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The SanitiStation

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Abstract: Covid-19 pandemic has changed all of mankind in 2020. Because of its fast & efficiently spreading nature, we were compelled to use face covering masks and gloves to protect from everything we touch.
Well, we can use masks to protect us outside but what about the things we bring home from market or things we exchange with other people.
For example: We cannot apply sanitizers on fruits, vegetables, packed food, batteries etc we buy from outside or we can't sanitize files, paperwork that doctors exchange with patients or employees exchange with each other. The SARS-COV2 virus is known to survive on surfaces of objects upto several hours.
The most commonly exchanged items like money, papers, bags are considered one the major sources of transmission of the virus. The aim of the project entitled as "The SanitiStation" is to develop a device to sanitize items which generally cannot be sanitized using liquid sanitizer to help stop the spread of the virus. The system is user friendly. A simple and cost effective system to sanitize user's handheld items and objects. This system can be installed anywhere. Outside malls, offices, shops etc.

Keywords: UV C, COVID-19, Sanitization, Sensors

I. INTRODUCTION

The greatest possible threat that we would ever face in our immediate lives wont come from space or through some another sci-fi source. A pathogen that is so small and cant be seen, that evolves so fast, is the one to look out for. Medicines of today have proved to be the pinnacle of human knowledge, science engineering, with even more than one cure available for diseases that half a century ago was considered end of the line. Prevention is better than cure as the quote goes, is the best solution/idea that everyone can follow. Prevention are measure(s) taken to avoid contracting or spreading of diseases that deteriorate quality of life. Prevention costs less, often requires very basic knowledge of the disease and can statistically improve your life. Technologies are being researched invented to promote more prevention or to spread awareness of preventive measures for various diseases. By spreading awareness about the disease along with prevention a lot of other problems like social stigma, false beliefs, rumours, incorrect information can be overcome. The main feature of this project is to create an all-in-one solution for prevention of diseases or spreading of pathogens by providing various sanitation techniques for the end user. There are two main objectives that will cover the entire project tasks: to start a new design of all in place sanitation device. To evaluate the performance of the new all-in place sanitation device.

So, we are trying to gives best solutions on the problem of pandemic situation through our project "The Sunnitisations"

II. LITERATURE REVIEW

The works associated in this field are outlined as follows. The following journals and research papers were surveyed for the project.

Evaluation of an Ultraviolet C (UVC) Light-Emitting Device for Disinfection of High Touch Surfaces in Hospital Critical Areas
Beatrice Casini, Benedetta Tuvo, Maria Luisa Cristina, Anna Maria Spagnolo, Michele Totaro, Angelo Baggiani, and Gaetano Pierpaolo Privitera

A Critical Review on Ultraviolet Disinfection Systems against COVID-19 Outbreak: Applicability, Validation, and Safety Considerations
W. Milad Raeiszadeh and Babak Adeli

UV-C irradiation is highly effective in inactivating SARS-CoV-2 replication
Mara Biasin, Andrea Bianco, Giovanni Pareschi, Adalberto Cavalleri, Claudia Cavatorta, Claudio Fenizia, Paola Galli, Luigi Lessio, Manuela Lualdi, Enrico Tombetti, Alessandro Ambrosi, Edoardo Maria Alberto Redaelli, Irma Saulle, Daria Trabattoni, Alessio Zanutta & Mario Clerici

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Ultraviolet C lamps for disinfection of surfaces potentially contaminated with SARS-CoV-2 in critical hospital settings: examples of their use and some practical advice. Manuela Lualdi, Adalberto Cavalleri, Andrea Bianco, Mara Biasin, Claudia Cavatorta, Mario Clerici, Paola Galli, Giovanni Pareschi & Emanuele Pignoli

UV Inactivation of SARS-CoV-2 across the UVC Spectrum: KrCl* Excimer, Mercury-Vapor, and Light-Emitting-Diode (LED) Sources
Authors: Ben Ma https://orcid.org/0000-0002-6635-7622, Patricia M. Gundy, Charles P. Gerba, Mark D. Sobsey, Karl G. Linden

III. PROBLEM DEFINITION

Sanitization solutions available in the market provide partial solution to the sanitization needs, a lot of items are exchanged by people on a daily basis e.g., cash, food, papers, files, folders etc which cannot be sanitized using just liquid sanitizer-based solutions a more reachable portable device with more efficient disinfection method is needed to solve this.

