Sanitizer Robot Using Raspberry Pi

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Abstract

For Sanitizing hospital rooms with human effort is not an easy task. It increases the chances of contracting infection, leading to further spread of harmful microorganisms.

The UV sanitization robot uses the power of UV rays to kill germs and bacteria. The robot can also give a live video stream of its surroundings. With the help of WiFi, we can control the robot and its GUI allows us to drive the robot inside a hospital room without physically being there. All this enables us to sanitize the hospital room as per our requirements. By killing the germs, the UV light restricts their multiplication by destroying their reproductive system.

Keywords: Raspberry,UV,Robot,Sanitizer

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.

Because of the COVID-19 virus, human lives and livelihoods change extensively and the only way to minimizing the spread of the virus is to maintain social distancing and follow guidelines proposed by our respective government. Not to mention sanitization and sterilization have become an indistinguishable part of our daily life. Talking about sanitization and sterilization, there is a problem, we can’t directly involve in the sterilization process, because there is a chance of getting the deadly virus from the contaminated space, but what we can do to solve this problem is to build a powerful, efficient, and autonomous robot, that can sterilize a place very easily without exposing ourselves. Robots are in use for several applications where humans can be at risk of exposure. So, in this tutorial will be building an ultraviolet sanitization robot that will be able to kill the coronavirus in the hospital and apartment building, and for that, we are going to be using an Arduino, some UV LEDs, and ultrasonic sensors

Importance of project

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.

Global issue corona pandemic and lock down has slowed down the human life. The fear of infection through not only direct contact but also through surfaces likely to have been touched by infected persons has led to the cleaning of packets, containers and even vegetables with soaps and detergents. It is notable that ingestion of detergent and similar molecules itself can pose problems to human body. Thus, there is a need for developing programmable disinfection units, which automatically move the packets to be sanitized on a conveyor belt from the entry end, hold them for specified period of time under UV irradiation and then move out to the delivery end. This system will stop the possibility of detergent/soap and such molecules entering the human body . The development of above described unit will require developing codes (programs) for movement, holding and then again movement of conveyor belt to carry the packages from entry to delivery end of the proposed disinfectant system. The sensors at entry end, holding place (inside the enclosure) and delivery end will control the conveyor belt movement. Such systems will be needed in large numbers in different types of manufacturing units/factories, shops, stores for a non-touch disinfection of goods enclosed in packets. To this end, suitable codes/programs will be developed to integrate conveyor belt movement, functioning of UV light sources, and programmable holding time of packets/goods through appropriate sensors.

Components for the Project:

1. **RASPBERRY PI 4** :Raspberry Pi 4 Model B was released in June 2019[2] with a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor, on-board 802.11ac Wi-Fi, Bluetooth 5, full gigabit Ethernet (throughput not limited), two USB 2.0 ports, two USB 3.0 ports, and dual-monitor support via a pair of micro HDMI (HDMI Type D) ports for up to 4K resolution. The Pi 4 is also powered via a USB-C port, enabling additional power to be provided to downstream peripherals, when used with an appropriate PSU. The initial Raspberry Pi 4 board has a design flaw where

third-party e-marked USB cables, such as those used on Apple MacBook, incorrectly identify it and refuse to provide power.

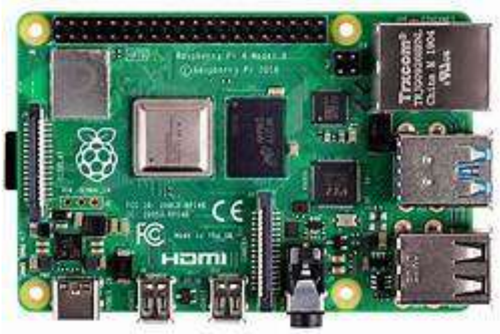


Fig 01: Raspberry Pi 4

2. **RASPBERRY PI CAMERA**: The Raspberry Pi Camera v2 is the new official camera board released by the Raspberry Pi Foundation. The Raspberry Pi Camera Module v2 is a high quality 8 megapixel Sony IMX219 image sensor custom designed add-on board for the Raspberry Pi, featuring a fixed focus lens.

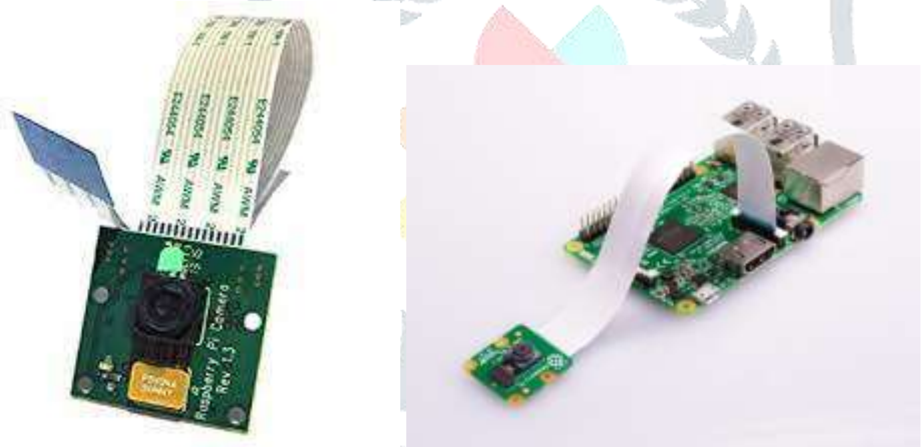


FIG 2: Raspberry Pi Camera

3. **MOTOR DRIVER**: It is an integrated circuit chip used as a motor controlling device in autonomous robots and embedded circuits. A motor driver is undoubtedly something that makes the motor move as per the given instructions or the inputs (high and low). It listens to the low voltage from the controller/processor and control an actual motor which needs high input voltage.

