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Sanitization and Sterilization Robot Ultra Violet Based

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ABSTRACT

In recent years, the demand for effective and efficient sanitization and sterilization methods has surged due to the increasing concerns over infectious diseases and the need for maintaining clean environments. Ultraviolet (UV) based sanitization and sterilization robots have emerged as a promising solution to address this demand. These robots utilize UV-C light, which has germicidal properties, to eliminate harmful microorganisms on various surfaces. This abstract presents an overview of UV-based sanitization and sterilization robots, discussing their working principles, advantages, and limitations. The robots employ manually controlled-navigation systems with camera surveillance to detect and sanitize target areas efficiently. They offer several advantages, including non-toxicity, broad spectrum effectiveness, and time efficiency. Overall, UV-based sanitization and sterilization robots have the potential to significantly contribute to maintaining clean and pathogen-free environments, benefiting diverse industries such as healthcare, hospitality, and transportation.

UV-based sanitization and sterilization robots have gained significant attention as an innovative solution for combatting the spread of infectious diseases and ensuring hygienic environments. This paper provides an in-depth analysis of UV-based sanitization and sterilization robots, focusing on their operational principles, key features, and potential applications. These robots employ UV-C light, a short-wavelength ultraviolet light, to disrupt the DNA and RNA of microorganisms, rendering them inactive and incapable of replication. They offer several advantages, including rapid disinfection, cost-effectiveness, and the ability to access hard-to-reach spaces. However, challenges such as shadowed areas, limited effectiveness on porous surfaces, and the need for proper safety precautions must be addressed. Further research and development efforts are essential to optimize their performance, address limitations, and ensure widespread adoption of this technology.

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INTRODUCTION

Surgical site infection (SSI) is an important problem in terms of treatment and care. 7% of patients in developing countries and 10% in developing countries are at risk of at least one SSI. The purpose of workplace disinfection is to minimize disease control, including nonresistant disease. To ensure a safe environment for patients and doctors, underwent antiseptic procedures. Approximately 19-23% of infections occur in the operating room, and 37% of nosocomial infections occur in active patients. Therefore, preoperative and terminal disinfection of the operating room is the best preventative method used to complete the work affecting microbial enumeration and other organic waste in operating theatres and other child care centres. Hospital operating rooms are cleaned and disinfected by exposed personnel to prevent surgical site infections (SSI) and infections from infectious agents. Detergents and disinfectants for decontamination in hospitals are provided by expert committees. However, hand washing and disinfecting is time consuming. Different cleaning and disinfection

procedures, wrong choice of detergent or disinfectant, and not providing the necessary contact time for disinfectants can be beneficial in standard procedures. Inspection proved that more than 50% of the living space was not clean due to numerous blind spots and crevices located in inaccessible places. In the ultraviolet spectrum, the specific wavelength range has the ability to inhibit bacterial growth in the range of 200-280 nm. This line is located in the C band of the ultraviolet (UV) region. This wavelength competition is effective in controlling the spread of almost all types of bacteria, viruses and fungi. Previous reviews have described disinfection procedures that use UV-C radiation in addition to cleaning and disinfection and can reduce the risk of contracting SSIs. UV-C radiation with a wavelength of 200-280 nm is best at destroying the DNA or RNA structure of bacteria. Therefore, the UV C band is considered "pathogenic" in nature.

LITERATURE SURVEY

Between 2019 and 2020, people are facing one of the deadliest viruses of the decade. The most commonly used methods suggest isopropyl alcohol, bleach, and hydrogen peroxide. Most are in liquid and spray form for surface disinfectants. The article talks about a robot that can clean continuously without human intervention. The robot is designed to ensure that there is no human contact between the hospital's disinfection process and the factory where chemicals are sprayed, preventing the spread of the virus in any area. [1]

Obesity plays an important role in economic and clinical or medical burden in the world. Increase the effectiveness of infection control and reduce the time and resources used in the disinfection process as technology standards evolve. The routine is not good because we can take it as an example of covid 19. People are not afraid of disinfection which causes a virus outbreak. Do not repeat this type of behavior in the future. [4], [5].

