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Corona Virus Sterilizer | Food Mask Sterilizer Box

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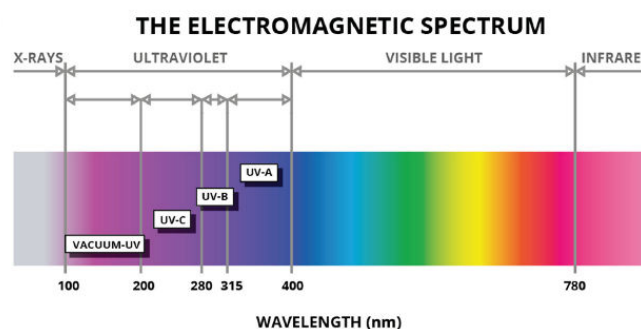
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ABSTRACT: Ultra Violet radiation, washing with soap and heating are some of the methods of sterilizing. Ultra Violet light is the good sterilizing and disinfectant agent, used for household as well as medical purpose. Packaged foods, books, stationery, medical equipment, toys, electronic gadget like mobile phones, laptops, wrist watches, etc. can be sterilized with UV radiation whereas other methods of sterilization cannot be used. UV light does not release any waste items and is eco-friendly, if used in a controlled manner UV radiation is a type of electromagnetic radiation with a shorter wavelength. UV-C, which has a wavelength of 100-280 nm, is the finest disinfectant for purifying drinking water, air, sterilizing vegetables, fruits and surgical equipments. UV-C wavelength has been demonstrated to kill dangerous fungus, bacteria, and viruses such as the SARS-CoV-2 Virus in studies. The article shows how to make a low-cost UV-C sterilization box that uses UV radiation in a sealed environment. The article describes the fabrication of a low cost UV-C Sterilization Box where UV radiation is taking place in a closed environment to protect individuals from UV radiation exposure, safety features are also considered.

KEYWORDS: SARS-CoV-2, COVID-19, Sterilization, UV radiation, Bacteria.

I. INTRODUCTION

Ultraviolet Radiation is an electromagnetic wave with shorter wavelength and high energy lying between X-rays and Visible Light spectrum. UV photons have a wavelength of 400 to 100 nanometers. UV-A, UV-B, and UV-C bands make up this spectrum. UV-A radiation has a wavelength of 400nm to 315nm., UV-B light is from 315nm to 280nm. UV-C type radiation covers wavelength spectrum from 280 nm to 200 nm. UV radiation below 200nm does not travel in air and can only pass through vacuum, so this band is also as called Vacuum-UV. Ultraviolet germicidal irradiation (UVGI) with wavelength of 254 nm can terminate or destroy the DNA of bacteria or virus like SARS-CoV-2 more effectively, but this particular wavelength radiation can penetrate into human skin pores and eye retina and causes damage to both. But the far UV-C with wavelength between 222nm to 207nm, have almost similar germ-killing properties and very less impact on human body. So the disinfectant UV-C radiators are designed to operate in the spectrum.



II. LITERATURE REVIEW AND OBJECTIVE

According to recent microbiological and epidemiological studies, dirty surfaces in hospitals can help spread nosocomial infections and viruses. In particular, for methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci, there appears to be a risk of pathogen acquisition from previous room occupants (VRE), *Clostridium difficile* and *Acinetobacter baumannii*. Accordingly, existing research indicates that improved surface cleaning and disinfection can reduce healthcare-related infections. Manual processes for terminal disinfecting are frequently sub-optimal, suggesting that automatic decontamination processes might offer an opportunity to improve cleaning effect

and consistency. There are two main UV light systems currently in use for environmental disinfection: ultraviolet-C (UV-C) light devices that continuously emit wavelengths of UV light in the range of 254 nm, and pulsed-xenon ultraviolet (PX-UV) lights that emit a broader spectrum of light in small pulses. Following discharge, automated mobile UV light systems might be put in patient rooms as an alternative to terminal cleaning. Due to the requirement of physical filth removal from surfaces, UV light systems are recommended as an addition to, rather than a replacement for, normal discharge cleaning procedures. The advantage of UV light devices include their easy-to-use, minimum need for special training of cleaning staffs, and the ability to utilise devices without closing room doors and vents (unlike airborne hydrogen peroxide systems). Although, their efficacy is dependent upon the organic load and pathogen, the intensity and amount of the UV light, the distance from the device and the exposure time also, whether the surface to be cleaned is within direct line-of-sight. Their main disadvantages are the substantial setup costs for equipments, the need to evacuate staff and patients from the room before sterilization, the time required by staff to move equipment from room to room, and the need to physically remove waste and debris before usage. UV light systems have been claimed to be capable of significantly reducing the number of environmental difficile spores, proving their ability to clean rooms after patients have been discharged under contact precautions. Under transmission-based measures, the NHS Scotland National Infection Prevention and Control Manual¹⁰ recommends using a disinfectant solution diluted to 1,000 parts per million (ppm) available chlorine for routine and terminal room cleaning. The purpose of this review is to analyse the evidence base on the efficacy of UV light disinfection systems in the healthcare environment for both routine cleaning and terminal disinfection.

