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(54) Title: SYSTEMS FOR MONITORING AND CONTROLLING DISINFECTION

(57) Abstract: A disinfection monitoring system, comprising: a sensor module configured to detect use of one or more disinfectants on a surface or in an area; a data logger module connected to the sensor module and configured to log data relating to detected uses of the one or more disinfectants; and a wireless communication module connected to the data logger module and configured to wirelessly communicate the logged data relating to detected use of the one or more disinfectants to a remote monitoring module.

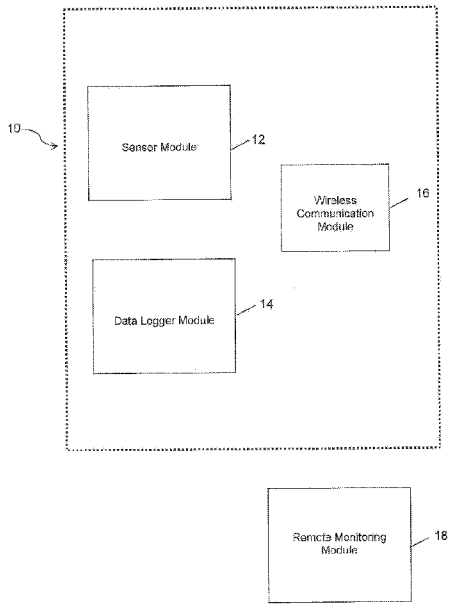

Figure 1

WO 2019/178639 A1

SYSTEMS FOR MONITORING AND CONTROLLING DISINFECTION

Field

[0001] The present invention relates to systems for monitoring and controlling disinfection in hospitals, healthcare facilities, aged care facilities, specialist offices, medical centres, research labs, veterinary labs, childcare facilities, schools, etc.

Background

[0002] Hospital-acquired infections (HAIs) kill many patients every year and contribute to rising healthcare costs. HAIs may be reduced or avoided by disinfecting surfaces and areas in hospitals using chemical disinfectants, such as bleach or hydrogen peroxide vapour. In addition, germicidal ultraviolet (UV) light in the C spectrum (UVC) is starting to be used to disinfect hospital surfaces, equipment, instruments, rooms and areas.

[0003] However, because of time demands and human errors which frequently occur in hospitals, health care providers or hospital cleaners may forget or skip disinfection treatments, or only perform minimal disinfection treatments on an occasional basis.

[0004] In this context, there is a need for improved solutions for monitoring and controlling disinfection.

Summary

[0005] According to the present invention, there is provided a disinfection monitoring system, comprising:

a sensor module configured to detect use of one or more disinfectants on a surface or in an area;

a data logger module connected to the sensor module and configured to log data relating to detected uses of the one or more disinfectants; and

a wireless communication module connected to the data logger module and configured to wirelessly communicate the logged data relating to detected use of the one or more disinfectants to a remote monitoring module.

[0006] The one or more disinfectants may be selected from a light-based disinfectant, a gas disinfectant, a vapour disinfectant, a liquid disinfectant, and combinations thereof.

[0007] The light-based disinfectant may be UV light, the vapour disinfectant may be hydrogen peroxide vapour, and the liquid disinfectant may be bleach.

[0008] The sensor module may comprise one or more sensors selected from a UV light sensor, a gas sensor, a vapour sensor, a chemical sensor, a thermal sensor, and combinations thereof.

[0009] The sensor module may further comprise a location sensor, such as a global positioning system (GPS) sensor.

[0010] The data logger module may comprise a data storage device configured to store the logged data relating to detected use of the one or more disinfectants.

[0011] The wireless communication module may comprise a low power wireless communication module, such as a Bluetooth low power module.

[0012] The remote monitoring module may be a cloud-based monitoring and reporting application, such as a cloud dashboard.

[0013] The disinfection monitoring system may further comprise a microcontroller connected to a power source and each of the sensor module, the data logger module and the wireless communication module.

[0014] The disinfection monitoring system may further comprise a visual indicator connected to the microcontroller and the power source, wherein the microcontroller is configured to control the visual indicator to visually indicate the disinfection status of the surface or the area.

[0015] The visual indicator may be a light emitting diode (LED) indicator.

[0016] The power source may be a battery, a solar panel, or both.

[0017] The present invention also provides a UV disinfection system, comprising:

a UV lamp configured to apply UV light to a surface or an area in a hospital;

a mobile base configured to adjustably support the UV lamp adjacent to the surface or the area; and

a controller connected to the UV lamp and configured to control the UV lamp to vary the UV light applied to the surface or the area.

