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GSM Based Multipurpose UV-C Sterilizer

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ABSTRACT: The pandemic in the year 2019 created a serious impact in our lives which led the world into economic crisis. During this crucial period, people spent lot of money on purchasing masks, sanitizers and everyday items in the fear of reusing the things as they might spread the virus. By considering these situations, we have created a disinfecting chamber that allows not only all daily-used objects to be disinfected but also masks to be reused. In order to minimize the effect of viruses on our gadgets, different methods have been developed to clean the objects. In the previous methodologies, total 360-degree surface coverage was not achieved because the cleaning procedure was obtained either at one surface or at the bottom surface. Our project has been designed in such a way to kill viruses on the daily-used objects by rotating 360 degrees, which can cover all surfaces of the different gadgets. The design of the sterilization box is based on the Raspberry Pi Pico microcontroller, which utilizes a wavelength of 100–280 nm known as UV-C. In order to prevent transmission of viruses through physical contact, researchers designed a system that can make users access a sterilization chamber without the need to make physical contact with the device, namely by using a Bluetooth module with the help of applications that can be accessed through the user's smart device. This tool can operate using a Smartphone and media via the Bluetooth HC-05 module, so it can minimize the process of spreading COVID-19 or any other virus that occurs through Physical contact. Finally, an alert Message is sent through the GSM module. This system provides 360- degree, i.e., all-surface disinfection of the object.

KEYWORDS: Bluetooth Module, GSM, LCD display, Sterilizer, UV LED, Raspberry Pi Pico.

I. INTRODUCTION

People are still facing problems due to viruses like COVID-19, plus the number of people exposed today has increased, which in turn increases the spread of the virus through direct or indirect contact. The transmission from direct contact can be in the form of touching infected patients or objects exposed to the virus. This leads to the realization that one should not be affected by the virus. So, a method like preventing the virus before humans get touched by it would be helpful. A sterilization box is needed in order to kill viruses or pathogens on objects after daily use. The main purpose of this sterilization box is to kill the viruses on the objects we use in our daily lives, allowing us to reuse the things that are needed. It uses a shorter wavelength of 100 to 280 nm. This is the best disinfectant used for purifying water, air, sterilizing vegetables, and surgical equipment. Research has shown that the UV-C wavelength can kill harmful fungi, bacteria, and viruses like the SARS-CoV-2 virus. The construction of a low-cost UV-C sterilizer chamber where UV radiation takes place should be in a closed environment. UV disinfecting chambers have already hit the market, but one of the most important features that they all lacked was 360-degree all-surface disinfection of the object. The design of the tool is used to sterilize daily- used objects that are exposed to viruses or bacteria, such as medical equipment, face masks, clothing, shoes, food packets, money, electronic gadgets, etc. The spread of the COVID-19 virus can be reduced and even avoided by sterilizing objects before and after use. The use of a UV-C sterilization chamber not only destroys the COVID-19 virus but can also be applied to sterilize medical surgical instruments, baby equipment, work equipment, and others. This tool is designed using a Smartphone application that uses the Bluetooth module (HC-05) between the smart phone application and the Raspberry Pi Pico. In this system, we are using the GSM module, so it would be required to send the alert message to the user. Finally, using the GSM module, the data can be viewed on mobile devices.

II. METHODOLOGY

The sterilization chamber was developed to disinfect daily-used items. The box utilizes UV radiation. UV light is the best sterilizing and disinfectant agent, used for domestic as well as clinical purposes. Food packets, books, stationery, medical equipment, toys, electronic gadgets, etc. can be sterilized with UV radiation.

