

AI SMART BABY CLEAN ROOM SYSTEM

FIELD OF THE INVENTION

[0001] The present disclosure relates to air cleaning and smart control, and more particularly to a clean room system which relates to baby health, and provides an AI smart clean room system for achieving the safety and comfort of baby.

BACKGROUND OF THE INVENTION

[0002] With air pollution becomes worse and pollution sources increases in modern urban environments, especially for babies whose immune systems are not yet fully developed, PM2.5 in particular may seriously cause otitis media, increase cancer risk and damage brain function. Thus, a clean air environment is important for baby health. However, the conventional air cleaning system has difficulty in achieving an instant and precise air quality control, and is unable to automatically adjust according to the indoor environment for keeping the indoor air pollution at a level close to zero. Therefore, there is a need of an AI smart clean room system capable of instantly and intelligently monitoring and dynamically adjusting the indoor air quality.

SUMMARY OF THE INVENTION

[0003] An object of the present disclosure is to provide an AI smart clean room system for babies which combines efficient air purification technology with artificial intelligent control to achieve the automatic adjustment of indoor air quality, thereby creating a safe and clean breathing environment for babies.

[0004] In accordance with an aspect of the present disclosure, an AI smart baby clean room system includes a plurality of air monitoring sensors arranged in an indoor field and an outdoor field for detecting an air pollution and outputting an air quality data via Internet of Things (IoT) communication; at least one air pollution purification apparatus disposed in the indoor field and including at least one air monitoring sensor, at least one gas guider, at least one filter element and at least one driving controller disposed therein, wherein the at least one air monitoring sensor is electrically connected to the at least one driving controller and receives a control instruction via Internet of Things (IoT) communication for enabling the at least one gas guider to circulate and purify the air pollution in the indoor field so as to reach a cleanness of cleanroom class with a level of air pollution close to zero; at least one networking cloud computing server comprising a wireless network cloud computing service module, a cloud control service unit, a device management unit, an application program unit and an AI smart calculation platform; and at least one central control computer apparatus receiving the control instruction issued by the at least one networking cloud computing server via Internet of Things (IoT) communication, transmitting the control instruction to the at least one air monitoring sensor of the at least one air pollution purification apparatus for enabling the at least one gas guider; wherein the networking cloud computing server receives the air quality data outputted by the plurality of air monitoring sensors via Internet of Things (IoT) communication, and issues the control instruction, based on an analysis result obtained from analyzing the air quality data by the AI smart calculation platform, for automatically adjusting an operation mode of the at least one air pollution purification apparatus so as to circulate and purify the air pollution in the

indoor field, thereby reaching the cleanness of cleanroom class with the level of air pollution close to zero..

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The above contents of the present disclosure will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

[0006] FIG. 1A is a schematic view illustrating an AI smart baby clean room system according to an embodiment of the present disclosure;

[0007] FIG. 1B is a schematic view illustrating the architecture of an air pollution purification apparatus according to an embodiment of the present disclosure;

[0008] FIG. 2A is a schematic view illustrating the implementation of the AI smart baby clean room system according to an embodiment of the present disclosure;

[0009] FIG. 2B is a schematic view illustrating a gas exchange device of the air pollution purification apparatus according to an embodiment of the present disclosure;

[0010] FIG. 2C is a schematic view illustrating a purifier of the air pollution purification apparatus according to an embodiment of the present disclosure;

[0011] FIG. 2D is a schematic cross-sectional view illustrating the purifier of the air pollution purification apparatus shown in FIG. 2A and FIG. 2C;

[0012] FIG. 2E is a schematic view illustrating a fan filter unit (FFU) of the air pollution purification apparatus according to an embodiment of the present disclosure;

[0013] FIG. 2F is a schematic cross-sectional view illustrating a humidity controller of the air pollution purification apparatus shown in FIG. 2A;

[0014] FIG. 2G is a schematic diagram illustrating a process of comparing a pressure difference of carbon dioxide (CO₂) between indoor field and outdoor field so as to control a positive pressure air intake, wherein the process is performed by the gas exchange device through the networking cloud computing server according to an embodiment of the present disclosure;

[0015] FIG. 2H is a schematic view illustrating the combination of filter elements of the air pollution purification apparatus according to an embodiment of the present disclosure;

[0016] FIG. 3A is a schematic perspective view illustrating an air monitoring sensor according to an embodiment of the present disclosure;

[0017] FIG. 3B is a schematic perspective view illustrating the air monitoring sensor according to the embodiment of the present disclosure from another view angle;

[0018] FIG. 3C is a schematic perspective view illustrating an air monitoring sensor according to another embodiment of the present disclosure;

[0019] FIG. 4A is a schematic perspective view (1) illustrating a gas detection main part according to the embodiment of the present disclosure;

[0020] FIG. 4B is a schematic perspective view (2) illustrating the gas detection main part according to the embodiment of the present disclosure;

[0021] FIG. 4C is an exploded view illustrating the gas detection main part according to the embodiment of the present disclosure;

[0022] FIG. 5A is a schematic perspective view (1) illustrating a base according to the embodiment of the present disclosure;

[0023] FIG. 5B is a schematic perspective view (2) illustrating the base according to the embodiment of the present disclosure;

[0024] FIG. 6 is a schematic view (3) illustrating the base according to the embodiment of the present disclosure;

[0025] FIG. 7A is a schematic exploded view illustrating a piezoelectric actuator and the base according to the embodiment of the present disclosure;

[0026] FIG. 7B is a schematic perspective view illustrating the combination of the piezoelectric actuator and the base according to the embodiment of the present disclosure;

[0027] FIG. 8A is a schematic exploded view (1) illustrating the piezoelectric actuator according to the embodiment of the present disclosure;

[0028] FIG. 8B is a schematic exploded view (2) illustrating the piezoelectric actuator according to the embodiment of the present disclosure;

[0029] FIG. 9A is a schematic cross-sectional view (1) illustrating an action of the piezoelectric actuator according to the embodiment of the present disclosure;

[0030] FIG. 9B is a schematic cross-sectional view (2) illustrating an action of the piezoelectric actuator according to the embodiment of the present disclosure;

[0031] FIG. 9C is a schematic cross-sectional view (3) illustrating an action of the piezoelectric actuator according to the embodiment of the present disclosure;

[0032] FIG. 10A is a schematic cross-sectional view (1) illustrating the gas detection main part according to the embodiment of the present disclosure;

[0033] FIG. 10B is a schematic cross-sectional view (2) illustrating the gas detection main part according to the embodiment of the present disclosure;

[0034] FIG. 10C is a schematic cross-sectional view (3) illustrating the gas detection main part according to the embodiment of the present disclosure;

[0035] FIG. 11 is a block diagram illustrating the communication of the air monitoring sensor according to the embodiment of the present disclosure.

