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Sterilization using Ultra Violet C with Biosafety Cabinet

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ABSTRACT: Here we discuss about the cost and energy efficient way of disinfecting items used daily in our lives, most of the pathogens including SARS-CoV-2 are prevented from infecting the surfaces of these items by using ultra violet radiation. This box uses UV-C light to cleanse the surface and it's designed to be able to sterilize small items which cannot be washed with soap or cleaned with alcohol. Covid19 changed all of humanity in 2020. Because of its quick and effectively spreading nature, we had to utilize facial coverings and gloves to safeguard from all that we contact. Well, we can utilize covers to safeguard us outside yet what might be said about the things we bring back from market or things we trade with others.

KEYWORDS: Sterilization, UVC, Arduino Uno, Covid-19 biosafety cabinet.

I.INTRODUCTION

India is a developing country with a huge population to be taken care of. With the rapid spread of the deadly coronavirus the shortage of masks and sanitizers was bound to happen. Focusing towards the critical situations after the outbreak of Covid-19 it is important to be doing things the right way. All of us have experienced the effects of pandemic in the last two years and a lot of changes have been accepted throughout our lives.

It has become a necessity to have access to sufficient precautionary measures and there was a gap to be filled in the methods of sanitizing. For example, alcohol is not suitable for vegetables and soaps aren't suitable for documents. Commonly disinfectants use alcohols, chlorine compounds, and iodophors and as the nature of chemicals wrong combinations or concentrations can be a reason for excessive cost. All of the addressed problems can be solved by using UV radiation. Ultraviolet (UV) light exposure is a direct antimicrobial approach,[8] and its effectiveness against different strains of airborne viruses has long been established.[7]

We are programming Arduino Uno to operate a UV-C light which is proven to be able to inactivate the SARS-COV-2 by damaging its protein structure. Our project will aid to provide a safer, eco-friendly and cost-effective solution for the coming years.

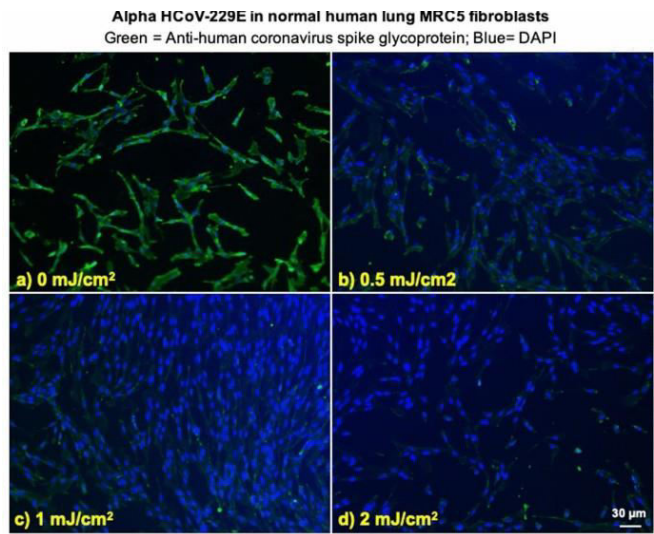


Fig 1. Shows the green glycoprotein spike reducing in the increasing exposure of UV-C radiation.

In the research published by Manuela Buonanno, David Welch, Igor Shuryak & David J. Brenner on at.al it clearly stated that, far-UVC light (207–222 nm) efficiently kills pathogens potentially without harm to exposed human tissues. In that research the public places were tested for the presence of SARS-CoV-2, and then far UV-C light was used expecting that it would show inactivation efficiency against the novel coronavirus. [1]

II.SYSTEM MODEL AND ASSUMPTIONS

Ultraviolet (UV) light is a band of electromagnetic radiation which have high energies and short wavelengths than visible light, which makes it invisible to the human eye.

The UV light spectrum is further categorized into four subcategories based on their wavelengths: UVA, UVB, UVC and vacuum-UV as shown in Table 1.