The development of a UV robot is to use a UV-based robot that can be remotely controlled and used to disinfect the area or room where the robot is used, and a reflective plate when it is reflected where the light is. used to disinfect rooms or areas [6]. Everything in this robot is controlled by the microcontroller used in the system design. This has the advantage that the area or room can be free from non-human bacteria or viruses, which is great because no one has to risk their lives and clean the area, which is easy to do in remote areas. [6]

Another important technique is to design the intensity of UV light used for disinfection and test the efficiency of the system through a piece of glass or cloth or a top or tube set to test the effectiveness of the robot. [5]

The light is very important to check the presence of the light that comes out of it and does not harm the eyes and human skin, it has the safety of using a virus and germ disinfection system, which makes the place safe. [9]

UV robots or UV bots for sterilization in operating theaters or patient rooms. The UV shoe has 3 19.3 watt UV lamps on top of the UV shoe platform that covers 360°. The UV bot is used in a system that helps robots navigate and avoid obstacles on the Raspberry Pi platform. This project was completed by testing the ability to destroy the DNA of Staphylococcus Aureus [10]

UV is used in this project because it has germicidal properties, especially against bacteria and viruses, but it is also harmful to humans. An updated robot that follows a predetermined path is used to operate the robot without human intervention. Uses a UV 3 20W lamp to spread the light in all directions [3]

As it has been mentioned that UV radiation is harmful to humans, in systems like Arduino, many components combined with PIR sensors are placed in the robot to detect human interference. If humans/humans or animals/animals are detected, the robot will eliminate bacteria and viruses when the disinfection process stops in their presence.[2]

Move around the user's sleeping area, using an infrared sensor. UVC light.207-222nm long helps to close around to disinfect the germicidal effect. The robot's power requirements were tested to ensure that the PSLB could run for 5 hours straight at a speed of 2 meters per second.

Ultra Bot technology has the ability to offer optimal autonomous disinfection performance while protecting people from exposure to UV-C radiation. This study demonstrates the mechanical and electrical feasibility of the UltraBot design, as well as the implementation of low- and high-level control systems. Experiments demonstrate the efficiency of the robot localization module and the optimal trajectory for UV-C disinfection. [7]

The results of UV-C disinfection revealed a 94 percent reduction of bacteria (TBC) at a distance of 2.8 meters from the robot. This study highlights the importance of infection prevention control (IPC) in providing quality care. As the prevention of antimicrobial resistance (AMR), IPC is an important factor in patient safety and quality decisions in auxiliary devices. [6]

The main goal of IPC is to prevent the spread of infectious diseases and their pathogens, and to prevent the spread of pathogens and AMR. The main purpose of the note is to create a safe and quality atmosphere, especially in HOSPITAL. A completely new infection disinfection method and UV disinfection mechanism are planned for most sterilizers for hospital rooms. Programmed bots kill germs at other times. [4]

Authors of papers [11], [12], [13], [14] have worked on Photoplethysmograph which will help in non invasive diagnosis of diseases.

In paper [15], 16], [17], [18] author Power Supply Rejection Ratio (PSRR) is the capability for the DA to reject any noise being induced from the power supply.

Paper[19], [20] work on images of original OFDM systems.

The bot uses ultraviolet rays that travel several meters and eradicate nearby areas. These bots are more efficient than humans and help clean areas and prevent infections. The mechanism is controlled remotely via a mobile app to avoid direct contact and eliminate cross-contamination. [3]

C (UVC) light with a wavelength between 207nm-222nm can eradicate bacteria by inactivating bacteria such as sweet potato whitewash (infectious agents that develop immunity to chemical disinfectants), contributing to the fight against the Covid-19 virus. [2]

Therefore, this device saves time and can reduce cleaning costs compared to chemical disinfection. Numerical model of the radiation field around the UV disinfection robot.

From [1], we have utilized information or findings related to the use of a UV-C disinfection robot in routine cleaning processes, particularly in an academic hospital setting. From [2], we have incorporated the concept or ideas related to an ultra-violet sterilization robot designed for disinfection purposes.

From [3], We have used with technical guidance, system architecture, and integration approaches for developing your own UV-based sanitization and sterilization robot. From [6], we have explored the applicability or insights regarding the use of Robot-O assisted UV disinfection in the field of radiology. From [9], we have incorporated survey data or information related to surface disinfection robots utilizing UV light and liquid sanitizer.

