within the information processing apparatus.

[0059] [Forms of Electronic Parts]

[0060] First of all, with reference to FIG. 4, there will be described the examples of the forms of the electronic parts within the information processing apparatus. FIG. 4 illustrates an information processing apparatus in which electronic parts having symmetrical forms about the air flow path are arranged.

[0061] As illustrated in FIG. 4, the forms of the electronic parts 21 within the information processing apparatus 21 are preferably schematically symmetrical about the air flow path (or the direction of air flow). Thus, even when the direction of air flow is changed by 180 degrees (for example, direction is changed from (1) to (2)), the electronic parts 21 can be efficiently cooled independently of the direction of air flow since the resistances that the air flow receives from the electronic parts are schematically equal.

[0062] [Arrangement of Electronic Parts]

[0063] Next, with reference to FIG. 5, there will be described an example of the arrangement of the electronic parts within the information processing apparatus. FIG. 5 illustrates an information processing apparatus having electronic parts arranged symmetrically about the air flow path.

[0064] When a plurality of electronic parts perform the same processing, the electronic parts are preferably arranged symmetrically about the air flow path (the direction of air flow), as illustrated in FIG. 5. For example, many information processing apparatuses with high precision having high-speed processing performance have a plurality of CPUs and memories. In this case, the symmetrical arrangement of the electronic parts about the air flow path allows schematically equal resistances that the air flow receives from the electronic parts even when the direction of the air flow is changed by 180 degrees. As a result, independently of the direction of the air flow, the electronic parts can be efficiently cooled.

Fourth Embodiment

[0065] According to the first to third embodiments, there have been described the examples of the information processing apparatus that control the direction of air flow. However, a rack that stores a plurality of information processing apparatuses may have a control portion that controls the direction of air flow as described above.

[0066] According to a fourth embodiment, there will be described a rack having an air-conditioning control function with reference to FIG. 6. FIG. 6 illustrates a configuration of a rack having an air-conditioning control function.

[0067] As illustrated in FIG. 6, the rack according to the fourth embodiment internally has a control portion, a plurality of information processing apparatuses, (a total of four) sensors at upper and lower positions on the front and rear surfaces, and three fans 22 on the front faces. The positions and numbers of the apparatuses, fans 22 and sensors here are given for illustration purpose and are not limited thereto.

[0068] Each of the information processing apparatuses held by the rack is the apparatus having the functions according to one of the first to third embodiments. Each of the sensors may be a thermometer or hygrometer that acquires environmental information such as temperature and humidity as in the second embodiment. Each of the fans 22 is a blower that rotates to generate an air flow.

[0069] The control portion is a computer having similar functions to those of the environmental-information acquiring portion 26 and direction-of-air-flow changing portion 27 according to the second embodiment. That is, the control portion acquires ambient environmental information on the rack through the sensors, and, on the basis of the acquired environmental information, changes the operating condition of the fans 22 to change the direction of the air flow.

[0070] For example, if the front of the rack has a higher temperature or humidity than the rear, the control portion instructs the fans 22 to rotate clockwise and generates the air flow path on which air is taken in from the front of the rack and is exhausted to the rear. If the rear of the rack has a higher temperature or humidity than the front, the control portion instructs the fans 22 to rotate counterclockwise and generates the air flow path on which air is taken in from the rear of the information processing apparatus 20 and is exhausted to the front.

[0071] In this way, according to the fourth embodiment, the air flow for cooling the information processing apparatuses and the electronic parts within the information processing apparatuses can be efficiently taken into the rack. As a result, in the information processing apparatuses stored in the rack, the internal electronic parts can be efficiently cooled. Storing information processing apparatuses in the past that are not the information processing apparatus disclosed by the present application in the rack according to the fourth embodiment can provide the same effects as that of one of the first to third
embodiment. In other words, even in an information processing apparatus in the past, the internal electronic parts can be efficiently cooled.