UVA LIGHT has the lowest amount of energy. when you're out in the sun ,you're mainly being exposed to UVA light .exposure to UVA light has been linked to skin aging and damage
UVB LIGHT site in the middle of the UV light spectrum. a small portion of sunlight contains UVB light that contributes to sunburns and cause most skin cancers.
UVC LIGHT has the most energy. UVC light form the sun is mostly absorbed in the Earth's ozone, so you're not normally exposed to it on a daily basis. However, there are various human-made sources of UVC light

Table 1UVA wavelengths are the longest and fall between 315 to 400 nanometers.

Far-UVC light ranges from 207 nm to 222nm which is not harmful for human tissues as well as effective against damaging the protein structure of viruses. Since, all the viruses have similar structure, far UVC light can be used to treat all of them.

While, vacuum-UV that fall between 100 and 200 nanometers has the shortest wavelengths.

Columbia University Irving Medical Center researched about effect of UV radiation on Covid-19 and found that more than 99.99% of airborne droplets coronaviruses were inactivated when exposed to a wavelength called far-UVC light at 222 nanometers.

A very simple assembly of wooden box with a door on top was designed to enclose the objects to clean and a glass slab will hold them above the UVC germicidal lamp which allows for the light ray to get in contact with the surface of the objects placed. While the lamp is working the light rays will reflect inside the box and help to eradicate all the microbes. For the reflection reflective aluminum tape was used for proper cleaning.

As the light rays emitted by the lamp is harmful if it comes in direct contact of a human body. For this a safety mechanism is in place which will automatically switch off the operation of lamp if it is opened whilst the objects placed



are undergoing sterilization. This was achieved by using a magnetic reed switch at the door. In addition, the box is carefully designed to avoid any leakage from the inside.

Arduino Uno which is the main controlling unit of the project has been programmed to work simultaneously with the lamp as well as the OLED display to let user know which mode is the machine working in. The OLED display can show the designed menus which have presets of timer mode and manual mode.

Abbreviations and Acronyms

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), Coronavirus 2019 (Covid-19), Ultra Violet (UV), Ultra Violet C (UV-C), Organic Light Emitting Diode (OLED).

Future Scope

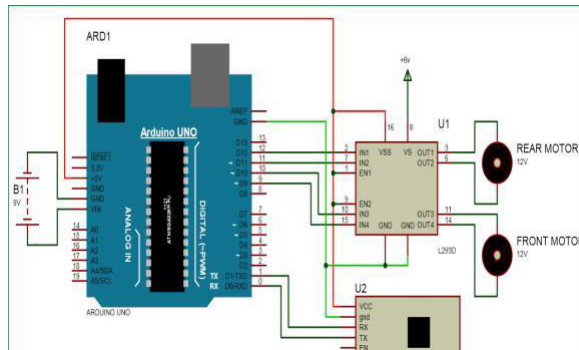
With the current situation it is easily advisable to be careful with the surroundings. The effective sterilization of any material or device to be implanted in or used in close contact with the human body is essential for the elimination of harmful agents such as bacteria.[7] As all human coronaviruses have similar genomic sizes which is a primary determinant of UV sensitivity, it is reasonable to expect that far-UVC light will show similar inactivation efficiency against all human coronaviruses, including SARS-CoV-2.[1][9]

Equipment Used

Arduinio uno
Philips 11 wattuv-c germicidal lamp
11w Electronics Ballast
Reflective Aluminium tape
Fuse holder
Piezoelectric buzzer
0.96”OLED 64x128 display module
Rotary encoder with push button
Magnetic reed switch
5 V SPDT relay
2N2222 NPN/transistor
1K resister
Ply Board
Laminate
Breadboard

III.CIRCUIT DIAGRAM

Below is the circuit diagram of the hardware which shows the connections between Arduino, Bluetooth and motors. It also shows a motor driver L293D which is responsible for movement of the motors in either direction. RxD pin of the Arduino is connected to the TxD pin of Esp8266 and vice versa. Supply of 5V is provided to the motors.



IV. RESULT AND DISCUSSION

An OLED display follows the same principle as a LED display, but operates in a slightly different manner. A LED panel requires a dedicated backlighting setup to produce light. However, an OLED panel can produce its own light. All this is possible due specially constructed OLED diodes.