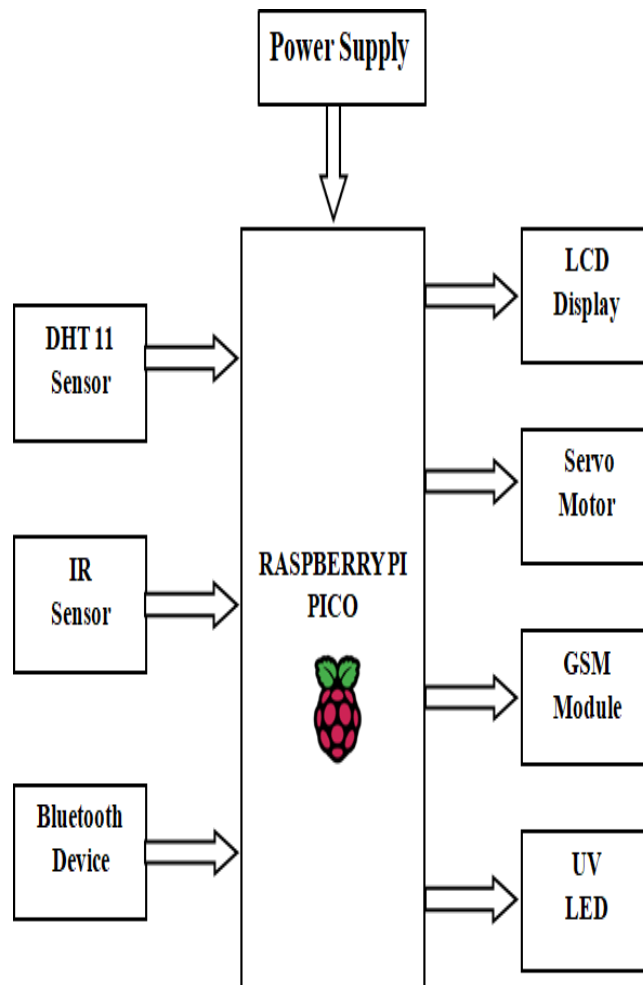


Fig.1 Block Diagram of GSM Based MultipurposeUV-C Sterilizer

From the diagram, a 5v power supply is applied to the Microcontroller board and the Servo Motor separately. The Raspberry Pi acts as the heart of the system. The Bluetooth module is used to interface between the Smartphone and microcontroller. A UV LED and temperature sensor are used for the sterilization of the device. An IR sensor is used to detect the user's hand. After detecting the user's hand, the servo motor opens the door of the sterilizer chamber. After inserting the object into the sterilizer chamber, the door automatically closes, and the servo motor is also used for the 360-degree rotation of the UV LED. An LCD is used to display the status of the sterilization chamber. Finally, an alert message is sent to the user through the GSM. In previous system the sterilization chamber is operated manually by pressing the switch attached to it and it does not have 360 degree all surface disinfection mechanism. This proposed system overcomes those limitations. Incubation with UV at 70°C for 3 minutes was found to be effective in unfolding the viruses. UV light is the good sterilizing and disinfectant agent, used for domestic as well as clinical purpose. Food packets, books, stationery, medical equipment's, toys, electronic gadgets like mobile phones, laptops etc can be sterilized with UV radiation. An alert message is sent to the user through GSM after the disinfection process.

FLOW CHART

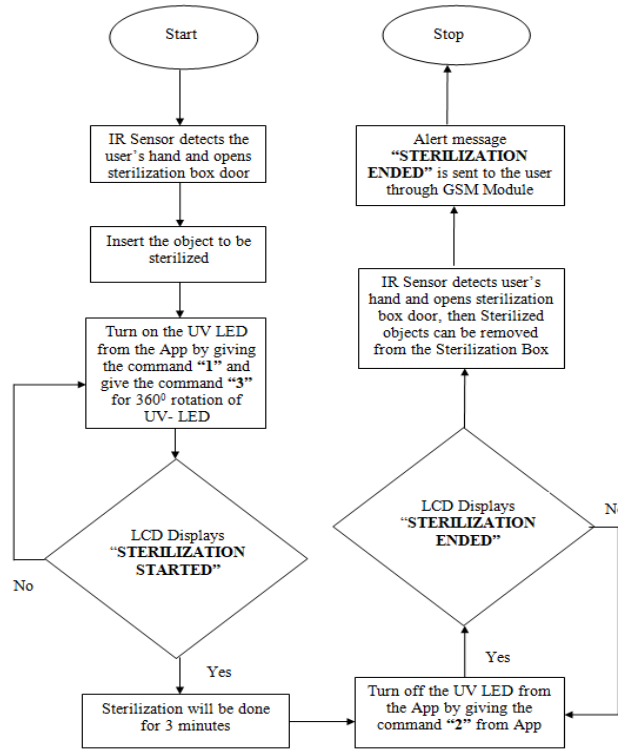


Fig.2 Flowchart

III. HARDWARE REQUIREMENTS

- Raspberry Pi Pico
- Bluetooth Device
- UV-C LED
- GSM Module
- LCD Display
- IR Sensor
- Servo Motor
- DHT 11 Temperature Sensor

RASPBERRY PI PICO:

The Raspberry Pi Pico is a low-cost; high- performance microcontroller board compared flexible digital interfaces. RP2040 microcontroller board is connected to a computer with a micro USB cable to turn it ON. A Raspberry Pi Pico has GPIO pins, which means it, can be used to control and receive input from a variety of electronic devices. GPIO pins GP10, GP11, GP12, GP13, GP14, and GP15 are connected to the RS, E, D4, D5, D6, D7, LED+, LED- pins of LCD display which



Fig.3 Raspberry Pi Pico

displays the status of Sterilization process. IR sensor and DHT 11 Temperature Sensor OUT, GND, VCC are connected to the GND, VCC, IO pins of Raspberry Pi Pico. IR sensor detects the user's hand which automatically opens the door. Temperature Sensor detects the temperature and humidity inside the chamber. Bluetooth Module pins RXD, TXD, GND, VCC are connected to the GP8, GP9, GND, VCC of Microcontroller. GSM Module RST, RXD, TXD is connected to the T, R, VCC, GND of Microcontroller.