[0036] FIG. 12 is a block diagram illustrating the architecture of a networking cloud computing server according to the embodiment of the present disclosure; and

[0037] FIG. 13 is a table showing the cleanness of cleanroom CLASS 7~12 achieved by the AI smart baby clean room system of the present disclosure through detecting and purifying the air pollution to a level close to zero.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0038] The present disclosure will now be described more specifically with reference to the following embodiments. It is to be noted that the following descriptions of preferred embodiments of this disclosure are presented herein for purpose of illustration and description only. It is not intended to be exhaustive or to be limited to the precise form disclosed.

[0039] Please refer FIG. 1A. The present disclosure is related to an AI smart baby clean room system including a plurality of air monitoring sensors 1, at least one air pollution purification apparatus 2, at least one networking cloud computing server 3 and at least one central control computer apparatus 4. The networking cloud computing server 3 receives

air quality data outputted by the air monitoring sensors 1 via Internet of Things (IoT) communication, and an AI smart calculation platform 35 of the networking cloud computing server 3 analyzes the air quality data. Based on the analysis result, the networking cloud computing server 3 intelligently issues a control instruction for automatically adjusting the operation mode of the air pollution purification apparatus 2 so as to circulate and purify the air pollution in the indoor field to a level close to zero, thereby reach a cleanness of cleanroom class for the indoor field.

[0040] The above-mentioned air monitoring sensors 1 are installed in the indoor field and the outdoor field for detecting the air quality data, such as particle matters (PM1, PM2.5, PM10), the concentration of carbon dioxide (CO₂), temperature and humidity. As shown in FIG. 2A, the plurality of air monitoring sensors 1 mentioned above are arranged in an indoor field A and an outdoor field B for detecting the air pollution and outputting the air quality data via Iot communication. Notably, the air quality data includes particle matters (PM1, PM2.5, PM10), the concentration of carbon dioxide (CO₂), temperature, humidity etc.

[0041] As shown in FIG. 2A, the air pollution purification apparatuses 2 mentioned above includes a gas exchange device 2a, a purifier 2b, a fan filter unit (FFU) 2c, an exhaust device 2d, a heating and cooling air conditioner 2e, and a humidity controller 2f and is disposed in the indoor field A in a build-in manner or a plug-in manner. The gas exchange device 2a is implemented to achieve the ventilation of indoor field A and provide a positive pressure air intake for preventing air pollution from entering indoor field A. The purifier 2b, the fan filter unit (FFU) 2c and the exhaust device 2d are provided for purifying the air pollution in the indoor field A to a level close to zero so as to reach a cleanness of cleanroom class. The heating and cooling air conditioner 2e

and the humidity controller 2f are implemented to adjust the temperature and the humidity of indoor field A. Moreover, each air pollution purification apparatus 2 includes at least one air monitoring sensor 1, at least one gas guider 21, at least one filter element 22 and at least one driving controller 23 disposed therein. The air monitoring sensor 1 is electrically connected to the driving controller 23, receives the control instruction via IoT communication and provides the control instruction to the driving controller 23 for enabling the gas guider 21, so that, according to the control instruction from the networking cloud computing server 3, the air monitoring sensor 1 is capable of automatically performing operations of air filtration, air exchanging, temperature and humidity adjustment and sterilization, thereby circulating and purifying the air pollution in the indoor field A to reach a cleanness of classroom class.

[0042] Please refer to FIG. 12. In the embodiment, the networking cloud computing server 3 mentioned above includes a wireless network cloud computing service module 31, a cloud control service unit 32, a device management unit 33, an application program unit 34 and an AI smart calculation platform 35. The wireless network cloud computing service module 31 receives air quality data of the outdoor field B and the indoor field A, receives communication information of the air pollution purification apparatus(es) 2, and issues the control instruction. Moreover, the wireless network cloud computing service module 31 receives the air quality data of the indoor field A and the outdoor field B and transmits thereof to the cloud control service unit 32 to store and form an big data database of air pollution data, and performs an intelligence computing and comparison based on the big data database of air pollution data for issuing the control instruction to the wireless network cloud computing service module 31 and then to the air pollution purification apparatus(es) 2 through

the wireless network cloud computing service module 31 for enabling the air pollution purification apparatus(es) 2. The device management unit 33 receives the communication information of the air pollution purification apparatus(es) 2 through the wireless network cloud computing service module 31 for managing the user login and device binding, and also provides the management information to the application program unit 34 for system control and management, wherein the management information may include the maintenance and management, and the automatic abnormal point detection, analysis, treatment and improvement of the air pollution purification apparatus(es) 2, whether the inspection and measurement is controlled to reach the cleanness requirement of cleanroom class, the customer demand feedback, and the correction mechanism for software and hardware technology improvement. The application program unit 34 can also display and inform the air quality information obtained from the cloud control service unit 32, so the user can know the real-time status of air pollution removal through the mobile phone or the communication device. Moreover, the user can control the operation of the AI smart baby clean room system through the application program unit 34 of the mobile phone or the communication device. The AI smart calculation platform 35 receives the air quality data from the air monitoring sensors 1 through the IoT communication, analyzes thereof, and generates the control instruction based on the analysis result, so as to achieve the automatic control and optimization of the air pollution purification apparatus(es) 2, thereby automatically adjusting the operation mode of the air pollution purification apparatus(es) 2.

[0043] The AI smart calculation platform 35 includes functions of AI smart control, intelligent energy management and automatic malfunction diagnosis. The AI smart control performs calculation based on the air

quality data and automatically adjusts parameters of air volume and purification mode through the preset calculation, so as to precisely control the operation of the air pollution purification apparatus(es) 2 according to the air quality data (such as PM2.5) detected in the indoor field in real time, thereby optimizing the systematic energy efficiency and maintaining a best air quality. The intelligent energy management dynamically adjusts the usage of energy according to the environmental condition of the indoor field A and the operation of the air pollution purification apparatus(es) 2 so as to meet the requirements for babies, wherein the temperature and humidity of the environment condition of the indoor field A is precisely controlled within a range suitable for babies, and the power consumption is automatically reduced when the air pollution purification apparatus(es) 2 is/are idle so as to effectively save energy and minimize energy consumption. The automatic malfunction diagnosis automatically generates the report and notifies the user when the air pollution purification apparatus(es) 2 operate(s) abnormally, for promptly alarming and providing maintenance suggestions, such that the apparatus(es) can be monitored, maintained and repaired in time, and potential failures also can be predicted, especially for the automatic cleaning of the filter element and the flowing channel, which reduces the requirements of daily maintenances and helps in maintaining the long term and efficient operation of the apparatus(es).

[0044] As shown in FIG. 1A and FIG. 1B, the central control computer apparatus 4 receives the control instruction from the networking cloud computing server 3 via Internet of Things (IoT) communication, and transmits thereof to the air monitoring sensor 1 of each air pollution purification apparatus 2, so as to enable the gas guider 21. Alternatively, the central control computer apparatus 4 includes a function of edge computing for calculating and analyzing the air quality data received from

the air monitoring sensor 1 in each air pollution purification apparatus 2, generating the control instruction based on the analysis result and directly issuing the control instruction to the air monitoring sensor 1 of each air pollution purification apparatus 2 via Internet of Things (IoT) communication so as to enable the gas guider 21, thereby achieving the automatic control and the optimization of the air pollution purification apparatus(es) 2.