[0072] An apparatus generating a large amount of heat or an air flow of exhaust heat in the vicinity may cause an increase in intake temperature heat and becomes a disadvantage in design. However, according to the embodiment, an advantageous direction of air flow can be found by the information processing apparatus or the rack on the basis of the ambient environment, and the internal electronic parts can be forcibly cooled in the direction of air flow. As a result, the temperature of the semiconductor devices (or electronic parts) therein such as a CPU can be lowered, and energy-saving and high reliability can be attained.

Fifth Embodiment

[0073] Next, there will be described cases 30 where the information processing apparatuses 20A to 20N according to one of the first to fourth embodiments are effectively provided in a space such as a machine room having an air-conditioning system in the past for air circulation.

[0074] [Case Where Air-conditioning System is to be Relocated]

[0075] First of all, with reference to FIG. 7, there will be described a case where air-conditioning systems 40A and 40B defined in rear of a rack is to be relocated to the front of the rack. FIGS. 7A and 7B are a diagram for explaining a case where a rack 30 is to be relocated. The arrows in FIG. 7A indicate the flows of air.

[0076] In FIG. 7A, the information communication apparatuses and rack receive the supply of air from the rear side of the apparatuses and rack 30 from the floor-mounted air-conditioning system 40A and take in cool air from the rear side 30B and exhaust the air warmed as a result of the cooling of the electronic parts to the front. There will be described a case where, under the condition, the air-conditioning system is to be relocated to the front of the rack as illustrated in FIG. 7B.

[0077] In general, relocating an air-conditioning system may require changing the direction of the rack 30 and information communication apparatuses stored in the rack. In that case, as the size of the rack increases and as the complexity of the configurations of the information communication apparatuses increases, the numbers of power supply cables and signal cables and the complexity of the connection forms increase. For that, it is not easy to change the directions, and high construction cost may be involved in only changing the directions.

[0078] On the other hand, when the information processing apparatuses according to one of the first to third embodiments and/or the rack 30 according to the fourth embodiment are applied as the information processing apparatuses and rack 30 illustrated in FIGS. 7A and 7B, relocating the air-conditioning systems 40A and 40B may only require controlling the fans 22 so as to take in air from the direction of air supply. In other words, as described above, the necessity is eliminated for changing the direction of the apparatuses in consideration of the power supply cables and signal cables for the relocation of the air-conditioning system, and no construction cost is involved. In this way, even when the necessity for relocating the air-conditioning system rises in the future, the air at a low temperature can be taken in to efficiently cool the internal electronic parts, with no costs.

[0079] [Case Using Under-floor-Outlet Air-conditioning System]

[0080] Next, with reference to FIGS. 8A and 8B, there will be described a case using an under-floor-outlet air-conditioning system. FIGS. 8A and 8B illustrate an example of the case using an under-floor 34-outlet air-conditioning system 40A.

[0081] Since an under-floor-outlet air-conditioning system 40A emits cool air to under floor 34, a rack 30 or information communication apparatuses may require sucking up the emitted cool air from under floor 34 and supplying the air to the inside of the rack 30 or apparatuses to cool the internal electronic parts.

[0082] Normally, the amount of air emitted from under floor by an under-floor-outlet air-conditioning system 40A is manually measured, the floor at position where the air can be sucked up is torn up and the fans 22 of the rack 30 and information communication apparatus is adjust to suck up the air from there. In other words, the information on the performance of the under-floor-outlet-air-conditioning system and the floor and space where the rack is placed is determined totally, which takes time and costs.

[0083] On the other hand, when the information processing apparatuses according to one of the first to third embodiments and/or the rack according to the fourth embodiment are used in an environment using an under floor-outlet air-conditioning system, a sensor is used to detect the part releasing cool air of the floor. Then, the information processing apparatuses and/or rack 30 may be required to control the fans 22 so as to suck the cool air from the detected part. For example, if the information processing apparatuses and/or rack detect that cool air is emitted from between the air-conditioning system and the rack, as illustrated FIG. 8A, the information processing apparatuses and/or rack may be required to control the fans 22 so as to suck the air from the detected part. If the information processing apparatus or rack detects that cool air is emitted from the opposite side of the air-conditioning system, as illustrated in FIG. 8B, the information processing apparatuses and/or rack may be required to control the fans 22 so as to suck the air from the detected part. In this way, air at a low temperature can be easily taken in, and the internal electronic parts can thus be efficiently cooled, without requiring totally determining the information on the performance of the under-floor-outlet air-conditioning system and the floor and space where the rack is placed.