III. MATERIALS

3.1 Hardware Used

- Power Switch
- At Mega 328P
- UV-C Tubes
- LCD Display
- Arduino UNO

3.1.1 Power Switch

A Power Switch provides an electrical connection from a voltage source or ground to the load. It saves power across multiple voltages and protects sub-systems from damages. It also provides enhanced component protection, inrush current protection, and minimizes printed circuit boards (PCB) size.

3.1.2 AT Mega328 P

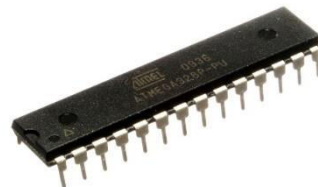


Fig : AT Mega328 P

The Microchip Pico Power 8-bits AVR@ RISC-based microcontroller has 32 kb of ISP Flash memory and read-while-write capabilities, Internal and external interrupts, serial programmable USART, 1024b EEPROM, 2 kb SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three adjustable timers or counters with compare modes, internal and external interrupts, SPI serial port, byte-oriented Two Wire serial interface, 6-channel 10-bit A/D

converter (8-channels in TQFP and QFN MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power-saving modes. The device runs on 1.8-5.5 volts.

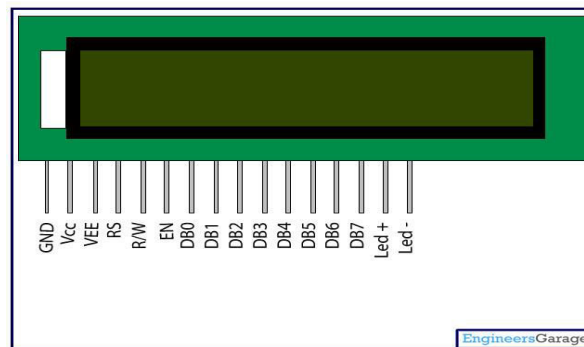
3.1.3 UV-C Tubes



Fig : UV-C Tubes

The exterior protein coating of the SARS-Coronavirus, which is a distinct virus than the present SARS-CoV-2 virus, has been demonstrated to be damaged by UVC radiation. The virus is eventually rendered inactive as a result of the harm. The damage ultimately leads to inactivation of the virus. UVC light has been shown to be efficient in killing SARS-CoV-2 viruses, which is the virus that causes the Coronavirus-Disease 2019 (COVID-19).

2.1.4 LCD Display



Liquid Crystal Display (LCD) is a type of electrical display that has a wide range of uses. A 16x2 LCD display is a simple module that can be found in a wide range of electrical devices and circuits. Seven-segment displays and other multi-segment LED displays are favoured over these modules. LCDs are cost-effective, easily programmed, and capable of displaying a wide range of special and even custom characters, animations, and other effects. A 16x2 LCD can display 16 characters per line, and there are two lines of this type. Each character is presented in a 5 by 7 pixel matrix on this LCD. The Command register and Data register are the two registers on this LCD. The command instruction supplied to the LCD display is stored in the command register. A command is a series of instructions supplied to an LCD display to perform certain activities, such as initialising it, clearing its screen, positioning the pointer, and controlling the display. The data register stores the data to be displayed on the screen display.

2.1.5 Arduino UNO

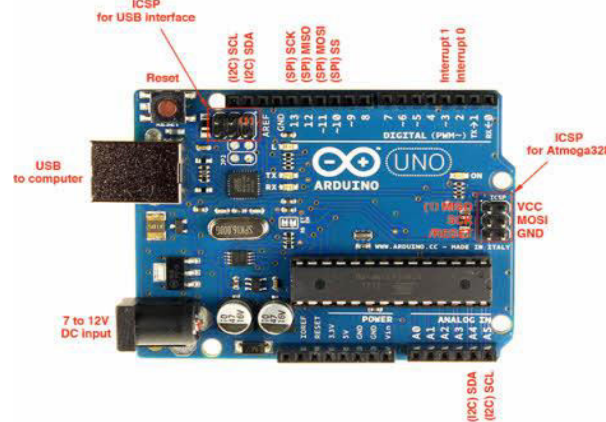


Fig: Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 IC, and Uno is an Italian word for "one." The name Arduino Uno was chosen to commemorate the imminent release of the Arduino Uno microcontroller board. This board includes digital input/output pins=14, a power jack, The board has a microcontroller with a frequency of 1.16 MHz, ceramic resonator-A16MHz, an RST button, and an ICSP header. The power supply can be done with the help of an AC to DC adapter, a USB cable, or a battery.