[0045] Notably, the Internet of Things (IoT) communication mentioned above refers to the collective network which connects various devices and the mutual communication technology between devices and between device and the cloud. The IoT communication can provide wired communication for the networking cloud computing server 3 to communicate in a wired manner. The IoT communication also can provide wireless communication for the networking cloud computing server 3 to communicate wirelessly. Preferably but not exclusively, the wireless communication is one selected from the group consisting of a Wi-Fi communication, a Bluetooth communication, a radio frequency identification communication and a near field communication.

[0046] Notably, as shown in FIG. 3A and FIG. 3B, the air monitoring sensor 1 is configured with an external power terminal, and the external power terminal can be directly inserted into the power interface in the indoor field A for enabling the detection of the air quality data of air pollution, concentration of carbon dioxide (CO₂), temperature and humidity. Alternatively, as shown in FIG. 3C, the air monitoring sensor 1 is configured without external power supply terminals and is directly disposed on and electrically connected to the air pollution purification apparatus 2 for receiving the control instruction for controlling the power

supply of the air pollution purification apparatus 2 and thus controlling the enablement of the gas guider 21.

[0047] Notably, in the embodiment, the air pollution includes at least one selected from the group consisting of particulate matter, carbon monoxide, carbon dioxide, ozone, sulfur dioxide, nitrogen dioxide, lead, total volatile organic compounds (TVOC), formaldehyde, bacteria, fungi, virus and a combination thereof.

[0048] Followings are embodiments of the air pollution purification apparatus 2 disposed in the indoor field A. As shown in FIG. 2A, the air pollution purification apparatuses 2 are disposed in the indoor field A, and the indoor field A includes at least one gas introducing opening C1 and at least one gas discharging opening C2.

[0049] As shown in FIG. 2A and FIG. 2B, the gas exchange device 2a includes a gas guiding channel 24. The gas guiding channel 24 includes a gas introducing port 24a corresponding to the gas introducing opening C1 of the indoor field A, a circulation returning port 24b communicated with the indoor field A, and a gas filtering channel 24c communicated with the indoor field A. A gas exchanger 25 is disposed near the circulation returning port 24b, and the gas filtering channel 24c has the gas guider 21 and the filter element 22 disposed therein. In the embodiment, the networking cloud computing server 3 intelligently computes to compare the carbon dioxide (CO₂) pressure detection information of the indoor field A and the outdoor field B, and the safety value of the carbon dioxide (CO₂) pressure detection information of the indoor field A must be maintained at 400~600 ppm. As shown in FIG. 2G, when the networking cloud computing server 3 receives the detection information of the gas exchange device 2a via Internet of Things (IoT) communication, the pressures of carbon dioxide (CO₂) in the indoor field A and in the outdoor field B are

compared to check whether the balance of zero pressure difference is reached (namely, the carbon dioxide (CO₂) pressure detection information of the indoor field A and the outdoor field B are the same to achieve the balance). When the balance of zero pressure difference is not reached, the control instruction is selectively issued to the air monitoring sensor 1 of the gas exchange device 2a for controlling the driving controller 23 to enable the gas guider 21. Accordingly, the gas in the outdoor field B is introduced into the gas filtering channel 24c through the gas introducing opening C1, is filtered through passing through the filter element 22, and enters the indoor field A, and at the same time, the gas in the indoor field A enters the gas filtering channel 24c again through the circulation returning port 24b for circulation and filtration, thereby achieving temperature adjustment and gas exchange. The gas exchange is implemented to reach a level of carbon dioxide pressure difference between the indoor field A and the outdoor field B close to zero. Notably, when the gas exchange device 2a is enabled to perform the gas exchange, a positive pressure higher than 0 Pa must be maintained in the indoor field A, so that the air pollution in the outdoor field B does not enter the indoor field A. In the embodiment, the air monitoring sensor 1 inside the air pollution purification apparatus 2 continuously receives the control instruction from the networking cloud computing server 3 for controlling the driving controller 23 to enable the gas guider 21, and continuously circulates and purifies the air pollution in the indoor field A to reach the cleanness of cleanroom class with the level of air pollution close to zero and adjust the temperature and humidity. When the networking cloud computing server 3 performs comparison and confirms that the pressure difference of carbon dioxide (CO₂) between the indoor field A and the outdoor field B reaches the balance of zero pressure difference, the networking cloud computing server 3 issues the control

instruction to the air monitoring sensor 1 inside the air pollution purification apparatus 2 for controlling the driving controller 23 to reduce the air volume of the gas guider 21, so as to save energy consumption and effectively reduce the generation of airflow noises, thereby achieving a real-time air pollution detection and purification for reaching the cleanness of cleanroom class with the level of air pollution close to zero. Notably, as shown in FIG. 1B, the gas exchange device 2a is a fresh air exchanging system, or the gas exchange device 2a is an energy recovery ventilation system, or the gas exchange device 2a is a heating, ventilation and air conditioning (HVAC) system, but not limited thereto.

[0050] As shown in FIG. 2A, FIG. 2C and FIG. 2D, the purifier 2b is disposed in the indoor field A in a plug-in manner, and the networking cloud computing server 3 issues the control instruction via IoT communication to the air monitoring sensor 1 inside the purifier 2b for controlling the driving controller 23 to enable the gas guider 21, so that the air pollution in the indoor field A is guided to pass through the filter element 22 for filtration and purification, and then, the purified air is introduced into the indoor field A again. Therefore, the air pollution in the indoor field A may be guided to pass through the filter element 22 multiple times to execute the purification procedure for reaching the cleanness of cleanroom class with the level of air pollution close to zero.

[0051] As shown in FIG. 2A and FIG. 2E, the fan filter unit (FFU) 2c is disposed in the indoor field A in a build-in manner. The fan filter unit (FFU) 2c includes a guiding channel 24. The gas guiding channel 24 includes a circulation returning port 24b communicated with the indoor field A, and a gas filtering channel 24c communicated with the indoor field A, wherein the gas filtering channel 24c has the gas guider 21 and the filter element 22 disposed therein. In that embodiment, the networking cloud

computing server 3 issues the control instruction via IoT communication to the air monitoring sensor 1 inside the fan filter unit (FFU) 2c for controlling the driving controller 23 to enable the gas guider 21, so that the air pollution in the indoor field A is guided to enter the gas filtering channel 24c through the circulation returning port 24b and pass through the filter element 22 for filtration and purification, and then, the purified air is introduced into the indoor field A again. Therefore, the air pollution in the indoor field A is guided to enter the guiding channel 24 multiple times for effectively inhibiting the gas backflow effect during circulation and filtration, thereby achieving the purification procedure for reaching the cleanness of cleanroom class with the level of air pollution close to zero.

