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Ultra-Violet Sterilization Robot For Disinfection

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Abstract: Ultraviolet (UV) sterilization technology is used to aid in reduction of microorganisms that may remain on the surfaces after a standard cleaning to the minimum number. A comprehensive disinfection is necessary to minimize the risk of transmission and infection of hazard diseases. Currently there is no effective fast cleaning and disinfecting technology available. Ultraviolet sterilization bot is used for disinfecting air to kill Pathogens without human intervention. Cleaning and disinfecting floor using alcohol sprayer is very effective. Pathogens can be detected using air quality sensor. The proposed robot uses this mechanism to disinfect affected regions. Automated path planning for robot is used to move from one place to other using fixed geometry. This system develops a UV robot or UV bot for sterilization in an operating or a patient room and other places like airport, hotels etc. The cleaning is done without human intervention. UV bot has three 19.3 watt of UV lamps mounted on top of the UV bot platform covering 360° direction. UV bot employed an embedded system based on a armlpc2148 to aid in navigation to avoid obstacles.

Keywords: Ultraviolet (UV), Automated, UV robot, Disinfection, Cleaning robot, Alcoholic sprayer.

I. INTRODUCTION

The goal of environmental control in the Operating Room (OR) or a patient room setting is to keep microorganisms including drug-resistant bacteria to an irreducible minimum in order to provide a safe environment for the patient and healthcare worker. At present, there are as many as 14-17% of infections in operating, and 38% of hospital infections occur in patients who have surgery. Therefore, both daily perioperative and terminal cleaning of the OR environment is one of the most effective infection control methods used to accomplish the goal in minimizing the number of microorganisms, dust, and organic debris present in the environment. However, a standard cleaning procedure via cleaning solutions by human alone cannot reduce the number of these microorganisms as there are many blind spots or unreachable areas such as walls and ceiling. Recently, a type of Ultra- Violet (UV) could aid hospitals in ongoing battle to keep microorganisms from lingering in patient rooms and causing new infections [2]. That particular wavelength range which can eradicate microorganisms is in the range of 200-280 nm, also known as C band of UV light (UV-C). This wavelength range is effective in inhibiting bacteria, viruses, and fungi. In addition, it can be used to sterilize in air, in water, on the surface, and very effective when using disinfection in the OR. Currently, fixed UV sterilization system has many limitations in use. For instance, a UV exposure is harmful to users if they are exposed for a long time or in a very large quantity. It can cause redness of the skin and eye infections (conjunctivitis) or ceiling lamp types. Furthermore, it cannot be used to disinfect in some areas hidden under the shadow of the object. To eliminate all the aforementioned issues, our research team designed a UV robot or UV bot that can either manually or autonomously (using machine learning or ML) navigate around a room including avoiding obstacles enabling it to thoroughly sterilize the entire OR with or without human intervention.

II. LITRATURE SURVEY

Algorithm Design and On-Field Measurements to Improve Surface Disinfection Against SARS-CoV-2 Ultraviolet type-C irradiation (UV-C) is an effective no-contact disinfection procedure for surfaces and environments. This work evaluates the effect of the adoption of mobile robots for UV-C irradiation, compared to conventional disinfection methods based on static UV-C lamps. On-field evaluation was conducted to measure the energy dose delivered by a robot-based moving source of UV-C radiation at different locations in an indoor environment. The effectively released radiation dose was experimentally measured using distributed UV-C-sensitive detectors, considering all of the environmental factors involved. A paper on this article proposes a novel trajectory planner consisting of a genetic algorithm (GA) that explores the possible trajectories and disinfection outcomes of a robot moving in a tuneable artificial potential field (APF) and is capable of maximizing the delivered UV dose based on ambient geometry. Compared to a conventional trajectory, an optimized one has better performance in terms of both the coverage of the radiated energy in the environment and the time required to complete the disinfection task [1]. There is a need of developing portable, cost effective, handheld, low–powered, easily manoeuvrable, easy to use and yet very effective sanitization bot that can help disinfect indoor environments. A research developed a bot, Portable Sanitization Locomotive Bot on similar grounds that can maneuverer

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indoor as per the path laid by the user. Regarding field trials it showed how accurately it can follow the bends with respect to the speed at which it navigates & the result have been very promising so as to have a commercial deployment [2].

The system consists of a floating robot mounted with a PLZT pyroelectric transducer and an air table with air nozzles and blocks. The robot uses the PLZT element to convert the optical energy to electric energy. Illuminating the PLZT with ultraviolet light generates an electric voltage high enough to drive the robot. To solve the friction problem, the air bearing and air guide system are used. The air system makes it possible for the robot to travel autonomously and to be driven by small force [3]. An autonomous mobile robot can execute a path-plan autonomously to perform certain behaviours or tasks. In this system the hardware overview consists of mechanical design, motion control system, and modular subsystem of ROM20. ROM20 is an autonomous mobile robot platform that is being developed at the Research Centre for Electrical Power and Mechatronics, for medical purpose. ROM20 uses four stepper motors connected to four mecum wheels. The motion control system is based on UART serial communication on each pin TX and RX of two microcontroller and blue tooth module. On top of the ROM20 is the modular which can be replaced with several subsystems such as Ultraviolet type C (UVC) lamp irradiation, disinfectant mist sprayer, and food delivery warmer.ROM20 can be controlled via Bluetooth communication with a distance up to 22 meters. The space used by ROM20 for maneuverer in any directions is around 63 cm × 63 cm of square tile [4].