FIG 3: L293D Motor Driver

4. **ROBOT CHASSIS:** Chassis is a framework which supports the body of a robot. It is a vehicle frame on which one can install the body of the robot.

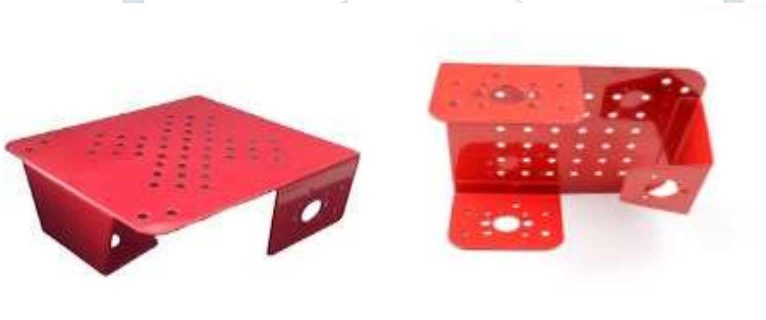
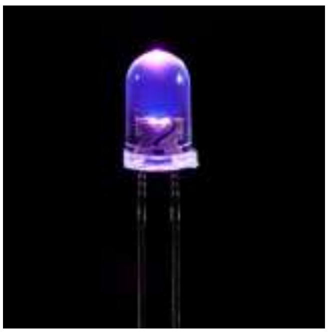


Fig 4: Robot Chassis

5. **UV LED:** LED which emits Ultraviolet Radiations Ultraviolet (UV) is a form of electromagnetic radiation with wavelength from 10 (with a corresponding frequency around 30 PHz) to 400 nm (750 THz), shorter than that of visible light UV Light wavelength for germicidal irradiation is a technology that utilizes a UV light in the range between 100- 400 nanometers. UV-C radiation (200 – 280 nm), which is considered the most germicidal wavelength range due to the fact that UV-C can inactivate microorganisms.



6. **DC Motor:** DC motors are used for the movement of the robot where itis connected with the motor driver, whenever the trigger signal is given to the motor driver then the motor moves according the trigger with the given speed.

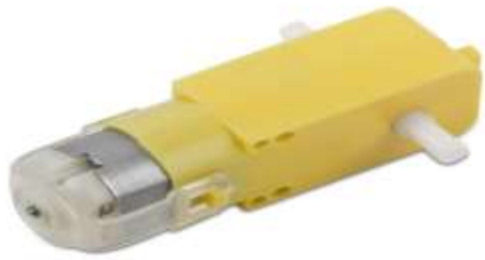


Fig 6: DC Motor

Methodology

Assemble all the components(UV LED,Raspberry Pi 4,a power source equipped with battery, Pi camera, Motor Driver) on the robot chassis and then fix the UV light on top of the robot. Place the Raspberry Pi in front of the robot in such a way that the camera can clearly view what is in front it. After that, open its screen on a remote desktop or smartphone using the VNC and then run the GUI and video camera Python code. Following Connection are made from Raspberry Pi 4 to the Motor Driver.

TEST

We controlled the Sanitizer Robot over WiFi through application made in Python.The robot was successfully able to receive and perform the given command. UV light was able to disinfect the particular area. Our fabricated UV bot is shown in Figure 7. The ability of the robot is user can control it via website by connect with same Wi-Fi network. User can control movement, speed motor and turn on-off lamp. Can observe environment by watching through the camera.

Result

With the collaboration of webcam camera and ultrasonic sensors allow the robot to avoid obstacles and move around the room. Maximum speed of our UV bot is 0 - 1.4 meter/sec and can operate via a battery is 30-45 minutes or connect to an electrical outlet.The UV light of Sanitizer Robot was able to disinfect most of germs in the given area albeit not all. There were still some harmless, **non**-pathogenic microorganisms in the area given.

Future Direction

Addition of Infrared Sensors to the robot and use of effective Mapping through help of Machine Learning as to make the robot sentient enough to avoid obstacle and other expensive medical equipment while effectively sanitizing each and every corner of the premises .It will also help in automatic locating and charging through Solar Panel enabled Charging Dock. In addition to this core functionality, the robot is equipped with a fall-detection system consisting of a video camera and a 3D LiDAR to identify patients who have fallen to the ground. The robot can notify the medical staff for the assistance in an emergency condition of a person detected by the fall detection module and remote condition monitoring module.

Conclusion

This study presents a comprehensive overview of the robotics potential in medicine and allied areas with special relation to the control of the COVID-19 pandemic. Effective management of COVID-19 can significantly reduce the number of infected patients and casualties as witnessed in the case of the Chinese outbreak. Since, it has currently turned out to be a global challenge, technologically advanced countries can aid others by donating support equipment and robotic infrastructure to enable a good outcome in controlling this disease. This review substantiates that the introduction of medical robotics has significantly augmented the safety and quality of health management systems compared to manual systems due to healthcare digitization. Classification of medical robots is only done using application-based categories to fit every aspect of hospital service ranging as well as fault tolerant control and dependable architectures for reliable and safe operation within the healthcare facilities.

Acknowledgement

We the authors of this project paper acknowledge the information used to prepare the paper is true to our knowledge. We also acknowledge that all the references used to prepare this paper are mentioned in the References section and they hold the copyright to that information.

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