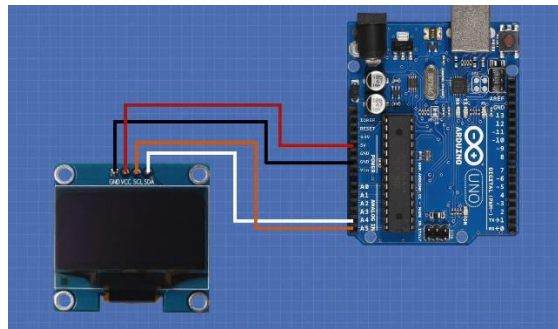


Fig 4.1.1 Schematic diagram for OLED DISPLAY

Image of bacterial culture turbidity with after different UV-treatments



Figure 1: Change in the bacterial load with different UV-treatments (Instrumentation)

Graphical representation of Sterility testing by turbidity assay (Spectrophotometric) after different UV-treatments.

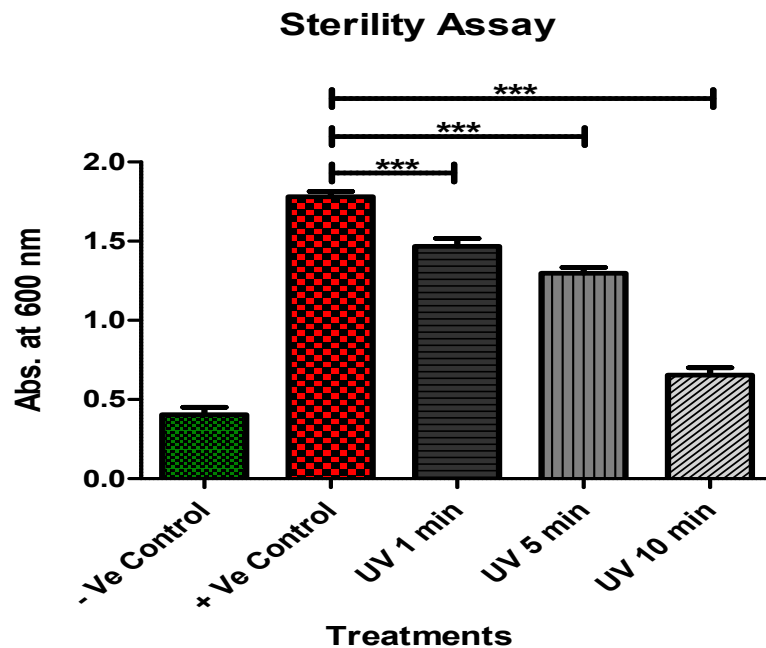


Figure 2: Change in bacterial density following different time periods of UV-exposure (Spectrophotometric Assay)
 Note: Results are expressed as Mean ±SD (n=3). *** representing the “P value < 0.001” statistical significance difference.