[0018] The UV disinfection system may further comprise:

a UV light sensor connected to the controller and configured to detect the UV light applied to the surface or the area;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the UV light detected by the UV light sensor.

[0019] The UV light sensor of the UV disinfection system may be the UV light sensor of the disinfection monitoring system described above.

[0020] The UV disinfection system may further comprise:

a location sensor connected to the controller and configured to detect the location of the UV lamp;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the location of the UV lamp detected by the location sensor.

[0021] The UV disinfection system may further comprise:

a distance measuring sensor connected to the controller and configured to detect the distance between the UV lamp and the surface or the area;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the distance between the UV lamp and the surface or the area detected by the distance measuring sensor.

[0022] The UV disinfection system may further comprise a wireless remote controller connected to the controller.

Brief Description of Drawings

[0023] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of an example embodiment of a disinfection monitoring system according to an example embodiment of the present invention;

Figure 2 is a schematic diagram of an example LED indicator of the disinfection monitoring system of Figure 1;

Figure 3 is a block diagram of an example embodiment of a UV disinfection system according to an example embodiment of the present invention; and

Figure 4 is a computer rendering of the hospital monitoring UV disinfection system of Figure 3.

Description of Embodiments

[0024] Referring to Figure 1, an example disinfection monitoring system 10 according to an example embodiment of the present invention may generally comprise a sensor module 12, a data logger module 14, and a wireless communication module 16.

[0025] The sensor module 12 may be configured to detect use of one or more disinfectants on a surface or in an area in hospitals, healthcare facilities, aged care facilities, specialist offices, medical centres, research labs, veterinary labs, childcare facilities, schools, etc. The sensor module 12 may be configured to detect the presence or absence of the one or more disinfectants on the surface or in the area. The one or more disinfectants may be selected from a light-based disinfectant, a gas disinfectant, a vapour disinfectant, a liquid disinfectant, and combinations thereof. The sensor module 12 may therefore comprise one or more sensors selected from a UV light sensor, a gas sensor, a vapour sensor, a chemical sensor, a thermal sensor, and combinations thereof.

[0026] For example, the light-based disinfectant may be UVC light, the vapour disinfectant may be hydrogen peroxide vapour, and the liquid disinfectant may be bleach. In one example embodiment, the sensor module 12 may therefore comprise a UV light sensor, a hydrogen peroxide vapour sensor (eg, a near infrared (NIR) sensor), and a chemical sensor capable of detecting bleach (or chemical constituents thereof).

[0027] The sensor module 12 may further comprise a location sensor, such as a GPS sensor. This may enable the location of the sensor module 12 within the hospital to be monitored and tracked.

[0028] The data logger module 14 may be connected to the sensor module 12 and configured to log data relating to detected uses of the one or more disinfectants. The data logger module 14 may comprise a data storage device configured to store the logged data relating to detected use of the one or more disinfectants. The logged data may comprise date, time, location, level of disinfectant present, etc.

[0029] The wireless communication module 16 may be connected to the data logger module 14 and configured to wirelessly communicate the logged data relating to detected use of the one or more disinfectants to a remote monitoring module 18. The wireless communication module may comprise a low power wireless communication module, such as a Bluetooth low power module. The remote monitoring module 18 may be a cloud-based monitoring and reporting application, such as a cloud dashboard. The cloud dashboard may provide monitoring, tracking, analytics, alerts, and reporting of the disinfection status of individual surfaces or areas in hospitals.

[0030] The disinfection monitoring system 10 may further comprise a microcontroller (not shown) connected to a power source (not shown) and each of the sensor module 12, the data logger module 14 and the wireless communication module 16. The power source may be a battery (not shown), a solar panel (not shown), or both.

[0031] Referring to Figure 2, a visual indicator 20 may be connected to the microcontroller and the power source, and the microcontroller may be configured to control the visual indicator 20 to visually indicate the disinfection status of the surface or the area. The visual indicator 20 may, for example, be a traffic-light LED indicator 20 having green, yellow and red LEDs 22, 24, 26. For example, a green LED 22 may visually indicate that disinfection is not required, while yellow or red LEDs 24, 26 may visually indicate that disinfection is required.

[0032] The sensor module 12, the data logger module 14 and the wireless communication module 16, power source, microcontroller, and traffic-light LED indicator 20 may be provided together on a printed circuit board (not shown), and housed

together in a common housing (not shown) that may be removably attachable or positionable on individual surfaces or in individual areas of hospitals. A plurality of the disinfection monitoring systems 10 may be provided as a network of disinfection sensors in hospitals, healthcare facilities, aged care facilities, specialist offices, medical centres, research labs, veterinary labs, childcare facilities, schools, etc.