Besides floor dusting, the robot must also be capable of sanitizing the wall up to maximum possible height. The designed robot is intelligent enough to cover both simple and complex path as per requirement, which makes it usable in all possible conditions. For security purposes, ultraviolet light is adjusted in a way that does not harm human while it is exposed to a particular section of the surface for an allowable time. All these working mechanisms are assembled in such a way that enables robot to work round the clock with maximum cleaning efficiency and trouble-free control [5].

To disinfect a wide range of surfaces, the robot has an arm with six degrees-of-freedom in addition to a wheeled platform. The wheeled platform attaches tube lamps on each side and underneath in the orientation perpendicular to the moving direction, and the robot arm has a spot UVC lamp. A method for projecting surface dosage using light properties is proposed and validated using the sensor measurements from the robotic system. A technique for creating a disinfection map is presented to prove surface disinfection of the environment in three-dimensional space. The developed robot was tested in an indoor environment with typical structures [6].

For various material-processing applications with robots we propose the use of high-power continuous wave and pulsed lasers and optical waveguides for delivering high powers in the ultraviolet (UV) regions. the use of low-loss silica glass fibre waveguides for delivering high-power laser beam in the UV to near-IR spectral region (0.3 to 2 μm), and the use of a waveguiding articulating arm for delivering high-power laser beam in the long IR (2 to 10 μm). We also describe a design for fitting a CO 2 laser waveguiding arm to the robotic arm, as well as the advantages of using optical waveguides for high-power laser delivery to robots for material processing [7].

The Sensor-Units are intelligent and smart enough to process the Sensor-Data and determine the Status as Normal, Alert or Alarm Condition and report the Sensors' ID, Location, Status, Date/Time, etc. to the Reporting Station (RS). The RS will transmit the status-information through a Base Station to a Centralized Monitoring Station (CMS). The CMS will display the Status of the Sensors for each Zone in real time and generate the Service-Report as required. The Sensors can be Stationary or Mobile and the Locations of the Stationary Sensors are pre-defined as Zone/Sub-Zone/X-Y Grid, while the Locations of the Airborne Sensors are determined with the help of the WiMAX System. The Sensor-Units, having low-power consumption, will be Solar-powered. The proposed System is based on Wi-Fi/WiMAX, having 'Broadband Wireless Technology' and Bi-directional (Symmetric) Communication Links. The System has several Applications, such as transmitting and receiving Voice, Data, Messages, Graphs, Images, Video and Multimedia [8].

It is almost impossible to secure the reproducibility and stability of a commercial thick-film metal oxide semiconductor gas sensor since it is very difficult to keep the consistency of the manufacturing environment. Thus, it is widely known that the general semiconductor-oxide gas sensors are not appropriate for the precise measurement systems. A research paper shows us that the output characteristic analyser of the various thick-film metal oxide semiconductor gas sensors that are used to recognize the air quality of an office/room are proposed and examined. The analysed output characters in normal air chamber are grouped by sensor ranks and used to fill out the characteristic table of the thick-film metal oxide semiconductor gas sensors. The characteristic table is used to determine the rank of the sensor that is equipped in the current air cleaner system of an office/room. The proposed air control system can also adapt the on-demand operation that recognizes the history of the office's/room manual-control [9]

III. SYSTEM DESIGN AND ARCHITECTURE

The block diagram and the flow chart is mentioned as follows.

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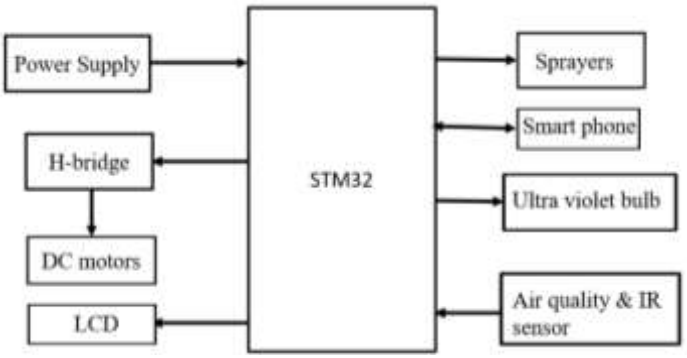