[0052] As shown in FIG. 2A, the exhaust device 2d is disposed in the indoor field A in a build-in manner, and is corresponding to the gas discharging opening C2 for exhausting the gas to the outdoor field B. In the embodiment, the networking cloud computing server 3 issues the control instruction via IoT communication to the air monitoring sensor 1 inside the exhaust device 2d for controlling the driving controller 23 to enable the gas guider 21, so that the air pollution in the indoor field A is guided by the gas guider 21 to pass through the filter element 22 for filtration and purification and exhaust to the outdoor field B, thereby achieving the purification procedure for reaching the cleanness of cleanroom class with the level of air pollution close to zero.

[0053] As shown in FIG. 2A, the heating and cooling air conditioner 2e is disposed in the indoor field A, and the heating and cooling air conditioner 2e includes a temperature regulator 26. In the embodiment, the networking cloud computing server 3 issues the control instruction via IoT communication to the air monitoring sensor 1 inside the heating and cooling air conditioner 2e for controlling the driving controller 23 to enable

the gas guider 21, so that the gas is guided to pass through the temperature regulator 26 for adjusting temperature and humidity of gas in the indoor field A. Also, the air monitoring sensor 1 outputs the temperature and humidity information of gas of the indoor field A. Notably, the heating and cooling air conditioner 2e is set to adjust the temperature of the indoor field A at $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$ and the humidity of the indoor field A at $50\%\pm 10\%$. Notably, as shown in FIG. 1B, the heating and cooling air conditioner 2e is an air cooling device, or the heating and cooling air conditioner 2e is an air heat generating device, or the heating and cooling air conditioner 2e is an air cooling and heating device, but not limited thereto.

[0054] As shown in FIG. 2A and FIG. 2F, the humidity controller 2f is disposed in the indoor field A in a plug-in manner, and the networking cloud computing server 3 issues the control instruction via IoT communication to the air monitoring sensor 1 inside the humidity controller 2f for controlling the driving controller 23 to enable the gas guider 21, so that the air pollution in the indoor field A is guided to pass through the filter element 22 for filtration and purification, thereby achieving the purification procedure for reaching the cleanness of cleanroom class with the level of air pollution close to zero, and adjusting the temperature and humidity of gas in the indoor field A. Notably, the humidity controller 2f is set to have a safety value of temperature at $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$, and a safety value of humidity at $50\%\pm 10\%$. Notably, as shown in FIG. 1B, the humidity controller 2f is a dehumidifier, or the humidity controller 2f is a humidifier, or the humidity controller 2f is a dehumidifying and humidifying device, but not limited thereto.

[0055] According to descriptions above, the present disclosure provides an AI smart baby clean room system, wherein through the air monitoring sensors 1 continuously monitoring the air quality data,

including temperature, humidity, concentration of carbon dioxide, PM2.5, for automatically enabling the air pollution purification apparatus 2, and simultaneously, through cooperating with the AI smart calculation platform 35 of the networking cloud computing server 3 with the functions of AI smart control, intelligent energy management and malfunction diagnosis, the air condition of the baby clean room can rapidly be adjusted according to the real time variation of environment, thereby optimizing the systematic energy efficiency and maintaining a best air quality. Accordingly, a continuously clean and healthy air environment for babies can be created, and the impact of harmful pollutants in the air on babies also can be reduced.

[0056] In the implementation of the AI smart baby clean room system of the present disclosure, through the air monitoring sensor continuously monitoring the air quality data, including temperature, humidity, concentration of carbon dioxide, PM2.5, for automatically enabling the air pollution purification apparatus 2, and simultaneously, through cooperating with the AI smart calculation platform 35 of the networking cloud computing server 3 with the functions of AI smart control, intelligent energy management and malfunction diagnosis, the air condition of the baby clean room can rapidly be adjusted according to the real time variation of environment, thereby optimizing the systematic energy efficiency and maintaining a best air quality, and also, achieving a real time air pollution detection and purification to reach the cleanness of cleanroom CLASS 7~12. Please refer to FIG. 13 which shows the cleanness of cleanroom CLASS 7~12. Through the AI smart baby clean room system of the present disclosure, the air pollution in the indoor field A can be purified in real time to reach the cleanness of cleanroom class better than the national standards, in which the cleanness is less than or equal to 1500

CFU/m³ of the amount of bacteria, less than or equal to 1000 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.08 ppm of the formaldehyde content, the average value per hour less than or equal to 0.56 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 1000 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 9 ppm of the carbon monoxide (CO) content, the average value less than or equal to 35 µg/m³ of PM_{2.5}, and the average value less than or equal to 75 µg/m³ of PM₁₀. Therefore, the best air quality can be maintained to create a continuously clean and healthy air environment for babies, and reduce the impact of harmful pollutants in the air on babies. The standard cleanness of cleanroom CLASS 7~12 are as follows.

[0057] The cleanness of CLASS 7 is less than or equal to 8 CFU/m³ of the amount of bacteria, less than or equal to 8 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.00600 ppm of the formaldehyde content, the average value per hour less than or equal to 0.02016 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 500~650 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 0.67500 ppm of the carbon monoxide (CO) content, the average value less than or equal to 0.012353 µg/m³ of PM_{2.5}, and the average value less than or equal to 0.018529 µg/m³ of PM₁₀.

[0058] The cleanness of CLASS 8 is less than or equal to 15 CFU/m³ of the amount of bacteria, less than or equal to 15 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.00900 ppm of the formaldehyde content, the average value per hour less than or equal to 0.02688 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 500~800 ppm of the carbon

dioxide (CO₂) content, the average value per 8 hours less than or equal to 1.01250 ppm of the carbon monoxide (CO) content, the average value less than or equal to 0.061765 µg/m³ of PM_{2.5}, and the average value less than or equal to 0.092647 µg/m³ of PM₁₀.

[0059] The cleanness of CLASS 9 is less than or equal to 20 CFU/m³ of the amount of bacteria, less than or equal to 20 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.01200 ppm of the formaldehyde content, the average value per hour less than or equal to 0.03360 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 500~800 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 1.35000 ppm of the carbon monoxide (CO) content, the average value less than or equal to 0.120000 µg/m³ of PM_{2.5}, and the average value less than or equal to 0.185294 µg/m³ of PM₁₀.

[0060] The cleanness of CLASS 10 is less than or equal to 100 CFU/m³ of the amount of bacteria, less than or equal to 80 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.01800 ppm of the formaldehyde content, the average value per hour less than or equal to 0.07280 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 500~800 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 2.02500 ppm of the carbon monoxide (CO) content, the average value less than or equal to 0.62000 µg/m³ of PM_{2.5}, and the average value less than or equal to 0.926470 µg/m³ of PM₁₀.

[0061] The cleanness of CLASS 11 is less than or equal to 200 CFU/m³ of the amount of bacteria, less than or equal to 150 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.02400 ppm of the formaldehyde content, the average value per hour less than or

equal to 0.11200 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 500~800 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 2.70000 ppm of the carbon monoxide (CO) content, the average value less than or equal to 1.240000 µg/m³ of PM_{2.5}, and the average value less than or equal to 1.850000 µg/m³ of PM₁₀.