[0033] Referring to Figure 3, an example UV disinfection system 30 according to an example embodiment of the present invention generally comprises a UV lamp 32, a mobile base 34 and a controller 36. The UV lamp 32 may be configured to apply UV light, for example UVC light, to a surface or an area in a hospital. The UV lamp 32 may comprise a plurality of UV lamps 32. The mobile base 34 may be configured to adjustably support the UV lamp 32 adjacent to the surface or the area. For example, as illustrated in Figure 4, the mobile base 34 may, for example, be a wheeled cabinet that pivotally adjustably supports two UV lamps 32. The controller 36 may be connected to the UV lamp 32 and configured to control the UV lamp 32 to vary the UV light applied to the surface or the area.

[0034] The UV disinfection system 30 may further comprise a UV light sensor (not shown) connected to the controller 36 and configured to detect the UV light applied to the surface or the area. The controller 36 may be further configured to control the UV lamp 32 and vary the UV light applied to the surface or the area based on the UV light detected by the UV light sensor. The UV light sensor of the UV disinfection system may, for example, be the UV light sensor of the disinfection monitoring system 10 described above.

[0035] The UV disinfection system 30 may further comprise a location sensor (not shown) connected to the controller 36 and configured to detect the location of the UV lamp 32 or the mobile base 34. The controller 34 may be further configured to control the UV lamp 32 and vary the UV light applied to the surface or the area based on the location of the UV lamp 32 or the mobile base 34 detected by the location sensor.

[0036] The UV disinfection system 30 may further comprise a distance measuring sensor connected to the controller 36 and configured to detect the distance between the UV lamp 32 and the surface or the area. The controller 36 may be further configured to control the UV lamp 32 and vary the UV light applied to the surface or the area based on

the distance between the UV lamp 32 and the surface or the area detected by the distance measuring sensor.

[0037] The UV disinfection system 30 may further comprise a wireless remote controller connected to the controller 30 to enable remote operation of the UV lamp 32. The usage, location, and UV dosage of the UV disinfection system 30 may be monitored, tracked, analysed and reported using the disinfection monitoring system 10 described above.

[0038] Embodiments of the present invention provide systems that are both generally and specifically useful for monitoring disinfection of surfaces, equipment, instruments, rooms and areas in hospitals, healthcare facilities, aged care facilities, specialist offices, medical centres, research labs, veterinary labs, childcare facilities, schools, etc. In addition, other embodiments, the present invention provides systems that are both generally and specifically useful for UV disinfection of surfaces, equipment, instruments, rooms and areas in hospitals, healthcare facilities, aged care facilities, specialist offices, medical centres, research labs, veterinary labs, childcare facilities, schools, etc.

[0039] For the purpose of this specification, the word "comprising" means "including but not limited to," and the word "comprises" has a corresponding meaning.

[0040] The above embodiments have been described by way of example only and modifications are possible within the scope of the claims that follow.

Claims

1. A disinfection monitoring system, comprising:

a sensor module configured to detect use of one or more disinfectants on a surface or in an area;

a data logger module connected to the sensor module and configured to log data relating to detected uses of the one or more disinfectants; and

a wireless communication module connected to the data logger module and configured to wirelessly communicate the logged data relating to detected use of the one or more disinfectants to a remote monitoring module.

2. The system of claim 1, wherein the one or more disinfectants are selected from a light-based disinfectant, a gas disinfectant, a vapour disinfectant, a liquid disinfectant, and combinations thereof.

3. The system of claim 2, wherein the light-based disinfectant is UV light, the vapour disinfectant is hydrogen peroxide vapour, and the liquid disinfectant is bleach.

4. The system of claim 2, wherein the sensor module comprises one or more sensors selected from a UV light sensor, a gas sensor, a vapour sensor, a chemical sensor, a thermal sensor, and combinations thereof.

5. The system of claim 4, wherein the sensor module further comprises a location sensor.

6. The system of claim 5, wherein the location sensor is a global positioning system (GPS) sensor.

7. The system of claim 1, wherein the data logger module comprises a data storage device configured to store the logged data relating to detected use of the one or more disinfectants.