FIG 1. BLOCK DIAGRAM

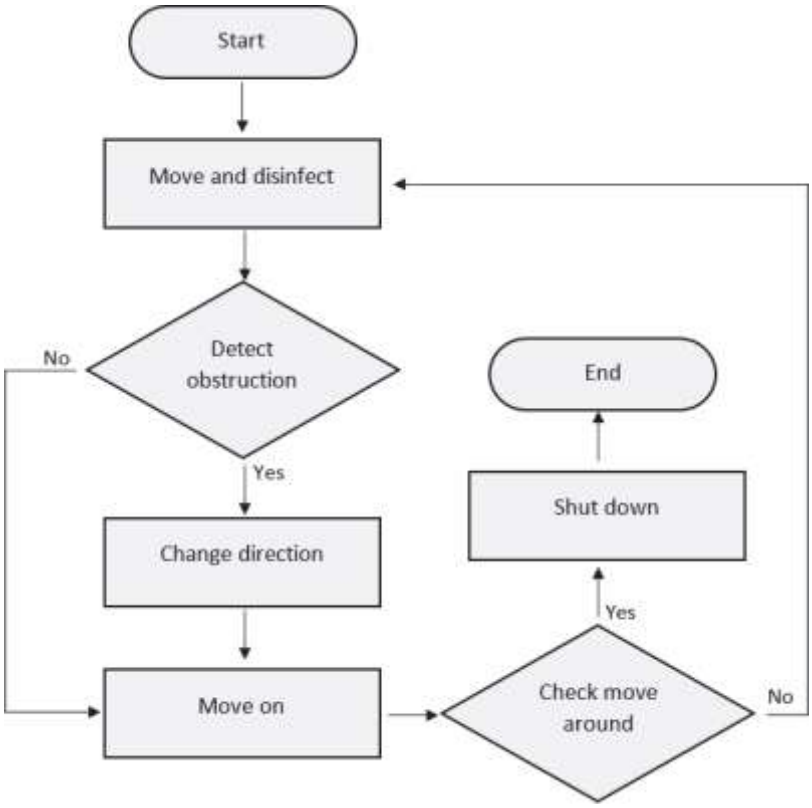

FIG 2. FLOW CHART

IV. ADVANTAGES

- It is used for cleaning hospital and airport.
- It can be implanted in medical sections.
- Comparing to the previous technology, a cost effective and simple
- It can be used in home cleaning.

V. CONCLUSION

From the experimental results of disinfection test, the UV bot requires at least 8 seconds in order to completely eradicate a medium size room. Some of the main reasons can be explained as follows. Firstly, there is a large discrepancy between the listed output power (19.3 W) by the UV lamp manufacturer and the actual output power (5.3 w). UV bot will be able to move around a room and avoiding obstacles by using a wireless control system via the website by connecting through the same Wi- Fi network enabling it to thoroughly sterilize the entire operating rooms. This system can be used in hospital used in different medical sections, implanted in industrial applications and in home cleaning.

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REFRENCES

[1]. Tiseni, L., Chiaradia, D. & Gabardi, M., 2021. *UV-C Mobile Robots with Optimized Path Planning: Algorithm Design & On-Field Measurements to Improve Surface Disinfection Against SARS-CoV-2*. Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/document/9335055/>
[2]. Ray, A. & Ray, H., 2021. *PSLB: Portable Sanitization Locomotive Bot*. Ieeexplore.ieee.org. https://ieeexplore.ieee.org/document/9270096
[3]. Ieeexplore.ieee.org. 2021. *Micro optical robotic system with cordless optical power supply*. online https://ieeexplore.ieee.org/document/583866
[4]. Baskoro, C. & Maja Saputra, H., 2021. *An Autonomous Mobile Robot Platform for Medical Purpose*. https:doi.org/10.1109/ICSEEA50711.2020.9306161
[5]. Rai, A. and Chaturvedi, C., 2021. *Autonomous Disinfection Robot*Ieeexplore.ieee.org. Available at: https://ieeexplore.ieee.org/document/9362728
[6]. Conte, D. and Leamy, S., 2021. *Design and Map-based Teleoperation of a Robot for Disinfection of COVID-19 in Complex Indoor Environments*. [online] Ieeexplore.ieee.org. Available at: https://ieeexplore.ieee.org/document/9292625
[7]. Lin, C., Beni, G. and Hackwood, S., 2021. *High-power lasers and optical waveguides for robotic material-processing applications*. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/document/6769990/>
[8]. Devendra, S., Verma, K. and Barhari, P., 2021. *Design and Development of WINGSNET (Wireless Intelligent GPS-Based Sensor Network) System for Monitoring Air Pollution and Radiation Based on WiFi & WiMAX Communication Network*. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/document/7035725>
[9]. Y. Kim, J., W. Kang, S. and Z. Shin, T., 2021. *Design of a Smart Gas Sensor System for Room Air-Cleaner of Automobile -Thick - Film Metal Oxide Semiconductor Gas Sensor*. [online] Ieeexplore.ieee.org. Available at: https://ieeexplore.ieee.org/document/4107315

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