BLUETOOTH MODULE:

The HC-05 Bluetooth module is connected to the microcontroller and Bluetooth from the user's Smartphone. Turn ON the Bluetooth on the smart phone then connect the Bluetooth module with the smart phone, by entering the default password "1234" the Bluetooth module will be paired in the phone settings. It is used as UART serial converter module and can easily transfer the UART data through the wireless Bluetooth.



Fig.4 Bluetooth Module

GSM MODULE:

GSM module is an electronic device that uses GSM mobile technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with the mobile networks. It uses SIM card to identify their device to the network. An alert message is sent through GSM to the user.



Fig.5 GSM Module

UV LED:

UV-C radiation has effectively been used to reduce the spread of bacteria or virus. The UV LED is operated by using the App that has been installed on Smartphone.

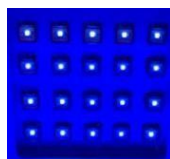


Fig.6 UV LED

SERVO MOTOR:

Normally this type of motor consists of a control circuit that provides feedback to the motor shaft; this feedback allows the servo motors to rotate with great precision. In our project it is used for opening and closing of door. And it makes the UV-LED rotate in 360.

IV. RESULTS & CONCLUSION

The Sterilization chamber was designed for disinfecting the daily used items such as face masks, wallets, food packets, currency, electronic gadgets like mobiles, laptops, etc. The Sterilization chamber utilizes UV radiation for disinfection from virus and bacteria. Our proposed methodology is operated by using Bluetooth module which can turn ON and OFF the sterilization chamber, and cleans in 360 degrees of the objects for 3 minutes which were placed inside the sterilization chamber, so this is helpful for everyone to kill the viruses. It is cost effective. We made this project more user friendly, echo friendly, and reliable. We have successfully implemented this project using Raspberry Pi Pico. Fig.7 shows the GSM Based Multipurpose UV Sterilizer with power supply.

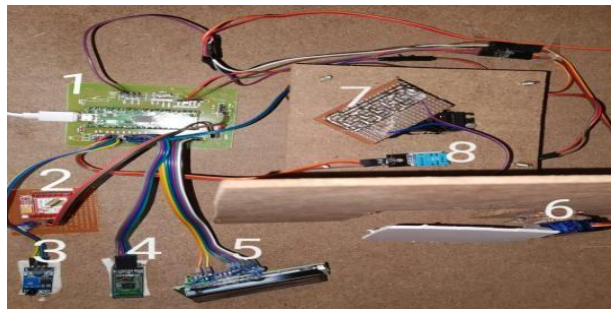


Fig.7 GSM Based Multipurpose UV sterilizer with power supply



Fig.8 Internal Circuit Diagram

The Fig.8 shows the Internal circuit diagram of the UV sterilizer in this the numbers 1-8 represents the Raspberry Pi Pico, GSM module, IR sensor, Bluetooth module, LCD display, Servo motor, UV LED, Temperature sensor respectively.

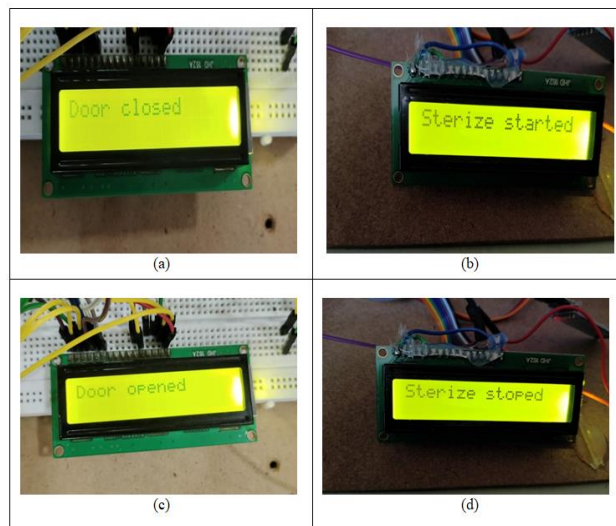


Fig.9 Sterilization Process Results at different stages

The Fig.9 (a) represents the door closed. When the IR sensor does not detect the user’s hand then door will get close which makes LCD to display **Door Closed** and Fig.9(b) represents the sterilization process will start after inserting the item inside the chamber. And in this case the LCD displays **Sterilization Started**. During the disinfection process the door will be closed. Fig.9(c) Represents the **Sterilization Stopped** after completion of disinfection process. Fig.9(d) Represents **Door Opened** when IR sensor detects the user’s hand which automatically opens the door.



Fig.10 Bluetooth pairing with App & Messages to User.

The sterilization process is performed by giving the commands through Application which is installed in the user's Smartphone as shown in Fig.10(a). When the Command "1" is given the UV LED will be turned ON this means it identifies that an object is placed inside the chamber. When the command "3" is given then the UV LED will starts sterilization, Servomotor helps the UV LED to rotate in 360 degrees i.e., all surfaces of the object will be disinfected. When the command "2" is given then the UV LED will be turned OFF, then remove the inserted object from the chamber. Finally, an Alert message will be sent to the user through GSM module, by indicating the Temperature and Humidity values in the sterilization chamber.

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