METHODOLOGY

Sl. No.	Components	Quantity
1.	ESP32 Cam	1
2.	ESP8266	1
3.	Dual channel Relay	1
4.	DC pump	1
5.	9V Battery	3
6.	4-Wheel Chasis	1
7.	UV LED	2
8.	L298N	1
9.	LCD	1
10.	I2C Converter	1

Table 1: Components Required

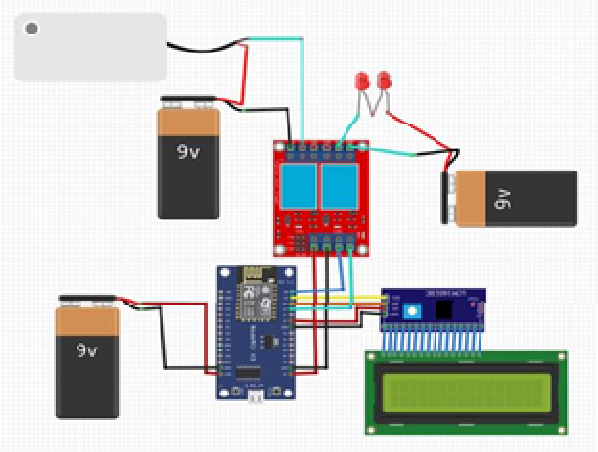

Figure 1: Circuit Diagram of LCD, LED and Sanitization control

The interfacing of the LCD and the UV LED's and Sanitizer using Dual Channel Relay is shown in the above figure. After the ESP8266 NODE-MCU connects to the Wi-Fi that it is programmed to connect to, using a GUI the Webpage through which the LCD, LED and sanitizer that can be controlled can be accessed. The IP address through which the GUI can be accessed is shown on the LCD display when the Robot is started.

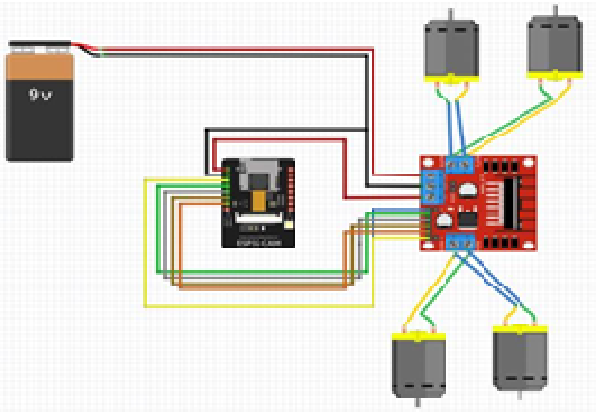

Figure 2: Circuit Diagram of Robot Directional Control

The interfacing of the ESP32 cam with the motors through the motor driver is shown in the figure. The

ESP32 cam module releases a Wi-Fi signal with the SSID and Password that it is coded with.

By connecting to the Wi-Fi module we can access the GUI to control the Robot. The GUI consists of a block that shows the positioning of the robot using surveillance camera of the ESP32 cam. The GUI also has the controls of the motors for the directional control of the robot. The GUI also has two sliders. One slider for the speed sensitivity and another slider for the Light sensitivity of the ESP 32 cam module.

In Figure, when Wi-Fi is established, the webserver and WebSocket are created, which perform the data transmission and reception between the robot and the connected device. The front-end is created using HTML and events are created and handled in Javascript. An IP address in the Wi-Fi can be used for the connection to the robot from the connected device.