[0084] [Case Using 1:1 Redundant Systems]

[0085] Next, with reference to FIG. 9, there will be described a case using 1:1 redundant air-conditioning systems 1 and 2. FIG. 9 illustrates an example of the case using 1:1 redundant air-conditioning systems.

[0086] For a very important information processing apparatuses or a rack 30 storing a very important system, redundant floor-mounted air-conditioning systems 1 and 2 are often provided in front and rear of the rack, as illustrated in FIG. 9, to improve reliability. Generally, in many cases, two air-conditioning systems 1 and 2 are alternately operated, and, with the switching of the operations by the air-conditioning systems, the directions of the air-conditioning systems may be changed toward the rack or information communication apparatuses.

[0087] Normally, the operation is performed for changing the air-conditioning systems 1 and 2 directed toward the rack 30 or information communication apparatus by watching the power supply cables and signal cables and without destroying the complicated connection forms. For that, it is not easy to
change the directions of the air-conditioning system, and, moreover, only changing the directions takes a large amount of time and money.

[0088] On the other hand, when the information processing apparatus and the rack according to the fourth embodiment are used as the information processing apparatus and rack illustrated in FIGS. 7A and 7B, detecting the running air-conditioning system and controlling the fans 22 so as to take in air from the detected direction may be required. In other words, since the directions of the air-conditioning systems are not required to change in consideration of the power supply cables and signal cables with the switching of the air-conditioning systems as described above, the cost and time are not required there for. In this way, even when 1:1 redundant air-conditioning systems are used, air at a low temperature can be taken in reasonably and easily to cool the internal electronic parts.

Sixth Embodiment

[0089] Having described the examples according to the first to fifth embodiments in which air-conditioning control is performed on information processing apparatuses and a rack, the embodiment allows efficient air-conditioning control over the entire space where the information processing apparatuses and rack there for are placed.

[0090] According to a sixth embodiment, with reference to FIGS. 10 to 12, there will be described an example in which efficient air-conditioning control is performed over the entire space where information processing apparatuses and a rack there for are placed. FIGS. 10 to 12 illustrate examples of air-conditioning control over the entire space where information processing apparatuses and a rack there for are placed.

[0091] According to the sixth embodiment, an indoor control device 44 is connected to indoor ceiling panels, under floor panels, an air-conditioning system that supplies air from under floor and eight racks via signal lines such as buses so as to allow opening/closing of the panels, control over the air-conditioning systems 43A and 43B, acquisition of the amounts of electric power consumption of the racks 30 and control over the operations of the fans 22 of the racks 30 or information processing apparatuses.

[0092] According to the sixth embodiment, an example will further be described in which the temperature increases by 1°C for a total amount of electrical power consumption of 1 kW of each of the racks, and the air-conditioning systems 43A and 43B supply air at 20°C. to the inside of the room to implement air-conditioning control for keeping the inside of the room at 35°C or lower.

[0093] For example, the total amount of electrical power consumption of each of the eight racks is 3 kW, the temperature of the air having passed through one rack increases by 3°C. The air-conditioning systems 43A and 43B take in the emitted air at 20°C before it reaches 35°C. (which is a temperature limit). In order to efficiently cool the information processing apparatuses, the air-conditioning systems 43A and 43B may take in the air having passed through four racks 30 (20°C + 3°C × 4 = 32°C, 35°C).

[0094] More specifically, as illustrated in FIG. 10, the indoor control device 44 opens the under floor panels at the middle of space having the eight racks 30 and opens the ceiling panels 40 at both ends of the room. Thus, the indoor control device 44 can form an air flow path on which air is taken in from under floor 34, is split and flows into the right and left. As a result, the indoor control device 44 can recover the air used for cooling the information processing apparatuses (or electronic parts), that is, the air emitted from the air-conditioning system at 20°C and heated to 32°C by passing through the four racks, without exceeding 35°C. Thus, since the air emitted once can be used for cooling by causing the air to pass through more racks, efficient air-conditioning control can be implemented.