8. The system of claim 1, wherein the wireless communication module comprises a low power wireless communication module.

9. The system of claim 8, wherein the low power wireless communication module is a Bluetooth low power module.

10. The system of claim 1, wherein the remote monitoring module is a cloud-based monitoring and reporting application.

11. The system of claim 10, wherein the cloud-based monitoring and reporting application is a cloud dashboard.

12. The system of claim 1, further comprising a microcontroller connected to a power source and each of the sensor module, the data logger module and the wireless communication module.

13. The system of claim 12, further comprising a visual indicator connected to the microcontroller and the power source, wherein the microcontroller is configured to control the visual indicator to visually indicate the disinfection status of the surface or the area.

14. The system of claim 13, wherein the visual indicator is a light emitting diode (LED) indicator.

15. The system of claim 12, wherein the power source is a battery, a solar panel, or both.

16. A ultraviolet (UV) disinfection system, comprising:

a UV lamp configured to apply UV light to a surface or an area in a hospital;

a mobile base configured to adjustably support the UV lamp adjacent to the surface or the area; and

a controller connected to the UV lamp and configured to control the UV lamp to vary the UV light applied to the surface or the area.

17. The system of claim 16, further comprising:

a UV light sensor connected to the controller and configured to detect the UV light applied to the surface or the area;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the UV light detected by the UV light sensor.

18. The system of claim 17, wherein the UV light sensor is the UV light sensor of the disinfection monitoring system of claim 4.

19. The system of claim 16, further comprising:

a location sensor connected to the controller and configured to detect the location of the UV lamp;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the location of the UV lamp detected by the location sensor.

20. The system of claim 16, further comprising:

a distance measuring sensor connected to the controller and configured to detect the distance between the UV lamp and the surface or the area;

wherein the controller is further configured to control the UV lamp and vary the UV light applied to the surface or the area based on the distance between the UV lamp and the surface or the area detected by the distance measuring sensor.

21. The system of claim 16, further comprising a wireless remote controller connected to the controller.

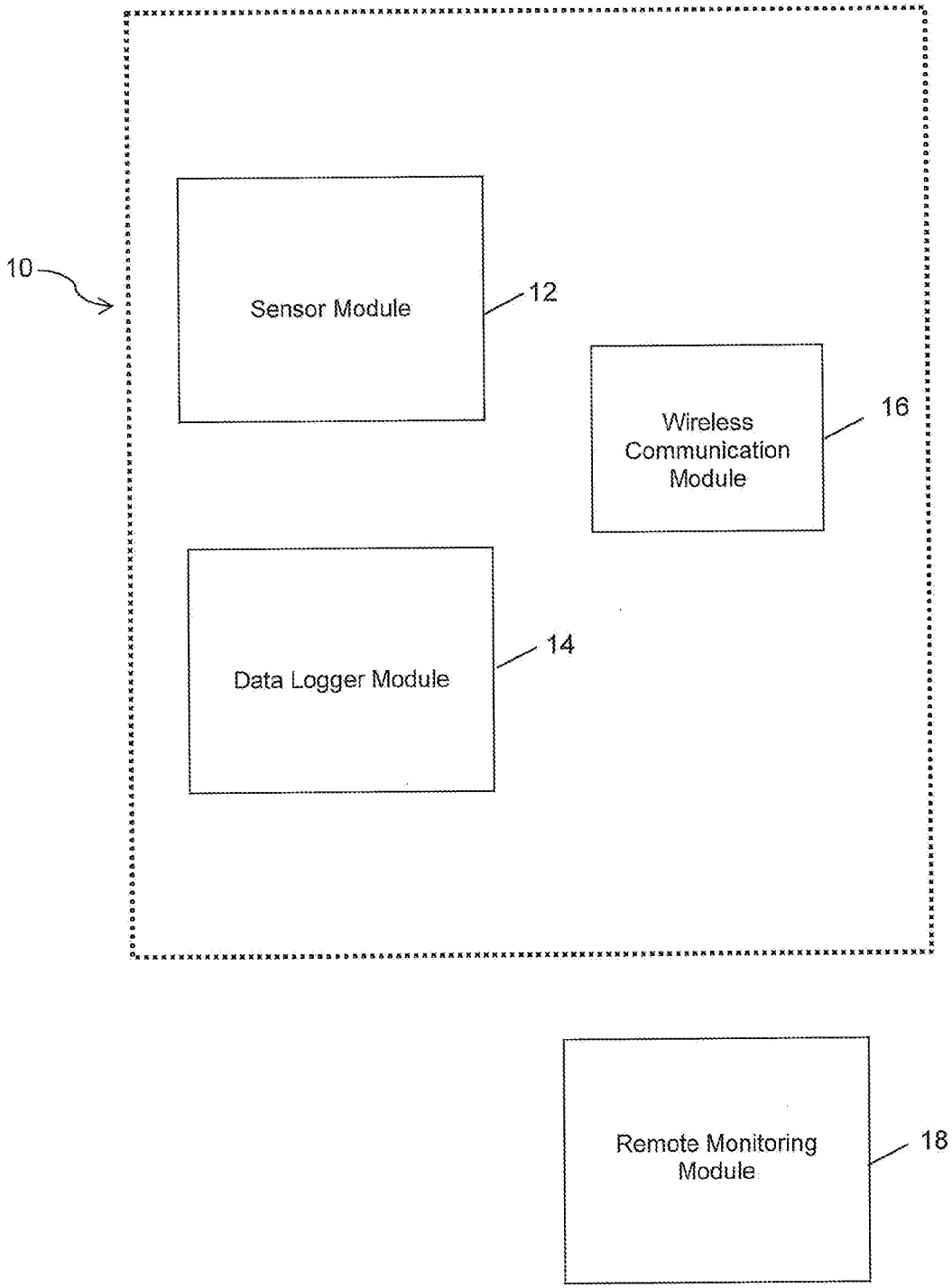
10
Sensor Module
12
Wireless Communication Module
16
Data Logger Module
14
Remote Monitoring Module
18

