

TITLE

AUTONOMOUS SELF-PROPELLED STERILISATION ROBOT

TECHNICAL FIELD

[001] The present invention relates to a robotic apparatus that uses ultraviolet radiation, chemical disinfectants, and ionisation (or a combination thereof) for the sterilisation and disinfection of a target area, that is able to operate and navigate in an autonomous and self-propelled manner.

BACKGROUND ART

[002] The background description provided herein is for the purpose of generally presenting the context of the disclosure and to provide more a complete scientific background. Any work described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly or impliedly admitted as prior art against the present disclosure.

[003] Conventionally, various methods are employed in the cleaning, sterilisation or disinfection of surfaces or areas to eradicate pathogens and contaminants in varying locations, including hospitals, clinics, nursing homes, schools and day care facilities.

[004] The use of ultraviolet radiation for room and surface disinfection is known in the art. Ultraviolet radiation may be used to eradicate pathogens or contaminants via the manipulation of the strength of the ultraviolet radiation being projected, the time of exposure of the ultraviolet radiation, or the distance of the ultraviolet light source to the pathogens or contaminants.

[005] Chemical disinfectants or agents are also employed. These types of disinfectants or agents may be applied or utilised in various ways, including application of measured volumes on surfaces, or atomisation and dispersal in the air.

[006] Air filtration devices are utilised to capture and eradicate airborne contaminants and allergens via a variety of mechanisms. Such mechanisms generally include the use of particulate matter filters, electrostatic filters, or ionisation tubes.

[007] Robotic platforms may incorporate some of these methods, and be used in sterilisation operations in a certain target area. Sensors may also be incorporated for purposes of assessing the general environment around the robot, which may provide feedback relevant to the robot's specific tasks.

SUMMARY OF INVENTION

Technical Problem

[008] Existing sterilisation or disinfecting systems on the market face several shortcomings. One main issue is ineffective sanitisation due to shadowing or blockage effects caused by, for example, the furniture and configuration of a room or area. If ultraviolet radiation or chemical disinfectants cannot be applied thoroughly and properly in-situ, it will lead to questionable and ineffective sterilisation of the target area. It would be necessary to ensure that any target area, including surfaces, angled surfaces, space and expanse, is exposed to an effective amount of sterilisation agent. In order to do so, an effective sterilisation or disinfecting system must be able to navigate and measure its coverage within a target area, and control the intensity, extent or amount of sterilisation method or agent that is being applied.

[009] In addition, there are a large variety of pathogens and biological contaminants, with differing characteristics and susceptibilities, and which require various methods and treatments in order to ensure effective eradication. As an example, within hospital facilities, there are increasing challenges due to drug-resistant pathogens, including *Mycobacterium Tuberculosis* and *Escherichia Coli*, amongst many others. In addition, various types of pathogenic microorganisms, including strains of smallpox and influenza viruses, may be carried through the air over varying distances. Such pathogens may also remain airborne indefinitely in air currents, and can travel throughout an enclosed space of building. Accordingly, there can be huge

variability in the types, nature and characteristics of pathogens in any particular area, and these variabilities present difficulties in the use of any single sterilisation method. An effective sterilisation or disinfecting system must therefore be able to use a combination of sterilisation methods or agents, and be able to do so in an adaptable or modifiable manner, that can allow it to handle a wide spectrum of pathogens.

[010] It is an object of the present invention to provide a robotic apparatus that is able to properly move, navigate and measure its coverage or progress within a target area, to provide effective sterilisation of the said area. It is another object of the present incorporate within the robotic apparatus several different sterilisation methods or agents, which when used singly or in combination, will provide effective eradication of a wide variety of pathogens.

Solution to Problem

[011] In order to achieve the above objects, the present invention comprises: a main body housing containing electrical and mechanical components with retractable or extendable sections, drive wheels that allows the whole system to move by itself, a battery that supplies electric power to electrical and mechanical components, charging input for the replenishment of battery capacity, internal computer for the operations of the whole system, external sensors for detection or measurement of the ambient environment, external audio output for the issuance of verbal cues, ultraviolet radiation lightbulbs, ionisation device, spraying or atomising device, and a container unit for the storage of chemical disinfectants.