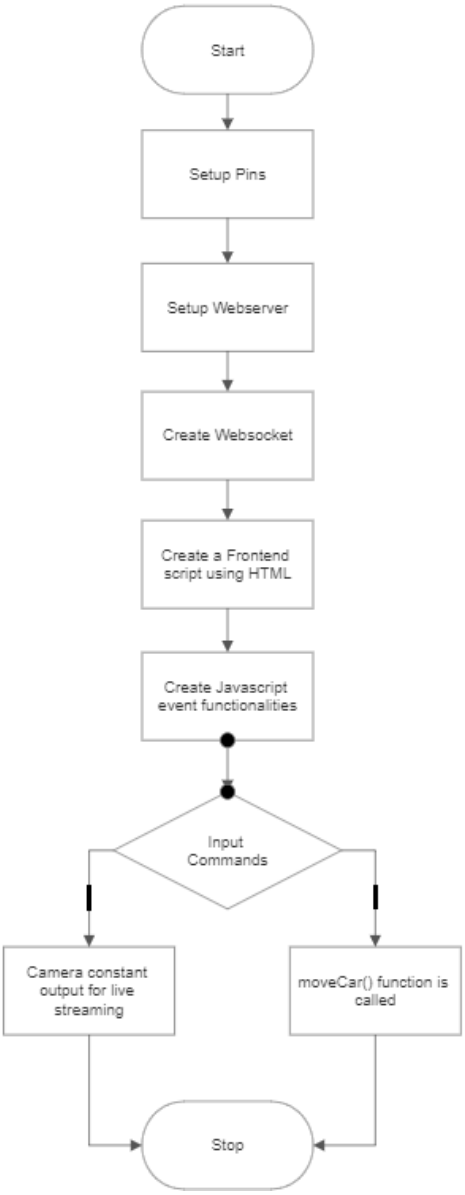

Figure 3: Flow diagram of Robot Directional Control

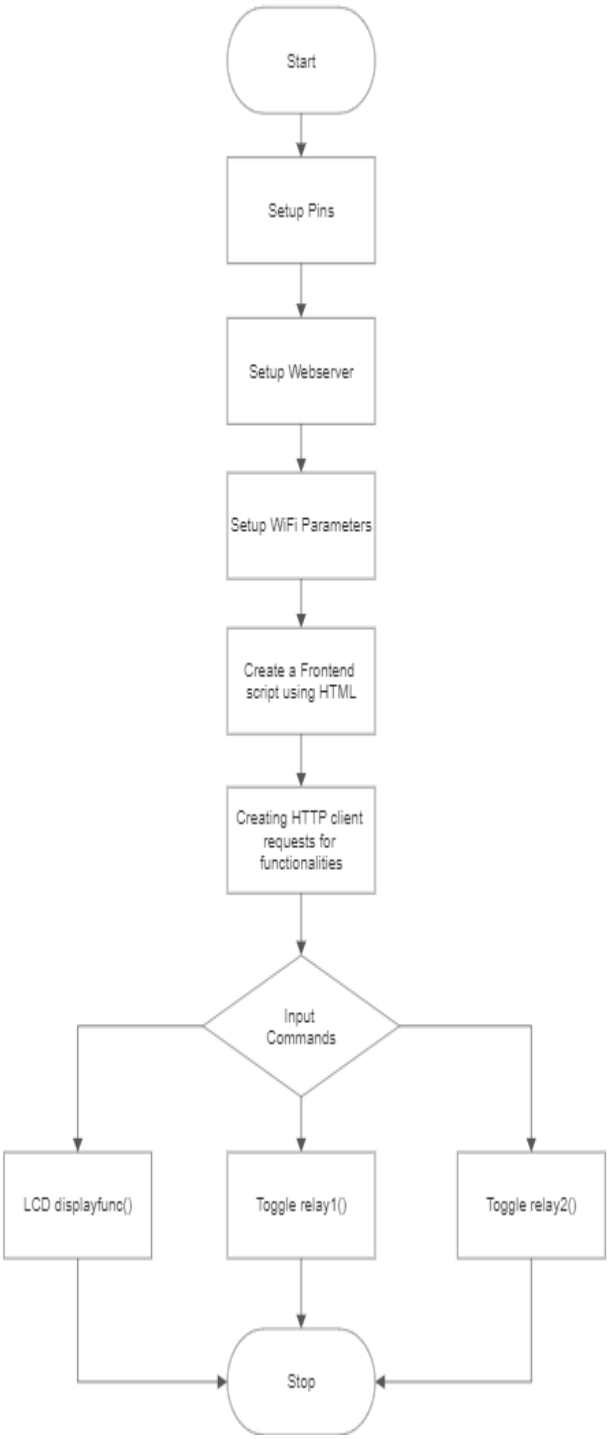

Figure 4: Flow Diagram of LCD, LED and Sanitization Control

The inputs given in the webpage call the moveCar() function which moves the robot in the required direction accordingly. In Figure, similar to the Robot direction control the Webserver and WebSocket are established. The Webpage can also be accessed form a specific IP address. The inputs from the Webpage are used to control the LCD, LED and sanitizer of the robot.