[0062] The cleanness of CLASS 12 is less than or equal to 1500 CFU/m³ of the amount of bacteria, less than or equal to 750 CFU/m³ of the amount of fungi, the average value per hour less than or equal to 0.08000 ppm of the formaldehyde content, the average value per hour less than or equal to 0.56000 ppm of the total volatile organic compounds (TVOC) content, the average value per 8 hours less than or equal to 800~1000 ppm of the carbon dioxide (CO₂) content, the average value per 8 hours less than or equal to 9 ppm of the carbon monoxide (CO) content, the average value less than or equal to 12.350000 µg/m³ of PM_{2.5}, and the average value less than or equal to 18.53000 µg/m³ of PM₁₀.

[0063] For understanding the implementation of the AI smart baby clean room system in the present disclosure, followings are the detailed descriptions of the air monitoring sensor 1. Please refer to FIG. 3A to FIG. 11. In the embodiment, the air monitoring sensor 1 includes a controlling circuit board 11, a gas detection main part 12, a microprocessor 13 and a communicator 14. The gas detection main part 12, the microprocessor 13 and the communicator 14 are integrally packaged on the controlling circuit board 11 and electrically connected to each other. The microprocessor 13 and the communicator 14 are mounted on the controlling circuit board 11. The microprocessor 13 controls the driving signal of the gas detection main part 12 for enabling the detection. In this way, the gas detection main part 12 detects the air pollution and outputs the detection information, and the

microprocessor 13 receives, processes and provides the detection information to the communicator 14 for externally transmitting to the networking cloud computing server 3 via IoT communication.

[0064] Please refer to FIG. 4A to FIG. 9A. The gas detection main part 12 includes a base 121, a piezoelectric actuator 122, a driving circuit board 123, a laser component 124, a particulate sensor 125, and an outer cover 126. In the embodiment, the base 121 includes a first surface 1211, a second surface 1212, a laser loading region 1213, a gas-inlet groove 1214, a gas-guiding-component loading region 1215 and a gas-outlet groove 1216. The first surface 1211 and the second surface 1212 are two surfaces opposite to each other. The laser loading region 1213 is hollowed out from the first surface 1211 toward the second surface 1212. The outer cover 126 covers the base 121 and includes a side plate 1261. The side plate 1261 has an inlet opening 1261a and an outlet opening 1261b. The gas-inlet groove 1214 is concavely formed from the second surface 1212 and disposed adjacent to the laser loading region 1213. The gas-inlet groove 1214 includes a gas-inlet 1214a and two lateral walls. The gas-inlet 1214a is in communication with an environment outside the base 121, and is spatially corresponding in position to an inlet opening 1261a of the outer cover 126. Two transparent windows 1214b are opened on the two lateral walls of the gas-inlet groove 1214 and are in communication with the laser loading region 1213. Therefore, the first surface 1211 of the base 121 is covered and attached by the outer cover 126, and the second surface 1212 is covered and attached by the driving circuit board 123, so that an inlet path is defined by the gas-inlet groove 1214. In the embodiment, the gas-guiding-component loading region 1215 is concavely formed from the second surface 1212 and in communication with the gas-inlet groove 1214. A ventilation hole 1215a penetrates a bottom surface of the

gas-guiding-component loading region 1215. The gas-guiding-component loading region 1215 includes four positioning protrusions 1215b disposed at four corners of the gas-guiding-component loading region 1215, respectively. In the embodiment, the gas-outlet groove 1216 includes a gas-outlet 1216a, and the gas-outlet 1216a is spatially corresponding to the outlet opening 1261b of the outer cover 126. The gas-outlet groove 1216 includes a first section 1216b and a second section 1216c. The first section 1216b is concavely formed out from the first surface 1211 in a region spatially corresponding to a vertical projection area of the gas-guiding-component loading region 1215. The second section 1216c is hollowed out from the first surface 1211 to the second surface 1212 in a region where the first surface 1211 is extended from the vertical projection area of the gas-guiding-component loading region 1215. The first section 1216b and the second section 1216c are connected to form a stepped structure. Moreover, the first section 1216b of the gas-outlet groove 1216 is in communication with the ventilation hole 1215a of the gas-guiding-component loading region 1215, and the second section 1216c of the gas-outlet groove 1216 is in communication with the gas-outlet 1216a. In that, when first surface 1211 of the base 121 is attached and covered by the outer cover 126 and the second surface 1212 of the base 121 is attached and covered by the driving circuit board 123, the gas-outlet groove 1216 and the driving circuit board 123 collaboratively define an outlet path.

[0065] In the embodiment, the laser component 124 and the particulate sensor 125 are disposed on and electrically connected to the driving circuit board 123 and located within the base 121. In order to clearly describe and illustrate the positions of the laser component 124 and the particulate sensor 125 in the base 121, the driving circuit board 123 is

intentionally omitted. The laser component 124 is accommodated in the laser loading region 1213 of the base 121, and the particulate sensor 125 is accommodated in the gas-inlet groove 1214 of the base 121 and is aligned to the laser component 124. In addition, the laser component 124 is spatially corresponding to the transparent window 1214b, so that a light beam emitted by the laser component 124 passes through the transparent window 1214b and is irradiated into the gas-inlet groove 1214. A light beam path emitted from the laser component 124 passes through the transparent window 1214b and extends in an orthogonal direction perpendicular to the gas-inlet groove 1214. In the embodiment, a projecting light beam emitted from the laser component 124 passes through the transparent window 1214b and enters the gas-inlet groove 1214 to irradiate the suspended particles contained in the gas passing through the gas-inlet groove 1214. When the suspended particles contained in the gas are irradiated and generate scattered light spots, the scattered light spots are received and calculated by the particulate sensor 125, which is in an orthogonal direction perpendicular to the gas-inlet groove 1214, to obtain the gas detection information.

[0066] In the embodiment, the piezoelectric actuator 122 is accommodated in the square-shaped gas-guiding-component loading region 1215 of the base 121. In addition, the gas-guiding-component loading region 1215 is in fluid communication with the gas-inlet groove 1214. When the piezoelectric actuator 122 is enabled, the gas in the gas-inlet groove 1214 is inhaled by the piezoelectric actuator 122, so that the gas flows into the piezoelectric actuator 122, and is transported into the gas-outlet groove 1216 through the ventilation hole 1215a of the gas-guiding-component loading region 1215. Moreover, the driving circuit board 123 covers the second surface 1212 of the base 121, and the laser

component 124 is positioned and disposed on the driving circuit board 123, and is electrically connected to the driving circuit board 123. The particulate sensor 125 is also positioned and disposed on the driving circuit board 123 and electrically connected to the driving circuit board 123. In that, when the outer cover 126 covers the base 121, the inlet opening 1261a is spatially corresponding to the gas-inlet 1214a of the base 121, and the outlet opening 1261b is spatially corresponding to the gas-outlet 1216a of the base 121.