Figure 1

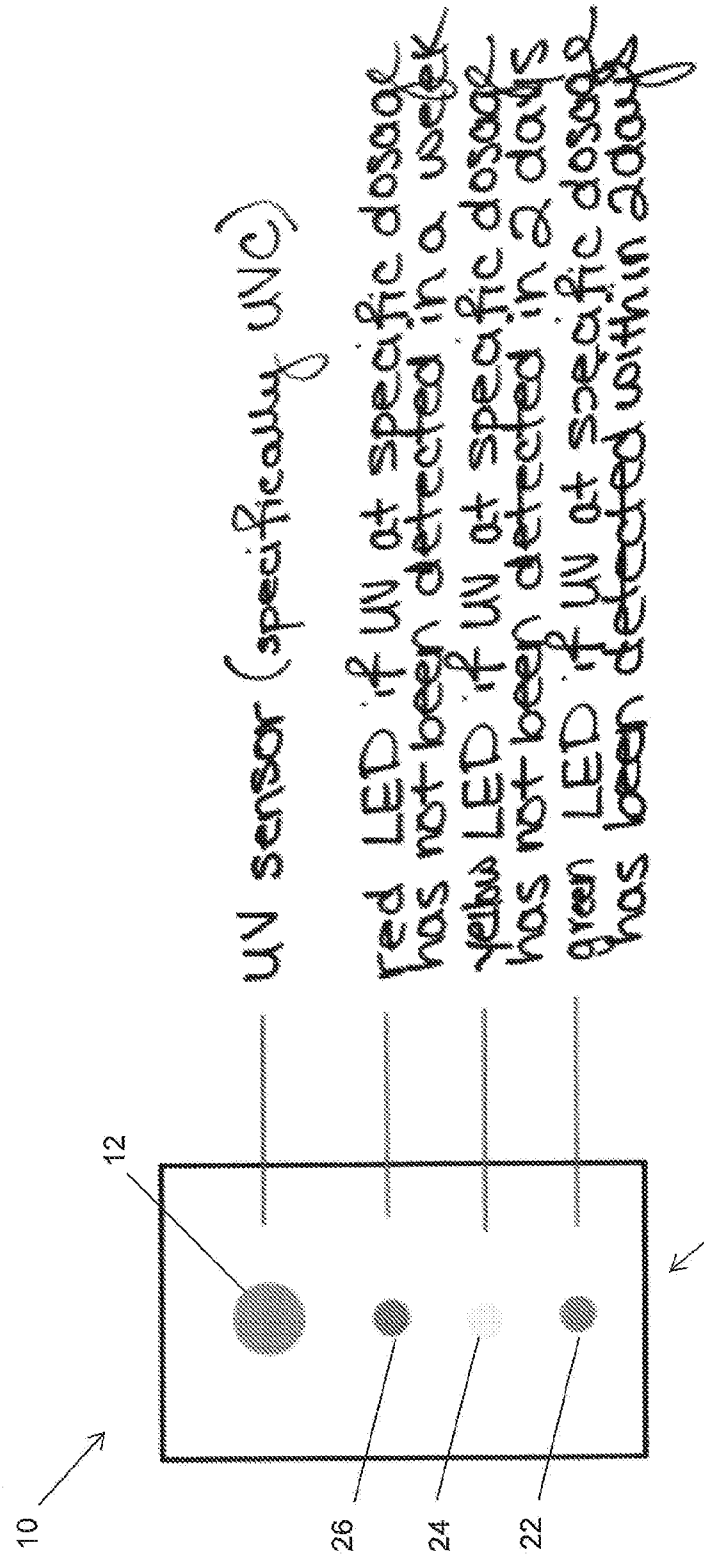
UV sensor (specifically UVC)
Red LED if UV at specific dosage has not been detected in a week
Yellow LED if UV at specific dosage has not been detected in 2 days
Green LED if UV at specific dosage has been detected within 2 days
12
20
10
26
24
22