[012] The system will be able to move omni-directionally using the drive wheels located at the base of the housing. Utilising the onboard computer and internal logic, coupled with an onboard battery, the system will apply power to the drive motors that enables the system to navigate and move over a target area in a self-propelled, artificially intelligent fashion. The system will provide proper time-on-target via speed control, and the capability to make several passes or to rely on a pre-programmed patrol routine.

[013] The external sensors onboard the system will allow for detection of obstacles, and the measurement of ambient conditions, that will enable the internal computer to make decisions on how to effectively move within a target area, to provide full coverage of the location while avoiding objects or humans. Should there be any obstacles in the path of the system, the internal computer will provide alternative navigation guidance to the system, and will move the system based on alternative paths that seeks to accomplish its patrol routine.

[014] The system incorporates multiple forms of pathogenic eradication capabilities, which the system will intelligently deploy in isolation or combination depending on the environment in detects. One such capability is in the form of ultraviolet radiation emission sources such as ultraviolet lightbulbs, of which the intensity and duration of ultraviolet emission can be varied to provide differing levels of eradication capability. Another such capability is in the form of a spraying or atomising system, integrated with a holding container, for the dispensing of chemical disinfectants. The type of disinfectant, amount to be dispensed, and duration of dispensation, can also be varied to provide different levels of eradication capability. Additionally, the system has an ionisation device to generate static charges that remove airborne pathogens and contaminants. The internal computer will allow for a multitude of sterilisation routines, encompassing one or more of the described capabilities, to be employed, and will govern the use of onboard energy reserves to achieve the operational goals of the system.

Advantageous Effects of Invention

[015] The present invention establishes a system that is able to navigate and move in a target area in a responsive and adaptive manner, and therefore provide full and effective coverage of the location of interest, in line with any sterilisation or sanitisation requirements. The ability to respond to obstacles and the specific configurations of any location allows the system to autonomously persist in executing a given directive, and also to ensure the its sanitisation efforts are optimised across the surfaces, angled surfaces and areas within a target location to the fullest possible extent. This will prevent issues of shadowing effects or blockages from negatively affecting the application of sterilising agents.

[016] Besides, the system provides multiple eradication capabilities by incorporating several forms of sterilisation devices and agents, that rely on ultraviolet irradiation, atomised disinfectants, and electrostatic filtration. These sterilisation devices or agents may be used singly or in combination, depending on the operational requirements or unique characteristics of a target area. This allows the present invention to provide effective sterilisation across a wide spectrum of surface or airborne pathogens or contaminants, and to suit the requirements of various locations.

[017] Additionally, the present invention is able to detect if there are humans in its immediate surroundings, and will cease any sterilisation activity such as ultraviolet irradiation or the spraying of disinfectant in the interest of ensuring the safety of nearby occupants. It can also issue verbal cues or appropriate warnings to nearby occupants, for their safety or to facilitate its ongoing sterilisation activities.

BRIEF DESCRIPTION OF THE DRAWINGS

[018] [Fig. 1] is a perspective view showing a robotic apparatus according to an embodiment of the present invention.

[Fig. 2] is another perspective view showing a robotic apparatus with certain elements extended according to the embodiment of the present invention.

[Fig. 3] is a side section view showing the robotic apparatus according to the embodiment of the present invention.

[Fig. 4] is a bottom view showing the robotic apparatus according to the embodiment of the present invention.

[Fig. 5] is a top view showing the robotic apparatus according to the embodiment of the present invention.

DETAILED DESCRIPTION

[019] Hereinafter, an embodiment of the present invention is described with reference to the drawings. Fig. 1 is a perspective view showing a robotic apparatus according to an embodiment of the present invention. A robotic apparatus 1 has a main body housing 2 with ultraviolet radiation lightbulbs 3, spraying or atomiser nozzles 4, air filtration grilles 5, external audio output grilles 6, sensor ports 7, multi-functional light source 8.