[0067] In the embodiment, the piezoelectric actuator 122 includes a gas-injection plate 1221, a chamber frame 1222, an actuator element 1223, an insulation frame 1224 and a conductive frame 1225. In the embodiment, the gas-injection plate 1221 is made by a flexible material and includes a suspension plate 1221a and a hollow aperture 1221b. The suspension plate 1221a is a sheet structure and is permitted to undergo a bending deformation. Preferably but not exclusively, the shape and the size of the suspension plate 1221a are corresponding to the inner edge of the gas-guiding-component loading region 1215, but not limited thereto. The hollow aperture 1221b passes through a center of the suspension plate 1221a, so as to allow the gas to flow therethrough. Preferably but not exclusively, in the embodiment, the shape of the suspension plate 1221a is selected from the group consisting of a square, a circle, an ellipse, a triangle and a polygon, but not limited thereto.

[0068] In the embodiment, the chamber frame 1222 is carried and stacked on the gas-injection plate 1221. In addition, the shape of the chamber frame 1222 is corresponding to the gas-injection plate 1221. The actuator element 1223 is carried and stacked on the chamber frame 1222 and collaboratively defines a resonance chamber 1226 with the chamber frame 1222 and the gas-injection plate 1221. The insulation frame 1224 is

carried and stacked on the actuator element 1223 and the appearance of the insulation frame 1224 is similar to that of the chamber frame 1222. The conductive frame 1225 is carried and stacked on the insulation frame 1224, and the appearance of the conductive frame 1225 is similar to that of the insulation frame 1224. In addition, the conductive frame 1225 includes a conducting pin 1225a and a conducting electrode 1225b. The conducting pin 1225a is extended outwardly from an outer edge of the conductive frame 1225, and the conducting electrode 1225b is extended inwardly from an inner edge of the conductive frame 1225. Moreover, the actuator element 1223 further includes a piezoelectric carrying plate 1223a, an adjusting resonance plate 1223b and a piezoelectric plate 1223c. The piezoelectric carrying plate 1223a is carried and stacked on the chamber frame 1222. The adjusting resonance plate 1223b is carried and stacked on the piezoelectric carrying plate 1223a. The piezoelectric plate 1223c is carried and stacked on the adjusting resonance plate 1223b. The adjusting resonance plate 1223b and the piezoelectric plate 1223c are accommodated in the insulation frame 1224. The conducting electrode 1225b of the conductive frame 1225 is electrically connected to the piezoelectric plate 1223c. In the embodiment, the piezoelectric carrying plate 1223a and the adjusting resonance plate 1223b are made by a conductive material. The piezoelectric carrying plate 1223a includes a piezoelectric pin 1223d. The piezoelectric pin 1223d and the conducting pin 1225a are electrically connected to a driving circuit (not shown) on the driving circuit board 123, so as to receive a driving signal (which can be a driving frequency and a driving voltage). Through this structure, a circuit is formed by the piezoelectric pin 1223d, the piezoelectric carrying plate 1223a, the adjusting resonance plate 1223b, the piezoelectric plate 1223c, the conducting electrode 1225b, the conductive frame 1225 and the conducting

pin 1225a for transmitting the driving signal. Moreover, the insulation frame 1224 is insulated between the conductive frame 1225 and the actuator element 1223, so as to avoid the occurrence of a short circuit, thereby transmitting the driving signal to the piezoelectric plate 1223c. After receiving the driving signal, the piezoelectric plate 1223c deforms due to the piezoelectric effect, and the piezoelectric carrying plate 1223a and the adjusting resonance plate 1223b are further driven to generate the bending deformation in the reciprocating manner.

[0069] Furthermore, in the embodiment, the adjusting resonance plate 1223b is located between the piezoelectric plate 1223c and the piezoelectric carrying plate 1223a and served as a cushion between the piezoelectric plate 1223c and the piezoelectric carrying plate 1223a. Accordingly, the vibration frequency of the piezoelectric carrying plate 1223a is adjustable. Basically, the thickness of the adjusting resonance plate 1223b is greater than the thickness of the piezoelectric carrying plate 1223a, and the vibration frequency of the actuator element 1223 can be adjusted by adjusting the thickness of the adjusting resonance plate 1223b.

[0070] Please further refer to FIG. 7A, FIG. 7B, FIG.8A, FIG. 8B and FIG. 9A. In the embodiment, the gas-injection plate 1221, the chamber frame 1222, the actuator element 1223, the insulation frame 1224 and the conductive frame 1225 are stacked and positioned in the gas-guiding-component loading region 1215 sequentially, so that the piezoelectric actuator 122 is supported and positioned in the gas-guiding-component loading region 1215. A clearance 1221c is defined between the suspension plate 1221a and an inner edge of the gas-guiding-component loading region 1215 for gas flowing therethrough. In the embodiment, a flowing chamber 1227 is formed between the gas-injection plate 1221 and the bottom surface of the

gas-guiding-component loading region 1215. The flowing chamber 1227 is in communication with the resonance chamber 1226 among the actuator element 1223, the chamber frame 1222 and the gas-injection plate 1221 through the hollow aperture 1221b of the gas-injection plate 1221. By controlling the vibration frequency of the gas in the resonance chamber 1226 to be close to the vibration frequency of the suspension plate 1221a, the Helmholtz resonance effect is generated between the resonance chamber 1226 and the suspension plate 1221a, so as to improve the efficiency of gas transportation. When the piezoelectric plate 1223c is moved away from the bottom surface of the gas-guiding-component loading region 1215, the suspension plate 1221a of the gas-injection plate 1221 is driven to move away from the bottom surface of the gas-guiding-component loading region 1215 by the piezoelectric plate 1223c. In that, the volume of the flowing chamber 1227 is expanded rapidly, the internal pressure of the flowing chamber 1227 is decreased to form a negative pressure, and the gas outside the piezoelectric actuator 122 is inhaled through the clearance 1221c and enters the resonance chamber 1226 through the hollow aperture 1221b. Consequently, the pressure in the resonance chamber 1226 is increased to generate a pressure gradient. When the suspension plate 1221a of the gas-injection plate 1221 is driven by the piezoelectric plate 1223c to move toward the bottom surface of the gas-guiding-component loading region 1215, the gas in the resonance chamber 1226 is discharged out rapidly through the hollow aperture 1221b, and the gas in the flowing chamber 1227 is compressed, such that the converged gas is quickly and massively ejected out of the flowing chamber 1227 under the condition close to an ideal gas state of the Bernoulli's law, and transported to the ventilation hole 1215a of the gas-guiding-component loading region 1215.