Figure 2

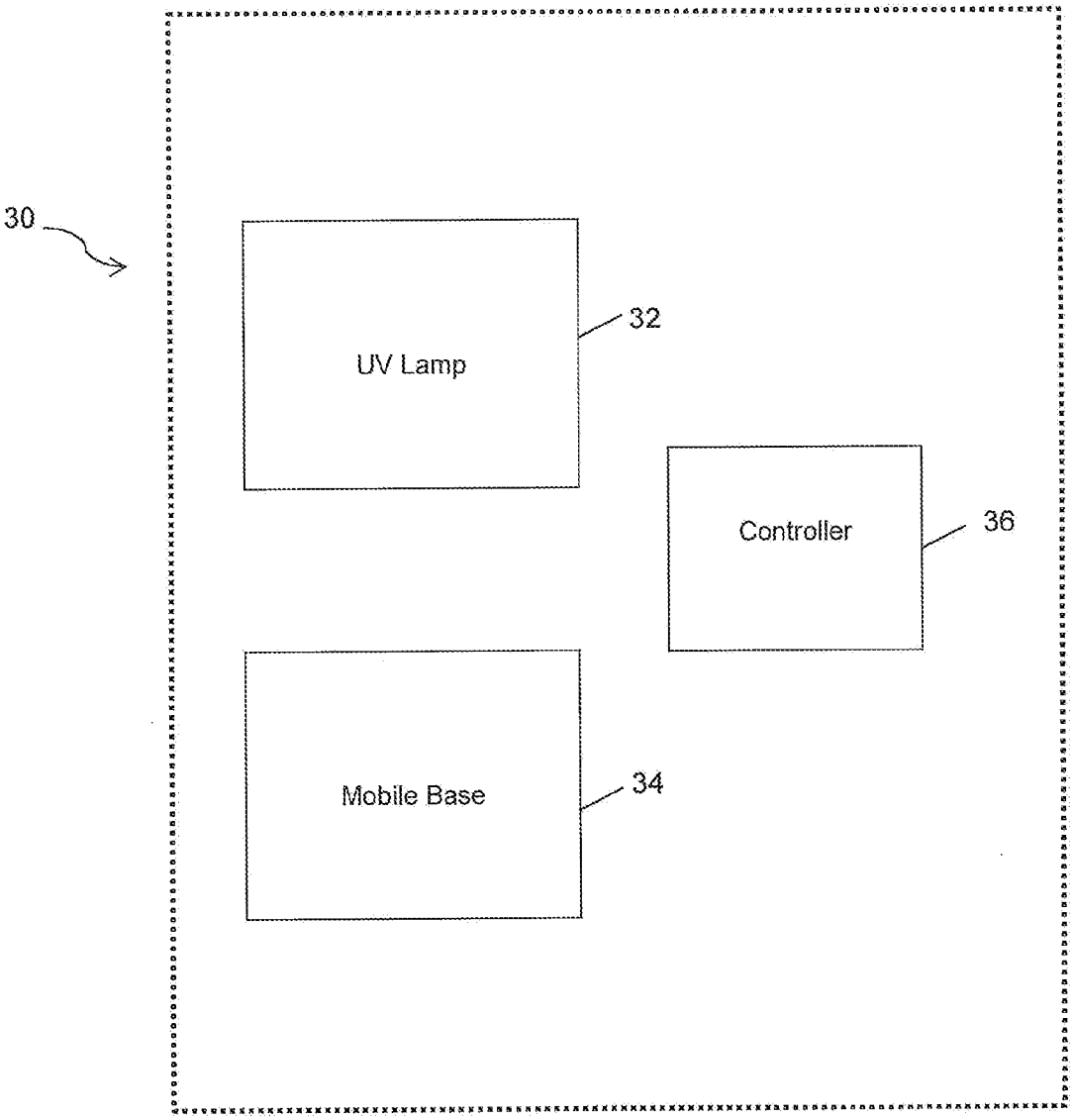

Figure 3

Figure 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2019/050242

A. CLASSIFICATION OF SUBJECT MATTER

A61L 2/24 (2006.01) A61L 2/26 (2006.01) A61L 2/28 (2006.01) A61L 2/02 (2006.01) A61L 2/08 (2006.01) A61L 2/16 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