IV. PROPOSED WORK

On a daily basis various items are being exchanged by people which can easy carry various germs and bacteria including covid-19 causing virus. We designed this project so that everyday items which can't be sanitized using traditional sanitizer liquid can be sanitized. Often these items that are exchanged are the main cause of the spread of the virus as it's been proven that the virus survives on object surfaces up to several hours
We are making a box which has enough space to put items as large as a bag to anything smaller than it which will be sanitized using UV-C radiation effortlessly without damaging the item in question. The box's enclosure is covered by reflective aluminium foil which will ensure the radiation is evenly spread around the item that's kept inside for sanitization.
The sanitization period is of 30 secs after which the UV-C radiation turns off and the internal timer is reset. The box consists of two powerful UV-C tubes one on top and bottom to ensure enough radiation is present to kill off maximum of the microorganisms from the surface of the object kept inside.
Further the box is equipped with a contactless thermometer which will display surrounding temperatures. The user can bring their hand near it and it will display the user's temperature. The thermometer is fully automatic and works in the background.

V. CIRCUIT DIAGRAM

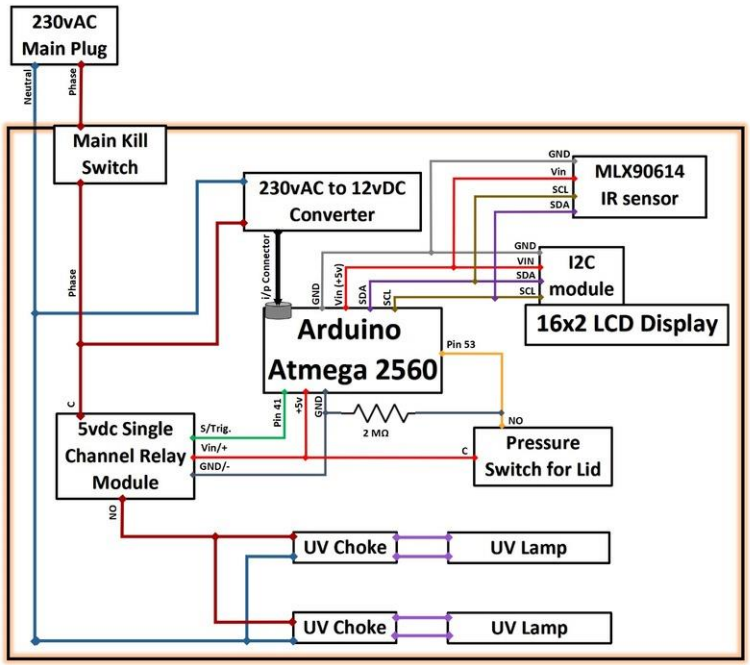

Fig.1 Circuit Diagram

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VI. WORKING

Theory:

Ultraviolet-C (UV-C) radiation (100-280nm) has been extensively used for many years for its germicidal effects [13]. Recently, numerous studies have been published on the possible application of UV-C in disinfecting contaminated surfaces by inducing photodimerization in the genomes of SARS-CoV-2 [4] As per scientific research bacteria/viruses will be killed in ten seconds at a distance of six inches from the UV-C lamp. The exposure dose of a UV-C lamp is measured in joules per square meter, J/m2 or millijoules per square centimeter, mJ/cm2. The International Ultraviolet Association (IUVA) says dosage values between 10 - 20 mJ/cm2 will inactivate viruses similar to COVID-19. That's based on using the UV wavelength 222-280 nm. This dosage can achieve 99.9% disinfection against viruses in the SARS family. 222nm is considered low powered and may require longer exposure times and the exposure time decreases as we reach 280nm, being the most effective wavelength. For the UV-C source in this device, an 11 W Phillips/Osram TUV is to be used. UV-C radiation is very dangerous for your eyes and skin. The UV-C light will be switched ON only when the top cover of the device is closed and switched off when the device is open. We are using osram TUV 11 tube as source of UV C radiation. As per the calculator software provided by the manufacturer on their website.