[0071] By repeating the above operation steps shown in FIG. 9B and FIG. 9C, the piezoelectric plate 1223c is driven to generate the bending deformation in a reciprocating manner. According to the principle of inertia, since the gas pressure inside the resonance chamber 1226 is lower than the equilibrium gas pressure after the converged gas is ejected out, the gas is introduced into the resonance chamber 1226 again. Moreover, the vibration frequency of the gas in the resonance chamber 1226 is controlled to be close to the vibration frequency of the piezoelectric plate 1223c, so as to generate the Helmholtz resonance effect to achieve the gas transportation at high speed and in large quantities. The gas is inhaled through the gas-inlet 1214a on the outer cover 126, flows into the gas-inlet groove 1214 of the base 121 through the gas-inlet 1214a, and is transported to the position of the particulate sensor 125. The piezoelectric actuator 122 is enabled continuously to inhale the gas into the inlet path, and facilitate the gas outside the gas detection module to be introduced rapidly, flow stably, and transported above the particulate sensor 125. At this time, a projecting light beam emitted from the laser component 124 passes through the transparent window 1214b to irritate the suspended particles contained in the gas flowing above the particulate sensor 125 in the gas-inlet groove 1214. When the suspended particles contained in the gas are irradiated and generate scattered light spots, the scattered light spots are received and calculated by the particulate sensor 125 for obtaining related information about the sizes and the concentration of the suspended particles contained in the gas. Moreover, the gas above the particulate sensor 125 is continuously driven and transported by the piezoelectric actuator 122 to flow into the ventilation hole 1215a of the gas-guiding-component loading region 1215, and is transported to the gas-outlet groove 1216. At last, after the gas flows into the gas outlet groove 1216, the gas is continuously

transported into the gas-outlet groove 1216 by the piezoelectric actuator 122, so that the gas in the gas-outlet groove 1216 is pushed to discharge through the gas-outlet 1216a and the outlet opening 1261b.

[0072] The air monitoring sensor 1 of the present disclosure not only can detect the particulate matters in the gas, but also can detect the gas characteristics of the introduced gas, for example, to determine whether the gas is formaldehyde, ammonia, carbon monoxide, carbon dioxide, oxygen, ozone, or the like. Therefore, in some embodiments, the air monitoring sensor 1 of the present disclosure further includes a gas sensor 127 positioned and disposed on the driving circuit board 123, electrically connected to the driving circuit board 123, and accommodated in the gas-outlet groove 1216, so as to detect the gas characteristics of the introduced gas. Preferably but not exclusively, in an embodiment, the gas sensor 127 includes a volatile-organic-compound sensor for detecting the information of carbon dioxide (CO₂) or volatile organic compounds (TVOC). Preferably but not exclusively, in an embodiment, the gas sensor 127 includes a formaldehyde sensor for detecting the information of formaldehyde (HCHO) gas. Preferably but not exclusively, in an embodiment, the gas sensor 127 includes a bacteria sensor for detecting the information of bacteria or fungi in the gas. Preferably but not exclusively, in an embodiment, the gas sensor 127 includes a virus sensor for detecting the information of virus in the gas. Preferably but not exclusively, the gas sensor 127 is a temperature and humidity sensor for detecting the temperature and humidity information of gas.

[0073] Please refer to FIG. 2H. The gas guider 21 of the air pollution purification apparatus 2 is controlled and enabled to guide the air pollution to pass through the filter element 22 for filtration. In the embodiment, the filter element 22 includes a MERV (Minimum Efficiency Reporting Value)

8 filter screen or above or a high efficiency particulate air (HEPA) filter screen which is configured to absorb the chemical smoke, the bacteria, the dust particles and the pollen contained in the air pollution for achieving the effect of filtration and purification. Notably, the HEPA filter screen in the present disclosure is a HEPA 10 filter screen or above with a dust containing capacity larger than 12000 mg or a more efficient ULPA (Ultra Low Penetration Air) 14 filter screen for further improving the filtration efficiency and meeting higher cleanness requirements. The filter element 22 is further combined with a material for providing sterilization effect in physical or chemical means by passing therethrough the air pollution, and the airflow of the gas guider 21 flows in the path indicated by the arrows. The filter element 22 is combined with a decomposition layer through coating for sterilizing in chemical means by passing therethrough the air pollution. Preferably but not exclusively, the decomposition layer includes an activated carbon 22a configured to remove organic and inorganic substances in the air pollution, and remove colored and odorous substances. Notably, the activated carbon 22a in the present disclosure has an absorptive capacity of formaldehyde larger than 1500 mg. Preferably but not exclusively, the decomposition layer includes a cleansing factor containing chlorine dioxide layer 22b configured to inhibit viruses, bacteria, fungi, influenza A, influenza B, enterovirus and norovirus in the air pollution, and the inhibition ratio can reach 99% and more, thereby reducing the cross-infection of viruses. Preferably but not exclusively, the decomposition layer includes an herbal protective layer 22c extracted from ginkgo and Japanese Rhus chinensis configured to resist allergy effectively and destroy a surface protein of influenza virus (such as H1N1 influenza virus) passing therethrough. Preferably but not exclusively, the decomposition layer includes a silver ion 22d configured to inhibit viruses,

bacteria and fungi contained in the air pollution. Preferably but not exclusively, the decomposition layer includes a zeolite 22e configured to remove ammonia nitrogen, heavy metals, organic pollutants, Escherichia coli, phenol, chloroform and anionic surfactants. Furthermore, in some embodiments, the filter element 22 is combined with a light irradiation element for sterilizing in chemical means by passing therethrough the air pollution. Preferably but not exclusively, the light irradiation element is a photo-catalyst unit including a photo catalyst 22f and an ultraviolet lamp 22g for further improving the removal efficiency of pollutants and allergens in the air. When the photo catalyst 22f is irradiated by the ultraviolet lamp 22g, the light energy is converted into the electrical energy, thereby decomposing harmful substances and disinfects bacteria contained in the air pollution, so as to achieve the effects of filtration and purification. Notably, the power of the ultraviolet lamp 22g is larger than 120 mW. Preferably but not exclusively, the light irradiation element is a photo-plasma unit including a nanometer irradiation tube 22h. When the introduced air pollution is irradiated by the nanometer irradiation tube 22h, the oxygen molecules and water molecules contained in the air pollution are decomposed into high oxidizing photo-plasma, and an ion flow capable of destroying organic molecules is generated. In that, volatile formaldehyde, volatile toluene and volatile organic compounds (VOC) contained in the air pollution are decomposed into water and carbon dioxide, for further improving the removal efficiency of pollutants and allergens in the air, thereby achieving the effects of filtration and purification. Moreover, in some embodiments, the filter element 22 is combined with a decomposition unit for sterilizing in chemical means by passing therethrough the air pollution. Preferably but not exclusively, the decomposition unit is a negative ion unit 22i which makes the suspended particles carrying positive

charges in the air pollution to adhere to negative charges for further improving the removal efficiency of pollutants and allergens in the air, thereby achieving the effects of filtration and purification. Preferably but not exclusively, the decomposition unit is a plasma ion unit 22j. The oxygen molecules and water molecules contained in the air pollution are decomposed into positive hydrogen ions (H^+) and negative oxygen ions (O^{2-}) by the plasma ion. The substances attached with water around the ions are adhered on the surfaces of viruses and bacteria and converted into OH radicals with extremely strong oxidizing power, thereby removing hydrogen (H) from the protein on the surfaces of viruses and bacteria, and thus decomposing (oxidizing) the protein. Accordingly, the pollutants, allergens and microorganism in the air can be decomposed and eliminated to improve the air cleanness and thus filter the introduced air pollution, thereby achieving the effects of filtration and purification.