PATENW: IPC/CPC: A61L2/24, A61L2/26, A61L2/28, A61L2/02, A61L2/08, A61L2/16; Keywords: disinfection, sterilization, hydrogen peroxide, status, monitor, track, manage, wireless, remote, communicate, transmit, and like terms; applicant and inventor names

Google and Google Patents: disinfection, sterilization, hydrogen peroxide, status, monitor, track, manage, wireless, remote, communicate, transmit, and like terms; applicant and inventor names

Applicant/Inventor names searched in internal databases provided by IP Australia

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2019	13 June 2019
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Joseph Horst AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262833177

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2019/050242

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-15

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2019/050242**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2527077 A (Specialist Hygiene Solutions Limited) 16 December 2015 Abstract, figure 2; claim 14; page 5, line 31 to page 6, line 2; page 6, lines 26-31; page 7, lines 5-13; page 8, lines 10-21; and page 13, lines 26-29	1-15
X	US 20120138818 A1 (Pugh et al) 07 June 2012 Abstract; and paragraphs 23, 24, 26 and 28	1-15
X	US 20150258234 A1 (KJØLBY-RESEARCH & DEVELOPMENT A/S) 17 September 2015 Abstract; and paragraphs 2, 24, 31, 36 and 37	1-15

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-15 are directed to a disinfectant monitoring system. The features of a sensor module configured to detect use of one or more disinfectants on a surface or in an area; a data logger module connected to the sensor module and configured to log data relating to detected uses of the one or more disinfectants; and a wireless communication module connected to the data logger module and configured to wirelessly communicate the logged data relating to detected use of the one or more disinfectants to a remote monitoring module are specific to this group of claims.
- Claims 16-21 are directed to an ultraviolet disinfection system. The features of a UV lamp configured to apply UV light to a surface or an area in a hospital; a mobile base configured to adjustably support the UV lamp adjacent to the surface or the area; and a controller connected to the UV lamp and configured to control the UV lamp to vary the UV light applied to the surface or the area are specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/050242**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
GB 2527077 A	16 December 2015	GB 2527077 A	16 Dec 2015
		GB 2527077 B	06 Jun 2018
		WO 2015189615 A1	17 Dec 2015
US 20120138818 A1	07 June 2012	US 2012138818 A1	07 Jun 2012
		US 8969830 B2	03 Mar 2015
		AR 084218 A1	02 May 2013
		AR 084688 A1	05 Jun 2013
		AR 084689 A1	05 Jun 2013
		AR 084690 A1	05 Jun 2013
		AU 2011256273 A1	10 Jan 2013
		AU 2011256273 B2	10 Dec 2015
		AU 2011256277 A1	10 Jan 2013
		AU 2011256277 B2	03 Sep 2015
		AU 2011256281 A1	10 Jan 2013
		AU 2013212127 A1	11 Sep 2014
		AU 2013217066 A1	18 Sep 2014
		AU 2013217066 B2	11 Aug 2016
		AU 2013217070 A1	18 Sep 2014
		AU 2013217070 B2	13 Jul 2017
		AU 2015203093 A1	02 Jul 2015
		AU 2015203699 A1	23 Jul 2015
		AU 2015203699 B2	15 Dec 2016
		BR 112012029420 A2	22 Sep 2015
		BR 112012029439 A2	22 Sep 2015
		BR 112012029439 B1	18 Dec 2018
		BR 112012029443 A2	13 Oct 2015
		CA 2799946 A1	24 Nov 2011
		CA 2799950 A1	24 Nov 2011
		CA 2799955 A1	24 Nov 2011
		CA 2820366 A1	14 Jun 2012
		CA 2862637 A1	01 Aug 2013
		CA 2864020 A1	15 Aug 2013
		CA 2864033 A1	15 Aug 2013
		CA 3040132 A1	14 Jun 2012
		CN 102892436 A	23 Jan 2013