We found that the exposure time required for the complete inactivation of the covid-19 virus at a distance of 40 cms from the tube is 4 secs. The other values are given in the above table. Given the size of our box and the internal reflection of the radiation we have proposed a total exposure time of about 30 secs.

Construction: The box is constructed using wooden sheets of 12mm thickness. The dimensions of box are: 700mm x 350mm x 350mm. As we go inside the box, bottom part consists of all the main circuitry. The bottom part's circuitry is hidden underneath a glass sheet which is covered with reflective aluminium foil. The aluminium foil is also covered on the inner walls of the box, with the concept being that the radiation will be properly reflected inside the box to cover the entire surface of the item that is placed inside the box. The sheet's thickness of 12 mm goes towards the overall integrity of the box and capacity of holding even big items.

The bottom part of the box has a raised area to allow for all the circuitry to be placed in the area which gets hidden by the glass sheet. The glass sheet on the bottom provides the base to put the item, to be disinfected, inside the device. The wires connecting the micro-controller board, main supply, sensors are soldered for efficient flow or current. The glass sheet is covered with the same reflective aluminium foil to not allow any UV rays below. Two UV-C tubes of 11W each are installed on top and bottom part of the device for efficient disinfection. The front of the box houses the 16x2 LCD display with IR temperature sensor.

Circuitry: As shown in the circuit diagram. The core of the mechanism consists of Arduino mega micro-controller, this is responsible for operating the processes of the device. On the mouth of the box we have added a pressure switch which is connected to the micro-controller and provides the main input. The input is received by the micro-controller which sends a trigger to the relay circuit which turns on the UV tubes. The main supply of 240 Volts is provided. The device has a main 'ON' switch to control the supply. The supply is further connected to the UV choke which power the UV tubes. The supply is further provided to Arduino through the 12V AC to DC adapter. The Arduino board's pins '41' and '53' of the digital i/o are used as output and input respectively. pin 53 receives the input from the pressure switch which passes to the trigger of a 5V single channel relay module. This relay is connected to the UV choke's trigger which turns on the UV tubes for the disinfection to begin. The supply to the tube is already provided. A 2 Mega Ohms resistor is connected to the switch's 'NO' to GND. The switch is known to hold some current from the initial close circuit. To avoid this current to change the logic of the program a resistor is added to drain the remaining current to GND.

Software: The program of Arduino is called a sketch. The program is coded using their IDE. Its uploaded to the internal ROM of the Arduino.

This program controls the operation of the disinfection process. As mentioned in above section, the i/o is set on pins 53 and 41 respectively. The pressure switch sends an input to the micro-controller which is saved in a variable. Another variable is set as a 'status' flag during initialization with same zero value of the switch (which is in 'off' state). Once an input is received there is a mismatch of values in status and switch variables which allows the output to be sent to the 'trigger' of relay which turns on the UV tubes.

A timer of 30 secs starts internally after which the circuit turns off the UV-tubes and all variables and timers are reset to initial values. The reset occurs if the lid of the device is opened before the process is complete or if the 30 secs time is finished, whichever happens first.

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VII. RESULTS

As per the observations an item with bacterial specimen was tested in the device. After the disinfection was performed the overall bacterial load was highly decreased. The places near direct exposure of UV tubes showed negligible load compared to the areas which were indirectly irradiated by the tube. The item didn't show any changes on the surface due to the exposure to UV-C. The disinfection operation with the programmed logic worked correctly everytime with the lamps auto turning off once the operation was complete or if the lid were to be opened in the middle of it. The reflectiveness of aluminium foil is found to be efficient. The IR thermometer showing accurate temperature readings when tested with a very cold object (eg.ice) and afterwards a hotter object (eg. cup of hot tea). Further the object temperature showing similar temperature readings when compared with a temperature gun on the same objects.

VIII. CONCLUSION

The project “The SanitiStation” is a very efficient device to help curb the spread of covid-19 virus. The designed system is compact, and its operation is automated. The effectiveness of UV-C lamps is strongly dependent on the power of the lamps and on the design of their reflecting mechanism.Our results show that using this device it is possible to dispense the dose necessary to obtain SARS-CoV-2 inactivation. IR sensor is displaying stable readings for measuring body temperatures. The exposure time and mechanism is correctly working for sanitizing the object kept in the device.

IX. REFERENCES

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