[0074] In conclusion, the present disclosure provides an AI smart baby clean room system. In the system, through the air monitoring sensors continuously monitoring the air quality data, including temperature, humidity, concentration of carbon dioxide, PM2.5, for automatically enabling the air pollution purification apparatus, and simultaneously, through cooperating with the AI smart calculation platform of the networking cloud computing server with functions of AI smart control, intelligent energy management and malfunction diagnosis, the air condition of the baby clean room can rapidly be adjusted according to the real time variation of environment, thereby optimizing the systematic energy efficiency and maintaining the best air quality. Accordingly, a continuously clean and healthy air environment for babies can be created, and the impact of harmful pollutants in the air on babies also can be reduced.

[0075] While the disclosure has been described in terms of what is presently considered to be the most practical and preferred embodiments, it is to be understood that the disclosure needs not be limited to the disclosed embodiment. On the contrary, it is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

WHAT IS CLAIMED IS:

1. An AI smart baby clean room system, comprising:

a plurality of air monitoring sensors arranged in an indoor field and an outdoor field for detecting an air pollution and outputting an air quality data via Internet of Things (IoT) communication;

at least one air pollution purification apparatus disposed in the indoor field and comprising at least one air monitoring sensor, at least one gas guider, at least one filter element and at least one driving controller, wherein the at least one air monitoring sensor is electrically connected to the at least one driving controller and receives a control instruction via Internet of Things (IoT) communication for enabling the at least one gas guider to circulate and purify the air pollution in the indoor field so as to reach a cleanness of cleanroom class with a level of air pollution close to zero;

at least one networking cloud computing server comprising a wireless network cloud computing service module, a cloud control service unit, a device management unit, an application program unit and an AI smart calculation platform; and

at least one central control computer apparatus receiving the control instruction issued by the at least one networking cloud computing server via Internet of Things (IoT) communication, transmitting the control instruction to the at least one air monitoring sensor of the at least one air pollution purification apparatus for enabling the at least one gas guider;

wherein the at least one networking cloud computing server receives the air quality data outputted by the plurality of air monitoring sensors via Internet of Things (IoT) communication, and issues the control instruction, based on an analysis result obtained from analyzing the air quality data by the AI smart calculation platform, for automatically adjusting an operation

mode of the at least one air pollution purification apparatus so as to circulate and purify the air pollution in the indoor field, thereby reaching the cleanness of cleanroom class with the level of air pollution close to zero.

2. The AI smart baby clean room system as claimed in claim 1, wherein the air quality data comprises particle matters, a concentration of carbon dioxide (CO₂), temperature, and humidity.
3. The AI smart baby clean room system as claimed in claim 1, wherein the AI smart calculation platform comprises a function of AI smart control for performing a calculation based on the air quality data and automatically adjusting parameters of air volume and purification mode through a preset calculation, so as to precisely control an operation of the at least one air pollution purification apparatus according to the air quality data detected in the indoor field in real time, thereby optimizing systematic energy efficiency and maintaining best air quality.
4. The AI smart baby clean room system as claimed in claim 1, wherein the AI smart calculation platform comprises a function of intelligent energy management for dynamically adjusting a usage of energy according to an environmental condition of the indoor field and an operation of the at least one air pollution purification apparatus, and wherein the at least one air pollution purification apparatus comprises a gas exchange device, a purifier, a fan filter unit (FFU), an exhaust device, a heating and cooling air conditioner, and a humidity controller.
5. The AI smart baby clean room system as claimed in claim 4, wherein the gas exchange device comprises a fresh air exchanging system, an energy recovery ventilation system, or a heating, ventilation and air conditioning (HVAC) system, and the heating and cooling air conditioner comprises

an air cooling device, an air heat generating device or an air cooling and heating device.

6. The AI smart baby clean room system as claimed in claim 1, wherein the at least one filter element is a MERV (Minimum Efficiency Reporting Value) 8 filter screen or above or a HEPA (High Efficiency Particulate Air) filter screen, wherein the HEPA filter screen is a HEPA 10 filter screen or above with a dust containing capacity larger than 12000 mg.
7. The AI smart baby clean room system as claimed in claim 1, wherein the at least one filter element is a ULPA (Ultra Low Penetration Air) 14 filter screen or above; or the at least one filter element is combined with a decomposition layer through coating for sterilizing in chemical means by passing therethrough the air pollution, and the decomposition layer comprises an activated carbon having an absorptive capacity of formaldehyde larger than 1500 mg.
8. The AI smart baby clean room system as claimed in claim 1, wherein the at least one filter element is combined with a light irradiation element for sterilizing in chemical means by passing therethrough the air pollution, and the light irradiation element is a photo-catalyst unit including a photo catalyst and an ultraviolet lamp, or a photo-plasma unit including a nanometer irradiation tube, wherein a power of the ultraviolet lamp is larger than 120 mW.
9. The AI smart baby clean room system as claimed in claim 1, wherein the at least one filter element is combined with a decomposition unit for sterilizing in chemical means by passing therethrough the air pollution, and the decomposition unit is a negative ion unit or a plasma ion unit.
10. The AI smart baby clean room system as claimed in claim 1, wherein the IoT communication comprises a wireless communication for the at

least one networking cloud computing server to communicate wirelessly, wherein the wireless communication is one selected from the group consisting of a Wi-Fi communication, a Bluetooth communication, a radio frequency identification communication and a near field communication; or the IoT communication comprises a wired communication for the at least one networking cloud computing server to communicate in a wired manner.

11. The AI smart baby clean room system as claimed in claim 1, wherein each of the plurality of air monitoring sensors comprises a controlling circuit board, a gas detection main part, a microprocessor and a communicator, wherein the controlling circuit board is electrically connected to the at least one driving controller, the gas detection main part, the microprocessor and the communicator are integrally packaged on the controlling circuit board and electrically connected to the controlling circuit board, the microprocessor controls a detection operation of the gas detection main part for detecting the air pollution, and the microprocessor processes and provides a detection information to the communicator for external communication transmission.
12. The AI smart baby clean room system as claimed in claim 1, wherein the at least one central control computer apparatus is equipped with a function of edge computing for calculating and analyzing the air quality data received from the at least one air monitoring sensor in each of the at least one air pollution purification apparatus, generating the control instruction based on an analysis result and directly issuing the control instruction to the at least one air monitoring sensor in each of the at least one air pollution purification apparatus via Internet of Things (IoT) communication so as to enable the at least one gas guider, thereby

achieving an automatic control and an optimization of the at least one air pollution purification apparatus.

13. The AI smart baby clean room system as claimed in claim 1, wherein the cleanness of cleanroom class meets requirements of cleanroom CLASS 7-12.