The GUI can be viewed on either a smartphone or a PC by connecting to the required Wi-Fi. We have two GUI's as shown in the below figures.

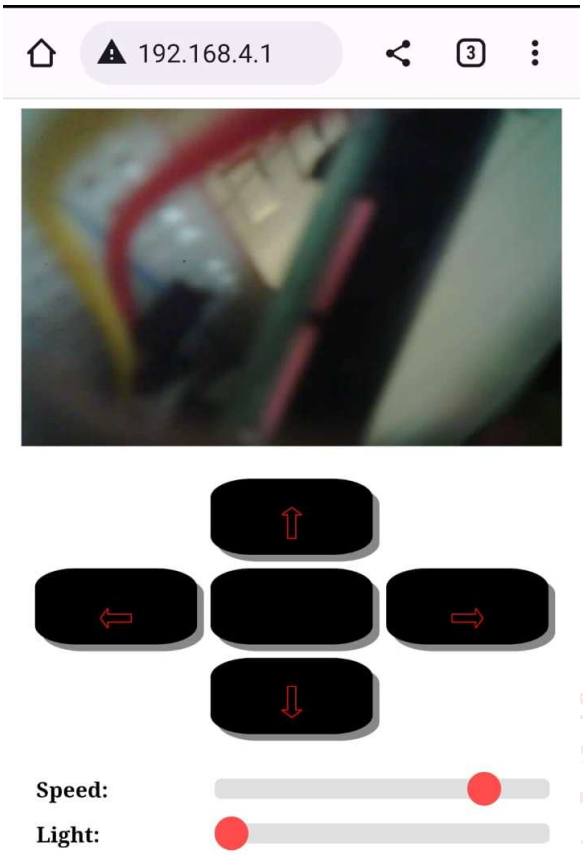

Figure 5: GUI for Directional Control

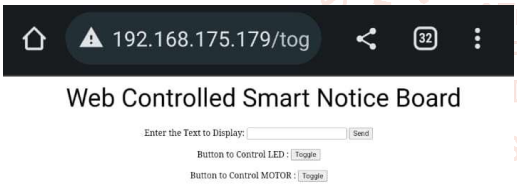

Figure 6: GUI for LCD, LED and Sanitization Control

This GUI is to control the robot using the arrows in the GUI. The upper portion of the GUI is used for surveillance of the robot to find the positioning of the robot. The slider present in the bottom are for controlling the speed and light sensitivity of the robot.

This GUI is to display the required text on the LCD and to toggle the UV LED's and the sanitizer of the robot.

RESULTS

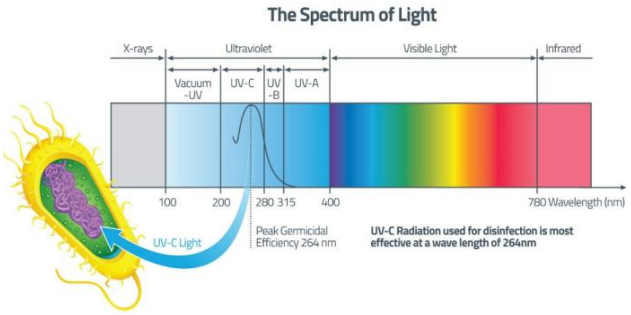

Figure 7: UV light on Light Spectrum

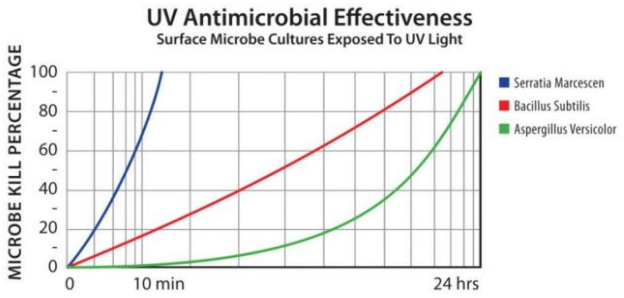

Figure 8: UV light disinfection percentage

One of the major advantages of UV-based sanitization and sterilization robots is that they can quickly and effectively sanitize a variety of surfaces, including hard-to-reach areas such as under tables and in corners. They also do not require any chemicals or consumables, making them a more environmentally friendly and cost-effective solution compared to traditional cleaning methods.

