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Portable Sanitizing Machine

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Abstract

With over 7 million people infected globally and over 5 lakh deaths reported worldwide by COVID-19 virus, World Health Organization (WHO) has declared it as an epidemic. There is no respite in view as of now because the numbers still increase exponentially with each passing day. The only possible thing to control the virus is that the availability of vaccine, which can take a couple of months to be acquired by masses. Till then, the worldwide economy has got to start reopening slowly with several precautionary measures in situ as advised by the WHO, like mandatory wearing of masks in public places, frequent hand washing, practicing good personal hygiene, and social distancing. Recently, the Govt of India (GOI) has also opened its economy with all the precautionary measures in situ. Disinfecting of places of labor, modes of transport, hospitals, and customary areas is emerging as a mammoth challenge. With the target of arresting the spread of COVID-19 virus and providing an efficient solution to the above problem, a transportable disinfectant device is meant. The novelty of this device lies in its innovative design that provide UV light-based disinfection methodologies. For this, the device uses UV-C radiations to increase the virus kill efficiency.[7]

Healthcare-associated infections (HAIs) can be caused by microorganisms present in common practice instruments generating major health problems in the hospital environment. These instruments can be disinfected with the help of some chemicals or UV-C light. As, using those liquids for disinfection; some of their strain on the instrument may cause any harm to the patient. UV-C light can disinfect objects without living any strain on the objects. UV C light is very good disinfectant against much type of bacteria and viruses.[5] Here is presented an object disinfection device based on Ultraviolet-C radiation. It offers the capacity to be remotely disinfect objects using an Android mobile device and it has a door status detection security system that turns off the system when door is open. The system here described is definitely scalable to get higher ultraviolet dosages adding more UV-C lamps. The experimental tests showed the very high effectiveness of this device to eliminate high bacterial inoculate.[6][5] The sanitizing method employed by this device affects a really wide selection of microorganisms and it's several advantages reference to chemical based sanitizing methods. The total cost to make this open-source device is very less and it is easily customizable which is different respect to proprietary commercial devices actually available. This device represents an open source, secure, fast and automated equipment for object disinfecting. The device does not require continuous monitoring. Comparing to already existing techniques this machine is improved to about more than 90% and has very negligible hazards. The UV C light can kill wide range of bacteria and viruses and hence can be used in hospitals to sanitize operating tools. The UV C light can kill bacteria and viruses in air as well.[3]

Index Terms— Arduino UNO, HC-05 Bluetooth Module, Relay, UV-C Light Source

Introduction

The term sanitary refers to the state of a food contact surface or utensil where it doesn't contain microorganisms at tier which can permit the transmission of disease or compromise food safety. Sanitizers are substances capable

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of destroying microorganisms including those bacteria that cause gastrointestinal disorder and other diseases. When used properly, they're going to reduce surface contamination by bacteria to a secure level.

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Sanitizing is typically achieved using heat and water, or chemicals, or a mixture of both methods. An honest alternative to chemical sanitizers is quandary used at (75°C or hotter) to soak items for 2 minutes or more. Some sanitizers are toxic to people and also the residue must be rinsed off, while other sanitizers are food- safe and don't require rinsing. Sanitizers all work best at the correct dilution. If they're too weak, they're doing not work effectively, if they're too strong you're wasting your money. Sanitizers need time to work. The contact time varies and might be seconds or minutes counting on the work. Sanitizing solution are often made-up pro re nata and put into labelled spray bottles to be used on bench tops, fridges, door handles and other surfaces. Check the dilution, contact time, safety precautions, period of time and storage of all chemicals before use. the foremost thing is that when it involves us, i.e., Either humans or animals, we are ready to sanitize ourselves with the assistance of soaps or different sanitizers etc. but when it involves nonliving things or electronic material, one cannot use all those things and also the foremost effective alternative remains, UV Light. As per the present scenario it's mandatory for all people to stay social distancing since it spreads due to human touch. So, as if to avoid the identical it's a necessity to sanitize all the products and be safe. Here we use UV light in an exceedingly very sterilization box because if we use the rays without precaution, then it should harm us to extend because biologically proven it should directly harm our gene and alter DNA. the foremost positive reason for its use is because the medical team is using those PPE Kits, after using these kits they directly dump it to the rubbish area but if we use this ULTRAVIOLET SANITIZING MACHINE even the kits would be sanitized and also the municipal corporation demand goes to be fulfilled also.