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/050242**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
		CN 102892436 B	10 Feb 2016
		CN 102892438 A	23 Jan 2013
		CN 102892438 B	24 Aug 2016
		CN 102905731 A	30 Jan 2013
		CN 102905731 B	24 May 2017
		CN 103347547 A	09 Oct 2013
		CN 103347547 B	11 May 2016
		CN 104080486 A	01 Oct 2014
		CN 104221020 A	17 Dec 2014
		CN 104221020 B	19 Jun 2018
		CN 104244762 A	24 Dec 2014
		EP 2571536 A1	27 Mar 2013
		EP 2571536 B1	15 Mar 2017
		EP 2571538 A1	27 Mar 2013
		EP 2571538 B1	03 May 2017
		EP 2571539 A1	27 Mar 2013
		EP 2648771 A1	16 Oct 2013
		EP 2648771 B1	24 Feb 2016
		EP 2806904 A1	03 Dec 2014
		EP 2812035 A1	17 Dec 2014
		EP 2812826 A1	17 Dec 2014
		HK 1190102 A1	13 Apr 2017
		HK 1202462 A1	02 Oct 2015
		HK 1204455 A1	20 Nov 2015
		HK 1205004 A1	11 Dec 2015
		HK 1205300 A1	11 Dec 2015
		IL 212782 A	31 Mar 2016
		IL 212783 A	31 Jan 2017
		IL 212784 A	30 Nov 2015
		JP 2013532004 A	15 Aug 2013
		JP 5889879 B2	22 Mar 2016
		JP 2013530422 A	25 Jul 2013
		JP 5989638 B2	07 Sep 2016
		JP 2013532305 A	15 Aug 2013
		JP 5992400 B2	14 Sep 2016
		JP 2015509762 A	02 Apr 2015

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INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/050242**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
		JP 6169616 B2	26 Jul 2017
		JP 2015513412 A	14 May 2015
		JP 6181083 B2	16 Aug 2017
		JP 2015509613 A	30 Mar 2015
		JP 6246736 B2	13 Dec 2017
		JP 2014500527 A	09 Jan 2014
		KR 20130079436 A	10 Jul 2013
		KR 101838871 B1	16 Mar 2018
		KR 20130079437 A	10 Jul 2013
		KR 101838873 B1	16 Mar 2018
		KR 20130079438 A	10 Jul 2013
		RU 2012155004 A	27 Jun 2014
		RU 2012154891 A	27 Jun 2014
		RU 2012154892 A	27 Jun 2014
		SG 185610 A1	28 Dec 2012
		SG 185612 A1	28 Dec 2012
		SG 185613 A1	28 Dec 2012
		SG 10201503894Q A	29 Jun 2015
		SG 10201503900T A	29 Jun 2015
		SG 10201503901R A	29 Jun 2015
		TW 201240680 A	16 Oct 2012
		TW I554291 B	21 Oct 2016
		TW 201351180 A	16 Dec 2013
		TW I556127 B	01 Nov 2016
		TW 201200168 A	01 Jan 2012
		TW I565485 B	11 Jan 2017
		TW 201343206 A	01 Nov 2013
		TW I566788 B	21 Jan 2017
		TW 201341283 A	16 Oct 2013
		TW I597219 B	01 Sep 2017
		TW 201200167 A	01 Jan 2012
		TW 201206507 A	16 Feb 2012
		US 2013144556 A1	06 Jun 2013
		US 8942841 B2	27 Jan 2015
		US 2012138819 A1	07 Jun 2012
		US 9282796 B2	15 Mar 2016

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INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/050242**

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Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
		US 2016193378 A1	07 Jul 2016
		US 9789220 B2	17 Oct 2017
		US 2016184472 A1	30 Jun 2016
		US 9795704 B2	24 Oct 2017
		US 2011284772 A1	24 Nov 2011
		US 9872933 B2	23 Jan 2018
		US 2011284764 A1	24 Nov 2011
		US 2011284773 A1	24 Nov 2011
		US 2013144743 A1	06 Jun 2013
		WO 2011146497 A1	24 Nov 2011
		WO 2011146501 A1	24 Nov 2011
		WO 2011146505 A1	24 Nov 2011
		WO 2012078744 A1	14 Jun 2012
		WO 2013112752 A1	01 Aug 2013
		WO 2013119757 A1	15 Aug 2013
		WO 2013119761 A1	15 Aug 2013
US 20150258234 A1	17 September 2015	US 2015258234 A1	17 Sep 2015
		US 9511163 B2	06 Dec 2016
		EP 2908867 A1	26 Aug 2015
		EP 2908867 B1	21 Dec 2016
		WO 2014060051 A1	24 Apr 2014

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.