[0095] Next, there will be described a case where each of the eight racks 30 has a total amount of electrical power consumption of 5 kW. In this case, since the air emitted at 20°C from the air-conditioning systems 44A and 44B reaches the temperature limit 35°C by passing through three racks, the air may be caused to pass through up to two racks.

[0096] More specifically, as illustrated in FIG. 11, the indoor control device 44 alternately opens the under floor panels 42A and the ceiling panels by leaving two racks between them. Thus, the indoor control device 44 can form the air flow path on which air is taken into the room from under floor 34, is caused to pass through two racks 30 and is then recovered. As a result, since the air emitted once can be used for cooling by causing the air to pass through more racks 30, efficient air-conditioning control can be implemented.

[0097] Next, there will be a case where each of the eight racks has a total amount of electrical power consumption of 10 kW. In this case, since the air emitted at 20°C from the air-conditioning system reaches the temperature limit 35°C or higher, for example, 40°C, by passing through two racks, the air may be caused to pass through up to one rack.

[0098] More specifically, as illustrated in FIG. 12, the indoor control device 44 alternately opens the under floor panels 42 and the ceiling panels 40 by leaving one rack between them. Thus, the indoor control device 44 can form the air flow path on which air is taken into the room from under floor 37, is caused to pass through one rack and is then recovered. As a result, since the air emitted once can be used for cooling by causing the air to pass through more racks, efficient air-conditioning control can be implemented.

[0099] Having described according to the sixth embodiment the examples in which each of the racks has an equal total amount of electrical power consumption, it is given for illustration purpose only. The racks generally have different total amounts of electrical power consumption. Also in such a case, as described above, the number of racks that the air emitted from the air-conditioning system can pass through under the indoor temperature limit may be determined. Then, the under floor panels and ceiling panels may be opened so as to form an air flow path allowing recovery of the air passed through the determined number of racks.

[0100] A secure air flow path can be formed by controlling exhaust partitions 44 as illustrated in FIG. 13 in opening the ceiling panels for easy exhaust of the air through the opened ceiling panels 40. As illustrated in FIG. 14, a gas-liquid heat exchange system that implements a heat exchange function may be attached to both faces (inlet side and outlet side) of each of the racks 30. Thus, air can be cooled once before exhausted from the outlet side. As a result, compared with the aforementioned example, since the air emitted once can be used for cooling by causing the air to pass through more racks, efficient air-conditioning control can be implemented. FIG. 13 is a diagram for explaining a configuration of each of...
the exhaust partition 44s, and FIG. 14 illustrates a rack having the gas-liquid heat exchange system.

Seventh Embodiment

[0101] Having described the embodiments up to this point, the embodiment may be implemented in various different forms, in addition to the aforementioned embodiments. Now, there will be described different embodiments regarding the air flow generation portion, environmental information, system configuration and others and programs below.

[0102] [Air Flow Generation Portion]

[0103] Having described according to the first to sixth embodiments that fans 22 are used as the air flow generation portion, the embodiment is not limited thereto. For example, any device such as a blower can be usable if the device can suck and exhaust air.

[0104] For example, identical fans 22 may be attached to both ends (or the outlet side and inlet side) of an air flow, and either one of the fans 22 may be operated on the basis of environmental information. Thus, the direction of air flow can be controlled.

[0105] Having described according to the first to sixth embodiments that the direction of rotation of the fans 22 are automatically controlled, the number of rotations may be controlled and may furthermore be controlled manually, for example. On the basis of environmental information, the direction of the attached fans 22 (which are the air flow generation portion) may be rotated by 180 degrees.

[0106] [Environmental Information]

[0107] Having described according to the first to sixth embodiments that the environmental information is an ambient temperature or humidity of the apparatus, the embodiment is not limited thereto. Various kinds of information may be used as the environmental information for controlling the air flow generation portion. For example, the temperature or humidity within each of the apparatuses may be detected for the same processing.