However, there are some limitations to the use of UV-based sanitization and sterilization robots. First, the effectiveness of the robot depends on the intensity and duration of the UV-C light exposure, as well as the distance between the light source and the surface being sanitized. Second, these robots can only disinfect surfaces that are directly exposed to the UV-C light, which means that surfaces that are hidden or obstructed may not be effectively sanitized.

Finally, UV-C light can be harmful to humans and can cause skin and eye damage if proper safety measures are not taken. Overall, UV-based sanitization and sterilization robots have shown promise in reducing the risk of infection transmission, particularly in healthcare settings. However, proper safety measures must be taken to ensure that they are used safely and effectively. Ongoing research and development of UV-based sanitization and sterilization robots will likely continue to improve their effectiveness and expand their potential applications.

The harmful micro-organisms on the floor is sterilized by Ultra- violet LED. The UV LED destroys the DNA/RNA of the microorganisms using the powerful UV radiation. This is an eco- friendly method as UV light does not leave any residue. It is very essential to design the device in way that UV-C radiation will not affect the humans or its rays will not come in contact users. Here, we have developed the design that follow the certain guidelines of using UV-C light and it will not affect the humans as it is very dangerous to direct exposure [6].

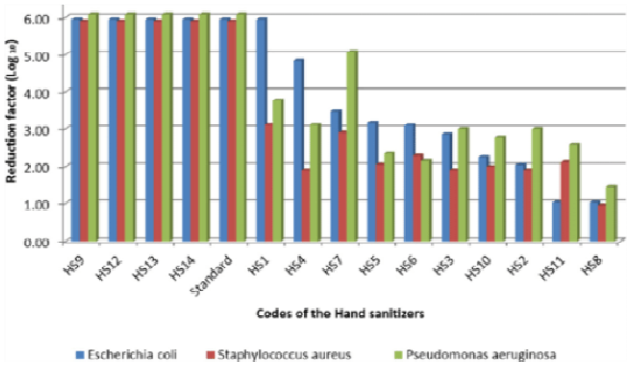

Figure 9: Effect of different sanitizers on different bacteria

Disinfection Type	Advantages	Disadvantages	Approx cost
Isopropyl Alcohol	Readily Available	Expensive, does not work	2500
Bleach/Hydrogen Peroxide	Readily Available	Expensive, does not work	500
UV Robot	Portable	Initial Cost is high	30

Table 2: Advantages and Disadvantages based on disinfection type

CONCLUSION

The robot is made with a phone application and, as we said at the beginning, it can be easily controlled with a remote or phone without human contact and without contact from the field. disease or illness. Preventing infection or disease can be avoided by using these techniques and technology, and in the future, more technology like this will be used to prevent rapid diseases like covid 19 that will help people, be good and beneficial. in many areas of interest, such as using robots to kill viruses or diseases. Disinfection and disinfection techniques in an epidemic situation. People will be affected by the disease when they are directly involved in the disinfection process. Book cleaning is a time-consuming process and also requires the work of a large number of people. In this case, surface disinfection robots are the best solution. The robot has the ability to disinfect areas that humans cannot reach. One of the main advantages of UV-based disinfection and sterilization is their versatility. They can be used in many places, including hospitals, schools, offices and public places. They can be designed to navigate harsh environments, paint surfaces as they move, and use UV-C light to kill bacteria. They can also be operated remotely, allowing operators to control their power and turn on the UV-C light. As a result, UV-based disinfection and sterilization robots have revolutionized the way we disinfect spaces. They offer a safe, nontoxic and environmentally friendly way to keep our environment clean and safe. As we move forward, we can expect UV-based robots to play a larger role in public health and safety.

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