[020] Fig. 2 is another perspective view showing an extended version of the robotic apparatus. The extendable housing 9 incorporates ultraviolet radiation lightbulbs 10, and spraying and atomising nozzles 4. The extendable housing 9 can be retracted when not in use. The charging connectors 11, are used to connect to an external charging dock for the replenishment of the robotic apparatus's battery.

[021] Fig. 3 is a side sectional view of the robotic apparatus, with the main body housing 2 functioning as the outer shell of the apparatus, and the extendable housing 9 contained within the main body housing 2. The ultraviolet radiation lightbulbs 3 are located on the main body housing 2, and the ultraviolet lightbulbs 10 are located on the extendable housing 9. The main housing 2 contains the internal computer unit 12, sensors 13, an audio output 14, the battery 15, electrical connections to the battery 16, charging connectors 11, a holding container for the storage of chemical disinfectants 17, spray or atomising system 18, connecting tubes from the holding container to the spray or atomising system 19, an air ionisation and filtration device 20, a motor for the application for power to the drive wheels 21, and drive wheels for movement of the robotic apparatus 22.

[022] The holding container 17 is made of a material that can safely handle a wide variety of chemical disinfectant solutions. The spray or atomising system 18 draws solution via the connecting tubes 19 for purposes of air dispersal of the solution.

[023] The air ionisation and filtration device 20 is situated just behind the main body housing of the robotic apparatus. It draws in and circulates air via external air filtration grilles located on the main body housing 2.

[024] The motor 21 draws electrical energy from the battery 15, and powers the drive wheels 22 based on given directions as provided by the internal computer unit 12.

[025] Fig. 4 is a bottom view showing the robotic apparatus according to the embodiment of the present invention. Located underneath are three separate sets of drive wheels 22, which when used in combination provides omni-directional mobility to the robotic apparatus.

[026] Fig. 5 is a top view showing the robotic apparatus according to the embodiment of the present invention. The spray or atomiser nozzles 4 are located on the top of the extendable housing.

CLAIMS

1. A robotic apparatus for sterilisation comprising:
 - a main body housing incorporating an internal volume that provides sufficient space for various electrical, mechanical or container components to reside within;
 - an extendable housing incorporating ultraviolet radiation lightbulbs and nozzles for the spray or atomising system;
 - an internal computer;
 - a container for the storage of chemical disinfectant solutions;
 - an atomising system for the dispersal and spraying of chemical disinfectant solutions;
 - an air ionisation and filtration device;
 - a set of three drive wheels which allow the main body housing to move omnidirectionally;
 - an electric motor to power the drive wheels; wherein
 - a battery supplies electric power to each component.
2. The robotic apparatus for sterilisation according to claim 1, wherein the external surface of the main housing incorporates ultraviolet radiation lightbulbs.
3. The robotic apparatus for sterilisation according to claim 1, wherein the extendable housing may be extended outside the main body housing, so as to provide ultraviolet radiation or the spraying of chemical disinfectant solutions from a higher position.
4. The robotic apparatus for sterilisation according to claim 1, wherein

sensors for the detection of surroundings or ambient conditions are situated on the main body housing.

5. The robotic apparatus for sterilisation according to claim 4, wherein sensors for the detection of surroundings or ambient conditions are situated on the extendable housing.
6. The robotic apparatus for sterilisation according to claim 1, wherein audio output and speaker grilles are situated on the main body housing for the generation and issuance of verbal cues and warnings.
7. The robotic apparatus for sterilisation according to claim 1, wherein air flow openings situated on the main body housing, connected to air flow paths that lead to the air ionisation and filtration device within the main body housing.
8. The robotic apparatus for sterilisation according to claim 7, wherein air flow openings situated on the extendable housing, connected to air flow paths that lead to the air ionisation and filtration device within the main body housing.
9. The robotic apparatus for sterilisation according to claim 1, wherein tubes connect the container for the storage of chemical disinfectant solutions to the atomising system within the main body housing.
10. The robotic apparatus for sterilisation according to claim 1, wherein a multi-functional light source is situated on the main body housing.
11. The robotic apparatus for sterilisation according to claim 1, wherein

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electrical connections are situated on the main body housing to allow for the charging of the battery within the main body housing.