[0108] For example, the environmental information may be information on the amount of air such as the wind direction and the volume of air or layout information on the space where the information processing apparatuses and/or racks are placed. The information processing apparatuses and/or rack can perform analysis processing on the layout information input by a user by using a general architectural program to calculate the direction of wind and the volume of air within the space. The information processing apparatuses and/or rack may control on the basis of the acquired the direction of wind and volume of air so as to form an air flow path on which the air immediately after taken in from the outside is captured to the apparatus or rack.

[0109] [System Configuration and Others]

[0110] In the processing described according to the aforementioned embodiments, all or a part of the processing that has been described to perform automatically may be performed manually. Conversely, all or a part of the processing that has been described to perform manually may be performed automatically. The processing routines, control routines, specific names, information including data and parameters described herein or in the attached drawings may be changed arbitrarily unless otherwise indicated.

[0111] The illustrated parts of the apparatuses are functional and conceptual and may not typically be required to be physically configured in the illustrated manners. In other words, the specific forms of the distribution/integration of the devices (such as the integration of the environmental-information acquiring portion and the direction-of-air-flow changing portion) are not limited to the illustrated one, all or part of them may be functionally or physically distributed or integrated in arbitrary units in accordance with the loads and usages. All or an arbitrary part of the processing functions implemented by the devices may be implemented by a CPU and a program to be analyzed and executed by the CPU or by a hard wired logic.

[0112] [Programs]

[0113] The air-conditioning control method according to the embodiments may be implemented by causing a computer such as a personal computer and a workstation to execute a prepared program. The program may be distributed over a network such as the Internet. The program may be recorded in a computer-readable recording medium such as a hard disk, a flexible disk (FD), a CD-ROM, an MO and a DVD and may be read from the recording medium.

All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiments of the present invention have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. An information handling apparatus comprising:
   a chassis installed a plurality of electric parts of the information handling apparatus, having a pair of openings on opposite sides for allowing an incoming and outgoing air flow for cooling down an inside of the information handling apparatus;
   a pair of temperature detectors for detecting temperature at each of the openings;
   a fan installed in the housing for generating airflow between the openings, the fan being capable of reversibly switching airflow direction; and
   a controller for performing switching of the airflow direction by the fan so that the fan generates the airflow from one of the openings at which a detected with lower temperature is detected as compared with the other of the openings.

2. A control apparatus for controlling a fan installed in a housing for generating airflow between the openings, the fan being capable of reversibly switching airflow direction, the housing accommodating a plurality of information handling apparatus and having a pair of openings on opposite sides for allowing an incoming and outgoing air flow for cooling down the information handling apparatus, the fan control apparatus comprising:
   a pair of temperature detectors for detecting temperature at each of the openings;
   a controller for performing switching of the airflow direction by the fan so that the fan generates the airflow from one of the openings at which a detected with lower temperature is detected as compared with the other of the openings.
3. The control apparatus according to claim 2, wherein the a housing is installed in an installation which includes an air-conditioner.

4. The control apparatus according to claim 3 wherein: the installation has a plurality of the housings which are arranged in the plurality of rows, and the air-conditioner has a plurality of vents and air inlets which are arranged between the rows, the plurality of the vents and the air inlets having respectively flaps which are openable and closable.

5. An installation comprising:
   a plurality of information handling apparatuses including respectively:
   a chassis installed a plurality of electric parts of the information handling apparatus, having a pair of openings on opposite sides for allowing an incoming and outgoing air flow for cooling down an inside of the information handling apparatus,
   a pair of temperature detectors for detecting temperature at each of the openings,
   a fan installed in the housing for generating airflow between the openings, the fan being capable of reversibly switching airflow direction, and a controller for performing switching of the airflow direction by the fan so that the fan generates the airflow from one of the openings at which a detected with lower temperature is detected as compared with the other of the openings; and
   an air conditioning apparatus for air conditioning within the installation.

6. The installation according to claim 5, further comprising a plurality of the housings each for accommodating a plurality of information handling apparatus, the plurality of the housings arranged in the plurality of rows: wherein the air conditioners has a plurality of vents and air inlets which are arranged between the rows, the plurality of the vents and the air inlets having respectively flaps which are openable and closable.

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