Power Supply

A USB power cable or an external power supply can be used to deliver power to the Arduino Uno. An AC to DC adapter or a battery are the most common external power sources. By inserting the adapter into the Arduino Uno's power jack, the adapter may be connected to the Arduino Uno. Similarly, the battery leads can be connected to the Power connector's V-in pin and Ground pin. 7 to 12 volts is the recommended voltage range.

Input and Output

With the help of routines like pinMode(), digitalWrite(), and Digital Read, the 14 digital pins on the Arduino Uno board can be used as input and output (). Pins 1 (TX) and 0 (RX) (Serial) This pin is connected to ATmega8U2 USB to TTL Serial equivalent pins and is used to transmit and receive TTL serial data. Pins 2 and 3 (External Interrupts) External pins can be used to trigger an interrupt when the low value, or change in value, is reached. 3rd, 5th, 6th, 9th, 10th, and 11th pins (PWM) By using the analogue function, this pin generates an 8-bit PWM output. Write(). Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), and Pin-13 (MISO) are SPI pins (SCK) Despite the fact that SPI communication is provided by basic hardware, it is not currently supported by the Arduino programming language. Pin-13(LED) Pin-13 can be used to connect the built-in LED (digital pin). When the pin is low, the light emitting diode is engaged like the high-value pin. Pins 4 (SDA) and 5 (SCL) (I2C) With the help of the Wire library, it provides TWI communication.

3.1 Software Used

Arduino IDE

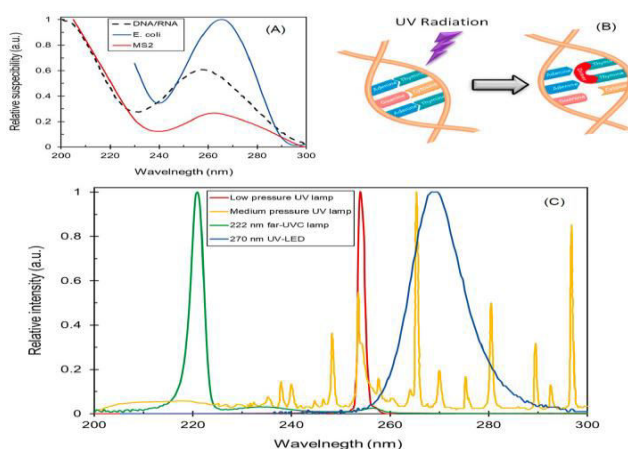
The Arduino Software (IDE) is free and open-source, making it simple to programme and upload to the board. This programme is compatible with all Arduino boards. This software can be used with all types of Arduino boards.

We will use embedded C language as it is easy to learn, understand, program & debug.

IV. FUNDAMENTALS OF UV DISINFECTIONS

UV disinfection is a tried-and-true method for killing viruses on surfaces, as well as in the air and water, for several years. A particular spectrum of UV radiation between 200nm & 280 nm, called as UVC spectrum, has been used extensively as the germicidal range of UV radiation. Over the UVC range, Because the intercellular components of microorganisms (RNA, DNA, and proteins) can easily absorb UVC photons, as shown in Figure, there is a greater influence on microbial cells. Absorbed UVC photons cause critical damage to microorganisms' genetic systems (nucleic acid and microorganismal proteins), preventing them from duplicating and surviving, as shown in Figure,

where the adenine thymine bond collapses and a covalent linkage, pyrimidine dimer, is formed between two adenines, preventing the cell from duplicating and surviving. Inactivation, rather than killing, is the impact of UV light on microorganisms. Although the effects of UV irradiation on virus infection capacity and nucleic acid have been reported, an increased ambient UV dose is expected to result in a higher mutation rate. Even though the virus can reproduce in the presence of mutations, the impact on viral genes will be different. UV-induced nucleic acid (DNA or RNA) damage has a fatal effect depending on where the alterations occur within the viral genome. Furthermore, because many mutations are corrected by the host nucleic acid mending system, many mutations will have no effect on the virus. Because most viral genes have a defined function to execute, the majority of mutations impair virus infectivity. Some alterations, on the other hand, may contribute to the emergence of more infectious viruses. For example, within the virus structure, an unique receptor binding protein can be produced, allowing the virus to infect a variety of cell types in the host. Some UV resistant viruses are also anticipated to evolve, maybe as a result of viruses evolving a larger capsid structure to protect the nucleic acid from UVC radiation damage.