Fig. 1: Images of prototype

RELATED WORK

Healthcare Associated Infections (HAIs) are a major and increasing problem within the global healthcare sector. every year ample patients are infected and thousands of patients die thanks to infections acquired during hospitalization. Furthermore, HAIs generate a large financial implication. Leveraging decades of UV Lighting and LED experience to develop solutions for continuous disinfection of occupied spaces to assist reduce exposure to surface bacteria. As many hospitals require sanitization, different machines are available that need man power. This gave an experience for all of our patients while ensuring peace of mind during the Covid-19 pandemic.

Already Existing Examples:

1) Nexqua Disinfection Nano Spray Gun, Household Sprayer Machine with Blue Light

About this item:

This Product Uses High-quality Nano-dispersion: rapid fogging, large fog volume, can make the hair hydrated and glossy quickly, put the disinfectant in a very volumetric flask, can even be used for disinfection and sterilization, safe and effective.

After Waiting 40 second the smoke is started automatically discharged, the electrical sprayer will purify the air for about 5 to eight minutes, so look forward to the smoke to soak up harmful substances within the air. After 10 minutes, open the door and you'll feel healthy and fresh air. Disinfection Steam Sterilizer is helpful with Disinfection Liquid for Sterilization of Cars, Home, office, etc.

2) Nexqua Dew Fog Sanitizer machine for Home, Office, Car, Purify Shops, Hotel; Fogger Machine for Disinfection; (White, 100ml)

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About this item: Suitable for Sanitization / Disinfection and purification of air in automobiles and indoor households. Light weight and portable, easy to use. Natural disinfection formula, safe and efficient; remove odor, fresh air; long-lasting bacteriostatic, lasting bactericidal effect; protect family from diseases.

Both the proposed algorithms take into consideration these real time problems and are evaluated through PROTEUS simulations. The most important contribution of our work is:
1) we designed a UV-C light-based sanitizing machine with approach to assist this current pandemic situation.[5]
2) The proposed algorithms successfully make the merchandize efficient by killing maximum germs while taking care of environmental calibration, UV based sanitization provides much efficient and contactless way to sanitize the objects and provides rapid, effective inactivation of microorganisms.[3][4][5]
3) we critically analyzed the proposed algorithms for abrupt changes within the cost of sanitization which is effectively reduced after we use UV disinfection technique.

The germicidal system is constructed using a UVC LED illumination module with a wavelength of 275 nm and a power of 1.8 mw. UVC LED has a smaller volume without heat radiation and pollution that meets the requirements of green energy and environmental protection. It is very suitable for sterilization and purification. It can destroy microbiological organisms such as bacteria, viruses, or spores, etc. [5] From this we got to know that UV C light is effective against viruses.

The UV C light can be used in sterilization of office rooms and workspaces. This shows that sterilization of air can also be performed with the help of UV light. [3]

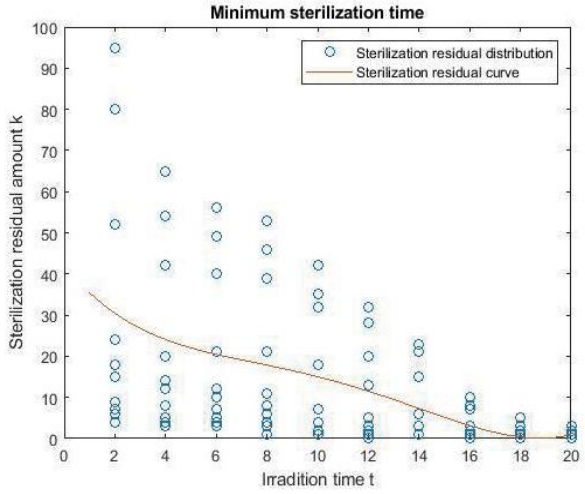

Fig. 2: Irradiation time t vs. Sterilization residual amount k [5]