V.CONCLUSION

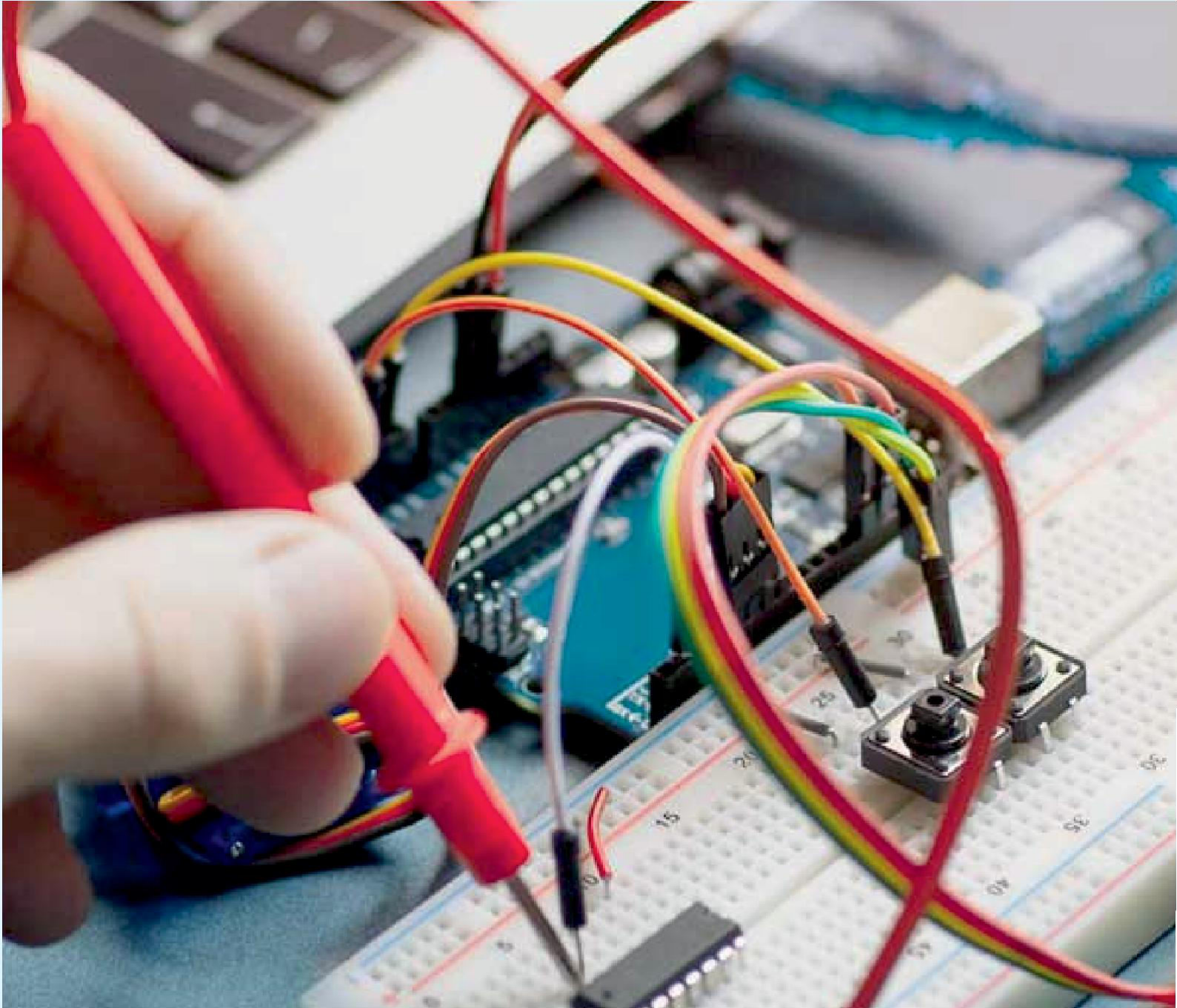
As a result of the original idea of COVID-19, research is as yet progressing. In this paper, we investigated a portion of the prior conditions that improve the probability of extreme sickness and utilized beforehand accessible examination to decide approaches to dealing with a portion of the symptoms that have all the earmarks of being connected to COVID-19 hospitalizations. This article presents numerous micronutrients and minerals, particularly Vitamin C, Vitamin D, and flavonoids, which can be utilized as a proactive dietary enhancement to assist with overseeing side effects and to lessen the gamble of serious sickness from COVID-19. We found that a significant number of the gamble bunch sicknesses shared normal side effects that are connected to serious diseases from COVID-19 further sup-orting that nourishment is pertinent to this infection anyway more epidemiological exploration is important to distinguish the steady job sustenance might have in the security of in danger gatherings. These dietary ideas have been founded on what we are familiar COVID-19 as well as on our insight into how sustenance cooperates with our safe framework and persistent circumstances anyway private dietary prerequisites fluctuate impressively so patients must al-ways counsel their essential consideration doctor for explicit rules fit to their necessities. Moreover, research in the job nourishment plays is broad be that as it may, further examinations are required in the connection among micronutrient and its system on how it impacts COVID-19 patients. Moreover, the job of cytokine tempests and how they might connect with nourishment is a region with huge exploration holes that we accept to be profoundly helpful. We additionally accept that exploration in sustenance the study of disease transmission for patients who were hospitalized is war-fumed. An essential area of concentration in the epidemiological examination ought to zero in on deficiencies that individuals hospitalized may have had during COVID-19 time.

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