Different UV-C sources, such as low and medium pressure mercury UV-c lamps, UV-C light-emitting diodes (UV-LEDs), and far-UV-C (200nm–240nm) projecting excimer and micro-plasma lamps, have been considered in academic and industry research. The spectral power distribution (SPD) of the various UV-C sources is shown in Figure? It's worth noting that UV-LEDs have distinct peak wavelengths in the UVC area, ranging from 255nm to 285nm, and therefore the SPD of a 270 nm UV-LED is different.

The supplied irradiance or fluence rate to microbial cells (mW cm^{-2}) multiplied by the exposure period in seconds yields the UV dosage (mJ cm^{-2}). As a result, the most appropriate way to describe kinetic data for UV-induced processes is as a function of UV radiation dose rather than time. In comparison to water treatment, disinfection of bio-contaminated air and surfaces could be thought of as a more basic and predictable application of UV radiation. However, various parameters are involved in achieving a legitimate inactivation value, such as 99.99 percent, via UV air or surface disinfection, which can be divided into two categories: inherent microbial characteristics and target medium characteristics.

V. SAFETY CONSIDERATIONS

UV radiation has a variety of impacts on skin, some of which are immediate and others which are delayed. The production of a cascade of mediators in the skin, which leads in "sunburn," is one of the most prevalent acute consequences of UV on the skin. UV radiation is also referred to as a "total carcinogen" since it is both a mutagen and a non-specific destructive agent, as well as a tumor starter and promoter. The risk of skin cancer is heavily increased by UV exposure and skin pigmentation. However, if the eye is exposed to excess UV radiation, several lethal effects are likely to take place, including photokeratitis, erythema of the eyelid, solar retinopathy, and retinal damage.

Direct UV radiation, as well as secondary UV reflections from reflecting surfaces, can cause dangerous UV exposure to the skin or eyes. Secondary UV exposure from materials with high UV reflectivity must be taken into account when constructing UV surface sterilizing equipment. Aluminum and stainless-steel surfaces, for example, can reflect up to 90% and 50% of UV-C light, respectively. The threshold limit value (TLV) for living thing UV exposure is an



“effective” UV dosage (irradiance \times exposure time) of 3 mJ cm^{-2} in an 8 hours’ time frame based on guidelines provided by different associations such as the American Cancer Society, American Conference of Governmental Industrial Hygienists, and European Agency for Workplace Safety and Health, and so on. The term “effective” is significant in this regulation, and it is defined based on the human eye’s maximal sensitivity, which was calculated to be around 270 nm. This wavelength is used as a standard for determining the efficacy of other UV wavelengths in eliciting a biological response. The spectral efficacy of UVC photons with a wavelength of 254 nm is 0.5, which indicates that 6 mJ cm^{-2} of 254 nm UVC can provide the same effect as 3 mJ cm^{-2} of 270 nm UVC (TLV for living thing exposure). The TLV values for the UV-C region are taken from the US Navy Environmental Health Center’s Ultraviolet Radiation Guide. Severe sunburn-like reactions can occur if the UV exposure surpasses the TLV, resulting in “sunburn cells” on the human skin. Providing some safety measures such as a kid lock and motion sensors, as well as constructing a shield for the UV exposure region, could considerably limit the likelihood of human exposure.

VI. CONCLUSIONS

The article describes about the construction and working principle of UV-C sterilizer Box which is controlled by microcontroller chip AT89C51. It also describes how to interface the microcontroller with minimum peripherals required to design an affordable, Do-it-yourself project and programming of ARDUINO microcontroller ATmega 328P. This project describes features like count-down timer, user safety features, easy to build and low cost than that of existing UVC sterilizers available in market.

VII. ACKNOWLEDGEMENTS

It gives us great pleasure in presenting the paper on “Corona Virus Sterilizer | Food Mask Sterilizer”. We would like to take this opportunity to thank our guide, Prof. S.S.Turkane, Professor, Department of Electronics and Telecommunication Engineering Department, Pravara Rural Engineering College, Loni for giving us all the help and guidance we needed. We are grateful to him for his kind support, and valuable suggestions were very helpful.

VIII. RESULT

In light of the COVID-19 epidemic, a prototype sterilization box was conceived and built for sanitizing everyday goods such as face masks, wallets, belts, and wristwatches. Eight 12 W UV-C lamps, as well as several electronic accessories, are included in the box. The cost of fabricating the prototype is less than 2000Rs. A study was conducted to study the effectiveness of the box chamber for sterilizing the items from bacteria and viruses.

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