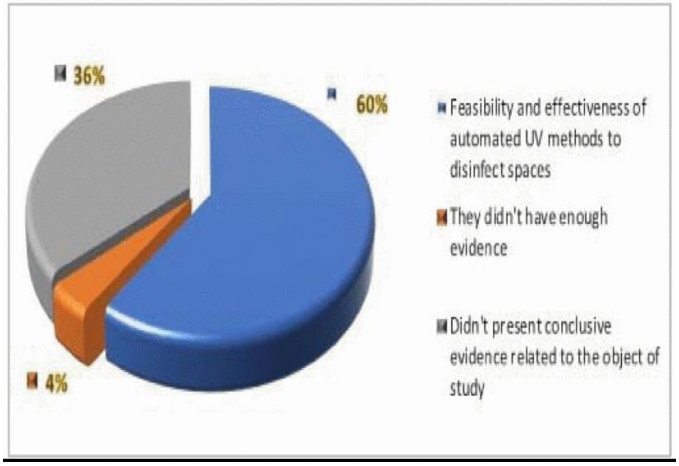

Fig. 3: Percentages of evidence in results [6]

UV type	NANOMETERS (nm)	SAFE for skin and eyes	Applied to/practical uses
VUV Far-UV	100-200	Yes	Medical equipment
Far-UV	207-222	Yes	Germicidal, most effective for disinfecting, sensing
UV-C	200-280	No	Germicidal, most effective for disinfecting, sensing
UV-B	280-315	No	Curing, tanning, medical applications
UV-A	315-400	No	Curing, tanning, lithography, sensing, medical applications

Table. 1: UV light Impact [7]

Above table shows the impact of various types of UV light on human being and for which purpose it is effective.[7] Above table shows that UV-C light is most effective for disinfecting.

SYSTEM DESIGN AND PERFORMANCE EVALUATION

System Design

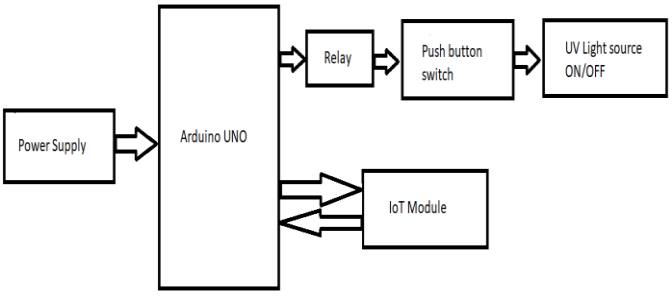

Fig. 4: Block Diagram of Sanitizing Machine

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Description:

This project is to sanitize objects with proper safety. Initially the objects are placed in sanitization box. Then, after giving a single to start the sanitization through IoT module, the relay will be turned on. Then, the condition for door closing is checked. This is done by observing the condition of push button switch. If switch is in closed state, then door is close and sanitization can be started.

UV light source is controlled with the help of relay as UV source operates on AC supply. IoT module consist of Bluetooth sensor HC-05, which can be connected wirelessly with smart devices.[8] The Bluetooth sensor can receive as well as transmit the signal.[12]

The Bluetooth module is connected to Arduino controller.[12] When Arduino receives start signal from Bluetooth module HC-05, it will turn on the relay, check the push button condition and accordingly The UV C light is turned on or turned off.[11]

Flowchart:

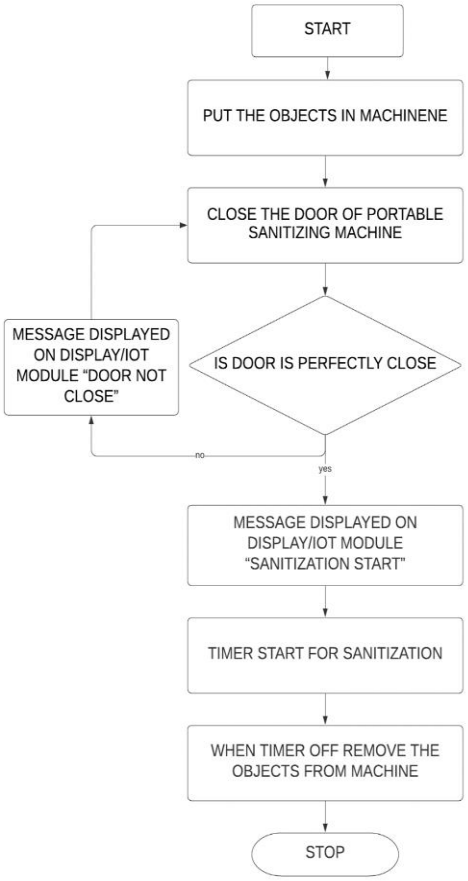

Fig. 5: Flowchart of sanitizing machine

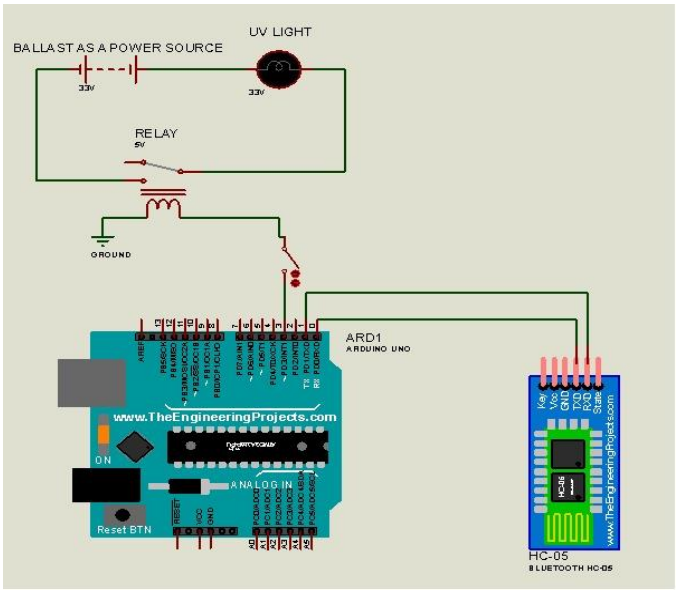

Fig. 6: Simulation Circuit of Sanitizing Machine

In the above figure, Arduino uno is the controller board used for all processing purposes. It is connected to HC-05 bluetooth module via serial ports. Serial port transmission consists of two wires namely, transmitter and receiver bus. They both are connected to transmitter and receiver pins of Arduino uno and HC-05 sensor vice versa. Relay is connected to pin 3 of arduino. The switch is used in between the pin 3 and relay to operate status of the door. On/Off signal is given to the HC-05 through android device. The information of android app used for this purpose is given below. HC-05 transfer commands to Arduino through serial port. Relay is used as we want to operate UV light of 33V. This much of voltage is not supported by Arduino hence we are using relay module. Instead of AC power source we have shown here a battery of 33V. By using battery operated UV lamp, we can use this machine anywhere.

The working starts with powering up all the components with their required power supply ratings. Then connect android device to bluetooth module HC-05. By clicking on the "Select Connection" button, user can see the available devices in nearby area and connect to HC-05 from the list. Now, after connecting, when user clicks on the "ON" button in android app the, the app sends on command to Arduino via serial port. The arduino uno then turns on supply for pin 3. After that the status of push button is checked, if it is closed then relay turns ON otherwise it stays in OFF condition.

User can turn the UV light ON/OFF anytime from the android app. If user forgets to turn it off after turning on, the Arduino will turn the light OFF after 5 minutes of turning it ON.

User can disconnect from the HC-05 module by clicking on the "Disconnect" button in the android app.

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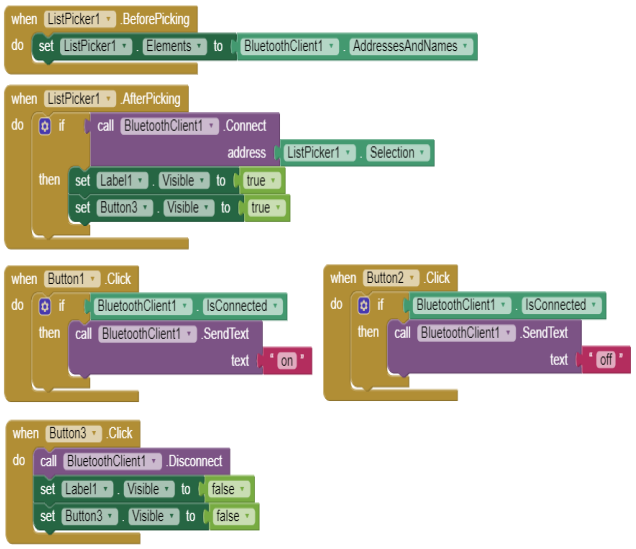

Fig. 7: Block Coding of Android App

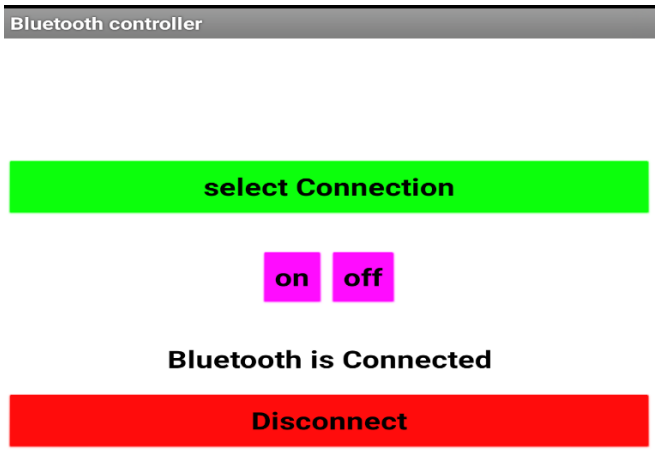

Fig. 8: Interface of Android App

Discussion of Results

The research work is carried out in two phases (Phase I and Phase II). Before the analyzing these two phases, a small attempt is made to find out the optimum efficiency by trial-and-error method for the given scenario. To sanitize Objects: Insuring sanitizing the objects by all dimensions.

To maintain safety of person operating the machine: The exposure of UV light is harmful for humans hence need to design proper module which ensures safety of operator.

Maintaining the efficiency of sanitization up to 80% to 90%: The efficiency of liquid sanitizers is quite low. So, UV based sanitization needs to maintain high efficiency while sanitizing.

The previous works that involved the use of UV C light for sanitization purpose doesn't give any human friendly working method for its use. In this work we are providing and human friendly interface for controlling operation of UV C light. Also, we are providing proper safety mechanism for the operator.

The other sanitizing machines like sanitizer sprayers may pose a great risk if they get into eyes and mouth. This type of UV sanitization box doesn't pose any kind of risk as sanitization will be performed in a closed box and with the precautions taken for operator's safety as it is controllable from smart device having bluetooth.

The other UV based sanitizing equipment's like handheld UV tubes are also hazardous as the person operating it will be in direct contact with the UV C light.

There are some closed box UV sanitizing machines are also there but they don't provide any IoT based interface for operating the machine.

CONCLUSIONS AND FUTURE WORK

The Current pandemic situation needs sanitization of objects and human beings. Humans can sanitize with the assistance of sanitizers, hot water, and also the other alternatives but when it involves non-living things, electronic objects or currency notes that can't be sanitized by liquid sanitizers as they will be damaged, therefore we used some technique which will sanitize them without damaging. This has been done using UV light. It nearly helps in killing 80% germs within 8 minutes of exposure. So, it's well tested and trusted source which might sanitize products in covid-19 pandemic situation. Sanitizing and disinfection, are very-very important steps in preventing the spread of communicable diseases and illnesses throughout the population. Therefore, it is concluded that the "Portable Sanitizing Machine" will help lots in terms of preventing spread of deadly viruses and bacteria.

Limitation:

The UV-C light employed in our project is hazardous for human eyes similarly to our skin.

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